GOVERNMENT OF KARNATAKA
KARNATAKA SCHOOL EXAMINATION AND ASSESSMENT BOARD
II PUC ANNUAL EXAMINATION : MARCH – 2023

Subject code: 33 **SCHEME OF EVALUATION** **Subject: PHYSICS**

General Instructions:

1. *All parts are compulsory.*
2. *Answers without relevant diagram / figure / circuit wherever necessary will not carry any marks.*
3. *Direct answers to the numerical problems without detailed solutions will not carry any marks.*

PART – A

I. Pick the correct option among the four given options for ALL of the following questions: **15 × 1 = 15**

1.	**Physical quantity measured in terms of "coulomb" is** a) electric charge b) electric current c) electric flux d) electric field	
Ans	**a) electric charge**	1
2.	**The electric field inside the cavity of a charged conductor is zero, this is known as** a) charging b) grounding c) electrostatic shielding d) electrostatic induction	
Ans	**c) electrostatic shielding**	1
3.	**An example for polar molecule is:** a) oxygen molecule b) nitrogen molecule c) water molecule d) hydrogen molecule	
Ans	**c) water molecule**	1
4.	**The magnitude of the drift velocity per unit electric field is :** a) mobility b) drift velocity c) relaxation time d) resistivity	
Ans	**a) mobility**	1
5.	**The device used to accelerate charged particle is** a) electroscope b) cyclotron c) galvanometer d) ammeter	
Ans	**b) cyclotron**	1
6.	**The net magnetic flux through any closed surface is zero is in accordance with** a) Gauss's law in magnetism b) Gauss's law in electrostatics c) Ampere's circuital law d) Biot-Savart's law	
Ans	**a) Gauss's law in magnetism**	1
7.	**S.I. unit of mutual inductance of pair of coils is:** a) henry b) ohm c) farad d) ohm-metre	
Ans	**a) henry**	1
8.	**If the number of turns of a solenoid is doubled, the self inductance of the solenoid will** a) remains unchanged b) be doubled c) be halved d) becomes four times	
Ans	**d) becomes four times**	1
9.	**The relation between peak value of current (i_m) and rms value of current (I) is** a) $I = \frac{i_m}{\sqrt{2}}$ b) $I = i_m\sqrt{2}$ c) $I = 2\, i_m$ d) $I = \frac{i_m}{2}$	
Ans	**a) $I = \frac{i_m}{\sqrt{2}}$**	1
10.	**The ultraviolet region of the electromagnetic spectrum lies between** a) X-ray region and visible region b) Microwave region and radio-wave region c) γ-rays region and X-rays region d) Visible region and microwave region	
Ans	**a) X-ray region and visible region**	1

11.	**Snell's law of refraction invalid at an angle of incidence(i) is** a) $i = 30^0$ b) $i = 60^o$ c) $i = 0^o$ d) $i = 90^o$	
Ans	**c) $i = 0^o$**	1
12.	**When a point source of light is placed at the principal focus of a thin convex lens, the shape of the emergent wave front is** a) Spherical convergent wave front b) Spherical divergent wave front c) Plane wave front d) Cylindrical wave front	
Ans	**c) Plane wave front**	1
13.	**C.J. Davisson – L.H. Germer experiment proved:** a) wave nature of electrons b) particle nature of electrons c) wave nature of light d) particle nature of light	
Ans	**a) wave nature of electrons**	1
14.	**Function of moderator in a nuclear reactor is** a) to slow down fast neutrons b) to absorb the neutrons c) to reduce heat energy d) to control the chain reaction	
Ans	**a) to slow down fast neutrons**	1
15.	**Energy gap (E_g) between the valence band and the conduction band for conductor is** a) Eg = 0 b) E_g < 3eV c) E_g > 3eV d) E_g = 3eV	
Ans	**a) Eg = 0**	1

II. Fill in the blanks by choosing appropriate answer given in the brackets for ALL the following questions: 5 × 1 = 5

(Curie temperature, electric dipole, transverse, isotopes, zener diode)

16.	A pair of equal and opposite point charges q and -q separated by a distance 2a is an _____________.	
Ans	**electric dipole**	1
17.	Temperature of transition from ferromagnetism to paramagnetism is called ____________.	
Ans	**Curie temperature**	1
18.	Phenomenon of polarisation proves the ____________ nature of light waves.	
Ans	**transverse**	1
19.	Nuclei having same atomic number and different mass number are called _____________.	
Ans	**isotopes**	1
20.	_____________ is used as voltage regulator.	
Ans	**Zener diode**	1

