केन्द्रीय विद्यालय संगठन

देहरादून संभाग

KENDRIYA VIDYALAYA SANGATHAN

DEHRADUN REGION

रसायन विज्ञान विषय हेतु संवर्धन कार्यशाला

SUBJECT ENRICHMENT WORKSHOP FOR CHEMISTRY

सत्र/SESSION – 2023-24

कक्षा 11 हेतु प्रतिदर्श प्रश्नपत्र संग्रह

COMPILATION OF MODEL QUESTION PAPERS OF CLASS XI

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CONTENTS

CLASS XI SESSION ENDING MODEL QUESTION PAPERS

S.No.	Question Paper Set	Page No.
1.	Class XI Session Ending Question Paper Set-1	4 – 19
2.	Class XI Session Ending Question Paper Set-2	20 – 26
3.	Class XI Session Ending Question Paper Set-3	27 – 36
4.	Class XI Session Ending Question Paper Set-4	37 – 50
5.	Class XI Session Ending Question Paper Set-5	51 – 61
6.	Class XI Session Ending Question Paper Set-6	62 – 75
7.	Class XI Session Ending Question Paper Set-7	76 – 82
8.	Class XI Session Ending Question Paper Set-8	83 – 100
9.	Class XI Session Ending Question Paper Set-9	101 – 112
10.	Class XI Session Ending Question Paper Set-10	113 – 123
11.	Class XI Session Ending Question Paper Set-11	124 – 137
12.	Class XI Session Ending Question Paper Set-12	138 – 144
13.	Class XI Session Ending Question Paper Set-13	145 – 149
14.	Class XI Session Ending Question Paper Set-14	150 – 165
15.	Class XI Session Ending Question Paper Set-15	166 – 176
16.	Class XI Session Ending Question Paper Set-16	177 – 189
17.	Class XI Session Ending Question Paper Set-17	190 – 189
18.	Class XI Session Ending Question Paper Set-18	203 – 212

CLASS XI

SESSION ENDING MODEL QUESTION PAPERS

SET-1

SESSION ENDING EXAMINATION
SESSION: 2022-23
SUBJECT: CHEMISTRY THEORY
CLASS-XI

MM: 70 **Time:3 Hours**

General Instructions:
Read the following instructions carefully.
(a) There are **33** questions in this question paper with internal choice.
(b) SECTION A consists of 16 multiple -choice questions carrying 1 mark each.
(c) SECTION B consists of 5 short answer questions carrying 2 marks each.
(d) SECTION C consists of 7 short answer questions carrying 3 marks each.
(e) SECTION D consists of 2 case - based questions carrying 4 marks each.
(f) SECTION E consists of 3 long answer questions carrying 5 marks each.
(g) All questions are compulsory.
(h) Use of log tables and calculators is not allowed.

SECTION: A

1. Which of the following is iso-electronic with neon -
   (A) O^{2-} (B) F^{+} (C) Mg (D) Na
2. The value of *l* and m for the last electron in the Cl^{-} ion are -
   (A) 1 and 2 (B) 2 and +1 (C) 3 and –1 (D) 1 and –1
3. Which of the following factor shifted the reaction $PCl_3 + Cl_2 \Leftrightarrow PCl_5$ at left side?
   (A) Adding PCl_5 (B) Increase pressure (C) Constant temp (D) Catalyst
4. In a reversible chemical reaction at equilibrium, if the concentration of any one of the reactants is doubled, then the equilibrium constant will
   (A) Also be Doubled (B) Be Halved (C) Remain the Same (D) Become One-Fourth
5. Which of the following molecules follow the octet rule?
   (A) ClF_3 (B) H_2O (C) XeF_4 (D) NO_2
6. Oxygen has an oxidation state of +2 in
   (A) H_2O_2 (B) H_2O (C) OF_2 (D) SO_2
7. The empirical formula of a compound of molecular mass 120 is CH_2O. The molecular formula of the compound is :
   (A) $C_2H_4O_2$ (B) $C_4H_8O_4$ (C) $C_3H_6O_3$ (D) all of these
8. Which of the following compound has highest covalent character
   (A) LiCl (B) LiBr (C) LiF (D) LiI
9. Which of the following rule out the existence of definite path or trajectories of electrons
   (A) Pauli's exclusion principle (B) Heisenberg's uncertainty principle
   (C) Hund's rule of maximum multiplicity (D) Aufbau's principle
10. The symbol of an element with atomic number 120 as per IUPAC will be
    (A) unb (B) unt (C) ubn (D) uun

11. What is the change in internal energy ΔU, for a system that does 70 joules of work as it absorbs 45 joules of heat?
(A) 115 J (B) 25 J (C) –25 J (D) –115 J
12. If the internal energy of an ideal gas decreases by the same amount as the work done by the system, the process is :-
(A) cyclic (B) isothermal (C) adiabatic (D) isolated

ASSERTION AND REASON TYPE QUESTIONS (1 MARK)

In the following questions, a statement of Assertion (A) followed by a statement of Reason (R) is given. Choose the correct option out of the choices are given below.

(A) Both A and R are true and R is the correct explanation of A.
(B) Both A and R are true but R is not the correct explanation of A.
(C) A is true but R is false.
(D) Both A and R are false.

13. **Assertion :** Equal moles of different substances contain same number of constituent particles.
Reason : Equal weights of different substances contain the same number of constituent particles.
14. **Assertion (A) :** Generally, ionization enthalpy increases from left to right in a period.
Reason (R) : When successive electrons are added to the orbitals in the same principal quantum level, the shielding effect of inner core of electrons does not increase very much to compensate for the increased attraction of the electron to the nucleus.
15. **Assertion (A):** Among the two O – H bonds in H_2O molecule, the energy required to break the first O – H bond and the other O – H bond is the same.
Reason (R): This is because the electronic environment around the oxygen is the same even after breakage of one O – H bond.
16. **Assertion (A):** In the reaction $H_2S + HNO3 \rightarrow NO + S + H_2O$, HNO3 acts as an oxidising agent .
Reason (R): HNO3 gets oxidised to NO.

SECTION B

This section contains 5 questions with internal choice in one question. The following questions are very short answer type and carry 2 marks each.

17. Calculate the number of atoms in each of the following
(i) 52 moles of Ar (ii) 52 u of He
18. What were the reasons for it's failure of Bohr' model?
19. Calculate the solubility of silver chloride in water at room temperature if the Ksp of AgCl is 1.6×10^{-10}.
20. Write the balanced redox reaction
$MnO_4^-(aq) + Fe^{2+}(aq) \rightarrow Mn^{2+}(aq) + Fe^{3+}(aq)$ [acidic medium]
21. Draw the cis and trans structures of hex-2-ene. Which isomer will have higher b.p. and why?

OR

Write IUPAC names of the products obtained by the ozonolysis of Pent-2-ene

SECTION : C

This section contains 7 questions with internal choice in one question. The following questions are short answer type and carry 3 marks each.

22. Dinitrogen and dihydrogen react with each other to produce ammonia according to the following chemical equation:

$$N_2(g) + H_2(g) \rightarrow 2NH_3(g)$$

(i) Calculate the mass of ammonia produced if 2.00×10^3 g dinitrogen reacts with 1.00×10^3 g of dihydrogen.

(ii) Will any of the two reactants remain unreacted?

(iii) If yes, which one and what would be its mass?

23. (i) Out of F or Cl which element would have a more negative electron gain enthalpy? Explain.

(ii) How would you explain the fact that the first ionization enthalpy of sodium is lower than that of magnesium but its second ionization enthalpy is higher than that of magnesium?

24. Calculate the standard enthalpy of formation of $CH_3OH(l)$ from the following data:

$$CH_3OH(l) + \frac{3}{2} O_2(g) \rightarrow CO_2(g) + 2H_2O(l) \; ; \; \Delta_r H^0 = -726 \text{ kJ mol}^{-1}$$

$$C(g) + O_2(g) \rightarrow CO_2(g) \; ; \; \Delta_c H^0 = -393 \text{ kJ mol}^{-1}$$

$$H_2(g) + \frac{1}{2} O_2(g) \rightarrow H_2O(l) \; ; \; \Delta_f H^0 = -286 \text{ kJ mol}^{-1}.$$

25. (i) Define Le-Chatlier principle.

(ii) Describe the effect of :

a) addition of H_2 b) addition of CH_3OH

c) removal of CO d) removal of CH_3OH

on the equilibrium of the reaction: $2H_2(g) + CO(g) = CH_3OH(g)$

26. (i) Draw the resonance structures of phenol. Show the electron shift using curved arrow notation.

(ii) What are carbanions? Give an example.

27. Explain the terms Inductive and Electromeric effects. Which electron displacement effect explains the following correct orders of acidity of the carboxylic acids?

(a) $Cl_3CCOOH > Cl_2CHCOOH > ClCH_2COOH$

(b) $CH_3CH2COOH > (CH_3)_2CHCOOH > (CH_3)_3C.COOH$

28. (i) What are the necessary conditions for any system to be aromatic?

(ii) Explain why the A not aromatic?

(A) 

OR

How would you convert the following compounds into benzene?

(i) Ethyne (ii) Ethene (iii) Hexane

SECTION D

The following questions are case -based questions. Each question has an internal choice and carries 4 (1+1+2) marks each. Read the passage carefully and answer the questions that follow.

29. he rotation of carbon-carbon single bond (sigma -bond), due to cylindrical symmetry of s-Mos (molecular orbitals) long internuclear axis, in alkanes results into different spatial arrangements of atoms in space, that are interconvertible. These arrangements are called conformations. However, weak repulsive interaction are present between the adjacent bonds in alkanes so the rotation of C—C single bond is not completely free and is hindered by a small energy barriers of 1-20 kJ mol^{-1}. The repulsive interaction between the adjacent bond is due to electron cloud. The two types of conformations are very common, i.e., staggered and eclipsed. The conformation in which the hydrogen atoms attached to the two carbon atoms are as far apart as possible is called the staggered conformation. The conformations in which the hydrogen atoms attached to the two carbon atoms are as closed as possible is called eclipsed conformation. Any intermediate conformation between the above two is called skew or gauche conformation.

(i) The electronic distribution of the sigma molecular orbital is symmetrical around the internuclear axis of C-C bond which permits free rotation around C-C bond. Such spatial arrangements of atoms in which conversion of one another takes place by rotation around C-C bond is known as

(A) rotamers (B) conformers (C) conformations (D) All of these

(ii) The possible rotamers of ethane is/are

(A) 2 (B) 3 (C) 4 (D) ∞

(iii) Draw the Newman's projections for conformations of ethane. Why do different conformations of ethane cannot be separated and isolated?

30. Every system is associated with a definite amount of energy, called the internal energy)U or E) of the system. It is the sum of chemical, electrical, mechanical or any other form of energy that anyone can may think of. However gravitational energy is generally necklaces neglected. It is a state function, i. e. independent of the path followed. lt may change when

i) heat flows in or out of the system.

ii) work is done on or by the system.

iii) matter enters or leaves the system

It is an extensive property i.e. depends upon the mass of a substance. It depends only on temperature. The absolute value of internal energy possessed by a substance cannot be calculated because it is not possible to predict the exact values of different forms of energy. Thus, we can just calculate the change in internal energy which is achieved by changing the state of a system. First law of thermodynamics was proposed by Helmholtz and Robert- mayer who stated that the energy in of an isolated system is constant. i.e. energy can neither we created nor be destroyed but can be converted from one form to another. That's why it is also called law of conservation of energy. When a system undergoes isothermal ΔU = zero i.e. there is no increase or decrease in the internal energy of the system then the first law of thermodynamics reduce to $0=q + w$ or $q = -w$.

i) neither q not w is a state function but q + w is a state function explain why?

ii) Out of mass and density which is an intensive property and why?

iii) Explain thermodynamically how is the heat absorbed by system is used in doing work at constant temperature and pressure.

OR

What is the change in the energy of system if 500 Cal of heat energy are added to a system and system does 350 cal of work on the surroundings?

SECTION E

The following questions are long answer type and carry 5 marks each. All questions have an internal choice.

31. (i) Write the electronic configurations of O_2 , O_2^+, O_2^- (superoxide), O_2^{2-} (peroxide)
(ii) Compare the relative stability of the above species and indicate their magnetic properties;

OR

(i) Explain hybridisation and its characteristics.
(ii) Describe the hybridisation in case of PCl_5.
(iii) Why are the axial bonds longer a compared to equatorial bonds?

32**.** Suggest a method to separate the constituents from the following mixture:
(i) Mixture of two miscible liquids
(ii) A mixture of oil and water
(iii) A mixture of plant pigments
(iv) A mixture of solid benzoic acid and sodium chloride
(v) o-Nitrophenol and p-Nitrophenol present in the mixture.

OR

(i) Define following with examples
(a) Functional isomerism (b) Electrophlies
(ii) An organic compound contains 69% carbon and 4.8% hydrogen, the remainder being oxygen. Calculate the masses of carbon dioxide and water produced when 0.20 g of this substance is subjected to complete combustion.

33. (i) The electron energy in hydrogen atom is given by $En = (-2.18 \times 10^{-18})/n^2$ J. Calculate the energy required to remove an electron completely from the $n = 2$ orbit. What is the longest wavelength of light in cm that can be used to cause this transition.
(ii) Find the energy of the 3^{th} Bohr's orbit of He^+ ion.
(iii) Calculate the number of radial nodes for 2p orbital.

OR

(i) How many electrons in an atom may have the following quantum numbers?
(a) $n = 4$, $ms = -½$ (b) $n = 3$, $l = 0$
(ii) Show that the circumference of the Bohr orbit for the hydrogen atom is an integral multiple of the de Broglie wavelength associated with the electron revolving around the orbit.
(iii) What is the maximum number of emission lines when the excited electron of a H atom in $n = 6$ drops to the ground state?

MARKING SCHEME

SECTION: A

1. (A) O^{2-} 1
2. (D) 1 and –1 1
3. (A) Adding PCl_5 1
4. (C) Remain the Same 1
5. (B) H_2O 1
6. (C) OF_2 1
7. (B) $C_4H_8O_4$ 1
8. (D) LiI 1
9. (B) Heisenberg's uncertainty principle 1
10. (C) ubn 1
11. (C) –25 J 1
12. (C) adiabatic 1
13. (C) 1
14. (A) 1
15. (D) 1
16. (C) 1

SECTION B

17. (i) 1 mole of Ar = 6.022×10^{23} atoms of Ar 1

52 mol of Ar = $52 \times 6.022 \times 10^{23}$ atoms of Ar

= **3.131×10^{25} atoms of Ar**

(ii)1 atom of He = 4 u of He Or, 4 u of He = 1 atom of He 1

1 u of He = 1/4 atom of He

52u of He = 52/4 atom of He

= **13 atoms of He**

18. **<u>Reasons for the Failure of the Bohr Model</u>**

1. Bohr model of the hydrogen atom, ignores dual behaviour of matter. In it electron is regarded as a charged particle moving in well-defined circular orbits about the nucleus. The wave character of the electron is not considered. 1

2. An orbit is a clearly defined path and this path can completely be defined only if both the position and the velocity of the electron are known exactly at the same time. This is not possible according to the Heisenberg uncertainty principle. 1

19.

(i) We first write the dissociation reaction of $AgCl$ in water as given below:

$$AgCl(s) \leftrightarrow Ag^{+}(aq) + Cl^{-}(aq)$$

Now, we use the formula for the solubility products:

$$K_{sp} = [Ag^{+}][Cl^{-}]$$

$$\Rightarrow K_{sp} = [Ag^+]^2 \quad (\text{Since } [Ag^+] = [Cl^-])$$

$$\Rightarrow [Ag^+] = \sqrt{K_{sp}}$$

$$= \sqrt{1.6 \times 10^{-10}}$$

$$= 1.26 \times 10^{-5}\ M$$

Hence, the solubility of silver chloride in water is $1.26 \times 10^{-5}\ M$

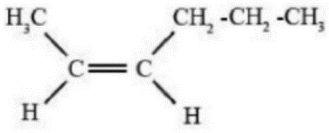
20. MnO_4^- + $8H^+$ + 5e- → Mn^{2+} + $4H_2O$ ……. (i) **2**

Fe^{2+} → Fe^{3+} + e- ……..(ii)

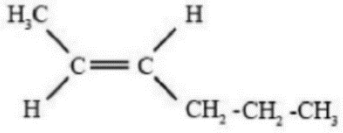
Eq. (i) + 5 x Eq. (ii), we get the balanced eq,

nO_4^- (aq) + $5Fe^{2+}$(aq) + $8H^+$(aq) → Mn^{2+}(aq)+ $5Fe^{3+}$(aq) + $4H_2O$

21. Geometrical isomers of hex-2-ene are: **2**



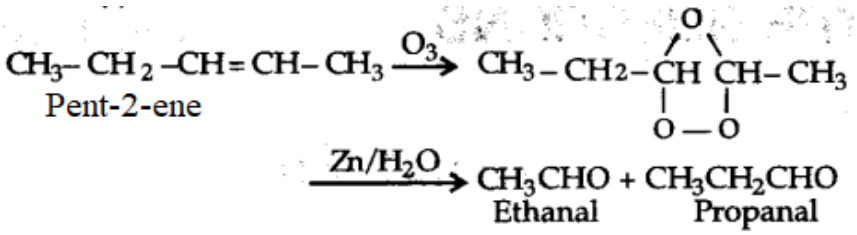
Cis -isomer



Trans -isomer

The dipole moment of cis-compound is a sum of the dipole moments of C−CH_3 and C−CH_2−CH_2CH_3 bonds acting in the same direction. The dipole moment of trans compound is the resultant of the dipole moments of C−CH_3 and C−CH_2−CH_2CH_3 bonds acting in opposite directions. Hence, cis-isomer is more polar than trans-isomer. The higher the polarity, the greater is the intermolecular dipole-dipole interaction and the higher will be the boiling point. Hence, cis-isomer will have a higher boiling point than trans-isomer.

OR **2**



SECTION : C

22. 1+1+1

$$\underset{\substack{1\text{ mol}\\=28.0\text{ g}}}{N_{2(g)}} + \underset{\substack{3\text{ mol}\\=6.0\text{ g}}}{3H_{2(g)}} \rightarrow \underset{\substack{2\text{ mol}\\=34.0\text{ g}}}{2NH_{3(g)}}$$

(i) 28.0 g of N_2 require 6.0 g of H_2 to produce

$= 34.0$ g of NH_3

2.00×10^3g of N_2 will produce

$= \frac{34}{28} \times 2.00 \times 10^3$g of NH_3

$= 2.43 \times 10^3$g of NH_3

$= 2430$ g NH_3

(ii) Yes, dihydrogen will remain unreacted to some extent

(iii) Amount of hydrogen that remains unreacted.

28.0 g of N_2 require 6.0 g of H_2

2.00 g $\times 10^3$g of N_2 will require

$= \frac{6.0}{28.0} \times 2.00 \times 10^3$ of $H_2 = 428.5$ g of H_2

$\therefore$ Amount of hydrogen that remains unreacted

$= [1.00 \times 10^3 - 428.5]_g$

$= 571.5$ g.

23. (i) The value of the electron gain enthalpy of Cl is more negative than that of F. This is because the atomic size of F is smaller than that of Cl. In F, the electron will be added to quantum level n = 2, but in Cl, the electron is added to quantum level n = 3. Therefore, there are less electron- electron repulsions in Cl and an additional electron can be accommodated easily. Hence, the electron gain enthalpy of Cl is more negative than that of F. 2

(ii) The electronic configurations are as follows: 1

Na - [Ne] $3s^1$ Mg - [Ne] $3s^2$

Sodium has one valence electron in 3s1 and by losing this electron it attains stable configuration. Therefore the 1st ionization energy of Na is less than Mg. After removing an electron the Na attains noble gas configuration whereas Mg has one electron left. To remove an electron from a noble gas configuration high energy is required. Therefore the second ionization enthalpy is higher than that of magnesium.

24. 1+2+1

The reaction that takes place during the formation of $CH_3OH(l)$ can be written as:

$$C(s) + 2H_2O(g) + \frac{1}{2}O_2(g) \longrightarrow CH_3OH(l) \quad (\mathbf{1})$$

The reaction (**1**) can be obtained from the given reactions by following the algebraic calculations as:

Equation (ii) + 2 × equation (iii) - equation (i)

$\Delta_f H^\theta [CH_3OH(l)] = \Delta_c H^\theta + 2\Delta_f H^\theta [H2O(l)] - \Delta_r H^\theta$

$= (-393 \text{ kJ mol}^{-1}) + 2(-286 \text{ kJ mol}^{-1}) - (-726 \text{ kJ mol}^{-1})$

$= (-393 - 572 + 726) \text{ kJ mol}^{-1}$

$\Delta_f H^\theta [CH_3OH(l)] = -239 \text{ kJ mol}^{-1}$

25. (i) Le Chatelier's principle states that if a dynamic equilibrium is disturbed by changing the conditions, the position of equilibrium shifts to counteract the change to reestablish an equilibrium. If a chemical reaction is at equilibrium and experiences a change in pressure, temperature, or concentration of products or reactants, the equilibrium shifts in the opposite direction to offset the change. 1

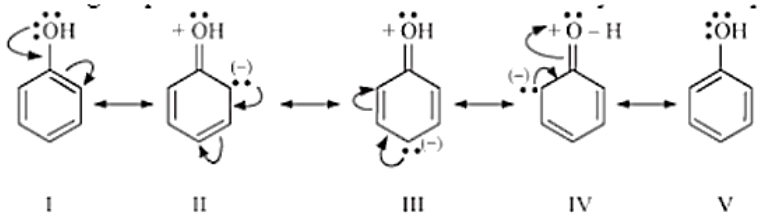
(ii) (a) According to Le Chatelier's principle, on the addition of H_2, the equilibrium of the given reaction will shift the forward direction. 2

(b) On addition of CH_3OH, the equilibrium will shift in the backward direction.

(c) On removing CO, the equilibrium will shift in the backward direction.

(d) On removing CH_3OH, the equilibrium will shift in the forward direction.

26. (i) Resonance structures of phenol. 2

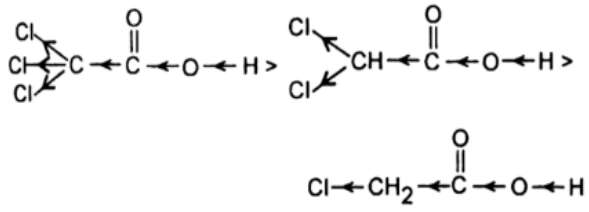


(ii) A carbanion is an anion in which carbon has an unshared pair of electrons and bears a negative charge usually with three substituents for a total of eight valence electrons. 1

Example: H_3C^-

27. 2

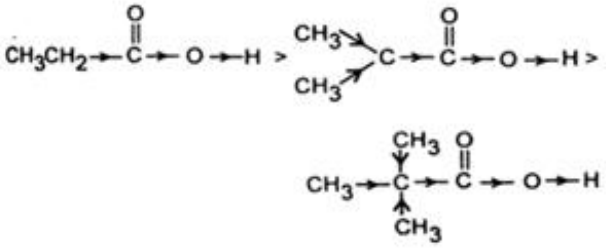
(a) The above order can be explained by - I effect of chlorine atoms.



As the number of halogen atoms decreases, the overall-I effect decreases and the acid strength decreases accordingly.

1

(b) The above order can be explained by +I effect of the methyl group.



As the number of alkyl groups increases, the +I effect increases and the acid strength decreases accordingly.

28. (i) A compound is said to be aromatic if it satisfies the following three conditions: 2

(a) It should have a planar structure.

(b) The π–electrons of the compound are completely delocalized in the ring.

(c) The total number of π–electrons present in the ring should be equal to (4n + 2), where n= 0, 1, 2 … etc. This is known as Huckel's rule.

(ii) A is not aromatic because 1

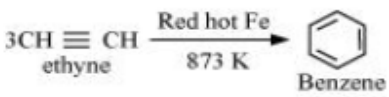
(a) It is not planar

(b) A does not follow Huckel's rule. (4n+2) = 8 => n = 1.5 (non integer)

OR

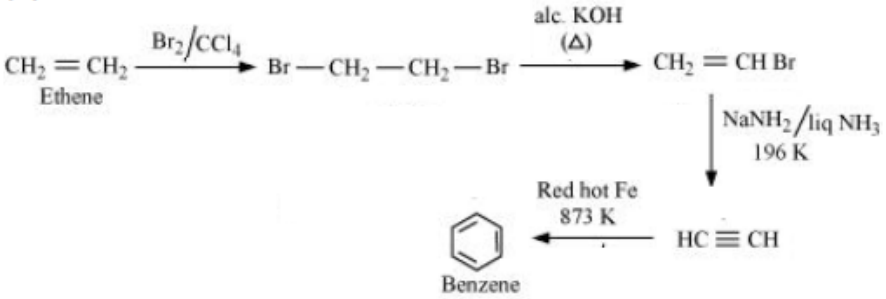
(i) Ethyne to Benzene 1

(i) Benzene from Ethyne:



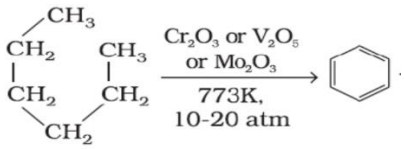
1

(ii) Benzene from Ethene:



1

(iii) Hexane to Benzene



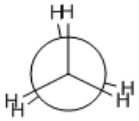
SECTION D

29. (i) (d) All of these 1

(ii) (d) ∞ 1

(iii) Newman's projections for conformations of ethane. 2

staggered



eclipsed

Because of small energy barrier.

30. **(**i) From first law of thermodynamics

$\Delta U = q + w$ as q + w is equal to ΔU which is a state function it does not depends upon path of reaction and only depends upon initial and final state. 1

(ii) Density is an intensive property as it characteristics of a material and does not change with amount where as mass does change. 1

(iii) $\Delta U = q + w$ (from first law of thermodynamics) 2

$0 = q + w$. ($\Delta U = 0$ at constant Temp.)

$0 = q - p\,\Delta V$

$q = -w$

Therefore heat absorbed is used to do work by the system.

OR

According to the first law of thermodynamics. 2

$\Delta U = q + w = 500 + (-350) =$ **+150 cal**.

SECTION: E

31. (i). <u>The electronic configuration of O_2 molecule can be written as:</u>

Total electrons = 8+8= 16 1

$[\sigma(1s)]^2\,[\sigma^*(1s)]^2\,[\sigma(2s)]^2\,[\sigma^*(2s)]^2\,[\sigma(2pz)]^2\,[\pi(2px)]^2\,[\pi(2py)]^2\,[\pi^*(2px)]^1\,[\pi^*(2py)]^1$

Nb=10 , Na= 6

(i) Bond order= $\frac{(Nb-Na)}{2} = \frac{(10-6)}{2} =$ **2**

(ii) Paramagnetic (2 unpaired electrons)

<u>The electronic configuration of O_2^+ can be written as</u>:

Total electrons = 8+8-1= 15 1

$[\sigma(1s)]^2\,[\sigma^*(1s)]^2\,[\sigma(2s)]^2\,[\sigma^*(2s)]^2\,[\sigma(2pz)]^2\,[\pi(2px)]^2\,[\pi(2py)]^2\,[\pi^*(2px)]^1\,[\pi^*(2py)]^0$

Nb=10 , Na= 5

(i) Bond order= $\frac{(Nb-Na)}{2} = \frac{(10-5)}{2} =$ **2.5**

(ii) Paramagnetic (1 unpaired electron)

<u>Electronic configuration of O_2^- ion will be:</u>

Total electrons = 8+8+1= 17 1

$[\sigma(1s)]^2\,[\sigma^*(1s)]^2\,[\sigma(2s)]^2\,[\sigma^*(2s)]^2\,[\sigma(2pz)]^2\,[\pi(2px)]^2\,[\pi(2py)]^2\,[\pi^*(2px)]^2\,[\pi^*(2py)]^1$

Nb=10 , Na= 7

(i) Bond order= $\frac{(Nb-Na)}{2} = \frac{(10-7)}{2} =$ **1.5**

(ii) Paramagnetic (1 unpaired electron)

Electronic configuration of O_2^{2-} ion will be:

Total electrons = 8+8+2= 18 1

$[\sigma(1s)]^2\ [\sigma*(1s)]^2\ [\sigma(2s)]^2\ [\sigma*(2s)]^2\ [\sigma(2pz)]^2\ [\pi(2px)]^2\ [\pi(2py)]^2\ [\pi*(2px)]^2\ [\pi*(2py)]^2$

Nb=10 , Na= 8

(i) Bond order= $\frac{(Nb-Na)}{2} = \frac{(10-8)}{2}$ = **1**

(ii) Diamagnetic (All paired electron)

(ii) Bond dissociation energy is directly proportional to bond order. Thus, the higher the bond order, the greater will be the stability. On this basis, the order of stability is 1

O_2^+ > O_2 > O_2^- > O_2^{2-}.

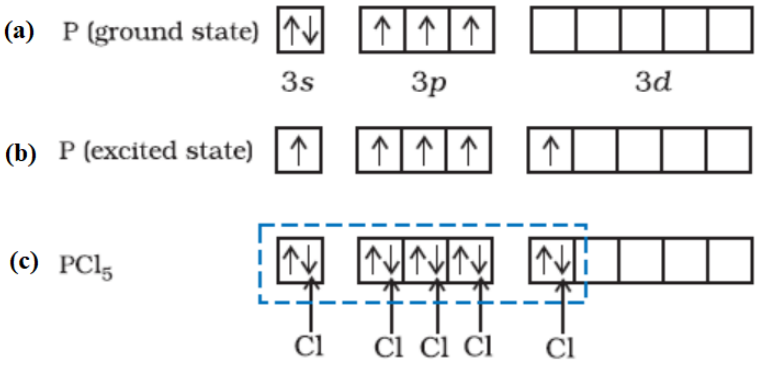
OR

(i) Hybridisation: It is the process of inter mixing atomic orbitals having slightly different energies to form new orbitals having equivalent energy and identical shape. The new orbitals formed are called hybrid orbitals. 2

Characteristics of hybridisation

1. The number of hybrid orbitals formed is equal to the number of atomic orbitals undergo hybridization.
2. The hybrid orbitals are always equivalent in energy and in identical shape.
3. The hybrid orbitals are more effective in forming stable bonds than the pure atomic orbitals.
4. The hybrid orbitals are directed to some fixed positions in space. So the type of hybridization gives the shape of the molecule.

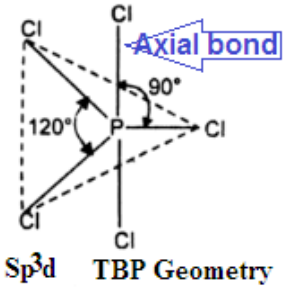
(ii) The ground state **(a)** and excited state **(b)** outer electronic configurations of phosphorus (Z=15) are: 2



Phosphorus atom is **sp^3d** hybridised fig. **(c)** in the excited state.

These 5 half-filled orbitals are filled by the electron donated by 5 Cl atoms.

(iii) **1**



There are 5 P–Cl sigma bonds in PCl_5. 3 P–Cl bonds lie in one plane and make an angle of 120° with each other. These bonds are called equatorial bonds. The remaining 2 P–Cl bonds lie above and below the equatorial plane and make an angle of 90° with the plane. These bonds are called axial bonds. As the **axial bond pairs suffer more** repulsion from the 3 equatorial bond pairs, axial bonds are slightly longer than equatorial bonds.

32. (i) Separation can be done by fractional distillation. 1

(ii) The two can be separated with a separating funnel. 1

(iii) Plants pigments can be separated by adsorption chromatograpgy. 1

(iv) Sublimation can be used for the separation. 1

(v) These can be separated by steam distillation. 1

OR

(i) (a) Functional isomerism: It is the type of isomers formed by compounds that have the same molecular formula but different functional groups. For example, propanone and propanal are functional isomers as they both have the same molecular formula but different functional groups. 1

(b) Electrophiles are electron deficient species and can accept an electron pair from electron rich species. Examples include carbocations and carbonyl compounds. 1

(ii) 1+1+1

Step I : Calculation of mass of CO_2 produced

Mass of compound $= 0.20g$

Percentage of carbon $= 69\,\%$

$$\text{Percentage of carbon} = \frac{12}{44} \times \frac{\text{Mass of carbon dioxide formed}}{\text{Mass of compound}} \times 100$$

$$69 = \frac{12}{44} \times \frac{\text{Mass of carbon dioxide formed}}{(0.20g)} \times 100$$

$$\therefore \text{ Mass of } CO_2 \text{ formed } = \frac{69 \times 44 \times (0.20g)}{12 \times 100} = 0.506g$$

Step II. Calculation of mass of H_2O produced

Mass of compound $= 0.20g$

Percentage of hydrogen $= 4.8\,\%$

$$\text{Percentage of hydrogen} = \frac{2}{18} \times \frac{\text{Mass of water formed}}{\text{Mass of compound}} \times 100$$

$$4.8 = \frac{2}{10} \times \frac{\text{Mass of water formed}}{(0.20g)} \times 100$$

$$\therefore \text{ Mass of } H_2O \text{ formed } = \frac{4.8 \times 18 \times (0.20g)}{2 \times 100} = 0.0864g.$$

33 (i) 1+1+1

Step I.

Calculation of energy required

The energy required is the difference in the energy when the electron jumps from orbit with n = ∞ to orbit with n = 2.

The energy required (ΔE) = $E_\infty - E_2$

$$= 0 - \left(-\frac{2.18\times10^{-18}}{4}\,J\right)$$

$= 5.45 \times 10^{-19}$ J.

Step II.

Calculation of the longest wavelength of light in cm used to cause the transition

$\Delta E = h\nu = hc / \lambda$.

$$\lambda = \frac{hc}{\Delta E} = \frac{(6.626 \times 10^{-34}\ J\ s) \times (3 \times 10^{8}\ ms^{-1})}{(5.45 \times 10^{-19}\ J)}$$

$$\lambda = \frac{hc}{\Delta E} = \frac{(6.626 \times 10^{-34}\ J\ s) \times (3 \times 10^{8}\ ms^{-1})}{(5.45 \times 10^{-19}\ J)}$$

n= 3.644×10^{-7}

m = $3.644 \times 10^{-7} \times 10^{2}$

= 3.645×10^{-5} cm.

(ii) 1

$$E_n = -2.18 \times 10^{-18} \times \frac{Z^2}{n^2}$$

En = $-2.18 \times 10^{-18} \times (2^2 / 3^2)$ = **-9.69×10^{-19} j/atom**

(iii) For 2p, 1

Radial nodes= $(n-l-1)=2-1-1=0$, i.e., 0 radial nodes.

OR

(i) (a) The Maximum no of electrons in 4th energy level = $2\times n^2 = 2\times4^2 = 32$ electrons 1

In 32 electrons half the electrons have ms = -1/2 and the other have ms = +1/2

So total no of electrons having n = 4 and $m_s = -1/2$ is $1/2\times32$ = **16**

(b) n = 3, l = 0 indicates that the electrons are present in the 3s orbital. Therefore, the number of electrons having n = 3 and l = 0 is 2. 1

(ii) Since a hydrogen atom has only one electron, according to Bohr's postulate, the angular momentum of that electron is given by: 1+1

mvr = $\frac{nh}{2\pi}$ .....(1) Where, n = 1, 2, 3, …

According to de Broglie's equation:

$\lambda = \frac{h}{mv}$ OR mv=h/λ .....(2)

Substituting the value of 'mv' from expression (2) in expression (1)

$(h/\lambda)r = nh/2\pi$ or

$2\pi r = n\lambda$ .....(3)

Since '2πr' represents the circumference of the Bohr orbit (r), it is proved by equation (3) that the circumference of the Bohr orbit of the hydrogen atom is an integral multiple of de Broglie's wavelength associated with the electron revolving around the orbit.

(iii) n= 6 1

Number of spectral lines = $\frac{n(n-1)}{2} = \frac{6(6-1)}{2}$ = **15**

BLUE PRINT-CLASS-XI

UNIT	MCQ (1M)	VSA (2M)	SA (3M)	CBQ (4M)	LA (5M)	Total
Some Basic Concepts Of Chemistry	1(1)	1(2)		1(4)	-	3(7)
Structure Of Atom	4(4)	1(2)	1(3)		-	6(9)
Classification Of Elements & Periodicity Of Elements	3(3)		1(3)	-	-	4(6)
Chemical Bonding & Molecular Structure		1(2)	-	-	1(5)	2(7)
Thermodynamics	-	1(2)	1(3)	1(4)	-	3(9)
Equiblrium	2(2)	-	-	-	1(5)	3(7)
Redox Reaction	1(1)		1(3)		-	2(4)
Organic Chemistry- Some Basic Principles & Techniques	3(3)	1(2)	2(6)		-	6(11)
Hydrocarbons	2(2)		1111111		1(5)	5(10)
	16(16)	7(14)	7(21)	2(8)	3(15)	35(70)

SET-2

SESSION ENDING EXAMINATION
SESSION: 2022-23
SUBJECT: CHEMISTRY THEORY
CLASS-XI

MM: 70 **Time:3 Hours**

Instructions-

1. Read the following instructions carefully.
2. (a) There are 33 questions in this question paper with internal choice.
   (b) SECTION A consists of 16 multiple -choice questions carrying 1 mark each.
   (c) SECTION B consists of 5 short answer questions carrying 2 marks each.
   (d) SECTION C consists of 7 short answer questions carrying 3 marks each.
   (e) SECTION D consists of 2 case - based questions carrying 4 marks each.
   (f) SECTION E consists of 3 long answer questions carrying 5 marks each.
3. All questions are compulsory.
4. Use of log tables and calculators is not allowed.

SECTION A

Q.1 The number of atoms present in one mole of an element is equal to Avogadro number. Which of the following element contains the greatest number of atoms?

(a) 4g He (b) 46g Na (c) 0.40g Ca (d) 12g He

Q.2 Which of the following set of quantum numbers is not possible?

(a) n = 3, l = 0, m = 0 (b) n = 3, l = 1, m = -1
(c) n = 2, l = 0, m = -1 (d) n = 2, l = 1, m = 0

Q.3 The ground state electronic configuration of Fe3+ ion is

(a) [Ar] $3d^3 4s^2$ (b) [Ar] $3d^6 4s^2$ (c) [Ar] $3d^5$ (d) [Ar] $3d^6$

Q.4 Whenever a list of radii is given, we find that the size of the noble gases is larger than the size of their adjacent halogens. The reason is

(a) Noble gases have a complete octet
(b) They have a higher inter electronic repulsion
(c) In halogens it is covalent radii and in noble gases it is Vander walls radii
(d)Noble gases cannot be liquefied

Q. 5 The increasing order of effective nuclear charge in Na, Al, Mg and Si atoms

(a) Na < Mg < Si <Al (b) Na < Mg <Al < Si
(c) Mg < Na <Al< Si (d) Na = Mg =Al = Si

Q.6 Find the pair with sp2 hybridisation of the central molecule

(a) NH_3 and NO_2^- (b) BF_3 and NH_2^- (c) BF_3 and NO_2^- (d) NH_2^- and H_2O

Q.7 Thermodynamics is not concerned about .

(a) energy changes involved in a chemical reaction.
(b) the extent to which a chemical reaction proceeds.
(c) the rate at which a reaction proceeds.
(d) the feasibility of a chemical reaction.

Q.8 The spontaneity means, having the potential to proceed without the assistance of

external agency. The processes which occur spontaneously are
(a) flow of heat from colder to warmer body.
(b) gas in a container contracting into one corner.
(c) gas expanding to fill the available volume.
(d) burning carbon in oxygen to give carbon dioxide.

Q.9 In a closed system $A(s) \rightleftharpoons 4\,B(g) + 3C(g)$
If partial pressure of C is doubled, then partial pressure of B will be
(a) $12 \times (2)^{1/2}$ times the original value
(b) ½ times the original value
(c) 2 times the original value
(d) ½ 2 times of the original value

Q.10 $H_2 + S \rightarrow H_2S$ + energy
In this reversible reaction, select the factor which will shift the equilibrium to the right.
(a) adding heat
(b) adding H2S
(c) blocking hydrogen gas reaction
(d) removing hydrogen sulphide gas

Q.11 One mole of ferrous oxalate requires____ moles of MnO_4^- to get oxidised completely in an acidic medium
(a) 0.6 moles (b) 0.4 moles (c) 0.2 moles (d) 7.5 moles

Q.12 The simplest member of organic compounds is?
(a) Methanol (b) Methane (c) Formaldehyde (d) Formic acid

Q.13 Assertion (A) : The empirical mass of ethene is half of its molecular mass.
Reason (R) : The empirical formula represents the simplest whole number ratio of various atoms present in a compound.
(a) Both A and R are true and R is the correct explanation of A.
(b) A is true but R is false.
(c) A is false but R is true.
(d) Both A and R are false

Q.14 Assertion (A) : The value of electron gain enthalpy decrease while moving left to right in a period.
Reason (R) : The electron gain enthalpy is the energy which released hence it represented with negative sign.
(a) Both A and R are true and R is the correct explanation of A.
(b) A is true but R is false.
(c) A is false but R is true.
(d) Both A and R are false

Q.15 Assertion (A) : The molecules which have same Hybridization always has the same shape.
Reason (R) : Lone pairs are not included in the shape of the molecule.
(a) Both A and R are true and R is the correct explanation of A.
(b) A is true but R is false.
(c) A is false but R is true.
(d) Both A and R are false

Q.16 Assertion (A) : Zinc displaces copper from copper sulphate solution

Reason (R) : The E^o of Zn is -0.76 V and that of Cu is +0.34 V.

(a) Both A and R are true and R is the correct explanation of A.

(b) A is true but R is false.

(c) A is false but R is true.

(d) Both A and R are false

SECTION B

Q.17 Give an example of a molecule in which the ratio of the molecular formula is six times the empirical formula.

Q.18 Give the electronic configuration of O_2^- and Na^+ ions.

Q.19 Aqueous solution of $CuSO_4$ is Acidic. Why ?

Q.20 Name one compound in which oxidation number of Cl is +4.

OR

Explain Disproportionation reaction with one example.

Q.21 Give IUPAC name of $(CH_3)_2$-CH-CH=CH_2

SECTION C

Q.22 The reactant which is entirely consumed in reaction is known as limiting reagent. In the reaction $2A + 4B \rightarrow 3C + 4D$, when 5 moles of A react with 6 moles of B, then-

(i) which is the limiting reagent?

(ii) calculate the amount of C formed?

Q.23 Elements A, B, C and D have atomic numbers 12,19, 29, and 36 respectively. On the basis of electronic configuration, write to which group of the periodic table each element belongs.

OR

Explain why cations are smaller and anions larger in radii than their parent atoms?

Q.24 Given that $\Delta H = 0$ for mixing of two gases. Explain whether the diffusion of these gases into each other in a closed container is a spontaneous process or not?

Q.25 The difference between Cp and Cv can be derived using the empirical relation H= U+PV. Calculate the difference between Cp and Cv for 10 moles of an ideal gas.

Q.26 The following concentration were obtained for the formation of NH_3 from N_2 and H_2 at equilibrium at 500 K. $[N_2(g)] = 1.5 \times 10^{-2}$ M $[H_2(g)] = 3.0 \times 10^{-2}$ M $[NH_3] = 1.2 \times 10^{-2}$ M. Calculate equilibrium constant.

Q.27 Nitric acid is an oxidizing agent which reacts with PbO but not with PbO_2. Explain why?

OR

MnO_4^{-2} shows disproportion reaction in acidic medium but MnO_4^- do not. Give Reason

Q.28 In an estimation of sulphur by carius method 0.468 g of an organic compound gave 0.668 g of barium sulphate. Find the percentage of sulphur in the compound. (atomic Mass of S=32u, atomic Mass of O=16u and at. Mass of Ba=137u)

Q.29 Which bond is more polar in the following pairs of molecules. (a) H_3C-H, H_3C-Br

(b) H_3C-OH, H_3C-SH (c) H-F, H-Cl

Q.28 Give the structure of alkyl halide which when treated with sodium metal in Presence of ether gives $(CH_3)_2CH$-$CH(CH_3)_2$.

SECTION D

Q.29 Read the following passage and answer questions.

Equilibrium Involving Dissolution of Gases in Liquids- When a soda water bottle is opened, some of The carbon dioxide gas dissolved in it fizzes Out rapidly. The phenomenon arises due to difference in solubility of carbon dioxide at different pressures. There is equilibrium between the molecules in the gaseous state and the molecules dissolved in the liquid under pressure i.e., CO_2 (gas) CO_2 (in solution).This equilibrium is governed by Henry's law, which states that the mass of a gas dissolved in a given mass of a solvent at any temperature is proportional to the pressure of the gas above the solvent. This amount decreases with increase of temperature. The soda water bottle is sealed under pressure of gas when its solubility in water is high. As soon as the bottle is opened, some of the dissolved carbon dioxide gas escapes to reach a new equilibrium condition required for the lower pressure, namely its partial pressure in the atmosphere. This is how the soda water in bottle when left open to the air for some time, turns 'flat'. It can be generalized that: For solid liquid equilibrium, there is only one temperature (melting point) at 1 atm (1.013 bar) at which the two phases can coexist. If there is no exchange of heat with the surroundings, the mass of the two phases remains constant. For liquid vapour equilibrium, the vapour pressure is constant at a given temperature. For dissolution of solids in liquids, the solubility is constant at a given temperature. For dissolution of gases in liquids, the Concentration of a gas in liquid is Proportional to the pressure (concentration) of the gas over the liquid

29.(i) ……..... states that the mass of a gas dissolved in a given mass of a solvent at any temperature is proportional to the pressure of the gas above the solvent.

a) Henry's Law b) Charles's law

c) Boyle's law d) Arrhenius law

29.(ii) Equilibrium is possible only in a ...…….....at a given temperature.

a) open system b) isolated system

c) closed system d) None of above

29.(iii) The value of R= .....

a) 0138 bar litre/mol K b) 0381 bar litre/mol K

c) 0318 bar litre/mol K d) 0831 bar litre/mol K

29.(iv) The equilibrium involving ions in aqueous solutions which is called as ...

a) static equilibrium b) dynamic equilibrium

c) physical equilibrium d) ionic equilibrium

Q.30 The rotation of carbon-carbon single bond (sigma -bond), due to cylindrical symmetry of s-MOs (molecular orbitals) long internuclear axis, in alkanes results into different spatial arrangements of atoms in space, that are interconvertible. These arrangements are called conformations. However, weak repulsive interaction are present between the adjacent bonds in alkanes so the rotation of C—C single bond is not completely free and is hindered by a small energy barriers of 1-20 kJ mol- 1. The repulsive interaction between the adjacent bond is due to electron cloud. The two types of conformations are very common, i.e., staggered and eclipsed. The conformation in which the hydrogen atoms attached to the two carbon atoms are as far apart as possible is called the staggered conformation. The conformations in which the hydrogen atoms attached to the two carbon atoms are as closed as possible is called eclipsed conformation. Any intermediate conformation between the above two is called skew or gauche conformation

30. (i) The electronic distribution of the sigma molecular orbital is symmetrical around the

internuclear axis of C-C bond which permits free rotation around C-C bond. Such spatial arrangements of atoms in which conversion of one another takes place by rotation around C-C bond is known as

(a) rotamers (b) conformers (c) conformations (d) All of these

30. (ii) The possible rotamers of ethane is/are

(a) 2 (b) 3 (c) 4 (d) ∞

30. (iii) Why do different conformations of ethane cannot be separated and isolated?

30. (iv) Define torsional strain

SECTION E

Q.31 In the Balmer series of atomic spectra of hydrogen atom, a line corresponding to wavelength 656.4 nm was obtained. Calculate the number of higher orbit from which the electron drops to produce this line.

Q.32 Discuss the shape of the following molecules using the VSEPR model: $BeCl_2$, BCl_3, $SiCl_4$, AsF_5, H_2S, PH_3

OR

Explain with the help of suitable example polar covalent bond.

Q.33 (i) Which of the following represents the correct IUPAC name for the compounds concerned?

(a) 2,2-Dimethylpentane or 2-Dimethylpentane

(b) But-3-yn-1-ol or But-4-ol-1-yne

(ii) Give condensed and bond line structural formulas and identify the functional group(s) present, if any, for :

(a) Hexanedial

(b) 3- Methyl pentan-2-one

OR

Explain the terms Inductive and Electromeric effects. Which electron displacement effect explains the following correct orders of acidity of the carboxylic acids?

(a) $Cl_3CCOOH > Cl_2CHCOOH > ClCH_2COOH$

(b) $CH_3CH_2COOH > (CH_3)_2CHCOOH > (CH_3)_3C.COOH$

MARKING SCHEME

SECTION A

Q.No.	Answer
1	D
2	C
3	C
4	B
5	B
6	C
7	B
8	C
9	A
10	D
11	B
12	B
13	A
14	A
15	C
16	A

SECTION B

17. Suitable Example 2
18. $2S^2\ 2P^6$ 2
19. Electron acceptor is acidic 2
20. Cl_2O_4 or suitable example 2
21. 3-methylbut-1-ene 2

SECTION C

22. (i) A is LR 1
(ii) 4.5 mols 2
23. suitable answer 3
24. Diffusion of gas is spontaneous process 3
25. Cp-Cv = nR 3
26. suitable explanation 3
27. Pb in PbO2 is already in maximum oxidation state 3

OR

MnO_4^- is stable 3
28. Proper Explanation 3

SECTION D

29. (i) a, (ii) c, (iii) d, (iv) 4
30. (i) d, (ii) d, (iii) Because of small energy barrier, (iv) exact definition 4

SECTION D

31. Transition Energy Formula

32. Linear, Trigonal Planer, Tetrahedral, Pentagonal Bipyrimidal, Bent, Pyramidal

OR

Proper Explaination

33. (i) 2,2-Dimethylpentane, But-3-yn-1-ol, (ii) proper structure

OR

explanation based in -I, and +I effect.

BLUE PRINT

UNIT	MCQ (1M)	VSA (2M)	SA (3M)	CBQ (4M)	LA (5M)	Total
Some Basic Concepts Of Chemistry	1(1)	1(2)		1(4)	-	3(7)
Structure Of Atom	4(4)	1(2)	1(3)		-	6(9)
Classification Of Elements & Periodicity Of Elements	3(3)		1(3)	-	-	4(6)
Chemical Bonding & Molecular Structure		1(2)	-	-	1(5)	2(7)
Thermodynamics	-	1(2)	1(3)	1(4)	-	3(9)
Equiblrium	2(2)	-	-	-	1(5)	3(7)
Redox Reaction	1(1)		1(3)		-	2(4)
Organic Chemistry- Some Basic Principles & Techniques	3(3)	1(2)	2(6)		-	6(11)
Hydrocarbons	2(2)		1111111		1(5)	5(10)
	16(16)	7(14)	7(21)	2(8)	3(15)	35(70)

SET-3

SESSION ENDING EXAMINATION
SUBJECT : CHEMISTRY
CLASS : XI

MM:70 Time: 3 hours

General Instructions:

Read the following instructions carefully.

a) There are 33 questions in this question paper with internal choice.
b) SECTION A consists of 16 multiple-choice questions carrying 1 mark each.
c) SECTION B consists of 5 very short answer questions carrying 2 marks each.
d) SECTION C consists of 7 short answer questions carrying 3 marks each.
e) SECTION D consists of 2 case- based questions carrying 4 marks each.
f) SECTION E consists of 3 long answer questions carrying 5 marks each.
g) All questions are compulsory.
h) Use of log tables and calculators is not allowed

SECTION A

1.What is the mass percent of hydrogen in in water?
(a) 0.034% (b) 11.1% (c) 3.4% (d) 28.7%

2.Principal, Azimuthal, and magnetic quantum numbers are respectively related to:
(a) size , shape, and orientation (b)shape, size and orientation
(c) size, orientation and shape (d) none of above

3.The three dimensional space where probability of finding the electrons is maximum is called
(a) Orbit (b) Orbital (c) Octet (d) Nodes

4.The correct order of radii is
(a) N< Be< B (b) $F^{-}<O^{2-}<N^{3-}$
(c) N< Li<K (d) $Fe^{3+}<Fe<Fe^{2+}$

5. For a reversible reaction, if the concentration of the reactants are doubled, then the equilibrium constant will
(a) Also be doubled (b) Be halved
(c) Become one fourth (d) Remain the same.

6.Which of the following is not a Lewis acid
(a) BF_3 (b) $FeCl_3$ (c) H_2O (d) PF_5

7.The oxidation number of Mn is maximum in
(b)K_2MnO_4
(c)Mn_3O_4
(d) $KMnO_4$.

8. The correct statement regarding electrophile is
(a) Electrophile is a negatively charge species and can form a bond by accepting a pair of electrons from a nucleophile
(b) Electrophile is a negatively charged species and can form a bond by accepting a pair of electrons from another electrophile

(c) Electrophiles are generally neutral species and can form a bond by accepting a pair of electrons from a nucleophile

(d) Electrophile can be either neutral or positively charged species and can form a bond by accepting a pair of electrons from a nucleophile.

9.The displacement of electrons in a multiple bond in the presence of attacking reagent is called

(a) Inductive effect (b) Electromeric effect

(c) Resonance (d) Hyper conjugation

10. cis-2-butene and trans 2-butene are

(a) conformational isomers (b) structural isomers

(c) configurational isomers (d) optical isomers

11. The order of reactivity of alkenes

$(CH_3)_2C=CH_2$, $CH_3CH=CH_2$, $CH_2=CH_2$

I II III

(a) I >II >III (b) I > III > II (c) III > II > I (d) II >I > III

12.The order of screening effect of electrons of s, p, d and f orbitals of a given shell of an atom on its outer shell electrons is

(a) s>p>d>f (b) f > d > p > s

(c) p < d < s > f (d) f > p > s > d

13**.** Given below are two statements labelled as Assertion (A) and Reason (R)

(a) If both assertion and reason are true, and reason is the true explanation of the assertion.

(b) If both assertion and reason are true, but reason is not the true explanation of the assertion.

(c) If assertion is true, but reason is false.

(d) If both assertion and reason are false.

Assertion: In Lyman series of H-spectra, the maximum wavelength of lines is 121.56nm.

Reason: Wavelength is maximum when the transition is from the very next level.

14**.** Given below are two statements labelled as Assertion (A) and Reason (R)

(a) If both assertion and reason are true, and reason is the true explanation of the assertion.

(b) If both assertion and reason are true, but reason is not the true explanation of the assertion.

(c) If assertion is true, but reason is false.

(d) If both assertion and reason are false.

Assertion: According to Thomson model of atom, mass of the atom is concentrated in the centre of the atom.

Reason: According the Thomson model, positive charge is concentrated in the centre of the atom.

15. Given below are two statements labelled as Assertion (A) and Reason (R)

(a) If both assertion and reason are true, and reason is the true explanation of the assertion.

(b) If both assertion and reason are true, but reason is not the true explanation of the assertion.

(c) If assertion is true, but reason is false.

(d) If both assertion and reason are false.

Assertion: The first ionization enthalpy of aluminium is lower than that of magnesium.

Reason: Ionic radius of aluminium is smaller than that of magnesium.

16. Given below are two statements labelled as Assertion (A) and Reason (R)

(a) If both assertion and reason are true, and reason is the true explanation of the assertion.

(b) If both assertion and reason are true, but reason is not the true explanation of the assertion.

(c) If assertion is true, but reason is false.

(d) If both assertion and reason are false.

Assertion: Boiling point of alkanes increases with increase in molecular weight.
Reason: van der Waal's forces increase with increase in molecular weight.

SECTION B

17 (i) State the law of constant composition

(ii) Define molality.

OR

Determine the empirical & Molecular formulae for a compound with the following elemental composition:40.00% C, 6.66% H, 53.34% O. (Given molecular mass = 180)

18. (i) What are the types of H-bonding?

(ii) Which force is most stronger between Hydrogen bond and vander Waal force of attraction?

OR

(i) Which one of the following has the highest bond order?

N_2, N^{2+} or N^{2-}.

(ii) Why is BF_3 non – polar?

19 Find the de Broglie wavelength for an electron moving at the speed of 2.19×10^6 ms^{-1} (Given: Mass of an electron = 9.1×10^{-31} kg & h = 6.6 x 10^{-34} Js)

20. (i) Give reasons: A real crystal has more entropy than an ideal crystal.

(ii) What is the relationship between q_p and q_v?

21 (i) How many σ and π bonds are present in $CH_2=C=CHCH_3$ molecule?

(ii) Derive the structure of pent-4-en-2-ol

SECTION C

22. Explain the following:

i. Electronegativity of elements increases on moving from left to right in the periodic table.

ii. Ionisation enthalpy decreases in a group from top to bottom

iii. How does the metallic and non metallic character vary on moving from left to right in a period

23 (i) State two postulates of Bohr's model of hydrogen atom.

(ii) Write a drawback of Bohr's model of hydrogen atom.

OR

(i) Calculate wave number of yellow radiations having wavelength of 5800 A^0 .

(ii) What are the values of n and l for 4f orbital

24 (i) 0.15g of an organic compound gave 0.12g of AgBr by Carius method. Find the percentage of bromine in the compound.

(ii) Arrange the following in increasing order of -I effect. $-NO_2$, -COOH, -F, -CN, – I.

OR

(i) What do you understand by Homolytic fission?

(ii) What are carbanions? Give an example.

25. (i) Which gas is liberated in Kjeldhal's method?

(ii) What are electrophiles and nucleophiles? Explain with example.

26. Calculate the enthalpy of formation of ethane from the following data:

$H_2 + ½\ O_2 \rightarrow H_2O$ $\Delta H^0 = -286$ kJ ……(1)

$C(graphite) + O_2 \text{ -}\square\ CO_2$ $\Delta H^0 = -393.5$ kJ .....(2)

$C_2H_6 + 7/2\ O_2 \text{ -}\square\ 2CO_2 + 3H_2O$ $\Delta H^0 = -1560$ kJ ……(3)

27.(i) Define disproportionation reaction. Give example.

