# NCERT

# CHAPTER WISE

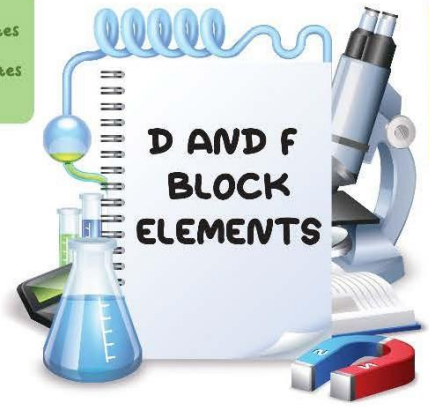
# TOPIC WISE

## LINE BY LINE QUESTIONS

## 2024

BY
SCHOOL OF
EDUCATORS

# D AND F BLOCK ELEMENTS



## D BLOCK ELEMENTS (TRANSITION ELEMENTS)

### Physical Properties

- They are hard
- They show metallic characteristics
- They have low volatility except Zn, Cd, Hg
- Melting & Boiling Point: They have high melting and boiling point. Due to stronger metallic bond and presence of covalent bond by unpaired d-electrons
- 4d Series: Y(39) to Cd(48)
- 5d Series: La(57) to Hg(80)
- 3d Series: Sc(21) to Zn(30)
- Conjugation: $(n-1)d^{1-10}ns^{1-2}$

### Atomic Size

Atomic and ionic radii of d-block elements are smaller than s-block.

Decrease in atomic radii with increase in atomic number is not regular.

### Ionisation Enthalpy

Increases from left to right in a period

### Coloured Complex

Due to d-d transition.

### Oxidation State

Transition metal shows variableoxidation state.

Due to participation of both ns and (n - 1) elements.

Manganese shows all O.S. from +2 to +7.

Scandium doesn't show variable oxidation state.

### Alloy Formation

Due to similar atomic sizes

### Oxides

Lower oxidation states oxides are basic.

Higher oxidation states oxides are acidic or amphoteric

### Catalytic Properties

Due to variable oxidation state.

Ex: Finely divided Fe in Haber's process.

### Chemical Reaction

LN reacts with:

- halogens → $LNX_3$
- acids → $H_2$
- heated with S → $Ln_2S_3$
- heated with N → LnN
- $H_2O$ → $Ln(OH)_3 + H_2$
- C, 2773 K → $LnC_2$
- burns in $O_2$ → $Ln_2O_3$

## LANTHANOIDS

### Lanthanoid Contraction

- Steady decrease in the rise of lanthanoid metals (from La to Lu) with increase in atomic number.

**Consequences**

- Zr and Hf have similar sizes.
- Seperation of lanthanoids elements.
- 5d series have high ionisation energy than 4d series.
- Lutetium hydroxide is less basic than lanthanum hydroxide.

### Elements

Total 14 element Ce(58) to Lu (71)

### Electronic Configuration

+3 is the most common oxidation Salt

$4f^{1-14}\ 5d^{0-1}\ 6s^2$

### Oxidation State

+3 is the most common oxidation stat

Some elements also shows +2 and +4 oxidation state

## F BLOCK ELEMENTS INNER TRANSITION ELEMENTS

## ACTINOIDS

### Electronic Configuration

$5f^{1-14}\ 6d^{0-1}\ 7s^2$

Consist of 14 elements Th(90) to Lr(103)

### Radioactivity

Actinoids are mostly radioactive

### Oxidation State

Most Stable oxidation state is +3.

Actinoids also show +4, +5, +6 and +7 also

### Actinoid Contraction

Gradual decreae in the size of actinoids element across a period

## IMPORTANT COMPOUNDS

### Potassium Permanganate $KMnO_4$

#### Structure

Due to variable oxidation State. Ex: Finely divided Fe in Haber's process

Tetrahedral purple Colour Ion

#### Preparation

Prepared from mineral pyrolusite

$$2MnO_2 + 4KOH + O_2 \longrightarrow 2K_2MnO_4 + 2H_2O$$

$$3MnO_2^{2-} + 4H^+ \longrightarrow 2MnO_4^- + MnO_2 + 2H_2O$$

#### Oxidising Properties

**In neutral or fainty alkaline medium**

$$MnO_4^- + 2H_2O + 3e \longrightarrow MnO_2 + 4H_2O$$

It oxidises $S_2O_3^{2-}$ to $SO_4^{2-}$, $I^-$ to $IO_3^-$.

**In acidic medium**

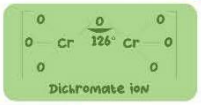
$$MnO_4^- + 8H^+ + 5e^- \longrightarrow Mn^{2+} + 4H_2O$$

It oxidises $I^-$ to $I_2$, $NO_2^-$ to $NO_3^-$, $Fe_2^+$ to $Fe_3^+$, $C_2O_4^{2-}$ to $CO^2$.

### Potassium dichromate $K_2Cr_2O_7$

$$Cr_2O_7^{2-} + 14H^+ + 6e \longrightarrow 2Cr^{3+} + 7H_2O$$

It oxidises $I^-$ to $I_2$, $H_2S$ to S, $SO_3^{2-}$ to $SO_4^{2-}$, $NO_2^-$ to $NO_3^-$.



Dichromate ion

Prepared from chromite ore.

$$4FeCr_2O_4 + 8Na_2CO_3 + 7O_2 \rightarrow 8Na_2CrO_4 + 2Fe_2O_3 + 8CO_2$$

$$2Na_2CrO_4 + H_2SO_4 \rightarrow Na_2Cr_2O_7 + Na_2SO_4 + Na_2SO_4 + H_2O$$

$$2Na_2Cr_2O_7 + 2KCl \longrightarrow K_2Cr_2O_7 + 2NaCl$$

Chromates and dichromates are interconvertible.

$$\underset{\text{dichromate ion (orange red)}}{Cr_2O_7^{2-}} + H_2O \underset{\text{basic medium}}{\overset{\text{acidic medium}}{\rightleftharpoons}} \underset{\text{Chromate ion (yellow)}}{2CrO_4^{2-}} + 2H^+$$

### Application

- $MnO_2$ are used in batteries
- Zeigler Natta catalyst ($TiCl_4$ + $Al(CH_3)_3$ used in polythene)
- $PdCl_2$ is used as a catalyst in wakes process.
- AgBr in photographic industry
- Helps in production of iron and steels.

# 08. THE D- & F-BLOCK ELEMENTS

**(1.)** Among the transition metals of 3d-series, the one that has the highest negative $M^{2+}/M$ standard electrode potential is

(a.) Ti (b.) Cu

(c.) Mn (d.) Ni

**(2.)** Compute the given reaction of $KMnO_4$ in acidic medium:

$5Fe^{2+} + MnO_4^- + 8H^+ \rightarrow Mn^{2+} + 4H_2O + 5X$

$5S^{2-} + 2MnO_4^- + 16H^+ \rightarrow 2Mn^{2+} + 8H_2O + 5Y$

$ZNO_2^- + 2MnO_4^- + 6H^+ \rightarrow 2Mn^{2+} + ZNO_3^- + 3H_2O$

X, Y and Z are respectively

(a.) $Fe, S^{2+}, 6$ (b.) $Fe^{3+}, S, 7$

(c.) $Fe^{3+}, S, 5$ (d.) $Fe^{2+}, S^{2+}, 5$

**(3.)** Solution of oxalate is colourless. It is made acidic by adding exceeds of $H^+$, then titrated with $KMnO_4$. Now at a moment if someone has added large amount of $KMnO_4$ in it then the possible products are

(a.) $CO_2, Mn^{2+}, H_2O$ (b.) $CO_2, MnO_2, H_2O$

(c.) $MnO_2, H_2O, CO_2$ (d.) $CO_2, MnO_2, H_2O, Mn^{2+}$

**(4.)** Which of the comparison regarding Zn, Cd, Hg is/ are incorrect〉.

I $ZnCl_2$ is ionic whereas $CdCl_2$ and $HgCl_2$ are covalent.

II Zn and Cd dissolves in dilute acid $(HCl)$ liberating $H_2$ but Hg cannot.

III Zn and Cd forming white ppt. of $Zn(OH)_2$ and $Cd(OH)_2$ but Hg form coloured ppt. of $Hg(OH)_2$.

(a.) I & III (b.) I & II

(c.) II & III (d.) only I

**(5.)** The silver UK coins are

(a.) Cu / Zn alloy (b.) Cu / Ni alloy

(c.) Ag / Ni alloy (d.) Ag / Au alloy.

**(6.)** Match the following.

| | |
|---|---|
| (P) Radioactive lanthanoid | (I) Eu |
| (Q) Lanthanoid which has $4f^7$ in +2 oxidation state | (II) La |
| (R) Lanthanoid which has $4f^7$ in +3 oxidation state | (III) Pm |
| (S) Lanthanoid which has $4f^0$ in +3 oxidation state | (IV) Gd |

(a.) P-III,Q-I,R-IV,S-II
(b.) P-III,Q-IV,R-I,S-II
(c.) P-I,Q-IILR-IV,S-II
(d.) P-II,Q-III,R-IV,S-I

**(7.)** The melting point of copper is higher than that of zinc because

(a.) the atomic structure of copper is much denser than zinc
(b.) the atomic volume of copper is high
(c.) involvement of lesser number of electrons in metallic bonding
(d.) involvement of $(n-1)$ d electrons in metallic bonding.

**(8.)** What happens when KCl is heated with $H_2SO_4$ and potassium dichromate?

(a.) $CrO_2Cl_2$ is formed.
(b.) $CrCl_3$ is formed.
(c.) $K_2CrO_4$ is formed.
(d.) $Cr_2(SO_4)_3$ is formed.

