KEY ANSWER FOR PUC - II YEAR MODEL QUESTION PAPER – 2023-2024

Time: 3 Hrs. 15 Minutes | **Sub: PHYSICS (33)** | **Max. Marks: 70**

General Instructions:

1. All parts are compulsory.

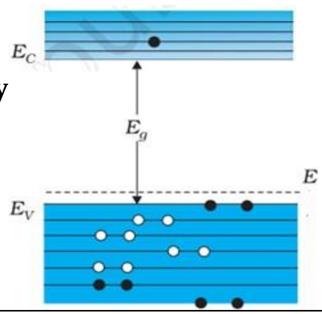
2. For Part – A questions, first written-answer will be considered for awarding marks.

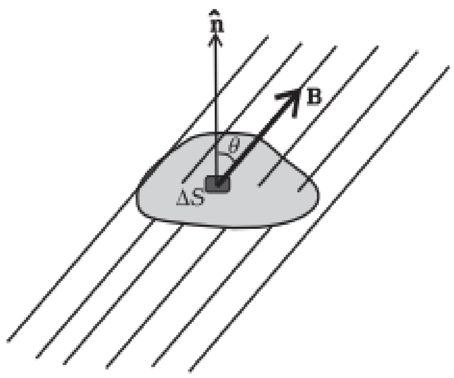
3. Answers without relevant diagram / figure / circuit wherever necessary will not carry any marks.

4. Direct answers to numerical problems without detailed solutions will not carry any marks.

SCHEME OF EVALUATION **Date:11-08-2023**

Q.No.	PART-A	Marks
I	**Pick the correct option among the four given options for ALL of the following questions:** **15 X 1 = 15**	
1.	**A glass rod is rubbed with silk cloth. The charge acquired by glass rod is__________.** (A) negative (B) positive (C) zero (D) positive on one end and negative on the opposite end	
	(B) positive	1
2.	**A spherical conductor of radius R is carrying a charge of $+Q$. The ratio of the electric potentials corresponding to a point on the surface of the conductor and a point at a distance $\frac{R}{2}$ from the centre of the conductor are in the ratio** (A) 1: 2 (B) 2: 1 (C) 1:1 (D) 4:1	
	(C) 1:1	1
3.	**The resistivity of a metallic conductor_______with decrease in temperature.** (A) increases (B) decreases (C) first increases and then decreases (D) first decreases and then increases	
	(B) decreases	1
4.	**The Lorentz force is the force on a charged particle moving in a region containing_______.** (A) only electric field (B) only magnetic field (C) both electric and magnetic fields (D) only crossed electric and magnetic fields	
	(C) both electric and magnetic fields.	1
5.	**Below are the two statements related to magnetic field lines: Statement-I: The magnetic field lines do not intersect.** **Statement-II: The direction of magnetic field at a point is unique.** (A) Both the statements I and II are correct and II is the correct explanation for I (B) Both the statements I and II are correct and II is not the correct explanation for I (C) Statement I is wrong but the statement II is correct (D) Statement I is correct but the statement II is wrong	
	(A) Both the statements I and II are correct and II is the correct explanation for I	1
6.	**A straight conductor of length 'l' is moving with a velocity 'v' in the direction of uniform magnetic field of strength 'B'. The magnitude of emf induced between the ends of the conductor is** (A) Blv (B) $\frac{Blv}{2}$ (C) 0 (D) $2Blv$	
	(C) 0	1
7.	**The SI unit of magnetic flux is:** (A) $Wb\ m^{-1}$ (B) $T\ m^{-2}$ (C) $weber$ (D) $Wb\ m^{-2}$	
	(C) $weber$	1
8.	The average power dissipated in an ac circuit is maximum if the ac source is connected: (A) only to pure resistor (B) only to pure inductor	