(ii) In the reaction given below, identify the species undergoing oxidation and reduction:

$H_2S\ (g) + Cl_2\ (g) \rightarrow 2HCl\ (g) + S\ (s$

28. How will you convert benzene into

(i) p – nitrobromobenzene

(ii) m – nitrochlorobenzene

(iii) Write the structures and names of products obtained in the reactions of sodium with a mixture of 1-iodo-2-methylpropane

SECTION D

The following questions are case-based questions. Each question has an internal choice and carries 4 (1+1+1+1) marks each. Read the passage carefully and answer the questions that follow.

29.. The identity of a substance is defined not only by the types of atoms or ions it contains, but by the quantity of each type of atom or ion. The experimental approach required the introduction of a new unit for amount of substances, the mole, which remains indispensable in modern chemical science. The mole is an amount unit similar to familiar units like pair, dozen, gross, etc. It provides a specific measure of the number of atoms or molecules in a bulk sample of matter. A mole is defined as the amount of substance containing the same number of discrete entities (atoms, molecules, ions, etc.) as the number of atoms in a sample of pure 12C weighing exactly 12g. One Latin connotation for the word "mole" is "large mass" or "bulk," which is consistent with its use as the name for this unit. The mole provides a link between an easily measured macroscopic property, bulk mass, and an extremely important fundamental property, number of atoms, molecules and so forth. The number of entities composing a mole has been experimentally determined to be $6.02214179 \times 10^{23}$.

(i) How many moles of magnesium phosphate, $Mg_3(PO)_4$ will contain 0.25 mole of oxygen atoms?

(a) 1.25×10^{-2} (b) 2.5×10^{-2}

(c) 0.02 (d) 3.125×10^{-2}

(ii)What is the mass of one molecule of yellow phosphorus? (At. mass of phosphorus =30)

(a)1.993×10^{-22} mg (b)1.993×10^{-19} mg

(c) 4.983×10^{-20} mg (d) 4.983×10^{-23} mg

(iii) The number of moles of oxygen in 1L of air containing 21% oxygen by volume, in standard conditions is

(a) 0.186 mol (b) 0.21 mol

(c) 2.10 mol (d) 0.0093 mol

(iv)The number of moles present in 6 gm of carbon is:

(a) 2 (b) 0.5 (c) 5 (d) 1

OR

The mass of an atom of carbon is ————.

(a) 1g (b) 1.99×10^{-23} g (c) 1/12 g (d) 1.99×10^{23} g

30. A system in thermodynamics refers to that part of universe in which observations are made and remaining universe constitutes the surroundings. The surroundings include everything other than the system. System and the surroundings together constitute the universe. The universe = The system + The surroundings However, the entire universe other than the system is not affected by the changes taking place in the system. Therefore, for all practical purposes, the surroundings are that portion of the remaining universe which can interact with the system. Usually, the region of space in the neighbourhood of the system constitutes its surroundings. The wall that separates the system from the surroundings is called boundary.

(i) State the I law of thermodynamics.

(ii) Write the mathematical statement of first law of thermodynamics.

(iii) From thermodynamic point of view, to which system the animals and plants belong?

(iv) Predict the internal energy change for an isolated system?

OR

In a process 701 J of heat is absorbed by a system and 394 J work is done by the system. What is the change in internal energy for the process?

SECTION E

31. (i) What are the necessary conditions for any system to be aromatic?

(ii) What is decarboxylation? Give an example.

OR

(a) How will you convert the following compounds into benzene?

(i) Ethyne (ii) Ethene (iii) Hexane.

(b)Why does benzene undergo electrophilic substitution reactions easily and nucleophilic substitutions with difficulty?

32. What is K_c for the following reaction in state of equilibrium?

$$2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)$$

Given: $[SO_2] = 0.6$ M; $[O_2] = 0.82$ M; and $[SO_3] = 1.90$ M

(ii) Define common ion effect.

OR

(i) Define Le Chatelier's principle.

(ii) Following reactions occur in a Blast furnace.

$Fe_2O_3(s) + 3CO(g) \longrightarrow 2Fe(s) + 3CO_2(g)$

use Le Chatelier's principle to predict the direction of reaction when equilibrium mixture is disturbed by

(a) adding Fe_2O_3 (b) removing CO_2.

(c) removing CO.

33. (i) Distinguish between a sigma bond and a pi bond.

(ii) Use molecular orbital theory to explain why the Be_2 molecule does not exist.

(iii) Predict the shapes of the following molecules using VSEPR theory?

(a) $BeCl_2$ (b) $SiCl_4$

OR

(i) What do you understand by bond pairs and lone pairs of electrons? Illustrate by giving one example of each type.

(ii) Which out of NH_3 and NF_3 has higher dipole moment and why?

(iii) How do you express the bond strength in terms of bond order?

MARKING SCHEME

<table>
<tr><td colspan="2">SECTION A</td><td></td></tr>
<tr><td>Q.NO</td><td>VALUE POINTS</td><td>MARKS</td></tr>
<tr><td>1</td><td>b</td><td>1</td></tr>
<tr><td>2</td><td>a</td><td>1</td></tr>
<tr><td>3</td><td>b</td><td>1</td></tr>
<tr><td>4</td><td>b</td><td>1</td></tr>
<tr><td>5</td><td>d</td><td>1</td></tr>
<tr><td>6</td><td>c</td><td>1</td></tr>
<tr><td>7</td><td>d</td><td>1</td></tr>
<tr><td>8</td><td>d</td><td>1</td></tr>
<tr><td>9</td><td>b</td><td>1</td></tr>
<tr><td>10</td><td>c</td><td>1</td></tr>
<tr><td>11</td><td>a</td><td>1</td></tr>
<tr><td>12</td><td>a</td><td>1</td></tr>
<tr><td>13</td><td>a</td><td>1</td></tr>
<tr><td>14</td><td>b</td><td>1</td></tr>
<tr><td>15</td><td>b</td><td>1</td></tr>
<tr><td>16</td><td>a</td><td>1</td></tr>
<tr><td></td><td>SECTION B</td><td></td></tr>
<tr><td>19</td><td>Statement of law of constant composition, Definition of molality
OR
<table>
<tr><td>Element</td><td>percentage</td><td>Atomic mass</td><td>Relative number of Atoms</td><td>Dividing by least number</td><td>Simple ratio</td></tr>
<tr><td>C</td><td>40</td><td>12</td><td>40/12 = 3.33</td><td>3.33/3.33</td><td>1</td></tr>
<tr><td>H</td><td>6.66</td><td>1</td><td>6.66/1 =6.66</td><td>6.66/3.33</td><td>2</td></tr>
<tr><td>O</td><td>53.34</td><td>16</td><td>53.34/16 =3.33</td><td>3.33/3.33</td><td>1</td></tr>
</table></td><td>1+1

1</td></tr>
<tr><td></td><td>Empirical formula = $C_1H_2O_1$; Empirical formula mass =12+2 x 1+16 = 30u
Given relative molecular mass = 180
n=180/30 = 6
The molecular formula ($C_1H_2O_1$) x 6 = $C_6H_{12}O_6$</td><td>½

1/2</td></tr>
<tr><td>21</td><td>(i) Inter-molecular H-bonding
(ii) Hydrogen-bonding.
OR
(i) N_2 has the highest bond order
(ii) Because BF_3 has symmetrical shape, the net dipole moment is zero and thus it is non – polar.</td><td>1

1
1

1</td></tr>
<tr><td>22</td><td>$\lambda = \frac{h}{mv} = \frac{6.626 \times 10^{-34}}{9.11 \times 10^{-31} \times 2.19 \times 10^{6}} = 3.32 \times 10^{-10} m = 332\ pm$</td><td>2</td></tr>
<tr><td>23</td><td>(i) An ideal crystal has a perfect order of its constituent particles while a real crystal has less order because of some defects. Therefore, a real crystal has more entropy than an ideal crystal.
(ii)$q_p = q_v + \Delta ng\ RT$, where $\Delta n = n_p – n_r$ (gaseous).</td><td>1
1</td></tr>
</table>

24	(i) 9 sigma 2 pi (ii) CH_2=$CHCH_2CH(OH)CH_3$	1 1. .
25		
25	**SECTION C** 1. Due to the general decrease in atom size and increase in nuclear charge, the electronegative of elements increases as one moves from left to right in the periodic table. 2. The ionisation enthalpy of a group decreases from top to bottom due to the increase in atomic size caused by the addition of a new shell. 3.Moving from left to right in a period, metallic character decreases and nonmetallic character increases	1 1 1
26	(i)Two postulates of Bohr's model of atom (ii)Any one drawback of Bohr's model of atom **OR** (i) Wave number is reciprocal of wavelength. Therefore, v= 1/ λ = 1/ 5800 x 10-10 = 1.72 x 106 m-1 (ii) n = 4 and l = 3	2 +1 2 1
27	(i) Mass of AgBr formed = 0.12g 188 g of AgBr contains bromine = 80g. Therefore, 0.12g of AgBr will contain bromine = 80×0.12188 = 0.051 g Percentage of bromine = 0.0510.15 × 100 = 34% (ii) -I < -F < -COOH < -CN < -NO_2. **OR** (i) Homolytic fission is breaking of a bond in such a manner that each atom takes one electron each to form free radicals. A——-B ———-> A + B (ii) Organic ions which contain a negatively charged carbon atom are called carbanions. e.g., CH_3^- is carbanion.	2 1 1 1+1
28	(i) NH_3 (ii) correct definition with example	1 1+ 1
29	Required equation, $2C + 3H_2 \rightarrow C_2H_6$ ΔH^0=? Multiply eqn. (1) by 3 and eqn. (2) by 2, reverse eqn. (3) and add. $3H_2 + 2C + 3\ ½O_2 \rightarrow 2\ CO_2 + 3\ H_2O$ $\Delta H = -1645$ kJ ……(4) Reverse eqn. (3) and add eqn.(4) $2CO_2 + 3H_2O \rightarrow C_2H_6 + 7/2\ O_2$ $\Delta H = +1560$ kJ ……(5) Add eqn. (4) and eqn. (5) $3H_2 + 2C \rightarrow C_2H_6$ $\Delta H = -85$ kJ Therefore, the enthalpy of formation of ethane = -85 kJ.	
30	(i) correct definition with example (ii) H_2S is oxidized to S while Cl_2 is reduced to HCl	2 1
	SECTION D	
31	(i) d (ii) b (iii) d (iv) b or b	1X4=4
32	(i) correct statement & $\Delta U = q + w$ (ii) open system (iii)Zero OR	2 1 1

	$\Delta U = q - w = 701 - 394 = 307$ J	
	SECTION E	
33	(i)Correct statements (ii) correct definition with suitable example **OR** (a) (b) Due to the presence of an electron cloud containing 6 n-electrons above and below the plane of the ring, benzene is a rich source of electrons.	3 2 3 + 2
34	(i) $2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)$ $K_c = \frac{[SO_3]^2}{[SO_2]^2[O_2]} = \frac{(1.9\,M) \times (1.9\,M)}{(0.6\,M) \times (0.6\,M) \times (0.82\,M)}$ $= 12.229\ M^{-1} = \mathbf{12.229\ L\ mol^{-1}}$ (ii)The supervision in concentration of one of the ions by adding other ion as common ion is called common ion effect **OR** (i) Definition: When a system under equilibrium is subjected to a change in temperature, pressure or concentration, then the equilibrium shifts in such a direction so as to undo the effect of the change. (ii) (a) On adding $Fe_2O_3(s)$, the equilibrium will remain unaffected. (b) By removing $CO_2(g)$, the equilibrium will be shifted in the forward direction. (c) By removing CO(g), the equilibrium will be shifted in the backward direction.	3 2 2+3
35	(i)Any two differences between a sigma bond and a pi bond. (ii) E.C. of Be = $1s^2\ 2s^2$ M.O.E.C. of Be_2 = $\sigma^2 1s\ \sigma^{*2} 1s\ \sigma^2 2s\ \sigma^{*2} 2s$ Bond order = $\frac{1}{2}(4-4)$ = 0 Hence, Be_2 does not exist. (iii) (a) Linear (b) Tetrahedral	2 2 ½+1/2
	OR (i) The electron pair involved in sharing between two atoms during covalent bonding is called shared pair or bond pair. At the same time, the electron pair which is not involved in sharing is called lone pair of electrons. (Any relevant example) (ii)In NH_3, the dipole moments of the three N—H bonds are in the same direction as the lone pair of electron. But in NF_3, the dipole moments of the three N—F bonds are in the direction opposite to that of the lone pair. (iii) Bond strength is directly proportional to the bond order. Greater the bond order, more is the bond strength.	3 1 1

BLUE PRINT

UNIT	MCQ (1M)	VSA (2M)	SA (3M)	CBQ (4M)	LA (5M)	Total
Some Basic Concepts Of Chemistry	1(1)	1(2)		1(4)	-	3(7)
Structure Of Atom	4(4)	1(2)	1(3)		-	6(9)
Classification Of Elements & Periodicity Of Elements	3(3)		1(3)	-	-	4(6)
Chemical Bonding & Molecular Structure		1(2)	-	-	1(5)	2(7)
Thermodynamics	-	1(2)	1(3)	1(4)	-	3(9)
Equiblrium	2(2)	-	-	-	1(5)	3(7)
Redox Reaction	1(1)		1(3)		-	2(4)
Organic Chemistry- Some Basic Principles & Techniques	3(3)	1(2)	2(6)		-	6(11)
Hydrocarbons	2(2)				1(5)	5(10)
	16(16)	7(14)	7(21)	2(8)	3(15)	35(70)

SET-4

SESSION ENDING EXAMINATION
CLASS-XI
SUB: CHEMISTRY

MM:70 Time: 3 hours

General Instructions:

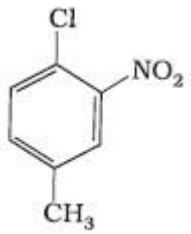
Read the following instructions carefully.

(a) There are 33 questions in this question paper with internal choice.
(b) SECTION A consists of 16 multiple -choice questions carrying 1 mark each.
(c) SECTION B consists of 5 short answer questions carrying 2 marks each.
(d) SECTION C consists of 7 short answer questions carrying 3 marks each.
(e) SECTION D consists of 2 case - based questions carrying 4 marks each.
(f) SECTION E consists of 3 long answer questions carrying 5 marks each.
(g) All questions are compulsory.
(h) Use of log tables and calculators is not allowed

SECTION A

The following questions are multiple -choice questions with one correct answer. Each question carries 1 mark. There is no internal choice in this section.

Q.No		Marks
1	Arrange the halogens F_2, Cl_2, Br_2, I_2, in order of their increasing reactivity with alkanes. (i) $I_2 < Br_2 < Cl2 < F_2$ (ii) $Br_2 < Cl_2 < F2 < I_2$ (iii) $F_2 < Cl_2 < Br2 < I_2$ (iv) $Br_2 < I_2 < Cl2 < F_2$	1
2	Arrange the following in decreasing order of their boiling points. (A) n–butane (B) 2–methylbutane (C) n-pentane (D) 2,2–dimethylpropane (i) A > B > C > D (ii) B > C > D > A (iii) D > C > B > A (iv) C > B > D > A	1
3	Which of the following is responsible to rule out the existence of definite paths or trajectories of electrons? (i) Pauli's exclusion principle. (ii) Heisenberg's uncertainty principle. (iii) Hund's rule of maximum multiplicity. (iv) Aufbau principle	1
4	The order of screening effect of electrons of s, p, d and f orbitals of a given shell of an atom on its outer shell electrons is: (i) s > p > d > f (ii) f > d > p > s (iii) p < d < s > f (iv) f > p > s > d	1
5	The types of hybrid orbitals of nitrogen in NO_2^+, NO_3^- and NH_4^+ respectively are expected to be (i) sp, sp^3 and sp^2 (ii) sp, sp^2 and sp^3 (iii) sp^2, sp and sp^3 (iv) sp^2, sp^3 and sp	1

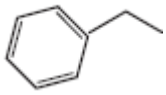
6	Which of the following order of energies of molecular orbitals of N_2 is correct? (i) $(\pi 2py) < (\sigma 2pz) < (\pi^* 2px) \approx (\pi^* 2py)$ (ii) $(\pi 2py) > (\sigma 2pz) > (\pi^* 2px) \approx (\pi^* 2py)$ (iii) $(\pi 2py) < (\sigma 2pz) > (\pi^* 2px) \approx (\pi^* 2py)$ (iv) $(\pi 2py) > (\sigma 2pz) < (\pi^* 2px) \approx (\pi^* 2py)$	1
7	In an adiabatic process, no transfer of heat takes place between system and surroundings. Choose the correct option for free expansion of an ideal gas under adiabatic condition from the following. (i) $q = 0, \Delta T \neq 0, w = 0$ (ii) $q \neq 0, \Delta T = 0, w = 0$ (iii) $q = 0, \Delta T = 0, w = 0$ (iv) $q = 0, \Delta T < 0, w \neq 0$	1
8	Enthalpy of sublimation of a substance is equal to (i) enthalpy of fusion + enthalpy of vapourisation (ii) enthalpy of fusion (iii) enthalpy of vapourisation (iv) twice the enthalpy of vapourisation	1
9	We know that the relationship between K_c and K_p is $K_p = K_c (RT)^{\Delta n}$ What would be the value of Δn for the reaction $NH_4Cl (s) \Leftrightarrow NH_3 (g) + HCl (g)$ (i) 1 (ii) 0.5 (iii) 1.5 (iv) 2	1
10	Using the standard electrode potential, find out the pair between which redox reaction is not feasible. $\mathbf{E^{\ominus}\ values}: Fe^{3+}/Fe^{2+} = +0.77; I_2/I^- = +0.54;$ $Cu^{2+}/Cu = +0.34; Ag^+/Ag = +0.80\ V$ i) Fe^{3+} and I^- (ii) Ag^+ and Cu (iii) Fe^{3+} (iv) Ag and Fe^3	1
11	The IUPAC name for  (i) 1-Chloro-2-nitro-4-methylbenzene (ii) 1-Chloro-4-methyl-2-nitrobenzene (iii) 2-Chloro-1-nitro-5-methylbenzene (iv) m-Nitro-p-chlorotoluene	1
12	In which of the following, functional group isomerism is not possible? (i) Alcohols (ii) Aldehydes (iii) Alkyl halides (iv) Cyanides	1
13	Assertion (A) : Sodium chloride formed by the action of chlorine gas on sodium metal is a stable compound. Reason (R) : This is because sodium and chloride ions acquire octet in sodium chloride formation. (i) A and R both are correct, and R is the correct explanation of A.	1

	(ii) A and R both are correct, but R is not the correct explanation of A. (iii) A is true but R is false. (iv) A and R both are false	
14	Assertion (A) : Black body is an ideal body that emits and absorbs radiations of all frequencies. Reason (R) : The frequency of radiation emitted by a body goes from a lower frequency to higher frequency with an increase in temperature. (i) Both A and R are true and R is the correct explanation of A. (ii) Both A and R are true but R is not the explanation of A. (iii) A is true and R is false. (iv) Both A and R are false.	1
15	Assertion (A) : Significant figures for 0.200 is 3 where as for 200 it is 1. Reason (R) : Zero at the end or right of a number are significant provided they are not on the right side of the decimal point. (i) Both A and R are true and R is correct explanation of A. (ii) Both A and R are true but R is not a correct explanation of A. (iii) A is true but R is false. (iv) Both A and R are false	1
16	Assertion (A) : Though the central atom of both NH_3 and H_2O molecules are sp3 hybridised, yet H–N–H bond angle is greater than that of H–O–H. Reason (R) : This is because nitrogen atom has one lone pair and oxygen atom has two lone pairs. (i) A and R both are correct, and R is the correct explanation of A. (ii) A and R both are correct, but R is not the correct explanation of A. (iii) A is true but R is false. (iv) A and R both are false.	1

SECTION B

Directions (Q. No. 17-21) : This section contains 5 questions with internal choice in one questions. The following questions are very short answer type and carry 2 marks each.

17	What is stoichiometry? What is the difference between precision and accuracy?	2
18	State the following (i) Aufbau's principle (ii) Heisenberg uncertainty principle **OR** Write the electronic configuration of the Ni^{2+} (Z=28) and Cr (Z=24)	2
19	All transition elements are d-block elements, but all d-block elements are not transition elements. Explain	2
20	Draw the resonating structure of (i) Ozone molecule (ii) Nitrate ion	2
21	Give two points of differences between inductive effect and resonance effect.	2

	SECTION C **Directions (Q. No. 22-28): This section contains 7 questions with no internal choice. The following questions are short answer type and carry 3 marks each.**	
22	Calcium carbonate reacts with aqueous HCl to give $CaCl_2$ and CO_2 according to the reaction given below: $CaCO_3$ (s) + 2HCl (aq) → $CaCl_2$(aq) + CO_2(g) + H_2O(l) What mass of $CaCl_2$ will be formed when 250 mL of 0.76 M HCl reacts with 1000 g of $CaCO_3$? Name the limiting reagent. Calculate the number of moles of $CaCl_2$ formed in the reaction.	3
23	Draw molecular orbital diagram of N_2 molecule and find its bond order.	3
24	Balance the following ionic equation by ion- electron method. MnO_4^- (aq) + I^- (aq) → MnO_2 (s) + I_2(s) (in basic medium)	3
25	Draw Newman and Sawhorse projections for the eclipsed and staggered conformations of ethane. Which of these conformations is more stable and why?	3
26	Arrange the elements N, P, O and S in the order of- (i) increasing first ionisation enthalpy. (ii) increasing non metallic character. (iii) increasing atomic size	3
27	(i) Write bond line formula for Isopropyl alcohol (ii) Give IUPAC name for  (iii)Indicate the σ and π bonds in the following molecules: C_6H_6, CH_2=C=CH_2	3
28	.(i) Write the expression for equilibrium constant Kc for the reaction $CaCO_3(s) \rightleftharpoons CaO(s) + CO_2$ (ii) Define common ion effect (iii) Permanganate ion (MnO_4^-) reacts with sulphur dioxide gas in acidic medium to produce Mn^{2+} and hydrogensulphate ion. (Balance by ion electron method)	3

SECTION D

29	**Read the given passage and answer the questions.** Orbitals are regions or spaces where there is a maximum probability of finding electrons. Qualitatively, these orbitals can be distinguished by their size, shape, and orientation. An orbital of small size means there is more chance of finding the electron near the nucleus. Shape and orientation mean the direction in which the probability of finding the electron is maximum. Atomic orbitals can be distinguished by quantum numbers. Each orbital is designated by three quantum numbers n, l, and ml (magnetic quantum number) which define energy, shape, and orientation but these are not sufficient to explain spectra of multi-electrons atoms. Spin quantum	

	number (ms) determines the spin of electrons. Spin angular momentum of the electron has two orientations relative to the chosen axis which are distinguished by spin quantum numbers ms which can take values +1/2 and –1/2 I. How many orbitals are associated with n = 3? II. How many electrons are possible in an orbital? Why? III. What is the shape of 's' and 'p' orbitals? IV. Name two d-orbitals that are on-axis.	4
30	**Read the passage given below and answer the following questions:** If a system is subjected to a change in concentration of one or more reactants, or a change in temperature or pressure, the equilibrium condition of the system is altered. A net reaction will take place in some direction until a new equilibrium state is attained. In 1884, a French Chemist and Engineer, Le Chatelier, showed that in every such case, the new equilibrium state partially reduces the effect of change that brought it about. This principle is known as Le Chatelier's Principle. The principle states that, if a system at equilibrium is subjected to a change of pressure or temperature or number of moles of the component, there will be a tendency for a net reaction in the direction that reduces the effect of this change. Generally, we can say that; • An increase in the concentration of the reactants shifts the equilibrium in the forward direction and a decrease in the concentration of the reactants shifts the equilibrium in the backward direction. • Similarly, an increase in concentration of the products shifts the equilibrium in the backward direction and a decrease in the concentration of the products shifts the equilibrium in the forward direction. (i) Le Chatelier Principle is applicable to a) heterogeneous reaction b) homogeneous reaction c) irreversible reaction d) system in equilibrium (ii) In what manner will increase of pressure affect the following equation $C(s) + H_2O(g) \rightleftharpoons CO(g) + H_2(g)$ a) shift in the reverse direction b) shift in the forward direction c) increase in the yield of hydrogen d) no effect (iii) For the reaction at equilibrium $2H_2(g) + CO(g) \rightleftharpoons CH_3OH(g)$ On addition of more CO to the reaction mixture, the concentration of CH_3OH will a) increase b) decrease c) doubles d) remains same (iv) For the reaction at equilibrium $PCl_5(g) \rightleftharpoons PCl_3(g) + Cl_2(g)$ $\Delta r H^0 = 124.0 \text{ kJ mol}^{-1}$ Decreasing the temperature will increase the concentration of the a) products b) reactants	4

	c) both d) none	

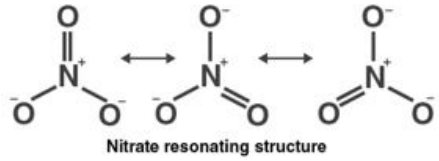
SECTION-E

Directions (Q. No. 31-33) . Each question has an internal choice and carries 5 (1+2+2) marks each

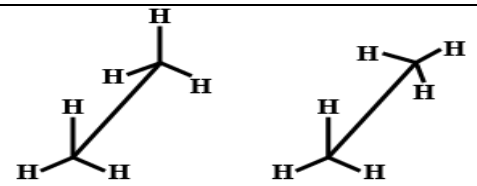
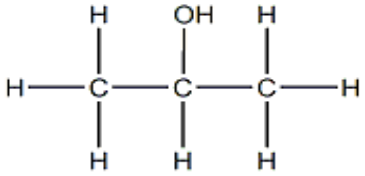
31	I. What is second law of thermodynamics? II. For an isolated system $\Delta U = 0$; what will be ΔS ? III. Given that $\Delta H = 0$ for mixing of two gases. Explain whether the diffusion of these gases into each other in a closed container is a spontaneous process or not? **OR** I. For the reaction ; $2Cl\ (g) \rightarrow Cl_2(g)$; what will be the signs of ΔH and ΔS ? II. Write third law of thermodynamics III. For a reaction at 298 K $2\ A + B \rightarrow C$ $\Delta H = 400\ kJ\ mol^{-1}$ and $\Delta S = 0.2\ kJ\ K'1\ mol^{-1}$. At what temperature will the reaction become spontaneous considering ΔH and ΔS to be constant over the temperature range ?	5
32	I. Which is the best and latest technique for isolation, purification and separation of organic compounds ? II. Write the formula of the compound formed in the Lassaigne's test for nitrogen in an organic compound, due to which Prussian blue colour is obtained . III. What are nucleophiles and electrophiles. Explain with examples. Or I. It is not advisable to use sulphuric acid in place of acetic acid for acidification while testing sulphur by lead acetate test. Assign reason II. Which is expected to be more stable : $O_2NCH_2CH_2O^-$ or $CH_3CH_2O^-$ and why ? III. Give a brief description of the principle of the following processes taking one example in each case. (1) Distillation (2) Chromatography	5
33	I. Write the IUPAC names of the products obtained by the ozonolysis Pent-2-ene II. Arrange benzene, n-hexane and ethyne in decreasing order of acidic strength. Also give reason for this behaviour III. How will you convert benzene into (i) p-chloronitrobenzene (ii) m-chloronitrobenzene OR I. Write the IUPAC names of the products obtained by the ozonolysis 3, 4-dimethylhept-3-ene	5

	II. Arrange the following sets of compounds in order of their decreasing relative reactivity with an electrophile and assign reason. Chlorobenzene, 2, 4-dinitrochlorobenzene, p-nitrochlorobenzene. III. How will you convert benzene into (i) p-nitrotoluene (ii) Acetophenone	

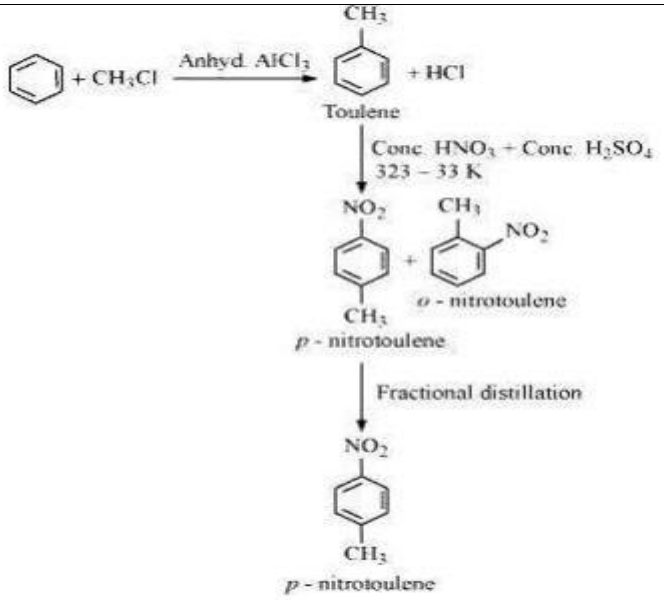
MARKING SCHEME

S. No.	Expected Answer	Marks
1	1	1
2	4	1
3	2	1
4	1	1
5	2	1
6	1	1
7	3	1
8	1	1
9	4	1
10	4	1
11	2	1
12	3	1
13	1	1
14	2	1
15	3	1
16	1	1
17	Stoichiometry is a section of chemistry that involves using relationships between reactants and/or products in a chemical reaction to determine desired quantitative data.Accuracy refers to how close a measurement is to the true or accepted value. Precision refers to how close measurements of the same item are to each other	1+1
18	Correct statements for (i) and (ii) OR Ni^{2+} (Z=28): [Ar] $3d^8$ and Cr (Z=24): [Ar] $3d^5 4s^1$	1+1
19	Elements in which the last electron enters in the d-orbitals, are called d-block elements of transition elements. These elements have the general electronic configuration $(n-1)d^{10}$ ns^2 d^{10} ns^2 do not show most of the properties of transition elements. The d-orbitals in these elements are completely filled in the ground state as well as in their common oxidation states. Therefore, they are not regarded as transition elements. Thus, on the basis of properties, all transition elements are d-block elements but on the basis of electrons configuration, all d-block elements are not transition elements.	1+1
20	 Nitrate resonating structure 	1+1

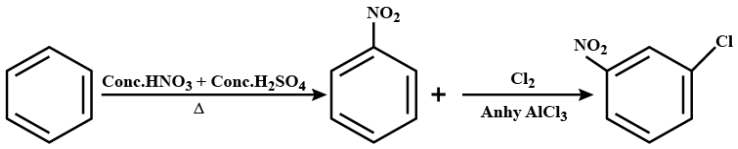
21	The primary distinction between inductive and resonance effects is that the former explains the electrical charge transmission between molecules of atoms. In contrast, the latter explains the transfer of electron pairs among the molecules of atoms .	1+1
22	The mass of HCl is **10000.75×36.5×25=0.684g**. 1 mole of calcium carbonate reacts with 2 moles of HCl. Hence, the mass of calcium carbonate that will react completely with 0.684 g of HCl is **2×36.5100×0.684=0.937g**.	1 1 1
23	N_2: $KK'(\sigma 2s)^2 (\sigma^*2s)^2 (\pi 2Px)^2 (\pi 2py)^2 (\sigma 2pz)^2$ Bond order = $(N_b - N_a)/2$ B.O = $(10-4)/2$ B.O = 3 **OR** (ii) $N_2 > N_2^+ > N_2^-$ N_2 - Diamagnetic, N_2^+, N_2^- - paramagnetic	 1 1 1
24	The unbalanced chemical equation **MnO4−(aq)+I−(aq)→MnO2(s)+I2(s)** The oxidation half reaction is **I−(aq)→I2(s)** The reduction half reaction is **MnO4−(aq)→MnO2(aq)** Balance I atoms and charges in the oxidation half reaction. **2I−(aq)→I2(s)+2e−** In the reduction half reaction, the oxidation number of Mn changes from +7 to +4. Hence, add 3 electrons to reactant side of the reaction. **MnO4−(aq)+3e−→MnO2(aq)** Balance charge in the reduction half reaction by adding 4 hydroxide ions to product side. **MnO4−(aq)+3e−→MnO2(aq)+4OH−** To balance O atoms, add 2 water molecules to reactant side. **MnO4−(aq)+3e−+2H2O→MnO2(aq)+4OH−** To equalize the number of electrons, multiply the oxidation half reaction by 3 and multiply the reduction half reaction by 2. **6I−(aq)→3I2(s)+6e−** **2MnO4−(aq)+6e−+4H2O→2MnO2(aq)+8OH−** Add two half cell reactions to obtain the balanced equation. **2MnO4−(aq)+6I−(aq)+4H2O2(l)→2MnO2(s)+3I2(s)+8OH−**	1 1 1
25	Stability of conformation: In staggered form of ethane, the electron clouds of C-H bonds are as far apart as possible. Thus, there are minimum repulsive forces, minimum energy and maximum stability of the molecule. On the other hand, when the staggered form changes into the eclipsed form, the electron clouds of the C-H bonds come closer to each other resulting in increase in electron cloud repulsion. To check the increased repulsive forces, molecule will have to posses more energy and thus has lesser stability. Staggered form is more stable.	½ + ½ 1 1

	 (i) Eclipsed (ii) Staggered **Sawhorse projections of ethane**	
26	I. increasing order of first ionization enthalpy of these elements follows the order: **S<P<0<N**. II. increasing order of negative electron gain enthalpy of these elements follows the order: **N<P<0<S** III. increasing non-metallic character is: **P<S<N<O**.	1 ½ x 4
27	(i)  isopropyl alcohol (ii) Ethyl Benzene **OR** C_6H_6: 12 and 3, $CH_2=C=CH_2$: 6 and 2	1+ ½ + ½
28	i. $K_c=[CaCO_3(s)][CaO(s)]_2[CO_2(g)]$ ii. The reduction of the degree of dissociation of a salt by the addition of a common-ion is called the common ion effect. iii. $2MnO_4^- + 16H^+ + 10e^- \longrightarrow 2Mn^{2+} + 8H_2O$ $5SO_2 + 10H_2O \longrightarrow 5HSO_4^- + 15H^+ + 10e^-$ $2MnO_4^- + H^+ + 5SO_2 + 2H_2O \longrightarrow 2Mn^{2+} + 5HSO_4^-$	1+1+1
29	The possible values of l and **m1** are : **lm1** **00** **1−1,0,+1** **2−2,−1,0,+1,+2** (ii) The quantum numbers (**m1** and **l**) of electrons for 3d orbital are **l=2,m1 =−2,−1,0,+1,+2**. (iii) **2s**,**2p** orbitals are possible.	1 1 1 1
30	I. D II. B III. A IV. B **OR** A	1 1 1 1

31	I.	Correct statement	1
	II.	Δ S will be positive i.e., greater than zero	1
	III.	The mixing of two gases have ΔH equal to zero. Therefore, it is spontaneous process because energy factor has no role to play but randomness increases i.e., randomness factor favours the process. OR ΔH and ΔS are negative Correct statement $\Delta G=\Delta H-T\Delta S$ Assuming that equation at equilibrium then $\Delta G = 0$ $\Delta G=\Delta H-T\Delta S=0$ $T=\Delta S\Delta H=0.2400=2000K$	2
32	I.	chromatography	
	II.	On heating with sulphuric acid, some ferrous is oxidized to ferric hexacyanoferate (II) $Fe_4[Fe(CN)_6]_3$ which is Prussian blue in colour	1 1
	III.	Electrophiles (atom, molecule) are electron deficient species and can accept an electron pair from electron rich species. Ex: carbocation & carbonyl compounds. Nucleophiles (atom, molecule are electron rich species and donates electron pair to electron deficient species OR	2
	I.	Answers It necessary to use acetic acid and not sulphuric acid for acidification of sodium extract for testing sulphur by lead acetate test because sulphuric acid will react with lead acetate To form a precipitate of lead sulphate, thus interfering in the test of sulphur. $Pb(CH_3COO)_2 + H_2SO_4 \rightarrow PbSO_4\downarrow + 2CH_3COOH$	
	II.	$O_2NCH_2CH_2O-$ is more stable than CH_3CH_2O- because NO_2 group has –I effect and hence it tends to disperse the negative charge on the oxygen atom. In contrast, CH_3CH_2 has +I effect. It, therefore, tends to intensify the negative charge and hence destabilizes it.	
	III.	sufficient difference in their boiling points. and It is based on the difference in movement of individual components of a mixture through the stationary phase under the influence of mobile phase.	
33.	I.	The IUPAC name of Product (I) is ethanal and Product (II)is propanal.	1 1
	II.	The s–character increases in the order: sp3<sp2<sp Hence, the decreasing order of acidic behaviour is Ethyne > Benzene > Hexane.	2



III.

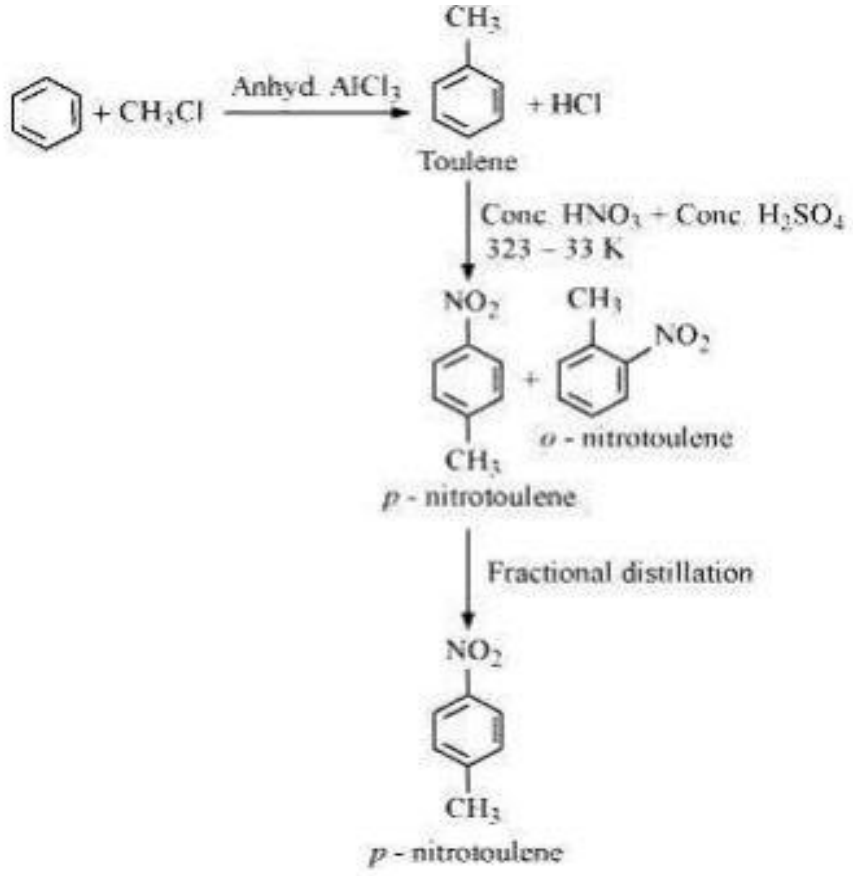


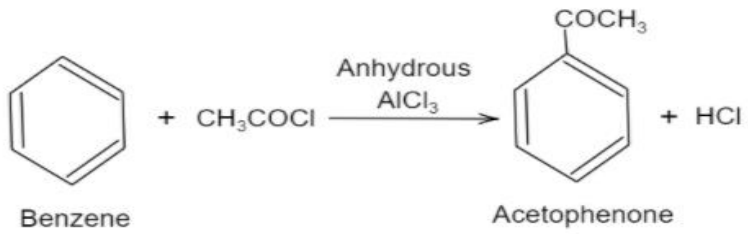
OR

I. 1-Phenylbut-1-ene

II. The decreasing order of relative reactivity with an electrophile is:
Chlorobenzene >p− nitrochlorobenzene >2,4 dinitrochlorobenzene

III.




COCH3
Anhydrous
AlCl3
+ CH3COCl
+ HCl
Benzene
Acetophenone

BLUE PRINT

UnitNo.	Name of Unit	Sec-A		Sec- B	Sec- C	Sec- D	Sec- E	Total
		1 Mark		2 Marks	3 Marks	4 Marks	5 Marks	
		MCQ	A-R	VSA	SA	Case Based	LA	
UNIT I	Some Basic Concepts of Chemistry		1 (1)	2 (1)	3 (1)			**6 (3)**
UNIT II	Structure of Atom	1 (1)	1 (1)	2 (1)		4 (1)		**8 (4)**
UNIT III	Classification of Elements and Periodicity in Properties	1 (1)		2 (1)	3 (1)			**6(3)**
UNIT IV	Chemical Bonding and Molecular Structure	2 (2)	2 (2)		3 (1)			**7 (5)**
UNIT VI	Chemical Thermodynamics	2 (2)		2 (1)			5 (1)	**9 (4)**
UNIT VII	Equilibrium	1 (1)			3 (1)	4 (1)		**8(3)**
UNIT VIII	Redox Reactions	1 (1)			3 (1)			**4 (2)**
UNIT XII	Organic Chemistry: Some basic Principles and Techniques	2 (2)		2 (1)	3 (1)		5 (1)	**12 (5)**
UNIT XIII	Hydrocarbons	2 (2)			3 (1)		5 (1)	**10 (4)**
	Total	**12 (12)**	**4 (4)**	**10 (5)**	**21 (7)**	**8 (2)**	**15 (3)**	**70(33)**

SET-5

SESSION ENDING EXAMINATION
CLASS-XI
CHEMISTRY (THEORY)

MM:70 Time: 3 hours

Read the following instructions carefully.

(a) There are 33 questions in this question paper with internal choice.
(b) SECTION A consists of 16 multiple -choice questions carrying 1 mark each.
(c) SECTION B consists of 5 short answer questions carrying 2 marks each.
(d) SECTION C consists of 7 short answer questions carrying 3 marks each.
(e) SECTION D consists of 2 case - based questions carrying 4 marks each.
(f) SECTION E consists of 3 long answer questions carrying 5 marks each.
(g) All questions are compulsory.

SECTION – A

1.What will be the molarity of a solution which contains 5.85g of NaCl per 500 ml?
(a) 4 mol/L (b) 0.2 mol/L (c) 20 mol/L zd) 2 mol/L

2. The number of water molecules is maximum in
(a) 18 gram of water (b) 18 moles of water
(c) 18 molecules of water (d) 1.8 gram of water

3. Rutherford's Alpha particle scattering experiment eventually led to the conclusion that
(a) mass and energy are related
(b) electrons occupy space around the nucleus
(c) neutrons are buried deep in the nucleus
(d) the point of impact with matter can be precisely determined

4. Which of the following statement is not correct about the characteristics of cathode rays?
(a) They start from the cathode and move towards the anode.
(b) They travel in straight line in the absence of an external electrical or magnetic field.
(c) Characteristics of cathode rays do not depend upon the material of electrodes in cathode ray tube.
(d) Characteristics of cathode rays depend upon the nature of gas present in the cathode ray tube.

5. Which block elements are also considered as Transition Elements?
a. s- block b. p- block c. d- block d. f- block

6. The correct order of first ionization potential among following elements, Be, B, C, N and O is
(a) B < Be < C < O < N (b) B < Be < C < N < O
(c) Be < B < C < N < O (d) Be < B < C < O < N

7. The group number, number of valence electrons, and valency of an element with the atomic number 15, respectively, are:
(a) 16, 5 and 2 (b) 15, 5 and 3 (c) 16, 6 and 3 (d) 15, 6 and 2

8. Which of the following compound has highest covalent character
(a) LiCl (b) LiBr (c) LiF (d) LiI

9. Which of the following molecules follow the octet rule?
(a) ClF_3 b) H_2O (c) XeF_4 (d) NO_2

10. Reaction occurs spontaneously if

(a)$T\Delta S > \Delta H$ andΔH is +ve and ΔS is –ve
(b)$T\Delta S = \Delta H$ and both ΔH and ΔS are +ve
(c)$T\Delta S < \Delta H$ and both ΔH and ΔS are +ve
(d)$T\Delta S > \Delta H$ and both ΔH and ΔS are+ve

11. Answer the following question selecting the appropriate option given below:
a) Assertion and reason both are correct statements and reason is correct explanation for assertion.
b) Assertion and reason both are correct statements but reason is not correct explanation for assertion.
c) Assertion is correct, but reason is incorrect statement
d) Assertion is incorrect, but reason is correct statement
Assertion: Addition of HBr to propene in presence of benzoyl peroxide produces -bromopropane as the major product.
Reason: Addition of HBr to propene follows free radical chain mechanism.

12. .Given below two statements labelled as assertion (A) and Reason(R)
Assertion (A): Heat energy is completely transformed into work during the isothermal expansion of an ideal gas.
Reason(R): During an isothermal process the change in internal energy of a gas due to decrease in pressure is nullified by the change due to increase in volume. Select the most appropriate answer from the option given below
(a) Both A and R are true and R is the correct explanation of A.
(b) Both A and R are true and R is not the correct explanation of A.
(c) A is true but R is false.
(d) A is false but R is true.

13. Given below two statements labelled as assertion (A) and Reason(R)
Assertion: Energy of resonance hybrid is equal to the average of energies of all canonical forms.
Reason: Resonance hybrid cannot be presented by a single structure. Select the most appropriate answer from the option given below
(a) Both A and R are true and R is the correct explanation of A.
(b) Both A and R are true and R is not the correct explanation of A.
(c) A is true but R is false.
(d) A is false but R is true.

14. White P reacts with caustic soda. The products are PH_3 and NaH_2PO_2.
This reaction is an example of
(a) oxidation (b) reduction
(c) disproportionation (d) neutralization

15. Arenes do not show
(a) Delocalisation of pi-electrons (b) Greater stability
(c) Resonance (d) Electrophilic additions

16. The catalyst used in Friedel – Crafts reaction is
(a) Aluminium Chloride (b) Anhydrous Aluminium Chloride
(c) Ferric Chloride (d) Copper

SECTION – B

17. . In the reaction: $3C + 4D \rightarrow 2A + 4B$ When 5 moles of A react with 6 moles of B then

(i) Which is the limiting reagent?
(ii) Calculate the amount of C formed?

18. . What is Heisenberg's uncertainty Principle? What is it's significance?

19. Explain why BeH_2 molecule has zero dipole moment although the Be–H bonds are polar?

20. Explain how value of Qc and Kc decides the direction of reaction.

21. (a) Which is more suitable method for the purification of a compound in liquid state which decomposes at or below its boiling point?

(b) How will you separate a mixture of ammonium chloride and common salt?

SECTION – C

22. The molecular mass of an organic compound is 78 and its percentage composition is 92.4 % C and 7.6 % H. Determine the molecular formula of the compound.

23. Write the drawbacks in Mendeleev's periodic table that led to its modification.

24. Draw the shape of following molecules according to VSEPR theory; ClF_3, SF_6 and H_2O.

25.i) State first law of thermodynamics. Write mathematical expression for first law of thermodynamics.

ii) Calculate the number of kJ of heat necessary to raise the temperature of 60 g of aluminium from 35°C to 55°C. Molar heat capacity of Al is 24 J mol^{-1} K^{-1}.

26. Account for the followings : (i) Why does fluorine not show a disproportionation reaction?.

(ii) The compound AgF_2 is unstable. However, if formed, the compound acts as a very strong oxidising agent.

27. Explain hyperconjugation effect. How does hyperconjugation effect explain the stability of alkenes?

28. How will you bring out the following conversions.

(i) Acetylene to ethane (ii) Benzene to Toluene (iii) Ethanol to ethene?

SECTION – D

29. Entropy refers to the measure of the level of disorder in a thermodynamic system. It is measured as joule per Kelvin(J/K) and denoted by the symbol 'S'. For any spontaneous process, the entropy of the system should increase. Entropy is the measure of the number of possible microscopic configurations of the atoms and molecules or accordance with the microscopic state of the system. Solids have lowest entropy due to the more regular crystalline structure liquids have an intermediate entropy as they are more ordered then gas but less ordered then solids. Gases are known to have the highest entropy as they have the most disorder. In order to define the relationship that exists between entropy and enthalpy. Gives free energy is used to measure the amount of available energy that a chemical reaction provides.

(i) Write the expression for total entropy change.

(ii) Why is Molar Entropy of vaporization for water more than ethanol ?

(iii) For the reaction, $2Cl(g) \rightarrow Cl_2(g)$, what are the signs of ΔH and ΔS ?

OR

Entropy of diamond is less than that of graphite. What conclusion do you draw from this?

30. Aromatic compounds are those organic compounds that contain one or more rings with pi electrons delocalized all the way around them. The term "aromatic" was assigned before the physical mechanism determining aromaticity was discovered, and referred simply to the fact that many such

compounds have a sweet or pleasant odour; however, not all aromatic compounds have a sweet odour, and not all compounds with a sweet odour are aromatic compounds. The properties of aromatic hydrocarbons translate into their uses. One of the main uses for aromatic hydrocarbons is as a non-polar solvent for other molecules. Thus, aromatic hydrocarbons can be used as additives in gasoline, paints, lacquers, and other solutions. Their low reactivity also contributes to their use as a solvent. For example, toluene is an aromatic molecule that is used as a solvent in paint thinners. The aromatic compound benzene is used in high-octane fuel production as well as the production of other chemicals, such as pesticides, detergents, dyes, and more. Benzene was once a common additive in gasoline, but due to the discovery of its carcinogenic nature in humans, it's use has been reduced to mainly high-octane fuels.

(a) Benzene on treatment with methyl chloride in the presence of anhydrous $AlCl_3$ produces toluene. The function of anhydrous $AlCl_3$ is

i) to produce electrophile ii) to produce nucleophile

iii) to produce free radicals iv) to absorb moisture

(b) The reaction of benzene with chlorine in the presence of anhydrous $FeCl_3$ is classified as

i) Nucleophilic substitution ii) Electrophilic substitution

iii) Nucleophilic addition iv) Electrophilic addition

(c) Which of the following is false about benzene?

i) It is a planar molecule.

ii) It can be converted into cyclohexane by hydrogenation in the presence of nickel catalyst.

iii) The C atoms in a benzene ring are sp2 hybridised.

iv) There are 6 isomeric dichlorobenzenes.

(d)What do you mean by carcinogenic nature of compound.

SECTION - E

31. a) i) How many sub-shells are associated with n = 4 ?

ii) How many electrons will be present in the sub-shells having ms value of -1/2 for n = 4 ?

b) An ion with mass number 37 possesses one unit of negative charge. If the ion contains 11 .1% more neutrons than the electrons, find the symbol of the ion.

32. a) State Le-Chatelier's Principle .

b) What is the effect of:

(i) addition of H_2 (ii) addition of CH_3OH

(iii) removal of CO (iv) removal of CH3OH

On the equilibrium $2H_2(g) + CO(g) \rightleftharpoons CH_3OH(g)$

c) What is the equilibrium concentration of each of the substances in the equilibrium when the initial concentration of ICl was 0.78 M?

$2ICl(g) \rightleftharpoons I_2(g) + Cl_2(g)\ ;\ K_c = 0.14$

33.i) Differentiate between the principle of estimation of nitrogen in an organic compound by

(a) Dumas method

(b) Kjeldahl's method.

ii) An organic compound contains 69% carbon and 4.8% hydrogen, the remainder being oxygen. Calculate the masses of carbon dioxide and water produced when 0.20 g of this compound is subjected to complete combustion.

MARKING SCHEME

SECTION – A

QUESTIONS 1TO 16 ARE OF 1 MARK EACH .

1. (b)
2. (b)
3. (b)
4.(d)
5.(c)
6.(b)
7.(d)
8.(d)
9.(b)
10.(d)
11.(a)
12.(a)
13.(d)
14.(c)
15.(d)
16.(b)

SECTION – B

17. 2 moles of A require 4 moles of B for the reaction For 5 moles of A, the moles of B required= 4/2 x 5 = 10 mol But we have only 6 moles of B. Hence, (i) B is the limiting reagent **(1MARK)**
(ii) 4 moles of B give 3 mole of C
6 moles of B will give= ¾ x 6 = 4.5 mol of C **(1MARK)**

18. It states that it is impossible to determine simultaneously, the exact position and exact momentum (or velocity) of an electron. It rules out existence of definite paths or trajectories of electrons and other similar particles **(1+1=2MARKS)**

19. In the linear BeH_2 molecule, the resultant dipole moment of two Be−H bonds cancel each other. Due to this, the overall dipole moment of the molecule is zero. **(2MARKS)**

20. Relation between Qc & Kc .

Qc>Kc Reaction will proceed in backward direction, Qc=Kc reaction is at equilibrium, Qc< Kc Reaction will proceed in backward direction. **(1/2*4=2 MARKS)**

21. (a) Distillation under reduced pressure or vacuum distillation
(b) Sublimation. **(1*2=2MARKS)**

SECTION – C

22.

Calculation of empirical formula

Element	Percentage	At mass	Moles	Mole ratio	Simplest whole no. ratio
C	92.4	12	92.4/12 = 7.7	7.7/7.6 = 1.01	1
H	7.6	1	7.6/1 = 7.6	7.6/7.6 = 1	1

The simplest whole no ratio of C : H is 1:1 **(1MARK)**

The empirical formula of the compound is CH empirical formula mass = 1 x 12 + 1x 1= 13

Molecular mass = 78 n = 78/13 = 6 **(1MARK)**

Molecular formula of the compound = 6 × (CH) = C_6H_6 **(1MARK)**

23. Hydrogen's position: Hydrogen is assigned to group I. It does, however, resemble elements from Group I (alkali metals) as well as elements from Group VIIA (halogens). As a result, the position of hydrogen in the periodic table is incorrect. **(1MARK)**

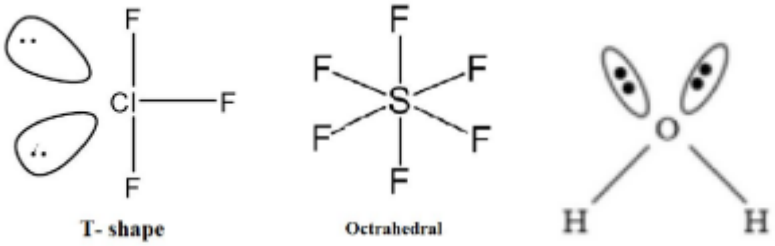
Anomalous pairs: The increasing order of atomic masses was not followed in certain pairs of elements. Mendeleev arranged the elements in these cases based on similarities in their properties rather than the increasing order of their atomic masses. Argon (Ar, atomic mass 39.9), for example, is placed before potassium (K, atomic mass 39.1). Likewise, cobalt (Co, atomic mass 58.9) comes before nickel (Ni, atomic mass 58.6), and tellurium (Te, atomic mass 127.6) comes before iodine (I, atomic mass 126.9). These positions were not justified. **(1MARK)**

Isotopes are atoms of the same element that have different atomic masses but the same atomic number. As a result, according to Mendeleev's classification, these should be classified differently based on their atomic masses. For example, hydrogen isotopes with atomic masses 1, 2, and 3 should be placed in three different locations. Isotopes, on the other hand, do not have their own spot in the periodic table.

OR

Several gaps in the periodic table were left because he believed that several elements were yet to be discovered, for example, gallium was not discovered at the time. Position of lanthanoids (or lanthanides) and actinoids (or actinides): The fourteen elements that follow lanthanum (known as lanthanoids, atomic numbers 58-71) and the fourteen elements that follow actinium (known as actinoids, atomic numbers 58-71) are not included separately. **(1MARK)**

24.



v-shape **(1*3= 3 MARKS)**

25.i) Energy can neither be created nor destroyed all though it may be converted from one form to another. $\Delta U = q + w$ **(1/2*2=1 MARK)**

ii) No. of moles of Al (m) = (60g)/ (27 g mol-1) = 2.22 mol

Molar heat capacity (C) = 24 J mol^{-1} K^{-1}.

Rise in temperature (ΔT) = 55 – 35 = 20°C or 20 K

Heat evolved (q) = C x m x T = (24 J mol-1 K^{-1}) x (2.22 mol) x (20 K)

= 1065.6 J = 1.067 kJ **(2MARKS)**

26.i) Disproportionation is a redox reaction in which one intermediate oxidation state component transforms into two higher and lower oxidation state compounds. The element must be in at least three oxidation states for such a redox reaction to occur. As a result, that element is in the intermediate state during the disproportionation reaction and can transition to both higher and lower oxidation states. Fluorine is the most electronegative and oxidising element of all the halogens, and

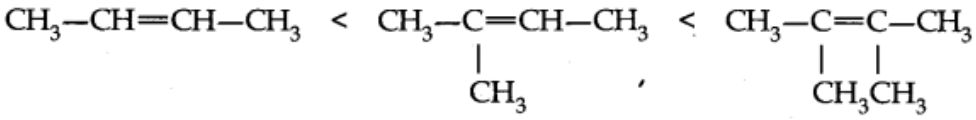
it is also the smallest. It doesn't have a positive oxidation state (only one) and doesn't go through the disproportionation reaction. **(1.5 MARKS)**

ii) In AgF_2 oxidation state of Ag is +2 which is very very unstable. Therefore, it quickly accepts an electron to form the more stable +1 oxidation state.

