GOVERNMENT OF KARNATAKA
KARNATAKA SCHOOL EXAMINATION AND ASSESSMENT BOARD
II PUC SUPPLEMENTARY EXAMINATION MAY/JUNE– 2023

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

PART – A

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

1.	**The SI unit of electric field is** **(a) NC (b) NC^{-2} (c) NC^{-1} (d) Vm**	
Ans	(c) NC^{-1}	**1**
2.	**The electric potential due to an electric dipole falls off, at large distances (along axis) as** **(a) $\frac{1}{r}$ (b) $\frac{1}{r^2}$ (c) $\frac{1}{r^3}$ (d) r^2**	
Ans	(b) $\frac{1}{r^2}$	**1**
3.	**The capacitance of a parallel plate capacitor is independent of** **(a) area of plates (b) distances between the plates** **(c) dielectric medium present between the plates (d) potential difference between the plates**	
Ans	(d) potential difference between the plates	**1**
4.	**Potential difference can be measured accurately using** **(a) galvanometer (b)ammeter (c) potentiometer (d) voltmeter**	
Ans	(c) potentiometer	**1**
5.	**The cyclotron frequency is given by the equation** **(a) $\nu_c = \frac{qB}{2\pi m}$ (b) $\nu_c = \frac{qm}{2\pi B}$ (c) $\nu_c = \frac{mB}{2\pi q}$ (d) $\nu_c = \frac{q}{2\pi mB}$**	
Ans	(a) $\nu_c = \frac{qB}{2\pi m}$	**1**
6.	**The magnetic susceptibility of a diamagnetic material is** **(a) small and positive (b) small and negative** **(c) large and positive (d) large and negative**	
Ans	(b) small and negative	**1**
7.	**"The magnitude of the induced emf in a circuit is equal to the time rate of change of magnetic flux through the circuit". This is the statement of** **(a) Lenz's law (b) Faraday's law of electromagnetic induction** **(c) Ampere's circuital law (d) Gauss' law of magnetism**	
Ans	(b) Faraday's law of electromagnetic induction	**1**
8.	**The frequency of alternating current in an AC generator is decided by** **(a) area of the coil (b) number of turns of the coil** **(c) frequency of revolution of the coil (d) strength of magnetic fleld**	

Ans	(c) frequency of revolution of the coil	1
9.	**In case of a pure capacitor connected to an AC source, the phase difference between voltage and current through the circuit is** **(a) 180°** **(b) 90°** **(c) 0°** **(d) 45°**	
Ans	(b) 90°	1
10.	**Electromagnetic waves are produced by** **(a) accelerated charges** **(b) stationary charges** **(c) charges in uniform motion** **(d) a conductor carrying steady current**	
Ans	(a) accelerated charges	1
11.	**A concave mirror produces virtual image when the object is placed** **(a) at its centre of curvature** **(b) beyond its centre of curvature** **(c) between its principal focus and centre of curvature** **(d) within its principal focus**	
Ans	(d) within its principal focus	1
12.	**The bending of light around the corners of a small opaque object is called** **(a) polarisation** **(b) diffraction** **(c) interference** **(d) refraction**	
Ans	(b) diffraction	1
13.	**In photoelectric experiment, increase in the intensity of light ($\nu > \nu_0$)** **(a) increases kinetic energy of photoelectrons** **(b) increases photoelectric current** **(c) decreases kinetic energy of photoelectrons** **(d) photoelectric current remains constant**	
Ans	(b) increases photoelectric current	1
14.	**The nuclides $^{3}_{1}H$ and $^{3}_{2}He$ are** **(a) isotopes** **(b) radioactive** **(c) isotones** **(d) isobars**	
Ans	(d) isobars	1
15.	**The universal logic gate among the following is** **(a) NOT gate** **(b) AND gate** **(c) NAND gate** **(d) OR gate**	
Ans	**(c) NAND gate**	1