**(9.)** Consider the given statements:

I In its higher oxidation states, manganese forms stable compounds with oxygen and fluorine.
II $Mn^{3+}$ and $Co^{3+}$ are oxidising agents in aqueous solution.
III $Ti^{2+}$ and $Cr^{2+}$ are reducing agents in aqueous solution.

Which of the given statement(s) is/are correct

(a.) I only
(b.) I & II only
(c.) II & III only
(d.) all of these

**(10.)** Electronic configuration of Cu is given as $[Ar]\ 3d^{10}4s^2$. Then which of the following is correct about $Cu(I)$ and $Cu(II)$?

(a.) E.C. of $Cu(I)$ is $3d^9$ and $Cu(II)$ is $3d^{10}$.
(b.) $Cu(II)$ is more stable than $Cu(I)$.
(c.) $Cu(I)$ and $Cu(II)$ are equally stable.
(d.) Stability of $Cu(I)$ and $Cu(II)$ depends on nature of copper salts.

**(11.)** **Assertion:** The highest oxidation state of osmium is +6.
**Reason:** Osmium is a 6d-block element.

(a.) Both A and R are correct and R is correct explanation of A.
(b.) Both A and R are correct but R is not correct explanation of A.
(c.) A is true but R is false.
(d.) Both A and R are false.

**(12.)** **Assertion:** Separation of Zr and Hf is difficult.
**Reason:** Both have same chemical properties due to similar radius

(a.) Both A and R are correct and R is correct explanation of A.
(b.) Both A and R are correct but R is not correct explanation of A.
(c.) A is true but R is false.
(d.) Both A and R are false.

**(13.)** The separation of lanthanides by ion exchange method is based on

(a.) size of the ions
(b.) the solubility of their nitrates
(c.) oxidation states of the ions
(d.) basicity of the hydroxides of lanthanides.

**(14.)** Which of the following ions show higher spin only magnetic moment value

(a.) $Ti^{3+}$ & $Mn^{2+}$
(b.) $Mn^{2+}$ & $Ti^{3+}$

(c.) $Mn^{2+}$ & $Fe^{2+}$ (d.) $Co^{3+}$ & $Mn^{2+}$

**(15.)** Manganese exhibit its highest oxidation state $(+7)$ in its oxide not in its fluoride, why

(a.) Oxygen is less electronegative than fluorine.

(b.) Oxygen posses d-orbitals while fluorine does nor.

(c.) Fluorine stabilises lower oxidation state.

(d.) In covalent compounds fluorine can form single bond only while oxygen forms double bonds.

**(16.)** Which of the following factors is responsible for the value of ionisation enthalpy.

(a.) Attraction of each electron towards nucleus

(b.) Repulsion between the electrons

(c.) Exchange energy

(d.) All of these

**(17.)** Transition elements show magnetic moment due to presence of unpaired electrons. Which of the following pairs have same magnetic moment?

(a.) $Co^{2+}, Cr^{2+}$,

(b.) $Cr^{2+}, Mn^{2+}$

(c.) $Mn^{2+}, Cr^{3+}$

(d.) $Co^{2+}, Cr^{3+}$

**(18.)** When a mixture of NaCl and $K_2Cr_2O_7$ is gently warmed with contracted $H_2SO_4$, then

(I) Chlorine gas is evolved
(II) Orange red vapours are evolved
(III) The vapours when passed into NaOH solution give a yellow solution of $Na_2CrO_4$
Which of the following is/are correct

(a.) I only

(b.) II & III

(c.) I & III

(d.) All are correct

**(19.)** The reason for greater range of oxidation stare in actinoids is attributed to

(a.) the radioactive nature of actinoids

(b.) actinoid contraction

(c.) 5f, 6d and 7s levels having comparable energies

(d.) 4f and 5d levels being close in energies.

**(20.)** General electronic configuration of lanthanoids is

(a.) $(n-2)f^{1-14}(n-1)s^2p^6d^{0-1}ns^2$

(b.) $(n-2)f^{10-14}(n-1)d^{0-1}ns^2$

(c.) $(n-2)f^{0-14}(n-1)d^{10}ns^2$

(d.) $(n-2)d^{0-1}(n-1)f^{1-14}ns^2$

**(21.)** **Assertion:** Potassium dichromate is used as a primary standard in volumetric analysis.
**Reason:** Sodium and potassium dichromates are strong oxidising agents.

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

(b.) Both A and R are correct but R is nor correct explanation of A.

(c.) A is true but R is false.

(d.) Both A and R are false.

**(22.)** Match the catalysts with the processes.

| | |
|---|---|
| (i) $Ni / H_2$ | (P) Reaction between iodide and persulphate ions |

| | |
|---|---|
| (ii) $Cu_2Cl_2$ | (Q) Vegetable oil to ghee |
| (iii) Fe (III) | (R) Sandmeyer reaction |
| (iv) Finely divided Fe | (S) Haber's process |

(a.) (i)-Q, (ii)-P, (iii)-S, (iv)-R
(b.) (i)-P, (ii)-Q, (iii)-S, (iv)-R
(c.) (i)-P, (ii)-R, (iii)-Q, (iv)-S
(d.) (i)-Q, (ii)-R, (iii)-P, (iv)-S

**(23.)** Which of the following elements shows maximum number of different oxidation states in its compounds?

(a.) Eu
(b.) La
(c.) Gd
(d.) Am

**(24.)** Which of the following are radioactive?

(a.) Tb & Pm
(b.) Pm & Pa
(c.) Am & Tb
(d.) Pa & Am

**(25.)** Which of the following is correct about reaction of $KMnO_4$ with oxalic acid?

(a.) $CO_2$ is formed as the product.
(b.) The decolourisaton of $KMnO_4$ is slow in the beginning and become instantaneous after sometime.
(c.) $Mn^{2+}$ catalyses the reaction.
(d.) All of these

**(26.)** The colour of $KMnO_4$ is due to

(a.) $L \rightarrow M$ charge transfer
(b.) $\sigma \rightarrow \sigma^*$ transition
(c.) $M \rightarrow L$ charge transfer
(d.) d - d transition.

**(27.)** Actinoids are generally slightly affected by $HNO_3$ but HCl attacks almost all metals because

(a.) HCl is stronger acid than $HNO_3$
(b.) $HNO_3$ is stronger acid than HCl
(c.) formation of protective oxide layer by $HNO_3$
(d.) formation of protective oxide layer by HCl.

**(28.)** Reduction of metal centre in aqueous permanganate ion involves

I 3 electrons in neutral medium
II 5 electrons in acidic medium
III 1 electron in alkaline medium

Which of the following is/are correct

(a.) Only II
(b.) II & III
(c.) I & II
(d.) All of these

**(29.)** The reason behind the same physical and chemical properties of zirconium (4d – series) and hafnium (5d – series) is

(a.) same number of valence electrons
(b.) same value of electrode potential
(c.) almost similar atomic radius
(d.) same enthalpy of atomisation.

**(30.)** When neutral or faintly alkaline $KMnO_4$ is treated with potassium iodide, iodide ion is converted into X. X is

(a.) IO (b.) $I_2$

(c.) $IO_4$ (d.) $IO_3$

**(31.)** The electronic configuration of Eu (Atomic no. 63), Gd (Atomic no. 64) and Tb (Atomic no. 65) are

(a.) $[Xe]\ 4f^7 6s^2, [Xe]4f^8 6s^2 \text{ and } [Xe]4f^8 5d^1 6s^2$ (b.) $[Xe]\ 4f^6 5d^1 6s^2, [Xe]4f^7 5d^1 6s^2 \text{ and } [Xe]4f^9 6s^2$

(c.) $[Xe]\ 4f^6 5d^1 6s^2, [Xe]4f^7 5d^1 6s^2 \text{ and } [Xe]4f^8 5d^1 6s^2$ (d.) $[Xe]\ 4f^7 6s^2, [Xe]4f^7 5d^1 6s^2 \text{ and } [Xe]4f^{9'} 6s^2$

**(32.)** Which of the following is not correctly matched with $K_2Cr_2O_7$ reactions?

(a.) $I^- \rightarrow I_2$ (b.) $Sn^{2+} \rightarrow Sn^{3+}$

(c.) $H_2S \rightarrow S$ (d.) $Fe^{2+} \rightarrow Fe^{3+}$

**(33.)** The magnetic moment of a divalent ion in aqueous solution if its atomic number is 27, is

(a.) 3.87 B.M . (b.) 5.90 B.M

(c.) 4.89 B.M . (d.) 2.9 B.M.

**(34.)** March the following columns.

| | |
|---|---|
| (P) Reagent oxidised $Fe^{2+}$ to $Fe^{3+}$ | (i) $K_2MnO_4$ |
| (Q) Compound having dark purple crystal isostructure with $KClO_4$ | (ii) $KMnO_4$ |
| (R) Green compound formed by fusing KOH with $MnO_2$ | (iii) $K_2Cr_2O_7$ |
| (S) Compound which has orange crystal tetrahedral structure acidified | (iv) $KMnO_4$ |

(a.) P-(iv) , Q-(ii) , R-(i) , S-(iii) (b.) P-(iii) , Q-(ii) , R-(i) , S-(iv)

(c.) P-(iv) , Q-(i) , R-(ii) , S-(iii) (d.) P-(iii) , Q-(i) , R-(ii) , S-(iv)

**(35.)** **Assertion:** $KMnO_4$ is used for bleaching wool, cotton, silk and other textile fibres and for decolourisation of oils.

**Reason:** $KMnO_4$ is a strong oxidising agent.

(a.) Both A and R are correct and R is correct explanation of A. (b.) Both A and R are correct but R is not correct explanation of A.

(c.) A is true but R is false. (d.) Both A and R are false.

**(36.)** Which one of the following statements related to lanthanoids is incorrect?

(a.) Europium shows +2 oxidation state. (b.) The basicity decrease as the ionic radius decreases from Pr to Lu.