$Ag_2^+ + e^- \rightarrow Ag^+$

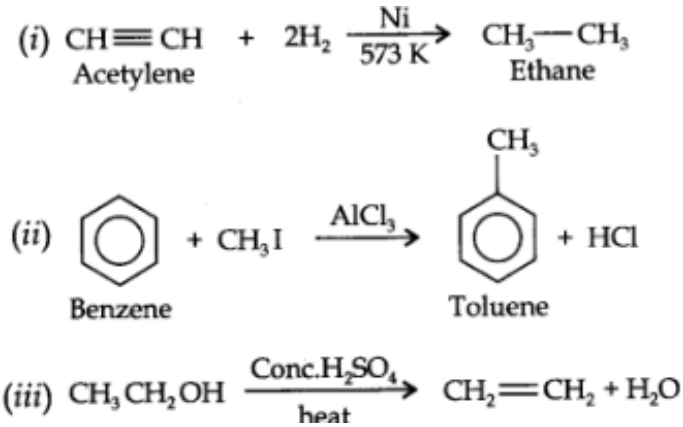
Therefore, AgF_2, if formed, will act as a strong oxidising agent. **(1.5 MARKS)**

27. Hyperconjugation: The relative stability of various classes of carbonium ions may be explained by the number of no-bond resonance structures that can be written for them. Such structures are arrived by shifting the bonding electrons from an adjacent C—H bond to the electron-deficient carbon. In this way, the positive charge originally on carbon is dispersed to the hydrogen. This manner of electron release by assuming no-bond character in the adjacent C—H bond is called Hyperconjugation or No-Bond Resonance. The greater the hyperconjugation, the greater will be the stability of the compound. The increasing order of stability can be shown as.



(1+2=3 MARKS)

28.



(1*3=3MARKS)

SECTION – D

29. . i)ΔS total=ΔS system+ΔS surroundings **(1MARK)**

(ii) Molar Entropy of water is higher as it has greater intermolecular forces of attraction then ethanol. **(1MARK)**

(iii) In the given reaction a molecule of Cl_2 is formed from its two gaseous atoms and the energy is released with the formation of bond. Hence ΔH is – ve. In this reaction, randomness (entropy) also decreases because two mole atoms of Cl have more randomness then one mole molecule of chlorine. hence, ΔS is – ve.

OR

Less entropy of diamond means less disorder, i.e. all the carbon atoms are linked to form a network structure. Greater entropy of graphite impliessome disorder which is due to presence of free electron and slipping of layers over each other. **(2 MARKS)**

30. a) (i) to produce electrophile

b) (ii) Electrophilic substitution

c) (iv) There are 6 isomeric dichlorobenzenes

d) Benzene and polynuclear hydrocarbons containing more than two benzene rings fused together are toxic and said to possess cancer producing (carcinogenic) property and can cause cancer in humans. **(1*4=4 MARKS)**

SECTION – E

31.a) (i) For n = 4 ; No. of sub-shells = (l = 0, l = 1, l = 2, l = 3) = 4.

(ii) Total number of orbitals which can be present = n2 = 42 = 16.

Each orbital can have an electron with ms = – 1/2

Total no. of electrons with m, = – 1/2 is 16. **(1*2=2 MARKS)**

b)

Let the no. of electron in the ion = x

∴ the no. of protons = x – 1 (as the ion has one unit negative charge)

and the no. of neutrons = $x + \frac{x \times 11.1}{100} = 1.111\,x$

Mass no. or mass of the ion = No. of protons + No. of neutrons

(x – 1 + 1.111 x)

Given mass of the ion = 37

∴ x- 1 + 1.111 x = 37 or 2.111 x = 37 + 1 = 38

$x = \frac{38}{2.111} = 18$

No. of electrons = 18 ; No. of protons = 18 – 1 = 17

Atomic no. of the ion = 17 ; Atom corresponding to ion = Cl

Symbol of the ion = $^{37}_{17}Cl^-$

(3 MARKS)

32. a) When a system under equilibrium is subjected to a change in temperature, pressure or concentration, then the equilibrium shifts in such a direction so as to undo the effect of the change. **(1 MARK)**

b) (i) Equilibrium will be shifted in the forward direction.

(ii) Equilibrium will be shifted in the backward direction.

(iii) Equilibrium will be shifted in the backward direction.

(iv) Equilibrium will be shifted in the forward direction. **(1/2*4=2 MARKS)**

Suppose at equilibrium, the molar concentration of both I_2 (g) and Cl_2 (g) is x mol L^{-1}.

	$2ICl(g)$	$\rightleftharpoons$	$I_2(g)$	+	$Cl_2(g)$
Initial molar conc.	0.78 M		0		0
Eqn. molar conc.	(0.78 – 2x)M		x		x

$$K_c = \frac{[I_2(g)][Cl_2(g)]}{[ICl(g)^2]} = \frac{(x)\times(x)}{(0.78-2x)^2}$$

$$\frac{x}{(0.78-2x)} = (0.14)^{1/2} = 0.374 \quad \text{or} \quad x = 0.374\,(0.78 - 2x)$$

$$x = 0.292 - 0.748x \quad \text{or} \quad 1.748x = 0.292\,;\, x = \frac{0.292}{1.748} = 0.167$$

$$[ICl] = (0.78 - 2 \times 0.167) = (0.78 - 0.334) = \mathbf{0.446\ M}$$

$$[I_2] = 0.167\ M\,;\, [Cl_2] = \mathbf{0.167\ M}$$

c) **(2 MARKS)**

33. i) **(a) Dumas method:** The organic compound is heated strongly with excess of CuO ' (Cupric Oxide) in an atmosphere of CO_2 when free nitrogen, CO_2 and H_2O are obtained.

(b)Kjeldahl's method: A known mass of the organic compound is heated strongly with concentrated H_2SO_4, a little potassium sulphate (K_2SO_4) and a little mercury (a catalyst). As a result of reaction the nitrogen present in the organic compound is converted to ammonium sulphate ($(NH_4)_2SO_4$). **(1*2=2MARKS)**

ii)

Step I. Calculation of mass of CO_2 produced

Mass of compound = 0.20 g

Percentage of carbon = 69%

$$\text{Percentage of carbon} = \frac{12}{44} \times \frac{\text{Mass of carbon dioxide formed}}{\text{Mass of compound}} \times 100$$

$$69 = \frac{12}{44} \times \frac{\text{Mass of carbon dioxide formed}}{(0.20\ \text{g})} \times 100$$

$$\therefore \text{ Mass of } CO_2 \text{ formed} = \frac{69 \times 44 \times (0.20\ g)}{12 \times 100} = \mathbf{0.506\ g}$$

Step II. Calculation of mass of H_2O produced

Mass of compound = 0.20 g

Percentage of hydrogen = 4.8%

$$\text{Percentage of hydrogen} = \frac{2}{18} \times \frac{\text{Mass of water formed}}{\text{Mass of compound}} \times 100$$

$$4.8 = \frac{2}{18} \times \frac{\text{Mass of water formed}}{(0.20\ \text{g})} \times 100$$

$$\therefore \text{ Mass of } H_2O \text{ formed} = \frac{4.8 \times 18 \times (0.20\ g)}{2 \times 100} = \mathbf{0.0864\ g}$$

(3MARKS)

BLUE PRINT

CHAPTERWISE & SECTION WISE QUESTIONS IN THE QUESTION PAPER						
SR.NO	CHAPTERS -	SECTION A 16 QNS (1MARK EACH)	SECTION B 5 QNS (2 MARKS EACH)	SECTION C 7 QNS (3 MARKS EACH)	SECTION D 2 QNS (4 MARKS EACH)	SECTION E 3 QNS (5 MARKS EACH)
1	Some Basic Concepts of Chemistry	2	2	3		
2	Structure of Atom	2	2			5
3	Classification of Elements and Periodicity in Properties	3		3		
4	Chemical Bonding and Molecular Structure	2	2	3		
5	Thermodynamics	2		3	4	
6	Equilibrium		2			5
7	Redox Reactions	1		3		
8	Organic Chemistry: Some basic Principles and Techniques	1	2	3		5
9	Hydrocarbons	3		3	4	

SET-6

KENDRIYA VIDYALAYA SANGATHAN
DEHRADUN REGION CLASS – XI 2023-24
SUBJECT - CHEMISTRY

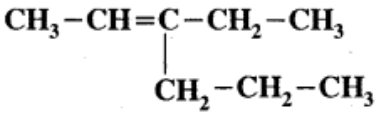
TIME: 3Hrs. M.M.: 70

General Instructions:

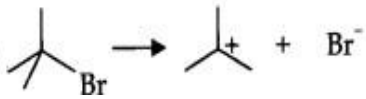
Read the following instructions carefully.

a) There are 33 questions in this question paper with internal choice.
b) SECTION A consists of 16 multiple-choice questions carrying 1 mark each.
c) SECTION B consists of 5 very short answer questions carrying 2 marks each.
d) SECTION C consists of 7 short answer questions carrying 3 marks each.
e) SECTION D consists of 2 case- based questions carrying 4 marks each.
f) SECTION E consists of 3 long answer questions carrying 5 marks each.
g) All questions are compulsory.
h) Use of log tables and calculators is not allowed

	SECTION A	
01	How many moles of electrons weight one kilogram? (a) 6.023×10^{23} (b) $1/9.1 \times 10^{31}$ (c) $6023 \times 10^{54}/9.1$ (d) 9.1×10^{8}	1
02	The magnetic quantum number specifies (a) Size of orbitals (b) Shape of orbitals (c) Orientation of orbitals (d) Nuclear Stability	1
03	Consider the isoelectronic series: K^+, S^{2-}, Cl^- and Ca^{2+}, radii of the ions decrease as (a) $Ca^{2+} < K^+ > Cl^-, S^{2-}$ (b) $Cl^- > S^{2-} > K^+ > Ca^{2+}$ (c) $S^{2-} > Cl^- > K^+ > Ca^{2+}$ (d) $K^+ > Ca^{2+} > S^{2-} > Cl.$	1
04	A buffer solution with pH more than 9 can be prepared by mixing (a) CH_3COONa and CH_3COOH (b) NaCl and NaOH (c) NH_4Cl and NaOH (d) KH_2PO_4 and K_2HPO_4	1
05	Amongst H_2O, H_2S, H_2Se and H_2Te the one with the highest boiling point is (a) H_2O because of hydrogen bonding (b) H_2Te because of higher molecular weight (c) H_2S because of hydrogen bonding (d) H_2Se because of lower molecular weight.	1
06	Which of the following represents most electropositive element? (a)$[He]2s^1$ (b)$[He]2s^2$ (c)$[Xe]6s^1$ (d) $[Xe]6s^2$	1
07	The group number, number of valence electrons, and valency of an element with the atomic number 15, respectively, are: (a) 16, 5 and 2 (b) 15, 5 and 3 (c) 16, 6 and 3 (d) 15, 6 and 2	1
08	In the reaction $NH_3 + H_2O \rightleftharpoons NH{-}2 + H_3O^+$ The conjugate base of NH_3 is (a) H_3O^- (b) NH^{-2} (c) H_2O (d) None of these	1

09	The I.U.P.A.C. name of the following compound is  (a) 3-Ethyl-2-hexene (b) 3-Propyl-2-hexene (c) 3-Propyl-3-hexene (d) 4-Ethyl-4-hexene	1
10.	Which of the following compounds will exhibit cis-trans isomerism? (a) Butanol (b) 2- Butyne (c) 2-Butenol (d) 2-Butene	1
11.	The last entering electron in an element has quantum number n=3, l =2, m=+2 and s=+1/2. The atomic number of the element will be (a) 13 (b) 21 (c) 29 (d) 39	1
12	The ionic radius of cation is always_____. (a) less than the atomic radius (b) more than the atomic radius (c) equal to atomic radius (d) Cannot be predicted	1
13	Given below are two statements labelled as Assertion (A) and Reason (R) Assertion: Components of a mixture of red and blue inks can be separated by distributing the components between stationary and mobile phases in paper chromatography. Reason: The coloured components of inks migrate at different rates because paper selectively retains different components according to the difference in their partition between the two phases. a. Both A and R are true and R is the correct explanation of A b. Both A and R are true but R is not the correct explanation of A. c. A is true but R is false. d. A is false but R is true.	1
14	Given below are two statements labelled as Assertion (A) and Reason (R) Assertion (A): It is impossible to determine the exact position and exact momentum of an electron simultaneously. Reason (R): The path of an electron in an atom is clearly defined. Select the most appropriate answer from the options given below: a. Both A and R are true and R is the correct explanation of A b. Both A and R are true but R is not the correct explanation of A. c. A is true but R is false. d. A is false but R is true.	1
15	Given below are two statements labelled as Assertion (A) and Reason (R) Assertion : Smaller the size of an atom greater is the electronegativity. Reason : Electronegativity refers to the tendency of atom so share electrons with other atom. Select the most appropriate answer from the options given elow: a. Both A and R are true and R is the correct explanation of A b. Both A and R are true but R is not the correct explanation of A. c. A is true but R is false. d. A is false but R is true.	1

16	Given below are two statements labelled as Assertion (A) and Reason (R) Assertion (A): Eclipsed conformation of ethane is less stable. Reason (R): Staggered conformation of ethane is more stable. Select the most appropriate answer from the options given below: a. Both A and R are true and R is the correct explanation of A b. Both A and R are true but R is not the correct explanation of A. c. A is true but R is false. d. A is false but R is true.	1
	SECTION B	
17	Calculate the amount of carbon dioxide that could be produced when (i) 1 mole of carbon is burnt in air. (ii) 1 mole of carbon is burnt in 16 g of dioxygen.	2
18.	What are the shortcomings of Bohr's atomic model? (Write any two) **OR** Calculate the wavelength and frequency of light wave whose period is 2.0×10^{-10} s.	2
19	Give two differences between sigma and pi bond.	2
20	For the reaction; $2Cl(g) \rightarrow Cl_2(g)$; what will be the signs of ΔH and ΔS?	2
21.	(a) Which is more suitable method for the purification of a compound in liquid state which decomposes at or below its boiling point? (b) How will you separate a mixture of ammonium chloride and common salt?	1 1
22	Attempt any 3 of the following- a) State Pauli's Exclusion Principle. b) Write the electronic configuration of Cu^{2+} ion. c) Calculate the total number of angular nodes and radial nodes present in the 3p orbital. d) How many numbers of electrons having- n = 3 , m s = -1/2	3
23	The reaction of cyanamide, $NH_2CN(s)$ with dioxygen was carried out in a bomb calorimeter and ΔU was found to be -742,7 KJ^{-1} mol^{-1} at 298 K. Calculate the enthalpy change for the reaction at 298 K. $NH_2CN\ (S) + 3/2\ O_2(g) \rightarrow N_2(g) + CO_2(g) + H_2O\ (Z)$	3
24	Balance the reaction by ion electron method $MnO_4^- + SO_2 \rightarrow Mn^{2+} + HSO_4^-$ (acidic medium)	3
25.	0.395 g of an organic compound by Carius method for the estimation of sulphur gave 0.582 g of $BaSO_4$. Calculate the percentage of sculpture in the compound.	3
26	a) Name the species formed in: (i) Homolytic cleavage (ii) Heterolytic cleavage of a chemical bond b) What is Lassaigne's extract? c) Identify the reagent shown in bold in the following equation as nucleophile or electrophile $CH_3COOH + HO^- \longrightarrow CH_3COO^- + H_2O$ **OR** For the following bond cleavages, use curved-arrows to show the electron flow and classify each as homolysis or heterolysis. Identify reactive intermediate produced as free radical,	3

	carbocation and carbanion. (a) $CH_3O—OCH_3 \longrightarrow CH_3\dot{O} + \dot{O}CH_3$ (b)  (c) 	
27	Predict the formulas of the stable binary compounds that would be formed by the combination of the following pairs of elements: (a) Lithium and oxygen (b) Magnesium and nitrogen (c) Aluminium and iodine(d) Silicon and oxygen	
28	Draw the cis- and trans-structures for hex-2-ene. Which iosmer will have higher b.p. and why?	
	SECTION D The following questions are case-based questions. Each question has an internal choice and carries 4 (1+1+2) marks each. Read the passage carefully and answer the questions that follow.	
29	Concentration of solutions: Molarity and Molality are the terms used to express the concentration of the solution. The concentration of a solution is defined as the measure of the quantity of one substance when it is mixed with another substance. The concentration of a chemical solution is measured by both molarity and molality. The major difference between the two is one of mass vs. volume. The molality refers to the number of moles of the solute per unit mass of the solvent, whereas the molarity refers to the number of moles of the solute per unit volume of the solution. If the solution has a solvent and the solute, a Mole Fraction gives a concentration as the ratio of moles of one component to the total moles present in the solution. When the concentration is expressed as the percent of one component in the solution by mass it is called Mass Percentage. Answer the following questions: a) Give units of molality and molarity. b) Which concentration term is a dimensionless quantity? Give its expression. c) Calculate the Molarity of 15 % H_2SO_4 solution by weight having density 1.1 g/mL. Atomic masses: H-1, S - 32, O-16 OR A Solution contains 15gm of sugar in 60gm of water. Find out the mass % for sugar in the solution.	1+1+2
30	Spontaneous and Non-spontaneous Processes - Naturally, all processes have a tendency to occur in one direction under a given set of conditions. A spontaneous process is an irreversible process and it could only be reversed by some external agents. The entropy of any system is defined as the degree of randomness in it. Generally, the total entropy change is the essential parameter which defines the spontaneity of any process. Since most of the chemical reactions fall under the category of a closed system and open system; we can say	1+1+2

	there is a change in enthalpy too along with the change in entropy. Since, change in enthalpy also increases or decreases the randomness by affecting the molecular motions, entropy change alone cannot account for the spontaneity of such a process. Therefore, for explaining the spontaneity of a process we use the Gibbs energy change. Gibbs' energy is a state function and an extensive property. Reactions are favourable when they result in a decrease in enthalpy and an increase in entropy of the system. When both of these conditions are met, the reaction occurs naturally. A spontaneous reaction is a reaction that favours the formation of products at the conditions under which the reaction is occurring. A spontaneous process is capable of proceeding in a given direction without needing to be driven by an outside source of energy. An endergonic reaction (also called a nonspontaneous reaction) is a chemical reaction in which the standard change in free energy is positive and energy is absorbed. Answer the following questions: a) Give relationship between enthalpy change, entropy change and Gibb's free energy change. b) For a reaction ΔH and ΔS are positive. What is the condition that this reaction occurs spontaneously? c) Enthalpy & entropy changes of a reaction are 40.63 kJ mol^{-1}& 108.8 $JK^{-1}mol^{-1}$ respectively. Predict the feasibility of the reaction at 27°C. **OR** At 0°C ice and water are in equilibrium and ΔH=6.0 kJ mol^{-1} for the process $H_2O(s) \rightarrow H_2O(l)$. What will be ΔS and ΔG for the conversion of ice to liquid water?	
	SECTION E	
31.	a) what is the hybridisation of each carbon atom in Ethene and Ethyne b) Give the shapes and draw the structures of H_2O and NH_3 molecule on the basis of VSEPR Theory. c) Describe the hybridisation and shape of SF_6 molecule. **OR** a) Write molecular orbital configuration of O_2 molecule and find its bond order. Compare the magnetic behaviour and relative stabilities of O_2, O_2^+, O_2^- and O_2^{2-}	
32.	a) Define Le Chatelier's Principle. b) What is the effect of: (i) addition of H_2 (ii) addition of CH3OH (iii) removal of CO (iv) increase of pressure on the equilibrium of - $2H_2(g) + CO(g) \rightleftharpoons CH_3OH(g)$ c) Classify the following species into Lewis acids and Lewis bases. (i) OH– ions (ii) F– (iii) H+	1 2

	(iv) BCl3 **OR** a) Define: (i) Buffer solution (ii) common ion effect b) At 473 K, the equilibrium constant Kc for the decomposition of phosphorus pentachloride (PCl5) is 8.3 x 10-3. if decomposition proceeds as: (i) Write an expression for Kc for the reaction (ii) What is the value of Kc for the reverse reaction at the same temperature? (iii) What would be the effect on Kc if temperature is increased?	2 2 3
33	I. Write the IUPAC names of the products obtained by the ozonolysis Pent-2-ene II. Arrange benzene, n-hexane and ethyne in decreasing order of acidic strength. Also give reason for this behaviour III. How will you convert benzene into (i) p-chloronitrobenzene (ii) m-chloronitrobenzene OR I. Write the IUPAC names of the products obtained by the ozonolysis 3, 4-dimethylhept 3-ene II. Arrange the following sets of compounds in order of their decreasing relative reactivity with an electrophile and assign reason. Chlorobenzene, 2, 4-dinitrochlorobenzene, p-nitrochlorobenzene. III. How will you convert benzene into (i) p-nitrotoluene (ii) Acetophenone	1 2 2 1 2 2

MARKING SCHEME

SECTION A		
Q.NO.	**VALUE POINTS**	**MARKS**
1	(d) (d) 9.1×10^8	1
2	(c) Orientation of orbitals	1
3	(c) $S^{2-} > Cl^- > K^+ > Ca^{2+}$	1
4	(a) CH_3COONa and CH_3COOH	1
5	(a) H_2O because of hydrogen bonding	1
6	(c)$[Xe]6s^1$	1
7	(b) 15, 5 and 3	1
8	(b) NH^{-2}	1
9	(a) 3-Ethyl-2-hexene	1
10	(d) 2-Butene	1
11	(c) 29	1
12	(a) less than the atomic radius	1
13	a. Both A and R are true and R is the correct explanation of A	1
14	c. A is true but R is false.	1
15	b. Both A and R are true but R is not the correct explanation of A.	1
16	b. Both A and R are true but R is not the correct explanation of A.	1
	SECTION B	

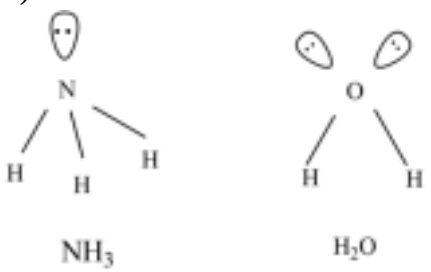
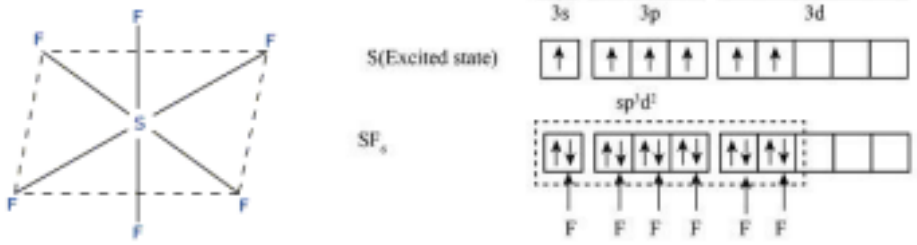
<table>
<tr><td>17</td><td>The balanced equation for the combustion of carbon in dioxygen/air is
$C(s) + O_2(g) \longrightarrow CO_2(g)$
1 mole 1 mole (32 g) 1 mole (44 g)
(i) In air, combustion is complete. Therefore,$C0_2$ produced from the combustion of 1 mole of carbon = 44 g
.(ii) As only 16 g of dioxygen is available, it can combine only with 0.5 mole of carbon, i.e., dioxygen is the limiting reactant. Hence,$C0_2$ produced = 22 g.</td><td>1
1</td></tr>
<tr><td>18</td><td>1. It couldn't explain the spectra of multi-electron atoms.
2. It fails to explain the splitting of spectral lines when subjected to the electrostatic or magnetic fields (Stark or Zeeman's effect).
3. It does not account for the fine splitting of spectral lines (Any Two)
OR
Frequency (ν) $= \frac{1}{\text{Period}} = \frac{1}{(2{\cdot}0 \times 10^{-10}\,\text{s})} = 5{\cdot}0 \times 10^{9}\,\text{s}^{-1}$
Wavelength (λ) $= \frac{c}{\nu} = \frac{(3\times10^{8}\,\text{m s}^{-1})}{(5\times10^{9}\,\text{s}^{-1})} = 6{\cdot}0 \times 10^{-2}\,\text{m}$</td><td>1+1
1
1</td></tr>
<tr><td>18</td><td><table><tr><th>Sigma (σ) Bond</th><th>Pi (π) Bond</th></tr><tr><td>(a) It is formed by the end to end overlap of orbitals.</td><td>It is formed by the lateral overlap of orbitals.</td></tr><tr><td>(b) The orbitals involved in the overlapping are s–s, s–p, or p–p.</td><td>These bonds are formed by the overlap of p–p orbitals only.</td></tr><tr><td>(c) It is a strong bond.</td><td>It is weak bond.</td></tr><tr><td>(d) The electron cloud is symmetrical about the line joining the two nuclei.</td><td>The electron cloud is not symmetrical.</td></tr><tr><td>(e) It consists of one electron cloud, which is symmetrical about the internuclear axis.</td><td>There are two electron clouds lying above and below the plane of the atomic nuclei.</td></tr><tr><td>(f) Free rotation about σ bonds is possible.</td><td>Rotation is restricted in case of pi-bonds.</td></tr></table>Any two differences</td><td>1+1</td></tr>
<tr><td>19</td><td>the signs of ΔH and ΔS
-ve and -ve</td><td>½ + ½
1</td></tr>
<tr><td>20</td><td>(a) Steam distillation
(b) sublimation</td><td>1
1</td></tr>
</table>

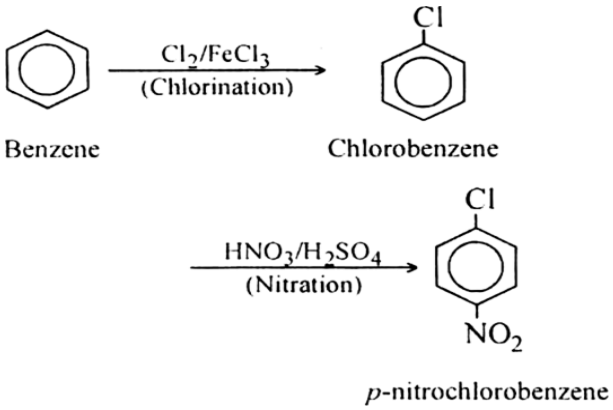
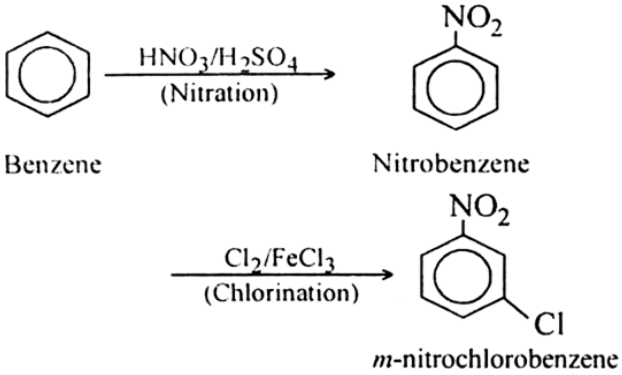
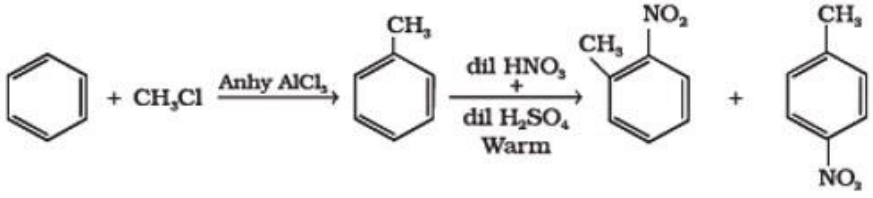
	SECTION C	
21	**Any Three** a) No two electrons in an atom can have the same set of all the four quantum numbers. b) $Cu^{2+} = 1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^9$ c) For the 3p – orbital, the principal quantum number is n = 3 and the azimuthal number is l = 1. Number of angular nodes will be l = 1 The number of radial nodes is equal to n – l – 1 = 3 – 1 – 1 = 1. d) 9 electrons	1 1 ½ ½ 1
22	$\Delta U = -742.7\ KJ^{-1}\ mol^{-1}$; $\Delta^{ng} = 2 - 3/2 = +1/2$ mol. R = 8.314 x 10-3$KJ^{-1}\ mol^{-1}$; T = 298 K According to the relation, $\Delta H = \Delta U + \Delta^{ng}RT$ ΔH = (- 742.7 kj) + (1/2 mol) x (8.314 x10^{-3} $KJ^{-1}\ mol^{-1}$) x (298 K) = – 742.7 kj + 1.239 kj = – 741.5 kj.	

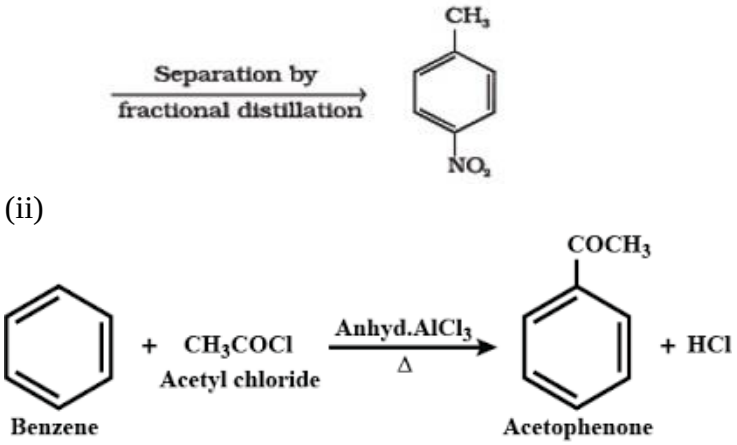
23	$\overset{+7\ -2}{Mn\,O_4^-} + \overset{+4\ -2}{SO_2} \longrightarrow \overset{+2}{Mn^{2+}} + \overset{+1\ +6\ -2}{H\,S\,O_4^-}$ (Skeletal equation) Oxidation half: $SO_2 \longrightarrow HSO_4^-$ Reduction half: $MnO_4^- \longrightarrow Mn^{2+}$ Oxidation half: $SO_2 \longrightarrow HSO_4^- + 2e^-$ $SO_2 + 2H_2O \longrightarrow HSO_4^- + 3H^+ + 2e^-$ …(i) (Add $2H_2O$ molecules to balance O atoms) Reduction half: $MnO_4^- + 5e^- \longrightarrow Mn^{2+}$ $MnO_4^- + 8H^+ + 5e^- \longrightarrow Mn^{2+} + 4H_2O$ …(ii) (Add $4H_2O$ molecules to balance O atoms and H atoms) Add oxidation and reduction half $[SO_2 + 2H_2O \longrightarrow HSO_4^- + 3H^+ + 2e^-] \times 5$ $[MnO_4^- + 8H^+ + 5e^- \longrightarrow Mn^{2+} + 4H_2O] \times 2$ $2MnO_4^- + 5SO_2 + 2H_2O + H^+ \longrightarrow 5HSO_4^- + 2Mn^{2+}$	1 1 1

24	Mass of *BaSO*4 =0.582g Molecular weight of $BaSO_4$ = 233g/mol 233g of $BaSO_4$ contain sulphur = 32 g 0.582g of $BaSO_4$ contains sulphur = 32/233×0.582 Percentage of sulphur = *weight of sulphurweight of compound*×100 = 32×0.582/233×0.395×100=20.24	1 1 1
25	a) (i) Homolytic cleavage - Free Radicals (ii) Heterolytic cleavage- Ions b) When organic compound is fused with sodium metal and then extracted by water, it is called Lassaigne's extract. c) Nucleophile **OR** (a) $CH_3O-OCH_3 \xrightarrow{\text{Homolysis}} CH_3\dot{O} + \dot{O}CH_3$ (Free radicals) (b) $HO^- + H-CH_2-C(=O)- \xrightarrow{\text{Heterolysis}} HOH + {}^-CH_2-C(=O)-$ (Carbanion) (c) $R-Br \xrightarrow{\text{Heterolysis}} R^+ + Br^-$ (Carbocation)	½ + ½ 1 1 ½ + ½ ½ + ½ ½ + ½
26	(a) $Li0_2$(Lithium oxide) (b) Mg_3N_2(Magnesium nitride) (c) AlI_3(Aluminium iodide) (d) $Si0_2$ (Silicon dioxide)	1 1 1
27	The structures of cis- and trans-isomer of hex-2-ene are: cis-Hex-2-ene (Higher dipole moment, higher b.p.) trans-Hex-2-ene (Lower dipole moment, lower b.p.) The boiling point of a molecule depends upon dipole-dipole interactions. Since cis-isomer has higher dipole moment, therefore, it has higher boiling point.	2 1
	SECTION D	
28	a) Molality - mol kg^{-1}. Molarity - mol L^{-1} b) mole fraction. $X_1 = \frac{n_1}{n_1+n_2}$ = mole fraction of species 1 $X_2 = \frac{n_2}{n_1+n_2}$ = mole fraction of species 2 (Any one)	½ + ½ ½ ½

	c) Molarity = [w x d x 10] / (MM) = (15 x 1.1 x 10)/ 98 = 1.68 mol L^{-1} **OR** Mass of the solution = 15g sugar + 60 gm of water = 75g. Mass % formula is given by Mass by Mass % = Mass of solute X 100 Mass of Solution Mass % of sugar in the solution is (15/75) x 100 = 20%	1 1 ½ ½ 1
30	a) $\Delta G = \Delta H - T\Delta S$ b) To make ΔG negative $T\Delta S > \Delta H$. c) $\Delta H = 40.63$ kJ $mol^{-1} = 40630$ $Jmol^{-1}$ $\Delta S = 108.8$ JK^{-1} mol^{-1} T = 27°C =27 + 273 = 300 K Now $\Delta G = \Delta H - T\Delta S$ = 40630 – 3 × 108.8 = 7990 J mol^{-1} Since ΔG comes out to be positive (i.e., $\Delta G > 0$), the reaction is not feasible at 27°C in the forward direction. **OR** Since the given process is in equilibrium $\Delta G = 0$ ∴ from the equation $\Delta G = \Delta H - T\Delta S$ ΔH becomes = $T\Delta S$ $\therefore \Delta S = \frac{6000 \text{ J mol}^{-1}}{273 \text{ K}} = 21.98 \text{ JK}^{-1} \text{ mol}^{-1}$.	1 1 1 1 1 1
	SECTION E	

31	a) (i) each C = sp 2 in ethane (ii) Each C = sp in ethyne b)  NH_3 H_2O c) SF6 molecule has sp^3d^2hybridisation and hence octahedral shape.  **OR** a) O_2: KK'$(\sigma 2s)^2(\sigma^*2s)^2(\sigma 2pz)^2(\pi 2px)^2(\pi 2py)^2(\pi^*2px)^1(\pi^*2py)^1$	½ +1/2 1+1 1+1 1
	Bond order = (Nb−Na) /2 B.O = (8−4)/2 = 2 b) $O_2^+ > O2 > O_2^- > O_2$**2-** O_2**2-**- Diamagnetic; O_2^+, O2 ,O_2^-- Paramagnetic	1 ½ x 4=2
32	a) If a system is subjected to a change in pressure, concentration etc., the equilibrium will shift in such a way so as to undo the effect of the change. b) (i) Equilibrium will be shifted in the forward direction. (ii) Equilibrium will be shifted in the backward direction. (iii) Equilibrium will be shifted in the backward direction. (iv) Equilibrium will be shifted in the forward direction. c) (i) OH^-ions (ii) F^-- Lewis Bases (iii) H^+ (iv) BCl3 - Lewis Acids **OR** a) (i) **Buffer solution**: A buffer solution is the solution which can resist the change in pH on addition of small amount of acid or base. (ii) **Common ion effect**: The effect by which the ionization of one electrolyte is suppressed by the presence of a common ion. b) (i) The expression for $K_c = \frac{[PCl_3(g)][Cl_2(g)]}{[PCl_5(g)]}$	1 ½ ½ ½ ½ ½ + ½ ½ + ½ 1 1 1

	(ii) For reverse reaction $(K_c') = \frac{PCl_5(g)}{[PCl_3(g)][Cl_2(g)]} = \frac{1}{8.3 \times 10^{-3}} = 120.48$ (iii) By increasing the temperature, the forward reaction will.be favoured since it is endothermic in nature. Therefore, the value of equilibrium constant will increase.	1 1
33	I. The IUPAC name of Product (I) is ethanal and Product (II)is propanal. II. The s–character increases in the order: sp3<sp2<sp Hence, the decreasing order of acidic behaviouris Ethyne> Benzene > Hexane. III.(i)  *p*-nitrochlorobenzene (ii)  *m*-nitrochlorobenzene **OR** I. 1-Phenylbut-1-ene II. The decreasing order of relative reactivity with an electrophile is Chlorobenzene >p-nitrochlorobenzene>2,4-dinitrochlorobenzene **III. (I)**  	1 2 1 1 1 2 1

	(ii)  	1

BLUE PRINT

Name of Unit	Sec-A	Sec-B	Sec-C	Sec-D	Sec-E	Total
	1 M MCQ A-R	2 M	3 M	4 M	5 M	
		VSA	SA	Case Based	LA	
Basic Concepts of Chemistry	1(1)	2(1)		4 (1)		**7**
Structure of Atom	1(4)	2(1)	3(1)			**9**
Classification of Elements	1(3)		3(1)			**6**
Chemical Bonding and Molecular Structure		2(1)			5 (1)	**7**
Chemical Thermodynamics		2(1)	3(1)	4 (1)		**9**
Equilibrium	1(2)				5 (1)	**7**
Redox Reactions	1(1)		3(1)			**4**
Organic Chemistry: Some basic Principles and Techniques	1(3)	2(1)	3(2)			**11**
Hydrocarbons	1(2)		3(1)		5 (1)	**10**
	16(16)	**10 (5)**	**21(7)**	**8 (2)**	**15 (3)**	**70**

SET-7

SESSION ENDING EXAMINATION
CHEMISTRY THEORY (043)
CLASS - XI

MM : 70 MARKS **TIME : 3 HOURS**

General Instructions

1. There are **33** questions in this question paper with internal choice.
2. SECTION A consists of 16 multiple -choice questions carrying 1 mark each.
3. SECTION B consists of 5 short answer questions carrying 2 marks each.
4. SECTION C consists of 7 short answer questions carrying 3 marks each.
5. SECTION D consists of 2 case - based questions carrying 4 marks each.
6. SECTION E consists of 3 long answer questions carrying 5 marks each.
7. All questions are compulsory.
8. Use of log tables and calculators is not allowed

Section A

The following questions are multiple -choice questions with one correct answer. Each question carries 1 mark. There is no internal choice in this section.

1	Which of the following contain highest number of atoms? (a) 1.0 g of water (b) 1.0 g of silver (c) 1.0 g of nitrogen (d) 1.0 g of propane	**1**
2	Photoelectric emission is observed from a metal surface with incident frequencies V_1 and V_2 where $V_1 > V_2$ .If the kinetic energies of the photoelectrons emitted in the two cases are in the ratio 2:1 then the threshold frequency V^0 of the metal is (a)V_1-V_2 (b) $(V_1-V_2)/h$ (c) $2V_1-V_2$ (d) $2V_2-V_1$	**1**
3	Which of the following will not show deflection from the path on passing through an electric field? (a) Proton (b) cathode rays (c) electron (d) neutron	**1**
4	Which of the following has the smallest radius? a. Sn^{+4} b. Li^{+} c. Ca^{+2} d. Al^{+3}	**1**
5	The chemistry of lithium is very similar to that of magnesium even though they are placed in different groups. It's reason is: (a) Both are found together in nature (b) Both have nearly the same size (c) Both have similar electronic configuration (d) The ratio of their charge and size (i.e. charge density) is nearly the same	**1**
6	Which of the following chemical species has highest bond order? (a) O_2 (b) O_2^{+} (c) O_2^{-} (d) O_2^{2-}	**1**
7	Given that $C + O_2 \rightarrow CO_2$, $\Delta H° = - x$ kJ $2CO + O_2 \rightarrow 2CO_2$, $\Delta H° = - y$ kJ The enthalpy of formation of carbon monoxide will be (a) y - 2x (b) 2x-y / 2 (c) y-2x / 2 (d) 2x-y	**1**
8	Which one of the following demonstrates a decrease in entropy?	**1**

	(a) Dissolving a solid into solution (b) An expanding universe (c) Burning a log in a fire place (d) Raking up leaves into a trash bag	
9	What will be the pH of a H_2SO_4 solution having $[H]^+$ ion concentration 1 x 10^{-4} (a) 10.4 (b) 3.70 (c) 3.4 (d) 6	**1**
10	The solubility of M_2S salt is 3.5×10^{-6} then find out solubility product. (a) 1.7×10^{-6} (b) 1.7×10^{-16} (c) 1.7×10^{-18} (d) 1.7×10^{-12}	**1**
11	The value of x & y in the following redox reaction- $xCl_2 + 6OH^- \rightarrow ClO_3^{-3} + yCl^- + 3H_2O$ are (a) x = 2, y = 3 (b) x = 5, y = 3 (c) x = 3, y = 5 (d) x = 4, y = 2	**1**
12	What happens when a mixture of acetylene and hydrogen is passed over heated Lindlar's catalyst? (a) Ethylene and water are formed (b) Ethane and water are formed (c) Ethylene is formed (d) Acetylene and ethane are formed	**1**
	Question No. 13 to 16 consist of two statements – Assertion (A) and Reason (R). Answer these questions selecting the appropriate option given below: **a) Both A and R are true, and R is the correct explanation of A.** **b) Both A and R are true, and R is not the correct explanation of A.** **c) A is true but R is false.** **d) Both Assertion and Reason are incorrect**	
13	**Assertion :** One atomic mass unit is defined as one-twelfth of the mass of one carbon-12 atom. **Reason :** Carbon-12 isotope is the most abundant isotope of carbon and has been chosen as the standard.	**1**
14	**Assertion :** Boron has a smaller first ionization enthalpy than beryllium. **Reason :** The penetration of a 2s electron to the nucleus is more than the 2p electron hence 2p electron is more shielded by the inner core of electrons than the 2s electrons.	**1**
15	**Assertion :** BF_3 molecule obeys octet rule. **Reason :** BF_3 is an odd electron spices.	**1**
16	**Assertion :** Silver cannot displace copper from $CuSO_4$ solution. **Reason** : Silver is placed below copper in the electrochemical series.	**1**
	SECTION B **This section contains 5 questions with internal choice in one question. The following questions are very short answer type and carry 2 marks each.**	
17	Which aqueous solution has higher concentration: 1 molar or 1 molal solution of the same solute? Give reason.	**2**
18	Calculate the wave number of line associated with the transition in Balmer series when the electron moves to **n** = 4 orbit. (R_H = 109677 cm^{-1})	**2**

19	Equilibrium constant for certain reactions at 20^oC temp and 50^oC are respectively $1x10^{-2}$ and $1x10^{-3}$. Can it help in predicting the exothermic or endothermic nature of the forward reaction?	**2**
20	What is the oxidation number of O in (i) OF_2 (ii) O_2F_2 OR Write the balanced redox reaction MnO^- (aq) + Fe^{2+}(aq) → Mn^{2+}(aq)+ Fe^{3+}(aq) [acidic medium]	**2**
21	Explain the following with examples: (i) Wurtz reaction (ii) Friedel-Crafts acylation Reaction	**2**
	SECTION C **This section contains 7 questions with internal choice in one question. The following questions are short answer type and carry 3 marks each.**	
22	(a) What do mean by molarity. Calculate the molarity of NaOH in the solution prepared by dissolving its 4 g in enough water to form 250 mL of the solution. (b) At what temperature have the Celsius and Fahrenheit reading the same numerical value?	**3**
23	a) Arrange the following elements on the basis of first ionization enthalpy. Li, Be, B, C, N, O, F, Ne b) Write the IUPAC name of the elements with atomic number 112 and 123 c) Why the successive ionization enthalpies always increase ?	**3**
24	The reaction of cyanamide, $NH_2CN(s)$ with dioxygen was carried out in a bomb calorimeter and ΔU was found to be -742.7 KJ mol^{-1} at 298 K. Calculate the enthalpy change for the reaction at 298 K. NH_2CN (S) + $3/2O_2(g) \rightarrow N_2(g) + CO_2(g) + H_2O(l)$ **OR** Calculate the enthalpy for the reaction: $N_2O_4(g) + 3CO(g) \rightarrow N_2O(g) + 3CO_2(g)$ Given that; $\Delta_f H$ CO(g) = – 110 kJ mol^{-1}, $\Delta_f H$ $CO_2(g)$ = –393 kJ mol^{-1} $\Delta_f H$ $N_2O(g)$ = 81 kJ mol^{-1} $\Delta_f H$ $N_2O_4(g)$ = 9.7 kJ mol^{-1}	**3**
25	a) Write the expression for the equilibrium constant, Kc for each of the following reactions 1. $2NOCl(g) \rightarrow 2NO(g) + Cl_2(g)$ 2. $CH_3COOC_2H_5(aq) + H_2O(l)$ ----------> $CH_3COOH(aq) + C_2H_5OH(aq)$ b) Select the one that is not a Lewis acid H_2O, H^+, BF_3, NH_4^+	**2 + 1**
26	a. Write all structural isomers of molecular formula C_3H_6O. b. Arrange the following in increasing order of C—C bond length: C_2H_6 & C_2H_4, C_2H_2. c. write short note about Kolbe's Reaction (Give reaction also).	**3**
27	Give Examples for the following (write chemical equation only):	**1½**

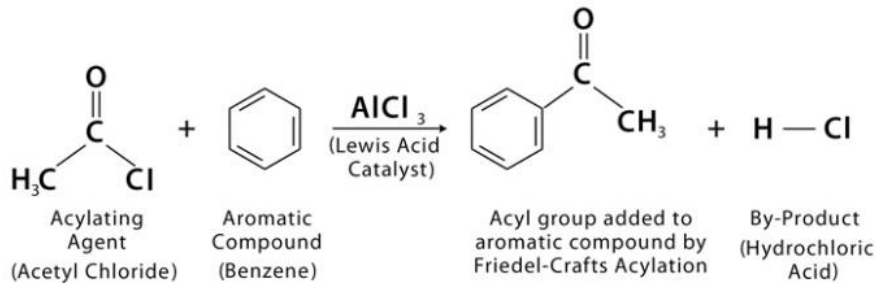
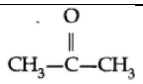
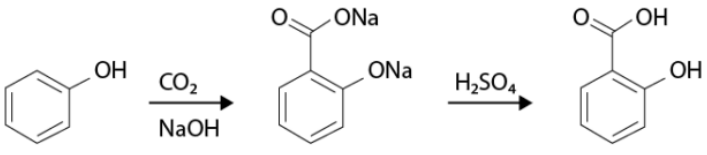
	(i) Electrophilic Substitution (ii) Nucleophilic Substitution	+ **1½**
28	**a)** An alkene 'A' on ozonolysis gives a mixture of ethanal and pentan-3-one. Write the structure and IUPAC name of 'A'. **b)** How will you convert benzene into (i) Nitrobenzene (ii) (ii) Toluene	**1** **1** **1**
SECTION D **The following questions are case - based questions. Each question has an internal choice and carries 4 (1+1+2) marks each. Read the passage carefully and answer the questions that follow.**		
29	**Read the following passage and answer the questions from i) to iii):** Every system is associated with a definite amount of energy, called the internal energy (U or E) of the system. It is the sum of chemical, electrical, mechanical or any other form of energy that anyone can think of. However gravitational energy is generally necklaces neglected. It is a state function, i. e. independent of the path followed. lt may change when i) Heat flows in or out of the system. ii) Work is done on or by the system. iii) Matter enters or leaves the system It is an extensive property i.e. depends upon the mass of a substance. It depends only on temperature. The absolute value of internal energy possessed by a substance cannot be calculated because it is not possible to predict the exact values of different forms of energy. Thus, we can just calculate the change in internal energy which is achieved by changing the state of a system. First law of thermodynamics was proposed by Helmholtz and Robert- mayer who stated that the energy in of an isolated system is constant. i.e. energy can neither we created nor be destroyed but can be converted from one form to another. That's why it is also called law of conservation of energy. When a system undergoes isothermal ΔU = zero i.e. there is no increase or decrease in the internal energy of the system then the first law of thermodynamics reduce to 0 = q + w or q = -w. i) neither q not w is a state function but q + w is a state function explain why? ii) Out of mass and density which is an intensive property and why? iii) Explain thermodynamically how is the heat absorbed by system is used in doing work at constant temperature and pressure. **OR** What is the change in the energy of system if 500 Cal of heat energy are added to a system and system does 350 cal of work on the surroundings?	 **1** **1** **2**
30	**Conformations** Alkanes contain carbon-carbon sigma (σ) bonds. Electron distribution of the sigma molecular orbital is symmetrical around the internuclear axis of the C–C bond which is not disturbed due to rotation about its axis. This permits free rotation about C–C single bond. This rotation results into different spatial arrangements of atoms in space which can change into one another. Such spatial arrangements of atoms which can be	

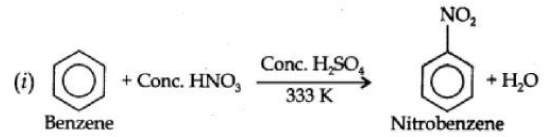
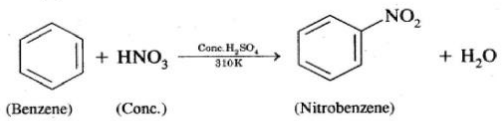
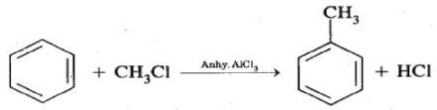
	converted into one another by rotation around a C-C single bond are called **conformations** or **conformers** or **rotamers**. Alkanes can thus have infinite number of conformations by rotation around C-C single bonds. However, it may be remembered that rotation around a C-C single bond is not completely free. It is hindered by a small energy barrier of 1-20 kJ mol–1 due to weak repulsive interaction between the adjacent bonds. Such a type of repulsive interaction is called **torsional strain.** ***Conformations of ethane :*** keep onecarbon atom stationary and rotate the other carbon atom around the C-C axis. This rotation results into infinite number of spatial arrangements of hydrogen atoms attached to one carbon atom with respect to the hydrogen atoms attached to the other carbon atom. These are called **conformational isomers** (conformers). One such conformation in which hydrogen atoms attached to two carbons are as closed together as possible is called **eclipsed** conformation and the other in which hydrogens are as far apart as possible is known as the **staggered** conformation. Any other intermediate conformation is called a **skew** conformation. (i) What is the dihedral angle in eclipsed and staggered conformations of ethane? (ii) Which is the most stable conformation of ethane? OR Which one of the following will exhibit conformational isomerism ? a. Ethylene b. Methane c. Chloromethane d. propane (iii) Which is the most stable conformation of butane?	**1** **1** **2**
SECTION E **The following questions are long answer type and carry 5 marks each. All questions have an internal choice.**		
31	**(a)** Calculate the (i) frequency, (ii) wavelength, and (iii) wavenumber of a light wave whose time period is 2.0×10^{-10} s. **(b)** An atom of an element contains 29 electrons and 35 neutrons. Deduce **(i)** The number of protons and **(ii)** The electronic configuration of the element. **OR** **(a)** When a photon of frequency 1.0×10^{15} s^{-1} was allowed to hit a metal surface, an electron having 1.988×10^{-19} J of kinetic energy was emitted. Calculate the threshold frequency of this metal. Show that an electron will not be emitted if a photon with a wavelength equal to 600 nm hits the metal surface. **(b)** Write electronic configuration of Cr and Cu^+	**5**
32	**(a)** Write the electronic configurations of O_2 ,O_2^+ ,O_2^- (superoxide), O_2^{2-} (peroxide) **(b)** Compare the relative stability of the above species and indicate their magnetic properties; **OR** (i) What is hybridization and shape of the following chemical species. (Draw structure with lone pair) ICl_2^- , XeO_2F_2 , PCl_6^- (ii) Describe the hybridisation in case of PCl_5. Why are the axial bonds longer compared to equatorial bonds? (iii) Water is liquid at room temperature while H_2S is gas. Why?	**5**

33	Draw the resonance structures for the following compounds. Show the electron shift using curved arrow notation. (a) C_6H_5OH (b) $C_6H_5NO_2$ (c) $CH_3CH=CHCHO$ (d) C_6H_5—CHO (e) C_6H5— CH_2^- **OR** (a) Explain the terms inductive and electromeric effects. (b) Which electron displacement effect explains the following correct orders of acidity of the carboxylic acids? (i) $Cl_3CCOOH > Cl_2CHCOOH > ClCH_2COOH$ (ii) $CH_3CH_2COOH > (CH_3)_2CHCOOH > (CH_3)_3CCOOH$	**5**

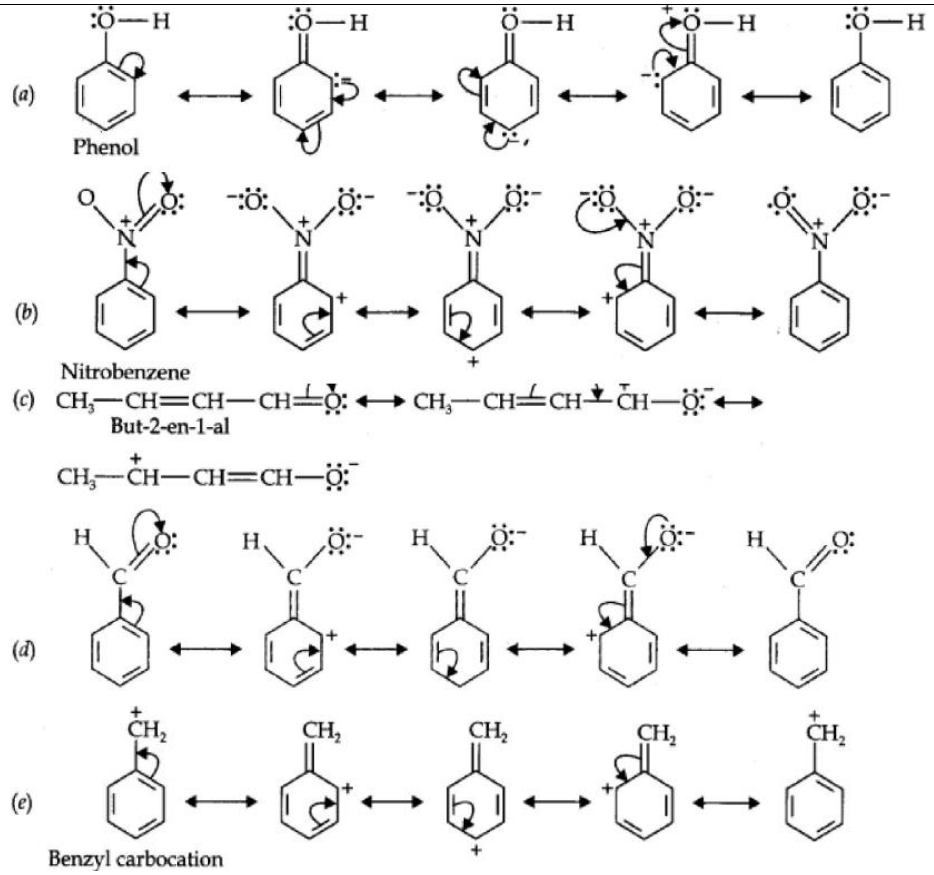
Marking Scheme

Section A		
Q. No.	**Question**	**Mk**
1	(d) 1.0 g of propane	**1**
2	(d) $2V_2$-V_1	**1**
3	(d) neutron	**1**
4	a. Sn^{+4}	**1**
5	(d) The ratio of their charge and size (i.e. charge density) is nearly the same	**1**
6	(b) O_2^+	**1**
7	(c) y-2x / 2	**1**
8	(d) Raking up leaves into a trash bag	**1**
9	(b) 3.70	**1**
10	(b) 1.7×10^{-16}	**1**
11	(a) x = 2, y = 3	**1**
12	(c) Ethylene is formed	**1**
13	B. Both A and R are true, and R is not the correct explanation of A	**1**
14	C. A is true but R is false	**1**
15	D. Both Assertion and Reason are incorrect	**1**
16	B. Both A and R are true, and R is not the correct explanation of A.	**1**
SECTION B **This section contains 5 questions with internal choice in one question. The following questions are very short answer type and carry 2 marks each.**		
17	1 molar aqueous solution has higher concentration than 1 molal solution. A molar solution contains one mole of solute in one litre of solution while a one molal solution contains one mole of solute in 1000 g of solvent. If density of water is 1 then one mole of solute is present in 1000ml of water in 1 molal solution while one mole of solute is present in less than 1000 ml of water in 1 molar solution. Thus, 1 molar solution is more concentrated.	**2**
18	$\bar{\nu} = 109677 \left(\frac{1}{n_i^2} - \frac{1}{n_f^2}\right) \text{ cm}^{-1}$ For $n_i = 2$ to $n_f = 4$ transition in Balmer series. $\bar{\nu} = 109677 \left(\frac{1}{2^2} - \frac{1}{4^2}\right) \text{ cm}^{-1}$ $= 109677 \left(\frac{1}{4} - \frac{1}{16}\right) \text{ cm}^{-1} = 20564.44 \text{ cm}^{-1}$	**2**
19	At high temperatures the value of K decreases indicating that the reaction occurs in the backward direction. Now according to Le Chattelier's principle raising the temperature shifts the reaction in endothermic side.	**2**
20	(i) +2 (ii) +1 OR $5Fe^{2+} + 1MnO^{-4} + 8H^+ \rightarrow 5Fe^{3+} + 1Mn^{2+} + 4H_2O$	**2**
21	(i) R-X + 2Na + X-R⟶ R–R + 2NaX	**1**

	(ii)  	**1**
	SECTION C **This section contains 7 questions with internal choice in one question. The following questions are short answer type and carry 3 marks each.**	
22	**Ans.** The number of moles of solute dissolved per litre (dm^3) of the solution is called molarity. Since molarity (M) = No. of moles of solute /Volume of solution in litres = (Mass of NaOH/Molar mass of NaOH)/0.250 L = (4 g / 40 g 0.1 mol)/0.250L = 0.1 mol/0.250 L = 0.4 mol /L = 0.4 M. a. ^{0} C= 5/9 (F-32) x = 5/9 (x-32) 4x = -160 Therefore x= -40 Thus at – 40 ^{0}C, -40 ^{0}F b.	**2 + 1**
23	a. Ne > F > N > O > C > Be > B > Li b. 112- unnunnbium (uub), 123- unnbitrium (ubt)\ c. Because it requires more energy to remove an electron from the cation than the neutral atom.	**3**
24	**Ans.** $\Delta U = -742.7$ KJ mol^{-1}; $\Delta_{ng} = 2 - 3/2 = +1/2$ mol. R = 8.314 x 10-3KJ mol^{-1} ; T = 298 K According to the relation, $\Delta H = \Delta U + \Delta_{ng} RT$ ΔH = (- 742.7 kJmol^{-1}) + (1/2 mol) x (8.314 x10-3 KJ mol^{-1}) x (298 K) = – 742.7 kJ + 1.239 kJ = – 741.5 kJ. OR Enthalpy of reaction (ΔrH) = [81 + 3 (- 393)] – [9.7 + 3 (- 110)] = [81 – 1179] – [9.7 – 330] = – 777.7 kJ mol-1 .	**3**
25	Ans: Expression for the equilibrium constant, Kc for each of the following reactions $Kc = [NO]^2[Cl_2] / [NOCl]^2$ a. $Kc = [CH_3COOH][C_2H_5OH]/[CH_3COOC2H_5]$ b. H_2O	**2 + 1**
26	a. CH_3CH_2CHO  b. C2H2 (120 pm) < C2H4 (134 pm) < C2H6 (154 pm) c.  	**3**

27	(i)  (ii) $CH_3CH_2I + KOH(aq) \longrightarrow CH_3CH_2OH + KI$ (ethanol)	**1½ + 1½**
28	a. CH3-CH=C(C2H5)2 , 3-Ethylpent-2-ene **Ans:** (i) benzene into Nitrobenzene  (ii) benzene into toluene  b. Benzene (methyl chloride) (Toluene)	**1** **1** **1**
	SECTION D **The following questions are case - based questions. Each question has an internal choice and carries 4 (1+1+2) marks each. Read the passage carefully and answer the questions that follow.**	
29	i) from first law of thermodynamics $\Delta U = q + w$ as q + w is equal to ΔU which is a state function it does not depends upon path of reaction and only depends upon initial and final state. ii) Density is an intensive property as it characteristics of a material and does not change with amount where as mass does change. iii) $\Delta U = q + w$ (from first law of thermodynamics) $0 = q + w$. ($\Delta U = 0$ at constant Temp.) $0 = q - p\,\Delta V$ $q = -w$ Therefore heat absorbed is used to do work by the system. **OR** According to the first law of thermodynamics. $\Delta E = q + w = 500 + (-350) = +150$ cal	**1 + 1 + 2**
30	(i) 0^o , 60^o (ii) staggered OR d. Propane (iii) The anti-conformation is the most stable conformation of butane, as the bulky groups are separated by a dihedral angle of 180°.	**1** **1** **2**
	SECTION E **The following questions are long answer type and carry 5 marks each. All questions have an internal choice.**	
31	a.	**5**

	(i) The frequency of the light wave is $\frac{1}{\text{period}} = \frac{1}{2.0 \times 10^{-10}\text{s}} = 5 \times 10^{9}/\text{s}.$ (ii) The wavelength of light wave is $\frac{c}{\nu} = \frac{3 \times 10^{8}\text{m/s}}{5 \times 10^{9}/\text{s}} = 6.0 \times 10^{-2}\text{m}.$ (iii) The wave number of light wave is $\bar{\nu} = \frac{1}{\lambda} = \frac{1}{6.0 \times 10^{-2}} = 16.66/\text{m}.$ (b) protons=29 Cu : $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^{10}\ 4s^1$ **OR** **Ans:** (a) V=$1.0\times10^{15}\ s^{-1}$ K.E=1.988×10^{-19} J V_0=? $h\nu = h\nu_0 + K.E$ $V_0 = V - K.E/h$ $= 1x10^{15} - (1.988x10^{-19}) / 6.626 \times 10^{-34}\ S^{-1}$ $= 7 \times 10^{14}\ S^{-1}$ Now λ=600 nm =6×10^{-7}m Therefore $\nu = C/\lambda = 5 \times 10^{14}\ S^{-1}$ As V is less than V_0 , electrons will not be ejected. (b) Cr : $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^5\ 4s^1$ Cu+ : $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^{10}\ 4s^0$	
32	**Ans**: **The electronic configuration of O_2 molecule can be written as:** Total electrons = 8+8= 16 $[\sigma(1s)]^2\ [\sigma*(1s)]^2\ [\sigma(2s)]^2\ [\sigma*(2s)]^2\ [\sigma(2pz)]^2\ [\pi(2px)]^2\ [\pi(2py)]^2\ [\pi*(2px)]^1\ [\pi*(2py)]^1$ Nb=10 , Na= 6 (i) Bond order= $\frac{(Nb-Na)}{2} = \frac{(10-6)}{2}$ = **2** (ii) Paramagnetic (2 unpaired electrons) **The electronic configuration of O_2^+ can be written as:** Total electrons = 8+8-1= 15 $[\sigma(1s)]^2\ [\sigma*(1s)]^2\ [\sigma(2s)]^2\ [\sigma*(2s)]^2\ [\sigma(2pz)]^2\ [\pi(2px)]^2\ [\pi(2py)]^2\ [\pi*(2px)]^1\ [\pi*(2py)]^0$ Nb=10 , Na= 5 (i) Bond order= $\frac{(Nb-Na)}{2} = \frac{(10-5)}{2}$ = **2.5** (ii) Paramagnetic (1 unpaired electron) **Electronic configuration of O_2^- ion will be:** Total electrons = 8+8+1= 17 $[\sigma(1s)]^2\ [\sigma*(1s)]^2\ [\sigma(2s)]^2\ [\sigma*(2s)]^2\ [\sigma(2pz)]^2\ [\pi(2px)]^2\ [\pi(2py)]^2\ [\pi*(2px)]^2\ [\pi*(2py)]^1$ Nb=10 , Na= 7	**5**

	(i) Bond order= $\frac{(Nb-Na)}{2}=\frac{(10-7)}{2}$ = **1.5** (ii) Paramagnetic (1 unpaired electron) **Electronic configuration of O_2^{2-} ion will be:** Total electrons = 8+8+2= 18 $[\sigma(1s)]^2\,[\sigma*(1s)]^2\,[\sigma(2s)]^2\,[\sigma*(2s)]^2\,[\sigma(2pz)]^2\,[\pi(2px)]^2\,[\pi(2py)]^2\,[\pi*(2px)]^2\,[\pi*(2py)]^2$ Nb=10 , Na= 8 (i) Bond order= $\frac{(Nb-Na)}{2}=\frac{(10-8)}{2}$ = **1** (ii) Diamagnetic (All paired electron) Bond dissociation energy is directly proportional to bond order. Thus, the higher the bond order, the greater will be the stability. On this basis, the order of stability is O_2^+ > O_2 > O_2^- > O_2^{2-}.	
33	 (a) Phenol (b) Nitrobenzene (c) But-2-en-1-al (d) (e) Benzyl carbocation **OR** **Inductive Effect:** The inductive effect refers to the polarity produced in a molecule as a result of higher electronegativity of one atom compared to another. Atoms or groups which lose electron towards a carbon atom are said to have +I Effect. Those atoms or groups which draw electron away from a carbon atom are said to have -I Effect. Common examples of -I effect are: NO_2, F, Cl, Br, I, OH etc.	**5**

Examples of +I effect are (Electron releasing) $(CH_3)_2C$—, $(CH_3)_2CH$—, CH_3CH_2— CH_3— etc.