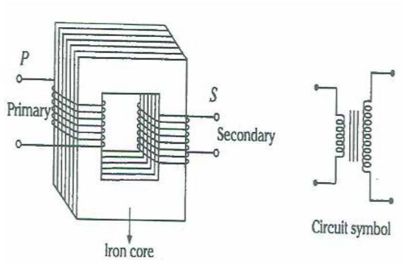
	(C) only to pure capacitor (D) to a series combination of capacitor and inductor	
	(A) only to pure resistor.	**1**
9.	**The electromagnetic waves with lowest frequency among the following are:** (A) gamma rays (B) UV rays (C) microwaves (D) radio waves	
	(D) radio waves	**1**
10.	**A ray of light coming from an object which is incident parallel to the principal axis of a convex lens placed in air after refraction_.** (A) appears to diverge from first principal focus (B) emerges without any deviation (C) appears to diverge from second principal focus (D) passes through second principal focus	
	(D) passes through second principal focus	**1**
11.	**If unpolarized light of intensity I_0 is passed through a polaroid, the intensity of emergent light is** (A) $\frac{I_0}{4}$ (B) $\frac{2I_0}{3}$ (C) $\frac{I_0}{3}$ (D) $\frac{I_0}{2}$	
	(D) $\frac{I_0}{2}$	**1**
12.	**The following are the statements related to photo emission:** **(i) Photoelectric current is independent of intensity of incident radiation.** **(ii) Stopping potential is different for different photosensitive metal surfaces for a radiation of particular frequency ($\nu > \nu o$).** **(iii) Maximum speed of photoelectrons is independent of frequency of incident radiation.** **(iv) Saturation current is different for radiations of different intensities having same frequency.** (A) Only (i) and (iii) are correct (B) Only (i) and (ii) are correct (C) Only (iii) and (iv) are correct (D) Only (ii) and (iv) are correct	
	(D) Only (ii) and (iv) are correct	**1**
13.	**The minimum energy required to free the electron from the ground state of a hydrogen atom is** (A) 0.85 eV (B) 3.4 eV (C) 13.6 eV (D) 1.51 eV	
	(C) 13.6 eV	**1**
14.	**The radioactive decay in which a helium nucleus is emitted is called________.** (A) gamma decay (B) alpha decay (C) negative β decay (D) positive β decay	
	(B) alpha decay	**1**
15.	**In the figure, E_V and E_C are the valence band and conduction band corresponding to an extrinsic semiconductor. E is the energy state corresponding to the impurity present in it. The impurity present in it can be** (A) arsenic (B) indium (C) phosphorous (D) antimony  	
	(B) indium	**1**
II	**Fill in the blanks by choosing appropriate answer given in the brackets for ALL the following questions: 5 X 1 = 05** **(maximum, decrease, thermonuclear fusion, generator, increase, cell)**	

16.	**A convenient way to increase the current sensitivity of a galvanometer is to________the number of turns of the coil.**	
	increase	**1**
17.	**The device used to convert mechanical energy into electrical energy is called a__________.**	
	generator	**1**
18.	**If two waves coming from two coherent sources superpose at a point in phase, then the intensity of light at that point is___________.**	
	maximum	**1**
19.	**The source of energy output in the interior of stars is____________.**	
	thermonuclear fusion	**1**
20.	**The width of depletion region of a pn-junction diode will______on increasing the forward bias voltage.**	
	decrease	**1**
	PART - B	
III.	**Answer any FIVE of the following question: 5 X 2 = 10**	
21.	**Mention any two basic properties of electric charges.**	
	❖ Charge is additive in nature. ❖ Charge is conserved. ❖ Charge is quantized. (Any Two)	**1** **1**
22.	**The amount of work done in bringing a point charge of 3 mC from infinity to a point P is $0.06\ J$. Find the electric potential at the point P.**	
	Electric potential at P is $V = \frac{W}{q}$ $V = \frac{0.06}{3\ X\ 10^{-3}} = 0.02\ X\ 10^{3}$ $V = 20\ V$	**1** **1**
23.	**Write the expression for magnetic force per unit length between two long straight parallel conductors carrying current. Give the nature of force between two parallel conductors carrying current in same direction.**	
	$\frac{F}{l} = \frac{\mu_0}{4\pi}\frac{2I_1I_2}{d}$ Nature of force is attractive	**1** **1**
24.	**State and explain Gauss's law in magnetism.**	
	Statement: The net magnetic flux through any closed surface is zero. Consider a Gaussian surface $\vec{S}$ in a uniform magnetic field $\vec{B}$ The magnetic flux $\Delta\phi_B$ through the surface ΔS is given by: $\Delta\phi_B = \vec{B}.\Delta\vec{s}$ If ϕ_B is total flux over the surface $\vec{S}$ then according to Gauss law in magnetism, $\phi_B = \sum \vec{B}.\Delta\vec{s} = 0$ 	**1** **1**

25. Mention any two factors on which self-inductance of a long solenoid depends.

- ❖ Length of the coil. **1**
- ❖ Number of turns of the coil. **1**
- ❖ Permeability of the medium inside the coil.
- ❖ Area of cross section of the coil. (Any Two)

26. Briefly explain the construction of a transformer.



A transformer consists of a two coils of insulated copper wires which are wound on a laminated soft iron core. When an alternating voltage is applied to the primary, the resulting current produces an alternating magnetic flux. Thus, the magnetic flux linked with the secondary coil changes and an emf is induced in it. The value of this emf depends on the number of turns in the secondary coil. If N_S , N_P , v_S , and v_P are number of turns and voltages in secondary and primary coils respectively then for transformer **1**

1

$$\frac{N_S}{N_P} = \frac{v_S}{v_P} = \frac{i_P}{i_S} = T$$

Where T is transformer's turns ratio.