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

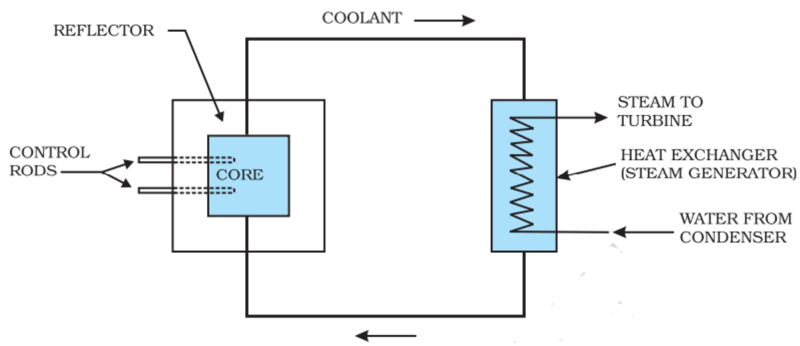
(wavefront, zero, vacuum, hysteresis, beta decay)

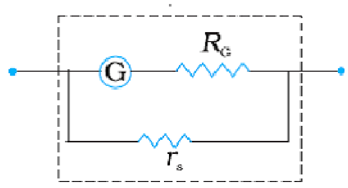
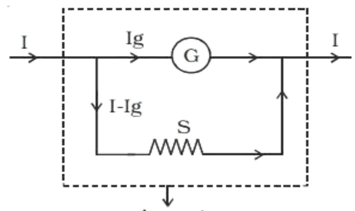
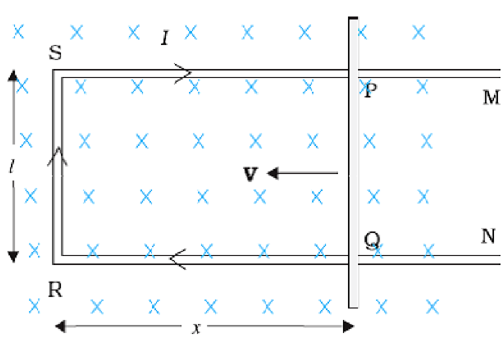
16.	**The electrostatic force between two charges is maximum in ____________.**	
Ans	vacuum	1
17.	**Ferromagnetic materials exhibit the phenomenon of ___________.**	
Ans	hysteresis	1
18.	**___________ is defined as a surface of constant phase.**	
Ans	wavefront	1
19.	**In____________a nucleus spontaneously emits an electron or a positron.**	
Ans	beta decay	1
20.	**Energy gap (E_g) in case of conductors is ____________.**	
Ans	Zero	1

PART – B

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

21.	**Mention any two properties of equipotential surfaces.**	
Ans	i) For any charge configuration, equipotential surface through a point is normal to the electric field at that point. ii) Work done to move a charge on an equipotential surface is zero. iii) The equipotential surfaces corresponding to different potentials will be (a) very close in case of strong field and (b) far apart in case of weak field. iv) Two equipotential surfaces do not intersect **Any 2 properties**	2
22.	**Write the expression for the magnitude of force experienced by a charged particle moving in a magnetic field and explain the terms.**	
Ans	The magnitude of force on a charged particle moving in a magnetic field is **F=** $qvB\sin\theta$ where, q is the charge on the particle, v is the speed of the particle, B is the magnetic field, θ is the angle subtended by velocity vector ($\vec{v}$) with magnetic field vector ($\vec{B}$) **(Explanation of any 2 terms)** **NOTE: Even if $\vec{F} = q(\vec{v}\times\vec{B})$ = $qvB\sin\theta\,\hat{n}$ is written, mark must be awarded.**	1 1
23.	**State and explain Gauss' law in magnetism.**	
Ans	**Statement:** The net magnetic flux through any closed surface placed in magnetic field is zero. **Explanation:** The magnetic field lines always form a closed loop. Therefore the total magnetic flux through the closed surface $\Phi = \sum \vec{B}\cdot\Delta\vec{S} = 0$ **OR** The isolated magnetic poles do not exist. Therefore the total magnetic flux through the closed surface $\Phi = \sum \vec{B}\cdot\Delta\vec{S} = 0$	1 1
24.	**A coil of self inductance 2H is carrying a steady current of 1 A. Calculate the energy stored in the coil.**	
Ans	Energy stored in the coil, U = $\frac{1}{2}LI^2$ $= \frac{1}{2} \times 2 \times 1^2 = 1\,J$	1 1
25.	**What is a transformer? Mention its principle of working.**	
Ans	Transformer is a device used to **increase or decrease alternating voltage** (i.e. to **vary ac**) It works on the principle of **mutual induction**.	1 1
26.	**What are displacement currents and conduction currents?**	
Ans	The current due to **time varying electric field/flux** is called displacement current. **OR** A time varying electric field between the plates of a capacitor produces a current. It is called as displacement current. The current due to flowing charges is called conduction current.	1 1
27.	**Give any two uses of Polaroids.**	
Ans	Polaroids are used i) to produce or analyse plane polarised light,	