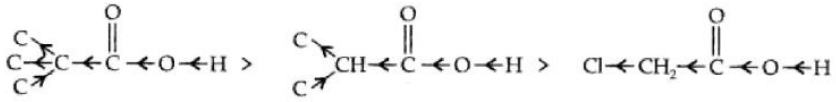
Electromeric effect: The electromeric effect refers to the polarity produced in a multiple bonded compound as it is approached by a reagent.

The atom A has lost its share in the electron pair and B has gained this share.

As a result A acquires a positive charge and B a negative charge. It is a temporary effect and takes place only in the presence of a reagent.

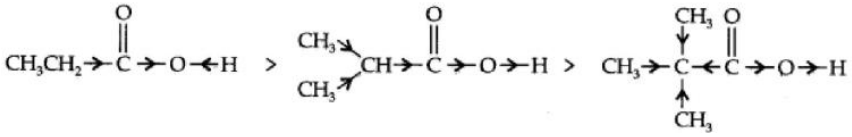
(a) -I-effect as shown below:

As the number of halogen atoms decreases, the overall -I- effect decreases and the acid strength decreases accordingly.



(b) +I-effect as shown below:

As the number of alkyl groups increases, the +I-effect increases and the acid strength decreases accordingly.



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Unit No.	Name of Unit	Sec-A		Sect- B	Sec- C	Sect- D	Sect- E	Total
		1 M		2 M	3 M	4 M	5 M	
		MCQ	A-R	VSA	SA	Case Based	LA	
1.	**Some Basic Concepts of Chemistry**	1 (1)	1 (1)	1 (2)	1 (3)			**4 (7)**
2.	**Structure of Atom**	2 (2)		1 (2)			**1 (5)**	**4 (9)**
3.	**Classification of Elements and Periodicity in Properties**	2 (2)	1 (1)		**1 (3)**			**4 (6)**
4.	**Chemical Bonding and Molecular Structure**	1 (1)	1 (1)				**1 (5)**	**3 (7)**
5.	**Chemical Thermodynamics**	2 (2)			1 (3)	**1(4)**		**4 (9)**
6.	**Equilibrium**	2 (2)		1 (2)	1 (3)			**4 (7)**
7.	**Redox Reactions**	1 (1)	1(1)	**1 (2)**				**3 (4)**
8.	**Organic Chemistry: Some basic Principles and Techniques**				2 (6)		**1 (5)**	**3 (11)**
9.	**Hydrocarbons**	1 (1)		1 (2)	1 (3)	**1(4)**		**4 (10)**
	Total No. of questions	**12 (12)**	**4 (4)**	**5 (10)**	**7 (3)**	**2 (4)**	**3 (5)**	**33 (70)**

SET-8

SESSION ENDING EXAMINATION
CHEMISTRY THEORY (043)
CLASS - XI

MM : 70 MARKS **TIME : 3 HOURS**

General Instructions:

Read the following instructions carefully.

(a) There are 33 questions in this question paper with internal choice.
(b) SECTION A consists of 16 multiple -choice questions carrying 1 mark each.
(c) SECTION B consists of 5 short answer questions carrying 2 marks each.
(d) SECTION C consists of 7 short answer questions carrying 3 marks each.
(e) SECTION D consists of 2 case - based questions carrying 4 marks each.
(f) SECTION E consists of 3 long answer questions carrying 5 marks each.
(g) All questions are compulsory.
(h) Use of log tables and calculators is not allowed.

SECTION A

The following questions are multiple -choice questions with one correct answer. Each question carries 1 mark. There is no internal choice in this section.

1. The significant figures in 0.00051 are ————.
(a) 5 (b) 3 (c) 2 (d) 26

2. Which of the following is the correct formula for molality?
(a) Molality = kilograms of solute ÷ litres of solvent
(b) Molality = moles of solute ÷ kilograms of solvent
(c) Molality = kilograms of solute ÷ kilograms of solution
(d) Molality = moles of solute ÷ moles of solution

3.From the following sets of quantum numbers, state which are possible. Explain why the others are not possible.
a. n = 0, l = 0, m_l = 0, m_s = +1/2
b. n = 1, l = 0, m_l = 0, m_s – – 1/2
c. n = 1, l = 1, m_l = 0, m_s= +1/2
d. n = 1, l = 0, m_l = +1, m_s= +1/2

4.Considering the elements F, Cl, O and N, the correct order of their chemical reactivity in terms of oxidising property is:
(a) F > Cl> O > N (b) F > O > Cl> N (c) Cl> F > O > N (d) O > F > N > Cl

5. In $S0_2$ molecule, S atom is:
(a) sp^3 hybridized (b) sp hybridized (c) sp^2 hybridized (d) d sp^2 hybridized

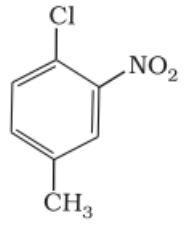
6. For the process to occur under adiabatic conditions, the correct condition is:
(a) ΔT= 0 (b) Δp = 0 (c) q = 0 (d) w = 0

7.What is the oxidation number of chlorine in $HClO_4$?
a. +3 b. +5 c. +7 d. +8

8. Which of the following is the correct IUPAC name?
(a) 3-Ethyl-4, 4-dimethylheptane (b) 4,4-Dimethyl-3-ethylheptane

(c) 5-Ethyl-4, 4-dimethylheptane (d) 4,4-Bis(methyl)-3-ethylheptane

9.The IUPAC name for



a)1-Chloro-2-nitro-4-methylbenzene (b) 1-Chloro-4-methyl-2-nitrobenzene
(c) 2-Chloro-1-nitro-5-methylbenzene (d) m-Nitro-p-chlorotoluene

10.Arrange the following in decreasing order of their boiling points.

(A) n–butane (B) 2–methylbutane
(C) n-pentane (D) 2,2–dimethylpropane

(a) A > B > C > D (b) B > C > D > A
(c) D > C > B > A (d) C > B > D > A

Each of these questions contain two statements, Assertion and Reason. Each of these questions also has four alternative choices, only one of which is the correct answer. You have to select one of the codes (a), (b), (c) and (d) given below.

(a) Assertion is correct, reason is correct; reason is a correct explanation for assertion.

(b) Assertion is correct, reason is correct; reason is not a correct explanation for assertion

(c) Assertion is correct, reason is incorrect

(d) Assertion is incorrect, reason is correct.

11.Assertion : Atoms can combine either by transfer of valence of electrons from one atom to another or by sharing of valence electrons.
Reason : Sharing and transfer of valence electrons is done by atoms to have an octet in their valence shell.

12. Assertion : The sum of q + w is a state function.
Reason : Work and heat are state functions.

13.Assertion (A): For any chemical reaction at a particular temperature the equilibrium constant is fixed and is a characteristic property.
Reason (R): Equilibrium constant is independent of temperature.

14. Assertion (A) : All the carbon atoms in $H_2C = C = CH_2$ are sp2 hybridised Reason
(R) : In this molecule all the carbon atoms are attached to each other by double bonds.

15.Assertion (A) : Toluene on Friedal Crafts methylation gives o– and p–xylene.
Reason (R) : CH_3-group bonded to benzene ring increases electron density at o– and p– position.

16.Assertion (A) : The compound cyclooctane has the following structural formula : It is cyclic and has conjugated 8π-electron system but it is not an aromatic compound.
Reason (R) : (4n + 2) π electrons rule does not hold good and ring is not planar.

SECTION B

This section contains 5 questions with internal choice in one question. The following questions are very short answer type and carry 2 marks each.

17. In the reaction, $A + B_2 \rightarrow AB_2$, identify the limiting reagent, if any, in the following mixtures
(i) 300 atoms of A + 200 molecules of B
(ii) 2 mol A + 3 mol B
(iii) 100 atoms of A + 100 molecules of B
(iv) 5 mol A + 2.5 mol B

OR

Determine the empirical formula of an oxide of Iron which has 69.9 % iron and 30.1 % dioxygen by mass.

18. Consider the following species:
N^{3-}, O^{2-}, F^-, Na^+, Mg^{2+}, Al^{3+}
(a) What is common in them?
(b) Arrange them in order of increasing ionic radii?

19.Account for the following:
(i) Water is a liquid while H_2S is a gas
(ii) NH_3 has higher boiling point than PH_3.

20.Predict in which of the following, entropy increases/decreases.
(i) A liquid crystallizes into a solid
(ii) Temperature of a crystallize solid is raised from OK to 115 K
(iii) $2NaHCO_3$ (s) ———-> Na_2 $C0_3$ (s) + $C0_2$ (g) + H_2O (g)
(iv) H_2(g)——>2H(g)

21.A reaction between ammonia and boron trifluoride is given below:

$NH_3 + BF_3 \rightarrow H_3N : BF_3$

Identify the acid and base in this reaction. What is the hybridisation of B and N in the reactants?

SECTION C

This section contains 7 questions with internal choice in one question. The following questions are short answer type and carry 3 marks each

22. State the following:
(i) Aufbau principle
(ii) Pauli exclusion principle.
(iii) Hund's rule of maximum multiplicity.

23. Among the second period elements, the actual ionization enthalpies are in the order:

Li <B< Be <C<0<KI<F< Ne

Explain why
(i) Be has higher $\Delta_iH_1$than B ?
(ii) O has lower Δ_iH_1 than N and F?

24..Calculate the mass percent of different elements present in sodium sulphate (Na_2 SO_4).

25.(i)Write any two differences between sigma and pi bond
(ii) What is the total number of sigma and pi bonds in the following molecules?
(a) C_2 H_2 (b) C_2 H_4

OR

Compare the relative stability of the following species and indicate their magnetic properties: O_2, O_2, O_2^- (Superoxide),O_2^{2-} (peroxide)

26. Balance the following redox reaction by ion-electron method.

(b) MnO_4^-(aq) + S02(g) ——-> Mn^{2+}(aq) +$H_2S0_4^-$(in acidic solution)

27.(i)What are electrophiles and nucleophiles?

(ii)Why does SO3 act as an electrophile?

28.Draw Newman and Sawhorse projections for the eclipsed and staggered conformations of ethane. Which of these conformations is more stable and why?

SECTION D

The following questions are case -based questions. Each question has an internal choice and carries 4 (1+1+2) marks each. Read the passage carefully and answer the questions that follow.

29.A mixture of reactants and products in the equilibrium state is called an equilibrium mixture. let us consider a general reversible reaction:

A + B ⇌ C + D

where A and B are the reactants, C and D are the products in the balanced chemical equation. On the basis of experimental studies of many reversible reactions, the Norwegian chemists Cato Maximillian Guldberg and Peter Waage pr oposed in 1864 that the concentrations in an equilibrium mixture are related by the following equilibrium equation,

$$K_c = \frac{[C][D]}{[A][B]}$$

where K_c is the *equilibrium constant*

(i) The equilibrium constant expression for a gas reaction is,

$$K_c = \frac{[NH_3]^4[O_2]^5}{[NO]^4[H_2O]^6}$$

Write the balanced chemical equation corresponding to this expression.

OR

Write the expression for the equilibrium constant for each of the following reactions

$2NO\,(g) + Br_2\,(g) \rightleftharpoons 2NOBr(g)$

(ii)For the following equilibrium, K =6.3 x 10^{14} at 1000 K. NO(g)+O_3 ——>NO_2(g) + O_2(g) Both the forward and reverse reactions in the equilibrium are elementary bimolecular reactions. What is K_c for the reverse reaction?

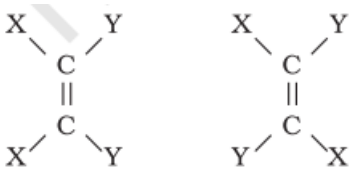
(iii)What is K_c for the following reaction in state of equilibrium?

$2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)$

Given: $[SO_2]$ = 0.6 M; $[O_2]$ = 0.82 M; and $[SO_3]$ = 1.90 M

30. Alkenes show both structural isomerism and geometrical isomerism. As in alkanes, ethene (C_2H_4) and propene (C_3H_6) can have only one structure but alkenes higher than propene have different structures

Doubly bonded carbon atoms have to satisfy the remaining two valences by joining with two atoms or groups. If the two atoms or groups attached to each carbon atom are different, they can be represented by YX C = C XY like structure. YX C = C XY can be represented in space in the



These are geometrical isomers (cis and trans)

Thus cis and trans isomers have the same structure but have different configuration (arrangement of atoms or groups in space). Due to different arrangement of atoms or groups in space, these isomers differ in their properties like melting point, boiling point, dipole moment, solubility etc.

(j) Draw the structural isomers of butene

(ii) Draw the geometrical isomers of but-2-ene.

OR

Which geometrical isomer of butene has higher dipole moment and why

(iii) Draw cis and trans isomers of the following compounds. Also write their IUPAC names

(a) CHCl = CHCl

(b) $C_2H_5CCH_3 = CCH_3C_2H_5$

SECTION E

The following questions are long answer type and carry 5 marks each

31. (a) State hess's law

(b) Calculate the standard enthalpy of formation of CH_3OH. from the following data:

(i) $CH_3OH(l) + 3/2\ 0_2\ (g) \longrightarrow CO_2\ (g) + 2H_20\ (l)$; $\Delta_rH^- = -726 kj\ mol^{-1}$

(ii) $C(s) + 0_2(g) \longrightarrow C0_2\ (g)$; $\Delta_cH^- = -393\ kj\ mol^{-1}$

(iii) $H_2(g) + 1/20_2(g) \longrightarrow H_20\ (l)$; $\Delta_fH^- = -286\ kj\ mol^{-1}$

(c)

The equilibrium constant for the reaction is 10. Calculate the value of $\Delta G^{\ominus}$; Given $R = 8.314\ JK^{-1}\ mol^{-1}$; $T = 300\ K$.

32.Attempt any 5 of the followings-

(i) Arrange the following carbocation in increasing order of their stability.

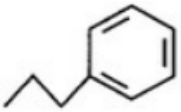
$(CH_3)_2\overset{\oplus}{C}H,\ CH_3\overset{+}{C}H_2,\ (CH_3)_3C^+,\ \overset{+}{C}H_3$

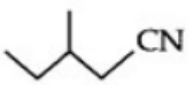
(ii) Write the IUPAC name of following compound.

(a) $CH_3-\underset{\displaystyle OH}{\underset{|}{CH}}-CH_2-OC_2H_5$

(iii) Draw the resonance structure of C_6H_5OH

(iv)give the IUPAC name of following

(a) 

(b) 

(v) Draw the structure of

2, 2, 4-Trimethylpentane, Hexanedial.

(vi) Explain why alkyl groups act as electron donors when attached to a π-system.

(vii) Name the intermediate formed after homolytic cleveage.

33.(i)What type of metals are used in photoelectric cells? Give one example.

(ii)Neon gas is generally used in sign boards. If it emits strongly at 616 nm, calculate :

(a) frequency of emission

(b) the distance travelled by this radiation in 30s

(c) energy of quantum

(d) number of quanta present if it produces 2 J of energy.

OR

(i)Write any two weaknesses or limitations of Bohr's model of atoms ? Briefly describe the quantum mechanical model of atom.

(ii)What are the two longest wavelength lines (in nanometers) in the Lyman series of hydrogen spectrum?

MARKING SCHEME

1. (c) 2
2. (b) Molality = moles of solute ÷ kilograms of solvent
3. **(b)**
4. **(b) F > O > Cl> N**
5. **sp^2 hybridized**
6. **(iii)**
7. **c**
8. **(c)**
9. **(ii)**
10. **(iv)**
11. (a)
12. (c)
13. (d)
14. (d)
15. (a**)**
16. (a)

17.(i)According to the given reaction, 1 atom of A reacts with 1 molecule of B. 200 molecules of B will react with 200 atoms of A and 100 atoms of A will be left unreacted. Hence, B is the limiting reagent while A is the excess reagent.

(ii) According to the given reaction, 1 mol of A reacts with 1 mol of B. 2 mol of A will react with 2 mol of B. Hence, A is the limiting reactant.

(iii) No limiting reagent.

(iv) 2.5 mol of B will react with 2.5 mol of A. Hence, B is the limiting reagent.

OR

Element	*Symbol*	*% by mass*	*Atomic mass*	*Moles of the element (Relative no. of moles)*	*Simplest molar ratio*	*Simplest whole number molar ratio*
Iron	Fe	69.9	55.85	$\frac{69.9}{55.85} = 1.25$	$\frac{1.25}{1.25} = 1$	2
Oxygen	O	30.1	16.00	$\frac{30.1}{16.00} = 1.88$	$\frac{1.88}{1.25} = 1.5$	3

∴ Empirical formula = $\mathbf{Fe_2O_3}$.

18.a) All of them are isoelectronic in nature and have 10 electrons each.

(b) In isoelectronic species, greater the nuclear charge, lesser will be the atomic or ionic radius.

$Al^{3+} < Mg^{2+} < Na^{+} < F^{-} < O^{2-} < N^{3-}$

19.(i) In case of water hydrogen bonding causes association of the H_2O molecules. There is no such hydrogen bonding in H_2S, that's why it is a gas.

(ii) There is hydrogen bonding in NH_3 but not in PH_3.

20.(i) After freezing, the molecules attain an ordered state and therefore, entropy decreases.

(ii) At 0 K the constituent particles are in static form therefore, entropy is minimum. If the

temperature is raised to 115 K particles begin to move and entropy increases.
(iii) Reactant, $NaHCO_3$ is solid. Thus, its entropy is less in comparison to product which has high entropy.
(iv) Here, one molecule gives two atoms. Thus, number of particles increases and this leads to more disordered form.
21. lewis acid-BF3
Lewis base- NH3
B- sp2 , n_sp3
22. correct statement(1+1+1)
23. (i) In case of Be ($1s^2\ 2s^2$) the outermost electron is present in 2s-orbital while in B ($1s^2\ 2s^2\ 2p^1$) it is present in 2p-orbital. Since 2s – electrons are more strongly attracted by the nucleus than 2p-electrons, therefore, lesser amount of energy is required to knock out a 2p-electron than a 2s – electron. Consequently, At of Be is higher than that Δ_iH_1 of B.
(ii) The electronic configuration of
$N_7 = 1s^2\ 2s^2\ 2p_x^1\ 2p_y^1\ 2p_z^1$
$O_8 = 1s^2\ 2s^2\ 2p_x^1\ 2p_y^1\ 2p_z^1$
We can see that in case of nitrogen 2p-orbitals are exactly half filled. Therefore, it is difficult to remove an electron from N than from O. As a result Δ_iH_1 of N is higher than that of O
24.

$$\text{Mass \% of an element} = \frac{\text{Mass of that element in the compound}}{\text{Molar mass of the compound}} \times 100$$

Now, Molar mass of Na_2SO_4 = 2 (23.0) + 32.0 + 4 × 16.0
= 142 g mol^{-1} ,

$$\text{Mass percent of sodium} = \frac{46}{142} \times 100$$
$$= 32.39\ \%$$

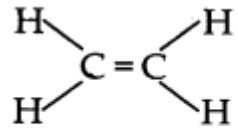
$$\text{Mass percent of sulphur} = \frac{32}{142} \times 100$$
$$= 22.54\ \%$$

$$\text{Mass percent of oxygen} = \frac{64}{142} \times 100$$
$$= 45.07\ \%$$

25.Answer: any two differences (1+2)

Sigma (σ) Bond	*pi (π) Bond*
(1) σ-bond is formed by the axial overlap of the atomic orbitals.	(1) π-bond is formed by the sidewise overlap of atomic orbitals.
(2) The bond is quite strong.	(2) Comparatively weak bond.
(3) Only one lobe of the p-orbitals is involved in the overlap.	(3) Both lobes of the p-orbitals are involved in the overlap.
(4) Electron cloud of the molecular orbital is symmetrical around the internuclear axis.	(4) The electron cloud is not symmetrical.

(ii)(a) H—C = C—H
Sigma bond = 3 Π bonds = 2

(b) 

Sigma bond = 5

π bonds = 1

OR .

Answer: O_2— Bond order = 2, paramagnetic (1/2 x4+1)

O_2^+— Bond order = 2.5, paramagnetic

O_2^-— Bond order = 1.5, paramagnetic

O_2^{2-} — Bond order = 1, diamagnetic

Order of relative stability is

$O_2^+ > O_2 > O_2^- > O_2^{2-}$

(2.5) (2.0) (1.5) (1.0)

26. The balanced half reaction equations are:

Oxidation half equation:

$S0_2(g) + 2H_2O(l) \longrightarrow HS0_4^-(aq) + 3H^+(aq) + 2e^-$ …(i)

Reduction half equation:

$MnO_4^-(aq) + 8H^+(aq) + 5e^- \longrightarrow Mn^{2+}(aq) + 4H_2O(l)$ ……..(ii)

Multiply Eq. (i) by 3 and Eq. (ii) by 2 and add, we have,

$2MnO_4^-(aq) + 5S0_2(g) + 2H_20(l) + H^+(aq) \longrightarrow 2Mn^{2+}(aq) + 5HSO_4^-(aq)$

27.(i)Electrophiles: The name electrophiles means electron loving. Electrophiles are electron deficient. They may be positive ions or neutral molecules.

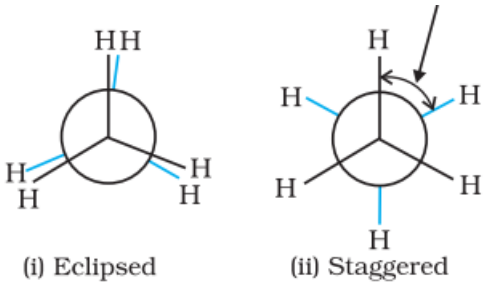
Ex: H^+, Cl^+,$AlCl_3$, BF_3

Nucleophiles: The name nucleophiles means 'nucleus loving' and indicates that it attacks the region of low electron density (positive centres) in a substrate molecule. They are electron rich they may be negative ions or neutral molecules.

Ex: Cl^- Br^-,NH_3, RNH_2, H_2O, ROH etc.

(ii)Three highly electronegative oxygen atoms are attached to sulphur atom. It makes sulphur atom electron deficient. Due to resonance also, sulphur acquires positive charge. Both these factors make SO3 an electrophile.

28. (1+1+1)



(i) Eclipsed (ii) Staggered

Staggered form is more stable than eclipsed

29. Answer: (1+1+2)

(i) Correct equation or expression

(ii)

For the reverse reaction $K_c = \frac{1}{K_c} = \frac{1}{6.3 \times 10^{14}} = \mathbf{1.59 \times 10^{-15}}$.

For the reverse reaction $K_c = \frac{1}{K_c} = \frac{1}{6.3 \times 10^{14}} = \mathbf{1.59 \times 10^{-15}}$.

$2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)$

$$K_c = \frac{[SO_3]^2}{[SO_2]^2[O_2]} = \frac{(1.9\ M) \times (1.9\ M)}{(0.6\ M) \times (0.6\ M) \times (0.82\ M)}$$

$= 12.229\ M^{-1} = \mathbf{12.229\ L\ mol^{-1}}$

30. (i)

$CH_2 = CH - CH_2 - CH_3$

But-1-ene

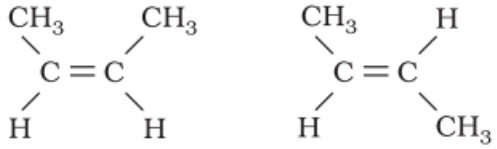
(C_4H_8)

$CH_3 - CH = CH - CH_3$

But-2-ene

(C_4H_8)

(ii)



cis-But-2-ene

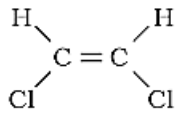
trans-But-2-ene

OR cis form

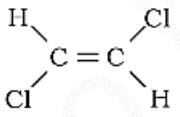
it is clear that in the trans-but-2-ene, the two methyl groups are in opposite directions, Threfore, dipole moments of C-CH3 bonds cancel, thus making the trans form non-polar

(iii)

(i)

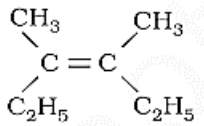


cis-1, 2-Dichloroethene

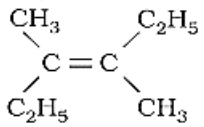


trans-1, 2-Dichloroethene

(ii)



cis-3, 4-Dimethylhex-3-ene



trans-3, 4-Dimethylhex -3-ene

31.(i)The metals with low ionisation enthalpies are used in photoelectric cells. Caesium (Cs), an alkali metal belonging to group 1 is the most commonly used metal.

(ii)

(a) Frequency of emission (ν) $= \frac{c}{\lambda} = \frac{(3.0 \times 10^8 \text{ m s}^{-1})}{(616 \times 10^{-9} \text{ m})} = \mathbf{4.87 \times 10^{14} \text{ s}^{-1}}$

(b) Velocity of radiation (c) $= 3.0 \times 10^8 \text{ m s}^{-1}$

Distance travelled in 30s $= (3.0 \times 10^8 \text{ m s}^{-1}) \times (30\text{s}) = \mathbf{9.0 \times 10^9 \text{ m}}$

(c) Energy of quanta (E) $= h\nu = \frac{hc}{\lambda} = \frac{(6.626 \times 10^{-34} \text{ Js}) \times (3 \times 10^8 \text{ m s}^{-1})}{(616 \times 10^{-9} \text{ m})}$

$= \mathbf{32.27 \times 10^{-20} \text{ J}}$

(d) Number of quanta present in 2 J of energy

$= \frac{\text{Total energy}}{\text{Energy per quanta}} = \frac{(2\text{J})}{(32.27 \times 10^{-20} \text{ J})} = \mathbf{6.2 \times 10^{18}}$

Or

Limitations of Bohr's model of an atom

- It could not explain spectrum of multi-electron atoms.
- It could not explain Zeeman and Stark effects.
- It could not explain shape of molecules.
- It was not in accordance with Heisenberg's uncertainty principle.

Quantum Mechanical Model: It was developed on the basis of Heisenberg's uncertainty principle and dual behaviour of matter.

Main features of this model are given below :

- The energy of electrons in an atom is quantized i.e. can only have certain values.
- The existence of quantized electronic energy levels is a direct result of the wave like properties of electrons.
- Both, the exact position and velocity of an electron in an atom cannot be determined simultaneously.
- The orbitals are filled in increasing order of energy. All the information about the electron in an atom is stored in orbital wave function Ψ.
- From the value of Ψ^2 at different points within atom, it is possible to predict the region around the nucleus where electron most probably will be found.

According to Rydberg-Balmer equation.

$$\frac{1}{\lambda} = R\left[\frac{1}{n_1^2} - \frac{1}{n_2^2}\right] = R\left[\frac{1}{1^2,} - \frac{1}{n_2^2}\right]$$

The wavelength (λ) will be the longest when n_2 is the smallest *i.e.*, $n_2 = 2$ and 3 for two longest wavelength lines.

For $n_2 = 2$: $\frac{1}{\lambda} = (1.097 \times 10^{-2} \text{ nm}^{-1}) \left[\frac{1}{1^2} - \frac{1}{2^2}\right]$

$= (1.097 \times 10^{-2} \text{ nm}^{-1}) \times \frac{3}{4} = 8.228 \times 10^{-3} \text{ nm}^{-1}$ or $\lambda = \mathbf{121.54 \text{ nm}}$

For $n_2 = 3$: $\frac{1}{\lambda} = (1.097 \times 10^{-2} \text{ nm}^{-1}) \left[\frac{1}{1^2} - \frac{1}{3^2}\right]$

$= (1.097 \times 10^{-2} \text{ nm}^{-1}) \times (8/9) = 9.75 \times 10^{-3} \text{ nm}^{-1}$; $\lambda = \mathbf{102.56 \text{ nm}}$

32.The change of enthalpy of a reaction remains same whether the reaction is carried out in one step or several steps.

$\Delta H = \Delta H1 + \Delta H2 + \Delta H3$……

(ii)The equation we aim at;

$C(s) + 2H_2(g) + l/20_2(g)$ ———> CH_3OH (l);$\Delta_f H^- = \pm?$ … (iv)

Multiply eqn. (iii) by 2 and add to eqn. (ii)

$C(s) + 2H_2(g) + 20_2(g)$ ————->$C0_2(g) + 2H_20(Z)$

$\Delta H = -(393 + 522) = -965$ kj moH Subtract eqn. (iv) from eqn. (i)

$CH_3OH(Z) + 3/20_2(g)$ ————> $C0_2(y) + 2H_20(Z)$; $\Delta H = -726$ kj mol^{-1}

Subtract: $C(s) + 2H_2(y) + l/20_2(g)$ ———-> $CH_3OH(Z)$; $\Delta_f He = -239$ kj mol^{-1}

(iii)

$\Delta G^{\ominus} = -RT \ln K = -2.303\ RT \log K.$

$R = 8.314\ JK^{-1}\ mol^{-1}$; $T = 300$ K; $K = 10$

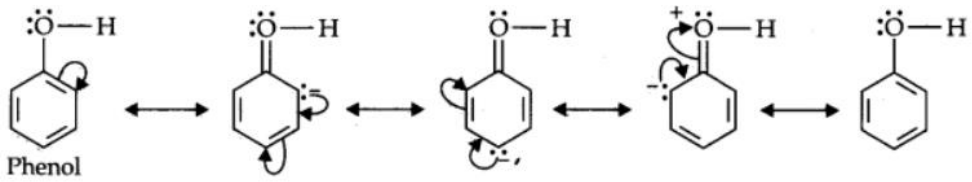
$\Delta G^{\ominus} = -2.303 \times 8.314\ JK^{-1}\ mol^{-1} \times (300\ K) \times \log 10$

$= -5527\ J\ mol^{-1} = \mathbf{-5.527\ kJ\ mol^{-1}}.$

33.

(*i*) $\overset{\oplus}{C}H_3 < CH_3\overset{\oplus}{C}H_2 < (CH_3)_2\overset{\oplus}{C}H < (CH_3)_3\overset{\oplus}{C}$

(*ii*) 1-Ethoxypropan-2-ol



Phenol

(iii)

(iv)(a) Propylbenzene (b) 3-Methylpentanenitrite

(v) correct structure

(vi) due to the hyperconjugation

(vii) homolytic cleveage

BLUE PRINT

Unit No.	Name of Unit	Sec-A		Sec- B	Sec- C	Sec- D	Sec- E	Total
		1 Mark		2 Marks	3 Marks	4 Marks	5 Marks	
		MCQ	A-R	VSA	SA	Case Based	LA	
I	Some Basic Concepts of Chemistry	2(1)		1 (2)	1 (3)			**7**
II	Structure of atom	1 (1)			1 (3)		1 (5)	**9**
III	Classification of Elements and Periodicity in Properties	1(1)		1 (2)	1 (3)			**6**
IV	Chemical Bonding and Molecular Structure	1 (1)	1 (1)	1 (2)	1 (3)			**7**
V	Chemical thermodyna mics	1 (1)	1 (1)	1 (2)			1 (5)	**9**
VI	Equlibrium		1(1)	1 (2)		1(4)		**7**
VII	Redox reactions	1 (1)			1 (3)			**4**
VIII	Organic Chemistry: Some basic Principles and Techniques	2 (1)	1 (1)		1 (3)		1 (5)	**11**
IX	Hydrocarbons	2 (1)	1 (1)		1 (3)	1(4)		**10**
	Total	**1(11)**	**1(5)**	**5(10)**	**7 (21)**	**2 (8)**	**3 (15)**	**33 (70)**

SET-9

SESSION ENDING EXAMINATION
CHEMISTRY THEORY (043)
SUBJECT – CHEMISTRY
CLASS - XI

MM : 70 MARKS **TIME : 3 HOURS**

General Instructions: Read the following instructions carefully.

a) There are 33 questions in this question paper with internal choice.
b) SECTION A consists of 16multiple-choice questions carrying 1 mark each.
c) SECTION B consists of 5 very short answer questions carrying 2 marks each.
d) SECTION C consists of 7 short answer questions carrying 3 marks each.
e) SECTION D consists of 2 case- based questions carrying 4 marks each.
f) SECTION E consists of 3 long answer questions carrying 5 marks each.
g) All questions are compulsory.
h) Use of log tables and calculators is not allowed

SECTION A

The following questions are multiple-choice questions with one correct answer. Each question carries 1 mark. There is no internal choice in this section.

1. The mass of one mole a chloride formed by metal 'X' is 111.0 g. Which one could be formula of chloride?
   (a) XCl (b) XCl_2 (c) XCl_3 (d) XCl_4
2. Which of the following represents largest number of particles.
   (a) Atoms in mole of CH_4 (b) Atoms in 0.5 mol of SO_3
   (c) Atoms in 0.5 mole of CO_2 (d) Atoms in 1 mol of CO
3. Magnetic moment 2.83 BM is given by which of the following ions? [At. No Ti = 22, Cr = 24, Mn = 25, Ni = 28]
   (a) Ti^{3+} (b) Ni^{2+} (c) Cr^{2+} (d) Mn^{2+}
4. In which of the following pairs, the ions are isoelectronic?
   (a) Na^+, Mg^{2+} (b) Al^{3+}, O^- (c) Na^+, O^- (d) N^{3-}, Cl^-
5. The order of screening effect of electrons of s, p, d and f orbitals of a given shell of an atom on its outer shell electrons is:
   (a) f > d > p > s (b) s > p > d > f (c) p < d < s > f (d) f > p > s > d
6. Z = 114 has been discovered recently. It will belong to which of the following family group and electronic configuration?
   (a) Carbon family [Rn] $5f^{14}\ 6d^{10}\ 7s^2\ 7p^2$ (b) Oxygen family [Rn] $5f^{4}\ 6d^{10}\ 7s^2\ 7p^4$
   (c) Nitrogen family [Rn] $5f^{14}\ 6d^{10}\ 7s^2\ 7p^5$ (d) Halogen family [Rn] $5f^{14}\ 6d^{10}\ 7s^2\ 7p^5$
7. Which of the following pair consist of only paramagnetic species?
   (a) O_2, NO (b) O_2^+, O_2^{2-} (c) CO, NO (d) O_2^{2-}, N^-
8. Predict the correct order (where bp is bonded paper and lp is lone pair of electrons)
   (a) bp – bp > lp – bp > lp – bp (b) lp – bp > bp – bp > lp – lp
   (c) lp – lp > lp – bp > bp – bp (d) lp – lp > bp – bp > lp – bp
9. The types of hybrid orbitals of nitrogen in NO_2^+, NO_3^- and NH_4^+ respectively are expected to be

(a) sp, sp^3 and sp^2 (b) sp, sp^2 and sp^3 (c) sp^2, sp and sp^3 (d) sp^2, sp^3 and sp

10. The correct thermodynamic conditions for the spontaneous reaction at all temperature is
    (a) $\Delta H < 0$ and $\Delta S > 0$ (b) $\Delta H < 0$ and $\Delta S < 0$
    (c) $\Delta H < 0$ and $\Delta S = 0$ (d) $\Delta H > 0$ and $\Delta S < 0$
11. Which of the following is an endothermic process?
    (a) $2H_2 + O_2 \rightarrow 2H_2O$; $\Delta H = -$ q kJ
    (b) $N_2 + O_2 \rightarrow 2NO - Y$ kJ
    (c) $CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$; $\Delta H = -$ X kJ mol^{-1}
    (d) $NaOH + HCl \rightarrow NaCl + H_2O +$ Z kJ
12. $2NO2(g) \leftrightharpoons N2O4(g) + 60.0$ kJ, the increase in temperature
    (a) favour the formation of N2O4 (b) favour the decomposition of N2O4
    (c) does not affect the equilibrium (d) stops the process

The following questions given below consist of an "Assertion" (A) and "Reason" (R) Type questions. Use the following Key to choose the appropriate answer.

(A)If both (A) and (R) are true, and (R) is the correct explanation of (A).

(B)If both (A) and (R) are true but (R) is not the correct explanation of (A).

(C)If (A) is true but (R) is false.

(D) If (A) is false but (R) is true.

13-**Assertion**-OH- is ortho and pera directive in electrophilic substitution reaction
Reason- OH- group show +R effect

14-**Assertion(A):**The number of significant figures in 507000 is three.
Reason(R): In 507000, all the zeros are significant.

15-Assertion(A) : Formation of Cl^- is exothermic whereas formation of O^{2-} is endothermic.
Reason (R) : EA_2 of oxygen is endothermic and greater than its exothermic value (EA_1) of oxygen.

16-Assertion(A) : The active mass of pure solid and pure liquid is taken unity.
Reason (R): The active mass of pure solids and liquids depends on density and molecular mass. The density and molecular mass of pure liquids and solids are constant.

SECTION B

This section contains 5-questions with internal choice in two questions. The following questions are very short answer type and carry 2 marks each.

17-Calculate the molarity of NaOH in the solution prepared by dissolving its 4 g in enough water to form 250 ml of the solution.

18-How do you account for the formation of ethane during chlorination of methane?

19-(i) State Hund's maximum multiplicity rule.
(ii) What is the lowest value of n that allows g-orbital to exist?
(OR)
Explain giving reason, which of the following sets of quantum numbers are not possible:

(*i*) $n = 1,\ l = 1,\ m_l = 0,\ m_s = +\frac{1}{2}$

(*ii*) $n = 0,\ l = 2,\ m_l = -2,\ m_s = -\frac{1}{2}$

20-An alkene 'A' contains three C – C, eight C – H σ bonds and one C – C π bond. 'A' on ozonolysis gives two moles of an aldehyde of molar mass 44 u. Write IUPAC name of 'A'.?

21-Fluorine reacts with ice and results in the change:

$H_2O(s) + F_2(g) \rightarrow HF(g) + HOF(g)$

Justify that this reaction is a redox reaction?

SECTION C

This section contains 7 questions with internal choice in two questions. The following questions are short answer type and carry 3 marks each.

22-(i) Give the number of electrons in the species H_2^+ and O_2^-.

(ii) Using s, p, d notations, describe the orbital with the quantum numbers:

(a) n = 3, l = 1, m = 0,(b) n = 1, l = 0

(OR)

(i) State Heisenberg's uncertainty principle.

(ii) An electron has a speed of 40 m s^{-1} accurate upto 99.99%. What is the uncertainty in locating its position? [Given, $m_e = 9.11 \times 10^{-31}$ kg]

23-Give a brief account for the following:

(i) Anions are bigger in size than their parent atom.

(ii) Oxygen has lesser first ionization enthalpy than nitrogen.

24-What are the necessary conditions for any system to be aromatic?

25-What is the hybrid state of

(i) B in BF_3,

(ii) S in SF_6,

(iii) P in PCl_5?

(OR)

Although geometries of NH_3 and H_2O molecules are distorted tetrahedral, bond angle in water is less than that of ammonia. Discuss.

26-Define the following:

(a) First law of thermodynamics.

(b) Standard enthalpy of formation.

(C) Second law of Thermodynamics

27 -Give condensed and bond line structural formulas and identify the functional group(s) present, if any, for :

(a) 2,2,4-Trimethylpentane

(b) 2-Hydroxy-1,2,3-propanetricarboxylic acid

(c) Hexanedial

28-Arrange the following set of compounds in order of their decreasing relative reactivity with an electrophile, E+

(a) Chlorobenzene, 2,4-dinitrochlorobenzene, p-nitrochlorobenzene

(b) Toluene, p-H3C – C6H4 – NO2, p-O2N – C6H4 NO2.

SECTION D

The following questions are case-based questions. Each question has an internal choice and carries 4 (1+1+2) marks each. Read the passage carefully and answer the questions that follow

29-A total of four quantum numbers are used to describe completely the movement and trajectories of each electron within an atom. The combination of all quantum numbers of all electrons in an atom is described by a wave function that complies with the Schrödinger equation. Each electron in an atom has a unique set of quantum numbers; according to the Pauli Exclusion Principle, no two electrons can share the same combination of four quantum numbers. Quantum numbers are important because they can be used to determine the electron configuration of an atom and the probable location of the atom's electrons. Quantum numbers are also used to understand other characteristics of atoms, such as ionization energy and the atomic radius. In atoms, there are a total of four quantum numbers: the principal quantum number (n), the orbital angular momentum quantum number (l), the magnetic quantum number (m_l), and the electron spin quantum number (m_s).

Answer the following questions:

(a) Give the sets of quantum numbers that describe an electron in a 3p orbital

(b) What is the value of azimuthal quantum number for d-subshell ?

(c) Which of the following orbitals are not possible? 2d, 4f, 4g and 6d

(OR)

Give the values of the quantum numbers for the electron with the highest energy in sodium atom.

30-The VSEPR Theory is able to predict geometry of a large number of molecules, especially the compounds of p-block elements accurately. It is also quite successful in determining the geometry quite-accurately even when the energy difference between possible structures is very small. Similar to electronic repulsion, orbitals containing electrons also experience electrostatic repulsion from one another. According to VSEPR theory "the orbital occupied by electron in the valence shell of the central atom should be arranged in space in a way that they lie as far away from one another as possible to provide maximum stability to the molecule. The repulsion between different types of electron pair is not the same in magnitude but it follows the following order – " lone-pair-lone pair > lone pair-bond pair > bond pair-bond pair"

Answer the following questions:

(a) State True or False. The shape a molecule occupies allows to minimize repulsions among them and maximize the space between them. a) True b) False

(b) The shape of H_2O according to VSEPR model is…….

(c) Give reason BeF_2 is linear while SF_2 is angular through both are triatomic.

(OR)

Decreasing order of bond angle among the following species is CH_4 >NH_3> H_2O. Explain.

SECTION E

The following questions are long answer type and carry 5 marks each. Two questions have an internal choice.

31-(i) What is the SI unit of mass? How is it defined? (1)

(ii) Round up the following upto three significant figures: (a) 34.216 (b) 10.4107 (2)

(iii)Calculate the molecular mass of the following : (a) H_2O (b) CO_2 (c) CH_4 (d) NH_3 (2)

(OR)

(i) How much copper can be obtained from 100g of copper sulphate ($CuSO_4$) ? (1)

(ii) Express the following in the scientific notation: (a) 0.0048 (b) 234,000 (2)

(iii)How are 0.50 mol Na_2CO_3 and 0.50 M Na_2CO_3 different? (2)

32-(i) In a process, 701 J of heat is absorbed by a system and 394 J of work is done by the system. What is the change in internal energy for the process? (2)

(ii) Given $N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$; $\Delta_r H = -92.4$ kJ mol^{-1}. The standard enthalpy of formation of NH_3 gas is? (2)

33-What are electrophiles and nucleophiles? Explain with examples.?(2)

Explain the terms Inductive and Electromeric effects.?(3)

MARKING SCHEME

1 : (b) XCl_2. $CaCl_2 = 40 + 71 = 111.0$ g mol^{-1}

2: (a) Atoms in mole of CH_4.

1 mole of $CH_4 = 5 \times 6.022 \times 10^{23}$,

0.5 mol of $SO_3 = 4 \times 0.5 \times 6.022 \times 10^{23}$,

0.5 mole of $CO_2 = 0.5 \times 3 \times 6.022 \times 10^{23}$,

1 mole of $CO = 2 \times 6.022 \times 10^{23}$

3: (b) Ni^{2+}

$4s^0 3d^8$ has 3 unpaired electron

$$\mu = \sqrt{n(n+2)} = \sqrt{3 \times 5}$$

= 2.83 BM.

4: (a) Na^+ and Mg^{2+} have 10 electrons and

5 : (b) $s > p > d > f$

6: (a) Carbon family [Rn] $5f^{14}\ 6d^{10}\ 7s^2\ 7p^2$

It belongs to Group 14 as it has four valence electrons

7 (a) O_2, NO

Both are paramagnetic due to presence of unpaired electrons.

8: (c) *lp* – *lp* > *lp* – *bp* > *bp* – *bp*

Lone pair have maximum repulsion with lone pair, followed by *lp* – *bp*, minimum *bp* – *bp*.

9: (b) *sp*, sp^2 and sp^3

10: (b) $\Delta H < 0$ and $\Delta S < 0$.

In exothermic process, if entropy increases, ΔG will be –ve at all temperatures and spontaneous at all temperatures.

11: (b) $N_2 + O_2 \rightarrow 2NO(g) - Y$ kJ.

It is an endothermic process as heat is being absorbed.

12: (b) favour the decomposition of N_2O_4.

It will favour backward reaction because process is exothermic

13: A

14. C

15 A

16. A

17

$$M = \frac{W_B}{M_B} \times \frac{1000}{\text{Volume of solution in ml}}$$

$$\Rightarrow M = \frac{4}{40} \times \frac{1000}{250} = \frac{16}{40} = 0.4 \text{ mol } L^{-1}$$

18 Chlorination of methane proceeds via a free radical chain mechanism. The whole reaction takes place in the given three steps.

Step 1: Initiation:

The reaction begins with the homolytic cleavage of Cl – Cl bond as:

Step 2: Propagation:

In the second step, chlorine free radicals attack methane molecules and break down the C–H bond to generate methyl radicals as:

These methyl radicals react with other chlorine free radicals to form methyl chloride along

with the liberation of a chlorine free radical.
Hence, methyl free radicals and chlorine free radicals set up a chain reaction. While HCl and CH3Cl are the major products formed, other higher halogenated compounds are also formed as:
Step 3: Termination:
Formation of ethane is a result of the termination of chain reactions taking place as a result of the consumption of reactants as:
Hence, by this process, ethane is obtained as a by-product of chlorination of methane.
19- (i) Hund's rule states that the pairing of electrons in the orbital belonging to the same sub-shell does not take place until each degenerate orbital has got one electron.
(ii) For g-orbital to exist minimum value of n is 5.
OR
(i) It is not possible because n =1 , l=1.□
(ii) It is also not possible because l cannot be greater than n
20-Answer:
As per the given information, 'A' on ozonolysis gives two moles of an aldehyde of molar mass 44 u. The formation of two moles of an aldehyde indicates the presence of identical structural units on both sides of the double bond containing carbon atoms. Hence, the structure of 'A' can be represented as:
XC = CX
There are eight C–H σ bonds. Hence, there are 8 hydrogen atoms in 'A'. Also, there are three C–C bonds. Hence, there are four carbon atoms present in the structure of 'A'.
Combining the inferences, the structure of 'A' can be represented as:
'A' has 3 C–C bonds, 8 C–H σ bonds, and one C–C π bond.
Hence, the IUPAC name of 'A' is But-2-ene.
Ozonolysis of 'A' takes place as:
The final product is ethanal with molecular mass44u
21-Answer:
Let us write the oxidation number of each atom involved in the given reaction above its symbol as:
Here, we have observed that the oxidation number of F increases from 0 in F2 to +1 in
HOF. Also, the oxidation number decreases from 0 in F2 to –1 in HF. Thus, in the above
reaction, F is both oxidized and reduced. Hence, the given reaction is a redox reaction.
22- (i) Number of electrons in H_2^+ = 1; O_2^- = 17
(ii) (a) $3p_y$; (b) 1s
(OR)

(i) Heisenberg's Uncertainty Principle states that it is impossible to determine simultaneously the exact position and exact momentum (or velocity) of an electron.

(ii)

According to Uncertainity principle

$$\Delta x.\, m\Delta v = \frac{h}{4\pi}$$

$\Delta v = 40$ m/s (Accurate upto 99.99%)

$$= \frac{100 - 99.99}{100} \times 40$$

$$= 0.004 \text{ m/s}$$

$m = 9.1 \times 10^{-31}$ kg

$$\Delta x = \frac{h}{4\pi.m\Delta v}$$

$$\Delta x = \frac{6.626 \times 10^{-34}}{4 \times 3.14 \times 9.1 \times 10^{-31} \times 0.004}$$

$\Delta x = 0.0144$ m

23- (i) Anions are always larger than their parent atoms because the addition of 1 or more electrons would result in increased repulsion among the electrons and a decrease in the effective nuclear charge.

(iii) Nitrogen has half-filled electronic configuration and hence its ionization energy is greater than oxygen. In oxygen after it loses its electron, it goes to half-filled electronic configuration and hence, it has less ionization energy than nitrogen.

24- compound is said to be aromatic if it satisfies the following three conditions:

(i) It should have a planar structure.

(ii) The π–electrons of the compound are completely delocalized in the ring.

(iii) The total number of π–electrons present in the ring should be equal to (4n + 2),

where n = 0, 1, 2 … etc. This is known as Huckel's rule.

25-

(i) B in BF_3---- sp^2

(ii) S in SF_6----- sp^3d^2

(iii) P in PCl_5------- sp^3d

(OR)

It is because repulsion in water is more due to two lone pairs of electrons whereas in NH3, there is less repulsion due to one lone pair and lone pair (lp) – lone pair (lp) repulsion > lone pair (lp) – bond pair (bp) repulsion.

26-. (a) First Law of Thermodynamics. It states that energy can neither be created nor be destroyed. It can change from one form to another. The total energy of universe remains constant.

(b) Standard Enthalpy of Formation. It is defined as enthalpy change when 1 mole of compound is formed from its constituting elements.

27-(a) 2, 2, 4–trimethylpentane

Condensed formula:

$(CH_3)_2CHCH_2C(CH_3)_3$

Bond line formula:

(b) 2–hydroxy–1, 2, 3–propanetricarboxylic acid

Condensed Formula:

$(COOH)CH_2C(OH)\ (COOH)CH_2$

(COOH)

Bond line formula:

The functional groups present in the given compound are carboxylic acid (–COOH) and alcoholic (–OH) groups.

(c) Hexanedial

Condensed Formula:

$(CHO)\ (CH_2)_4(CHO)$

Bond line Formula:

The functional group present in the given compound is aldehyde (–CHO).

28-Answer:

Electrophiles are reagents that participate in a reaction by accepting an electron pair in order to bond to nucleophiles.

The higher the electron density on a benzene ring, the more reactive is the compound towards an electrophile, E^+ (Electrophilic reaction).

(a) The presence of an electron withdrawing group (i.e., NO_2^- and Cl^-) deactivates the aromatic ring by decreasing the electron density.

Since NO_2^-group is more electron withdrawing (due to resonance effect) than the Cl– group (due to inductive effect), the decreasing order of reactivity is as follows: Chlorobenzene > p – nitrochlorobenzene > 2, 4–dinitrochlorobenzene

(b) While CH_3– is an electron donating group, NO_2^- group is electron withdrawing. Hence, toluene will have the maximum electron density and is most easily attacked by E^+. NO_2^- is an electron withdrawing group. Hence, when the number of NO2– substituents is greater, the order is as follows:

Toluene > p–CH_3–C_6H_4–NO_2

, p –O_2 N–C_6H_4–NO_2

29-. a. True

b. According to VSEPR theory, the water molecule arrives at a bent or a V-shape due to the presence of lone pair-lone pair, lone pair-bond pair and bond pair-bond pair repulsions.

c. Be atom(the central atom) in BeF_2 molecule has two bond pairs of electrons and no lone pair of electrons with it. So, BeF_2 molecule is linear with F-Be- F bond angle of 180°. The S atom (the central atom)in SF_2 molecule has two lone pairs and two bond pairs of electrons with it.