27. What is displacement current? Give expression for the same.

The current which appears in the region where electric field and hence electric flux is changing with respect to time is called displacement current. **1**

$$i_D = \varepsilon_0 \frac{d\emptyset_E}{dt}$$ **1**

28. Write the two conditions required for total internal reflection.

- ❖ A ray of light must travel from denser to rarer medium. **1**
- ❖ Angle of incidence must be greater than critical angle. **1**

29. Differentiate conductors from insulators on the basis of band theory of solids.

	Conductors	Insulators
1	Conduction Band (C.B) Over lapping Valence Band (V.B)	Conduction Band (C.B) ↕ Large energy gap Valence Band (V.B)
2	Energy gap between C.B and V.B is zero.	Energy gap between C.B and V.B is greater than 3eV.
3	C.B is completely filled with electrons at room temperature.	C.B is completely empty.
4	Conductivity decreases with increase in temperature.	Conductivity is zero.
5	They allow current to pass through them.	They do not allow current to pass through them. (Any Three)

1
1
1

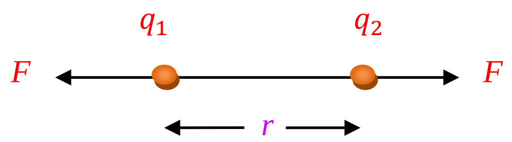
PART-C

IV. Answer any FIVE of the following questions: **5 x 3 = 15**

30. State and explain Coulomb's law. Define '1 coulomb'.

Statement: The electrostatic force between any two point charges is directly proportional to the product of magnitude of charges and inversely proportional to the square of the distance between them and acts along the line joining the two charges. 1

Explanation: Consider two point charges q_1 and q_2 separated by a distance r in free space as shown in fig.



If F is the electrostatic force between the two charges then,

From Coulomb's law,

$F \propto \frac{q_1 q_2}{r^2}$ ………. (1)

$F = K\,\frac{q_1 q_2}{r^2}$ ……… (2)

Where K is a constant called Coulomb's constant and is given by $K = \frac{1}{4\pi\varepsilon_0}$

$\therefore\ \ \boldsymbol{F = \frac{1}{4\pi\varepsilon_0}\frac{q_1 q_2}{r^2}}$ **……. (3)** 1

In vector form

$\vec{\boldsymbol{F}} = \frac{1}{4\pi\varepsilon_0}\frac{q_1 q_2}{r^2}\,\hat{\boldsymbol{r}}$

Definition of SI unit of charge: One coulomb of charge is that charge which when placed at a distance of one metre in vacuum from an identical charge which would repel it by a force of $9\ X\ 10^9$ N. 1

31. Obtain the expression for potential energy of an electric dipole placed in a uniform electric field.

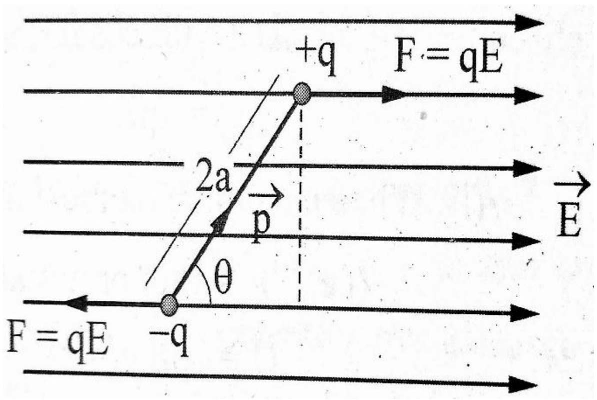
Consider an electric dipole placed at an angle θ in a uniform electric field as shown in fig.

W.K.T. Torque acting on the dipole in the electric field is

$\tau = PE\ sin\theta$ … (1)

If dW is the small work done in rotating the dipole to an angle $d\theta$ then,

$dW = \tau \cdot d\theta$ or $dW = PE\ sin\theta\ d\theta$ 1



If W is the total work done in rotating the dipole from θ_0 to θ_1 then

$W = \int_{\theta_0}^{\theta_1} PE\ sin\theta \cdot d\theta$ …. (2)

On integrating Eqn. (2) we get

$W = PE(-cos\theta)\ |_{\theta_0}^{\theta_1}$

$W = -PE(cos\theta_1 - cos\theta_0)$ **1**

If $\theta_0 = \frac{\pi}{2}$ and $\theta_1 = \theta$ then

$W = -PEcos\theta$ …. (3)

By definition this work done is equal to potential energy

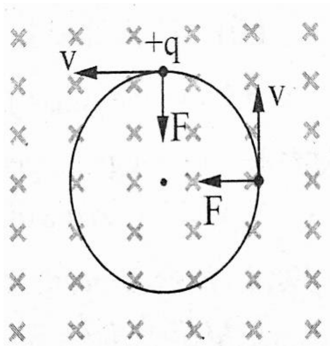
$\therefore U = -PEcos\theta$ …. (4) **1**

32. Mention three limitations of Ohm's law.

- ❖ Ohm's law is not applicable for semiconductors like diodes transistors etc. **1**
- ❖ Ohm's law is not applicable for conductors at very low and at very high temperature. **1**
- ❖ In the case of GaAs, the ratio of V/I is not constant. There is more than one value of I for the same value of V. **1**
- ❖ In devices such as semiconductors diodes the relation between V and I depend on the sign of V.