	ii) to control the intensity of light in sunglasses, windowpanes, etc. and iii) in photographic cameras and 3D movie cameras. **Any 2 uses**	2
28.	**Name the spectral series of hydrogen atom which lies in (i) visible region and (ii) ultraviolet region.**	
Ans	(i) Visible region : Balmer series (ii) Ultraviolet region : Lyman series	1 1
29.	**Draw the schematic diagram of a nuclear reactor based on thermal nuclear fission and label the parts.**	
Ans	 **Diagram** **Labelling any 2 parts**	1 1
	PART – C **IV. Answer any FIVE of the following questions: 5 × 3 = 15**	
30.	**State and explain Coulomb's law of electrostatics.**	
Ans	**Statement:** The electrostatic force of attraction or repulsion between two stationary point charges is directly proportional to the product of the magnitude of the two charges and inversely proportional to the square of the distance between charges. **Explanation:** If q_1 and q_2 are the two point charges at rest separated by a distance 'r', then by Coulomb's law. $F \alpha \frac{\lvert q_1 q_2 \rvert}{r^2}$ $\Rightarrow F = K \frac{\lvert q_1 q_2 \rvert}{r^2}$ Where, K is proportionality constant and $K = \frac{1}{4\pi\varepsilon_0}$ for air/vacuum in SI system **OR** $F = \frac{1}{4\pi\varepsilon_0} \frac{\lvert q_1 q_2 \rvert}{r^2}$	**1** **1** **1**
31.	**Derive the expression J= σE.**	
Ans	By Ohm's law, V = RI. therefore $V = \left(\frac{\rho L}{A}\right) I$ Because, $R = \rho\left(\frac{L}{A}\right)$. OR $V = \rho L J$ $(\because J = \frac{I}{A}$ is the current density) **OR** $\frac{V}{L} = \rho J \Rightarrow E = \rho J$ (because $\frac{V}{L} = E$)	**1** **1**

	Therefore $J = \frac{E}{\rho} = \sigma E$ where, $\sigma = \frac{1}{\rho}$ is the conductivity of the material of the conductor.	**1**
32.	**Explain the conversion of galvanometer into an ammeter with a circuit diagram.**	
Ans	 Ammeter **OR**  Ammeter A galvanometer can be converted into an ammeter by connecting a **low resistance in parallel** with it. **Circuit diagram** R_G – resistance of galvanometer G. r_s – shunt resistance in parallel with the galvanometer. **OR** The resistance of the arrangement $= \frac{R_G\ r_s}{R_G + r_s}$ **OR** Shunt resistance: $r_s = \frac{I_G\ R_G}{I - I_G}$ **OR** $S = \frac{I_g\ G}{I - I_g}$	1 1 1
33.	**Mention any three properties of magnetic field lines.**	
Ans	i) The magnetic field lines form closed loops. ii) The tangent to the field line at a given point represents the direction of the net magnetic field at that point. iii) The larger the number of field lines crossing per unit area, the stronger is the magnitude of the magnetic field. iv) The magnetic field lines do not intersect. **Any 3 properties**	3
34.	**Derive an expression for motional emf induced in a straight conductor moving perpendicular to a uniform magnetic field.**	
Ans	 **Labelled diagram** (current not necessary in figure) Magnetic flux enclosed by the loop PQRS is $\phi_B = BA\cos 0 = Blx$ Induced emf $\varepsilon = -\frac{d\phi_B}{dt}$ $\varepsilon = -\frac{d}{dt}(B\,l\,x) = -B\,l\frac{dx}{dt} = B\,l\,v$ (because $-dx/dt = v$)	1 1 1
35.	**What is meant by total internal reflection? Mention two uses of optical fibres.**	
Ans	When light travelling from an optically denser medium to a rarer medium incident on the interface at an angle greater than a particular angle (i.e. critical angle) is completely reflected back into the same medium. This phenomenon is called the total internal reflection. <u>**Uses of optical fibres**</u> 1) Optical fibres are used in **communication** for the transmission of signals. 2) Optical fibres are used in **endoscopy**. 3) Plastic optical fibres are used in **decorative lamps**. **Any 2 uses**	1 2