30. Bond angle of CH4 = 109°28'. Bond angle of NH3 < 109°28' (Due to 1 lone pair repulsion). Bond angle of H2O << 109°28' (Very less because of 2 lone pair repulsion). ∴ CH4 > NH3 >H2O.

31-(i) The SI unit of mass is kilogram (kg). 1 Kilogram is defined as the mass equal to the mass of the international prototype of kilogram.

(ii) (a) 34.2 (b) 10.4

(iii) (a) 18 (b) 44 (c) 16 (d) 17

(OR)

(I)

$CuSO_4$	Cu
(63.5 + 32 + 64)g	63.5 g
159.5 g	

$$\text{Mass of copper obtained} = \frac{63.5\text{g}}{159.5\text{g}} \times 100\text{ g} = 39.8\text{ g}$$

(II) (a) $0.0048 = 4.8 \times 10^{-3}$ (b) $234,000 = 2.34 \times 10^{5}$

(III)

$$\text{Molar mass of } Na_2CO_3 = (2 \times 23) + 12.00 + (3 \times 16) = 106\text{ g mol}^{-1}$$

$$\text{Now, 1 mole of } Na_2CO_3 = 2 \times 23 + 12 + 3 \times 16 = 106\text{g}$$

$$0.5\text{ mol of } Na_2CO_3 = \frac{106\text{g}}{1\text{ mole}} \times 0.5\text{ mol } Na_2CO_3 = 53\text{ g } Na_2CO_3$$

$$\therefore\ 0.50\text{ M of } Na_2CO_3 = 0.50\text{ mol/L } Na_2CO_3$$

Hence, 0.50 mol of Na_2CO_3 is present in 1 L of solution or 53 g of Na_2CO_3 is present in 1 L of solution.

32 (i) According to the first law of thermodynamics, $\Delta U = q + W$ ..... (i)

Where, ΔU = change in internal energy for a process, q = heat, W = work

Given, q = + 701 J (Since heat is absorbed)

W = –394 J (Since work is done by the system)

Substituting the values in expression (i), we get

$\Delta U = 701\text{ J} + (-394\text{ J})$

$\Delta U = 307\text{ J}$

Hence, the change in internal energy for the given process is 307 J.

(ii)

Standard enthalpy of formation of a compound is the change in enthalpy that takes place during the formation of 1 mole of a substance in its standard form from its constituent elements in their standard state.

Re-writing the given equation for 1 mole of $NH_3(g)$,

$$\frac{1}{2}N_2(g) + \frac{3}{2}H_2(g) \rightarrow NH_3(g)$$

$$\therefore\ \text{Standard enthalpy of formation of } NH_3(g) = \frac{1}{2}\Delta_r H^{\ominus} = \frac{1}{2}(-92.4\text{ kJ mol}^{-1}) = -46.2\text{ kJ mol}^{-1}.$$

(iii) $\Delta S > 0$

33-a. (i) An electrophile is a reagent that takes away an electron pair. In other words, an electron-seeking reagent is called an electrophile (E+). Electrophiles are electron-deficient and can receive an electron pair. Carbocation and neutral molecules having functional groups such as carbonyl group (>C=O) are examples of electrophiles.

A nulceophile is a reagent that brings an electron pair. In other words, a nucleus-seeking reagent is called a nulceophile (Nu:).

For example: OH–, NC–, carbanions (R_3C–), etc.

Neutral molecules such as $H_2Ö$ and ammonia also act as nulceophiles because of the presence of a lone pair.

33(b) Inductive effect

The permanent displacement of sigma (σ) electrons along a saturated chain, whenever an electron withdrawing or electron donating group is present, is called inductive effect. Inductive effect could be + I effect or – I effect. When an atom or group attracts electrons towards itself more strongly

than hydrogen, it is said to possess – I effect. For example, When an atom or group attracts electrons towards itself less strongly than hydrogen, it is said to possess + I effect. For example,

Electrometric effect

It involves the complete transfer of the shared pair of π electrons to either of the two atoms linked by multiple bonds in the presence of an attacking agent. For example, Electrometric effect could be + E effect or – E effect. + E effect: When the electrons are transferred towards the attacking reagent

CLASS XI (2023-24)
CHEMISTRY

Unit No.	Name of Unit	Sec-A		Sect- B	Sec- C	Sect- D	Sect- E	Total
		1 M		2 M	3 M	4 M	5 M	
		MCQ	A-R	VSA	SA	Case Based	LA	
1.	**Some Basic Concepts of Chemistry**	1 (1)	1 (1)	1 (2)	1 (3)			**4 (7)**
2.	**Structure of Atom**	2 (2)		1 (2)			**1 (5)**	**4 (9)**
3.	**Classification of Elements and Periodicity in Properties**	2 (2)	1 (1)		**1 (3)**			**4 (6)**
4.	**Chemical Bonding and Molecular Structure**	1 (1)	1 (1)				**1 (5)**	**3 (7)**
5.	**Chemical Thermodynamics**	2 (2)			1 (3)	**1(4)**		**4 (9)**
6.	**Equilibrium**	2 (2)		1 (2)	1 (3)			**4 (7)**
7.	**Redox Reactions**	1 (1)	1(1)	**1 (2)**				**3 (4)**
8.	**Organic Chemistry: Some basic Principles and Techniques**				2 (6)		**1 (5)**	**3 (11)**
9.	**Hydrocarbons**	1 (1)		1 (2)	1 (3)	**1(4)**		**4 (10)**
	Total No. of questions	**12 (12)**	**4 (4)**	**5 (10)**	**7 (3)**	**2 (4)**	**3 (5)**	**33 (70)**

SET-10

SESSION ENDING EXAMINATION
CHEMISTRY THEORY (043)
SUBJECT – CHEMISTRY
CLASS - XI

MM : 70 MARKS **TIME : 3 HOURS**

General Instructions:

Read the following instructions carefully.

(a) There are **33** questions in this question paper with internal choice.
(b) SECTION A consists of 12 multiple -choice questions and 4 assertion and reasoning carrying 1 mark each.
(c) SECTION B consists of 5 short answer questions carrying 2 marks each.
(d) SECTION C consists of 7 short answer questions carrying 3 marks each.
(e) SECTION D consists of 2 case - based questions carrying 4 marks each.
(f) SECTION E consists of 3 long answer questions carrying 5 marks each.

SECTION A

Multiple-choice questions with one correct answer. Each question carries 1 mark.

1) What is the mass percent of carbon in C_2H_4
(a) 34% (b) 85.7% (c)3.4% (d)28.%

2) The spectral line in hydrogen spectrum obtained when the electron jumps from n=6 to n=1 energy level belongs to
(a) Pfund series (b) balmer series (c) Paschen (c) Lyman series

3) Which of the pair is isoelectronic F^-, Ne, Na^+
(a) F^-, Na^+ (b) Ne, Na (c) F, Ne, (d) F^-,Na

4) The structure of PCl_5 is
(a) pentagonal bipyramidal (b) square pyramidal
(c) Trigonal bipyramidal (d) octahedral

5) The pH of a 10^{-11} M NaOH solution is nearest to
(a) 10 (b) 7 (c) 4 (d) 11

6) The oxidation no of Mn in $KMnO_4$ is
(a) -6 (b) +6 (c) +7 (d) -2

7) The displacement of electron in a multiple bond in presence of attacking reagent is called;
(a) inductive effect (b) electromeric effect
(c) Resonance (d) hyperconjugation

8) Types of hybridization in CH2=CH2
(a) sp3 , sp3 (b) sp2, sp2 (c) sp3, sp2 (d) sp3, sp

9) Which of the following compounds will exhibit cis-trans isomerism
(a) butanol (b) 2-butyne (c) 2-butanol (d) 2-butene

10) Benzene reacts with CH_3Cl in the presence of anhydrous $AlCl_3$ to form
(a) chlorobenzene (b) benzyl chloride (c) xylene (d) toluene

11) Number of mole in 27g of H_2O
(a)1mole (b) 1.5 mole (c) 2.5 mole (d) 01.5 mole

12) The atomic orbital is-

(a) The circular path of electron (b) Elliptical shaped orbit

(c) Three dimensional field around nucleus

(d) The region in which there is maximum probability of finding an electron

Assertion and Reasons

Given below are two statements labelled as Assertion (A) and Reason (R

a. Both A and R are true and R is the correct explanation of A

b. Both A and R are true but R is not the correct explanation of A.

c. A is true but R is false.

d. A is false but R is true

13 **Assertion (A):** Decrease in free energy causes spontaneous reaction

Reason(R): Spontaneous reactions are invariably exothermic reactions

14) Assertion: BF_3 molecule has zero dipole moment

Reason: F is electronegative and B-F bonds are polar in nature

15) **Assertion**: Alkyl group act as electron donors when attached to a pi–system.

Reason: it is due to hyperconjugation.

16) **Assertion:** Even though there are infinite numbers of conformations of ethane, staggered conformation is most stable.

Reason: The staggered conformation has the least torsional strain.

SECTION-B

This section contains 5 questions with internal choice in two questions. The following questions are very short answer type and carry 2 marks each.

17) What is the percentage composition of carbon, hydrogen and oxygen in ethanol?

18) What is n+l rule? Arrange the following orbitals in the increasing order of energy.

(a) 4*s*, 3*s*, 3*p*, 4*d*

(b) 5*p*, 4*d*, 5*d*, 4*f*, 6*s*

OR

The electronic configuration of valence shell of Cu is $3d^{10}4s^1$ and not $3d^9 4s^2$.

How is this configuration explained? Write electronic configuration of Cu^+.

19) Among the elements B, Al, C and Si,

(i) which element has the highest first ionisation enthalpy?

(ii) which element has the most metallic character?

OR

. Explain the following:

(i) Electronegativity of elements increases on moving from left to right in the periodic table.

(ii) Ionisation enthalpy decreases in a group from top to bottom?

20) Which one of NH_3 and NF_3 has higher dipole moment and why?

21) Write the conjugate acids for the following bronsted bases:

NH_2^- , NH_3 , $HCOO^-$, OH^-

SECTION-C

This section contains 7 questions with internal choice in one question. The following questions are short answer type and carry 3 marks each.

22) Dinitrogen and dihydrogen react with each other to produce ammonia according to the following chemical equation:

$$N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$$

(i) Calculate the mass of ammonia produced if 2.00×10^3 g dinitrogen reacts with 1.00×10^3 g of dihydrogen.

(ii) Will any of the two reactants remain unreacted?

(iii) If yes, which one and what would be its mass?

23) How would you explain the fact that first conization enthalpy of sodium is lower than Mg but its second ionization enthalpy is higher than that of Mg?

24) Explain why Pcl_5 is trigonal bipyramidal whereas IF_5 is square pyramidal?

25) (a) What is Lassaigne's extract? Will NaCN give a positive Lassaigne's test for nitrogen?

(b) Which colour will appear in the Lassaigne's test if the compound contains both nitrogen and sulphur.

(c) Why is Lassaigne's extract prepared in distilled water? Can we detect oxygen in a compound by Lassaigne's test?

26) What is aromatization? How will you convert ^hexane into benzene?

OR

How will you convert benzene into

(i) P- nitrobromobenzene

(ii) P- nitrotoluene

(iii) acetophenone

27) Calculate the number of kJ of heat necessary to raise the temperature of 60 g of aluminium from 35°C to 55°C. Molar heat capacity of Al is 24 J mol^{-1} K^{-1}.

28) Write short notes on :

(a)Electrochemical series

(b) redox reactions

(c) oxidizing agents

SECTION-D

Case study based questions (4 marks)

The following questions are case-based questions. Each question has an internal choice and carries 4 (1+1+1+1) marks each. Read the passage carefully and answer the questions.

29) The rotation of carbon-carbon single bond (**sigma** -bond), due to cylindrical symmetry of s-MOs (molecular orbitals) long internuclear axis, in alkanes results into different spatial arrangements of atoms in space, that are interconvertible. These arrangements are called conformations. However, weak repulsive interaction are present between the adjacent bonds in alkanes so the rotation of C—C single bond is not completely free and is hindered by a small energy barriers of 1-20 kJ mol^{-1}. The repulsive interaction between the adjacent bond is due to electron cloud. The two types of conformations are very common, i.e., staggered and eclipsed. The conformation in which the hydrogen atoms attached to the two carbon atoms are as far apart as possible is called the staggered conformation. The conformations in which the hydrogen atoms attached to the two carbon atoms are as closed as possible is called eclipsed conformation. Any intermediate conformation between the above two is called skew or gauche conformation.

(i) The electronic distribution of the sigma molecular orbital is symmetrical around the internuclear axis of C-C bond which permits free rotation around C-C bond. Such spatial arrangements of atoms in which conversion of one another takes place by rotation around C-C bond is known as

(a) rotamers (b) conformers (c) conformations (d) All of these

(ii) The possible rotamers of ethane is/are

(a) 2 (b) 3 (c) 4 (d) ∞

(iii) Why do different conformations of ethane cannot be separated and isolated ?

(iv) Define torsional strain.

30) Read the following passage and answer questions from 41 to 45

Equilibrium Involving Dissolution of Gases in Liquids- When a soda water bottle is opened, some of The carbon dioxide gas dissolved in it fizzes Out rapidly. The phenomenon arises due to difference in solubility of carbon dioxide at different pressures. There is equilibrium between the molecules in the gaseous state and the molecules dissolved in the liquid under pressure i.e., CO_2 (gas) CO_2 (in solution).This equilibrium is governed by Henry's law, which states that the mass of a gas dissolved in a given mass of a solvent at any temperature is proportional to the pressure of the gas above the solvent. This amount decreases with increase of temperature. The soda water bottle is sealed under pressure of gas when its solubility in water is high. As soon as the bottle is opened, some of the dissolved carbon dioxide gas escapes to reach a new equilibrium condition required for the lower pressure, namely its partial pressure in the atmosphere. This is how the soda water in bottle when left open to the air for some time, turns 'flat'. It can be generalized that: For solid liquid equilibrium, there is only one temperature (melting point) at 1 atm (1.013 bar) at which the two phases can coexist. If there is no exchange of heat with the surroundings, the mass of the two phases remains constant. For liquid vapour equilibrium, the vapour pressure is constant at a given temperature. For dissolution of solids in liquids, the solubility is constant at a given temperature. For dissolution of gases in liquids, the Concentration of a gas in liquid is Proportional to the pressure (concentration) of the gas over the liquid.

(i). …. states that the mass of a gas dissolved in a given mass of a solvent at any temperature is proportional to the pressure of the gas above the solvent.

a) Henry's Law b) Charles's law

c) Boyle's law d) Arrhenius law

(ii). Equilibrium is possible only in a ……at a given temperature.

a) open system b) isolated system c) closed system d) None of above

(iii). The value of R= …….

a) 0138 bar litre/mol K b) 0381 bar litre/mol K

c) 0318 bar litre/mol K d) 0831 bar litre/mol K

(iv). The equilibrium involving ions in aqueous solutions which is called as …

a) static equilibrium b) dynamic equilibrium

c) physical equilibrium d) ionic equilibrium

Section-E

The following questions are long answer type and carry 5 marks each. Two questions have an internal choice.

31.(a) Calculate the wave number of line associated with the transition in Balmer series when the electron moves to $n = 4$ orbit. (RH = 109677 cm–1)

(b) Wavelengths of different radiations are given below :

(a) 300 nm (b) 300 mm (c) 3 nm (d) 30 A^0

Arrange these radiations in the increasing order of their energies

OR

(I) State Heisenberg's uncertainty principle. Write its mathematical expression.

(II) Draw the boundary surface diagram of dx^2-y^2, dz^2 orbital

(III) How many sub-shells are associated with n=4? How many electrons will be present in the sub-shell having m=-1/2, n=4

32.Define the following terms.

i) Reversible reaction

ii) Hess's law of constant heat summation

iii) Gibbs energy

iv) Exothermic reaction

v) Adiabatic process

. **OR**

(a) Define entropy. Predict if entropy increases/decreases when $H_2 \rightarrow 2H(g)$

(b) State second law of thermodynamics.

(c) The equilibrium constant for a reaction is 10. What will be the value of ΔG°?

R=8.314 JK^{-1} mol^{-1}, T= 300 K, log 10=1

33**.** (a) Explain the reason for the fusion of organic compound with Na metal for the detection of elements.

(b) In sulphur estimation, 0·157 g of an organic compound gave 0·4813 g of $BaSO_4$. What is the % of Sulphur in the given oragnic compund ? (At mass of Ba = 137, S = 32, O = 16)

MARKING SCHEME

Q.No.	ANSWER	MARKS
1.	(b) 85.7%	1
2.	(d) Lyman series	1
3.	(a) F^-, Na^+	1
4.	(c) Trigonal bipyramidal	1
5	(d) 11	1
6.	(c) +7	1
7.	(b) electromeric effect	1
8.	(b) sp2, sp2	1
9	(d) 2-butene	1
10.	(d) toluene	1
11.	(b) 1.5 mole	1
12.	(d) the region in which there is maximum probability of	1
13.	(c) Both Assertion and Reason are the true but reason is not correct explanation of assertion	1
14.	**(**b) both assertion and reason are correct but reason is not correct explanation of assertion	1
15.	(a) assertion and reason both correct , reason is correct	1
16.	(a) assertion and reason both coreect, reason is correct Explation of assertion	1

17.. **Ans.** Molecular formula of ethanol is : C_2H_5OH 2

Molar mass of ethanol is : (2x12.01 + 6 x1.008 + 16.00) g = 46.068 g

Mass per cent of carbon = (24.02g / 46.068g) ×100 = 52.14%

Mass per cent of hydrogen = (6.048g / 46.068g) ×100 = 13.13%

Mass per cent of oxygen = (16.00 g / 46.068g) ×100 = 34.73%

18. What is n+l rule? Arrange the following orbitals in the increasing order of energy. 1+1

(a) 3*s*, 3*p*, 4*s*, 4*d*

(b) 4*d*, 5*p*, 6s, 4*f*, 5*d*,

19. Among the elements, B, Al, C and Si

(i) The element that has the highest first ionisation enthalpy is C.

(ii) The element that has the most metallic character is Al. 1+1

OR

(i) Due to the general decrease in atom size and increase in nuclear charge, the electronegative of elements increases as one moves from left to right in the periodic table.

(ii)The ionisation enthalpy of a group decreases from top to bottom due to the increase in atomic size caused by the addition of a new shell. 1+1

20. F is more electronegative than H and N-F bond is more polar than N-H Bond, Hence, NF_3 has more dipole moment. 1½+½

21. NH_3, NH_4^+, HCOOH, H_2O ½+½+½+½

22. Balancing the given chemical equation,

$$N_2 + 3\,H_2 \rightarrow 2NH_3$$

From the equation, 1 mole (28 g) of dinitrogen reacts with 3 mole (6 g) of dihydrogen to give 2 mole (34 g) of ammonia.

$\Rightarrow 2.00 \times 10^3$ g of dinitrogen will react with (6 g x 2.00 x 10^3)/28 Dihydrogen i.e., 2.00×10^3 g of dinitrogen will react with 428.6 g of dihydrogen.

Given, Amount of dihydrogen = 1.00×10^3 g

Hence, N_2 is the limiting reagent.

28 g of N_2 produces 34 g of NH_3

Hence, mass of ammonia produced by 2000 g of N_2 = (34g x 2000)/ 28 g

= 2428.57 g

(ii) N_2 is the limiting reagent and H_2 is the excess reagent. Hence, H_2 will remain unreacted.

(iii) Moles of H_2 initially taken = 500ml

Moles of H_2 reacted = 214.29

Moles of H_2 unreacted = 500 – 214.29 = 285.71 mol

Mass of dihydrogen left unreacted = 285.71 x 2 = 571.4 g 1+1+1

23. By losing one valence electron , sodium attains stable configuration. Therefore, 1st I.E. of Na is less than Mg.To remove an electron from noble gas configuration, high energy is required.Therefore 2nd ionization enthalpy is higher than Mg 3

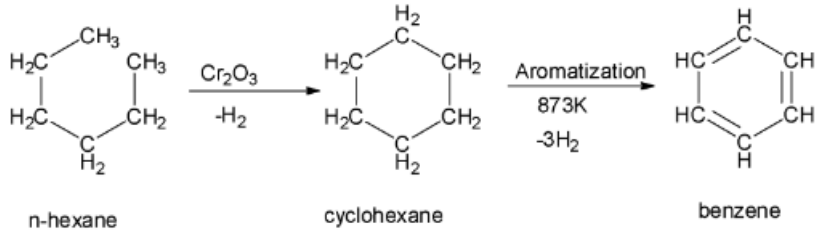
24. Presence of lone pair of electrons on iodine, which is oriented so as to minimise repulsion While in PCl_5 has no non bonding pair. 3

25. **:** (a) When organic compound is fused with sodium metal and then extracted by water, it is called Lassaigne's extract. Yes.

(b) Blood red colour.

(c) Lassaigne's extract is prepared in distilled water since tap water contains CL ions. No, oxygen cannot be detected by Lassaigne's test. 1+1+1

26. Aromatization. It is the process that involves cyclization, isomerization, and dehydrogenation with the application of heat and catalyst to convert alkanes containing six or more carbon atoms into aromatic hydrocarbons.

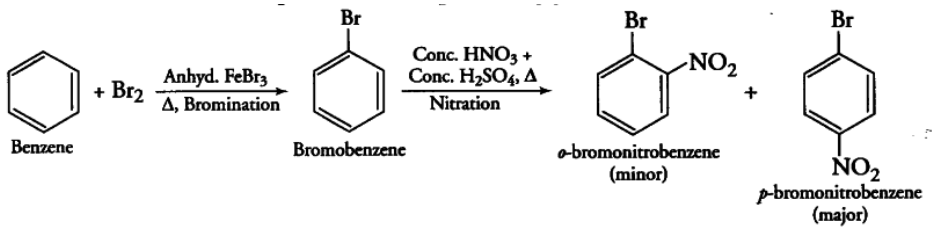


n-hexane cyclohexane benzene

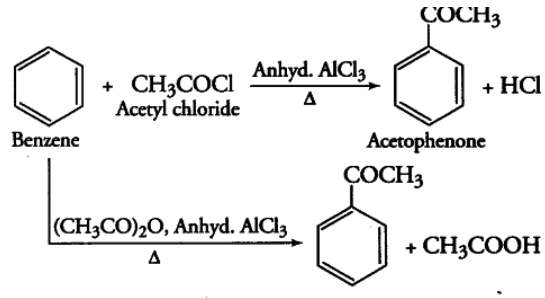
1+1+1

OR

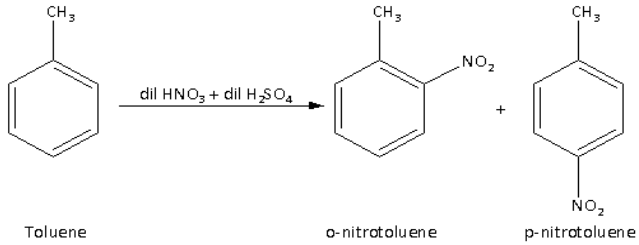
i. 1+1+1



ii.



iii.



27) No. of moles of Al (m) = (60g)/ (27 g mol-1) = 2.22 mol

Molar heat capacity (C) = 24 J mol-1 K-1.

Rise in temperature (ΔT) = 55 – 35 = 20°C or 20 K

Heat evolved (q) = C x m x T = (24 J mol-1 K-1) x (2.22 mol) x (20 K)

= 1065.6 J = 1.067 kJ 1+1+1

28) (a) Electrochemical series :- arrangement of metals(non-metals also)in increasing order of their reducing power or vice versa.

(b) Reactions in which both Oxidation and reduction take place simultaneously are redox reactions.

(c)oxidizing agents : chemical specie which can oxidize the other one or canreduce itself. 1+1+1

29. i) d 1

ii) d 1

iii) Because of small energy barrier 1

(iv) The repulsive interaction between the electron clouds, which affects stability of a conformation is termed as torsional strain. 1

30. i) a 1

ii) c 1

iii)d 1

iv) d 1

31(a)

$$\bar{\nu} = 109677 \ \frac{1}{n_i^2} - \frac{1}{n_f^2} \ \text{cm}^{-1}$$

For $n_i = 2$ to $n_f = 4$ transition in Balmer series.

$$\bar{\nu} = 109677 \ \frac{1}{2^2} - \frac{1}{4^2} \ \text{cm}^{-1}$$

$$= 109677 \ \frac{1}{4} - \frac{1}{16} \ \text{cm}^{-1} = 20564.44 \ \text{cm}^{-1}$$

3

(b) B < A < C = D

$E = h C/\lambda$ 2

OR

i) principle + expression 2+2+½+½

ii) diagram

iii) 4 subshells, 16 electrons

32**.** i) **Reversible process** is a process which is carried out infinitesimally slowly so that all changes occurring in the direct process can be exactly reversed and the system remains almost in a state of equilibrium with the surrounding at every stage of the process.

ii) **Hess's law of constant heat summation**- The total amount of heat evolved or absorbed in a reaction is the same whether the reaction takes place in one step or in a number of steps. In other words, the total amount of heat change in a reaction depends only upon the nature of the initial reactants and the nature of the final products and its independence of the path or the manner by which change is brought about.

iii) **Gibbs energy-** This is another thermodynamic quantity that helps in predicting the spontaneity of a process.

OR

Gibb's free energy is that case built questions thermodynamic quantity of a system the decrease in whose value during a process is equal to the maximum possible useful work that can be obtained from the system.

iv) These are the reactions which are accompanied by the evolution of heat.

v) **Adiabatic process:** when a process is carried out in such a manner that no heat can flow from the system to the surroundings or vice versa i.e., the system is completely insulated from the surroundings, it is called an adiabatic process. 1+1+1+1+1

OR

(a) entropy is measure of randomness.

Entropy increases 1+1

(b)statement 1

(c) $\Delta G^0 = -2.303RT\log Kc$ 2

$= -2.303 \times 8.31 \times 300 \times \log 10$

$= -5744.14 J/mol$

33(a) Before proceeding for testing of N, S, P and halogens in the given oragnic compund, the organic compund is fused with metallic sodium. These elements are present in the organic compoun by forming covalent bond like N in urea [NH_2— CO—NH_2] or sulphur in thiourea [NH_2CSNH_2]. By fusing the organic compund with sodium, these elements are converted into NaCN or Na_2S or NaX that is, ionic compound which can be easiy detected by ionic reaction.

(b) Here, mass of substance taken = 0·157 g

Mass of $BaSO_4$ precipitate = 0·4813 g

Now, 1 mole of $BaSO_4$ = 1g atom of sulphur

Now 233 (137 + 32 + 64) of $BaSO_4$ = 32 g of S

i.e., 233 g of $BaSO_4$ contain sulphur = 32 g

$\therefore$ 0·4813 g of $baSO_4$ will contain sulphur

$$= \frac{32}{233} \times 0{\cdot}4813 \text{ g}$$

$\therefore$ % age of sulphur in the compund

$$= \frac{32}{233} \times 0{\cdot}4813 \times \frac{100}{0{\cdot}157}$$

$$= 42{\cdot}10\%$$

BLUE PRINT

CHAPTER	MCQ (1)	A/R (1)	VSA (2)	SA (3)	Case Study (4)	LA (5)	Weightage
Some Basic Concepts Of Chemistry	2(1)		1(2)	1(3)			7
Structure Of Atom	2(1)		1(2)			1(5)	9
Classification Of Elements And Periodicity In Properties	1(1)		1(2)	1(3)			6
Chemical Bonding And Molecular Structure	1(1)	1(1)	1(2)	1(3)			7
Thermodynamics		1(1)		1(3)		1(5)	9
Equilibrium	1(1)		1(2)		1(4)		7
Redox Reactions	1(1)			1(3)			4
Organic Chemistry-Some Basic Principles And Techniques	2(1)	1(1)		1(3)		1(5)	11
Hydrocarbons	2(1)	1(1)		1(3)	1(4)		10
TOTAL	12(1)	4(1)	5(2)	7(3)	2(4)	3(5)	33(70)

SET-11

QUESTION PAPER-XI
SESSION ENDING EXAMINATION
CHEMISTRY THEORY (043)

MM:70 **Time: 3 Hrs**

General Instructions:

Read the following instructions carefully.

(a) There are 33 questions in this question paper with internal choice.

(b) SECTION A consists of 16 multiple -choice questions carrying 1 mark each.

(c) SECTION B consists of 5 short answer questions carrying 2 marks each.

(d) SECTION C consists of 7 short answer questions carrying 3 marks each.

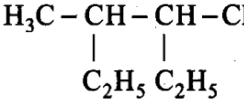
(e) SECTION D consists of 2 case - based questions carrying 4 marks each.

(f) SECTION E consists of 3 long answer questions carrying 5 marks each.

(g) All questions are compulsory.

(h) Use of log tables and calculators is not allowed.

	SECTION A *The following questions are multiple -choice questions with one correct answer. Each question carries 1 mark. There is no internal choice in this section.*	
1	What will be the molarity of a solution, which contains 5.85 g of NaCl(s) per 500 mL? (a) 4 mol L^{-1} (b) 20 mol L^{-1} (c) 0.2 mol L^{-1} (d) 2 mol L^{-1}	1
2	What is the mass per cent of carbon in carbon dioxide? (a) 0.034% (b) 27.27% (c) 3.4% (d) 28.7%	1
3	The number of radial nodes for 3p orbital is . (a) 3 (b) 4 (c) 2 (d) 1	1
4	Among halogens, the correct order of amount of energy released in electron gain (electron gain enthalpy) is (a) F > Cl > Br > I (b) F < Cl < Br < I (c) F < Cl > Br > I (d) F < Cl < Br > I	1
5	Isostructural species are those which have the same shape and hybridization. Among the given species identify the isostructural pairs. (a) [NF_3 and BF_3] (b) [BF^{-}_4andNH^{+}_4] (c) [$BC1_3$ and $BrCl_3$] (d) [NH_3 and $N0^{-}_3$]	1
6	Which of the following options represents the correct bond order? (a) O_2^{-}> O_2> O_2^{+} (b) O_2^{-}< O_2< O_2^{+} (c) O_2^{-}> O_2^{+}< O_2 (d) O_2^{-}< O_2> O_2^{+}	1
7	During complete combustion of one mole of butane, 2658 kJ of heat is released. The thermochemical reaction for above change is (a) $2C_4H_{10}(g) + 13O_2(g) \longrightarrow 8CO_2(g) + 10H_2O(l)\ \Delta_cH = -2658.0\ kJ\ mol^{-1}$ (b) $C_4H_{10}(g) + \frac{13}{2}O_2(g) \longrightarrow 4CO_2(g) + 5H_2O(g)\ \Delta_cH = -1329.0\ kJ\ mol^{-1}$ (c) $C_4H_{10}(g) + \frac{13}{2}O_2(g) \longrightarrow 4CO_2(g) + 5H_2O(l)\ \Delta_cH = -2658.0\ kJ\ mol^{-1}$ (d) $C_4H_{10}(g) + \frac{13}{2}O_2(g) \longrightarrow 4CO_2(g) + 5H_2O(l)\ \Delta_cH = +2658.0\ kJ\ mol^{-1}$	1
8	The entropy change can be calculated by using the expression $\Delta S = q_{rev} / T$. When water freezes in a glass beaker, choose the correct statement amongst the following:	1

	When water freezes in a glass beaker, choose the correct statement amongst the following: (a) $\Delta S_{(system)}$ decreases but $\Delta S_{(surroundings)}$ remains the same. (b) $\Delta S_{(system)}$ increases but $\Delta S_{(surroundings)}$ decreases. (c) $\Delta S_{(system)}$ decreases but $\Delta S_{(surroundmgs)}$ increases. (d) $\Delta S_{(system)}$ decreases but $\Delta S_{(surroundings)}$ also decreases.	
9	Acidity of BF3 can be explained on the basis of which of the following concepts? (a) Arrhenius concept (b) Bronsted Lowry concept (c) Lewis concept (d) Bronsted Lowry as well as Lewis concept	1
10	Which of the following is not an example of redox reaction? (a) $CuO + H_2 \rightarrow Cu + H_2O$ (b) $Fe_20_2 + 3CO \rightarrow 2Fe + 3C0_2$ (c).$2K + F_2 \rightarrow 2KF$ (d) $BaCl_2 + H_2S0_4 \rightarrow BaS0_4 + 2HCl$	1
11	Correct IUPAC name for the following is-  (a) 2-Ethyl-3-methylpentane (b) 3,4-Dimethylhexane (c) 2-sec-Butylbutane (d) 2,3-Dimethylbutane	1
12	Arrange the following in decreasing order of their boiling points. (a) n-Butane (b) 2-Methylbutane (c) n-Pentane (d) 2,2-Dimethylpropane (a) A > B > C > D (b) B > C > D > A (c) D>C>B>A (d) C >B>D > A	1
13	Assertion (A): Generally, ionization enthalpy increases from left to right in a period. Reason (R): When successive electrons are added to the orbitals in the same principal quantum level, the shielding effect of inner core of electrons does not increase very much to compensate for the increased attraction of the electron to the nucleus. (a) Both A and R are true and R is the correct explanation of A. (b) Both A and R are true but R is not the correct explanation of A. (c) A is true but R is false. (d) Both A and R are false.	1
14	Assertion (A) : Increasing order of acidity of hydrogen halides is HF<HCl<HBr<HI Reason (R): While comparing acids formed by the elements belonging to the same group of periodic table, H–A bond strength is a more important factor in determining acidity of an acid than the polar nature of the bond. (a) Both A and R are true and R is the correct explanation of A. (b) Both A and R are true but R is not the correct explanation of A. (c) A is true but R is false. (d) Both A and R are false.	1
15	Assertion: In a reaction $Zn(s) + CuSO4 (aq) \rightarrow ZnSO_4(aq) + Cu(s)$ Zn is a reductant but itself get oxidized. Reason: In a redox reaction, oxidant is reduced by accepting electrons and reductant is oxidized by losing electrons. (a) Both A and R are true and R is the correct explanation of A. (b) Both A and R are true but R is not the correct explanation of A. (c) A is true but R is false. (d) Both A and R are false.	1

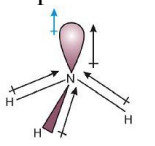
16	Assertion : Sodium acetate on Kolbe's electrolysis gives methane. Reason : Methyl free radical is formed at anode. (a) Both A and R are true and R is the correct explanation of A. (b) Both A and R are true but R is not the correct explanation of A. (c) A is false but R is true. (d) Both A and R are false.	1
	SECTION B *This section contains 5 questions with internal choice in one question. The following questions are very short answer type and carry 2 marks each.*	
17	One of the spectral line of the caesium has a wavelength of 456 nm. Calculate the frequency of this line.	2
18	Define ionisation enthalpy. List any the factors affecting ionisation enthalpy of the elements.	2
19	What is the basic difference between the terms electron gain enthalpy and electronegativity?	2
20	Distinguish between a sigma and a pi bond. OR Which among F^- ion or an I^- ion would be more polarisable and why?	2
21	Fluorine reacts with ice and results in the change: $H_2O(s) + F_2(g) \rightarrow HF(g) + HOF(g)$ Justify that this reaction is a redox reaction.	2
	SECTION C This section contains 7 questions with internal choice in one question. The following questions are short answer type and carry 3 marks each.	
22	(i) What transition in the hydrogen spectrum would have the same wavelength as the Balmer transition $n = 4$ to $n = 2$ of He^+ spectrum ? (ii) How many electrons in an atom may have the following quantum numbers? (a) $n = 4$, $ms = -½$ (b) $n = 3$, $l = 0$	3
23	(i) Among the following pairs of orbitals which orbital will experience the larger effective nuclear charge? (a) 2*s* and 3*s*, (b) 4*d* and 4*f* (ii) Define (a)Heisenberg uncertainty principle (b) Hund's Rule	3
24	(i) Write the Lewis dot structure of CO molecule. (ii) Write one limitation of the octet rule. (iii) Draw shape of SF_4 molecule and state the type of hybridization of central atom. (iv) Why NH_3 has high dipole moment than NF_3 though both are pyramidal?	3
25	Calculate the standard enthalpy of formation of CH_3OH (*l*) from the following data: $CH_3OH(l) + 3/2\ O_2(g) \rightarrow CO_2(g) + 2H_2O(l)$ $\Delta_rH^o = -726$ kJ/mol $C(graphite) + O_2(g) \rightarrow CO_2(g)$ $\Delta_cH^o = -393$ kJ/mol $H_2(g) + 1/2\ O_2(g) \rightarrow H_2O\ (l)$ $\Delta_fH^o = -286$ kJ/mol	3
26	0.2033g of an organic compound in Dumas method gave 31.7 mL of moist N_2 at 14°C and 758 mm pressure. Percentage of N_2 in the compound is (Aq. Tension at 14°C=14mm).	3
27	(i) In $C_6H_5NH_2$, show the movement of electrons by curved arrows.	3

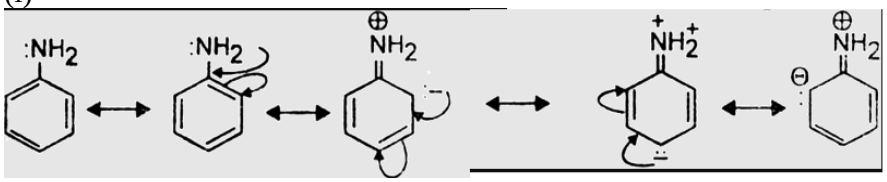
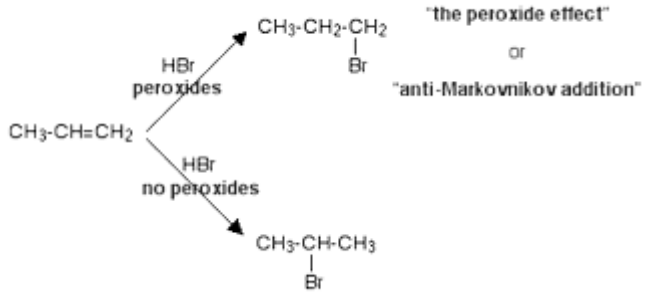
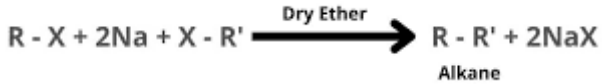
	(ii) Explain why is $(CH_3)_3C^+$ more stable than $CH_3CH_2^+$ & H_3C^+ is the least stable cation?	
28	(i) Propene reacts with HBr to give Isopropyl bromide but does not give n-propyl bromide. Why? (ii) How will you prepare alkanes by (a) Wurtz reaction (b) Kolbe's electrolytic method.	3
	SECTION D The following questions are case -based questions. Each question has an internal choice and carries 4 (1+1+2) marks each. Read the passage carefully and answer the questions that follow.	
29	**Read the following paragraph carefully and answer the following questions:** We can measure the transfer of heat from one system to another which cause change in temperature. The magnitude of change in temperature depends upon heat capacity of the substance. The enthalpy change of reaction remains the same irrespective of number of steps is Hess's law.It helps to calculate enthalpy of formation, combustion and other enthalpy changes. Enthalpy change can also be calculated by using bond enthalpies. First law gives law of conservation of energy but does not give direction of reaction. Second law states, entropy of universe is continuously increasing due to spontaneous processes taking place in it. ΔH and ΔS (entropy change) cannot decide spontaneity of process. We need ΔΔG (free energy change) which is -ve for spontaneous, +ve for non-spontaneous. ΔG = 0 for process in equilibrium. ΔG is related to equilibrium constant. If ΔG = -ve, 'K' is +ve and vice versa. Third law of thermodynamics states the entropy of perfectly crystalline substance is zero at zero kelvin. (i) What are sign of ΔH and ΔS for process to be always spontaneous? (ii) Give mathematical expression for second law of thermodynamics. (iii) For the reaction at 298 K, $2A + B \rightarrow C$ ΔH = 400 kJ mol^{-1} and ΔS = 0.2 kJ K^{-1} mol^{-1} At what temperature will the reaction become spontaneous considering ΔH and ΔS to be constant over the temperature range. **OR** For the reaction $2\ A(g) + B(g) \rightarrow 2D(g)$ ΔU^o = –10.5 kJ and ΔS^o = –44.1 JK^{-1}. Calculate ΔG^o for the reaction, and predict whether the reaction may occur spontaneously.	
30	**Read the following paragraph carefully and answer the following questions:** Organic compounds are formed by covalent bonding. The nature of covalent bonding can described with the help of hybridisation, sp, Sp^2 and sp^3. The structure and reactivity depends upon type of bonds present in organic compounds. Organic compound can be represented by various structural formulae, Wedge and Dash formula is 3-D representation. Organic compounds can be classified on the basis of functional groups. Organic reactions mechanism are based on structure of substrate and the attacking reagent.The intermediate formed can be free radical, carbocation, carbanion or carbene. The attacking reagent can be electrophile or nucleophile. The inductive, electromeric, resonance and hyper conjugative effect may help in polarisation of covalent bond. Organic reactions may be regarded as substitution, addition, elimination and	

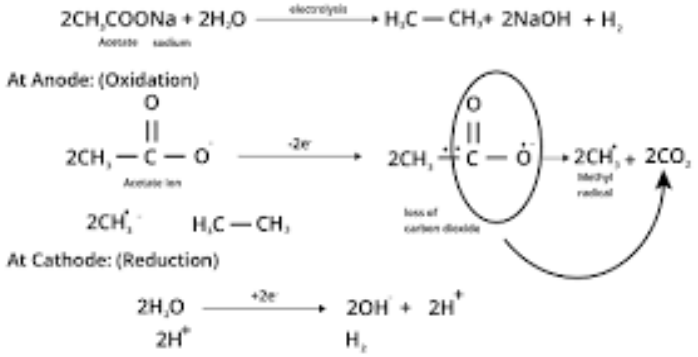
	rearrangement, oxidation and reduction reaction. After the compound is obtained in pure state, qualitative analysis helps to detect elements present in organic compounds whereas quantitative analysis helps to find percentage of various elements. Dumas and Kjeldahl method help to determine percentage of nitrogen, Carius method for halogens and sulphur. Carbon and hydrogen are estimated by the amount of CO_2 and H_2Oformed. Phosphorus estimation is done by oxidising it to $H_3 PO_4$, sulphur to $H_2 SO_4$, The percentage of oxygen is determined by taking the difference of 100 and percentage of all elements. Empirical formula gives simple ratios of elements whereas molecular formula gives exact number of atoms of each element present in a compound. (i) What are free radicals? **OR** What are the nucleophiles? (ii) Write the order of stability of carboanion. (iii) 0.395 g of an organic compound by various method for the estimation of sulphur gave 0.582g of BaS04. Calculate the percentage of Sulphur.	
	SECTION E The following questions are long answer type and carry 5 marks each. All questions have an internal choice.	
31	Calculate the pH of a 0.10M ammonia solution. Calculate the pH after 50.0 mL of this solution is treated with 25.0 mL of 0.10M HCl. The dissociation constant of ammonia, $K_b = 1.77 \times\times 10^{-5}$ **OR** Equilibrium constant K_c for the reaction, $N_2(g)+3H_2(g) \rightleftharpoons 2NH_3(g)$ at 500 K is 0.061. At a particular time, the analysis shows that the composition of the reaction mixture is: 3.0 mol L^{-1} of N_2,. 2.0 mol L^{-1} of H_2 and 0.50 mol L^{-1} of NH_3. Is the reaction at equilibrium? If not, in which direction does the reaction tend to proceed to reach the equilibrium?	5
32	(i)What do you understand by significant figures?. (ii) 4 litres of water are added to 2L of 6 molar HCl solutions. What is the molarity of resulting solution? (iii) In the reaction $2A + 4B \rightarrow 3C + 4D$, if 5 moles of A react with 6 moles of B, then (a) which is the limiting reagent? (b) calculate the amount of C formed? **OR** Calcium carbonate reacts with aqueous HCl to give $CaCl_2$ and CO_2 according to the reaction, $CaCO_3$ (s) + 2HCl (aq) $\rightarrow$ $CaCl_2$(aq) + CO_2(g) + H_2O(l) What mass of $CaCO_3$ is required to react completely with 25 mL of 0.75 M HCl?	5
33	(i)How is the aromaticity of a compound judged? (ii)Write IUPAC names of the products obtained by the ozonolysis of Pent-2-ene. Also Write the reaction. **OR** (i) Out of benzene, m–dinitrobenzene and toluene which will undergo nitration most easily and why? (ii) How would you convert Ethyne into benzene? (iii) What effect does branching of an alkane chain has on its boiling point?	5

MARKING SCHEME

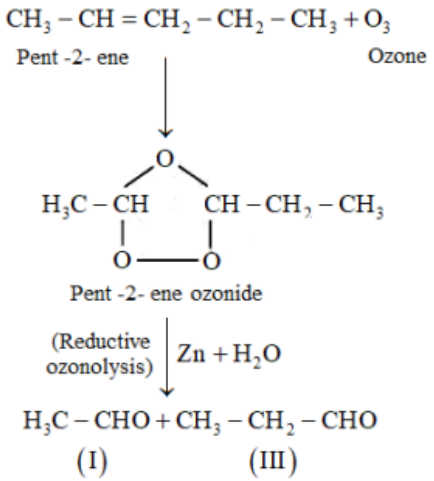
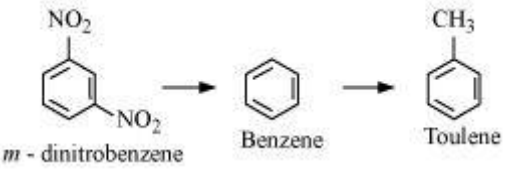
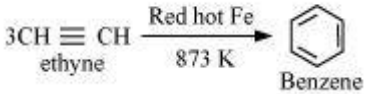
	SECTION A	
1	C	1
2	B	1
3	C	1
4	C	1
5	B	1
6	B	1
7	C	1
8	C	1
9	C	1
10	D	1
11	B	1
12	D	1
13	A	1
14	A	
15	A	1
16	C	1
	SECTION B	
17	To calculate the frequency of the spectral line of caesium with a wavelength of 456 nm, we can use the following equation: $v = c / \lambda$ where: v is the frequency in Hz c is the speed of light in m/s (3 x 10^8 m/s) λ is the wavelength in m (456 x 10^-9 m) Substituting the values into the equation, we get: v = (3 x 10^8 m/s) / (456 x 10^-9 m) = 6.58 x 10^14 Hz Therefore, the frequency of the spectral line of caesium with a wavelength of 456 nm is 6.58 x 10^14 Hz.	1 1
18	Ionisation Enthalpy: The amount of energy required to remove an e from an isolated gaseous atom in its gaseous state is defined as an element's ionisation enthalpy. The following factors influence ionisation enthalpy(any Two) 1. Atom size 2. Screening Effect 3. Nuclear chargeHalf-filled and fully-filled orbitals 4. Orbital shape	1 1
19	Electron gain enthalpy is the energy change involved in adding an electron to an isolated atom, while electronegativity is the ability of an atom to attract electrons in a chemical bond. Electron gain enthalpy is a thermodynamic property, while electronegativity is a chemical property.	2
20	Difference Between Sigma and Pi bond (Any two)	2
	Sigma Bond / Pi Bond	
	During sigma bond formation overlapping orbitals can either be one hybrid orbital and a single pure orbital, or two pure orbitals and two hybrid orbitals. / During pi bond formation overlapping orbitals must be two unhybridized orbitals.	
	Sigma bonds are known to exist independently and allow free rotation. / Pi-bond must always exist along with sigma bond and the rotation is restricted.	
	OR The fact that polarisable anions are often big and strongly charged can be used to our advantage. An F^- ion is a single-charged, tiny particle. An I^- ion has the same charge as a proton but is much larger. As a result, an I- ion is more likely to be polarisab	2

21	The reaction between fluorine and ice is a redox reaction because the oxidation states of fluorine change from 0 in the reactants to -1 and +1 in the products. This means that fluorine is both oxidized and reduced in the reaction.	2
	SECTION C	
22	(i) For $H; = \frac{1}{\lambda} = R\left[\frac{1}{n_1^2} - \frac{1}{n_2^2}\right]$ Since λ is same $\therefore\ 2^2\left[\frac{1}{2^2} - \frac{1}{4^2}\right] = \left[\frac{1}{n_1^2} - \frac{1}{n_2^2}\right]$ $[\because\ Z = 2 \text{ for } He^+]$ $\therefore\ \left[\frac{1}{1^2} - \frac{1}{2^2}\right] = \left[\frac{1}{n_1^2} - \frac{1}{n_2^2}\right]$ Therefore $n_1 = 1$, $n_2 = 2$. (ii) (a) For n = 4 and ms = -½, there can be 1 electron. (b) For n = 3 and l = 0, there can be 2 electrons.	2 ½ ½
23	(i)(a) 2s will experience a larger effective nuclear charge compared to 3s. (b) 4d will experience a larger effective nuclear charge compared to 4f. (ii) (a) Heisenberg Uncertainty Principle: It is impossible to simultaneously know the precise position and momentum of a subatomic particle. (b) Hund's Rule: Electrons fill degenerate orbitals singly before pairing up, and they maximize their total spin before pairing.	½ ½ 1 1
24	(i) $:C\equiv O:$ (ii) One limitation of the octet rule is that it does not apply to all atoms in all molecules. For example, some atoms, such as beryllium, boron, and aluminum, can form stable compounds with fewer than eight electrons in their outer shells. Other atoms, such as phosphorus, sulfur, and chlorine, can form stable compounds with more than eight electrons in their outer shells. (iii)correct structure showing lp and bp, sp^3d (see saw) (iv)In case of NH_3 the orbital dipole due to lone pair is in the same direction as the resultant dipole moment of the N-H bonds, whereas in NF_3 the orbital dipole is in the direction opposite to the resultant dipole moment of the three N bonds. The orbital dipole become of lone pair decreases, which results in the low dipole moment. 	1 1 1
25	(i) $CH_3OH(l) + 3/2O_2(g) \rightarrow CO_2(g) + 2H_2O(l)$; $\Delta rH° = -726$ kJ mol-1 (ii) $C(g) + O_2(g) \rightarrow CO_2(g)$; $\Delta cH° = -393$ kJ mol-1 (iii) $H_2(g) + 1/2O_2(g) \rightarrow H_2O(l)$; $\Delta fH° = -286$ kJ mol-1 We aim at $C + 2H_2 + 1/2\ O_2 \rightarrow CH_3OH$ In order to get this thermochemical equation, multiply Eq. (ii) by 1 and Eq. (iii) by 2 and subtract Eq. (i) from their sum. $C + 2H_2 + 1/2O_2 \rightarrow CH_3OH$ $\Delta H = (-393) + 2(-286) - (-726) = -393 - 572 + 726 = -965 + 726 = -239$ kJ mol-1 Thus, the heat of formation of CH_3OH is $\Delta H_f = -239$ kJ mol-1	1 1 1
26	Dumas method V_1=31.7mL	1

	P_1=atmospheric pressure-tension +760-14=746mm T_1=14∘C=287∘K $\text{Volume of } N_2 \text{ at STP} = \frac{P_1V_1 \times 273}{760 \times 287} = \frac{746 \times 31.7 \times 273}{760 \times 287}$ $\therefore \text{ volume of } N_2 \text{ at STP} = 29.598 \text{ ml}$ $\%\, N_2 = \frac{\text{Mall Mass of } N_2}{22400 \text{ mL}} \times \frac{\text{valume at STP} \times 100}{\text{Mass of compound}} = \frac{28}{22400} \times \frac{29.6 \times 100}{6.2033}$ N_2= 18.19%	1 1
27	(i)  (ii) Hyperconjugation interaction in $(CH_3)_3\, C^+$ is greater than in $CH_3CH_2{}^+$ has 9 C -H bonds. In CH_3^+, the C -H bonds are in the nodal plane of the vacant 2p-orbital & hence cannot overlap with it. Thus H_3C^+ is least stable.	2 1
28	(i) The addition of unsymmetrical addendum (HBr) to unsymmetrical olefines ($CH_3CH = CH_2$) takes place according to Markownikov rule, the negative part of reagent (i.e. Br-) adds on the carbon atom having a minimum number of hydrogen atoms. Hence Isopropyl bromide will be formed.  (ii) (a)Wurtz reaction. Alkyl halides on treatment with sodium in dry ether give higher alkanes, preferably containing an even number of carbon atoms.  (b) Kolbe's electrolytic method. An aqueous solution of sodium or potassium salt of a carboxylic acid on electrolysis gives alkanes containing an even number of carbon atoms at the anode.	1 1 1

		
	SECTION D	
29	(i) For a process to be spontaneous, ΔH (enthalpy change) should be negative (exothermic), and ΔS (entropy change) should be positive (increasing entropy). (ii) $\Delta G=\Delta H-T\Delta S$ (iii) Assuming that equation at equilibrium then $\Delta G = 0$ $\Delta G=\Delta H-T\Delta S=0$ $T=\Delta H/\Delta S=400/0.2=2000K.$ For the reaction to be spontaneous ΔG must be negative. Therefore temprature should be greater than 2000 K. **OR** For the given reaction, $2\ A(g) + B(g) \rightarrow 2D(g)$ $\Delta ng = 2 - (3) = -1$ mole Substituting the value of ΔU^θ in the expression of ΔH: $\Delta H^\theta = \Delta U^\theta + \Delta ngRT = (-10.5\ kJ) - (-1)\ (8.314 \times 10{-}3\ kJ\ K^{-1}\ mol^{-1})\ (298\ K)$ $= -10.5\ kJ - 2.48\ kJ\ \Delta H\theta = -12.98\ kJ$ Substituting the values of ΔH^θ and $\Delta S\theta$ in the expression of ΔG^θ : $\Delta G^\theta = \Delta H^\theta - T\Delta S^\theta = -12.98\ kJ - (298\ K)\ (-44.1\ J\ K^{-1}) = -12.98\ kJ + 13.14\ kJ\ \Delta G^\theta = + 0.16\ kJ$ Since ΔG^θ for the reaction is positive, the reaction will not occur spontaneously.	1 1 1 1 1 1
30	(i)Free radicals are highly reactive chemical species with unpaired electrons. **OR** The electron rich species are called mucleopiles. A nucleophile has affection for a positively charge centre. (ii) Order of stability for carboanions: Tertiary > Secondary > Primary > Vinyl > Aryl (iii) Mass of $BaSO_4$ = 0.582 g 233g of $BaSO_4$ contain sulphur = 32g 0. 582 g of $BaSO_4$ contains sulphur Percentage of sulphur $= \frac{wt.of\ sulphur}{wt.of\ compound} x100$ $= \frac{32x0.582}{233x0.395} x100$ 20.24%	1 1 1 1 1
	SECTION E	
31	$NH_3 + H_2O \longrightarrow NH_{4+} + OH^-$ $K_b = [NH_4^+][OH^-]/[NH_3]=1.77\times10^{-5}[NH_{4+}][OH^-]/[NH_3]=1.77\times10^{-5}$ Before neutralization,	

	$[NH_3] = 0.10 - x = 0.10 [NH_3] = 0.10 - x = 0.10$ $x^2 / 0.10 = 1.77 \times 10^{-5}$ Thus, $x = 1.33 \times\times 10^{-3} = [OH^-]$ Therefore, $[H^+] = K_w/[OH^-] = 10^{-14} / (1.33 \times\times 10^{-3}) = 7.51 \times\times 10^{-12}$ $pH = -\log(7.5 \times 10^{-12}) = 11.12$ On addition of 25 mL of 0.1M HCl solution (i.e., 2.5 mmol of HCl) to 50 mL of 0.1M ammonia solution (i.e., 5 mmol of NH_3), 2.5 mmol of ammonia molecules are neutralized. The resulting 75 mL solution contains the remaining unneutralized 2.5 mmol of NH_3 molecules and 2.5 mmol of NH_4^+ $NH_3 + HCl \rightarrow NH_4^+ + Cl^-$ 2.5 2.5 0 0 At equilibrium 0 0 2.5 2.5 The resulting 75 mL of solution contains 2.5 mmol of NH+4NH4+ ions (i.e., 0.033 M) and 2.5 mmol (i.e., 0.033 M) of neutralised NH_3 molecules. This NH_3 exists in the following equilibrium: $NH_4OH \rightleftharpoons NH_4^+ + OH^-$ $0.033M - y \quad y \quad y$ where, $y = [OH^-] = [NH_4^+]$ The final 75 mL solution after neutralization already contains 2.5 m mol NH_4^+ ions (i.e. 0.033M), thus total concentration of NH_4^+ ions is given as: $[NH_4^+] = 0.033 + y$ As y is small, $[NH_4OH] \simeq 0.033$ M and $[NH_4^+] \simeq 0.033$M. We know, $Kb = [NH_4^+][OH^-]/[NH_4OH]$ $= y(0.033)/(0.033) = 1.77 \times\times 10^{-5}$ M Thus, $y = 1.77 \times\times 10^{-5} = [OH^-]$ $[H^+] = 10^{-14}/1.77 \times 10^{-5} = 0.56 \times 10^{-9}$ Hence, pH = 9.24 **OR** The given reaction is: $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$ According to available data. $[N_2] = [3.0]$; $[H_2] = [2.0]$ and $[NH_3] = [0.50]$ $Qc = [NH_3(g)]^2 / [N_2(g)][H_2(g)]^3$ $= [0.50]^2/[3.0][2.0]^3$ 0.0104 The value of the reaction quotient is smaller than the value of the equilibrium constant. Since the value of Q_c is less than that of K_c (0.061), the reaction is not in a state of equilibrium. It will proceed in the forward direction till Q_c becomes the same as K_c.	1 1 1 1 1 2 2 1
32	(i) Significant figures are meaningful digits which are known with certainty. The uncertainty in experimental or the calculated value is indicated by mentioning the number of significant figures. (ii) Initial volume, $V_1 = 2L$ Final volume, $V_2 = 4L + 2L = 6L$ Initial molarity, $M_1 = 6M$ Final molarity = M_2 $M_1V_1 = M_2V_2$ $6M \times 2L = M_2 \times 6L$ $M_2 = \frac{6M \times 2L}{6L} = 2M$	1 2

	Thus the resulting solution is 2M HCl. (iii) (a) B would be the limiting reagent as it gives the lesser amount of product. (b) Let B completely consumed 4 mol of B gives 3 mol of C 6 mol of B will give 3/4 *6 mol C =4.5 mol C **OR** 1000 mL of 0.75 M HCl have 0.75 mol of HCl = 0.75×36.5 g = 24.375 g ∴ Mass of HCl in 25mL of 0.75 M HCl = 24.375/ 1000 × 25 g = 0.6844 g From the given chemical equation, $CaCO_3$ (s) + 2HCl (aq) → $CaCl_2$(aq) + CO_2(g) + H_2O(l) 2 mol of HCl i.e. 73 g HCl react completely with 1 mol of $CaCO_3$ i.e. 100g ∴ 0.6844 g HCl reacts completely with $CaCO_3$ = 100/73 × 0.6844 g = 0.938 g	1 1 1 1
33	(i) The following characteristics decides aromaticity of a compound:- (i). Planarity (ii). Complete delocalization of the π -electrons in the ring. (iii). Presence of (4n+2) π -electrons in the ring where n is an integer (n=0, 1, 2 ----) This is often referred to as Huckel Rule. (ii) Pent-2-ene undergoes ozonolysis as:  The IUPAC name of Product (I) is ethanal and Product (II)is propanal. **OR** **(i)** The ease of nitration depends on the presence of electron density on the compound to form nitrates. Nitration reactions are examples of electrophilic substitution reactions where an electron-rich species is attacked by a nitronium ion (NO_2^-). Now, CH_3– group is electron donating and NO_2^- is electron withdrawing. Therefore, toluene will have the maximum electron density among the three compounds followed by benzene. On the other hand, m– Dinitrobenzene will have the least electron density. Hence, it will undergo nitration with difficulty. Hence, the increasing order of nitration is as follows:  **(ii)**  	2 3(one for each IUPC name and 1 for reaction 2 1 2

	(iii) Alkanes experience inter-molecular Van der Waals forces. The stronger the force, the greater will be the boiling point of the alkane. As branching increases, the surface area of the molecule decreases which results in a small area of contact. As a result, the Van der Waals force also decreases which can be overcome at a relatively lower temperature. Hence, the boiling point of an alkane chain decreases with an increase in branching.	