PART – B

III. Answer any FIVE of the following questions: 5 × 2 = 10

21.	**On what factors does the capacitance of a parallel plate capacitor depend?**	
Ans	(i) Area of plate (ii) distance between the plates (iii) dielectric constant or dielectric medium between the plates (**Any two**, one mark each)	**1** **1**
22.	**State and explain Ampere's circuital law.**	
Ans	**Statement:** The line integral of the magnetic field around a closed loop is equal to μ_0 times the current enclosed by the loop. **Explanation:** $\oint \vec{B}.d\vec{l} = \mu_0 I$; B – Magnetic field, dl – line element/elemental length and I – current	1 1
23.	**Define magnetic dip and declination at a place.**	
Ans	**Magnetic dip:** The angle between earth's magnetic field and the horizontal in the magnetic meridian at a place. **Declination**: The angle between the magnetic meridian and geographic meridian at a place. **OR** **Declination** is the angle between the true geographic north and the north shown by a compass needle.	1 1

24.	**What are eddy current? Mention any one use of it.**	
Ans	When bulk pieces of conductors/metals are subjected to changing magnetic flux/field, induced currents are produced in them. These currents are called **eddy currents.** **Uses:** Magnetic braking in trains, electromagnetic damping, Induction furnace, electric power meters, speedometer of vehicles, dead beat galvanometer **(any one)**	1 1
25.	**Write two sources of energy loss in a transformer.**	
Ans	• Flux leakage/ Magnetic loss. • Resistance of the windings/coils OR Copper loss. • **Eddy currents** loss. • **Hysteresis** loss. **(any two)**	1 1
26.	**What is displacement current? Give the expression for it.**	
Ans	The current due to **time varying electric flux (or field)** is called displacement current. Displacement current $= \varepsilon_0 \frac{d\phi_E}{dt}$ **OR** $i_d = \varepsilon_0 \frac{d\phi_E}{dt}$ **OR** $I_d = \varepsilon_0 \frac{d\phi_E}{dt}$	1 1
27.	**Mention the expression for limit of resolution of a telescope and explain the terms.**	
Ans	**Limit of resolution ($\Delta\theta$ or $d\theta$)** $= \frac{0.61\,\lambda}{a}$ OR $\boldsymbol{\Delta\theta} = \frac{1.22\,\lambda}{2a}$ OR $\boldsymbol{\Delta\theta} = \frac{1.22\,\lambda}{D}$ where λ the wavelength of light and 2a or D is the diameter of the objective. a is the radius of the aperture of objective.	1 1
28.	**Name the spectral series of hydrogen atom lies in** **a) ultraviolet region and b) visible region of electromagnetic spectrum.**	
Ans	a) Ultraviolet region : Lyman series b) Visible region : Balmer series	1 1
29.	**Give any two differences between nuclear fission and nuclear fusion.**	
Ans	see table below	1 1

Nuclear fission	Nuclear fusion
• The process in which heavy nucleus splits into two nuclei of comparable masses with release of energy is known as fission.	• The process in which two lighter nuclei combine to form a single nucleus with the release of energy is known as fusion.
• Fission can take place at room temperature.	• Fusion takes place only at high temperature.
• Energy released per nucleon (or per unit mass) of the reactant is less.	Energy released per nucleon (or per unit mass) of the reactant is more.
• Energy released per reaction is more.	• Energy released per reaction is less.
• Can be controlled.	• Cannot be controlled.
	(any two OR any other correct difference)

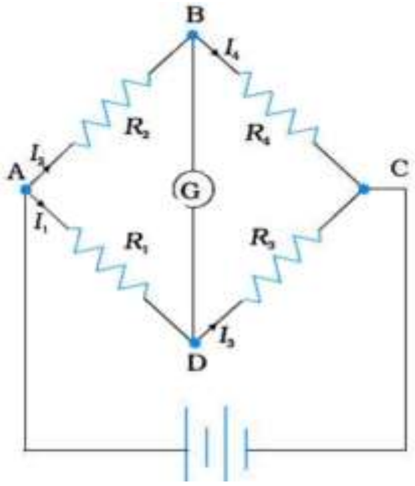
PART – C

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

30.	**Write any three properties of electric field lines.**	
Ans	• Electric field lines start from positive charge and end at negative charge. For a single charge, they may start or end at infinity. • In a charge-free region, electric field lines are continuous curves without any break. • Two field lines can never cross each other (never intersect each other). • A tangent drawn to a field line at any point gives the direction of electric field at that point. • Electrostatic field lines do not form any closed loops. **(any three)**	1 1 1