36. **Show that the total energy of an electron revolving in hydrogen atom is given by, $E=-\dfrac{e^2}{8\pi\varepsilon_0 r}$**

Ans +Ze is the charge of the nucleus of hydrogen atom, r is the radius of the circular orbit of an electron, v is the orbital velocity of the electron.

For stable orbit, centripetal force = electrostatic force

$$\frac{mv^2}{r}=\frac{1}{4\pi\varepsilon_0}\frac{e\times e}{r^2}. \qquad \text{(For H atom Z = 1)}$$

Where, m is the mass of electron, e - charge of an electron

$$mv^2=\frac{e^2}{4\pi\varepsilon_0 r} \quad \textbf{or} \quad v^2=\frac{e^2}{4\pi m\varepsilon_0 r}$$

$$\therefore\ KE=\frac{1}{2}mv^2=\frac{1}{2}m\frac{e^2}{4\pi m\varepsilon_0 r}=\frac{e^2}{8\pi\varepsilon_0 r} \qquad \text{--- (1)}$$ 1

$$P.E=\frac{1}{4\pi\varepsilon_0}\frac{e(-e)}{r}=-\frac{e^2}{4\pi\varepsilon_0 r} \qquad \text{--- (2)}$$ 1

The total energy of an electron is the sum of potential energy and kinetic energy. 1

$$\therefore\ \text{Total energy, TE = KE + PE}=\frac{e^2}{8\pi\varepsilon_0 r}-\frac{e^2}{4\pi\varepsilon_0 r}=\frac{e^2}{4\pi\varepsilon_0 r}\left[\frac{1}{2}-1\right]=-\frac{e^2}{8\pi\varepsilon_0 r}.$$

37. **The half-life of a radioactive sample is 4.5 x 10^5 years. Calculate (i) the radioactive decay constant and (ii) mean life of the sample.**

Ans T = 4.5 x 10^5 yrs = 4.5 x 10^5 x 365 x 24 x 60 x 60 = 1.42 x 10^{13} s

Radioactive decay constant, $\lambda=\dfrac{0.693}{T_{1/2}}$ 1

$$\lambda=\frac{0.693}{1.42\text{x}10^{13}}=4.88\text{ x }10^{-14}s^{-1} \quad \text{OR} \quad \lambda=\frac{0.693}{4.5\text{ x }10^5}=1.54\text{ x }10^{-6}\text{ year}^{-1}$$ 1

Mean life, $\tau=\dfrac{1}{\lambda}=\dfrac{1}{4.88\text{ x }10^{-14}}=2.05\text{ x }10^{13}s$ OR $\tau=\dfrac{1}{\lambda}=\dfrac{1}{1.54\text{ x }10^{-6}}=6.49\text{x }10^5\ year$ 1

38. **Mention any three differences between intrinsic and extrinsic semiconductors.**

Ans

Intrinsic semiconductors	Extrinsic semiconductors
i) It is a pure semiconductor	i) It is an impure semiconductor
ii) Number of holes and electrons will be equal	ii) Number of holes and electrons will be unequal
iii) Conductivity is zero at very low temperatures.	iii) Conductivity is not zero even at low temperatures.
iv) Conductivity depends only on temperature	iv) Conductivity depends on temperature and doping concentration.
v) Conductivity is relatively less	v) Conductivity is relatively more.