BLUE PRINT

Unit No.	Unit Name	Marks
1	Some Basic Concepts of Chemistry	**7**
2	Structure of Atom	**9**
3	Classification of Elements and Periodicity in Properties	**6**
4	Chemical Bonding and Molecular Structure	**7**
5	Chemical Thermodynamics	**9**
6	Equilibrium	**7**
7	Redox Reactions	**4**
8	Organic Chemistry: Some Basic Principles and Techniques	**11**
9	Hydrocarbons	**10**
	Total	**70**

Unit No.	Unit Name	1 MARKS	2 MARKS	3 MARKS	CBQ(4 MARKS)	5 MARKS	Marks
1	**Some Basic Concepts of Chemistry**	2				1	7
2	**Structure of Atom**	1	1	2			9
3	**Classification of Elements and Periodicity in Properties**	2	2				6
4	**Chemical Bonding and Molecular Structure**	2	1	1			7
5	**Chemical Thermodynamics**	2		1	1		9
6	**Equilibrium**	2				1	7
7	**Redox Reactions**	2	1				4
8	**Organic Chemistry: Some Basic Principles and Techniques**	1		2	1		11
9	**Hydrocarbons**	2		1		1	10
	Total	16	5	7	2	3	70

SET-12

QUESTION PAPER-XI
SESSION ENDING EXAMINATION
CHEMISTRY THEORY (043)

MM:70 **Time: 3 Hrs**

General instructions

Read the following instructions care fully.

(1) There are 33 question in this question paper with internal choice.
(2) SECTION A consists of 16 MCQ carrying 1 marks each
(3) SECTION B consists of 5 very short answer question carrying 2 marks each
(4) SECTION C consists of 7 short answer question carrying 3 marks each
(5) SECTION D consists of 2 case study based question carrying 4 marks each
(6) SECTION E consists of 3 long answer question carrying 5 marks each

SECTION A

Q.1	A measured temperature on Fahrenheit scale is 200 °F. What will this reading be on Celsius scale? (a) 40 °C (b) 94 °C (c) 93.3 °C (d) 30 °C	1
Q.2	The principal quantum number describes ____ a. energy and size of the orbit b. the shape of the orbital c. spatial orientation of the orbital d. the spin of the electron	
Q.3	The ionization enthalpies of the elements decline from top to bottom in a group of the periodic table due to _____. **1.** Increased densities **2.** a decline in the reactivities of chemicals **3.** the expansion of the atomic size **4.** Reduced electronegativities are	
Q.4	Which among the following has the largest dipole moment? (a) NH_3 (b) H_2O (c) HI (d) SO_3	
Q.5	The correct order of hybridisation of the central atom in the following species: NH_3, $[PtCl_4]_2^-$, PCl_5 and BCl_3 is (a) dsp^2, dsp^3, sp^2 and sp^3 (b) sp^3, dsp^2, dsp^3, sp^2 (c) dsp^2, sp^2, sp^3, dsp^3 (d) dsp^2, sp^3, sp^2, dsp^3	
Q.6	A well stoppered thermos flask contains some ice cubes. This is an example of (a) Closed system (b) Open system (c) Isolated system (d) Non thermodynamics system	
Q.7	Aluminium chloride is (a) Bronsted Lowry acid (b) Arrhenius acid (c) Lewis acid (d) Lewis base	
Q.8	When two reactants A and B are mixed to give products C and D, the concentration quotient (Q) at initial stage of the reaction	

	(a) Is zero (b) Decreases with time (c) Is independent of time (d) Increases with time	
Q.9	The oxidation number of Cl in Cl_2O_7 is: (a) + 7 (b) +5 (c) + 3 (d) – 7	
Q.10	3.The displacement of electrons in a multiple bond in the presence of attacking reagent is called (a) Inductive effect (b) Electromeric effect (c) Resonance (d) Hyperconjugation	
Q.11	9.The catalyst used in Friedel–Crafts reaction is a) Aluminium Chloride b) Anhydrous Aluminium Chloride c) Ferric Chloride d) Copper	
	Assertion and Reason Questions for Atomic Structure Directions : Each of these questions contain two statements, Assertion and Reason. Each of these questions also has four alternative choices, only one of which is the correct answer. You have to select one of the codes (a), (b), (c) and (d) given below. (a) Assertion is correct, reason is correct; reason is a correct explanation for assertion. (b) Assertion is correct, reason is correct; reason is not a correct explanation for assertion (c) Assertion is correct, reason is incorrect (d) Assertion is incorrect, reason is correct.	
Q.12	**Assertion :** One atomic mass unit is defined as one twelfth of the mass of one carbon – 12 atom. **Reason :** Carbon-12 isotope is the most abundant isotope of carbon and has been chosen as standard	
Q.13	**Q.2. Assertion :** It is impossible to determine the exact position and exact momentum of an electron simultaneously. **Reason :** The path of an electron in an atom is clearly defined.	
Q.14	Heat of neutralisation for both H2SO4 and HCl with NaOH is 53.7 kJ mol –1. **Reason :** Both HCl and H2SO4 are strong acids.	
Q15	**Assertion:** Different number of electron pairs are present in resonance structures. **Reason:** Resonance structures differ in the location of electrons around the constituent atoms.	
Q.16	**Assertion :** Sodium acetate on Kolbe's electrolysis gives methane. **Reason :** Methyl free radical is formed at anode.	

SECTION B

Q.17	What will be the mass of one atom of C-12 in grams?	
Q.18	**(a)** Define and state Mendeleev's periodic law. **(b)** Why Li and Mg show resemblance in chemical behaivour?	
Q.19	**(a)** Why is BF3 non – polar? **(b)** State the hybrid orbitals associated with B in BCl_3 and C in C_2H_4	

Q.20	At 298 K. Kp for the reaction N_2O_4 (g) ⇄ $2NO_2$ (g) is 0.98. Predict whether the reaction is spontaneous or not.	
Q.21	BF_3 does not have protons but still acts as an acid and reacts with NH_3. Why is it so? What type of bond is formed between the two?	

SECTION C

Q.22	(a) Define the limiting reagent, with example (b) Give the formula for calculation the equivalent weight of a ion	
Q.23	(a) Calculate the total number of angular nodes and radial nodes present in the 3p orbital. (b) The electronic configuration of the valence shell of Cu is $3d^{10}$ $4s^1$ and not $3d^9$ $4s^2$. How is this configuration explained?	
Q.24	(a) What do you mean by periodicity of properties of elements? (b) Arrange the following elements In their reasing metallic character. Br. Al, Mg, K (c) Determine the position of an element in periodic table whose atomic number is 32?	
Q.25	(a) Why BeH_2 is linear and not H_2S? (b) Arrange the NO_2^+, NO_2^- and NO_3^- in increasing order of bond length of N-O.	
Q.26	(a) A gas is kept in closed vessel at equilibrium, (atm), if helium is introduced into it; what happens at the same temperature? (b) If equilibrium constant K < 1; what does it indicate ? (c)What will be the conjugate acid of NH_2^-?	
Q.27	(a) MnO_4^{2-} undergoes disproportionation reaction in acidic medium but MnO_4^- does not. Give reason.	
Q.28	Draw all the possible isomers of $C_2H_2Cl_2$. Which one is non polar in it?	

SECTION D

Q.29	Electron moves around the nucleus in circular orbitals in fixed energy paths. As far as electron moves in these orbits neither energy is absorbed nor liberated. But when electron move from lower energy level to higher energy level energy is absorbed while when it comes back from higher energy level to lower energy level energy is liberated in the form of photon & a spectral line is formed. Corresponding to different possible transitions different lines are formed which form the particular serieses viz. lyman, balmer, paschen, bracket, pfund, Humphery etc. Answer the following question (a) When a electron jumped from lyman ro paschen series the how many photon energy absorb? (b) Why the electron fixed in a energy path? (c) write the formula of angular momentum of electron in balmer series. (d) which effect explain a spectral line is a group of lines ?	
Q.30	The existing large number of organic compounds and their ever-increasing numbers has made it necessary to classify them on the basis of their structures. Organic compounds are broadly classified as open-chain compounds which are	

	also called aliphatic compounds. Aliphatic compounds further classified as homocyclic and heterocyclic compounds. Aromatic compounds are special types of compounds. Alicyclic compounds, aromatic compounds may also have heteroatom in the ring. Such compounds are called heterocyclic aromatic compounds. Organic compounds can also be classified on the basis of functional groups, into families or homologous series. The members of a homologous series can be represented by general molecular formula and the successive members differ from each other in molecular formula by a $-CH_2$ unit. Answer the following question (i) Which type of compound is benzene? (ii) Write the name and structure of hetrocyclic compound (iii) Write the name and structure of a alicyclic compound (iv) Write the number of carbon atom and pi bonds in tropolone	

SECTION E

Q.31	(a) Why $\Delta U = 0$ for isothermal expansion of ideal gas? (b) When $\Delta S = \Delta H/T$ is valid? (c)Hess's law is supplementry of first law of thermodynamics. How?	
Q.32	(a) Write the resonace structure of phenol (b) Write the stability or order of carbon cation (c) Write the structural formula of following compound (i) Butanoic acid (b) 2,2-di methyle propanal	
Q.33	Convert the following: (i) Methane from ethyne (ii) Ethyne from ethene (iii) Ethyne from ethene	

MARKING SCHEME

ANS.1	B	1
ANS.2	A	1
ANS.3	c	1
ANS.4	b	1
ANS.5	b	1
ANS.6	c	1
ANS.7	c	1
ANS.8	d	1
ANS.9	a	1
ANS.10	b	1
ANS.11	b	1
ANS.12	b	1
ANS.13	c	1
ANS.14	a	1
ANS.15	d	1
ANS.16	d	1
ANS.17	The mass of 1 mole of C-12 atoms = 12 g 1 mole of C-12 atoms = 6.022×10^{23} atoms The mass of 1 atom of C-12 = $12 / (6.022 \times 10^{23})$ = 1.99×10^{-23} g	2
ANS.18	(a) Right answer (b) Due to diagonal relationship, since their atomic size, electro negativity and ionisation potential are almost the same	1 1
ANS.19	(a) Because BF3 has symmetrical shape, the net dipole moment is zero and thus it is non – polar. (b) **. (i) SP^2** hybridization **(ii)SP^2** hybridization.	1 +1/2 +1/2
ANS.20	For a spontaneous reaction, ΔrG° is -ve. ΔrG° = – RT ln Kp = – RT ln (0.98) In (0.98) is – 0.02 ∴ΔrG° = – RT × –0.02 ∴ Δ G°will be positive.	½ ½ ½ ½
ANS.21	BF3 is electron-deficient and hence acts as Lewis acid. : NH3 has one lone pair, which can donate to BF3 and form a coordinate bond with NH_3, i.e. (NH_3: → BF_3).	2
ANS.22	(a) Right Answer (b) Atomic weight/charge	1.5 + 1.5
ANS.23	(a) For the 3p – orbital, the principal quantum number is n = 3 and the azimuthal number is l = 1. (b) Right answer	1.5 +1.5
ANS.24	(a) It is tendency to reoccur the properties of elements at regular interval. (b) Br < Al < Mg < K.	1 1

	(c) Block = p Period = IV Group = 10 + 2 + 2 = 14	1
ANS.25	(a) In BeH2, there is no lone pair on Be atom so it is ear while in H2S, there is lone pair on S-atom. So it is linear. (b) $NO_2^+ < NO_2^- < NO_3^-$.	1.5 1.5
ANS.26	(a) No effect (b)The reaction does not proceed in forward direction. (c) NH_3	1 1 1
ANS.27	In MnO4, Mn is in the highest oxidation state of +7 I hence it cannot undergo disproportionation. In trast in MnO2, the O.N. of Mn is +6. Therefore, it can increase its O.N. to +7 or decrease its O.N to some er value. Thus, it undergoes disproportionation in lic medium as; $3\overset{+6}{Mn}\overset{-2}{O_4^{2-}} + 4H^+ \rightarrow 2\overset{+7}{Mn}\overset{-2}{O_4^-} + \overset{+4}{Mn}\overset{-2}{O_2} + 2\overset{+1}{H_2}\overset{-2}{O}$	1.5 1.5
ANS.28	(i) Cis (ii) trance and 1,1 dichloro ethene (total =3 isomers)	1+1+1
ANS.29	(a) 2 photon (b) $MV^2 = Ze^2/r$, bohr first postulate (c) Mvr = 2h/2pi, h/pi (d) stark and Zeeman effect	1+1+1+1
ANS.30	(a) Aromatic compound (b) Right answer(pyrrole,furane,thiophene,puridine, etc) (c) Right answer (cyclo propane, cyclo hexane etc.) (d) Carbon atom = 7, pi bonds = 3	1 1 1 1/2 +1/2
ANS.31	(a) Since internal energy and change in internal nergy are related to temperature. In isothermal rocess, the temperature remains constant. So, AU will zero. (b) It is valid only when system is in equilibrium i.e., $\Delta G = 0$ (c) The first law of thermodynamics says that neither eat can be created nor be destroyed and according to Hess's law, there is no change in heat during direct or ndirect reactions".	2 1 2
ANS.32	(a) right struructure (b) $3^0 > 2^0 > 1^0$ (c) right structures	2 1 1+1
ANS.33	1. Right answer 2. Right answer 3. Right answer	2+1+2

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Sl.no.	Chapter name	Mark (Qn)	Mark (Qn)	Mark (Qn)	Mark (Qn)	Mark (Qn)	Total
1	Some basic concept of chemistry	1(2)	2(1)	3(1)			7
2	Atomic structute	1(2)		3(1)	4(1)		9
3	Classification of elements and their periodicity in properties	1(1)	2(1)	3(1)			6
4	Chemical bonding and molecular structure	1(2)	2(1)	3(1)			7
5	Thermodynamics	1(2)	2(1)			5(1)	9
6	Equilibrium	1(2)	2(1)	3(1)			7
7	Redox reaction	1(1)		3(1)			4
8	Organic chemistry	1(2)			4(1)	5(5)	11
9	Hydrocarbon	1(2)		3(1)		5(1)	10
Total		16	2 x 5 = 10	3 x 7= 21	4 x 2 =8	5 x 3 =15	70

SET-13

QUESTION PAPER-XI
SESSION ENDING EXAMINATION
CHEMISTRY THEORY (043)

MM:70 **Time: 3 Hrs**

General Instructions:

Read the following instructions carefully.

(a) There are **33** questions in this question paper with internal choice.
(b) SECTION A consists of 16 multiple-choice questions carrying 1 mark each.
(c) SECTION B consists of 5 short answer questions carrying 2 marks each.
(d) SECTION C consists of 7 short answer questions carrying 3 marks each.
(e) SECTION D consists of 2 case - based questions carrying 4 marks each.
(f) SECTION E consists of 3 long answer questions carrying 5 marks each.
(g) All questions are compulsory.
(h) Use of log tables and calculators is not allowed.

SECTION A

The following questions are multiple choice questions with one correct answer. Each question carries 1 mark. There is no internal choice in this section

Q.1. The magnetic quantum number specifies
(a) Size of orbitals (b) Shape of orbitals (c) Orientation of orbitals (d) Nuclear Stability

Q.2**.** In which of the following molecules octet rule is not followed?
(a) NH_3 (b) CH_4 (c) CO_2 (d) NO

Q.3. Which has maximum number of atoms?
(a) 24 g of C (12) (b) 56 g of Fe (56) (c) 27 g of Al (27) (d) 108 g of Ag (108)

Q.4. Which of the following has the highest entropy?
(a) Mercury (b)Hydrogen (c) Water (d) Graphite

Q.5. Among the following the weakest Bronsted base is
(a) F^- (b) Cl^- (c) Br^- (d) I^-

Q.6. Which of the following is a linear molecule?
(a) ClO_2 (b) CO_2 (c) NO_2 (d) SO_2

Q.7. The number of spherical nodes in 3p orbitals are
(a) one (b) three (c) two (d) None of these

Q.8. A miscible mixture of benzene and chloroform can be separated by:
(a) Sublimation (b) distillation (c) filtration (d) crystallisation

Q.9. Which of the following participate in the sulphonation of benzene?
(a) SO_2 (b) SO_3H^+ (c) SO_3 (d) SO_3H^-

Q.10. The element with atomic number 35 belongs to
(a) d – Block (b) f – Block (c) p – Block (d) s – Block

Q.11. Which of the following is a disproportion reaction?
(a) $C + O_2 \rightarrow CO_2$ (b) $H_2O_2 \rightarrow H_2O + ½\ O_2$
(c) $2Mg + O \rightarrow 2MgO$ (d) All of the above

Q.12. The number of significant figures for the three numbers 161 cm, 0.161 cm, 0.0161 cm are

(a) 3,4 and 5 respectively (b) 3,4 and 4 respectively
(c) 3,3 and 4 respectively (d) 3,3 and 3 respectively

In the following questions (Q. No. 13 to Q. No. 16), two statements are given—one labeled Assertion (A) and the other labeled Reason (R).Select the correct answer to these questions from the codes (a), (b),(c) and (d) as given below:

(a) Both Assertion (A) and Reason (R) are correct statements, and Reason (R) is the correct explanation of the Assertion (A).

(b) Both Assertion (A) and Reason (R) are correct statements, but Reason (R) is not the correct explanation of the Assertion (A).

(c) Assertion (A) is correct, but Reason (R) is incorrect statement.

(d) Assertion (A) is incorrect, but Reason (R) is correct statement

Q.13. **Assertion:** The reaction: $CaCO_3(s) \rightarrow CaO(s) + CO_2(g)$ is an example of decomposition reaction.

Reason: Above reaction is not a redox reaction.

Q.14. **Assertion:** K_p can be less than, greater than or equal to K_c.

Reason: Relation between K_p and K_c depends on the change in number of moles of gaseous reactants and products (Δn).

Q.15. **Assertion:** CH_2Cl_2 is non-polar and CCl_4 is polar molecule.

Reason : Molecule with zero dipole moment is non-polar in nature.

Q.16. Assertion: Boiling point of alkanes increases with increase in molecular weight. Reason : Vander Waal's forces increase with increase in molecular weight.

SECTION B

This section contains 5 questions with internal choice in one question. The following questions are very short answer type and carry 2 marks each.

Q.17. Red light has wavelength 750 nm, whereas violet light has wavelength 400 nm. Calculate their frequency and energy ($c = 3 \times 10^8$ ms^{-1}, $h = 6.63 \times 10^{-34}$ J s)

OR

Explain Aufbau's Principle or Hund's Principle.

Q.18. Balance the following equation in basic medium by ion electron method:

$P_4(s) + OH^-(aq) \rightarrow PH_3(g) + H_2PO_2^-(aq)$

Q.19. Arrange the following ions in the order of increasing size:

Be^{2+}, Cl^-, S^{2-}, Na^+, Mg^{2+}, Br^-

Q.20. Describe the effect of :

(a) addition of H_2 **(b)** addition of CH_3OH

(c) removal of CO **(d)** removal of CH_3OH

on the equilibrium of the reaction:

$2H_2(g) + CO(g) \rightleftharpoons CH_3OH$?

Q.21. Calculate the atomic mass (average) of chlorine using the following data :

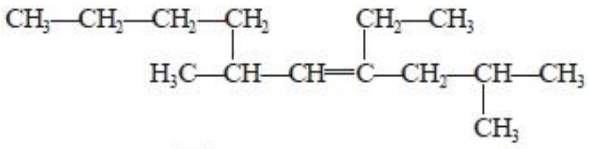
	% Natural Abundance	Molar Mass
35Cl	75.77	34.9689
37Cl	24.23	36.9659

SECTION C

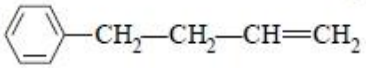
This section contains 7 questions with internal choice in one question. The following questions are short answer type and carry 3 marks each.

Q.22. (i) Write IUPAC names of the following:

(a)



(b)



(ii) Give mechanism of electrophilic substitution reaction of halogenation of arenes.

Q.23. The solubility product of $Al(OH)_3$ is 2.7×10^{-11}. Calculate its solubility in gL^{-1} and also find out pH of this solution. (Atomic mass of Al = 27 u)

OR

Explain Buffer Solution with example.

Q.24. An unsaturated hydrocarbon 'A' adds two molecules of H_2 and on reductive ozonolysis, gives butane-1,4-dial, ethanal and propanone. Give the structure of 'A', write its IUPAC name and explain the reactions involved

Q.25. Calculate the enthalpy of the reaction:

$N_2O_4(g) + 3CO(g) \rightarrow N_2O(g) + 3CO_2(g)$

Given that; $\Delta_f H^- CO(g) = -110$ kj mol^{-1}; $\Delta_f H\ CO_2(g) = -393$ kj mol^{-1}

$\Delta_f H\ N_2O(g) = 81$ kj mol^{-1}; $\Delta_f N_2O_4(g) = 9.7$ kj mol^{-1}

Q.26. Assign a reason for each of the following statements.

(i) First ionization enthalpy of boron (Z = 5) is slightly less than that of beryllium (Z = 4).

(ii) Electron gain enthalpy of F is less negative than chlorine (Cl).

(iii) The size of an anion is always larger than that of parent atom.

Q.27. Explain the following(Any Two)

a: Metamerism

b. Hyperconjugation

c. Chromatography.

Q.28. A compound contains 4.07% hydrogen, 24.27% carbon and 71.65% chlorine. Its molar mass is 98.96 g. What are its empirical and molecular formulae?

SECTION D

The following questions are case -based questions. Each question has an internal choice and carries 4 (1+1+2) marks each. Read the passage carefully and answer the questions that follow.

Q.29. The molecular orbital theory is based on the principle of a linear combination of atomic orbitals. According to this approach when atomic orbitals of the atoms come closer, they undergo constructive interference as well as destructive interference giving molecular orbitals, i.e. two atomic orbitals overlap to form two molecular orbitals, one of which lies at a lower energy level (bonding molecular orbital). Each molecular orbital can hold one or two electrons in accordance with Pauli's exclusion principle and Hund's rule of maximum multiplicity

Bond order=1/2 [bonding electrons – anti bonding electrons]

Bond order gives the following information:

I. If bond order is greater than zero, the molecule/ion exists otherwise not.

II. Higher the bond order, higher is the bond dissociation energy.
III. Higher the bond order, grater is the bond stability.
IV. Higher the bond order, shorter is the bond length.

Answer the following questions:

(a) Why He_2 does not exist?

(b) Compare the relative stability of O_2 and O_2^-

OR

Why bonding molecular orbital has lower energy?

(c) In which set of molecules all the species are paramagnetic?

a. B_2, O_2, N_2 b. B_2, O_2, NO c. B_2, F_2, O_2 d. B_2, O_2, L_{i2}

Q.30. The existing large number of organic compounds and their ever-increasing numbers has made it necessary to classify them on the basis of their structures. Organic compounds are broadly classified as open-chain compounds which are also called aliphatic compounds. Aliphatic compounds further classified as homocyclic and heterocyclic compounds. Aromatic compounds are special types of compounds. Alicyclic compounds, aromatic compounds may also have heteroatom in the ring. Such compounds are called heterocyclic aromatic compounds. Organic compounds can also be classified on the basis of functional groups, into families or homologous series. The members of a homologous series can be represented by general molecular formula and the successive members differ from each other in molecular formula by a $–CH_2$ unit.

Answer the following questions:

(a) Any one example of Hetrocyclic compound.

(b) Why organic compounds are large in number?

(c) What are the criterion to be an aromatic compound?

OR

Define Homologous series.

SECTION E

Directions (Q.Nos.31 -33): The following questions are long answer type and carry 5 marks each. All questions have an internal choice.

Q.31. (i) How can you convert:

(a) Acetylene to Toluene?

(b) But-2-ene to Ethanal?

(ii) Give a chemical test to distinguish between ethane and ethyne.

(iii) Give a brief account for the following statements:

(a) trans pent-2-ene is polar while trans but-2-ene is non-polar.

(b) n-Pentane has greater boiling point than neo-pentane.

OR

(i) Convert:

(a) Benzene to p-nitrobromobenzene

(b) Ethyl chloride to ethene

(ii) Give mechanism of addition of HBr to propene.

(iii) Write a note on Friedel–Crafts alkylation.

Q.32. a. Show that the circumference of the Bohr orbit for the hydrogen atom is an integral multiple of the de Broglie wavelength associated with the electron revolving around the orbit.

b. The mass of an electron is 9.1×10^{-31} kg. If its kinetic energy is 3.0×10^{-25} J, calculate its wavelength.

OR

Explain the following a: Photoelectric effect b. Heisenberg's Uncertainity principle

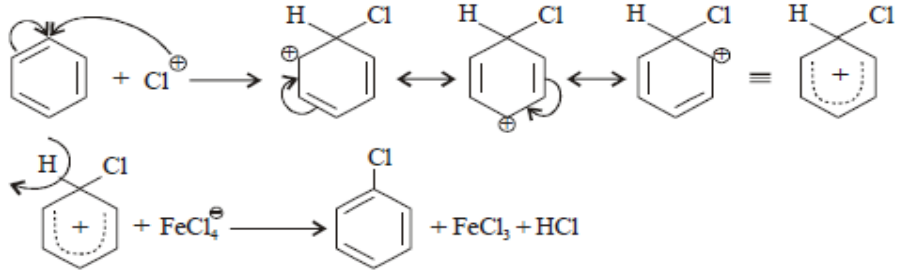
Q.33.a. Calculate the enthalpy change for the reaction: $H_2(g) + Cl_2(g) \longrightarrow 2HCl(g)$. Given that bond energies of H-H, Cl- Cl and H-Cl bonds are 433, 244 and 431kj mol^{-1} respectively.

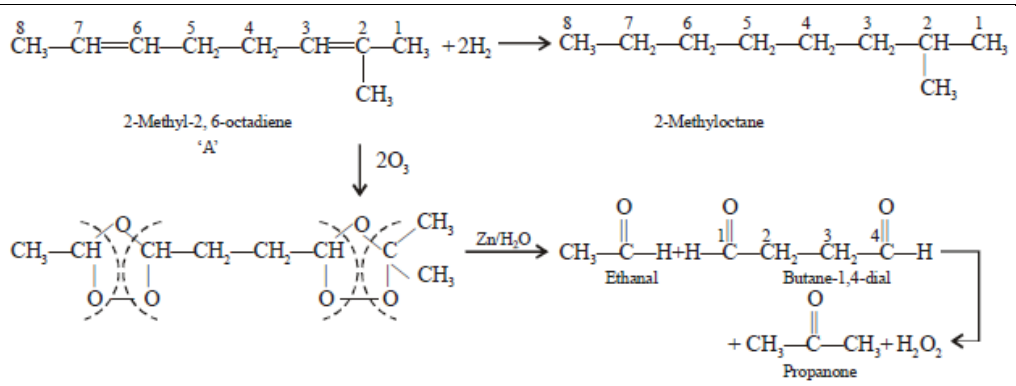
b. Explain Extensive and Intensive Properties.

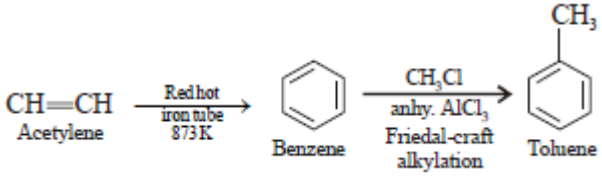
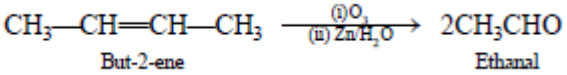
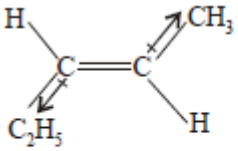
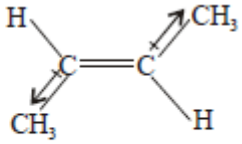
OR

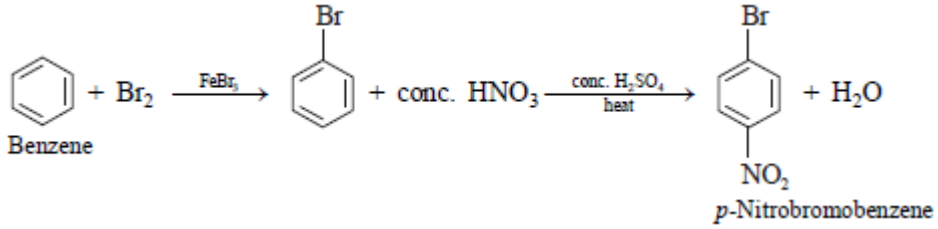
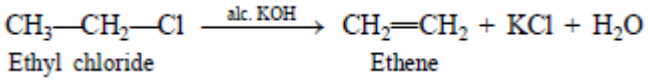
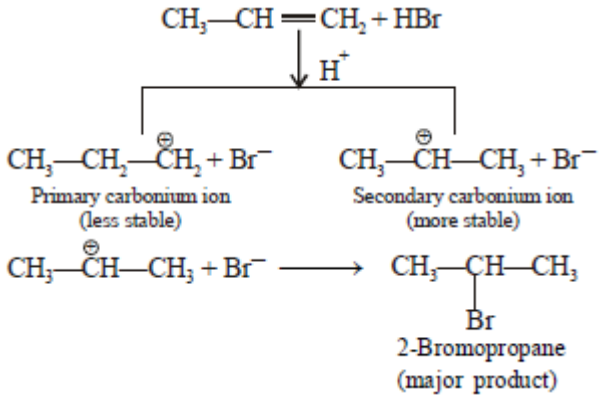
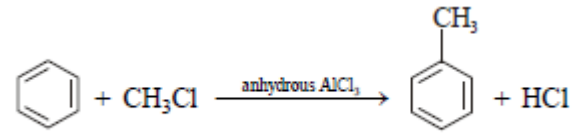
a. Derive the relationship of Cp and Cv
b. Explain Mathematical form of first law of thermodynamics.
c. What is Gibbs Helmholtz equation?

Marking scheme XI		
Q.1	(c) Orientation of orbitals	1
Q.2	(d) NO	1
Q.3	(a) 24 g of C (12)	1
Q.4	(b)Hydrogen	1
Q.5	(d) I^-	1
Q.6	(b) CO_2	1
Q.7	(a) one	1
Q.8	(b) distillation	1
Q.9	(c) SO_3	1
Q.10	(c) p – Block	1
Q.11	(b) $H_2O_2 \rightarrow H_2O + ½ O_2$	1
Q.12	(d) 3,3 and 3 respectively	1
Q.13	b	1
Q.14	a	1
Q.15	d	1
Q.16	a	1
Q.17	$\nu = \frac{c}{\lambda} = \frac{3\times10^8\ m\ s^{-1}}{750\times10^{-9}\ m} = 4 \times 10^{14}$ Hz; $E = h\nu = 6.63 \times 10^{-34} \times 4 \times 10^{14}$ $= 2.652 \times 10^{-19}$ J $\nu = \frac{3\times10^8\ m\ s^{-1}}{400\times10^{-9}\ m} = 7.5 \times 10^{14}$ Hz; $E = 6.63 \times 10^{-34} \times 7.5 \times 10^{14} = 4.972 \times 10^{-19}$ J OR Aufbau- A german word building up, Electrons always enters in an orbital in increasing order of energy. 1s< 2s<2p <3s …….. Hund's Rule – pairing will be done only when each orbital is singly occupied.	2 2
Q.18	$P_4(s) + OH^-(aq) \longrightarrow PH_3(g) + H_2PO_2^-(aq)$ $12H_2O(l) + 12e^- + P_4(s) \longrightarrow 4PH_3(g) + 12OH^-(aq)$ 0 −3 $[8OH^-(aq) + P_4(s) \longrightarrow 4H_2PO_2^-(aq) + 4e^-$ 0 +1 $12H_2O(l) + 4P_4(s) + 12OH^-(aq) \longrightarrow 4PH_3(g) + 12H_2PO_2^-(aq)$ is a balanced equa Dividing whole equation by 4, we get: $3H_2O(l) + P_4(s) + 3OH^-(aq) \longrightarrow 4PH_3(g) + 3H_2PO_2^-(aq)$ is balanced equation.	2
Q.19	$Be^{2+} < Mg^{2+} < Na^+ < Cl^- < S^{2-} < Br^-$	2
Q.20	(a) According to Le Chatelier's principle, on addition of H_2, the equilibrium of the given reaction will shift in the forward direction. (b) On addition of CH_3OH, the equilibrium will shift in the backward direction. (c) On removing CO, the equilibrium will shift in the backward direction. (d) On removing CH_3OH, the equilibrium will shift in the forward direction.	½*4 =2

Q.21	Average atomic mass $= \frac{34.9689 \times 75.77 + 36.9659 \times 24.23}{100}$ $= \frac{2649.59 + 895.68}{100} = 35.4527 \text{ g mol}^{-1}$	2
Q.22	(*i*) (*a*) 4-Ethyl-2,6-dimethyldec-4-ene (*b*) 4-Phenylbut-1-ene (*ii*) $FeCl_3 + Cl_2 \longrightarrow FeCl_4^{\ominus} + Cl^{\oplus}$  	1+1 +1
Q.23	$Al(OH)_3 \rightleftharpoons Al^{3+} + 3OH^-$ '*s*' '3*s*' Molar mass of $Al(OH)_3 = 27 + 48 + 3$ $= 78 \text{ g mol}^{-1}$ $K_{sp} = [Al^{3+}] [OH^-]^3$ $2.7 \times 10^{-11} = (s)\ (3s)^3$ $27 \times 10^{-12} = 27s^4$ $s = 1 \times 10^{-3} \text{ mol L}^{-1}$ Solubility in g L^{-1} = Solubility in mol L^{-1} × Molar mas $= 1 \times 10^{-3} \times 78 = 78 \times 10^{-3}$ $= 7.8 \times 10^{-2} \text{ g L}^{-1}$ $[OH^-] = 3 \times 10^{-3} \text{ M}$ $pOH = -\log [OH^-]$ $= -\log 3 \times 10^{-3}$ $= -\log 3 - \log 10^{-3}$ $= -0.4771 + 3.000 = 2.5229$ $pH = 14 - pOH = 14 - 2.5229 = 11.4771$ Or Buffer solution : A buffer solution is one which maintains its pH fairly constant even upon the addition of small amounts of acid or base. Two common types of bufffer solutions are : 1. a weak acid together with a salt of the same acid with a strong base. These are called acid buffers, (eg): $CH_3COOH+CH_3COONa$ 2. a weak base Mid its salt with a strong acid. These are called basic buffers, (eg) : NH_4OH+NH_4Cl	3 3

<table>
<tr><td>Q.24</td><td> 
</td><td>3</td></tr>
<tr><td>Q.25</td><td>$\Delta_r H^0 = \sum \Delta_f H^0$ (Products) $- \sum \Delta_f H^0$(Reactants)
$= [\Delta_f H^0(N_2O) + 3 \times \Delta_f H^0(CO_2)]$
$- [\Delta_f H^0(N_2O_4) + 3\Delta_f H^0(CO)]$
$= [81 + 3(-393)] - [9.7 + 3(-110)]$
$= 81 - 1179 - 9.7 + 330$
$= -1188.7 + 441 = -777.7$ kJ</td><td>3</td></tr>
<tr><td>Q.26</td><td>(i) It is due to completely filled ‘s’ orbital in case of Be (Z = 4), which is more stable.
(ii) It is due to strong interelectronic repulsion between valence electrons of ‘F’ atoms as compared to ‘Cl’ atoms.
(iii) Anions are formed by gain of electrons but number of protons remain the same, therefore, effective nuclear charge decreases, that is why the size of anion is larger than neutral atom.</td><td>1+1
+1</td></tr>
<tr><td>Q.27</td><td>a. It is a type of isomerism in which compounds have the same molecular formula but different alkyl groups on either side of functional groups and are called Metamers.
e.g. $C_4H_{10}O$ has $C_2H_5O\ C_2H_5$ and $C_3H_7O\ CH_3$
b. Hyperconjugation (conjugation or no-bond resonance) is the delocalization of electrons with the presence of mostly - character bonds in organic chemistry
c. Chromatography is an important biophysical technique that enables the separation, identification, and purification of the components of a mixture for qualitative and quantitative analysis.</td><td>1.5
*2</td></tr>
<tr><td>Q.28</td><td><table>
<tr><th>Element</th><th>%</th><th>Atomic Weight</th><th>Relative no. of Atoms</th><th>Divide by Least</th><th>Simplest Ratio</th></tr>
<tr><td>C</td><td>24.27</td><td>12</td><td>$\frac{24.27}{12} = 2.02$</td><td>$\frac{2.02}{2.02} = 1$</td><td>1</td></tr>
<tr><td>H</td><td>4.07</td><td>1</td><td>$\frac{4.07}{1} = 4.07$</td><td>$\frac{4.07}{2.02} = 2$</td><td>2</td></tr>
<tr><td>Cl</td><td>71.65</td><td>35.5</td><td>$\frac{71.65}{35.5} = 2.02$</td><td>$\frac{2.02}{2.02} = 1$</td><td>1</td></tr>
</table>
ANS:
Empirical formula = CH_2Cl
Empirical formula weight = 12 + 2 + 35.5 = 49.5
Molecular weight = 98.96 g mol–1</td><td>3</td></tr>
</table>

	Therefore, $n = \frac{98.96}{49.5} = 2$ Molecular formula = **n** (Empirical formula) = 2 (CH_2Cl) = $C_2H_4Cl_2$	
Q.29	a. As bond order of He is zero b. $O_2 > O_2^-$ or because of the increased stability associated with the formation of a bond. c. b. B_2, O_2, NO	1 +1+ 2
Q.30	a. Pyridine , Thiophene, Furan any one b. due to catenation and tetravalency c. It must be cyclic , show resonance and follow huckle rule 4n+2 pi electrons OR A series of compounds with same general formula and difference of –CH2	1+1 +2
Q.31	(i) (a) Acetylene to Toluene. Acetylene, on heating in presence of Fe tube gives benzene which on reaction with CH_3Cl in presence of $AlCl_3$ gives toluene.  (b) But-2-ene to Ethanal: But-2-ene, on ozonolysis followed by reduction with Zn with and H_2O gives ethanal.  (ii) On reaction of ethane with bromine, the brown colour of bromine does not get decolourised, but due to addition reaction in unsaturated compound ethyne, reddish brown colour of bromine is decolourised. (iii) (a) In trans pent-2-ene, the polarity is unequal in opposite directions but in trans but-2-ene, the dipole moment is equal in opposite directions and hence cancel leading to non-polar molecule.  Trans-pent-2-ene Dipole moment is unequal in opposite directions  Trans-but-2-ene Dipole moment is equal in opposite directions (b) Due to branching, the surface area of neo-pentane, is lesser than n-pentane. Hence, the magnitude of van der Waals' force of attraction in n-pentane is greater and it has higher boiling point. Or	1+1 +1+ 1+1 1+1 +2+ 1

	i)  Benzene *p*-Nitrobromobenzene (b) Ethyl chloride on treatement with alc KOH gives ethene.  Ethyl chloride Ethene (ii) Mechanism of addition of HBr to propene:  Primary carbonium ion (less stable) Secondary carbonium ion (more stable) 2-Bromopropane (major product) (iii) Friedel–Craft's alkylation: It is the reaction of benzene with alkyl halide in presence of anhydrous aluminium chloride. The reaction results in the formation of alkyl benzene.  Benzene Methylbenzene	
Q.32	a. Since a hydrogen atom has only one electron, according to Bohr's postulate, the angular momentum of that electron is given by: $mvr=nh2\pi$.....(1) Where, n = 1, 2, 3, … According to de Broglie's equation: $\lambda=hmv$or $mv=h\lambda$.....(2) Substituting the value of 'mv' from expression (2) in expression (1): $hr\lambda=nh2\pi$or $2\pi r=n\lambda$.....(3) b. From de Broglie's equation, $\lambda=hmv$ Given, Kinetic energy (K.E) of the electron = 3.0 × 10–25 J Since $K.E=12mv2\therefore$Velocity$(v)=\sqrt{2K.Em}$ $=\sqrt{2(3.0\times10-25J)9.10939\times10-31kg}$ $=\sqrt{6.5866\times10^4}$ $v=811.579ms-1$ Substituting the value in the expression of λ:	3+2 2.5 +2.5

	λ=6.626×10−34Js(9.10939×10−31kg)(811.579ms−1)λ=8.9625×10−7m Hence, the wavelength of the electron is 8.9625×10^{-7} m. or a.The **photoelectric effect** is a phenomenon in which electrons are ejected from the surface of a metal when light is incident on it. These ejected electrons are called **photoelectrons**. It is important to note that the emission of photoelectrons and the kinetic energy of the ejected photoelectrons is dependent on the frequency of the light that is incident on the metal's surface b. **Heisenberg's uncertainty principle** states that it is impossible to measure or calculate exactly both the position and the momentum of an object. This principle is based on the wave-particle duality of matter. Δx×ΔP>or=h/ **4π**	
Q.33	a. Energy absorbed for dissociation of 1 mole of H-H bonds = 433 kJ/mol Energy absorbed for dissociation of 1 mole of Cl-Cl bonds = 244 kJ/mol Total energy absorbed = 677 kJ/mol Energy released in the formation of 2 moles of H-Cl bond = 431 x 2 = 862 kJ/mol Energy released is greater than Energy absorbed Hence, net result is the release of energy. Energy released = 862 – 677 = 185 kJ/mol For the given reaction, ΔrH = - 185 kJ/mol b. Extensive : An extensive property of a system depends on the system size or the amount of matter in the system. E.g Volume Intensive :The properties of matter that do not depend on the size or quantity of matter in any way are referred to as an intensive property of matter. Temperatures, density, colour, melting point etc. **OR** a. From the equation **q = n C ΔT**, we can say: At constant pressure P, we have $\mathbf{q_P = n\,C_P\Delta T}$ This value is equal to the change in enthalpy, that is, $\mathbf{q_P = n\,C_P\Delta T = \Delta H}$ Similarly, at constant volume V, we have $\mathbf{q_V = n\,C_V\Delta T}$ This value is equal to the change in internal energy, that is, $\mathbf{q_V = n\,C_V\Delta T = \Delta U}$ We know that for one mole (n=1) of an ideal gas, $\mathbf{\Delta H = \Delta U + \Delta(pV)} = \Delta U + \Delta(RT) = \Delta U + R\,\Delta T$ Therefore, $\mathbf{\Delta H = \Delta U + R\,\Delta T}$ Substituting the values of ΔH and ΔU from above in the former equation, $\mathbf{C_P\Delta T = C_V\Delta T + R\,\Delta T}$ $\mathbf{C_P = C_V + R}$ $\mathbf{C_P - C_V = R}$	3+1 +1 3+2

	b. If U_1 is the initial internal energy of a system which absorb q heat and w work done on the system then internal energy become U_2. so $U_2 = U_1 + q + w$ i.e $\Delta U = q + w$. c. $\Delta G = \Delta H - T\Delta S$	

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S.No.	Name of Unit	1 Mark Question	2 Marks Question	3 Marks Question	4 Marks Question	5 Marks Question	Total Marks
1	Some Basic Concepts of Chemistry	**2(2)**	**1(2)**	**1(3)**	-	-	**7**
2	Structure of Atom	**2(2)**	**1(2)**	-		**1(5)**	**9**
3	Classification of Elements and Periodicity in Properties	**1(1))**	**1(2)**	**1(3)**		-	**6**
4	Chemical Bonding and Molecular Structure	**3(3)**	-	-	**1(4)**	-	**7**
5	Chemical Thermodynamics	**1(1)**	-	**1(3)**		**1(5)**	**9**
6	Equilibrium	**2(2)**	**1(2)**	**1(3)**		-	**7**
7	Redox Reactions	**2(2)**	**1(2)**			-	**4**
8	Organic Chemistry: Some basic Principles and Techniques	**1(1)**	-	**2(6)**	**1(4)**	-	**11**
9	Hydrocarbons	**2(2)**	-	**1(3)**	-	**1(5)**	**10**
	Total	**16**	**10**	**21**	**8**	**15**	**70**

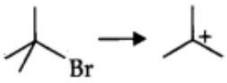
SET-14

QUESTION PAPER-XI
SESSION ENDING EXAMINATION
CHEMISTRY THEORY (043)

MM:70 **Time: 3 Hrs**

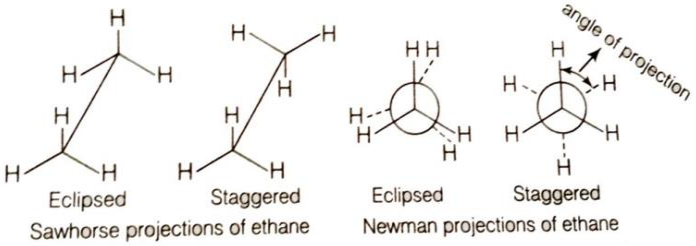
SECTION A

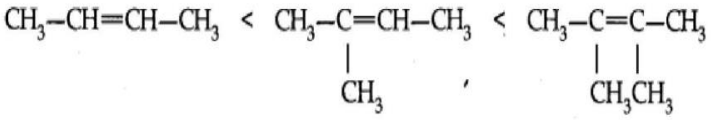
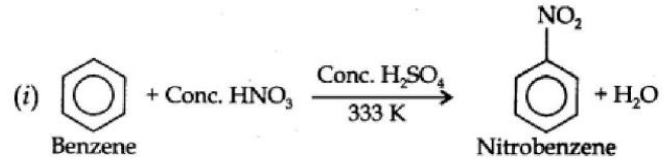
1	Which of the following is dependent on temperature? (a) Molality (b) Molarity (c) Mole fraction (d) Mass percentage	1
2	Correct set of four Quantum numbers for the valence electron of rubidium (Z= 37) is (a)5,0,0,+½ (b)5,1,0,+½ (c)5,1,1,+½ (e)6,0,0,+½	1
3	Which of the following orbitals has the lowest energy? (a) 4d (b) 4f (c) 5s (d) 5p	1
4	The correct order of first ionization potential among following elements, Be, B, C, N and O is (a) B < Be < C < O < N (b) B < Be < C < N < O (c) Be < B < C < N < O (d) Be < B < C < O < N	1
5	The electronic configuration of halogen is (a) ns^2 np6 (b) ns^2 np3 (c) ns^2 np5 (d) ns^2	1
6	Which of the following chemical species has highest bond order? (a) O^2 (b) O^{2+} (c) O^{2-} (d) $O2^{2-}$	1
7	Which one of the following pairs does not represent example for intensive property? (a) Temperature and density (b) Pressure and molar volume (c) Molar heat capacity and density (d) Heat capacity and enthalpy	1
8	The enthalpy's of all elements in their standard state are: (a) unity (b) zero (c) <0 (d) different for each element	1
9	Which of the following is not a Lewis acid (a) BF_3 (b) $AlCl_3$ (c) $FeCl_3$ (d) PH_3	1
10	Which of the following salts will give a basic solution on hydrolysis (a) NH_4Cl (b) KCl (c) K_2CO_3 (d) $(NH_4)_2CO_3$	1
11	A reducing agent is a substance which can (a) accept electrons (b) donate electrons (c) accept protons (d) donate protons	1
12	The oxidation number of C in CH_2O is (a) -2 (b) 0 (c) +2 (d) +4	1
13	Assertion (A) : Electron gain enthalpy becomes less negative as we go down a group. Reason (R) : Size of the atom increases on going down the group and the added electron would be farther from the nucleus.	1
14	Assertion. Copper is unable to displace H_2 form dil. H_2SO_4.	1

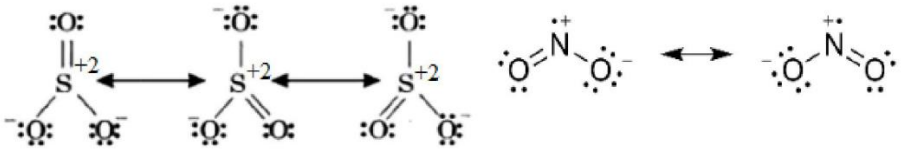
	Reason. The standard electrode potential for Cu^{2+}/Cu system is greater than that of H^+/H_2	
15	Assertion. 1.231 has three significant figures. Reason : All numbers right to the decimal point are significant.	1
16	Assertion. Energy of p orbital is greater than s orbital Reason : Energy of orbital depends on n+l.	1
	SECTION B	
17	What is n+l rule? Arrange the following orbitals in the increasing order of energy. (a) 4s, 3s, 3p, 4d (b) 5p, 4d, 5d, 4f, 6s	2
18	Give the law of chemical equilibrium. How the equilibrium constant for forward and backward reaction related to each other.	2
19	Draw Newman and Sawhorse projections for the eclipsed and staggered conformations of ethane. Which of these conformations is more stable and why?	2
20	List two measures used to prevent rusting of iron.	2
21	a)Arrange the following on the basis of their electron affinity. N, P, O, S, F, Cl b)Arrange the following elements on the basis of first ionization enthalpy. Li, Be, B, C, N, O, F, Ne	2
	SECTION C	
22	What are electrophiles and nucleophiles ? Explain with examples.	3
23	Explain hyperconjugation effect. How does hyperconjugation effect explain the stability of alkenes?	3
24	a) Name the species formed in: (i) Homolytic cleavage (ii) Heterolytic cleavage of a chemical bond b) What is Lassaigne's extract? c) Identify the reagent shown in bold in the following equation as nucleophile or electrophile $CH_3COOH + HO^- \rightarrow CH_3COO^- + H_2O$ OR For the following bond cleavages, use curved-arrows to show the electron flow and classify each as homolysis or heterolysis. Identify reactive intermediate produced as free radical, carbocation and carbanion. (a) $CH_3O—OCH_3 \longrightarrow CH_3\dot{O} + \dot{O}CH_3$ (b)  (c) 	3
25	a) Explain why the electron gain enthalpy of fluorine is less negative than that of chlorine. b) Write the IUPAC name of the elements with atomic number 112 and 123.	2+1=3
26	Give three important characteristics of equilibria involving physical processes. The value of ΔG^o for the hydrolysis of ester is 13.8kJ/mol. Find out the value of Kc at 298 K.	3
27	Give equation for the following: (i) Electrophilic Substitution (ii) Nucleophilic Substitution	3

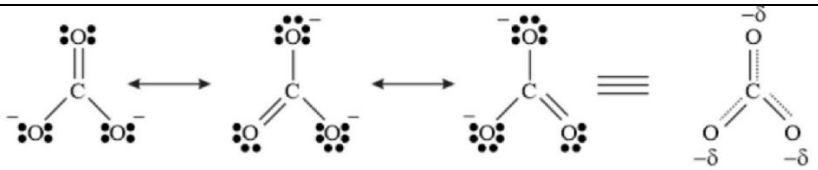
28	a) Predict in which of the following, entropy increases/decreases : (i) A liquid crystallizes into a solid. (ii) Temperature of a crystalline solid is raised from 0 K to 115 K	3
	SECTION D	
29	Read the following passage and answer the questions from i) to iii): Every system is associated with a definite amount of energy, called the internal energy (U or E) of the system. It is the sum of chemical, electrical, mechanical or any other form of energy that anyone can may think of. However gravitational energy is generally necklaces neglected. It is a state function, i. e. independent of the path followed. lt may change when i) heat flows in or out of the system. ii) work is done on or by the system. Iii) matter enters or leaves the system It is an extensive property i.e. depends upon the mass of a substance. It depends only on temperature. The absolute value of internal energy possessed by a substance cannot be calculated because it is not possible to predict the exact values of different forms of energy. Thus, we can just calculate the change in internal energy which is achieved by changing the state of a system. First law of thermodynamics was proposed by Helmholtz and Robert- mayer who stated that the energy in of an isolated system is constant. i.e. energy can neither we created nor be destroyed but can be converted from one form to another. That's why it is also called law of conservation of energy. When a system undergoes isothermal ΔU = zero i.e. there is no increase or decrease in the internal energy of the system then the first law of thermodynamics reduce to $0=q + w$ or $q = -w$. i) neither q not w is a state function but q + w is a state function explain why? ii) Out of mass and density which is an intensive property and why? iii) Explain thermodynamically how is the heat absorbed by system is used in doing work at constant temperature and pressure. OR What is the change in the energy of system if 500 Cal of heat energy are added to a system and system does 350 cal of work on the surroundings?	4
30	The rotation of carbon-carbon single bond (sigma -bond), due to cylindrical symmetry of s-MOs (molecular orbitals) long internuclear axis, in alkanes results into different spatial arrangements of atoms in space, that are interconvertible. These arrangements are called conformations. However, weak repulsive interaction are present between the adjacent bonds in alkanes so the rotation of C—C single bond is not completely free and is hindered by a small energy barriers of 1-20 kJ mol1 . The repulsive interaction between the adjacent bond is due to electron cloud. The two types of conformations are very common, i.e., staggered and eclipsed. The conformation in which the hydrogen atoms attached to the two carbon atoms are as far apart as possible is called the staggered conformation. The conformations in which the hydrogen atoms attached to the two carbon atoms are as closed as possible is called eclipsed	4

	conformation. Any intermediate conformation between the above two is called skew or gauche conformation (i) The electronic distribution of the sigma molecular orbital is symmetrical around the internuclear axis of C-C bond which permits free rotation around C-C bond. Such spatial arrangements of atoms in which conversion of one another takes place by rotation around C-C bond is known as (a) rotamers (b) conformers (c) conformations (d) All of these (ii) The possible rotamers of ethane is/are (a) 2 (b) 3 (c) 4 (d) ∞ (iii) Why can different conformations of ethane not be separated and isolated ? (iv) Define torsional strain. (v) What is the reason of conformation?	
31	a)What are the limitations of Bohr' model? What were the reasons for it's failure. b)What are the postulates of Rutherford's model of atom?	3+2= 5
32	a) o-Nitro phenol is steam volatile while p-Nitro phenol is not. Give reason. b) Why is H_2O liquid and H_2S a gas? c) Draw resonating structures of (i) SO_3 (ii) NO_2 (iii) CO_3^{2-}	3+2
33	i) Give three points of differences between inductive effect and resonance effect. ii) a)What is Lassaigne's extract? Will NaCN give a positive Lassaigne's test for nitrogen? (b) Which colour will appear in the Lassaigne's test if the compound contains both nitrogen and sulphur. (c) Why is Lassaigne's extract prepared in distilled water? Can we detect oxygen in a compound by Lassaigne's test?	3+2= 5

	MARKING SCHEME
	SECTION A
1	B
2	A
3	C
4	A
5	C
6	B
7	D
8	B
9	D
10	C
11	B
12	B
13	A
14	A
15	D
16	A
	SECTION B
17	The lower the value of (n + l) for an orbital, the lower is its energy. If two orbitals have the same value of (n + l), the orbital with lower value of n will have the lower energy. (a)3s<3p<4s< 5p < 6s < 4f < 5d
18	Ans: At a given temperature, the product of concentrations of the reaction products raised to the respective stoichiometric coefficient in the balanced chemical equation divided by the product of concentrations of the reactants raised to their individual stoichiometric coefficients has a constant value. This is known as the Equilibrium Law or Law of Chemical Equilibrium. Equilibrium constant for backward reaction is inverse of the equilibrium constant for the forward reaction.
19	Ans. The staggered conformation is most stable because the hydrogens and bonding pairs of electrons are at maximum distance.  Sawhorse projections of ethane Newman projections of ethane
20	Ans: (i) galvanization (coating iron by a more reactive metal) (ii) greasing/oiling and painting.
21	Ans. Cl > F > S > O > P > N Ans. Ne > F > N > O > C > Be > B > Li
	SECTION C

22	Nucleophile: A nucleophile is electron rich species and donates electron pairs to electron deficient species. Examples include carbanions, water , ammonia, cyanide ion etc Electrophile: Electrophiles are electron deficient species and can accept an electron pair from electron rich species. Examples - carbocations
23	Ans: Hyperconjugation: The relative stability of various classes of carbonium ions may be explained by the number of no-bond resonance structures that can be written for them. Such structures are arrived by shifting the bonding electrons from an adjacent C—H bond to the electron-deficient carbon. In this way, the positive charge originally on carbon is dispersed to the hydrogen. This manner of electron release by assuming no-bond character in the adjacent C—H bond is called Hyperconjugation or No-Bond Resonance. The greater the hyperconjugation, the greater will be the stability of the compound. The increasing order of stability can be shown as 
25	a) This is due to the small size of the fluorine atom. As a result of the strong inter-electronic repulsions in fluorine is relatively small 2p orbitals, the incoming electron does not experience much attraction. b). 112- unnunnbium (uub), 123- unnbitrium (ubt)
26	Ans: Any three important characteristics of equilibrium involving physical processes. Using $\Delta G0 = -2.303RT\log Kc$ $Kc = 3.81\times10^{-3}$
27	 (i) Benzene + Conc. HNO_3 $\xrightarrow[333\ K]{Conc.\ H_2SO_4}$ Nitrobenzene + H_2O (ii) $CH_3CH_2I + KOH(aq) \longrightarrow CH_3CH_2OH + KI$ (ethanol)
28	(i) decreases (ii) increases b) State first law of thermodynamics. Write mathematical expression for first law of thermodynamics. Ans. Energy can neither be created nor destroyed all though it may be converted from one form to another. $\Delta U = q + w$
	SECTION D
29	i) from first law of thermodynamics $\Delta U = q + w$ as $q + w$ is equal to ΔU which is a state function it does not depends upon path of reaction and only depends upon initial and final state. ii) Density is an intensive property as it characteristics of a material and does not change with amount where as mass does change. iii) $\Delta U = q + w$ (from first law of thermodynamics) $0 = q + w$. ($\Delta U = 0$ at constant Temp.) $0 = q - p\,\Delta V$ $q = -w$ Therefore heat absorbed is used to do work by the system. OR According to the first law of thermodynamics. $\Delta E = q + w = 500 + (-350) = +150$ cal.