31. **Draw a labelled Wheatstone's bridge and hence write the balancing condition in terms of resistances.**

Ans



Circuit diagram — 1

Labelling the four resistors and galvanometer — 1

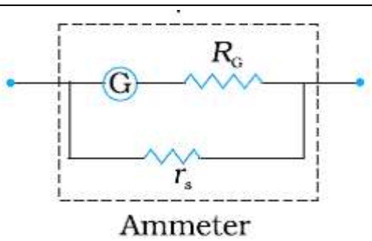
Balancing condition: — 1

$$\frac{R_2}{R_1} = \frac{R_4}{R_3} \quad \text{OR} \quad \frac{R_2}{R_4} = \frac{R_1}{R_3} \quad \text{OR} \quad \frac{R_1}{R_2} = \frac{R_3}{R_4}$$

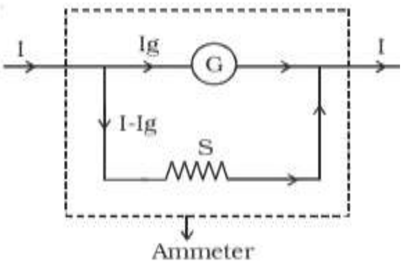
Note: Any other symbols used for resistors like P, Q, R, S and any other order should also be considered and balancing condition should be in accordance with the resistors shown in the circuit.

32. **How would you convert a galvanometer into an ammeter? Explain.**

Ans



OR



A galvanometer can be converted into a ammeter by connecting a **low resistance in parallel** with it. — 1

Diagram OR expression — 1

R_G – resistance of galvanometer G.

r_s – shunt resistance in parallel with the galvanometer. — 1

OR The resistance of the arrangement $= \dfrac{R_G \, r_s}{R_G + r_s}$

OR Shunt resistance: $r_s = \dfrac{I_G \, R_G}{I - I_G}$ **OR** $S = \dfrac{I_g \, G}{I - I_g}$

33. **Write three differences between diamagnetic and paramagnetic materials.**

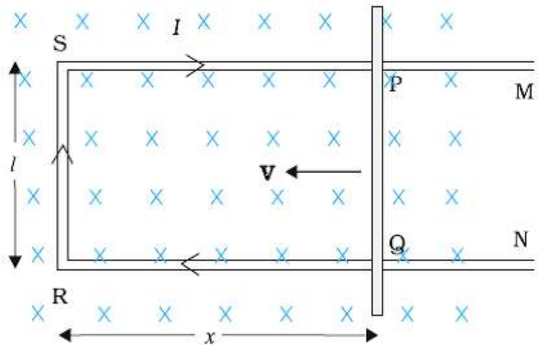
Ans

	Diamagnetic substances	Paramagnetic substances	
1	These are repelled by a magnet.	These are attracted by a magnet.	1
2	The magnetic susceptibility is negative, $\chi < 0$	The magnetic susceptibility is positive, $\chi > 0$	1
3	The susceptibility (or permeability or magnetisation) does not depend on the temperature. OR They do not obey Curie's law	The susceptibility (or permeability or magnetisation) depends on the temperature. OR They obey Curie's law.	1
4	Magnetic field lines are expelled out, when the diamagnetic substance is placed in an external magnetic field.	Magnetic field lines enter inside when the diamagnetic substance placed in an external magnetic field.	
5	Relative permeability is less than one, $\mu_r < 1$	Relative permeability is more than one, $\mu_r > 1$.	

(any three of these OR any other correct difference)

34. **Derive an expression for motional e.m.f induced in a conductor moving perpendicular to the uniform magnetic field.**

Ans



Labelled diagram (current not necessary in figure) 1

Magnetic flux enclosed by the loop PQRS is 1

$\phi_B = BA\cos 0 = Bl x$

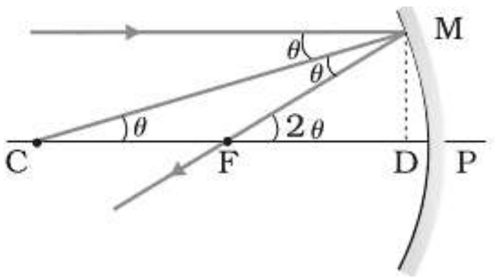
Induced emf $\varepsilon = -\dfrac{d\phi_B}{dt}$

$\varepsilon = -\dfrac{d}{dt}(B\,l\,x) = -B\,l\dfrac{dx}{dt} = B\,l\,v$ 1

(because $-dx/dt = v$)

35. **Arrive the relation between focal length and radius of curvature of a spherical concave mirror.**

Ans



Labelled diagram with arrows 1

$\angle MCP = \theta$ and $\angle MFP = 2\theta$.