33. Obtain an expression for the radius of circular path taken by a charged particle moving perpendicular to a uniform magnetic field.

\Let a charge particle of mass m and charge q enters to the magnetic field B with a velocity v at an angle $\theta = 90^0$ then it describes a circular path of radius r **1**



The force on the charge particle is $F = Bqv\sin\theta$

Or

$F = Bqv$ ….. (1) **1**

This force is balanced by centripetal force $F = \frac{mv^2}{r}$ ….. (2)

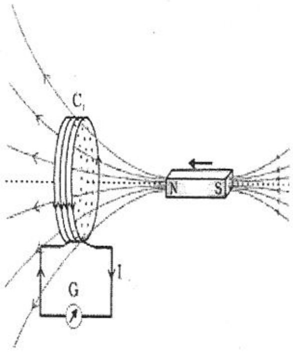
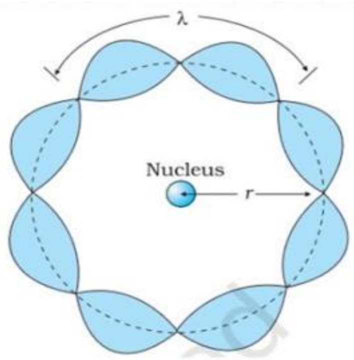
From Equation (1) and (2)

$\frac{mv^2}{r} = Bqv$

$r = \frac{mv}{Bq}$ ……….. (3) **1**

34. Mention any three differences between paramagnetic and diamagnetic materials.

Paramagnetic materials	Diamagnetic materials	Marks
1. Paramagnetic materials are feebly attracted by magnets.	1. Diamagnetic materials are feebly repelled by magnets.	1
2. Magnetic permeability is slightly greater than one.	2. Magnetic permeability is less than one.	1
3. Magnetic susceptibility is low and positive.	3. Magnetic susceptibility is low and negative.	1
4. Susceptibility varies inversely as the absolute temperature.	4. Susceptibility does not change with temperature. (Any Three)	

35.	**Explain briefly the coil and magnet experiment to demonstrate electromagnetic induction.**	
	Coil and magnet experiment: When the north pole of the magnet is moved towards or away from the coil C_1, the magnetic flux lined with the coil changes. As a result, emf is induced and current flows through the coil which causes a momentary deflection in the galvanometer G. If the magnet is kept stationary and the coil is moved, similar results are obtained. It is also observed that faster the moment of magnet, greater is the deflection. When the coil and magnet are kept stationary (no relative motion between the coil and the magnet, then no deflection is observed.  Thus, an emf and hence current are induced in a coil whenever change in magnetic flux linked with it.	1 1+1
36.	**Write the Cartesian sign conventions used in analyzing reflection of light by spherical mirrors.**	
	❖ All distances are measured from the pole of the spherical mirror along the principal axis. ❖ The distances measured along the direction of incident light are taken as positive and those measured in the direction opposite to the direction of incident light are taken as negative. ❖ The heights measured upwards perpendicular to the principal axis are taken as positive and the heights measured downwards perpendicular to the principal axis are taken as negative.	1 1 1
37.	**Give de Broglie's explanation of Bohr's second postulate of quantization of angular momentum.**	
	According to de-Broglie a particle of mass m moving with a velocity v associated with a wave given by $\lambda = \frac{h}{mv}$ …… (1) de-Broglie suggested that the electrons move around the nucleus in the form of circular standing waves that closes on itself. Thus, only those de-Broglie waves exist for which the circumference of the circular orbits contains a whole number of wavelengths. For an electron moving in n^{th} circular orbit of radius r_n the circumference of the orbit is $2\pi r_n$ $\therefore 2\pi r_n = n\lambda$ …. (2) Put Eqn. (1) in Eqn. (2) We get $2\pi r_n = n\left(\frac{h}{mv}\right)$ Or $mvr_n = n\left(\frac{h}{2\pi}\right)$ ….. (3)  This is the condition proposed by Bohr for the angular momentum of the electron.	1 1 1
38.	**Calculate the mass defect and binding energy of $_7N^{14}$, given that the rest mass of nitrogen nucleus is 14.00307 u, rest mass of proton is 1.00783 u and rest mass of neutron is 1.00867**	

u.

Given: $M = 14.00307\ u$ $Z = 7$ $A = 14$ $m_p = 1.00783\ u$ $m_n = 1.00867\ u$ $\Delta m = ?$ BE =?