30	i. (d) All of these ii. (d) ∞ iii. Ans. Because of small energy barrier iv. The repulsive interaction between the electron clouds, which affects stability of a conformation is termed as torsional strain. v. Ans. Rotation around carbon - carbon single bonds is the reason of conformation.
	SECTION E
31	**(a) Limitations of Bohr' model** 1.This model is also unable to explain the spectrum of atoms other than hydrogen 2.It was also unable to explain the splitting of spectral lines in the presence of magnetic field (Zeeman effect) or an electric field (Stark effect). 3. It could not explain the ability of atoms to form molecules by chemical bonds. 4.It could not explain doublet, that is two closely spaced lines of the hydrogen atom spectrum observed by using sophisticated spectroscopic techniques. **Reasons for the Failure of the Bohr Model** 1. Bohr model of the hydrogen atom, ignores dual behaviour of matter. In it electron is regarded as a charged particle moving in well defined circular orbits about the nucleus. The wave character of the electron is not considered. 2. An orbit is a clearly defined path and this path can completely be defined only if both the position and the velocity of the electron are known exactly at the same time. This is not possible according to the Heisenberg uncertainty principle. **(b)** Rutherford proposed the nuclear model of atom. According to this model: (i) The positive charge and most of the mass of the atom was densely concentrated in extremely small region. This very small portion of the atom was called nucleus by Rutherford. (ii) The nucleus is surrounded by electrons that move around the nucleus with a very high speed in circular paths called orbits. Thus, Rutherford's model of atom resembles the solar system in which the nucleus plays the role of sun and the electrons that of revolving planets. (iii) Electrons and the nucleus are held together by electrostatic forces of attraction.
32	(a) o-nitrophenol is steam volatile due to intramolecular hydrogen bonding while p-nitrophenol is less volatile due to intermolecular hydrogen bonding which causes the association of molecules. Intramolecular hydrogen bonding takes place in ortho-nitrophenol because of the NO_2 and OH molecules close proximity to each other. (b) Because of high electronegativity of oxygen, water molecules associates via intermolecular hydrogen bonding. ii. While because of low electronegativity of sulphur, no hydrogen bonding is possible for H_2S molecules. iii. Therefore at room temperature, H_2O is a liquid and H_2S is a gas. 



Resonating structures Resonating hybride

33

Inductive Effect	Resonance Effect
It involves the displacement of σ-electrons.	It involves the displacement of π-electrons or any lone pair of electrons.
This effect moves up to three carbon atoms before becoming insignificant after the fourth carbon atom.	The resonance effect moves all along the length of the conjugated system.
This operates in saturated compounds.	This operates only in unsaturated conjugated systems.

ii) (a) When organic compound is fused with sodium metal and then extracted by water, it is called Lassaigne's extract. Yes.
(b) Blood red colour. (c) Lassaigne's extract is prepared in distilled water since tap water contains CL ions. No, oxygen cannot be detected by Lassaigne's test.

BLUE PRINT

	Name of Unit	1 Mark Que	2 Marks Que	3 Marks Que	4 Marks Que	5 Marks Que	Total Marks
1	Some Basic Concepts of Chemistry	**2(2)**	**1(2)**	**1(3)**	-	-	**7**
2	Structure of Atom	**2(2)**	**1(2)**	-		**1(5)**	**9**
3	Classification of Elements and Periodicity in Properties	**1(1))**	**1(2)**	**1(3)**		-	**6**
4	Chemical Bonding and Molecular Structure	**3(3)**	-	-	**1(4)**	-	**7**
5	Chemical Thermodynamics	**1(1)**	-	**1(3)**		**1(5)**	**9**
6	Equilibrium	**2(2)**	**1(2)**	**1(3)**		-	**7**
7	Redox Reactions	**2(2)**	**1(2)**			-	**4**
8	Organic Chemistry: Some basic Principles and Techniques	**1(1)**	-	**2(6)**	**1(4)**	-	**11**
9	Hydrocarbons	**2(2)**	-	**1(3)**	-	**1(5)**	**10**
	Total	**16**	**10**	**21**	**8**	**15**	**70**

SET-15

QUESTION PAPER-XI
SESSION ENDING EXAMINATION
CHEMISTRY THEORY (043)

MM:70 **Time: 3 Hrs**

Read the following instructions carefully.

(a) There are 33 questions in this question paper with internal choice.
(b) SECTION A consists of 16 multiple -choice questions carrying 1 mark each.
(c) SECTION B consists of 5 short answer questions carrying 2 marks each.
(d) SECTION C consists of 7 short answer questions carrying 3 marks each.
(e) SECTION D consists of 2 case - based questions carrying 4 marks each.
(f) SECTION E consists of 3 long answer questions carrying 5 marks each.
(g) All questions are compulsory.
(h) Use of log tables and calculators is not allowed.

SECTION A

The following questions are multiple -choice questions with one correct answer. Each question carries 1 mark. There is no internal choice in this section.

1. On reaction of Carbon and oxygen, formation of CO and CO_2 illustrates the law of ————.
   a. Law of conservation of mass
   b. Law of Reciprocal proportion
   c. Law of Constant Proportion
   d. Law of Multiple Proportions
2. The atomic orbital is ————
   a. The circular path of the electron
   b. Elliptical shaped Orbit
   c. Three-dimensional field around nucleus
   d. The region with max probability for electron
3. The electronic configuration of chromium (Z=24) is:
   a. [Ne] $3s^2\ 3p^6\ 3d^4\ 4s^2$
   b. [Ne] $3s^2\ 3p^6\ 3d^5\ 4s^1$
   c. [Ne] $3s^2\ 3p^6\ 3d^1\ 4s^2$
   d. [Ne] $3s^2\ 3p^6\ 4s^2\ 4p^4$
4. Which one of the following statements is incorrect in relation to ionization enthalpy?
   a. Ionization enthalpy increases for each successive electron.
   b. The greatest increase in ionization enthalpy is experienced on removal of electron from core noble gas configuration.
   c. End of valence electrons is marked by a big jump in ionization enthalpy.
   d. Removal of electron from orbitals bearing lower *n* value is easier than from orbital having higher n value.
5. The size of isoelectronic species — F^-, Ne and Na^+ is affected by
   (a) nuclear charge (Z)
   (b) valence principal quantum number (n)
   (c) electron-electron interaction in the outer orbitals
   (d) none of the factors
6. Which one of them is the weakest?
   (a) Ionic bond (b) Covalent bond (c) Metallic Bond (d) van der Waals force
7. A thermodynamic state function is a quantity
   (a) used to determine heat changes
   (b) whose value is independent of path
   (c) used to determine pressure volume work
   (d) whose value depends on temperature only.
8. The enthalpies of all elements in their standard states are:

(a) unity (b) zero (c) < 0 (d) different for each element

9. According to Lewis concept, an acid is:

a. proton donor b. electron pair donor c. electron pair acceptor d. proton acceptor

10. The pH of a solution of hydrochloric acid is 4. The molarity of the solution is:

a. 4.0 b. 0.4 c. 0.0001 d. 0.04

11. The oxidation number of Cr in $K_2Cr_2O_7$ is

a. +6 b. +3 c. -6 d. -3

12. The correct order of stability of carbocation is

a. Primary< <Tertiary< Secondary b. Secondary<Tertiary< Primary

c. Primary<Secondary<Tertiary d. Secondary< Primary<Tertiary

13. Given below are two statements labelled as Assertion (A) and Reason (R)

Assertion: Equal moles of different substances contain same number of constituent particles.

Reason: Equal weights of different substances contain the same number of constituent particles.

(a) Both A and R are true and R is the correct explanation of A

(b) Both A and R are true but R is not the correct explanation of A.

(c) A is true but R is false.

(d) A is false but R is true.

14. Given below are two statements labelled as Assertion (A) and Reason (R)

Assertion: Elements in the same column have similar properties.

Reason: Periodic properties of elements is a function of atomic number.

(a) Both A and R are true and R is the correct explanation of A

(b) Both A and R are true but R is not the correct explanation of A.

(c) A is true but R is false.

(d) A is false but R is true.

15. Given below are two statements labelled as Assertion (A) and Reason (R)

Assertion: The bond order of helium is always zero.

Reason: The number of electrons in bonding molecular orbital and antibonding molecular orbital is equal.

(a) Both A and R are true and R is the correct explanation of A

(b) Both A and R are true but R is not the correct explanation of A.

(c) A is true but R is false.

(d) A is false but R is true.

16. Given below are two statements labelled as Assertion (A) and Reason (R)

Assertion (A): Elements with greater electron affinities are better oxidizing agents.

Reason (R): Oxidation is the gaining of electrons.

(a) Both A and R are true and R is the correct explanation of A

(b) Both A and R are true but R is not the correct explanation of A.

(c) A is true but R is false.

(d) A is false but R is true.

SECTION B

This section contains 5 questions with internal choice in one question. The following questions are very short answer type and carry 2 marks each.

17. a. Write significance of Heisenberg's principle.

b. Differentiate between ψ & ψ^2.

18. What is the energy of a photon emitted during a transition from $n = 5$ state to the $n = 2$ state in the hydrogen atom? ($R_H = 2.18 \times 10^{-18}$ J)

19. a. Predict in which of the following, entropy increases/decreases:
(i) A liquid crystallizes into a solid.
(ii) Temperature of a crystalline solid is raised from 0 K to 115 K.
b. For an isolated system, $\Delta U = 0$, what will be ΔS?

20. Balance the following redox reactions by ANY method
$MnO_4^-(aq) + I^-(aq) \rightarrow MnO_2(s) + I_2(s)$ (in basic medium)

OR

20. Assign oxidation number to the underlined elements in each of the following species:
(a) $NaH_2\underline{P}O_4$ (b) $NaH\underline{S}O_4$.

21. Draw the geometrical isomers (Cis/Trans) of Pent-2-ene.

SECTION C

This section contains 7 questions with internal choice in one question. The following questions are short answer type and carry 3 marks each.

22. a. Define molarity.
b. Calculate the molarity of NaOH in the solution prepared by dissolving its 4 g in enough water to form 250 mL of the solution. (Given Na – 23u, O – 16u, H – 1u).

23. a. Define diagonal relationship of the elements with reference to Modern Periodic Table.
b. How does ionization enthalpy generally vary in a period and in a group?
c. Among the second period elements the actual ionization enthalpies is in the order
Li < B < Be < C < O < N < F < Ne.
Explain why Oxygen has lower $\Delta_i H$ than Nitrogen?

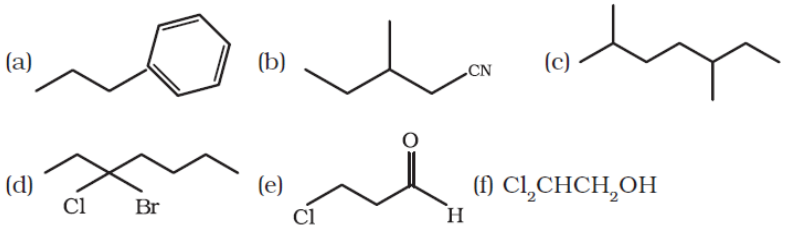
OR

23. a. Write one factor that affect ionization enthalpy.
b. Among the second period elements the actual ionization enthalpies is in the order
Li < B < Be < C < O < N < F < Ne. Explain why
(i) Be has higher $\Delta_i H$ than B (ii) O has lower $\Delta_i H$ than N and F?

24. Derive the following equation of work done.
$W = -2.303nRT\log V_2/V_1$, W, V_1 , V_2 have their usual meaning.

25. a. In a process, 701 J of heat is absorbed by a system and 394 J of work is done by the system. What is the change in internal energy for the process?
b. Derive the following equation
Cp-Cv = R, Cp, Cv and R have its usual meaning.

26. Write the IUPAC names of the following compounds.



27. a. What in inductive effect?

b. Arrange the following set of compounds in order of their decreasing relative reactivity with an electrophile, E^+

(i) Chlorobenzene, 2,4-Dinitrochlorobenzene, *p*-Nitrochlorobenzene

(ii) *p*-$H_3C - C_6H_4 - NO_2$, *p*-$O_2N - C_6H_4 - NO_2$, Toluene

28. a. Write product obtained and their IUPAC names by addition reactions of HBr to Hex-1-ene

(i) in the absence of peroxide and

(ii) in the presence of peroxide.

b. Write the products and IUPAC names of the products obtained by the ozonolysis of the compound: But-2-ene

SECTION D

The following questions are case -based questions. Each question has an internal choice and carries 4 (1+3) marks each. Read the passage carefully and answer the questions that follow.

29. Work Let us first examine a change in internal energy by doing work. We take a system containing some quantity of water in a thermos flask or in an insulated beaker. This would not allow exchange of heat between the system and surroundings through its boundary and we call this type of system as adiabatic. The manner in which the state of such a system may be changed will be called adiabatic process. Adiabatic process is a process in which there is no transfer of heat between the system and surroundings. Here, the wall separating the system and the surroundings is called the adiabatic wall.

Answer the following questions:

(i) Which of the following statement is correct?

(a) $\Delta U = W_{adiabatic}$

(b) W_{ad} = + ve, when work is done on the system

(c) W_{ad} = – ve, when work is done by the system

(d) All of the above.

(ii) A gas expands in vacuum. The work done by the gas is

(a) zero (b) minimum (c) maximum (d) cannot be predicted

(iii) 3 moles of an ideal gas are expanded isothermally and reversibly from 10 m^3 to 20 m^3 at 300 K. The work done is (R = 8.314 J K^{-1} mol^{-1}).

30. Conformations Alkanes contain carbon-carbon sigma (σ) bonds. Electron distribution of the sigma molecular orbital is symmetrical around the internuclear axis of the C–C bond which is not disturbed due to rotation about its axis. This permits free rotation about C–C single bond. This rotation results into different spatial arrangements of atoms in space which can change into one another. Such spatial arrangements of atoms which can be converted into one another by rotation around a C-C single bond are called conformations or conformers or rotamers. Alkanes can thus have infinite number of conformations by rotation around C-C single bonds. However, it may be remembered that rotation around a C-C single bond is not completely free. It is hindered by a small energy barrier of 1-20 kJ mol–1 due to weak repulsive interaction between the adjacent bonds. Such a type of repulsive interaction is called torsional strain. Conformations of Ethane: Ethane molecule (C2H6) contains a carbon – carbon single bond with each carbon atom attached to three hydrogen atoms. Considering the ball and stick model of ethane, keep one carbon atom stationary and rotate the other carbon atom around the C-C

axis. This rotation results into infinite number of spatial arrangements of hydrogen atoms attached to one carbon atom with respect to the hydrogen atoms attached to the other carbon atom. These are called conformational isomers (conformers). Thus, there are infinite number of conformations of ethane. However, there are two extreme cases. One such conformation in which hydrogen atoms attached to two carbons are as closed together as possible is called eclipsed conformation and the other in which hydrogens are as far apart as possible is known as the staggered conformation. Any other intermediate conformation is called a skew conformation. It may be remembered that in all the conformations, the bond angles and the bond lengths remain the same. Eclipsed and the staggered conformations can be represented by Sawhorse and Newman projections.

Answer the following questions:

a) Conformations are different arrangements of atoms that can be converted into one another by rotation about _____

i) Covalent bond ii) Double bond iii) Single bond iv) Triple bond

b) The energy required to rotate n-butane molecule about the carbon-carbon bond is called

i) Rotational energy ii) Torsional energy

iii) Enantiomeric energy iv) Potential energy

c) Draw both Staggered and eclipsed Newman's projections of ethane.

SECTION E

The following questions are long answer type and carry 5 marks each. All questions have an internal choice.

31. a. What would be the IUPAC name and symbol for the element with atomic number 119?

b. Which of the following species will have the largest and the smallest size?
Mg, Mg^{2+}, Al, Al^{3+}

c. Derive De Broglie equation.

d. What will be the wavelength of a ball of mass 0.1 kg moving with a velocity of 10 m s^{-1}?

OR

a. Write the electronic configurations of the following ions:
i) O^{2-} (ii) Na^{+}

b) What are the atomic numbers of elements whose outermost electrons are represented by
(i) $3s^1$ (ii) $2p^3$?

(c) Which atoms are indicated by the following configurations?
(i) [He] $2s^1$ (ii) [Ne] $3s^2\ 3p^3$

d. What is the lowest value of *n* that allows g orbitals to exist?

e. An atom of an element contains 29 electrons and 35 neutrons. Deduce the number of protons.

32. a. How many sigma and P bonds are present in each of the following molecules?
$H_2C=C=CHCH_3$

b. Explain why $(CH_3)_3C^+$ is more stable than $CH_3{}^+CH_2$ and $^+CH_3$ is the least stable cation.

c. Write the structures of the following names of organic compounds

i). *o*-Ethylanisole ii). *p*-Nitroaniline

iii). 2,3 - Dibromo -1 – phenylpentane iv). 4-Ethyl-1-fluoro-2-nitrobenzene.

v). 2,2-Dimethylpentane vi). But-3-yn-1-ol

OR

32. a. Which of the two: $O_2NCH_2CH_2O^-$ or $CH_3CH_2O^-$ is expected to be more stable and why?
    b. Explain why alkyl groups act as electron donors when attached to a π system.
    c. Explain the terms Inductive and Electromeric effects.
    $Cl_3CCOOH > Cl_2CHCOOH > ClCH_2COOH$
    d. Discuss the chemistry of Lassaigne's test.

33. a. Express the change in internal energy of a system when No heat is absorbed by the system from the surroundings, but work(w) is done on the system. What type of wall does the system have?
    b. Two litres of an ideal gas at a pressure of 10 atm expands isothermally at 25 °C into a vacuum until its total volume is 10 litres. How much heat is absorbed and how much work is done in the expansion?
    c. Define the Hess's Law of Constant Heat Summation.
    d. If water vapour is assumed to be a perfect gas, molar enthalpy changes for vaporisation of 1 mol of water at 1bar and 100°C is 41kJ mol^{-1}. Calculate the internal energy change, when 1 mol of water is vapourised at 1 bar pressure and 100°C.

OR

33. a. Define spontaneous reaction/process.
    b. Predict in which of the following, entropy increases/decreases:
    (i) A liquid crystallizes into a solid.
    (ii) Temperature of a crystalline solid is raised from 0 K to 115 K.
    c. Enthalpy of combustion of carbon to CO_2 is –393.5 kJ mol^{-1}. Calculate the heat released upon formation of 35.2 g of CO_2 from carbon and dioxygen gas.
    d. What is lattice enthalpy. How can we calculate the lattice enthalpy with the help of Born – Haber cycle?

MARKING SCHEME

SECTION A

1 to 16 each correct answer 1 mark

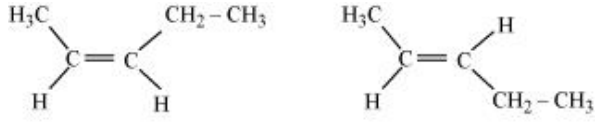
1. d. Law of Multiple Proportions
2. d. The region in which there is a maximum probability of finding an electron
3. b. [Ne] $3s^2\ 3p^6\ 3d^5\ 4s^1$
4. d. Removal of electron from orbitals bearing lower *n* value is easier than from orbital having higher n value.
5. (a) nuclear charge (Z)
6. (d) van der Waals force
7. (ii) whose value is independent of path
8. (ii) zero
9. a. proton donor
10. c. 0.0001
11. a. +6
12. c. Primary<Secondary<Tertiary
13. (c) A is true but R is false.
14. (b) Both A and R are true but R is not the correct explanation of A.
15. (a) Both A and R are true and R is the correct explanation of A
16. (c) A is true but R is false.

SECTION B

17. a. It rules out the existence of definite paths.
    b. ψ is a wave function & ψ^2 gives the probability to find an electron around the nucleus.
18. $\Delta E = R_H [1/n_i^2 - 1/n_f^2]Z^2$
    $= 2.18 \times 10^{-18}\ J\ [1/5^2 - 1/2^2]\ (1)^2$
    $= -4.58 \times 10^{-19}\ J$
19. a. (i) Decreases
    (ii) Increases
    b. ΔS will be positive i.e. greater than zero since ΔU is zero, reaction will be spontaneous
20. $2\ MnO_4^-(aq) + 6\ I^-(aq) + 4H_2O \rightarrow MnO_2(s) + 3I_2(s) + 8OH^-$

OR

20. a) +3
    b) +6
21.



Cis – isomer Trans – isomer

SECTION C

22. a. Moles of solute that is present in per unit volume of solution in liters.
    b. Molarity (M) = No. of moles of solute/Volume of solution in liters

= 4g/40g/0.250L

= 0.4M

23. a. When the first elements of second period show similar properties to the element present diagonally rather of its own group.

b. Period – Increases

Group – Decreases

c. Nitrogen has half-filled stable configuration and finds it difficult to remove its outermost electron in spite of its bigger size than oxygen.

OR

a. Size/nuclear charge/stable electronic configuration or any other correct

b. (i) Because Be has completely filled s orbital

(ii) O has lower than N because N has of stable half-filled configuration and Lower than F because F has smaller size and higher nuclear charge

24.

$$w_{rev} = -\int_{V_i}^{V_f} p_{in} dV$$

Now, the pressure of the gas (p_{in} which we can write as p now) can be expressed in terms of its volume through gas equation. For n mol of an ideal gas i.e., $pV = nRT$

$$\Rightarrow p = \frac{nRT}{V}$$

Therefore, at constant temperature (isothermal process),

$$w_{rev} = -\int_{V_i}^{V_f} nRT \frac{dV}{V} = -nRT \ln \frac{V_f}{V_i}$$

$$= -2.303\ nRT \log \frac{V_f}{V_i}$$

25. a. From first law of thermo

$\Delta U = q + W \quad = (+701\ J) + (-394\ J) \quad = +307\ J$

b.

For a mole of an ideal gas, $\Delta H = \Delta U + \Delta(pV)$

$= \Delta U + \Delta(RT)$

$= \Delta U + R\Delta T$

$\therefore\ \Delta H = \Delta U + R\Delta T \qquad (6.12)$

On putting the values of ΔH and ΔU, we have

$$C_p \Delta T = C_V \Delta T + R\Delta T$$

$$C_p = C_V + R$$

26. a. Propylbenzene

b. 3-Methylpentanenitrile

c. 2,3-Dimethylheptane

d. 3-Bromo-3-chloroheptane

e. 3-Chloropropanal

f. 2,2-Dichloroethanol

27. a. The **inductive effect** refers to the phenomenon wherein a permanent dipole arises in a given molecule due to the unequal sharing of the bonding electrons in the molecule. This effect can arise in sigma bonds, whereas the electromeric effect can only arise in pi bonds.
    b. (i)A>C>B
    (ii) C>A>B
28. a. 2-Bromohexane
    b. 1-Bromohexane

SECTION D

29. (I) (d) All of the above.
    (ii) (a) zero
    (iii) (b) –5.187 kJ
30. a) iii) Single bond
    b) ii) Torsional energy
    c)

SECTION

31. a. Ununennium & Uue
    b. Atomic radii decrease across a period. Cations are smaller than their parent atoms. Among isoelectronic species, the one with the larger positive nuclear charge will have a smaller radius. Hence the largest species is Mg; the smallest one is Al^{3+}.
    c.
    d. $\lambda = h/mv$
    $= 6.626 \text{ X } 10^{-34}\text{Js}/ (0.1 \text{ kg X } 10 \text{ ms}^{-1})$
    $= 6.626 \times 10^{-34}$ m

OR

a. (i)O^{2-} = 2,8 (ii) Na^{+} = 2,8
b. (i) 11 (ii) 7
c. (i) Li (ii) P
d. 5
e. 29

32. a. 9
    b. Hyperconjugation interaction in $(CH_3)_3C^+$is greater than in $CH_3{}^+CH_2$ as the $(CH_3)_3C^+$has nine C-H bonds. In $^+CH_3$, vacant *p* orbital is perpendicular to the plane in which C-H bonds lie; hence cannot overlap with it. Thus, $^+CH_3$ lacks hyperconjugative stability.
    c.

OR

a. $O_2NCH_2CH_2O^-$, as nitro group is an electron withdrawing group which decreases electron density at Oxygen thereby stabilizing it.
b. This is because alkyl group donated electrons to the pi system through hyperconjugation and stabilize it.

c. Cl group acts as an electron withdrawing group showing inductive effect make oxygen atom electron deficient and making acidic hydrogen removal easy. So more the number electron withdrawing groups more acidic the carboxylic acid is.

d. In this test insoluble organic compound is made soluble by converting it into a soluble ion. It is done by the reaction of organic compound with nitrogen in an ignition tube. For example, Nitrogen converts into soluble cyanide, Sulphur organic compounds convert to sulphides and similarly halogen compounds convert into soluble halides then these ions are easily detectable through salt analysis method.

33. a. ΔU = w ad, wall is adiabatic

b. We have $q = -w = p_e x\ (10 - 2) = 0(8) = 0$

No work is done; no heat is absorbed.

c. If a reaction takes place in several steps, then its standard reaction enthalpy is the sum of the standard enthalpies of the intermediate reactions into which the overall reaction may be divided at the same

temperature.

d. The change $H_2O\ (l) \rightarrow H_2O\ (g)$

$\Delta H = \Delta U + \Delta ng RT$

or $\Delta U = \Delta H - \Delta ng RT$,

$\Delta U = 41.00\ kJ\ mol^{-1} - 1 \times 8.3\ J\ mol^{-1}\ K^{-1} \times 373\ K$

$= 41.00\ kJ\ mol^{-1} - 3.096\ kJ\ mol^{-1}$

$= 37.904\ kJ\ mol^{-1}$

OR

a. A spontaneous process is an irreversible process and may only be reversed by some external agency.

b. (i) Decreases

(ii) Increases

c. Heat released from the formation of 35.2g carbon di oxide is

$= -393.5 KJmol^{-1}/44g = 314.8\ KJmol^{-1}$

d. The lattice enthalpy of an ionic compound is the enthalpy change which occurs when one mole of an ionic compound dissociates into its ions in gaseous state.

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Unit No.	Name of Unit	Sec-A		Sect- B	Sec- C	Sect- D	Sect- E	Total
		1 M		2 M	3 M	4 M	5 M	
		MCQ	A-R	VSA	SA	Case Based	LA	
1.	Some Basic Concepts of Chemistry	1 (1)	1 (1)	1 (2)	1 (3)			4 (7)
2.	Structure of Atom	2 (2)		1 (2)			1 (5)	4 (9)
3.	Classification of Elements and Periodicity in Properties	2 (2)	1 (1)		1 (3)			4 (6)
4.	Chemical Bonding and Molecular Structure	1 (1)	1 (1)				1 (5)	3 (7)
5.	Chemical Thermodynamics	2 (2)			1 (3)	1(4)		4 (9)
6.	Equilibrium	2 (2)		1 (2)	1 (3)			4 (7)
7.	Redox Reactions	1 (1)	1(1)	1 (2)				3 (4)
8.	Organic Chemistry: Some basic Principles and Techniques				2 (6)		1 (5)	3 (11)
9.	Hydrocarbons	1 (1)		1 (2)	1 (3)	1(4)		4 (10)
	Total No. of questions	12 (12)	4 (4)	5 (10)	7 (3)	2 (4)	3 (5)	33 (70)

SET-16

QUESTION PAPER-XI
SESSION ENDING EXAMINATION
CHEMISTRY THEORY (043)

MM:70 **Time: 3 Hrs**

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- SECTION E consists of 3 long answer questions carrying 5 marks each.
- All questions are compulsory.
- Use of log tables and calculators is not allowed.

SECTION A

The following questions are multiple-choice questions with one correct answer. Each question carries 1mark .There is no internal choice in this section.

1. Which of the following parameters is temperature dependent?

A. Molarity B. Mole fraction. C. Weight percentage D. Molality

2. Which of the following statements does not form a part of Bohr's model of hydrogen atom?

A .Energy of the electrons in the orbit is quantized.

B .The electron in the orbit nearest to the nucleus has the lowest energy.

C. Electrons revolve in different orbits around the nucleus.

D .The position and velocity of the electrons in the orbit cannot be determined simultaneously.

3. In photoelectric effect, the kinetic energy of photoelectrons increases linearly with the

A.Wavelength of incident light B. Frequency of incident light

C. Velocity of incident light D. Atomic mass of an element

4. BCl_3 is a planar molecule whereas NCl_3 is pyramidal because:

A. nitrogen atom is smaller than boron atom

B. BCl_3 has no lone pair of electrons whereas NCl_3 has a lone pair of electrons

C. N-Cl bond is more covalent than B-CI bond

D. B-Cl bond is more polar than N-Cl bond

5. For the following reaction, $H_2(g)+I_2(g)\rightleftharpoons 2HI(g)$at 250°C,

The effect on the state of equilibrium on doubling the volume of the system will be:

A.Shift to the reactant side B. Shift to the product side

C. No effect on the state of equilibrium D. Liquefaction of HI

6. When a buffer solution of CH_3COOH and CH_3COONa is diluted with water:

A.CH_3COO^- ion concentration increases B. $[H^+]$ ion concentration increases

C. OH^- ion concentration increases D. H^+ion concentration does not change

7. Which one of the following groups represent a collection of isoelectronic species? (At. no. Cs = 55, Br = 35)

(A) N^{3-}, F^-, Na^+ (B) Be, Al^{3+}, Cl^- (C) Ca^{2+}, Cs^+, Br (D) Na^+, Ca^{2+}, Mg^{2+}

8. Which of the following has the largest size
(A) N^{-3} (B) O^{-2} (C) K^{+1} (D) Ca^{+2}

9. Which of the following is an extensive property
A) Molar heat capacity B) Temperature C) Enthalpy D) All of these

10. Standard electrode potential of three metals X,Y and Z are -1.2V,+0.5V and -3.0V respectively. The reducing power of these metals will be
(A) X>Y>Z (B) Y>Z>X (C) Y>X>Z (D) Z>X>Y

11. The reactants used in Friedel-Craft`s alkylation are-
A.$C_6H_6+NH_2$ B. $C_6H_6+CH_4$ C. $C_6H_6+CH_3Cl$ D. $C_6H_6+CH_3COCl$

12. The reaction of toluene with Cl2 in presence of FeCl3 gives 'X' and the reaction in presence of lightgives 'Y'. 'X' and 'Y' are respectively-
A.X= Benzal chloride, Y= o-chlorotoluene
B.X= m-chlorotoluene, Y= p-chlorotoluene
C.X= o and p-chlorotoluene, Y= trichloromethyl benzene
D.X= Benzyl chloride, Y= m-chlorotoluene

The questions given below consist of an 'Assertion' (A) and the 'Reason' (R). Use the following keys for theappropriate answer:
A. If both (A) and (R) are correct and (R) is the correct reason for (A).
B. If both (A) and (R) are correct but (R) is not the correct explanation for (A).
C. If (A) is correct but (R) is incorrect.
D. If (A) is incorrect but (R) is correct.

13. Assertion (A) :In Rutherford's gold foil experiment, very few a-particles are deflected back.
Reason (R): Nucleus present inside the atom is heavy.

14. Assertion (A): Combustion of 16 g of methane gives 28 g of water.
Reason (R): In the combustion of methane, hydrogen is one of the products..

15. Assertion A: Nitrogen has higher I.E. than that of oxygen.
Reason R: Nitrogen atom has smaller atomic size than that of oxygen.

16. Assertion (A) : Nitration of benzene with nitric acid requires the use of concentrated sulphuric acid.**Reason (R)** : The mixture of concentrated sulphuric acid and concentrated nitric acid produces the electrophile, NO_2^+

SECTION B

17. What is the number of photons of light with a wavelength of 4000 pm that provide 1 J of energy?

18. Define the following terms: i. Molarity ii. Limitng reagent

19. What is mean by bond order? Calculate the bond order of O_2 molecule
OR
Discuss the shape of the following molecules using the VSEPR model:ClF3, NH_3

20. Define entropy. Predict whether entropy change in the following processes would be positive ornegative.
i. $N_2O_3(g) \rightarrow N_2O(g) + O_2(g)$
ii. $NH_3(g) + HCl(g) \rightarrow NH_4Cl(s)$

21. Draw the cis- and trans-structures for hex-2-ene. Which isomer will have higher b.p and why?

SECTION-C

22. Chlorine is prepared in the laboratory by treating manganese dioxide ($Mn0_2$) with aqueous hydrochloricacid according to the reaction.

$4\ HCl\ (aq) + Mn0_2\ (s \rightarrow 2\ H_2O\ (l) + MnCl_2(aq) + Cl_2(g)$

How many grams of HCl react with 5.0 g of manganese dioxide? (Atomic mass of Mn = 55 u)

23. Explain the following with proper reasons:

i). Halogens have very high negative electron gain enthalpies.

ii). Mg^{2+} ion is smaller than O^{2-}ion although both have the same electronic configuration.

iv) Electron gain enthalpy of fluorine is less negative than that of chlorine.

24. (i) Define the pH of the solution. The pH of a sample of vinegar is 3.76. Calculate the concentration ofhydrogen ion in it.

(ii) Write the expression for equilibrium constant, Kc for the reaction

$4\ NH_3(g) + 5\ O_2(g) \rightleftharpoons 4\ NO(g) + 6\ H_2O(l)$

OR

(i) State Le-Chatlier's principle

(ii) *On the equilibrium* $2H_2\ (g) + CO(g) \rightleftharpoons CH_3OH(g)$

What is the effect of:

(i) addition of H_2

(ii) addition of CH_3OH

(iii) removal of CO

(iv) removal of CH_3OH

25. Balance the following redox reactions by ion – electron method :

$Cr_2O_7^{2-}\ (aq) + SO_3^{-2}\ (g) \rightarrow Cr^{3+}\ (aq) + SO_4^{2-}(aq)$ (in acidic solution)

26. In the estimation of sulphur by carius method, 0.468 g of an organic sulphur compound gave 0.668 g of barium sulphate. Find the percentage of sulphur in the given compound.

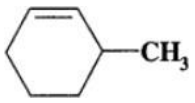
OR

0.3780 g of an organic chloro compound gave 0.5740 g of silver chloride in carius estimation. Calculate thepercentage of chlorine present in the compound.

27. (a) Draw the structure of the following compounds

i. Hex-3enoic acid

ii. 2-chloro-2-methyl butan-1-ol

(b) Write the IUPAC name of 

28. At 473 K, equilibrium constant Kc for decomposition of phosphorus pentachloride, PCl_5 is 8.3×10^{-3}. If decomposition is depicted as, $PCl_5\ (g) \rightarrow PCl_3\ (g) + Cl_2\ (g)$ $\Delta_r H\ 0 = 124.0\ kJ\ mol^{-1}$

(i) Write an expression for Kc for the reaction. Calculate the value.

(ii) What is the value of Kc for the reverse reaction at the same temperature?

(iii) What would be the effect on Kc if (i) more PCl5 is added (ii) pressure is increased (iii) the temperature is increased ?

SECTION D

Read the passage and answer the questions that follow:

29. When anions and cations approach each other, the valence shell of anions are pulled towards

cation nucleus and thus, shape of anion is deformed. The phenomenon of deformation of anion by a cation is known as polarization and the ability of the cation to polarize the anion is called as polarizing power of cation. Due to polarization, sharing of electrons occurs between two ions to some extent and the bond shows some covalent character. The magnitude of polarization depends upon a number of factors. Thesefactors were suggested by Pajan and are known as Fajan's rules.Greater is the polarization in a molecule, more is 0 covalent character.

As the charge on cation increases, its tendency to polarize the anion increases.as the size of the cation decreases or size of the anion increases, the polarization increases.The cations with 18 electrons in the outermost shell bring greater polarization of the anion than thosewith inert gas configuration even both the cations have same size and same charge.

(I) Considering $BeCl_2$, $MgCI_2$, $CaCl_2$ and $BaCl_2$, which one is most covalent?

(II) In which of the halides, there is maximum polarization?

A. AlF_3 B. $AlCl_3$ C. $AlBr_3$ D. AlI_3

(III) Why HCl is polar whereas the Cl2 molecule is non-polar?

OR

(III) Out of sigma and pi bonds, which one is stronger and why?

Read the passage and answer the questions that follow:

30. Dual nature of matter was proposed by de Broglie in 1923, it was experimentally verified by Davissonand Germer by diffraction experiment. Wave character of matter has significance only for microscopic particles. de Broglie wavelength or wavelength of matter wave can be calculated using the following relation:

$A=\frac{h}{mv}$

where, 'm' and v' are the mass and velocity of the particle. de Broglie hypothesis suggested that electron.Waves were being diffracted by the target, much as X-rays are. Diffracted by planes of atoms in the crystals.

(I) Planck's constant has same unit as that of:

A. work B. energy C. power D. angular momentum

OR

de 'Broglie equation is obtained by combination of which of the following theories?

A. Planck's quantum theory B. Einstein's theory of mass-energy equivalence

C. Theory of interference D. Theory of diffraction'

(II) We don’t see a car moving as a wave on the road why?

(III) The mass of an electron is 9.1 × 10-31 kg. If its kinetic energy is 3.0 × 10-25 J, calculate its wavelength.

SECTION –E

31. (i)Give the criteria for spontaneity of a process in terms of free energy change (ΔG).

(ii) Exothermic reactions associated with a decrease in entropy are spontaneous at lower temperatures.Justify on the basis of Gibbs equation.

(iii) For the reaction $2\ A(g) + B(g) \rightarrow 2D(g)$ $\Delta U^0 = -10.5$ kJ and $\Delta S^0 = -44.1\ JK^{-1}$. Calculate ΔG^0 for thereaction, and predict whether the reaction may occur spontaneously.

OR

(i) For a reaction both ΔH and ΔS are negative. Under what conditions does the reaction occur spontaneously?

(ii) Define- Lattice enthalpy

(iii)

Calculate the enthalpy change for the process

$$CCl_4(g) \longrightarrow C(g) + 4\,Cl(g)$$

and calculate bond enthalpy of C – Cl in $CCl_4(g)$

Given: $\Delta_{vap} H^{\ominus}(CCl_4) = 30.5\ kJ\ mol^{-1}$; $\Delta_f H^{\ominus}(CCl_4) = -135.5\ kJ\ mol^{-1}$

$\Delta_a H^{\ominus}(C) = 715.0\ kJ\ mol^{-1}$ *where* $\Delta_a H^{\ominus}$ *is enthalpy of atomisation*

$\Delta_a H^{\ominus}(Cl_2) = 242\ kJ\ mol^{-1}$.

32.

(i). Explain the terms Inductive and Electromeric effects.

(ii) Which electron displacement effect explains the following correct orders of acidity of the carboxylic acids? $Cl_3CCOOH > Cl_2CHCOOH > ClCH_2COOH$

(iii) Explain why alkyl groups act as electron donors when attached to a π system.

(iv) Give condensed and bond line structural formula of 2-Hydroxy-1,2,3-propanetricarboxylic acid

OR

a) What are electrophiles? Give an example.

b) Explain the principle of paper chromatography

c) Write the chemistry of lassaigne's test for qualitative analysis of nitrogen

33. Explain the following with suitable examples:

i. Decarboxylation ii. Aromatization iii. Kharash effect

iv. Sulphonation v. Friedel-Craft's Acylation reaction

OR

What happens when?

(i) The vapours of Phenol are passed over heated zinc dust.

(ii) Ethyne (acetylene) on passing through red hot iron tube at 873K.

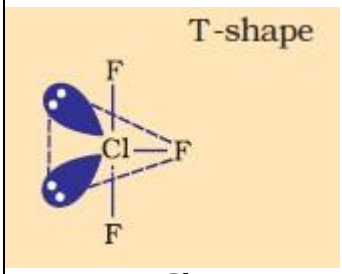
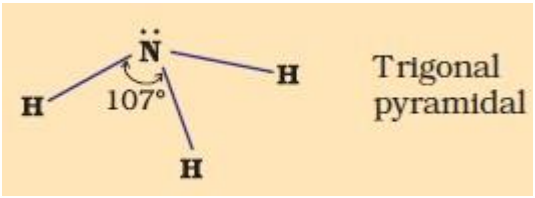
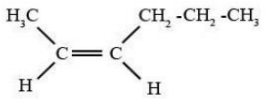
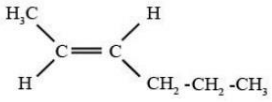
(iii) n-Alkanes on heating in the presence of anhydrous aluminium chloride and hydrogen chloride gas

(iv) Benzene on treatment with excess of chlorine in the presence of anhydrous $AlCl_3$ in dark

Propene is treated with HBr.

MARKING SCHEME

Q.No	Answer	Marks
1	A-Molarity	1
2	D-The position and velocity of the electrons in the orbit cannot be determined simultaneously.	1
3	A-Frequency of incident light	1
4	B-BCl_3 has no lone pair of electrons whereas NCl_3 has a lone pair of electrons	1
5	A-No effect on the state of equilibrium	1
6	D- H^+ion concentration does not change	1
7	(A) N^{3-}, F^-, Na^+	1
8	(A) N^{-3}	1
9	C) Enthalpy	1
10	(D) Z>X>Y	1
11	C. $C_6H_6+CH_3Cl$	1
12	C-X= o and p-chlorotoluene, Y= trichloromethyl benzene	1
13	B-If both (A) and (R) are correct and (R) is the not correct reason for (A).	1
14	D. If (A) is incorrect but (R) is correct.	1
15	C. If (A) is correct but (R) is incorrect.	1
16	A-Both A and R are correct and R is the correct explanation of A.	1
	SECTION B	
17	Energy (En) of 'n' photons = nhν $n=\frac{E}{h\nu}=\frac{E\lambda}{hc}$ λ = wavelength of light = 4000 pm = 4000 $\times 10^{-12}$ m c = velocity of light in vacuum = 3×10^8 m/s h = Planck's constant = 6.626×10^{-34}Js Substituting the values in the given expression of n: $n=\frac{E\lambda}{hc}$ = 1 J X 4000 $\times 10^{-12}$ m / 6.626×10^{-34}Js X 3×10^8 m/s n =2.012×10^{16}	1/2 ½ **1/2** 1/2
18	*i.*M*olarity:*it can be defined as the number of moles of his solute present inone litre of solution . ii. Limitng reagent:The limiting reagent in a chemical reaction is a reactant that is totally consumed when the chemical reaction is completed. The Amount of product formed is limited by this reagent, since the reaction cannotcontinue without it.	1 1
19	bond order: the number of bonds between two atoms in a molecule of an element or compound. Determining the electronic configuration of O2 $[\sigma(1s)]^2[\sigma*(1s)]^2[\sigma(2s)]^2[\sigma*(2s)]^2[\sigma(2pz)]^2[\pi(2px)]^2[\pi(2py)]^2[\pi*(2px)]^1[\pi*(2py)]^1$ The number of bonding electrons = 10 The number of anti-bonding electrons = 6 Step 3: Calculating the bond order of O2 Bond order = $\frac{\text{Number of electrons in bonding} - \text{Number of electrons in antibonding}}{2}$ Bond order = Bond order = 2	1 1/5 1/5

	Hence, the bond order for O2 is 2. OR   ClF_3 NH_3	
20	a) Entropy is a measure of the randomness or disorder of a system. b) $N_2O_3(g) \rightarrow N_2O(g) + O_2(g)$ -positive c) $NH_3(g) + HCl(g) \rightarrow NH_4Cl(s)$--negative	1, 1/5, 1/5
21	cis-isomer is more polar than trans-isomer. The higher the polarity, the greater is the intermolecular dipole-dipole interaction and the higher will be the boiling point. Hence, cis-isomer will have a higher boiling point than trans-isomer.	1
	 Cis -isomer  Trans -isomer	1
	SECTION C	
22	1 mole of MnO_2, i.e., 55 + 32 = 87 g MnO_2 react with 4 moles of HCl, i.e., 4 x 36.5 g = 146 g of HCl. $\therefore$ 5.0 g of MnO_2 will react with HCl = $\frac{146}{87} \times 5.0$ g = **8.40 g**	1 1 1
	(i) the general outermost electronic configuration of halogens is ns2,np5. They have great tendency to accept electron as it has only 1 electron less to complete its octet. So halogens have very high negative electron gain enthalpy. (ii) The nuclear charge in Mg2+ is + 12 and O2- is + 8 so with the increase in nuclear charge the size decreases and hence O2- > Mg2+ (iii) there are strong interelectronic repulsions in the relatively small 2p orbitals of fluorine and thus, the incoming electron does not experience much attraction.	1 1
24	i. The pH of a solution is defined as the negative logarithm to base 10 of theconcentration of hydrogen ion $[H^+]$. $p^H = -\log[H^+]$. pH = – log [H+] or log [H+] = – pH = – 3.76 = 4.24 [H+] = Antilog 4.24 = 1.738 x 10^{-4} = 1.74 x 10^{-4} M ii.	1 1 1

	$K_c = \frac{[NH_3]^4[O_2]^5}{[NO]^4[H_2O]^6}$	1
	OR	
	a. Le Chatelier's principle states that if a dynamic equilibrium is disturbed by changing the conditions, the position of equilibrium shifts to counteract the change to reestablish an equilibrium. b. (i) Equilibrium will be shifted in the forward direction. (ii) Equilibrium will be shifted in the backward direction. (iii) Equilibrium will be shifted in the backward direction. (iv) Equilibrium will be shifted in the forward direction.	½ ½ ½ ½
25	Oxidation half equation: $SO_2(g) + 2H_2O(l) \longrightarrow SO_4^{2-}(aq) + 4H^+(aq) + 2e^-$ …(i) Reduction half equation: $Cr_2O_7^{2-}(aq) + 14H^+(aq) + 6e^- \longrightarrow 2Cr^{3+}(aq) + 7H_2O(l)$ …(ii) Multiply Eq. (i) by 3 and add it to Eq. (ii), we have, $Cr_2O_7^{-2}(aq) + 3SO_3^{-2}(g) + 14H^+(aq) \longrightarrow 2Cr^{3+}(aq) + 3SO_4^{2-}(aq) + 7H_2O(l)$	1 1 1
26	Mass of the compound = 0.468 g Mass of barium sulphate= 0.668 g $\text{Percentage of sulphur} = \frac{32}{233} \times \frac{\text{Mass of barium sulphate}}{\text{Mass of compound}} \times 100$ $= \frac{32}{233} \times \frac{(0.668\ g)}{(0.468\ g)} \times 100 = \mathbf{19.60\%}$ **OR** Mass of the compound = 0.3780 g Mass of silver chloride = 0.5740 g $\text{Percentage of chlorine} = \frac{35.5}{143.5} \times \frac{\text{Mass of siliver chloride}}{\text{Mass of compound}} \times 100$ $= \frac{35.5}{143.5} \times \frac{(0.5740\ g)}{(0.3780\ g)} \times 100 = \mathbf{37.57\ g}$	1 2 OR 1 2
27	(a)CH_3-CH_2-CH=CH-CH_2-COOH (b)CH_3-CH_2-CCl(CH_3)-CH_2-OH (ii) 3–Methyl cyclohexene	1 1 1
28	(i) The equilibrium constant expression is Kc=[PCl3][Cl2]/[PCl5] (ii) The equilibrium constant expression for the reverse reaction is Kc(reverse)=1/8.3×10^{-3}=120.48 (iii) (i) When more PCl5 is added, the direction of equilibrium is affected but the value of equilibrium constant is unaffected as Kc is constant at a given temperature. (ii) When pressure is increased, the value of the equilibrium constant remains unaffected. (iii) When temperature is increased, the value of equilibrium constant is increased. The reaction is endothermic. When temperature is increased, Kf is increased. Hence, Kc=KrKf is also increased.	1 ½ ½ ½ 1/2
	SECTION D	
29	1. (a) $BeCl_2$ is most covalent of the given chlorides 2. (D) AlI_3 3. In Cl_2 both atoms have the same electronegativity. Hence the shared pair of electrons is attracted equally by both and remains exactly in the center. NO	1 1 1+1

	end acquires a negative or positive charge. In HCl, chlorine is more electronegative than H. Hence shared pair of electrons is more attracted towards chlorine, which,therefore acquires a negative charge while H acquires a positive charge. OR Sigma (a) bond is stronger This is because a bond is formed by head-on overlapping of atomic orbitals and such overlapping being on the internuclear axis islarge, n bond is formed by sidewise overlapping which is small and so a Pi bond is weaker.	1+1
30	1. (D) angular momentum OR (B) Einstein's theory of mass-energy equivalence 2. According to de Broglie relation :$\lambda=hmv$ i.e. $\lambda \propto 1m$. The mass of the car is very large and its wavelength (λ) or wave character is negligible. Therefore, we do not see a car moving like a wave. 3. $\lambda=\sqrt{h/(2mK.E)}_{1/2}$ $\lambda=\sqrt{6.626\times10^{-34}/(2\times9.1\times10^{-31}\times3\times10^{-25})} =1.2\times10^{-7}m$	1 1 1 1
	SECTION E	
31	i. For a reaction to be spontaneous ΔG should be negative. ii. if both ΔH and ΔS are negative, ΔG can be negative only if $T\Delta S < \Delta H$ in magnitude. $\Delta G = \Delta H - T\Delta S, \quad \Delta G = (-) - T(-)$ This is possible only if either ΔH has a large negative value or T is so low that $T\Delta S < \Delta H$. iii. $\Delta H^\ominus = \Delta U^\ominus + \Delta n_g RT$ $\Delta U^\ominus = -10.5\ kJ; \quad \Delta n_g = 2 - 3 = -1\ mol$ $R = 8.314 \times 10^{-3}\ kJ\ K^{-1}\ mol^{-1}; T = 298\ K$ $\therefore \quad \Delta H^\ominus = (-10.5\ kJ) + [(-1\ mol) \times (8.314 \times 10^{-3}\ kJ\ K^{-1}\ mol^{-1}) \times (298K)]$ $= -10.5\ kJ - 2.478\ kJ = -12.978\ kJ$ According to Gibbs Helmholtz equation: $\Delta G^\ominus = \Delta H^\ominus - T\Delta S^\ominus$ $\Delta G^\ominus = (-12.978\ kJ) - (298\ K) \times (-0.0441\ kJ\ K^{-1})$ $= -12.978 + 13.112 = -12.978 + 13.142 = \mathbf{0.164\ kJ}$ Since $\Delta G^\ominus$ is positive, the reaction is non-spontaneous in nature OR a. Both ΔH and ΔS are positive so ΔG will be negative only if $T\Delta S > \Delta H$ inmagnitude. $\Delta G = \Delta H - T\Delta S$ $\Delta G = (+) -$ $T(+)$ Thus either ΔS should be very large so that even if T is low, $T\Delta S$ is greater than ΔH, or if ΔS is small, T should be high so that $T\Delta S > \Delta H$.	1 1 1 1 1 1 1

	b. Lattice energy can be defined as the energy required to convert one mole of an ionic solid into gaseous ionic constituents.	1

The available data is:

(*i*) $CCl_4(l) \longrightarrow CCl_4(g)$, $\Delta_{vap}H^{\ominus} = 30.5\ kJ\ mol^{-1}$

(*ii*) $C(s) + 2Cl_2(g) \longrightarrow CCl_4(l)$, $\Delta_f H^{\ominus} = -135.5\ kJ\ mol^{-1}$

(*iii*) $C(s) \longrightarrow C(g)$, $\Delta_a H^{\ominus} = 715.0\ kJ\ mol^{-1}$

(*iv*) $Cl_2(g) \longrightarrow 2\ Cl\ (g)$, $\Delta_a H^{\ominus} = 242\ kJ\ mol^{-1}$

The equation we aim at is:

$$CCl_4(g) \longrightarrow C(g) + 4Cl(g); \Delta H = ?$$

Eqn. (*iii*) + 2 × Eqn. (*iv*) – Eqn. (*i*) – Eqn. (*ii*) gives the required equation with

$$\Delta H = 715.0 + 2\ (242) - 30.5 - (-135.5)\ kJ\ mol^{-1}$$
$$= 1304\ kJ\ mol^{-1}$$

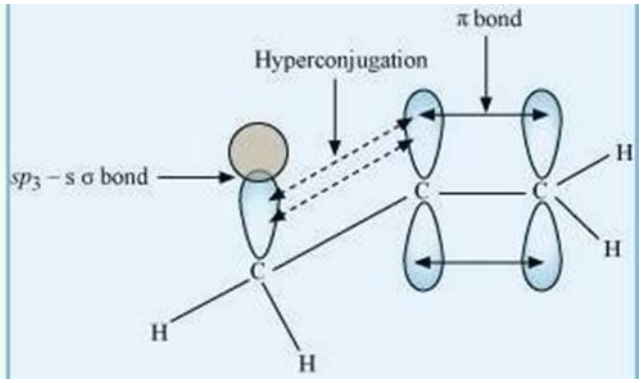
Bond enthalpy of C—Cl in CCl_4 (average value) = $\frac{1304}{4}$ = **326 kJ mol^{-1}.** — 1

i. Inductive effect is a partial shifting/displacement of σ electronstowards a more electronegative atom of σ bond. — 1

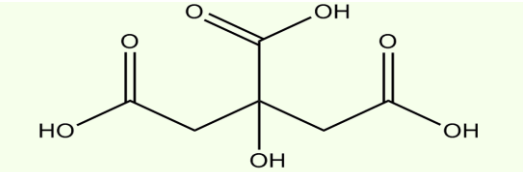
ii. The **spontaneous formation** of a **dipole molecule of** the **organic compound because** of the **complete transfer of shared pi electrons pairs to other atomsin the influence of attacking reagent present is referred to as Electromeric effect.** — 1

iii. Electron withdrawing inductive (-I) effect

When an alkyl group is attached to a π system, it acts as an electron-donor group by the process of hyperconjugation. — 1

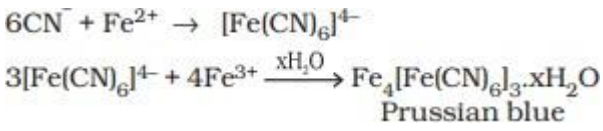
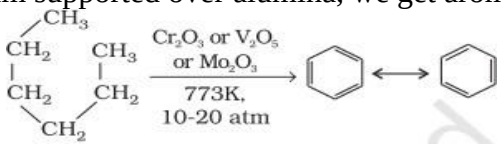
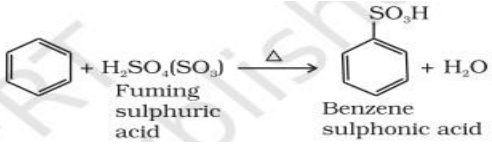
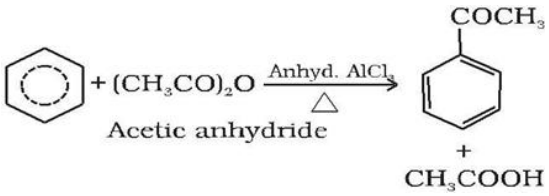


iv The condensed formula is $(COOH)CH_2C(OH)(COOH)CH_2COOH$.