$\tan\theta = \dfrac{MD}{CD}$ and $\tan 2\theta = \dfrac{MD}{FD}$.

For small angle θ, $\tan\theta \approx \theta$ and $\tan 2\theta \approx 2\theta$.

$\therefore 2\theta = \dfrac{MD}{FD}$, $2\dfrac{MD}{CD} = \dfrac{MD}{FD}$ $\Rightarrow$ $FD = \dfrac{CD}{2}$ 1

For small θ , the point D is very close to the point P. Therefore, FD = – f and CD = – R

Focal length: $f = \dfrac{R}{2}$ 1

36. **Give the three postulates of Bohr's atomic model.**

Ans

- **Bohr's first postulate:** An electron in an atom could revolve in certain stable orbits without the emission of radiant energy. 1
- **Bohr's second postulate:** An electron revolves around the nucleus only in those orbits for which the angular momentum is some integral multiple of $h/2\pi$, where h is the Planck's constant. 1
- **Bohr's third postulate:** An electron might make a transition from one of its specified non-radiating orbits to another of lower energy. When it does so, a photon is emitted having energy equal to the energy difference between the initial and final states. 1

37. **Calculate the mass defect and binding energy of helium nucleus ($_2He^4$) using the following data in MeV. Mass of proton 1.00727 u, Mass of neutron = 1.00866 u and Mass of helium nucleus = 4.00260 u.**

Ans

Mass defect: $\Delta m = [Zm_p + (A-Z)\,m_n] - M$ 1

$\Delta m = 2(1.00727) + (4-2)(1.00866) - 4.00260 = 0.02926\,u$ 1

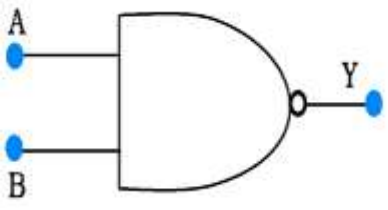
Binding energy : $E_b = \Delta m \times 931.5$ MeV = 0.02926×931.5 = 27.26 MeV **OR** 27 MeV 1

Note: Full marks should be awarded for taking 1u ≡ 931 MeV or 932 MeV.

38. **Write the logical symbol and truth table of NAND gate.**

Ans

Logical Symbol:



Logical Symbol 1

Truth Table: 2

Inputs		Output
A	B	$Y = \overline{A \bullet B}$
0	0	1
1	0	1
0	1	1
1	1	0

Note: For any two correct sets of truth values one mark each.

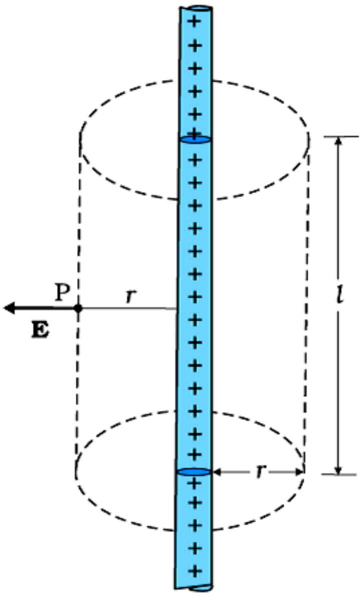
PART – D

V. Answer any THREE of the following questions: $3 \times 5 = 15$

39. State Gauss's law in electrostatics. Derive an expression for the electric field at a point due to an infinitely long thin charged straight wire using Gauss's law.

Ans

Gauss's law: The electric flux through a closed surface is $\frac{1}{\varepsilon_0}$ times the charge enclosed by it. 1



Labelled diagram 1

The electric field is everywhere radial, **flux through the two ends** of the **cylindrical Gaussian surface is zero.**

Let $\boldsymbol{l} \rightarrow$ length of the cylinder and $\lambda \rightarrow$ linear charge density

The **surface area** of the curved part of the cylinder is $\boldsymbol{2\pi rl}$.

Magnitude of **E** is same through the curved surface of the cylinder.

The electric flux ϕ through the Gaussian surface is

ϕ = Electric field × area = $E \times 2\pi r\boldsymbol{l}$ ……………. **(1)** 1

From Gauss's law, electric flux: $\phi = \frac{q}{\varepsilon_0}$ 1

The charge enclosed by the Gaussian surface: $q = \lambda \boldsymbol{l}$

then the flux: $\phi = \frac{\lambda \ell}{\varepsilon_0}$ ……………… **(2)**

From eq (1) and eq(2) , $E \times 2\pi r\boldsymbol{l} = \frac{\lambda \ell}{\varepsilon_0}$

Thus, the electric field: $E = \frac{\lambda}{2\pi\varepsilon_0 r}$ 1

40. Derive the expression for conductivity of a material: $\sigma = \frac{ne^2\tau}{m}$: where the terms have their usual meaning.