Mass defect:

$\Delta m = Zm_p + (A - Z)m_n - M$ **1**

$\Delta m = 7\ X 1.00783 + (14 - 7)\ X\ 1.00867 - 14.00307$

$\Delta m = 0.11243\ u$ **1**

Binding energy:

$BE = \Delta m\ X\ 931.5\ MeV$

$BE = 0.11243\ X\ 931.5\ MeV$

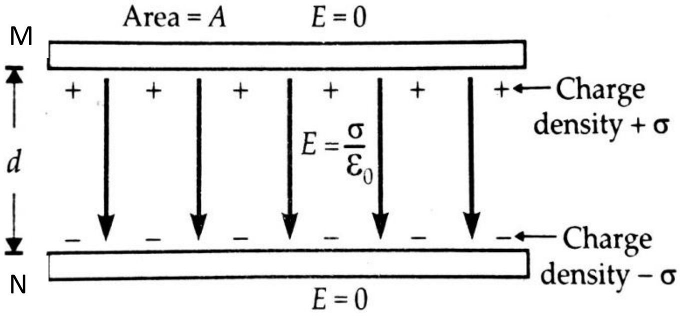
$BE = 104.72854\ MeV$ **1**

PART-D

V	**Answer any THREE of the following questions:**	**3 x 5 = 15**
39.	**Derive the expression for capacitance of a parallel plate capacitor with air as dielectric. Write the expression for capacitance of a parallel plate capacitor with some dielectric medium introduced between the plates.**	

Consider a parallel plate air capacitor with surface charge density $\sigma = \frac{Q}{A}$

The electric field above the plate M and below the plate N is zero.



Let E be the electric field between the plates then

$E = \frac{\sigma}{2\varepsilon_0} + \frac{\sigma}{2\varepsilon_0} = \frac{\sigma}{\varepsilon_0}$ …….. (1) **1**

$\because \quad \sigma = \frac{Q}{A}$ Then Eqn. (1) becomes

$E = \frac{Q}{\varepsilon_0 A}$ …….. (2) **1**

If V be the p.d. between the plates then $V = E\ d$

Or $V = \frac{Qd}{\varepsilon_0 A}$ …….. (3) **1**

If C is the capacitance of the capacitor then $C = \frac{Q}{V}$

Or $C = \frac{Q}{\frac{Qd}{\varepsilon_0 A}}$

Or $C = \frac{\varepsilon_0 A}{d}$ …… (4) **1**

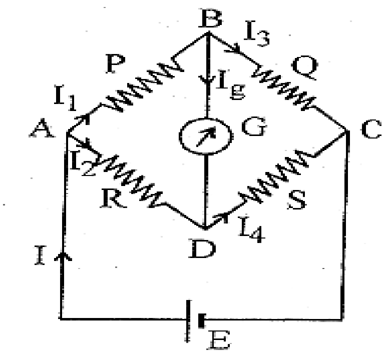
If C_m is the capacitance with dielectric medium with dielectric constant ε_r then

$C_m = \frac{\varepsilon_0\ \varepsilon_r A}{d}$ **1**

40. Obtain the condition for balance of Wheatstone bridge using Kirchhoff's rules.

Consider a Wheatstone's bridge with currents I_1, I_2, I_3, I_4 and I_g through resistors P Q R S and G as shown in fig.

The bridge is said to be balanced if current through the galvanometer is zero. i.e. $I_g = 0$ **1**



Apply KCL to junction B then,

$I_1 - I_3 - I_g = 0$

Or $I_1 = I_3$ …… (1) Since $I_g = 0$ **1**

Similarly, Apply KCL to junction D then

$I_2 + I_g - I_4 = 0$

Or $I_2 = I_4$ …… (2)

Now apply KVL to the loop ABDA then **1**

$-I_1P - I_gG + I_2R = 0$

Or $I_1P = I_2R$…… (3)