(c.) All the Lanthanons are much more reactive (d.) Ce(+4) solutions are widely used as oxidising

than aluminum.

agent in volumetric analysis.

**(37.)** Among the following pairs of ions, the lower oxidation state in aqueous solution is more stable than the other, in

(a.) $Ti^{+}, Ti^{3+}$

(b.) $Cu^{+}, Cu^{2+}$

(c.) $Cr^{2+}, Cr^{3+}$

(d.) $V^{2+}, VO^{2+}$

**(38.)** Among $Sc(III)$, $Ti(IV)$, $Pd(II)$ and $Cu(II)$ ions

(a.) all are paramagnetic

(b.) all the diamagnetic

(c.) $Sc(III)$, $Ti(IV)$ are paramagnetic and $Pd(II)$ and $Cu(II)$ are diamagnetic

(d.) $Sc(III)$, $Ti(IV)$ are diamagnetic and $Pd(II)$ and $Cu(II)$ are paramagnetic.

**(39.)** The reason for lanthanoid contraction is

(a.) greater shielding of $4f$ - electrons

(b.) poor shielding of $4f$ - electrons

(c.) greater shielding of $5d$ - electrons

(d.) poor shielding of $5d$ - electrons.

**(40.)** Correct set of amphoteric oxides is

(a.) $V_2O_5, Cr_2O_3$

(b.) $CrO, V_2O_5$

(c.) $V_2O_4, CrO_3$

(d.) $Mn_2O_7, CrO_3$

**(41.)** The composition of Mischmetal is

(a.) Lanthanoid metals $(-90) + Fe(-9.5\%) + S, C, Ca, Al$

(b.) Lanthanoid metals $(-95) + Fe(-5\%) + S, C, Ca, Al$

(c.) Lanthanoid metals $(90\%) + Actinoids\ (5\%) + C\ (5\%)$

(d.) Lanthanoid metals $(95\%) + C\ (5\%) + Fe, S, Al$

**(42.)** Which of the following reaction of $KMNO_4$ represent disproportionation

(a.) $3MnO_4^{2-} + 4H^{+} \rightarrow 2MnO_4^{-} + MnO_2 + 2H_2O$

(b.) $2KMnO_4 \rightarrow K_2MnO_4 + MnO_2 + O_2$

(c.) $2MnO_4^{-} + 3Mn^{2+} + 2H_2O \rightarrow 5MnO_2 + 4H^{+}$

(d.) All of these

**(43.)** Which of the following actinoids have $6d^1$ in their electronic configuration

(a.) U, Pa, Cm

(b.) U, Th, Fm

(c.) Th, Pa, Md

(d.) Cm, Fm, No

**(44.)** Stability of $Fe^{3+}$ compounds is much more than stability of $Fe^{2+}$ compounds. The correct reason form this is

(a.) ionic radius of $Fe^{3+}$ is smaller

(b.) $Fe^{3+}$ undergo disproportionauion

(c.) $Fe^{3+}$ has lower reduction potential

(d.) $Fe^{3+}$ has stable $d^5$ configuration.

**(45.)** **Assertion:** $5f$ electrons are more effectively shielded from the nuclear charge than the $4f$ - electrons of the corresponding lanthanoids.
**Reason:** The outer electrons are less firmly held.

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

(b.) Both A and R are correct but R is not correct explanation of A.

(c.) A is true but R is false.

(d.) Both A and R are false.

**(46.)** Which of the following elements will form $MF_3$ type compounds

(a.) Cr & Ni

(b.) Cr & Cu

(c.) Co & Cu

(d.) Cr & Co

**(47.)** Which of the following is not correctly matched for $KMnO_4$ ?

(a.) In acidic medium, $I^- \rightarrow I_2$

(b.) In neutral medium, $S_2O_3^{2-} \rightarrow SO_4^{2-}$

(c.) In acidic medium, $S^2 \rightarrow SO_4^{2-}$

(d.) In neutral medium, $Mn^{2+} \rightarrow MnO_2$

**(48.)** The correct reason for lanthanoid contraction is

(a.) imperfect shielding effect of f -orbitals

(b.) increasing nuclear charge

(c.) decreasing nuclear charge

(d.) decreasing in metallic radius.

**(49.)** Match the following.

| **Column I** | **Column II** |
|---|---|
| **(Compounds/elements)** | **(Use)** |
| (P) Lanthanoid oxide | (I) Lighter flint |
| (Q) Mg based alloy | (II) Alloy steel |
| (R) Mixed oxides of lanthanoids | (III) Television screen |
| (S) Lanthanoids | (IV) Petroleum cracking |

(a.) P-III,Q-I, R-IV,S-II

(b.) P-III,Q-II, R-I,S-IV

(c.) P-II,Q-IV, R-III,S-I

(d.) P-I,Q-III, R-II,S-IV

**(50.)** Which is not true about lanthanoids?

(a.) All the lanthanoids are silvery white soft metals and tarnish rapidly in air.

(b.) All lanthanoids are highly dense metals.

(c.) Lanthanides are separated from one another by ion exchange methods.

(d.) The hardness decreases with increasing atomic number, samarium being steel hard.

# TOPIC WISE PRACTICE QUESTIONS

## TOPIC 1: Characteristics of d-Block Elements

**1.** Which of the following is not a condition for complex formation?
1) Small atomic size 2) High nuclear charge
3) Variable oxidation states 4) Availability of vacant *d* orbitals

**2.** The stability of particular oxidation state of a metal in aqueous solution is determined by
1) enthalpy of sublimation of the metal 2) ionisation energy
3) enthalpy of hydration of the metal ion 4) all of these

**3.** In general, the melting and boiling points of transition metals
1) increases gradually across the period from left to right.
2) decreases gradually across the period from left to right.
3) first increases till the middle of the period and then decreases towards the end.
4) first decreases regularly till the middle of the period and then increases towards the end.

**4.** Which of the following is used in the preparation of chlorine?
1) Only $MnO_2$ 2) Only $KMnO_4$
3) Both$MnO_2$ and $KMnO_4$ 4) Either $MnO_2$ or $KMnO_4$

**5.** Chloro compound of vanadium has only spin magnetic moment of 1.73 BM. This vanadium chloride has the formula:
1) $VCl_2$ 2) $VCl_4$ 3) $VCl_3$ 4) $VCl_5$

**6.** The aqueous solution containing which one of the following ions will be colourless? (Atomic number: Sc = 21, Fe = 26, Ti = 22, Mn = 25).
1) $Sc^{3+}$ 2) $Fe^{2+}$ 3) $Ti^{3+}$ 4) $Mn^{2+}$

**7.** Among the transition elements the element with lowest melting point belongs to
1) Group 3 2) Group 11 3) Group 6 4) Group 12

**8.** Which of the following ions does not liberate hydrogen gas on reaction with dilute acids ?
1) $Ti^{2+}$ 2) $V^{2+}$ 3) $Cr^{2+}$ 4) $Mn^{2+}$

**9.** Which one of the following species is stable in aqueous solution ?
1) $Cr^{2+}$ 2) $MnO_4^{2-}$ 3) $MnO_4^{3-}$ 4) $Cu^{+}$

**10.** Which transition metal has lowest density?
1) Sc 2) Ti 3) Zn 4) La

**11.** Which of the following ions has the maximum magnetic moment?
1) $Mn^{+2}$ 2) $Fe^{+2}$ 3) $Ti^{+2}$ 4) $Cr^{+2}$

**12.** The maximum oxidation state shown by V (Z = 23), Cr (Z = 24), Co (Z = 27), Sc (Z = 21) are respectively
1) +5, +6, +2, +3 2) +3, +4, +5, +2 3) +5, +3, +2, +1 4) +4 in each case

**13.** Which of the following pairs has the same size?
1) $Fe^{2+}$ , $Ni^{2+}$ 2) $Zr^{4+}$ , $Ti^{4+}$ 3) $Zr^{4+}$ , $Hf^{4+}$ 4) $Zn^{2+}$ , $Hf^{4+}$

**14.** Of the following elements which is *not* expected to displayan oxidation state of +6 in any of its compounds?
1) Ti 2) Cr 3) Mn 4) W

**15.** Which one of the following does not correctly represent the correct order of the property indicated against it?
1) Ti < V < Cr < Mn : increasing number of oxidation states
2) $Ti^{3+} < V^{3+} < Cr^{3+} < Mn^{3+}$ : increasing magnetic moment
3) Ti < V < Cr < Mn : increasing melting points
4) Ti < V < Mn < Cr : increasing 2nd ionization enthalpy

**16.** Four successive members of the first series of the transition metals are listed below. For which one of them the standard potential $\left(E^0_{M^{2+}/M}\right)$ value has a positive sign?
1) Co (Z = 27) 2) Ni (Z = 28) 3) Cu (Z = 29) 4) Fe (Z = 26)

**17.** The catalytic activity of transition metals and their compounds is mainly due to

1) their magnetic behaviour 2) their unfilled *d*-orbitals
3) their ability to adopt variable oxidation state 4) their chemical reactivity

**18.** Which of the following has the maximum number of unpaired electrons?
1) $Ti^{2+}$ 2) $Fe^{2+}$ 3) $Cr^{+}$ 4) $Cu^{+}$

**19.** Which of the following species is/are paramagnetic?
$Fe^{2+}$, $Zn^{0}$, $Hg^{2+}$, $Ti^{4+}$
1) $Fe^{2+}$ only 2) $Zn^{0}$ and $Ti^{4+}$ 3) $Fe^{2+}$ and $Hg^{2+}$ 4) $Zn^{0}$ and $Hg^{2+}$

**20.** A compound of a metal ion $M^{x+}$ (Z = 24) has a spin only magnetic moment of $\sqrt{15}$ Bohr Magnetons. The number of unpaired electrons in the compound are
(a) 2 2) 4 3) 5 4) 3

## TOPIC 2: Compounds of Transition Metals

**21.** From a solution $CuSO_4$, the metal used to recover copper is
1) Na 2) Ag 3) Hg 4) Fe

**22.** Anhydrous cobalt (II) chloride is blue in colour but on dissolving in water it changes to pink in colour because :
1) Its oxidation state changes. 2) It magnetic character changes.
3) Its coordination number changes. 4) In water it shows fluorescence.