Ans

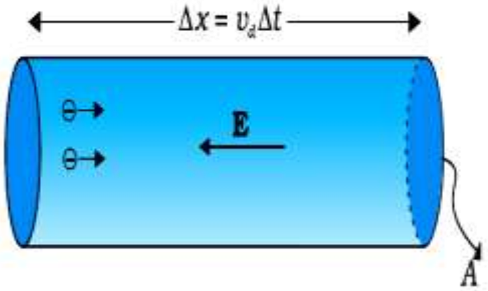


Diagram OR Explanation as given below: **1**

Volume = $A(\Delta x) = A\, v_d\,(\Delta t)$

Let '**n**' be the number of free electrons per unit volume (number density of free electrons) in the material, then there are $\mathbf{n\, v_d\, (\Delta t) A}$ electrons in this volume.

The electrons drift opposite to the electric field direction.

$A \rightarrow$ area of cross section and $v_d \rightarrow$ drift velocity.

The amount of charge crossing the area A to the left in time Δt is, $I(\Delta t) = neAv_d(\Delta t)$

OR Current: $I = neAv_d$ ………………. (1) **1**

Magnitude of drift velocity of electrons is $v_d = \left(\frac{e\tau}{m}\right)E$ ………………. (2) **1**

$e \rightarrow$ magnitude of electron charge. $\tau \rightarrow$ relaxation time.

$E \rightarrow$ electric field. $m \rightarrow$ mass of electron.

Substituting v_d from eq(2) in (1), $I = n\,e\,A\left(\frac{e\tau}{m}\right)E = \left(\frac{n\,e^2\,\tau A}{m}\right)E$

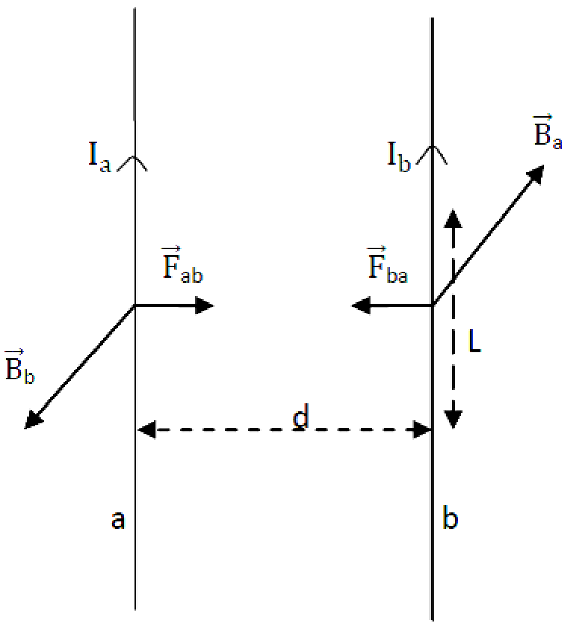
Thus, current density: $j = \frac{I}{A} = \left(\frac{n\,e^2\,\tau}{m}\right)E$ …………….(2) **1**

Also, $j = \sigma E$ ……………………..(3)

Thus, from eq(2) and eq(3), conductivity: $\sigma = \frac{n\,e^2\,\tau}{m}$ **1**

41. **Obtain the expression for the force between two straight long parallel conductors carrying current. Hence define "ampere".**

Ans



Labelled diagram 1
(F_{ab} and B_b are not necessary in the figure)

The magnetic field at the location of 'b' produced by the conductor 'a' is, $B_a = \frac{\mu_0 I_a}{2\pi d}$ ....(1) 1

The magnetic force on a segment L of the conductor 'b' due to 'a' is $F_{ba} = B_a I_b L \sin\theta$ 1

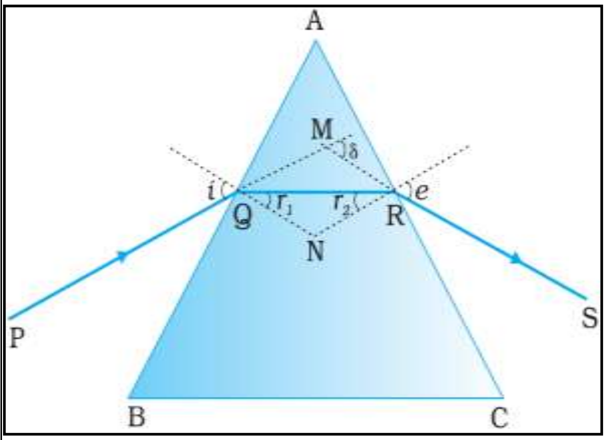
$\theta = 90^o$ and using equn(1), $F_{ba} = \frac{\mu_0 I_a I_b L}{2\pi d}$. 1