Now apply KVL to the loop BCDB then

$-I_3Q + I_4S + I_gG = 0$

$I_3Q = I_4S$…… (4) **1**

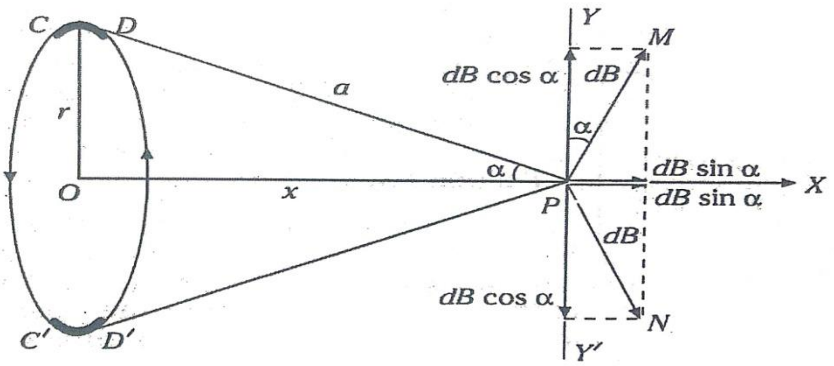
Divide Eqn. (3) and (4) We get

$\frac{I_1 P}{I_1 Q} = \frac{I_2 R}{I_2 S}$

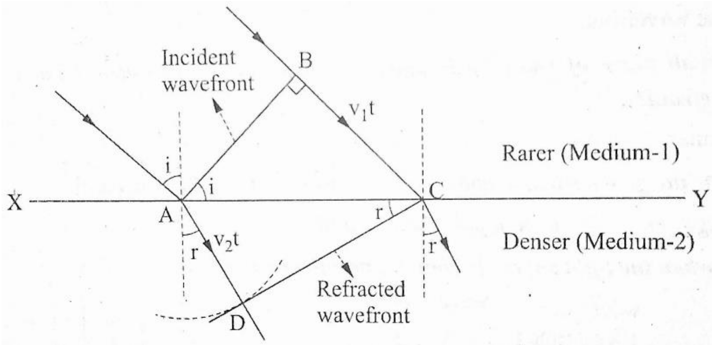
Or $\frac{P}{Q} = \frac{R}{S}$ ……… (5) **1**

41. Derive an expression for the magnetic field at a point on the axis of a circular current loop.

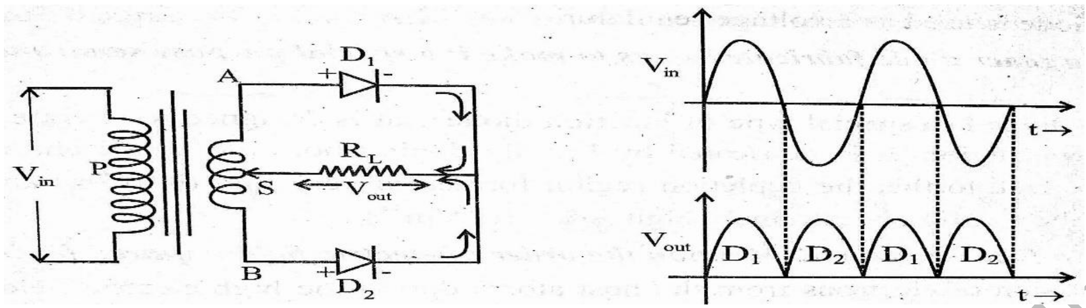
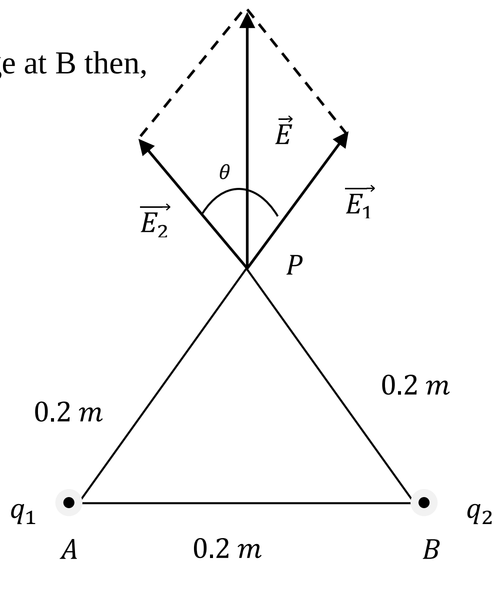
Consider a circular loop of radius r carrying current I. Let P be a point at a distance x from the centre of circular coil. C D and C^1 D^1 are two diametrically opposite current elements each of length dl **1**



According to Biot-Savart's law Magnetic field at P due to current element C D is

	$dB = \frac{\mu_0}{4\pi}\frac{I\,dl}{a^2}$ From fig. $a^2 = (r^2 + x^2)$ $\therefore dB = \frac{\mu_0}{4\pi}\frac{I\,dl}{(r^2+x^2)}$ ……. (1) Similarly, Magnetic field at P due to current element C^1 D^1 is $dB^1 = \frac{\mu_0}{4\pi}\frac{I\,dl}{(r^2+x^2)}$ ……. (2)	1
	The magnetic field dB and dB^1 are resolved into rectangular components. $dB\,cos\alpha$ along X-axis and $dB^1\,cos\alpha$ along Y-axis are cancel each other. $\therefore$ Resultant magnetic field at P is $B = \sum 2\,dB\,sin\alpha$	1
	Or $B = \sum 2\left(\frac{\mu_0}{4\pi}\frac{I\,dl}{(r^2+x^2)}\right) sin\alpha$ …… (3) From Fig, $sin\alpha = \frac{r}{(r^2+x^2)^{\frac{1}{2}}}$ and $\sum dl = \frac{2\pi r}{2} = \pi r$	1
	$B = \frac{\mu_0}{4\pi}\frac{2\pi I\,r^2}{(r^2+x^2).(r^2+x^2)^{\frac{1}{2}}}$ $B = \frac{\mu_0}{4\pi}\frac{2\pi I\,r^2}{(r^2+x^2)^{\frac{3}{2}}}$ …….. (4)	1
	In vector form $\vec{B} = \frac{\mu_0}{4\pi}\frac{2\pi I\,r^2}{(r^2+x^2)^{\frac{3}{2}}}\;\hat{\imath}$ ……… (5)	
42.	**a) State Huygens principle. (2)** **b) Using Huygens principle arrive at Snell's law of refraction for a plane wave. (3)**	
	a) According to Huygens' principle, ❖ Each point on a wave front is a source of secondary wavelets. These secondary wavelets spread out in all directions with the speed of the wave.	1
	❖ The tangent drawn to all secondary wavelets represent the position of new wave front.	1
	b) Consider a plane wave front AB incident at A at an angle i on a plane surface X Y separating rarer and denser as shown in fig. Let v_1 and v_2 are the speed of light in rarer and denser medium respectively. If the secondary wavelets from B strike the surface X Y at C in time t then $BC = v_1 t$ …… (1) In the same time the secondary wavelets from point A gets spread over a hemisphere of radius in denser medium is $AD = v_2 t$ …… (2) From fig in $\Delta\,ABC$ $\sin i = \frac{BC}{AC}$  	1