Any three differences 3

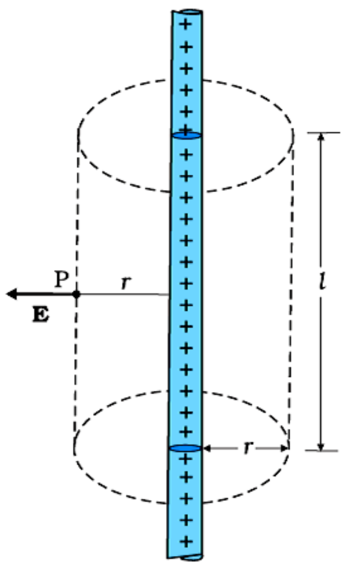
PART – D

V. Answer any THREE of the following questions: 3 × 5 = 15

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

Ans **Diagram with direction of electric field or field lines** 1

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



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

The **surface area** of the curved part is $\mathbf{2\pi r}\boldsymbol{l}$.

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 = $E \times 2\pi r l$ .... **(1)** 1

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

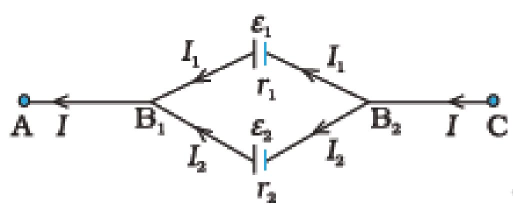
The enclosed by Gaussian surface: $q = \lambda l$ then $\phi = \dfrac{\lambda l}{\varepsilon_0}$ …… **(2)** 1

From equn(1) and (2) , $E \times 2\pi r l = \dfrac{\lambda l}{\varepsilon_0}$

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

40. Derive an expression for the effective emf and effective internal resistance of two cells connected in parallel.

Ans Let us consider the parallel combination of two cells with positive terminals connected to B_1 and negative terminals connected B_2. E_1, E_2 are the emf's of the two cells and r_1, r_2 their internal resistances, respectively. I_1 and I_2 are the currents leaving the positive electrodes of the cells. 1



Since as much charge flows in as out, we have $I = I_1 + I_2$

Let $V(B_1)$ and $V(B_2)$ be the potentials at B_1 and B_2, respectively.

Then, considering the first cell, the potential difference across its terminals is

$V = V(B_1) - V(B_2) = E_1 - I_1 r_1 \Rightarrow I_1 = \dfrac{E_1 - V}{r_1}$

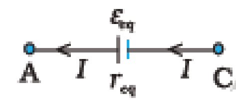
Similarly for the second cell, the potential difference across its terminals is 1

$V = V(B_1) - V(B_2) = E_2 - I_2 r_2 \Rightarrow I_2 = \dfrac{E_2 - V}{r_2}$

Therefore, $I = \dfrac{E_1 - V}{r_1} + \dfrac{E_2 - V}{r_2} = \dfrac{E_1}{r_1} + \dfrac{E_2}{r_2} - V\left(\dfrac{1}{r_1} + \dfrac{1}{r_2}\right)$ 1

$\Rightarrow V = \left(\dfrac{E_1 r_2 + E_2 r_1}{r_1 + r_2}\right) - I\left(\dfrac{r_1 r_2}{r_1 + r_2}\right)$ ……(1)

If the combination of cells is replaced by a single cell of emf E_{eq} and internal resistance r_{eq}, then $V = E_{eq} - I\,r_{eq}$ ....(2) ≡ **1**



From equations (1) and (2), $\mathbf{E_{eq}} = \dfrac{E_1 r_2 + E_2 r_1}{r_1 + r_2}$ and $\mathbf{r_{eq}} = \dfrac{r_1 r_2}{r_1 + r_2}$ **1**

41. **Derive an expression for magnetic dipole moment of an electron revolving in hydrogen atom.**

Ans According to Bohr model of hydrogen and hydrogen like atoms, the negatively charged electron revolves round the nucleus of charge +Ze. Let 'r' be the radius of the orbit, 'v' be the constant speed with which electron is revolving and 'T' be the period of revolution of the electron.