This force F_{ba} is towards conductor 'a'.
Similarly, we can find the magnetic force F_{ab} on a segment L of the conductor 'a' due to 'b'.
The force F_{ab} is equal in magnitude to F_{ba}, and directed towards 'b' **OR** $\vec{F}_{ba} = -\vec{F}_{ab}$

Definition of ampere: One ampere is that steady current which, when maintained in each of the **two very long, straight, parallel conductors** of negligible cross-section and placed **one metre apart** in **vacuum (free space/air)**, would produce a **force** of **2×10^{-7} newton per metre** length on each other. 1
(Note: Any other equivalent correct definition with necessary key terms should be considered)

42. **Arrive at the expression for refractive index of the material of the prism in terms of angle of minimum deviation and angle of the prism.**

Ans



Labelled ray diagram. 1
In the quadrilateral AQNR, two of the angles (at the vertices Q and R) are right angles. Therefore, the sum of the other angles of the quadrilateral is 180^o.

$\angle A + \angle QNR = 180^o$

In the ΔQNR,

$r_1 + r_2 + \angle QNR = 180^o$

Comparing the above two equations,

$\mathbf{A = r_1 + r_2}$ ....(1) 1

The total deviation (δ) is the sum of the deviations at the two faces,

$\delta = (i - r_1) + (e - r_2)$; (Using $A = r_1 + r_2$)

$\Rightarrow$ $\mathbf{\delta = i + e - A}$ **.................(2)** 1

At the minimum deviation position, $\delta = D_m$, $i = e$ and $r_1 = r_2$.

Eq(1) becomes $A = 2r_1 \Rightarrow \mathbf{r_1 = A/2}$ and eq(2) becomes $D_m = 2i - A$ or $\mathbf{i = (A + D_m)/2}$. 1

From Snell's law, refractive index: $n_{21} = \frac{n_2}{n_1} = \frac{\sin i}{\sin r_1} = \frac{\sin\left(\frac{A+D_m}{2}\right)}{\sin\left(\frac{A}{2}\right)}$ **OR** $n = \frac{\sin\left(\frac{A+D_m}{2}\right)}{\sin\left(\frac{A}{2}\right)}$ 1

43. **a) What is meant by photo electric effect?** **(1)**

b) Define work function. **(1)**

c) Write the three experimental observations of photo electric effect. **(3)**

Ans

a) The phenomenon of emission of electrons from a metal surface, when **light of suitable frequency (or wavelength or energy)** incident on it, is called as photo-electric effect. **1**

b) Work function: The **minimum energy** required to remove an electron from the metal surface. **1**

OR The **minimum energy** required by an electron to escape from the metal surface.

c) Experimental **observations** of photoelectric effect: **(any three)**

- Photo-electric effect is **instantaneous process.** **1**
- For a given photosensitive material, there exists a certain **minimum cut-off frequency** of the incident light (called threshold frequency), **below which no photoelectron emission** takes place. **1**
- For a given material and radiation above the threshold frequency, **the photo-current is directly proportional to the intensity of incident light.** **1**
- Above the threshold frequency, the **saturation current is proportional to the intensity of incident radiation** whereas the **stopping potential is independent of its intensity**.
- Above the threshold frequency, the **stopping potential** (or the maximum kinetic energy of the emitted photoelectrons) **increases linearly with the frequency** of the incident light.

44. **a) What is rectification?** **(1)**

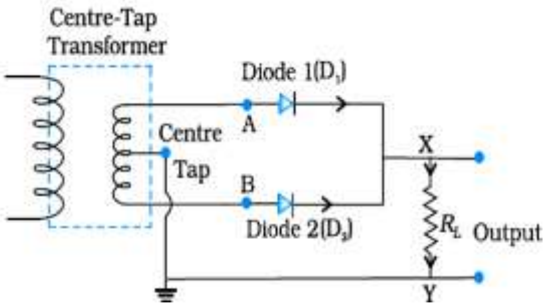
b) Draw the circuit diagram and input-output waveforms of a full wave rectifier. **(2)**