	Again, from fig in ΔADC $\sin r = \frac{AD}{AC}$ Or $\frac{\sin i}{\sin r} = \frac{BC}{AD}$ …… (3) Substituting Eqn. (1) and (2) in (3) we get $\frac{\sin i}{\sin r} = \frac{v_1 t}{v_2 t} = \frac{v_1}{v_2} = \frac{n_2}{n_1}$ Or $n_1 \sin i = n_2 \sin r$ …… (4)	1 1
43.	**a) Define work function of a photosensitive material. (1)** **b) What is meant by photoelectric effect? Give Einstein's explanation of photoelectric effect. (4)**	
	a) Photoelectric work function (ϕ_0): The minimum energy required to liberate the electrons from the metal surface is called work function of the metal.	1
	The phenomenon of emission of free electrons from a metal surface when light of suitable frequency is incident on it is called photoelectric effect. Einstein's photoelectric equation is given by $E = \phi_0 + K_{max}$ Or $h\vartheta = h\vartheta_0 + \frac{1}{2} mv^2{}_{max}$ ❖ Emission of photoelectrons is instantaneous because collision between electron and photon is the elastic collision between two micro particles. ❖ When $\vartheta < \vartheta_0$, we get K_{max} as negative value. Negative KE is not possible, hence emission does not occur. ❖ If $\vartheta = \vartheta_0$, electron just released from metal but Kinetic energy K.E = 0. ❖ When $\vartheta > \vartheta_0$ we get K_{max} as positive the photoelectric emission is possible when incident radiation is greater than threshold frequency.	1 1 1+1
44.	**What is rectification? Explain the working of a full wave rectifier using the circuit diagram. Also draw input-output waveforms.**	

	The process of conversion of AC into pulsating DC is called rectification.  	1 1 1
	Working: A full wave rectifier consists of two diodes connected across the ends of winding of a centre tapped step down transformer as shown in fig. During positive half cycle the diode D_1 becomes forward biased, whereas diode D_2 reverse biased. So, diode D_1 allows the current to flow through load resister R_L. During negative half cycle the diode D_1 becomes reverse biased, whereas diode D_2 forward biased. So, diode D_2 allows current through load resister R_L. Thus, a unidirectional pulsating DC current flows through load resistor R_L over the complete cycle of input signal.	1+1
VI.	**Answer any TWO of the following questions: 2 x 5 = 10**	
45.	**Two-point charges each of +2 μ C are placed at the two corners A and B of an equilateral triangle ABC of side 0.2 m. Find the magnitude and direction of the resultant electric field at C.**	
	$Given: q_1 = 2 X 10^{-6} C \quad q_2 = 2 X 10^{-6} C \quad r = 0.2\, m \quad E = ?$ Let E_1 be the electric field at P due to charge at A then, $E_1 = \frac{1}{4\pi\varepsilon_0}\frac{q_1}{r_1^2} = \frac{9 X 10^9 X 2 X 10^{-6}}{(2 X 10^{-1})^2}$ $E_1 = 4.5 X 10^5\, NC^{-1}\ Along\ AP$ Similarly, Let E_2 be the electric field at P due to charge at B then, $E_2 = \frac{1}{4\pi\varepsilon_0}\frac{q_2}{r_2^2} = \frac{9 X 10^9 X 2 X 10^{-6}}{(2 X 10^{-1})^2}$ $E_2 = 4.5 X 10^5\, NC^{-1}\ Along\ BP$ Resultant electric field at P is $E = \sqrt{E_1^2 + E_2^2 + 2\, E_1 E_2\, cos\theta}$  	1 1 1