**23.** Which of the following can be employed for the conversion of potassium manganate to potassium permanganate?
1) $O_3$ 2) $Cl_2$ 3) Electrolysis 4) All

**24.** In vapour state $Cu(NO_3)_2$ and $Cu_2(CH_3COO)_4 \cdot 2H_2O$ exist as :
1) Dimer, monomer 2) Monomer, dimer
3) Monomer, monomer 4) Dimer, Dimer

**25.** Which of the following is **false**?
1) Molten lead and zinc are miscible. 2) Silver is more soluble in molten zinc than lead.
3) Zinc-silver alloy is volatile. 4) Zinc-silver alloy is heavier and gets solidified later than lead.

**26.** Which of the following is used as purgative in medicine?
1) $ZnCl_2$ 2) $HgCl_2$ 3) $Hg_2Cl_2$ 4) $ZnSO_4 \cdot 7H_2O$

**27.** Mercury is the only metal which is liquid at 0°C. This is due to its :
1) Very high ionisation energy and weakly metallic bond. 2) Low ionisation potential.
3) High atomic weight. 4) High vapour pressure.

**28.** Which compound is formed when iron reacts with carbon?
1) $FeC_2$ 2) $Fe_3C$ 3) $FeC_3$ 4) $Fe_2C$

**29.** The aqueous solution of transition metal salt changes colour from pink to blue, when concentrated hydrochloric acid is added to it. The change in colour is due to
1) evolution of hydrogen that changes the oxidation state of the metal ion.
2) change in the coordination number of the metal ion from 6 to 4 and formation of new species in solution.
3) formation of a coordination complex of the metal ion with hydrochloric acid.
4) protonation of the metal ion.

**30.** Choose the correct increasing order of the oxidation state of the central metal atom in the following oxoanions.
$VO_2^+, VO^{2+}, TiO^{2+}, CrO_4^{2-}$
1) $VO^{2+} \square VO_2^+ < TiO^{2+} < CrO_4^{2-}$ 2) $VO^{2+} \square TiO^{2+} < VO_2^+ < CrO_4^{2-}$
3) $CrO_4^{2-} < TiO^{2+} < VO_2^+ < VO^{2+}$ 4) $TiO^{2+} < VO^{2+} \square VO_2^+ < CrO_4^{2-}$

**31.** The oxoanion in which the oxidation state of the central atom is same as its group number in the periodic table is:
1) $SO_4^{2-}$ 2) $VO_2^-$ 3) $MnO_4^{2-}$ 4) $Cr_2O_7^{2-}$

**32.** The acidic, basic or amphoteric nature of $Mn_2O_7$, $V_2O_5$ and CrO are respectively
1) acidic, acidic and basic 2) basic, amphoteric and acidic
3) acidic, amphoteric and basic 4) acidic, basic and amphoteric

**33.** When concentrated HCl is added to an aqueous solution of $CoCl_2$, its colour changes from reddish pink to deep blue. Which complex ion gives blue colour in this reaction?
1) $[CoCl_4]^{2-}$ 2) $[CoCl_6]^{3-}$ 3) $[CoCl_6]^{4-}$ 4) $[Co(H_2O)_6]^{2+}$

**34.** Colourless solutions of the following four salts are placed separately in four different test tubes and a strip of copper is dipped in each one of these. Which solution will turn blue?
1) $KNO_3$ 2) $AgNO_3$ 3) $Zn(NO_3)_2$ 4) $ZnSO_4$

**35.** Which of the following oxides of Cr is amphoteric
1) $Cr\ O_2$ 2) $Cr_2O_3$ 3) $CrO_5$ 4) $CrO_3$

**36.** Among the following, the compound that is both paramagnetic and coloured, is
1) $KMnO_4$ 2) $CuF_2$ 3) $K_2Cr_2O_7$ 4) All are coloured

**37.** $K_2Cr_2O_7$ on heating with aqueous NaOH gives
1) $CrO_4^{2-}$ 2) $Cr(OH)_3$ 3) $Cr_2O_7^{2-}$ 4) $Cr(OH)_2$

**38.** What would happen when a solution of potassium chromate is treated with an excess of dilute nitric acid?
1) $Cr_2O_7^{2-}$ and $H_2O$ are formed 2) $CrO_4^{2-}$ is reduced to +3 state of cr
3) $CrO_4^{2-}$ is oxidized to +7 state of Cr 4) $Cr^{3+}$ and $Cr_2O_7^{2-}$ are formed

**39.** The oxidation state of chromium in the final product formed by the reaction between KI and acidified potassium dichromate solution is:
1) + 3 2) + 2 3) + 6 4) + 4

**40.** The final products formed on the addition of KI to copper sulphate solution are :
1) $K_2SO_4$, $CuI_2$ and $I_2$ 2) $K_2SO_4$, $Cu_2I_2$ and $I_2$ 3) $K_2SO_4$ and $Cu_2O$ 4) $K_2SO_4$, CuO and $I_2$

**41.** $KMnO_4$ (acidic/alkaline) is not decolourised by
1) mohr salt 2) oxalic acid 3) benzene 4) propene

**42.** Acidified $K_2Cr_2O_7$ solution turns green when $Na_2SO_3$ is added to it. This is due to the formation of :
1) $Cr_2(SO_4)_3$ 2) $CrO_4^{2-}$ 3) $Cr_2(SO_3)_3$ 4) $CrSO_4$

**43.** $KMnO_4$ can be prepared from $K_2MnO_4$ as per the reaction:

$$3MnO_4^{2-} + 2H_2O \square\ 2MnO_4^{2-} + MnO_2 + 4OH^-$$

The reaction can go to completion by removing $OH^-$ ions by adding.
1) KOH 2) $CO_2$ 3) $SO_2$ 4) HCl

**44.** In the laboratory, manganese (II) salt is oxidised to permanganate ion in aqueous solution by
1) hydrogen peroxide 2) conc. nitric acid
3) peroxy disulphate 4) dichromate

**45.** The starting material for the manufacture of $KMnO_4$ is
1) pyrolusite 2) manganite 3) magnatite 4) haematite

**46.** Match the columns

| **Column-I** | **Column -II** |
|---|---|
| 1) Metal of the 3*d*-series which does not form MO type oxide. | (p) Manganese |
| 2) Metal of the 3*d*-series which forms most covalent oxide. | (q) Vanadium |
| 3) Metal of the 3*d*-series which forms the amphoteric oxide. | (r) Scandium |

1) A – (p), B – (r), C – (q) 2) A – (r), B – (p), C – (q)
3) A – (r), B – (q), C – (p) 4) A – (q), B – (p), C – (r)

**47.** Which one of the following is an amphoteric oxide ?
(i) $Mn_2O_7$ (ii) CrO (iii) $V_2O_4$ (iv) $Cr_2O_3$
1) (i) and (ii) 2) (ii), (iii) and (iv) 3) (iii) and (iv) 4) (ii) and (iv)

**48.** Dichromate [Cr(VI) ] is a strong oxidizing agent whereas Mo(VI) and W(VI) are found to be not. This is due to
1) Lanthanoid contraction 2) Down the group metallic character increases
3) Down the group metallic character decreases 4) Both 1) and 2)

**49.** Which of the following conversions can be carried out by both acidified $K_2Cr_2O_4$ and acidified $KMnO_4$?
(i) $Fe^{2+} \rightarrow Fe^{3+} + e^-$ (ii) $I^- \rightarrow$ (iii) $I^- \rightarrow I_2$ (iv) $H_2S \rightarrow S$
1) (i) and (iii) 2) (ii) and (iv) 3) (i), (iii) and (iv) 4) (i), (ii) and (iii)

**50.** Which ion is not coloured?
1) $Ni(DMG)_2$ 2) $[Co(SCN)_4]^{2-}$ 3) $[Fe(H_2O)_5SCN]^{2+}$ 4) $[Al(OH)_4]^-$

## TOPIC 3: Lanthanoids and Actinoids

51. The radius of $La^{3+}$ (Z = 57) is 106 pm. Which one of the following given values will be closest to the radius of $Lu^{3+}$ (Z = 71)?
1) 160 pm 2) 140 pm 3) 106 pm 4) 85 pm

52. Which of the following oxidation states is the most common among the lanthanoids?
1) 3 2) 4 3) 2 4) 5

53. What is the percentage of lanthanoid metal in mischmetall?
1) 90% 2) 20% 3) 5% 4) 95%

54. Among the lanthanoids, the one obtained by synthetic method is
1) Lu 2) Pm 3) Pr 4) Gd

55. Which one of the following elements shows maximum number of different oxidation states in its compounds?
1) Eu 2) La 3) Gd 4) Am

56. Which of the following factors may be regarded as the main cause of lanthanoid contraction?
1) Greater shielding of 5*d* electrons by 4*f* electrons
2) Poorer shielding of 5*d* electrons by 4*f* electrons
3) Effective shielding of one of 4*f* electrons by another in the subshell
4) Poor shielding of one of 4*f* electron by another in the Subshell

57. The heaviest atom amongst the following is
1) uranium 2) radium 3) lead 4) mercury

58. Although + 3 is the characteristic oxidation state for lanthanoids but cerium also shows + 4 oxidation state because _____ .
(i) it has variable ionisation enthalpy
(ii) it has a tendency to attain noble gas configuration
(iii) it has a tendency to attain *f* 0 configuration
(iv) it resembles $Pb^{4+}$
1) (ii) and (iii) 2) (i) and (iv) 3) (ii) and (iv) 4) (i), (ii) and (iii)

59. Which of the following exhibit only + 3 oxidation state ?
1) U 2) Th 3) Ac 4) Pa

60. Which of the following is the use of mischmetall ?
1) In bullets 2) In lighter flint 3) As catalyst in petroleum cracking 4) Both 1) and 2)

61. The approximate percentage of iron in mischmetal is
1) 10 2) 20 3) 50 4) 5

62. Gun metal is an alloy of
1) Cu and Al 2) Cu and Sn 3) Cu, Zn and Sn 4) Cu, Zn and Ni

63. Brass is an alloy of
1) Zn and Sn 2) Zn and Cu 3) Cu, Zn and Sn 4) Cu and Sn

64. Which one of the following is coinage metal ?
1) Zn 2) Cu 3) Sn 4) Pb.

65. Cerium (*Z* = 58) is an important member of lanthanides. Which of the following statements about cerium is *not* correct?
1) The common oxidation states of Ce are + 3 and + 4.