2-Hydroxy-1,2,3-propanetricarboxylic acid

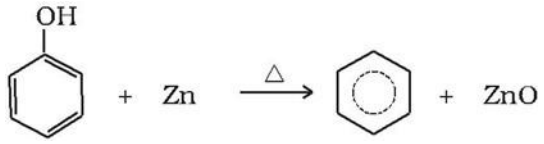
32	a. The species which are positively charged or electron deficient are called electrophiles(electron seeking agent).example: H^+, Cl^+,$AlCl_3$.	1
	b. In paper chromatography, chromatographic paper dipped in solvents act as a stationary phase whereas mixture of compounds dissolved in suitable solvents forms the mobile phase. Different compounds have different adsorbing power, therefore they move with different speeds and gets separated.	1

	c. Lassaigne's test for qualitative analysis of nitrogen: Fuse the organic compound with sodium metal. sodium reacts with C and N present in organic compound to  form NaCN. Add $FeSO_4$ to lassaigne's extract  Dilute H_2SO_4 is added to convert Fe^{2+} to Fe^{3+} and blue color is formed due to the formation of ferric ferrocyanide.	1 1 1
33	a) Decarboxylation: Sodium salt of carboxylic acids (R-COONa) on heating with soda lime (a mixture of NaOH and CaO), we get an alkane containing one carbon atom less than that of thecarboxylic acid. e.g. $CH_3COONa \xrightarrow{NaOH/CaO} CH_4 + Na_2CO_3$ Sodium acetate methane b) Aromatization: n-Alkanes having six or more carbon atoms on heating to 773K at 10-20 atmospheric pressure in the presence of oxides of vanadium, molybdenum or chromium supported over alumina, we get aromatic compounds.  c) Kharash effect: In the presence of peroxide, addition of HBr to unsymmetrical alkenes takes place against Markovnikov rule. This is known as *peroxide or Kharash effect or anti- Markovnikov addition reaction.* e.g. $CH_3\text{-}CH{=}CH_2 + HBr \xrightarrow{Org.peroxide} CH_3\text{-}CH_2\text{-}CH_2Br$ d) Sulphonation: It is the introduction of sulphonic acid ($-SO_3H$) group to a benzene ring. It is carried out by heating benzene with fuming sulphuric acid ($H_2S_2O_7$ or oleum).  e) Friedel-Craft's Acylation reaction: The reaction of benzene with an acyl halide or acid anhydride in the presence of Lewis acids ($AlCl_3$) yields acylbenzene 	1 1 1

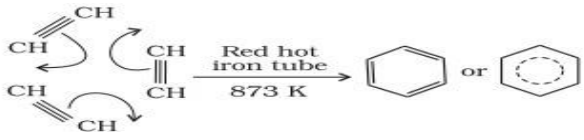
OR

a) What happens when 1

i. Phenol is reduced to benzene by passing its vapours over heated zinc dust. 1

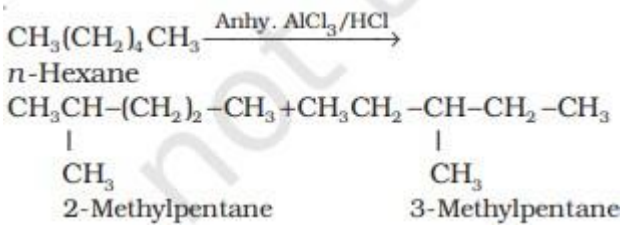


ii. Ethyne (acetylene) on passing through red hot iron tube at 873K, undergoes cyclic polymerisation to form benzene (C_6H_6).



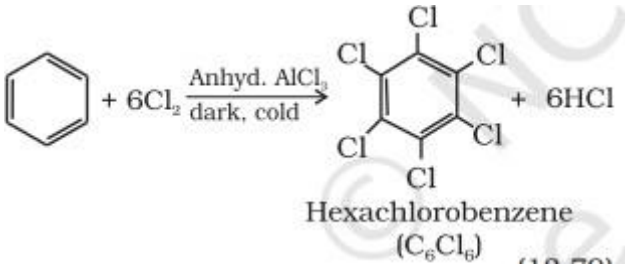
OR

iii. n-Alkanes on heating in the presence of anhydrous aluminium chloride andhydrogen chloride gas isomerise to branched chain alkanes. 1



1

iv. Benzene on treatment with excess of chlorine in the presence of anhydrous $AlCl_3$ in dark



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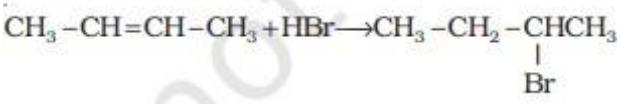
v. Propene is treated with HBr



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Unit No.	Name of Unit	Sec-A		Sect- B	Sec- C	Sect- D	Sect- E	Total
		1 M		2 M	3 M	4 M	5 M	
		MCQ	A-R	VSA	SA	Case Based	LA	
1.	Some Basic Concepts of Chemistry	1 (1)	1 (1)	1 (2)	1 (3)			4 (7)
2.	Structure of Atom	2 (2)		1 (2)			1 (5)	4 (9)
3.	Classification of Elements and Periodicity in Properties	2 (2)	1 (1)		1 (3)			4 (6)
4.	Chemical Bonding and Molecular Structure	1 (1)	1 (1)				1 (5)	3 (7)
5.	Chemical Thermodynamics	2 (2)			1 (3)	1(4)		4 (9)
6.	Equilibrium	2 (2)		1 (2)	1 (3)			4 (7)
7.	Redox Reactions	1 (1)	1(1)	1 (2)				3 (4)
8.	Organic Chemistry: Some basic Principles and Techniques				2 (6)		1 (5)	3 (11)
9.	Hydrocarbons	1 (1)		1 (2)	1 (3)	1(4)		4 (10)
	Total No. of questions	12 (12)	4 (4)	5 (10)	7 (3)	2 (4)	3 (5)	33 (70)

SET-17

QUESTION PAPER-XI
SESSION ENDING EXAMINATION
CHEMISTRY THEORY (043)

MM:70 **Time: 3 Hrs**

Time: 3 hrs **MM: 70**

	General Instructions: Read the following instructions carefully. (a) There are 33 questions in this question paper with internal choice. (b) SECTION A consists of 16 multiple -choice questions carrying 1 mark each. (c) SECTION B consists of 5 short answer questions carrying 2 marks each. (d) SECTION C consists of 7 short answer questions carrying 3 marks each. (e) SECTION D consists of 2 case - based questions carrying 4 marks each. (f) SECTION E consists of 3 long answer questions carrying 5 marks each.	
	SECTION A **The following questions are multiple -choice questions with one correct answer. Each question carries 1 mark. There is no internal choice in this section.**	
1.	Which of the following contains more molecules? (a) 1g CO_2 (b)1g N_2 (c)1g H_2 (d) 1g CH_4	**1**
2.	Total number of orbitals associated with third shell will be _____. (a) 2 (b) 9 (c) 4 (d) 3	**1**
3.	The correct order of first ionization potential among following elements, Be, B, C, N and O is (a) B < Be < C < O < N (b) B < Be < C < N < O (c) Be < B < C < N < O (d) Be < B < C < O < N	**1**
4.	Which of the following molecules has maximum bond angle (a) NH_3 (b) CH_4 (c) H_2O (d) CO_2	**1**
5.	In an exothermic reaction, heat is evolved and system loses heat to the surrounding. For such system: (a) q_p will be zero (b) $\Delta_r H$ will be negative (c) q_v will be positive (d) $\Delta_r H$ will be positive	**1**
6.	The enthalpies of all elements in their standard state are: (a) unity (b) zero (c)<0 (d) different for each element	**1**
7.	The oxidation number of Mn is maximum in (a) MnO_2 (b) K_2MnO_4 (c) Mn_3O_4 (d) $KMnO_4$	**1**
8.	The displacement of electrons in a multiple bond in the presence of attacking reagent is called (a) Inductive effect (b) Electromeric effect **(c)** Resonance **(d)** Hyper conjugation	**1**
9.	Chlorination of alkanes is an example of _____ (a) Radical (b) Elimination (c) Free radical (d) addition	**1**

10.	A miscible mixture of benzene and chloroform can be separated by: (a) Sublimation (b) distillation (c) filtration (d) crystallisation	**1**
11.	Which of the following is responsible to rule out the existence of definite paths or trajectories of electrons? (a) Pauli's exclusion principle. (b) Heisenberg's uncertainty principle. (c) Hund's rule of maximum multiplicity. (d) Aufbau principle.	**1**
12.	The I.U.P.A.C. name of $CH_3COCH(CH_3)_2$ is (a) 3–methyl–butan-2-one (b) Isopropyl methyl ketone (c) 2–methyl–butan-3-one (d) 4–methyl isopropyl ketone	**1**
13.	Given below are two statements labelled as Assertion (A) and Reason (R). **Assertion (A):** Molar Entropy of vaporization of water is different from ethanol. **Reason(R):** Water is more polar than ethanol. Select the most appropriate answer from the option given below (a) Both A and R are true and R is the correct explanation of A. (b)Both A and R are true and R is not the correct explanation of A. (c) A is true but R is false. (d) A is false but R is true.	**1**
14.	Given below are two statements labelled as Assertion (A) and Reason (R). **Assertion:** The empirical mass of ethene is half of its molecular mass. **Reason:** The empirical formula represents the simplest whole number ratio of various atoms present in a compound. Select the most appropriate answer from the option given below (a) Both A and R are true and R is the correct explanation of A. (b)Both A and R are true and R is not the correct explanation of A. (c) A is true but R is false. (d) A is false but R is true.	**1**
15.	Given below are two statements labelled as Assertion (A) and Reason (R). **Assertion**: Carbocations are planar in nature. **Reason**: Carbocations are sp^2 Hybridised. Select the most appropriate answer from the option given below (a) Both A and R are true and R is the correct explanation of A. (b)Both A and R are true and R is not the correct explanation of A. (c) A is true but R is false. (d) A is false but R is true.	**1**
16.	Given below are two statements labelled as Assertion (A) and Reason (R). **Assertion:** The boiling point of cis-But-2-ene is higher than that of trans-But-2-ene. **Reason:** cis-But-2-ene is non-polar whereas trans-But-2-ene is polar. Select the most appropriate answer from the option given below (a) Both A and R are true and R is the correct explanation of A. (b)Both A and R are true and R is not the correct explanation of A.	**1**

	(c) A is true but R is false. (d) A is false but R is true.	
	SECTION B **This section contains 5 questions with internal choice in one question. The following questions are very short answer type and carry 2 marks each.**	
17.	What do mean by molarity? Calculate the molarity of NaOH in the solution prepared by dissolving its 4 g in enough water to form 250 mL of the solution.	**2**
18.	What is Planck's quantum theory?	**2**
19.	Explain why the electron gain enthalpy of fluorine is less negative than that of chlorine.	**2**
20.	Enthalpy of combustion of carbon to CO_2 is -393.5 k J mol^{-}. Calculate the heat released upon formation of 35.2 g of CO_2 from carbon and dioxygen gas. OR Calculate the enthalpy of combustion of glucose from the following data: C (graphite) + O_2 (g) → CO_2 (g) Δ_rH^0 = -395 kJ H_2 (g) + ½ O_2 (g) → H_2O (l) Δ_rH^0 = -269.4 kJ 6C (graphite) + 6H_2 (g) + 3O_2 (g) → $C_6H_{12}O_6$ (s) Δ_rH^0 = -1169.9 kJ	**2**
21.	Explain how value of Qc and Kc decides the direction of reaction.	**2**
	SECTION C **This section contains 7 questions with internal choice in one question. The following questions are short answer type and carry 3 marks each**.	
22.	(i) Differentiate between empirical and molecular formula. (ii) The molecular mass of an organic compound is 78 and its percentage composition is 92.4 % C and 7.6 % H. Determine the molecular formula of the compound.	**1+2**
23.	(a) Identify an element with three electrons in an outer subshell. (b) Identify an element with that would tend to gain two electrons. **(c)** Identify the group having metal, non-metal, liquid as well as gas at the room temperature.	**1+1** **+1**
24.	(a) Write the electronic configurations of O_2, O_2^+, O_2^- (superoxide), O_2^{2-} (peroxide) (b) Compare the relative stability of the above species.	**2+1**
25.	(i) Draw diagrams showing the formation of a double bond and a triple bond between carbon atoms in C_2H_4 and C_2H_2 molecules. (ii) Which hybrid orbitals are used by carbon atoms in CH_3–CH=CH_2?	**3**
26.	Balance the following ionic equation by ion electron method: MnO_4^- (aq) +SO_2 (g) → Mn^{2+} (aq) + HSO_4^- (aq) (in acidic medium)	**3**
27.	(a) What is Lassaigne's extract? Will NaCN give a positive Lassaigne's test for nitrogen? (b) Which colour will appear in the Lassaigne's test if the compound contains both nitrogen and sulphur. (c) Why is Lassaigne's extract prepared in distilled water? Can we detect oxygen in a compound by Lassaigne's test?	**1** **1** **1**

28.	Addition of HBr to propene yields 2-bromoprapane, while in the presence of benzoyl peroxide, the same reaction yields 1-bromopropane. Explain and give mechanism. OR Explain the following name reactions: (i) Wurtz reaction (ii) Decarboxylation (iii) Catalytic hydrogenation	**3** **1** **1** **1**
	SECTION D **The following questions are case -based questions. Each question has an internal choice and carries 4 (1+1+2) marks each. Read the passage carefully and answer the questions that follow.**	
29.	**Read the following passage and answer the questions** Every system is associated with a definite amount of energy, called the internal energy (U or E) of the system. It is the sum of chemical, electrical, mechanical or any other form of energy that anyone can may think of. However gravitational energy is generally neglected. It is a state function, i. e. independent of the path followed. lt may change when i) heat flows in or out of the system. ii) work is done on or by the system. Iii) matter enters or leaves the system It is an extensive property i.e. depends upon the mass of a substance. It depends only on temperature. The absolute value of internal energy possessed by a substance cannot be calculated because it is not possible to predict the exact values of different forms of energy. Thus, we can just calculate the change in internal energy which is achieved by changing the state of a system. First law of thermodynamics was proposed by Helmholtz and Robert- mayer who stated that the energy in of an isolated system is constant. i.e. energy can neither we created nor be destroyed but can be converted from one form to another. That's why it is also called law of conservation of energy. When a system undergoes isothermal ΔU = zero i.e. there is no increase or decrease in the internal energy of the system then the first law of thermodynamics reduce to $0=q + w$ or $q = -w$. (i) Neither q not w is a state function but q + w is a state function explain why? ii) Out of mass and density which is an intensive property and why? iii) Explain thermodynamically how is the heat absorbed by system is used in doing work at constant temperature and pressure. **OR** What is the change in the energy of system if 500 Cal of heat energy are added to a system and system does 350 cal of work on the surroundings?	**1** **1** **2** **2**
30.	A large number of methods are available for the purification of substances. The choice of method, however, depends upon the nature of substance (whether solid or liquid). It also depends on the type of impurities present in it. We commonly use these methods for purification of substances: Simple crystallisation, Fractional crystallisation, Sublimation, Simple distillation, Fractional distillation, Distillation under reduced pressure, Steam distillation, Chromatography.	

	(i) Explain, why an organic liquid vaporises at a temperature below its boiling point in its steam distillation. (ii) Which method is used to separate mixture of ammonium chloride and sodium chloride ? (iii) State the principle of fractional distillation. OR Explain the principle of paper chromatography.	**1** **1** **2**
	SECTION E **The following questions are long answer type and carry 5 marks each. All questions have an internal choice.**	
31.	(a) Define Heisenberg's uncertainty principle. (b) A microscope using suitable photons is employed to locate an electron in an atom within a distance of 0.1 A^0. What is the uncertainty involved in the measurement of its velocity? (c) Find energy of each of photons which: (i) Correspond to light of frequency 3 X 10^{15} Hz. (ii) Have wavelength of 0.50 A^0. OR **(**a)When a photon of frequency 1.0×10^{15} s^{-1} was allowed to hit a metal surface, an electron having 1.988×10^{-19} J of kinetic energy was emitted. Calculate the threshold frequency of this metal. Show that an electron will not be emitted if a photon with a wavelength equal to 600 nm hits the metal surface. (b)Write electronic configuration of Cr and Cu+	**5** **3** **2**
32.	At 473 K, equilibrium K_c for decomposition of PCl_5 is 8.3 X 10^{-3}. If decomposition is depicted as PCl_5 (g) ↔ PCl_3 (g) + Cl_2 (g) Δ_rH^0 = 124.0 kJ/mol (a) Write an expression for K_c for the reaction. (b) What is the value of K_c for the reverse reaction at the same temperature? (c) What would be the effect on K_c if (i) More PCl_5 is added (ii) Pressure is increased (iii) The temperature is increased. Or (a) Explain the following terms: Buffer solution, Common ion effect (b) Define Le Chatelier's principle (c) Describe the effect of: (i) Addition of H_2 (ii) Addition of CH_3OH (iii) Removal of CO (iv) Removal of CH_3OH On the equilibrium of the reaction: $2H_2$ (g) +CO (g) ↔ CH_3OH (g)	 **1** **1** **1** **1** **1** **2** **1** **½** **½** **½** **½**

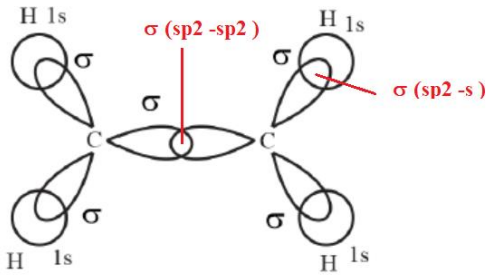
33.	(a) Arrange benzene, n-hexane and ethyne in decreasing order of acidic behaviour. (b) What are the necessary conditions for any system to be aromatic? (c) An alkene 'A' on ozonolysis gives a mixture of ethanal and pentan-3-one. Write structure and IUPAC name of 'A'. OR (a) What effect does branching of alkane chain has on its boiling point? (b) How would you convert the following compounds into benzene? (i) Ethyne (ii) Hexane (c) Draw the cis and trans structures of hex-2-ene. Which isomer will have higher b.p. and why?	1 2 2 1 1+1 1+1

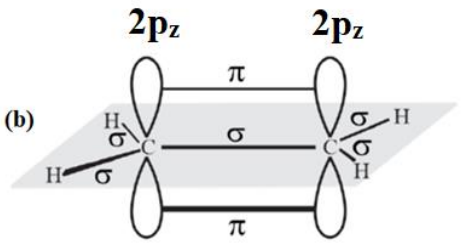
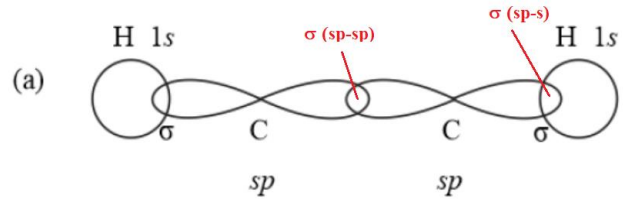
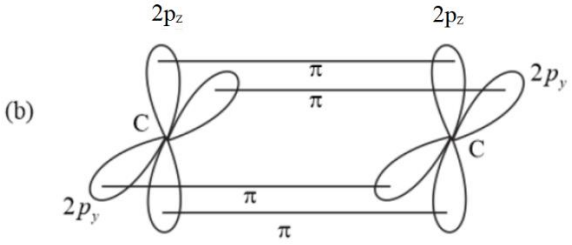
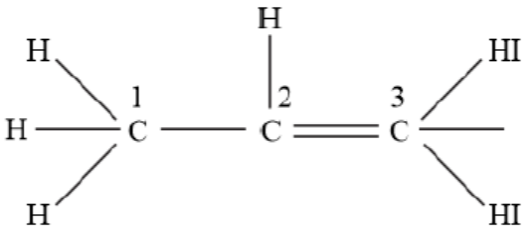
MARKING SCHEME

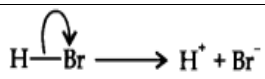
Q.No.	Answers	Mks
1.	(c) 1 g of H_2	**1**
2.	() 9	**1**
3.	(a) B < Be < C < O < N	**1**
4.	(d) CO_2	**1**
5.	(b) $\Delta_r H$ will be negative	**1**
6.	(b) zero	**1**
7.	(d) $KMnO_4$	**1**
8.	(b) Electromeric effect	**1**
9.	(c) Free radical	**1**
10.	(b) distillation	**1**
11.	(b) Heisenberg's uncertainty principle	**1**
12.	(a)3–methyl–butan-2-one	**1**
13.	(b)	**1**
14.	(b)	**1**
15.	**(a)**	**1**
16.	**(c)**	**1**
17.	The number of moles of solute dissolved per litre (dm^3) of the solution is called molarity. Since molarity (M) = No. of moles of solute /Volume of solution in litres = (Mass of NaOH/Molar mass of NaOH)/0.250 L = (4 g / 40 g 0.1 mol)/0.250L = 0.1 mol/0.250 L = 0.4 mol /L = 0.4 M.	½ ½ **1**
18.	Planck's quantum theory states the following postulates: 1. The energy is not radiated or emitted continuously. It is emitted in small proportions in the form of energy packets called quanta. 2. Radiation when in the form of light, each particle is known as a photon. Photons are energy particles of small proportion in the case of light. 3. The energy of a photon or one quantum of energy is directly proportional to the frequency of the radiation. E = hν where h is Planck's constant and v is the frequency of radiation.h has the value 6.626×10^{-34} J s.	**2**

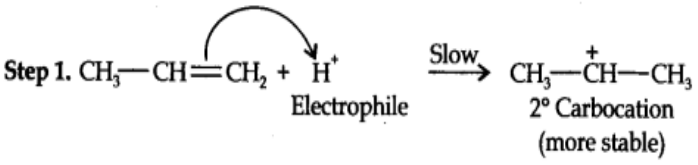
	4. The total energy of radiation is represented as a whole number multiple of energy of a quantum as hν, 2hν, 3hν and so on.	
19.	This is due to the small size of the fluorine atom. As a result of the strong inter-electronic repulsions in fluorine is relatively small 2p orbitals, the incoming electron does not experience much attraction.	**2**
20.	$C(s) + O_2(g) \rightarrow CO_2(g)$, $\Delta H = -395$kJ/mol. 1mol=44g Heat released when 44 g CO_2 is formed=393.5kJ Therefore, Heat released when 35.2g of CO_2 is formed=393.5/44 × 35.2kJ =314.8kJ OR The required equation is : (i) $C_6H_{12}O_6 (s) + 6 O_2 (g) \rightarrow 6CO_2 (g) + 6 H_2O (l)$ Multiply eq (i) by 6 and subtract eq (iii) from it (ii) $6C \text{ (graphite)} + 6O_2 (g) \rightarrow 6CO_2 (g)$ $\Delta_rH^0 = -2370$ kJ - $6C \text{ (graphite)} + 6H_2 (g) + 3O_2 (g) \rightarrow C_6H_{12}O_6 (s)$ $\Delta_rH^0 = -1169.9$ kJ (iii) $C_6H_{12}O_6 (s) + 3 O_2 (g) \rightarrow 6CO_2 (g) + 6 H_2 (g)$ $\Delta_rH^0 = -1200.2$ kJ Multiply eq (ii) by 6 and add to eq (vi) (iv) $6H_2 (g) + 3O_2 (g) \rightarrow 6H_2O (l)$ $\Delta_rH^0 = -1616.4$ kJ + $C_6H_{12}O_6 (s) + 3O_2 (g) \rightarrow 6CO_2 (g) + 6 H_2 (g)$ $\Delta_rH^0 = -1200.2$ kJ --- $C_6H_{12}O_6 (s) + 6O_2 (g) \rightarrow 6CO_2 (g) + 6 H_2O (l)$ $\Delta_rH^0 = -2816.6$ kJ	**2** **1** **1**
21.	**Qc>Kc** Reaction will proceed in backward direction, **Qc=Kc** reaction is at equilibrium, **Qc< Kc** Reaction will proceed in backward direction.	**2**
22.	(i) An empirical formula represents the simplest whole number ration of various atoms present in a compound whereas the molecular formula shows the exact number of different types of atoms present in a molecule of a compound. (ii) Calculation of empirical formula The simplest whole no ratio of C : H is 1:1 The empirical formula of the compound is CH empirical formula mass = 1 x 12 + 1x 1= 13 Molecular mass = 78 n = 78/13 = 6 Molecular formula of the compound = 6 × (CH) = C_6H_6	**1** **1** **1**
23.	**(**a) any element of 15 group (b) any element of 16 group	**1+1+1**

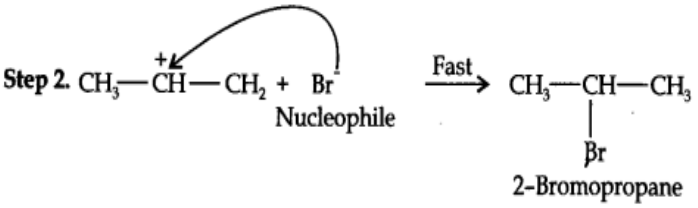
Element	Percentage	At mass	Moles	Mole ratio	Simplest whole no. ratio
C	92.4	12	92.4/12 = 7.7	7.7/7.6 = 1.01	1
H	7.6	1	7.6/1= 7.6	7.6/7.6 = 1	1

	(c) 17 group	
24.	(a) **<u>The electronic configuration of O_2 molecule can be written as:</u>** Total electrons = 8+8= 16 $[\sigma(1s)]^2\ [\sigma*(1s)]^2\ [\sigma(2s)]^2\ [\sigma*(2s)]^2\ [\sigma(2pz)]^2\ [\pi(2px)]^2\ [\pi(2py)]^2\ [\pi*(2px)]^1\ [\pi*(2py)]^1$ Nb=10 , Na= 6 (i) Bond order= $\frac{(Nb-Na)}{2}=\frac{(10-6)}{2}$ = **2** **<u>The electronic configuration of O_2^+ can be written as:</u>** Total electrons = 8+8-1= 15 $[\sigma(1s)]^2\ [\sigma*(1s)]^2\ [\sigma(2s)]^2\ [\sigma*(2s)]^2\ [\sigma(2pz)]^2\ [\pi(2px)]^2\ [\pi(2py)]^2\ [\pi*(2px)]^1\ [\pi*(2py)]^0$ Nb=10 , Na= 5 (i) Bond order= $\frac{(Nb-Na)}{2}=\frac{(10-5)}{2}$ = **2.5** **<u>Electronic configuration of O_2^- ion will be:</u>** Total electrons = 8+8+1= 17 $[\sigma(1s)]^2\ [\sigma*(1s)]^2\ [\sigma(2s)]^2\ [\sigma*(2s)]^2\ [\sigma(2pz)]^2\ [\pi(2px)]^2\ [\pi(2py)]^2\ [\pi*(2px)]^2\ [\pi*(2py)]^1$ Nb=10 , Na= 7 (i) Bond order= $\frac{(Nb-Na)}{2}=\frac{(10-7)}{2}$ = **1.5** **<u>Electronic configuration of O_2^{2-} ion will be:</u>** Total electrons = 8+8+2= 18 $[\sigma(1s)]^2\ [\sigma*(1s)]^2\ [\sigma(2s)]^2\ [\sigma*(2s)]^2\ [\sigma(2pz)]^2\ [\pi(2px)]^2\ [\pi(2py)]^2\ [\pi*(2px)]^2\ [\pi*(2py)]^2$ Nb=10 , Na= 8 (i) Bond order= $\frac{(Nb-Na)}{2}=\frac{(10-8)}{2}$ = **1** (b) Bond dissociation energy is directly proportional to bond order. Thus, the higher the bond order, the greater will be the stability. On this basis, the order of stability is $O_2^+ > O_2 > O_2^- > O_2^{2-}$.	**3**
25.	**(i)** (a)  	**1** **1**

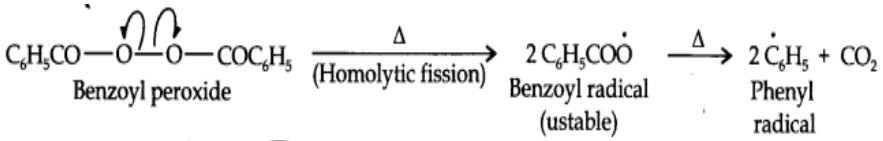
		1
		1
		1
	(ii)  C-1 is sp3 hybridized, while C-2 and C-3 are sp2 hybridized	
26.	The balanced half reaction equations are: Oxidation half equation: $S0_2(g) + 2H_2O(l) \longrightarrow HS0_4^-(aq) + 3H^+(aq) + 2e^-$ …(i) Reduction half equation: $MnO_4^-(aq) + 8H^+(aq) + 5e^- \longrightarrow Mn^{2+}(aq) + 4H_2O(l)$ ……..(ii) Multiply Eq. (i) by 3 and Eq. (ii) by 2 and add, we have, $2MnO_4^-(aq) + 5S0_2(g) + 2H_20(l) + H^+(aq) \longrightarrow 2Mn^{2+}(aq) + 5HSO_4^-(aq)$	1 1 1
27.	(a) When organic compound is fused with sodium metal and then extracted by water, it is called Lassaigne's extract. Yes. (b) Blood red colour. (c) Lassaigne's extract is prepared in distilled water since tap water contains Cl ions. No, oxygen cannot be detected by Lassaigne's test.	1 1 1
28.	Addition of HBr to propene is an ionic electrophilic addition reaction in which the electrophile, i.e., H^+ first adds to give a more stable 2° carbocation. In the 2nd step, the carbocation is rapidly attacked by the nucleophile Br^- ion to give 2-bromopropane.	**3**

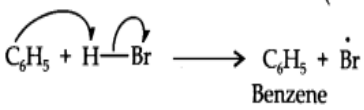




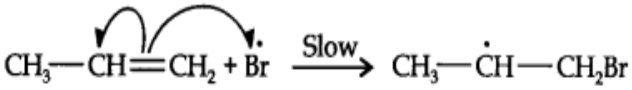


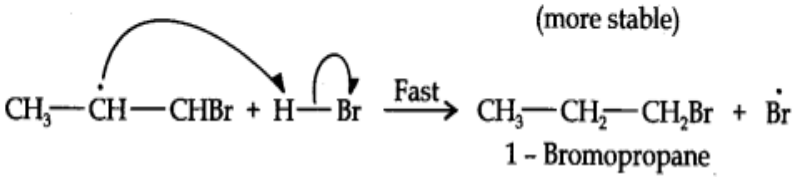
In presence of benzoyl peroxide, the reaction is still electrophilic but the electrophile here is a Br free radical which is obtained by the action of benzoyl peroxide on HBr





in the first step, Br radical adds to propene in such a way so as to generate the more stable 2° free radical. In the second step, the free radical thus obtained rapidly abstracts a hydrogen atom from HBr to give 1-bromopropane





From the above discussion, it is evident that although both reactions are electrophilic addition reactions but it is due to different order of addition of H and Br atoms which gives different products

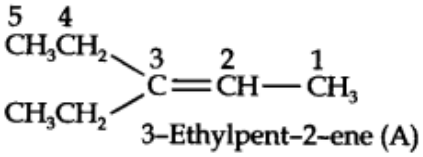
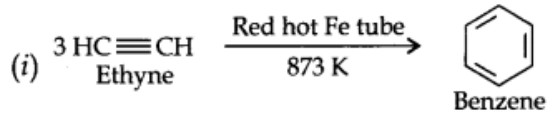
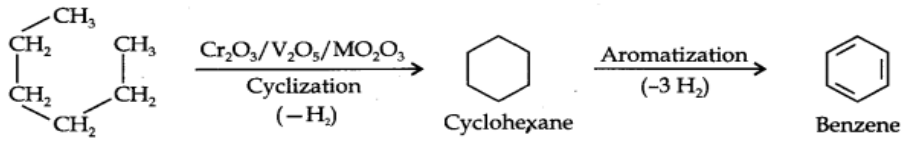
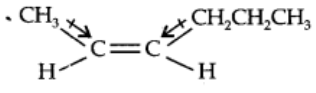
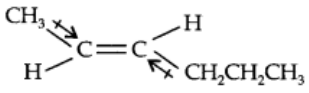
OR

Correct explanation and equation

3

29.	**(**i) from first law of thermodynamics $\Delta U = q + w$ as $q + w$ is equal to ΔU which is a state function it does not depends upon path of reaction and only depends upon initial and final state. ii) Density is an intensive property as it characteristics of a material and does not change with amount where as mass does change. iii)$\Delta U = q + w$ (from first law of thermodynamics) $0 = q + w$. ($\Delta U = 0$ at constant Temp.) $0 = q - p\,\Delta V$	**1** **1** **1** **1**

	$q = -w$ Therefore heat absorbed is used to do work by the system. **OR** According to the first law of thermodynamics. $\Delta E = q + w = 500 + (-350)$ $= +150$ cal.	**1** **1**
30.	(i) As the vapour pressure of water is appreciably higher than that of the organic liquid, it vaporises at a temperature much lower than its normal boiling point. (ii) Sublimation (iii) Correct definition or correct explanation	**1** **1** **2**
31.	(a) It states that it is impossible to determine simultaneously, the exact position and exact momentum of an electron. (b) $\Delta v = h/4\pi\Delta x.m$ $\Delta v = 6.626 \times 10^{-34}$ Js/4 x3.14 x 0.1 x 10^{-10}m x 9.11 x 10^{-3}kg $= 0.579 \times 10^7$ m/s or 5.79×10^6 m/s (c) (i) Energy of photon (E) = hv h = 6.626×10^{-34} J s ; v = 3×10^{15} Hz = $3 \times 10^{15} s^{-1}$ $\therefore$ E = $(6.626 \times 10^{-34}$ J s) × $(3 \times 10^{15}$ $s^{-1})$ = 1.986×10^{18} J (ii) Energy of photon (E) = hv = hc/λ h = 6.626 × 10 34 J s; c = 3×10^8 m s^{-1} ; λ= 0.50 Å = 0.5×10^{-10} m E = (6.626 X 10^{-34} Js) X (3 X 10^8 m/s)/(0.5 x 10^{-10} m) = 3.98 X 10^{-15} J OR (a) V=$1.0 \times 10^{15} s^{-1}$ K.E=1.988×10^{-19} J V_0=? hv = hv_0+ K.E V_0 =V-K.E/h = 1x10^{15} - (1.988x10^{-19}) / 6.626 x 10^{-34} S^{-1} =7 x 10^{14} S^{-1} Now λ=600 nm =6 x10^{-7}m Therefore v =C/λ =5 x10^{14} S^{-1} As V is less than V_0 , electrons will not be ejected. (b) Cr : $1s^2$ $2s^2$ $2p^6$ $3s^2$ $3p^6$ $3d^5$ $4s^1$ Cu+ : $1s^2$ $2s^2$ $2p^6$ $3s^2$ $3p^6$ $3d^{10}$ $4s^0$	**1** **1** **1** **1** **1** **1** **1**
32.	(a) The expression for $K_c = \frac{[PCl_3(g)][Cl_2(g)]}{[PCl_5(g)]}$ (b) For reverse reaction $(K_c') = \frac{PCl_5(g)}{[PCl_3(g)][Cl_2(g)]} = \frac{1}{8.3 \times 10^{-3}} = 120.48$ (c) (i) By adding more of PCl_5, value of K_c will remain constant because there is no change in temperature.	**1** **1** **1**

	(ii) No effect	**1**
	(iii) By increasing the temperature, the forward reaction will.be favoured since it is endothermic in nature. Therefore, the value of equilibrium constant will increase.	**1**
	OR	
	(a) Correct definition	**2**
	(b) Correct statement	**1**
	(i) Equilibrium will be shifted in the forward direction.	½
	(ii) Equilibrium will be shifted in the backward direction.	½
	(iii) Equilibrium will be shifted in the backward direction.	½
	(iv) Equilibrium will be shifted in the forward direction.	**1/2**
33.	(a) The acidic character decreases in the order: Ethyne > Benzene > Hexane.	**1**
	(b)The necessary conditions for a molecule to be aromatic are:	
	(i) It should have a single cyclic cloud of delocalised n-electrons above and below the plane of the molecule.	**2**
	(ii) It should be planar. This is because complete delocalization of n-electrons is possible only if the ring is planar to allow cyclic overlap of p-orbitals.	
	(iii)It should contain Huckel number of electrons, i.e., (4n + 2) n-electrons where n = 0, 1, 2, 3 etc.	**2**
	(c)  3–Ethylpent–2–ene (A)	
	OR	
	(a) Branching of carbon atom chain decreases the boiling point of alkane	**1**
	(i) 	
	(b) 	**1**
	(c) The structures of cis- and trans-isomer of hex-2-ene are	**1**
	 cis–Hex–2–ene (Higher dipole moment, higher b.p.)	**1**
	 trans–Hex–2–ene (Lower dipole moment, lower b.p.)	
	The boiling point of a molecule depends upon dipole-dipole interactions. Since cis-isomer has higher dipole moment, therefore, it has higher boiling point.	**1**

BLUE PRINT

Unit No.	Name of Unit	Sec-A		Sect- B	Sec- C	Sect- D	Sect- E	Total
		1 M		2 M	3 M	4 M	5 M	
		MCQ	A-R	VSA	SA	Case Based	LA	
1.	Some Basic Concepts of Chemistry	1 (1)	1 (1)	1 (2)	1 (3)			4 (7)
2.	Structure of Atom	2 (2)		1 (2)			1 (5)	4 (9)
3.	Classification of Elements and Periodicity in Properties	2 (2)	1 (1)		1 (3)			4 (6)
4.	Chemical Bonding and Molecular Structure	1 (1)	1 (1)				1 (5)	3 (7)
5.	Chemical Thermodynamics	2 (2)			1 (3)	1(4)		4 (9)
6.	Equilibrium	2 (2)		1 (2)	1 (3)			4 (7)
7.	Redox Reactions	1 (1)	1(1)	1 (2)				3 (4)
8.	Organic Chemistry: Some basic Principles and Techniques				2 (6)		1 (5)	3 (11)
9.	Hydrocarbons	1 (1)		1 (2)	1 (3)	1(4)		4 (10)
	Total No. of questions	12 (12)	4 (4)	5 (10)	7 (3)	2 (4)	3 (5)	33 (70)

SET-18

QUESTION PAPER-XI
SESSION ENDING EXAMINATION
CHEMISTRY THEORY (043)

MM:70 **Time: 3 Hrs**

Time: 3 hrs **MM: 70**

Read the following instructions carefully.

a) There are 33 questions in this question paper with internal choice.
b) SECTION A consists of 16 multiple-choice questions carrying 1 mark each.
c) SECTION B consists of 5 very short answer questions carrying 2 marks each.
d) SECTION C consists of 7 short answer questions carrying 3 marks each.
e) SECTION D consists of 2 case-based questions carrying 4 marks each.
f) SECTION E consists of 3 long answer questions carrying 5 marks each.
g) **All questions are compulsory.**
h) **Use of log tables and calculators is not allowed.**

	SECTION A The following questions are multiple-choice questions with one correct answer. Each question carries 1 mark. There is no internal choice in this section.	
1	A pure substance which contains only one type of atom is called ————. (a) An element (b) a compound (c) a solid (d) a liquid	1
2	The smallest particle that can take part in chemical reactions is ————. (a) Atom (b) molecule (c) Both (a) and (b) (d) none of these	1
3	Isotopes of an element have ———— (a) Different chemical and physical properties (b) Similar chemical and physical properties (c) Similar chemical but different physical properties (d) Similar physical but different chemical properties	1
4	The atomic orbital is ———— (a) The circular path of the electron (b) Elliptical shaped Orbit (c) Three-dimensional field around nucleus (d) The region in which there is a maximum probability of finding an electron	1
5	The elements with atomic numbers 9, 17, 35, 53, 85 are all ————- (a) halogens (b) noble gases (c) alkali earth metals (d) transition metals	1
6	Which of the following elements has the maximum negative electron gain enthalpy? (a) Oxygen (b) Chlorine (c) Fluorine (d) Nitrogen	1
7	Which of the following substances has a dipole moment more than zero? (a) Water (b) Methane (c) Carbon dioxide (d) Nitrogen	1
8	The third law of thermodynamics provides a method to evaluate which property? a) Absolute Energy	1

	b) Absolute Enthalpy c) Absolute Entropy d) Absolute free energy	
9	A well-stoppered thermos flask contains some ice cubes. This is an example of (a) Closed system (b) Open system (c) Isolated system (d) Non thermodynamics system	1
10	One mole of which of the following has the highest entropy? a) Liquid Nitrogen b) Hydrogen gas c) Mercury d) Diamond	1
11	Which of the following participate in the sulphonation of benzene? (a) SO_2 (b) SO_3H^+ (c) SO_3 (d) SO_3H^-	1
12	Which of the compounds show dipole moment? (a) 1,4-dichlorobenzene (b) 1,2-dichlorobenzene (c) trans-1,2-dichloroethane (d) trans-but-2-ene	1
	Given below are two statements labeled as Assertion (A) and Reason (R) Select the most appropriate answer from the options given below: a. Both A and R are true and R is the correct explanation of A b. Both A and R are true but R is not the correct explanation of A. c. A is true but R is false. d. A is false but R is true.	
13	**Assertion (A):** Kp =Kc for all reactions **Reason (R):** At constant temperature, the pressure of the gas is proportional to its concentration.	1
14	**Assertion:** In a reaction $Zn(s) + CuSO4 (aq) \rightarrow ZnSO_4(aq) + Cu(s)$ Zn is a reductant but itself get oxidized. **Reason:** In a redox reaction, oxidant is reduced by accepting electrons and reductant is oxidized by losing electrons.	1
15	**Assertion:** $HClO_4$ is a stronger acid than $HClO_3$. **Reason:** The oxidation state of Cl in $HClO_4$ is +7 and in $HClO_3$ +5.	1
16	**Assertion:** Chain isomerism is observed in compounds containing four or more than four carbon atoms **Reason:** Only alkanes show chain isomerism	1
	SECTION B This section contains 5 questions with internal choice in two questions. The following questions are very short answer type and carry 2 marks each.	
17	The average atomic mass of carbon is 12.011 amu. the percentage abundance of Carbon-13 is?	2
18	Using s,p,d and f notation, describe the orbital with the following quantum numbers- (a) n=1,l=0 (b) n=3, l=1 (c) n=4, l=2 (d) n=4, l=3 **OR** How many electrons in an atom have the following quantum numbers?	2

	(a) n=4, m_s= -1/2 (b) n =3 , l=0	
19	In a process, 701 J of heat is absorbed and 394 J of work is done by the system. What is the change in Internal energy for the process? **OR** Calculate entropy change in surroundings when 1.0 mol of $H2O_{(l)}$ is formed under standard conditions. Given $\Delta H^0 = -286 KJmol^{-1}$.	2
20	Write the balanced redox reaction. $MnO_4^-(aq) + Fe^{2+}(aq) \rightarrow Mn^{2+}(aq) + Fe^{3+}(aq)$ [acidic medium]	2
21	Explain why $(CH_3)_3C^+$ is more stable than $CH_3C^+H_2$.	2
	SECTION C This section contains 7 questions with internal choice in two questions. The following questions are short answer type and carry 3 marks each.	
22	Explain the followings: (a) What is the significant figures in 1.050×10^4? (b) What is the S.I. unit of Density? (c) What is limiting reagent?	1+1+1
23	Explain the followings: (a) What is the total number of sigma and pi bonds in the following molecules? C_2H_2 (b) C_2H_4 (b) Write the significance of a plus and a minus sign shown in representing the orbitals.	2+1
24	(a) Classify the following species into Lewis's acids and Lewis bases and show How these acts as such: (i) HO^- (ii)F^- (iii) H^+ (iv) BCl_3 (b) What is meant by the conjugate acid-base pair? Give example.	2+1
25	(a) Define Homologous series. Write the general formula of alkane, alkene and alkynes. (b) Define functional groups. Write the general formula of Carboxylic acids, and acid chlorides.	2+1
26	(a) What are the necessary conditions for any system to be aromatic? (b) What effect does the branching of an alkane chain have on its boiling point? **OR** (a) Although benzene is highly unsaturated, it does not undergo addition reactions, why? (b) What are alkanes? Why are they called paraffins?	2+1
27	(a)How do you express the bond strength in terms of bond order? (b) Define the bond length. **OR** (a) Define the octet rule. (b) Which type of bond is formed when the atoms have zero difference in electronegativity?	2+1
28	Explain the following :	1+1+1

	(i) Common ion effect (ii) solubility products (iii) pH	
	SECTION D The following questions are case-based questions. Each question has an internal choice and carries 4 (1+1+2) marks each. Read the passage carefully and answer the questions that follow.	
29	**Read the passage and answer the questions given below:** The atomic theory of matter was first proposed on a firm scientific basis by John Dalton, a British school teacher in 1808. His theory, called Dalton's atomic theory, regarded the atom as the ultimate particle of matter Dalton's atomic theory was able to explain the law of conservation of mass, the law of constant composition, and the law of multiple proportions very successfully. However, it failed to explain the results of many experiments. In the mid-1850s many scientists mainly Faraday began to study electrical discharge in partially evacuated tubes, known as as cathode ray discharge tubes. Electrical discharge carried out in the modified cathode ray tube led to the discovery of canal rays carrying positively charged particles.	
29.1	The atomic theory of matter was first proposed on a firm scientific basis by (a) John Dalton (b) Ernest Rutherford (c) J.Thomson (d) Henry Moseley	1
29.2	The cathode rays start from … and move towards the …. (a) Anode , Cathode (b) Centre , Anode (c) Cathod , Anode (d) Cathod , Centre	1
29.3	The smallest and lightest positive ion was obtained from …. and was called a proton. (a) Oxygen (b) Nitrogen (c) Carbon (d) Hydrogen	1
29.4	Electrically neutral particles having a mass slightly greater than that of protons, these particles termed as …. (a) Protons (b) electrons (c) Neutron (d) Positron	1
30	**Read the passage and answer the questions given below:** A system in thermodynamics refers to that part of universe in which observations are made and remaining universe constitutes the surroundings. The surroundings include everything other than the system. System and the surroundings together constitute the universe . The universe = The system + The surroundings However, the entire universe other than the system is not affected by the changes taking place in the system. Therefore, for all practical purposes, the surroundings are that portion of the remaining universe which can interact with the system. Usually, the region of space in the neighbourhood of the system constitutes its surroundings. The wall that separates the system from the surroundings is called boundary. The State of the System The system must be described in order to make any useful calculations by specifying quantitatively each of the properties such as its pressure (p), volume (V), and temperature (T) as well as the composition of the system. We need to describe the system by specifying it before and after the change. You would recall from your Physics course that the state of a system in mechanics is completely specified at a given instant of time, by the position and velocity of each mass point of the system. In thermodynamics, a different and much simpler	

	concept of the state of a system is introduced. It does not need detailed knowledge of motion of each particle because, we deal with average measurable properties of the system. We specify the state of the system by state functions or state variables. The state of a thermodynamic system is described by its measurable or macroscopic (bulk) properties. We can describe the state of a gas by quoting its pressure (p), volume (V), temperature (T), amount (n) etc. Variables like p, V, T are called state variables or state functions because their values depend only on the state of the system and not on how it is reached. In order to completely define the state of a system it is not necessary to define all the properties of the system; as only a certain number of properties can be varied independently. This number depends on the nature of the system. Once these minimum number of macroscopic properties are fixed, others automatically have definite values. The state of the surroundings can never be completely specified; fortunately it is not necessary to do so.	
30.1	**ΔU = …** a) q + w b) q + v c) q + m d) q + z	1
30.2	Which of the following is not an example of state variable ? a) pressure b) ionic radius c) volume d) amount	1
30.3	**ΔU = q + w is termed as …** a) Third law of thermodynamics b) Second law of thermodynamics c) First law of thermodynamics d) None of the above	1
30.4	**A … in thermodynamics refers to that part of the universe in which observations are made.** a) Universe b) System c) Surrounding d) Boundary	1
	SECTION E The following questions are long answer types and carry 5 marks each. Two questions have an internal choice.	
33	(a)The quantum numbers of six electrons are given below. Arrange them in order of increasing energy. If any of these combination(s) has/have the same energy lists: 1. n= 4, l = 2, m_l= –2 , m_s= –1/2 2. n= 3, l = 2, m_l= 1 , m_s= +1/2 3. n= 4, l = 1, m_l= 0 , m_s= +1/2 4. n = 3, l= 2, m_l= –2 , m_s= –1/2 5. n = 3, l= 1, m_l= –1 ,m_s= +1/2 6. n = 4, l= 1, m_l= 0 , m_s= +1/2 (b) Among the following pairs of orbitals which orbital will experience the larger effective nuclear charge? (i) 2s and 3s, (ii) 4d and 4f, (iii) 3d and 3p	3+2
34	(a) Explain hyperconjugation effect. How does hyperconjugation effect explain the stability of alkenes? (b) Define Isomerism. Explain position Isomerism and Functional Isomerism with examples. **OR**	3+2

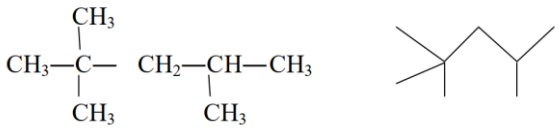
	(a) Write a short note on Resonance effect. Explain the types of resonance effect with proper examples. (b) Write the condensed and bond line formula of 2,2,4-Trimethylpentane.	
35	(a) Write IUPAC names of the products obtained by the ozonolysis of the following compounds (Do any three) (i) Pent-2-ene (ii) 3,4-Dimethylhept-3-ene (iii) 2-Ethylbut-1-ene (iv) 1-Phenylbut-1-ene (b) An alkene 'A' on ozonolysis gives a mixture of ethanal and pentan-3-one. Write structure and IUPAC name of 'A'. **OR** (a) How will you convert benzene into (Do any three) (i) p-nitrobromobenzene (ii) m- nitrochlorobenzene (iii) p – nitrotoluene (iv) acetophenone? (b) Why does benzene undergo electrophilic substitution reactions easily and nucleophilic substitutions with difficulty?	3+2

Marking Scheme

S.No.	Questions	Marks
	SECTION A The following questions are multiple-choice questions with one correct answer. Each question carries 1 mark. There is no internal choice in this section.	
1	(a) An element	1
2	(c) Both (a) and (b)	1
3	(c) Similar chemical but different physical properties	1
4	(d) The region in which there is a maximum probability of finding an electron	1
5	(a) halogens	1
6	(b) Chlorine	1
7	(a) Water	1
8	(c) Absolute entropy	1
9	(c) Isolated system	1
10	(b)Hydrogen gas	1
11	(c) SO_3	1
12	(b) 1,2-dichlorobenzene	1
	Given below are two statements labeled as Assertion (A) and Reason (R) Select the most appropriate answer from the options given below: a. Both A and R are true and R is the correct explanation of A b. Both A and R are true but R is not the correct explanation of A. c. A is true but R is false. d. A is false but R is true.	
13	B. Both A and R are true but R is not the correct explanation of A.	1
14	A. Both A and R are true and R is the correct explanation of A	1
15	B. Both A and R are true but R is not the correct explanation of A.	1
16	C. A is true but R is false.	1
	SECTION B This section contains 5 questions with internal choice in two questions. The following questions are very short answer type and carry 2 marks each.	
17	Let x be the percentage abundance of carbon-12 then (100-x) will be the percentage abundance of carbon-13. From formula $12.011 = \frac{x}{100} \times 12 + \frac{(100-x)}{100} \times 13$ On simplification we get x = 98.9 or abundance of C-12 is 98.9% and C-13 is 1.1%	2
18	(a) 1s (b) 3p (c)4d (d) 4f **OR** (a) 16 electrons (b) 2 electrons.	2
19	q = 701 J, w = 394J, so U = q + w = 701 – 394 = 307J **OR** $q_{(rev.)} = -\Delta H^0 = -286\ KJmol^{-1} = 286000 Jmol^{-1}$ $\Delta S = \frac{q_{(rev.)}}{T} = \frac{286000\ J.mol^{-1}}{298\ K} = 959\ J.K^{-1}mol^{-1}$	2

20	$MnO_4^-(aq) + 5Fe^{2+}(aq) + 8H^+(aq) \rightarrow Mn^{2+}(aq) + 5Fe^{3+}(aq) + 4H_2O(l)$	2
21	$(CH_3)_3C^+$ has nine alpha hydrogens and nine hyperconjugation structures while $CH_3C^+H_2$ has three alpha hydrogens and three hyperconjugation structures, therefore $(CH_3)_3C^+$ is more stable than $CH_3C^+H_2$	2
	SECTION C This section contains 7 questions with internal choice in two questions. The following questions are short answer type and carry 3 marks each.	
22	(a) Four (b) Kg m^{-3} (c) The reactant which gets consumed first or limits the amount of product formed is known as limiting reagent	1+1+1
23	(a) there are three sigma and two pi-bonds in C2H2. there are five sigma bonds and one pi-bond in C2H4. (b) Molecular orbitals are represented by wave functions. A plus sign in an orbital indicates a positive wave function while a minus sign in an orbital represents a negative wave function.	2+1
24	(a) Correct explanation (b) The acid-base pair that differs only by one proton is called a conjugate acid-base pair	2+1
25	(a) Correct explanation. (b) Correct explanation.	2 1
26	(a) A compound is said to be aromatic if it satisfies the following three conditions: (i) It should have a planar structure. (ii) The π–electrons of the compound are completely delocalized in the ring. (iii)The total number of π–electrons present in the ring should be equal to (4n + 2), where n = 0, 1, 2 … etc. This is known as Huckel's rule. (b) As branching increases, the surface area of the molecule decreases which results in a small area of contact. As a result, the Van der Waals force also decreases which can be overcome at a relatively lower temperature. Hence, the boiling point of an alkane chain decreases with an increase in branching. **OR** (a) Because of extra stability due to delocalization of π-electrons. (b) Those hydrocarbons which contain a single bond between carbon-carbon are called alkanes. They are called paraffins because they are very less reactive (Latin- Parum= little, affins = affinity)	
27	(a)bond strength represents the extent of bonding between two atoms forming a molecule. The larger the bond energy, the stronger is the bond and the greater is the bond order. (b) Bond length is defined as the equilibrium distance between the nuclei of two bonded atoms in a molecule.	

	OR (a) The elements tend to adjust the arrangement of their electrons in such a way that they (except H and He) achieve eight electrons in their outermost shell. This is called the octet rule. (b) Covalent bond.	
28	(i) Suppression of ionization of weak electrolyte by adding a strong electrolyte having an ion common. (ii) Product of the molar concentrations of the ions in a saturated solution, each concentration term raised to the power equal to the no. of ions produced. (iii) Negative logarithm of hydrogen ion concentration.	
	SECTION D The following questions are case-based questions. Each question has an internal choice and carries 4 (1+1+2) marks each. Read the passage carefully and answer the questions that follow.	
29	29.1 – A 29.2 – C 29.3 – D 29.4 - C	4
30	30.1- A 30.2- B 30.3- C 30.4- B	4
	SECTION E The following questions are long answer types and carry 5 marks each. Two questions have an internal choice.	
31	Ans.(a)For $n = 4$ and $l = 2$, the orbital occupied is $4d$. For $n = 3$ and $l = 2$, the orbital occupied is $3d$. For $n = 4$ and $l = 1$, the orbital occupied is $4p$. Hence, the six electrons i.e., 1, 2, 3, 4, 5, and 6 are present in the $4d$, $3d$, $4p$, $3d$, $3p$, and $4p$ orbitals respectively. Therefore, the increasing order of energies is $5(3p) < 2(3d) = 4(3d) < 3(4p) = 6(4p) < 1\ (4d)$. (b)Nuclear charge is defined as the net positive charge experienced by an electron in the orbital of a multi-electron atom. The closer the orbital, the greater is the nuclear charge experienced by the electron (s) in it. **(i)** The electron(s) present in the $2s$ orbital will experience greater nuclear charge (being closer to the nucleus) than the electron(s) in the $3s$ orbital. **(ii)** $4d$ will experience greater nuclear charge than $4f$since $4d$ is closer to the nucleus. **(iii)** $3p$ will experience greater nuclear charge since it is closer to the nucleus than $3f$.	3+2
32	(a) The relative stability of various classes of carbonium ions may be explained by the number of no-bond resonance structures that can be written for them. Such structures are obtained by shifting the bonding electrons from an adjacent C-H bond to the electron deficient carbon so the positive charge originally on carbon is dispersed to the hydrogen. This manner of electron release by assuming no bond character in the adjacent C-H bond is called Hyperconjugation. Greater the hyperconjugation greater will be the stability of alkenes. (b) Correct explanation. **OR** (a) Correct explanation	3+2

	(b) 	
33	(a) (i) (I) ethanal and (II) propanal. (ii) butanone and pentan-2-one. (iii) (I) pentan-3-one and (II) methanal. (iv) (I)is benzaldehyde and Product (II)is propanal. (b) The IUPAC name of 'A' is 3-Ethylpent-2-ene. **OR** (a) Correct explanation (b) Correct explanation	3+2

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S.No.	Name of the Chapter	MCQ (1 Mark)	Very Short Answers (2 Marks)	Short Answers (3 Marks)	CBQ (4 Marks)	Long Answers (5 Marks)	Total Marks
1	Some Basic Concepts of Chemistry	2(1)	1(2)	1(3)	-	-	7
2	Structure of Atom	2(1)	1(2)	-	-	1(5)	9
3	Classification of Elements and Periodicity in Properties	2(1)	-	-	1(4)	-	6
4	Chemical Bonding and Molecular Structure	1(1)	-	2(3)	-	-	7
5	Chemical Thermodynamics	3(1)	1(2)	-	1(4)	-	9
6	Equilibrium	1(1)	-	2(3)	-	-	7
7	Redox Reactions	2(1)	1(2)		-		4
8	Organic Chemistry: Some basic Principles and Techniques	1(1)	1(2)	1(3)	-	1(5)	11
9	Hydrocarbons	2(1)		1(3)	-	1(5)	10
	GRAND TOTAL	**16 (1)**	**5(2)**	**7(3)**	**2 (4)**	**3 (5)**	**33(70)**

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