	$E = \sqrt{(4.5\,X\,10^5)^2 + (4.5\,X\,10^5)^2 + 2\,X\,4.5\,X\,10^5\,X\,4.5\,X\,10^5\,cos60^0}$ $E = \sqrt{(4.5\,X\,10^5)^2 + (4.5\,X\,10^5)^2 + 2\,X\,4.5\,X\,10^5\,X\,4.5\,X\,10^5\left(\frac{1}{2}\right)}$ $E = \sqrt{(4.5\,X\,10^5)^2 + (4.5\,X\,10^5)^2 + (4.5\,X\,10^5)^2}$ $E = \sqrt{3}\,X\,4.5\,X\,10^5$ $E = 7.79\,X\,10^5\,NC^{-1}\,Perpendicular\ to\ AB$	1 1
46.	**The number density of free electrons in copper is estimated to be 8.5 x 10^{28} m^{-3}. A copper wire of length 3.0 m and area of cross-section 2.0 mm^2 is carrying a current of 3.0 A. Calculate the drift velocity of electrons. How long does an electron take to drift from one end of the wire to its other end?**	
	$Given{:}\ n = 8.5\,X\,10^{28}\,m^{-3}\ l = 3.0\ m\ \ A = 2.0\,X\,10^{-6}\,m^2\ \ I = 3.0\,A\ \ \ t = ?$ W.K.T Drift velocity of free electrons in a conductor is $v_d = \frac{I}{neA}$ $v_d = \frac{3}{8.5\,X\,10^{28}\,X\,1.6\,X\,10^{-19}\,X\,2.0\,X\,10^{-6}} = \frac{3}{27.2\,X\,10^3}$ $v_d = 0.11\,X\,10^{-3}\,ms^{-1}$ If t is the time taken by the electrons to drift from one end to the other end then $t = \frac{l}{v_d}$ $t = \frac{3}{0.11\,X\,10^{-3}} = 27.27\,X\,10^3$ $t = 27.27\,X\,10^3\,s$	1 1 1 1 1
47.	**A sinusoidal voltage of rms value 200 V and frequency 50 Hz is applied to a series RC circuit in which R = 5 Ω and C = 800 μF.** **Calculate: a) impedance of the circuit and b) the current through the circuit.**	
	$Given{:} R = 5\,\Omega\ \ \ C = 800\,\mu F\ \ v_{rms} = 200\,V\ \ \vartheta = 50\,Hz\ \ X_C = ?\ Z = ?\ i_{rms} = ?$ $X_C = \frac{1}{\omega C} = \frac{1}{2\pi\vartheta C} = \frac{1}{2\,X\,3.14\,X\,50\,X\,800\,X\,10^{-6}}$ $X_C = 3.985\,\Omega$ $Z = \sqrt{R^2 + {X_C}^2}$ $Z = \sqrt{5^2 + 3.98^{\,2}} = 6.39\,\Omega$ $i_{rms} = \frac{v_{rms}}{Z}$ $i_{rms} = \frac{200}{6.39} = 31.29\,A$	1 1 1 1 1
48.	**A parallel beam of light is incident on one face of an equilateral prism. By rotating the prism, the angle of minimum deviation is measured to be 40°. Determine the refractive index of the material of the prism. If the prism is immersed completely in water (refractive**	

	index = 1.33), calculate the new angle of minimum deviation.	
	$Given: A = 60^0 \quad D = 40^0 \quad n_g = ? \quad n_W = 1.33 \quad D' = ?$ Refractive index of the prism is $n_g = \frac{sin\left(\frac{A+D}{2}\right)}{sin\left(\frac{A}{2}\right)} = \frac{sin\left(\frac{60^0+40^0}{2}\right)}{sin\left(\frac{60^0}{2}\right)} = \frac{sin(50^0)}{sin(30^0)}$ $n_g = \frac{0.7660}{0.5000} = 1.532$ When the prism is immersed in water, RI of glass with respect to water is ${}_wn_g = \frac{n_g}{n_w} = \frac{1.532}{1.33} = 1.152$ If D' is new angle of minimum deviation then ${}_wn_g = \frac{sin\left(\frac{A+D'}{2}\right)}{sin\left(\frac{A}{2}\right)}$ $1.152 = \frac{sin\left(\frac{60^0+D'}{2}\right)}{sin\left(\frac{60^0}{2}\right)}$ $1.152\ X sin(30^0) = sin\left(\frac{60^0 + D'}{2}\right) \quad 1.152\ X\ 0.5000 = sin\left(\frac{60^0 + D'}{2}\right)$ $0.576 = sin\left(\frac{60^0 + D'}{2}\right)$ $\left(\frac{60^0 + D'}{2}\right) = sin^{-1}(0.576) = 35^0\ 10'$ $60^0 + D' = 35^0\ 10' X\ 2 = 70^0\ 20'$ $D' = 70^0\ 20' - 60^0 = 10^0\ 20'$	**1** **1** **1** **1** **1**
	Note: Any other alternate correct method /answer should be considered	

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