2) + 3 oxidation state is more stable than + 4 oxidation state.
3) + 4 oxidation state is not known in solution.
4) Ce (IV) acts as an oxidising agent.

66. Non-lanthanoid atom is
1) La 2) Lu 3) Pr 4) Pm

67. Which of the following lanthanoid ions is diamagnetic?
(At nos. Ce = 58, Sm = 62, Eu = 63, Yb = 70)
1) $Sm^{2+}$ 2) $Eu^{2+}$ 3) $Yb^{2+}$ 4) $Ce^{2+}$

68. Lanthanoid contraction can be observed in
1) At 2) Gd 3) Ac 4) Lw

69. The +3 ion of which one of the following has half filled 4f subshell?
1) La 2) Lu 3) Gd 4) Ac

70. Which one of the following statements concerning Lanthanoids elements is false?
1) Lanthanoids are separated from one another by ion exchange methods
2) The ionic radii of trivalent Lanthanoids steadily increase with increase in atomic number
3) All Lanthanoids are highly dense metals
4) Most typical oxidation of Lanthanoids is +3

## NEET PREVIOUS YEARS QUESTIONS

1. Which one of the following ions exhibits d-d transition and paramagnetism as well? **[2018]**
1) $CrO_4^{2-}$ 2) $Cr_2O_4^{2-}$ 3) $MnO_4^{2-}$ 4) $MnO_4^{-}$

2) Match the metal ions given in Column I with the spin magnetic moments of the ions given in Column II and assign the correct code **[2018]**

| Column I | | Column II | |
|---|---|---|---|
| (A) $Co^{3+}$ | | (i) | $\sqrt{8}$ BM |
| (B) $Cr^{3+}$ | | (ii) | $\sqrt{35}$ BM |
| (C) $Fe^{3+}$ | | (iii) | $\sqrt{3}$ BM |
| (D) $Ni^{2+}$ | | (iv) | $\sqrt{24}$ BM |
| | | (v) | $\sqrt{15}$ BM |

| | (A) | (B) | (C) | (D) |
|---|---|---|---|---|
| (a) | (iv) | (v) | (ii) | (i) |
| (b) | (i) | (ii) | (iii) | (iv) |
| (c) | (iii) | (v) | (i) | (ii) |
| (d) | (iv) | (i) | (ii) | (iii) |

3. Name the gas that can readily decolourise acidified $KMnO_4$ solution : **[2017]**
1) $SO_2$ 2) $NO_2$ 3) $P_2O_5$ 4) $CO_2$

4. $HgCl_2$ and I2 both when dissolved in water containing I ions the pair of species formed is : **[2017]**
1) $HgI_2$, $I^-$ 2) $HgI_4^{2-}$, $I_3^-$ 3) $Hg_2I_2$, $I^-$ 4) $HgI_2$, $I_3^-$

5. The reason for greater range of oxidation states in actinoids is attributed to : **[2017]**
1) Actinoid contraction. 2) 5*f*, 6*d* and 7*s* levels having comparable energies.
3) 4*f* and 5*d* levels being close in energies. 4) The radioactive nature of actinoids.

6. Which one of the following statements is correct when $SO_2$ is passed through acidified $K_2Cr_2O_7$ solution? **[2016]**
1) The solution turns blue. 2) The solution is decolourized.
3) $SO_2$ is reduced. 4) Green $Cr_2(SO_4)_3$ is formed.

**7.** The electronic configurations of Eu(Atomic No. 63), Gd (Atomic No. 64) and Tb (Atomic No. 65) are **[2016]**

1) $[Xe]4f^7 6s^2$, $[Xe]4f^8\ 6s^2$ and $[Xe]4f^8 5d^1 6s^2$ 2) $[Xe]4f^7 5d^1 6s^2$, $[Xe]4f^7\ 5d^1\ 6s^2$ and $[Xe]4f^9 6s^2$

3) $[Xe]4f^6 5d^1 6s^2$, $[Xe]4f^7 5d^1 6s^2$ and $[Xe]4f^8 5d^1 6s^2$ 4) $[Xe]4f^7 6s^2$, $[Xe]4f^7 5d^1 6s^2$ and $[Xe]4f^9 6s^2$

**8.** Gadolinium belongs to 4*f* series. It's atomic number is 64. Which of the following is the correct electronic configuration of gadolinium? **[2015]**

1) $[Xe]4f^8 6d^2$ 2) $[Xe]4f^9 5s^1$ 3) $[Xe]\ 4f^7 5d^1 6s^2$ 4) $[Xe]\ 4f^6 5d^2 6s^2$

9. Which of the following processes does not involve oxidation of iron? **[2015]**

1) Decolourization of blue $CuSO_4$ solution by iron.

2) Formation of $Fe(CO)_5$ from Fe.

3) Liberation of $H_2$ from steam by iron at high temperature.

4) Rusting of iron sheets.

**10.** Because of lanthanoid contraction, which of the following pairs of elements have nearly same atomic radii ? (Numbers in the parenthesis are atomic numbers). **[2015]**

1) Zr (40) and Nb (41) 2) Zr (40) and Hf (72) 3) Zr (40) and Ta (73) 4) Ti (22) and Zr (40)

**11.** The reaction of aqueous $KMnO_4$ with $H_2O_2$ in acidic conditions gives: **[2014]**

1) $Mn^{4+}$ and $O_2$ 2) $Mn^{2+}$ and $O_2$ 3) $Mn^{2+}$ and $O_3$ 4) $Mn^{4+}$ and $MnO_2$

**12.** Magnetic moment 2.83 BM is given by which of the following ions? **[2014]**
(At. nos. Ti = 22, Cr = 24, Mn = 25, Ni = 28):-

1) $Ti^{3+}$ 2) $Ni^{2+}$ 3) $Cr^{3+}$ 4) $Mn^{2+}$

**13.** Reason of lanthanoid contraction is:- **[2014]**

1) Negligible screening effect of '*f* ' orbitals. 2) Increasing nuclear charge.

3) Decreasing nuclear charge. 4) Decreasing screening effect.

14. The manganate and permanganate ions are tetrahedral, due to **[2019]**

(1) The p.bonding involves overlap of p.orbitals of oxygen with d.orbitals of manganese

(2) There is no p.bonding

(3) The p.bonding involves overlap of p.orbitals of oxygen with p.orbitals of managanese

(4) The p.bonding involves overlap of d.orbitals of oxygen with d.orbitals of manganese

15. When neutral or faintly alkaline KMnO4 is treated with potassium iodide, iodide ion is converted into 'X'. 'X' is- **[2019-ODISSA]**

(1) $I_2$ (2) $IO^-_4$ (3) $IO^-_3$ (4) $IO^-$

16. Identify the incorrect statement from the following:- **[2020-Covid-19]**

(1) Zirconium and Hafnium have identical radii of 160 pm and 159 pm, respectively as a consequence of lanthanoid contraction.

(2) Lanthanoids reveal only +3 oxidation state.

(3) The lanthanoidions other than the f0 type and the $f^{14}$ type are all paramagnetic.

(4) The overall decrease in atomic and ionic radii from lanthanum to lutetium is called lanthanoidcontraction.