The current associated with revolving electron, $I = \dfrac{e}{T}$ --- (1) **1**

The period of revolution of the electron is given by $T = \dfrac{2\pi r}{v}$ ---(2) **1**

$\therefore I = \dfrac{ev}{2\pi r}$ ---(3) **1**

The magnetic moment associated with the orbital motion which is equivalent to a current loop is given by $\mu_l = I\,A$ **1**

$= \dfrac{ev}{2\pi r} \times \pi r^2 = \dfrac{evr}{2}$ --- (4) **1**

(The derivation of expression for magnetic moment in terms of angular momentum considering following steps not compulsory)

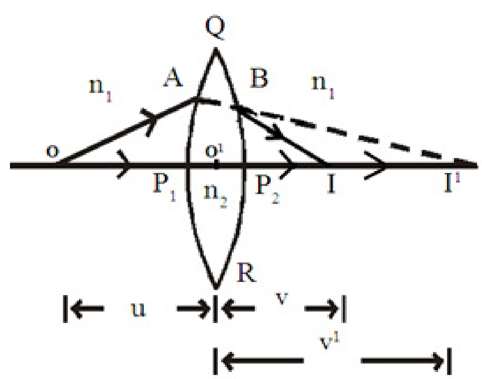
The magnitude of angular momentum of revolving electron is given by

$l = m_e v r$ **or** $vr = \dfrac{l}{m_e}$ --- (5) Where, m_e → mass of the electron

$\therefore \mu_l = \dfrac{el}{2m_e}$ --- (6)

42. **Derive Lens Maker's formula.**

Ans O be a point object placed on the principal axis of a thin convex lens of focal length 'f '. n_1 be the RI of the medium in which object is present and n_2 be the RI of the material of the lens. **1**



(i) **For the refraction at the surface QP_1R of radius of curvature R_1**

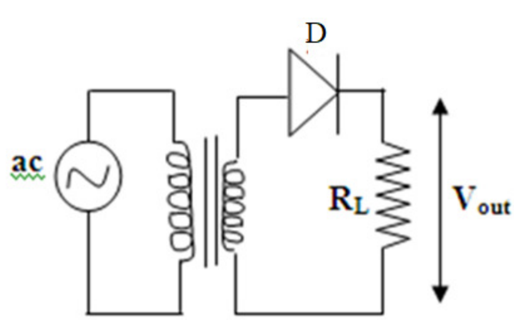
At I^1 a real image is formed in the medium of RI n_2.

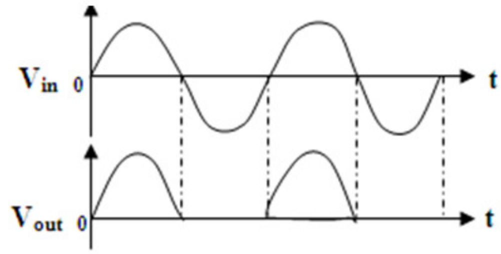
For this refraction $\dfrac{n_1}{-u} + \dfrac{n_2}{v^1} = \dfrac{(n_2 - n_1)}{R_1}$ ....(1) **1**

(ii) **For the refraction at the surface $Q\,P_2\,R$ of radius of curvature R_2**

The final image is formed at I and I^1 acts as virtual object.

For this refraction $\dfrac{n_2}{-v^1} + \dfrac{n_1}{v} = \dfrac{(n_2 - n_1)}{-R_2}$ ....(2) **1**