c) Explain the working of a full wave rectifier. **(2)**

Ans

a) The **process of conversion ac into dc** is called rectification. **1**

b) Circuit diagram **1**



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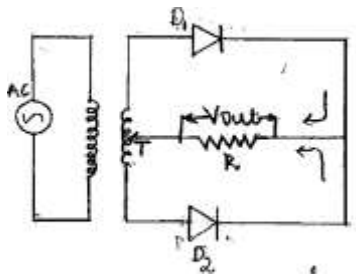
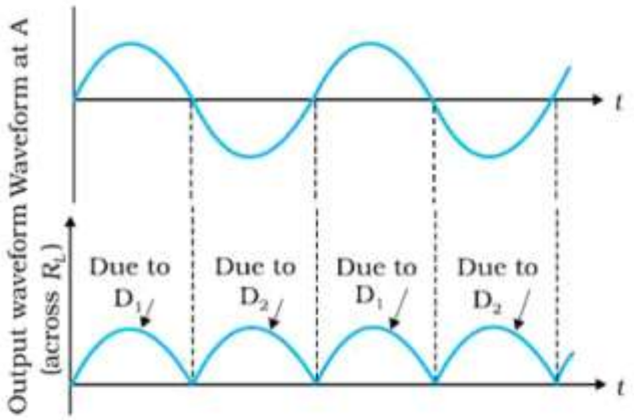


Waveform: **1**



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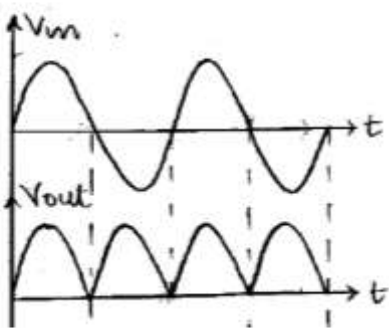

c) During positive half cycle of AC input the diode **D_1 is forward biased** and **conducts**, while D_2 reverse biased, does not conduct. So the output current flows through R_L as shown in the figure. **1**

During negative half cycle of AC input **D_2 is forward biased** and **conducts** while **D_1 is reverse biased**, does not conduct. Again the current flows through R_L as shown in the figure. **1**

Thus there is current flow through R_L over the complete cycle of AC input in the same direction.

VI. Answer any TWO of the following questions: $2 \times 5 = 10$

45. **Charges 2μC, 4μC and 6μC are placed at the three corners A, B and C respectively of a square ABCD of side X metre. Find the charge that must be placed at the fourth corner so that the total potential at the centre of the square is zero.**

Ans

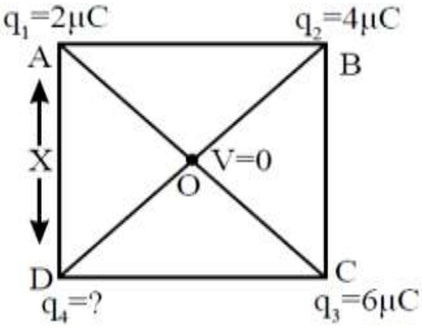

Figure OR Explanation 1

Distance of centre (O) from each corner: AO=BO=CO=DO

Let q_1, q_2, q_3, q_4 be the point charges at four corners A, B, C and D respectively. The total potential at the centre due to the configuration four charges is zero. V = 0

Formula: Electric potential $V = \frac{1}{4\pi\varepsilon_0}\frac{q}{r}$ 1

OR Total potential $V = \frac{1}{4\pi\varepsilon_0}\left(\frac{q_1}{AO}+\frac{q_2}{BO}+\frac{q_3}{CO}+\frac{q_4}{DO}\right)=0$

$\Rightarrow \left(\frac{q_1+q_2+q_3+q_4}{AO}\right)=0$ $\Rightarrow q_1 + q_2 + q_3 + q_4 = 0$ 1

$q_4 = -(q_1+q_2+q_3) = -(2+4+6)\mu C$ 1

$q_4 = -12\mu C$ 1

Thus a charge of '**–12μC**' must be placed at fourth corner D to have zero potential at the centre.

Note: Any other correct detailed method/solution should also be given full marks.