17. Match the following aspects with the respective metal. **[2020-Covid-19]**

| **Aspects** | **Metal** |
|---|---|
| (a) The metal which reveals a maximum number of oxidation states | (i) Scandium |
| (b) The metal although placed in 3d block is considered not as a transition element | (ii) Copper |
| (c) The metal which does not exhibit variable oxidation states | (iii) Manganese |
| (d) The metal which in +1 oxidation state in aqueous solution undergoes disproportionation | (iv) Zinc |

Select the correct option :

(1) (a)-(i) (b)-(iv) (c)-(ii) (d)-(iii) (2) (a)-(iii) (b)-(iv) (c)-(i) (d)-(ii)

(3) (a)-(iii) (b)-(i) (c)-(iv) (d)-(ii) (4) (a)-(ii) (b)-(iv) (c)-(i) (d)-(iii)

18. Urea reacts with water to form A which will decompose to form B. B when passed through $Cu^{2+}$ (aq), deep blue colour solution C is formed. What is the formula of C from the following? . **[2020]**

1) $CuCO_3Cu(OH)_2$ 2) $CuSO_4$ 3) $[Cu(NH_3)_4]^{2+}$ 4) $Cu(OH)_2$

19. Identify the incorrect statement. . **[2020]**

1) The oxidation states of chromium in $CrO_4^{2-}$ and $Cr_2O_7^{2-}$ are not the same

2) $Cr^{2+}\left(d^4\right)$ is a stronger reducing agent than $Fe^{2+}\left(d^6\right)$ in water

3) The transition metals and their compounds are known for their catalytic activity due to their ability to adopt multiple oxidation states and to form complexes

4) Interstitial compounds are those that are formed when small atoms like H, C or N are trapped inside the crystal lattices of metals

20. The incorrect statement among the following is **[NEET-2021]**

1) Most of the trivalent Lanthanoid ions are colorless in the solid state

2) Lanthanoids are good conductors of heat and electricity

3) Actinoids are highly reactive metals, especially when finely divided

4) Actinoid contraction is greater for element to element than Lanthanoid contraction

21. Gadolinium has a low value of third ionization enthalpy because of **[NEET-2022]**

1) small size 2) high exchange enthalpy

3) high electronegativity 4) high basic character

22. In the neutral or faintly alkaline medium, $KMnO_4$ oxidises iodide into iodate. The change in oxidation state of manganese in this reaction is from **[NEET-2022]**

1) +7 to +4 2) +6 to +4 3) +7 to +3 4) +6 to +5

## NCERT LINE BY LINE QUESTIONS – ANSWERS

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **(1.)** | a | **(2.)** | c | **(3.)** | d | **(4.)** | a | **(5.)** | b |
| **(6.)** | a | **(7.)** | d | **(8.)** | d | **(9.)** | d | **(10.)** | b |
| **(11.)** | d | **(12.)** | a | **(13.)** | a | **(14.)** | c | **(15.)** | d |
| **(16.)** | d | **(17.)** | d | **(18.)** | b | **(19.)** | c | **(20.)** | a |
| **(21.)** | b | **(22.)** | d | **(23.)** | d | **(24.)** | d | **(25.)** | d |
| **(26.)** | a | **(27.)** | c | **(28.)** | c | **(29.)** | c | **(30.)** | d |
| **(31.)** | d | **(32.)** | b | **(33.)** | c | **(34.)** | a | **(35.)** | a |
| **(36.)** | c | **(37.)** | a | **(38.)** | d | **(39.)** | b | **(40.)** | a |
| **(41.)** | b | **(42.)** | a | **(43.)** | a | **(44.)** | d | **(45.)** | a |
| **(46.)** | d | **(47.)** | c | **(48.)** | a | **(49.)** | a | **(50.)** | d |

## TOPIC WISE PRACTICE QUESTIONS - ANSWERS

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **1)** 3 | **2)** 4 | **3)** 3 | **4)** 3 | **5)** 1 | **6)** 1 | **7)** 4 | **8)** 4 | **9)** 2 | **10)** 1 |
| **11)** 1 | **12)** 1 | **13)** 3 | **14)** 1 | **15)** 3 | **16)** 3 | **17)** 3 | **18)** 3 | **19)** 1 | **20)** 4 |
| **21)** 4 | **22)** 3 | **23)** 4 | **24)** 2 | **25)** 4 | **26)** 3 | **27)** 1 | **28)** 2 | **29)** 2 | **30)** 2 |
| **31)** 4 | **32)** 3 | **33)** 1 | **34)** 2 | **35)** 1 | **36)** 2 | **37)** 1 | **38)** 1 | **39)** 1 | **40)** 2 |
| **41)** 3 | **42)** 1 | **43)** 2 | **44)** 3 | **45)** 1 | **46)** 2 | **47)** 3 | **48)** 2 | **49)** 3 | **50)** 4 |
| **51)** 4 | **52)** 1 | **53)** 4 | **54)** 2 | **55)** 4 | **56)** 2 | **57)** 1 | **58)** 1 | **59)** 3 | **60)** 4 |
| **61)** 4 | **62)** 3 | **63)** 2 | **64)** 2 | **65)** 3 | **66)** 1 | **67)** 3 | **68)** 2 | **69)** 3 | **70)** 2 |

## NEET PREVIOUS YEARS QUESTIONS-ANSWERS

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **1)** 3 | **2)** 1 | **3)** 1 | **4)** 2 | **5)** 2 | **6)** 4 | **7)** 4 | **8)** 3 | **9)** 2 | **10)** 2 |
| **11)** 2 | **12)** 2 | **13)** 1 | **14)** 1 | **15)** 3 | **16)** 2 | **17)** 2 | **18)** 3 | **19)** 1 | **20)** 1 |
| **21)** 2 | **22)** 1 | | | | | | | | |

## NCERT LINE BY LINE QUESTIONS – SOLUTIONS

**(2.)** (c)

$$5Fe^{2+} + MnO_4^- + 8H^+ \rightarrow Mn^{2+} + 4H_2O + 5Fe^{3+}$$

$$5S^{2-} + 2MnO_4^- + 16H^+ \rightarrow 2Mn^{2+} + 8H_2O + 5S$$

$$5NO_2^- + 2MnO_4^- + 6H^+ \rightarrow 2Mn^{2+} + 5NO_3^- + 3H_2O$$

**(5.)** (b) The elements of group 11 are still worthy of being called the coinage metals, although Ag and Au are restricted to collection items and the contemporary UK "copper" coins are copper coated steel. The 'silver' UK coins are a Cu / Ni alloy.

**(6.)** (a) Promethium (Pm) is radioactive.

$Eu^{2+} : [Xe]4f^{7}$

$Gd^{3+} : [Xe]4f^{7}$

$La^{3+} : [Xe]4f^{0}$

**(7.)** (d) Due to involvement of d-electrons in metallic bonding copper has higher melting point.

**(8.)** (d) $6KCl + K_2Cr_2O_7 + 7H_2SO_4 \rightarrow 4K_2SO_4 + Cr_2(SO_4)_3 + 3Cl_2 + 7H_2O$

**(9.)** (d) All the given statements are correct.

**(10.)** (b) The electronic configuration of $Cu(II)$ is $3d^9$ whereas that of $Cu(I)$ is $3d^{10}$ but $Cu(II)$ is more stable than $Cu(I)$.

**(11.)** (d) The highest oxidation state of osmium is $+8$ and it is a 5d - block element.

**(12.)** (a)

**(15.)** (d) The ability of oxygen to stabilise the high oxidation state is due to the formation of multiple bonds to metals which fluorine cannot do.

**(16.)** (d) All the three given terms are responsible for value of ionisation enthalpy.

**(17.)** (d) $Co^{2+}$ **[Ar]** $3d^7$ unpaired electrons 3

$Cr^{2+}$ : **[Ar]** $3d^4$ unpaired electrons 4

$Mn^{2+}$ : **[Ar]** $3d^5$ unpaired electrons 5

$Cr^{3+}$ : $[Ar]3d^3$ unpaired electrons 3

As $Co^{2+}$ and $Cr^{3+}$ have same number of unpaired electrons hence have same magnetic moment value.

**(18.)** (b) $K_2Cr_2O_7 + 4NaCl + 6H_2SO_4 \rightarrow 2KHSO_4 + 4NaHSO_4 + 2CrO_2Cl_2 + 3H_2O$

Orange red vapour

Chromyl chloride vapours when passed through $NaOH$ solution gives a yellow solution of $Na_2CrO_4$.

**(19.)** (c) There is a greater range of oxidation states, which is in part attributed to the fact that the 5f, 6d and 7s levels are of comparable energies.

**(20.)** (a) General electronic configuration of lanthanoids is $(n-2)f^{1-14}(n-1)s^2p^6d^{0-1}ns^2$

**(21.)** (b) Both the given statements are correct.

**(22.)** (d)

**(23.)** (d) $Am$ is an actinoid it shows more oxidation states than lanthanoids.

**(25.)** (d) Reaction between $KMnO_4$ and oxalic acid is

$2KMnO_4 + 5C_2H_2O_4 + 3H_2SO_4 \rightarrow K_2SO_4 + 2MnSO_4 + 10CO_2 + 8H_2O$

The reaction is slow in the starting but $Mn^{2+}$ acts as an autocatalyst and speed up the reaction.

**(27.)** (c) Hydrochloric acid attacks almost all metals but most are slightly affected by nitric acid owing to the formation of protective oxide layers.

**(29.)** (c) Due to lanthanoid contraction the second and third d-series exhibit similar radii ( Zr 160 pm, Hf 159 pm) and have very similar physical and chemical properties.

**(30.)** (d) In neutral or faintly alkaline solutions, $I^-$ is converted to $IO_{3^-}$

$2MnO_{4^-} + H_2O + I^- \rightarrow 2MnO_4 + 2OH^- + IO_{3^-}$

**(31.)** (d) $Eu(63) : [Xe]4f^7 6s^2$

$Gd(64) : [Xe]4f^7 5d^1 6s^2$

$Tb(65) : [Xe]4f^9 6s^2$

**(32.)** (b) Acidified potassium dichromate will oxidise iodides to iodine, sulphides to sulphur, ïin (II) to tin (IV) and iron (II) salts to iron (III)

**(33.)** (c) Electronic configuration of $Fe(27) \rightarrow [Ar]3d^6 4s^2$

Electronic configuration of $Fe^{2+} \rightarrow [Ar]3d^6$ Thus it has 4 unpaired electrons.

Magnetic moment $= \sqrt{n(n+2)}$

$= \sqrt{4(4+2)} = \sqrt{24} = 4.89 B.M.$

**(34.)** (a) Acidified $KMnO_4$ changes $Fe^{2+}$ to $Fe^{3+}$

Dark purple crystals: $KMnO_4$

Green compound formed by fusing $KOH$ with $MnO_2$ : $K_2MnO_4$

Orange crystals with tetrahedral structure: $K_2Cr_2O_7$

**(35.)** (a) $KMnO_4$ is a strong oxidising agent and its oxidising power is used for bleaching action.

**(36.)** (c) The first few members are quite reactive just like calcium. However with increasing atomic number, their behaviour becomes similar to that of aluminum.