	Equation (1) + (2) gives, $\frac{n_1}{-u} + \frac{n_1}{v} = \frac{(n_2 - n_1)}{R_1} - \frac{(n_2 - n_1)}{R_2}$	1
	⇨ $n_1\left(\frac{1}{-u} + \frac{1}{v}\right) = (n_2 - n_1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$ ➔ $\left(\frac{1}{-u} + \frac{1}{v}\right) = (\frac{n_2}{n_1} - 1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$	
	If u = ∞ then v = f. Therefore $\left(\frac{1}{-\infty} + \frac{1}{f}\right) = (\frac{n_2}{n_1} - 1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$	
	$\frac{1}{f} = \left(\frac{n_2}{n_1} - 1\right)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$ **OR** $\frac{1}{f} = (n_{21} - 1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$ This is lens maker's formula.	1
43.	**(i) Give Einstein's explanation of photoelectric effect. (3)** **(ii) Mention any two properties of photons. (2)**	
Ans	(i) Albert Einstein proposed a new picture of electromagnetic radiation to explain photoelectric effect. According to him, photoelectric emission does not take place by continuous absorption of energy from radiation. Radiation energy consists of discrete units called quanta of energy of radiation. Each quantum of radiant energy or photon has energy hν, where h is Planck's constant and ν the frequency of light.	1 1
	In photoelectric effect, an electron absorbs a photon of energy (hν) of radiation. If the energy absorbed exceeds the minimum energy needed for the electron to escape from the metal surface (i.e. work function φ_0), the electron is emitted with maximum kinetic energy (K_{max}).	1
	(ii) <u>Properties of photons</u> (a) In interaction of radiation with matter, radiation behaves as if it is made up of particles called photons. (b) Each photon has energy E = hν where ν is the frequency, momentum p = hν/c where *c is* the speed of light. (c) All photons of light of a particular frequency (ν), or wavelength (λ), have the same energy and momentum. The photon energy is independent of intensity of radiation. (d) Photons are electrically neutral and are not deflected by electric and magnetic fields. (e) In a photon-particle collision (such as photon-electron collision), the total energy and total momentum are conserved. However, the number of photons may not be conserved in a collision. **Any 2 properties**	2
44.	**(i) What is a rectifier? (1)** **(ii) Draw the circuit diagram and input-output waveforms of a half wave rectifier. (2)** **(iii) Explain the working of a half wave rectifier. (2)**	
Ans	The device which converts ac into dc is called a rectifier.	1
	 	1



1

During +ve half cycle of AC input the diode (D) is forward biased and hence it conducts. 1

But during the –ve half cycle of AC input, the diode is reverse biased and hence it does not conduct. 1

So the current flows through the load only during one half cycle of AC input. Hence the name half wave rectifier. The current flowing through the R_L is a rectified output in the form of pulsating D.C.

VI. Answer any TWO of the following questions: 2 × 5 = 10

45. **Two capacitors of capacitances 3µF and 7µF are connected in series and the combination is connected to a source of emf 10V. Calculate the effective capacitance of the combination. Also find the potential difference across each capacitor.**

Ans

To find C_S: Effective capacitance of series combination, $C_S = \frac{C_1 C_2}{C_1 + C_2}$ 1

$$= \frac{3 \times 10^{-6} \times 7 \times 10^{-6}}{(3 \times 10^{-6}) + (7 \times 10^{-6})} = 2.1\,\mu F$$ 1

To find V_1 and V_2: Charge stored in the combination, $Q = C_S V = 2.1 \times 10^{-6} \times 10 = 21 \times 10^{-6}$ C 1

Potential difference across 1st capacitor, $V_1 = \frac{Q}{C_1} = \frac{21 \times 10^{-6}}{3 \times 10^{-6}} = 7V$ 1

Potential difference across 2nd capacitor, $V_2 = \frac{Q}{C_2} = \frac{21 \times 10^{-6}}{7 \times 10^{-6}} = 3V$ 1