46. **Three resistors 2 Ω, 3 Ω and 6 Ω are combined in parallel. What is the total resistance of the combination? The combination is connected to a battery of emf 2V and negligible internal resistance. Determine the current through each resistor and total current drawn from the battery.**

Ans

Given $R_1 = 2\Omega$, $R_2 = 3\Omega$, $R_3 = 6\Omega$, emf: $\varepsilon = 2$ V, $r \approx 0$, R_P = ?, I_1 = ?, I_2 = ?, I_3 =?, I = ?,

As Internal resistance is negligible, $r \approx 0$ then terminal p.d. : $V \approx \varepsilon = 2$ V

Total (effective) resistance R_P is given by, $\frac{1}{R_P} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} = \frac{1}{2} + \frac{1}{3} + \frac{1}{6}$

Total resistance of the combination: $R_p = 1\ \Omega$ 1

Current through R_1 is $I_1 = \varepsilon / R_1 = 2/2 = 1$ A **OR** $I_1 = V/R_1 = 2/2 = 1$ A 1

Current through R_2 is $I_2 = \varepsilon / R_2 = 2/3$ A **OR** $I_2 = V/R_2 = 2/3$ A 1

Current through R_3 is $I_3 = \varepsilon / R_3 = 2/6 = 1/3$ A **OR** $I_3 = V/R_3 = = 1/3$ A 1

Total current drawn from the battery is I = 1 + 2/3 + 1/3 = 2 A 1

OR Total current drawn from the battery is $I = \frac{\varepsilon}{R_P + r} = \frac{2}{1+0} = 2$ A

47.	**A sinusoidal voltage of peak value 283 V and frequency 50 Hz is applied to a series LCR circuit in which R = 3 Ω, L = 25.48 mH and C = 796 μF.** **Calculate: a) impedance of the circuit** **b) the phase difference between the voltage across the source and the current.**	
Ans	Given, Peak voltage : $v_m = 283V$, R = 3 Ω, L = 25.48 mH, C = 796 μF, Z = ? , ϕ = ? **a)** $X_L = 2\pi\nu L = 2\times3.14\times50\times25.48\times10^{-3} = 8\ \Omega$ $X_C = \frac{1}{2\pi\nu C} = \frac{1}{2\times3.14\times50\times796\times10^{-6}} = 4\ \Omega$ **Impedance:** $Z = \sqrt{R^2+(X_C-X_L)^2}$ $Z = \sqrt{9+(4-8)^2} = \sqrt{9+16} = 5\ \Omega$ **b)** $\tan\phi = \frac{X_C - X_L}{R}$ OR $\phi = \tan^{-1}\left(\frac{X_C - X_L}{R}\right)$ **Phase difference:** $\phi = \tan^{-1}\left(\frac{4-8}{3}\right) = \tan^{-1}\left(\frac{-4}{3}\right) = \tan^{-1}(-1.3333) \approx -53^o$ **Alternatively,** $\cos\phi = \frac{R}{Z} \Rightarrow \phi = \cos^{-1}\left(\frac{R}{Z}\right) = \cos^{-1}\left(\frac{3}{5}\right) \approx 53^o$ **Note:** Full marks should be awarded for taking $Z = \sqrt{R^2+(X_L-X_C)^2}$ & getting Z=5 Ω and also for taking $\phi = \tan^{-1}\left(\frac{X_L - X_C}{R}\right) = \tan^{-1}\left(\frac{4}{3}\right) \approx 53^o$	1 1 1 1 1
48.	**Two narrow slits in Young's double slit experiment are 0.18 mm apart. When they are illuminated by a monochromatic light, fringes of width 2.7 mm are obtained on a screen 0.8m away. Find the wavelength of light used. If the source is replaced by another source of wavelength 450nm, find the change in the fringe width.**	
Ans	Given d = 0.18 mm = 0.18×10^{-3} m, β = 2.7 mm = 2.7×10^{-3} m, D = 0.8 m Fringe width : $\beta = \frac{\lambda D}{d}$ OR $\lambda = \frac{\beta d}{D}$ $\lambda = \frac{2.7\times10^{-3}\times0.18\times10^{-3}}{0.8}$ Wavelength of light: $\lambda = 0.6075\times10^{-6}$m OR 607.5 nm New fringe width : $\beta' = \frac{450\times10^{-9}\times0.8}{0.18\times10^{-3}} = 2000\times10^{-6}m = 2mm$ Change in fringe width: $\Delta\beta = \beta - \beta'$ = 2.7 mm – 2mm = 0.7 mm OR change in fringe width $\Delta\beta = \beta' - \beta$ = 2 mm – 2.7 mm = – 0.7 mm is also considered. If the change in fringe width is calculated directly without β' calculation, then also full marks should be awarded as follows. $\Delta\beta = \frac{(607.5\times10^{-9} - 450\times10^{-9})\times0.8}{0.18\times10^{-3}}$ (1 M) $\Delta\beta = 700\times10^{-6}$m OR 0.7 mm (1 M)	1 1 1 1 1

Note: Any other alternate correct method/answer should be considered.