**(37.)** (a) $Ti^{+}$ ions are more stable than $Ti^{3+}$ and thus $Ti^{3+}$ ions change to $Ti^{+}$ thereby acting as oxidising agents.

**(39.)** (b) 4f electrons shield each other from the nuclear charge quite poorly because of the very diffused shapes of f - orbitals.

**(40.)** (a) $Cr_2O_3$ and $V_2O_5$ are amphoteric.

**(41.)** (b) Mischmetal consists of a lanthanoid metal $(-95\%)$ andiron$(-5\%)$ and traces of S, C, Ca and Al.

**(42.)** (a) $\overset{+6}{MnO_4^{2-}} \rightarrow \overset{+7}{MnO_4^{-}} + \overset{+4}{MnO_2}$

As in this reaction Mn get reduced and oxidised both. Thus, it is a disproportionation reaction.

**(43.)** (a) $U(92): [Rn]\ 5f^3 6d^1 7s^2$

$Pa(91): [Rn] 5f\ 6d^1 7s^2$

$Cm(96): [Rn]\ 5f^7 6d^1 7s^2$

$Th\ (90): [Rn]\ 6d^2 7s^2$

$Fm\ (100): [Rn]\ 5f^{12} 7s^2$

$Md\ (101): [Rn]\ 5f^{13} 7s^2$

$No(102): [Rn]\ 5f^{14} 7s^2$

**(44.)** (d) $Fe^{3+}(d^5)$ compounds are more stable than $Fe^{2+}(d^6)$ due to extra stable half-filled electronic configuration.

**(45.)** (a)

**(47.)** (c) In acidic medium $KMnO_4$ oxidises $S^2$ to S as:

$$5S^{2-} + 2MnO_4^{-} + 16H^{+} \rightarrow 2Mn^{2+} + 8H_2O + 5S$$

**(48.)** (a) The factor responsible for lanthanoid contraction is the imperfect shielding effect of f-orbitals. The shielding of one 4f electron by another is less than that of one d-electron by another and as nuclear charge increases along the series, there is fairly regular decrease (lanthanoid contraction) in size of entire $4f^n$ orbitals.

**(49.)** (a) Lanthanoids are used for production of alloy steel. Mg -based alloy is used to produce bullets, shell and lighter flint. Mixed oxides of lanthanoids are employed as catalysts in petroleum cracking. Some individual Ln oxides are used as phosphors in television screens.

**(50.)** (d) All the lanthanides are silvery white metals, and hardness increases with increasing atomic number, samarium being steel hard.

## TOPIC WISE PRACTICE QUESTIONS - SOLUTIONS

1. 3) Tendency of an element to form complexes does not depend on whether the element shows variable O.S. or not.

2. 4) $M(s) \rightarrow M^{n+}(aq) + ne^{-}$

This changes involve sublimation, ionisation and hydration.

3. 3) First increases till the middle of period and then decreases towards the end as the atomic no. increases more the no. of unpaired e–s, more will be the melting point. As unpaired d-orbitals electron pair up, the M.P decreases There is a very small energy difference between

4. 3) Both $MnO_2$ and $KMnO_4$ used for the preparation of chlorine by the action of Conc. HCl

$$MnO_2 + 4HCl \rightarrow MnCl_2 + 2H_2O + Cl_2$$

$$2KMnO_4 + 16HCl \rightarrow 2KCl + 2MnCl_2 + 8H_2O + 5Cl_2$$

Chlorine is not obtained by dil HCl

$Ag_2S_2O_3 + H_2O \rightarrow Ag_2S + H_2SO_4$

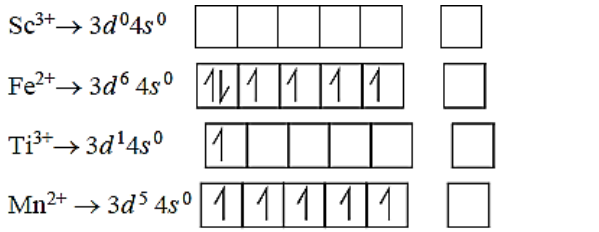
Black ppt

5. 1) $\mu = \sqrt{n(n+2)}$ ; $1.73 = \sqrt{n(n+2)}$

On calculating the value of *n* we find *n* = 1 ; No. of unpaired electrons = 1 ; hence its configuration will be $V(23) = [Ar]3d^3 4s^2$ ; $V^{4+} = [Ar]3d^1 4s^0$

$\therefore$ Its chloride has the formula $VCl_4$

6. 1)




In $Sc^{3+}$ there is no unpaired electron. So the aqueous solution of $Sc^{3+}$ will be colourless.

7. 4) Hg belongs to group 12.

8. 4)

| ions | $E^0$ (V) |
|---|---|
| $Ti^{2+}$ | –0.37 |
| $Cr^{2+}$ | -0.26 |
| $Mn^{2+}$ | +1.57 |

Negative value of E° means these metals liberate hydrogen from dilute acid.

$(M^{2+} + 2H^+ - e^- \rightarrow M^{3+} + H_2)$

9. 2) In $MnO_4^{2-}$ manganese is in +6 oxidation state which is having highest stability.

$MnO_4^{2-}$ disproportionates in neutral or acidic solution.

$3MnO_4^{2-} + 4H^+ \rightarrow 2MnO_4^{2-} + MnO_2 + 2H_2O$

10. 1)

11. 1) $Mn^{2+}$

12. 1)

13. 3) Due to lanthanide contraction, the size of Zr and Hf (atom and ions) become nearly similar.

14. 1) $Ti = [Ar]3d^2 4s^2$; The highest oxidation state will be +4.

15. (3) The melting points of the transition elements first rise to a maximum and then falls as the atomic number increases, manganese has abnormally low melting point.

16. 3)

$E^\circ_{Cu^{2+}/Cu} = 0.34\,V$

other three have – ve $E^\circ_{R.P.}$

$E^\circ_{Co^{2+}/Co} = -0.28\,V$

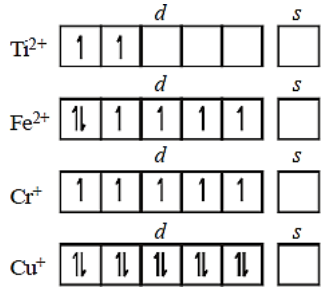
$E^\circ_{Ni^{2+}/Ni} = -0.25V$

$E^\circ_{Fe^{2+}/Fe} = -0.44V$

17. 3) The transition metals and their compounds are used as catalysts. Because of the variable oxidation states, they may form intermediate compounds with one of the reactants. These intermediates provide a new path with lower activation energy.

$V_2O_5 + SO_2 \rightarrow V_2O_4 + SO_3$ ; $2V_2O_4 + O_2 \rightarrow 2V_2O_5$

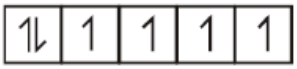
18. 3) The outer electronic configuration of the given ions is as




19. 1) The outermost electronic configuration of Fe is

$Fe = [Ar]3d^6\,4s^2$

$Fe^{2+} = [Ar]3d^6\,4s^0$



Since $Fe^{2+}$ has 4 unpaired electrons it is paramagnetic in nature.

$Zn = [Ar]3d^{10}\,4s^2$ – no unpaired $e^-$ ; $Hg^{2+} = [Ar]4f^{14}5d^{10}$ – no unpaired $e^-$

$Ti^{4+} = [Ar]3d^0\,4s^0$ – no unpaired $e^-$

20. 4) Magetic moment $\mu = \sqrt{n(n+2)}$ where n = number of unpaired electrons $\sqrt{15} = \sqrt{n(n+1)}\ \therefore n = 3$

21. 4) Fe can be used to recover Cu from CuSO4 solution.

22. (3) $Co^{II}\,Cl_2$ has a blue colour in tetrahedral geometry. It changes to pink in colour with the change in coordination number to six.

23. (4) 24. (2)

25. (4) Actually zinc silver alloy gets solidified earlier than lead.

26. (3) $Hg_2Cl_2$ is used as a purgative in medicine.

27. (1) It is due to very high IE which results in weak metallic bonding.

28. (2) Interstitial compound Fe3C (cementite) is formed.

29. (2)

30. 2) $\overset{+4}{V}O^{2+} \square \overset{+4}{Ti}O^{2+} < \overset{+5}{V}O_2^{+} < \overset{+6}{Cr}O_4^{2-}$

31. 4) $Cr_2O_7^{2-}$, oxidation state and group number is 6.

32. 3) $Mn_2O_7$ is acidic, $V_2O_5$ is amphoteric acid and CrO is basic.

33. 1) Aqueous solution of $CoCl_2$ contains $[Co(H_2O)_6]^{2+}$ which is pinkish in colour so option 4) is incorrect. Reduction potential of $Co^{3+} \rightarrow Co^{2+}$ is high so option2) is incorrect. $Co^{2+}$ does not oxidises easily to $Co^{3+}$. It is general case that symmetrical substituted octahedral complexes are less deeper in colour than tetrahedral complexes. So $[CoCl_4]^{2-}$ is deep blue in colour.

34. 2) $Cu + 2AgNO_3 \rightarrow Cu(NO_3)_2 + 2Ag.Cu^{2+}$ will give blue solution. Cu is below in ECS than K and Zn hence no reaction will occur with them.

35. 1) $CrO_2$ is amphoteric in nature

36. 2) $CuF_2$ is both paramagnetic and coloured.