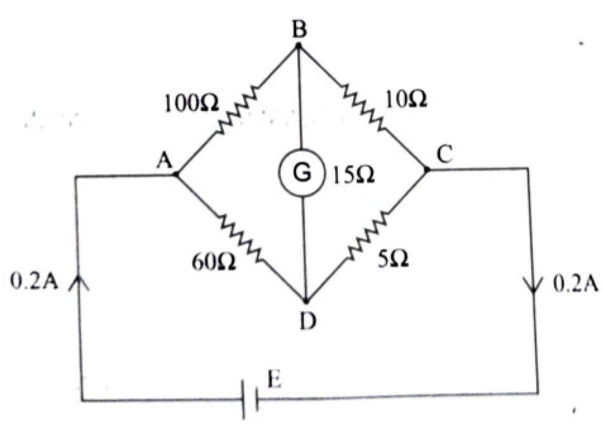
Alternate method to find V_1 and V_2

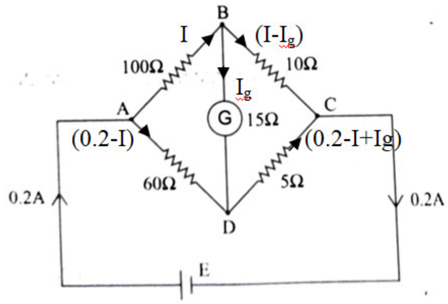
In series combination $V_1 : V_2 = C_2 : C_1 = 7 : 3$

$$V_1 = \frac{7}{10} \times 10 = 7\text{ V}$$

$$V_2 = \frac{3}{10} \times 10 = 3\text{ V}$$

46. **Calculate the current through the galvanometer in the following network.**



Ans	 Applying junction rule and representing branch currents	1
	From loop rule: For the loop ABDA $-100\,I - 15\,I_g + 60\,(0.2 - I) = 0$ ....(1) For the loop BCDB $-10\,(I - I_g) + 5\,(0.2 - I + I_g) + 15\,I_g = 0$ ......(2) Simplifying (1) and (2) to get $-160\,I - 15\,I_g = -12$ ....(3) $-15\,I + 30\,I_g = -1$ ....(4) Solving (3) and (4) to get $I_g = 3.98 \times 10^{-3}$ A	1 1 1 1
47.	**A series LCR circuit containing an inductor of 1.5 H, a capacitor of 35μF and a resistor of 50Ω is connected to ac source of 200V and 50Hz. Calculate (i) the impedance and (ii) power factor of the circuit.**	
Ans	**a)** $X_L = 2\pi\nu\,C = 2 \times 3.14 \times 50 \times 1.5 = 471\,\Omega$ $X_C = \dfrac{1}{2\pi\nu\,C} = \dfrac{1}{2 \times 3.14 \times 50 \times 35 \times 10^{-6}} = 90.99\,\Omega \approx 91\,\Omega$ **Impedance:** $Z = \sqrt{R^2 + (X_L - X_C)^2}$ $= \sqrt{50^2 + (471 - 91)^2} = 383.27\,\Omega \approx 383\,\Omega$ **Power factor,** $\cos\phi = \dfrac{R}{Z} = \dfrac{50}{383.27} = \mathbf{0.13}$	**1** **1** **1** **1** **1**
48.	**In a Young's double slit experiment, the slits are separated by 0.28 mm and the screen is placed 1.4 m away. The distance between the central bright fringe and the fourth bright fringe is measured to be 1.2 cm. Determine the wavelength of light used. Also find the distance of fifth dark fringe from the central bright fringe.**	
Ans	i) Distance of n^{th} bright fringe, $(x_n)_B = \dfrac{n\lambda D}{d}$ $\Rightarrow \lambda = \dfrac{(x_n)_B d}{nD} = \dfrac{1.2 \times 10^{-2} \times 0.28 \times 10^{-3}}{4 \times 1.4} = 0.6 \times 10^{-5}\,\text{m} = 6000 \times 10^{-10}\,m$ ii) Distance of n^{th} dark fringe, $(x_n)_D = \dfrac{(2n-1)\lambda D}{2d}$ Distance of 5^{th} dark fringe, $(x_5)_D = \dfrac{(2 \times 5 - 1) \times 6000 \times 10^{-10} \times 1.4}{2 \times 0.28 \times 10^{-3}}$ $= \dfrac{9 \times 6000 \times 10^{-10} \times 1.4}{2 \times 0.28 \times 10^{-3}} = 13.5 \times 10^{-3}$ m **OR** If the formula $(x_n)_D = \dfrac{(2n+1)\lambda D}{2d}$ is used, then for 5^{th} dark fringe n=4	**1** **1** **1** **1** **1**

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