37. 1) $Cr_2O_7^{2-} + 2OH^- \rightarrow 2CrO_4^{2-} + H_2O$

38. 1) $2K_2CrO_4 + 2HNO_3 \rightarrow K_2Cr_2O_7 + 2KNO_3 + H_2O$

39. 1) $Cr_2O_7^{2-} + 6I^- + 14H^+ \rightarrow 3I_2 + 7H_2O + 2Cr^{3+}$

Oxidation state of Cr is +3

40. 2) $2CuSO_4 + 4KI \rightarrow 2K_2SO_4 + Cu_2I_2 + I_2$

41. 3) Benzene does not decolourise KMnO4 (acidic/alkaline). It is due to the delocalization of p-electron in benzene. Mohr's salt and oxalic acid give redox reaction with KMnO4. Propene decolorises KMnO4 due to presence of C = C bond.

42. 1) The green colour appears due to the formation of

$Cr^{+++}$ ion, i.e., $Cr_2(SO_4)_3$

$Cr_2O_7^{2-} + 3SO_3^{2-} + 8H^+ \longrightarrow 3SO_4^{2-} + 2Cr^{3+} + 4H_2O$

43. 2) HCl and $SO_2$ are reducing agents and can reduce $MnO_4^-.CO_2$ which is neither oxidising and nor reducing will provide only acidic medium. It can shift reaction in forward direction and reaction can go to completion.
44. (3) In laboratory, manganese (II) ion salt is oxidised to permagnate ion in aqueous solution by peroxodisulphate.
45. 1) Pyrolusite (It is $MnO_2$)
46. 2)
47. 3) $Mn_2O_7 \rightarrow$ acidic ; $CrO \rightarrow$ basic ; $V_2O_4 \rightarrow$ amphoteric ; $Cr_2O_3 \rightarrow$ amphoteric
48. 2) Down the group metallic character increases hence tendency to loose electron increases.
49. 3) $I^-$ is converted to $IO_3^-$ by neutral or faintly alkaline $MnO_4^-$ as shown below

$2MnO_4^- + H_2O + I^- \rightarrow 2MnO_2 + 2OH^- + IO_3^-$

50. 4) $Al^{3+}$ has no unpaired *d* -electrons.
51. 4) Since ionic radii decreases from $La^{3+}$ to $Lu^{3+}$ due to lanthanoid contraction, so $La^{3+}$ have least ionic radii out of the given radii. Hence answer is 85 pm.
52. 1) 53. 4)
54. 2) Pm is obtained by synthetic method.
55. 4) We know that lanthanides La, Gd shows +3, oxidation state, while Eu shows oxidation state of +2 and + 3. Am shows +3, +4, +5 and +6 oxidation states. Therefore Americium (Am) has maximum number of oxidation states.
56. 2) In lanthanides, there is poorer shielding of 5*d* electrons by 4*f* electrons resulting in greater attraction of the nucleus over 5*d* electrons and contraction of the atomic radii.
57. 1) 58. 1)
59. 3) $Ac(89) = [Rn]\lfloor 6d^1 \rfloor \lceil 7s^2 \rceil$
60. 4)
61. 4) Mischmetal is an alloy which contains rare earth elements (94-95%), iron (5%) and traces of sulphur, carbon, silicon, calcium and aluminium. It is used in gas lighters, tracer bullets and shells.
62. (3) Gun metal is an alloy of Cu, Zn and Sn. It contains 88% Cu, 10% Sn and 2% Zn.
63. (2) Brass is an alloy of Cu and Zn
64. (2) Cu, Ag and Au are called coinage metals.
65. (3)
66. (1) La ( lanthanum ) is non lanthanoid atom.
67. 3)

$Sm^{2+}(Z=62)$

$[Xe]4f^6\ 6s^2$ – 6 unpaired $e^-$ $Eu^{2+}(Z=63)$

$[Xe]4f^7\ 6s^2$ – 7 unpaired $e^-$ $Yb^{2+}(Z=70)$

$[Xe]4f^{14}\ 6s^2$ – 0 unpaired $e^-$ $Ce^{2+}(Z=58)$

$[Xe]4f^1\ 5d^1\ 6s^2$ – 2 unpaired $e^-$

Only $Yb^{2+}$ is diamagnetic.

68. (2) Amongst the given elements, only Gd is a lanthanide.
69. (3)
70. (2) Ionic radii of trivalent lanthanoides decreases progressively with increase in atomic no. due to lanthanoides contraction.

## NEET PREVIOUS YEARS QUESTIONS-EXPLANATIONS

1. 3)

$CrO_4^{2-}$ $Cr^{6+}$ diamagnetic

$Cr_2O_7^{2-}$ $Cr^{6+}$ diamagnetic

$MnO_4^-$ $Mn^{7+}$ diamagnetic

$MnO_4^{2-}$ $Mn^{6+}$ paramagnetic

Thus unpaired electron is present, so *d*–*d* transition is possible.

2. 1) $Co^{3+} = [Ar]3d^6$, unpaired $e^- (n) = 4$

Spin magnetic moment = $\sqrt{4(4+2)} = \sqrt{24}$ B.M

$Cr^{3+} = [Ar]3d^3$, unpaired $e^- (n) = 3$

Spin magnetic moment $= \sqrt{3(3+2)} = \sqrt{15}$ B.M

$Fe^{3+} = [Ar]3d^5$, unpaired $e^- (n) = 5$

Spin magnetic moment $= \sqrt{5(5+2)} = \sqrt{35}$ B.M

$Ni^{2+} = [Ar]3d^8$, unpaired $e^- (n) = 2$

Spin magnetic moment $\sqrt{2(2+2)} = \sqrt{8}$ B.M

3) 1) Potassium permanganate has a purple colour. When sulphur dioxide reacts with potassium permanganate the solution decolourizes.

$5SO_2 + 2KMnO_4 + 2H_2O \rightarrow 2H_2SO_4 + 2MnSO_4 + K_2SO_4$

4) 2) In a solution containing $HgCl_2$, $I_2$ and $I^-$, both $HgCl_2$ and $I_2$ compete for $I^-$
Since formation constant of $[HgI_4]^{2-}$ is very large

$(1.9\times10^{30})$ as compared with $I_3$ $(K_f = 700)$

$\therefore I^-$ will preferentially combine with $HgCl_2$

$HgCl_2 + 2I^- \rightarrow HgI_2 \downarrow + 2Cl^-$

Red ppt

$HgI_2 + 2I^- \rightarrow [HgI_4]^{2-}$

soluble

5. 2) Minimum or comparable energy gap between 5*f*, 6*d* and 7*s* subshell makes electron excitation easier, hence there is a greater range of oxidation states in actinoids.

6. 4) $K_2Cr_2O_7 + SO_2 + H_2SO_4 \rightarrow K_2SO_4 + Cr_2(SO_4)_3 + H_2O$

Green colour

7. 4)

$Eu(63) = [Xe]4f^7 6s^2$

$Gd(64) = [Xe]4f^7 5d^1 6s^2$

$Tb(65) = [Xe]4f^7 5d^1 6s^2$

8. 3) $Gd(64) = [Xe]4f^7 5d^1 6s^2$

9. (2) Formation of Fe(CO)5 from Fe involves no change in oxidation state of iron.

10. (2) Due to lanthanoid contraction atomic radii of Zr and Hf is almost similar.

11. 2) $2KMnO_4 + 3H_2SO_4 + 5H_2O_2 \rightarrow K_2SO_4 + 2MnSO_4 + 8H_2O + 5O_2$ i.e. $Mn^{2+}$ ion and $O_2$

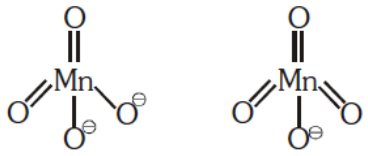
12. 2) Magnetic moment

$\mu = \sqrt{n(n+2)}$ ; $2.83 = \sqrt{n(n+2)}$ ; On solving n = 2

$Ni^{2+}$ have two unpaired electron.

13. 1) The shape of *f*-orbitals is very much diffused and they have poor shielding effect. The effective nuclear charge increases which causes the contractiion in the size of electron charge cloud. This contraction in size is quite
regular and known as lanthanoid contraction.

14. 1) $MnO_4^{-2}$ (Mangnate ion) and $MnO_4^{-}$ (Permangnate ion) both are tetrahedral



Since '$\pi$' bond is formed between p-orbital of oxygen and d-orbital of Managnese

$$KMnO_4 + I^- + OH^- \longrightarrow MnO_2 + IO_3^- + H_2O$$
(x)

15. 3)

16. 2) Lanthanoids shows general oxidation state +3 butsome elements can shows +2 as well as +4.

17. 2) In the given options
The metal which reveals a maximum number of oxidation state $\rightarrow$ Mn
The metal although placed in 3d block is considered not as a transition element is $\rightarrow$ Zn
The metal which does not exhibit variable oxidation state is $\rightarrow$ Sc (only +3)
The metal which in +1 oxidation state in aqueous solution undergoes disproportionation is $\rightarrow$ Cu
$Cu^{2+} + 4NH_3 \rightarrow \left[Cu(NH_3)_4\right]^{2+}$ deep blue colour

18. 3)

19. 1)In both $CrO_4^{2-}$ and $Cr_2O_7^{2-}$ oxidation state of chromium is +6

$Cr^{2+} \rightarrow Cr^{3+}$ $Fe^{+2} \rightarrow Fe^{+3}$ ;

$3d^4$ $3d^3$ $3d^6$ $3d^5$

$Cr^{3+}$ has more stable $t_2g^3$ configuration

20. 1)Actinoids are highly reactive metals, especially when finely divided
Actinoid contraction is greater from element to element than lanthanoid contraction resulting from poor shielding by 5f electrons
Many trivalent lanthanoids ions are coloured both in the solid state and in aqueous solutions.
Lanthanoids have typical metallic structure and are good conductors of heat and electricity

21. By the loss of 3 electrons from $5d^1$ and $6s^2$, it gets stable half-filled $4f^7$ configuration

22. Faintly alkaline medium or neutral
$KMnO_4 \rightarrow K_2MnO_4$ $MnO_2$
+7 to + 4