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MARKING SCHEME: PHYSICS (042)
Session: 2025–26

Code: 55/3/3

Q No.	VALUE POINTS/EXPECTED ANSWERS	Marks	Total Marks
	SECTION A		
1.	(A) $2.0 \times 10^8\ ms^{-1}$	1	1
2.	(B) Same frequency	1	1
3.	(C) 100 Ω	1	1
4.	(B) $4\ B_0L^2$	1	1
5.	(B) 1.27×10^{-24} J	1	1
6.	(B) $\frac{-R}{\mu-1}$	1	1
7.	(B) Curve 3 correspondence to forward biasing and Curve 1 corresponds to reverse biasing.	1	1
8.	(B) $\frac{4}{3}$	1	1
9.	(C) Total internal reflection occurs for both green and blue lights.	1	1
10.	(D) $\frac{1}{3}$	1	1
11.	(D) 2.0 eV	1	1
12.	(A) 2nπ	1	1
13.	(D) Both Assertion (A) and Reason (R) are false.	1	1
14.	(B) Both Assertion (A) and Reason (R) are true but Reason (R) is **not** the correct explanation of the Assertion (A).	1	1
15.	(A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A).	1	1
16.	(D) Both Assertion (A) and Reason (R) are false.	1	1
	SECTION B		
17.	Two points of difference between intrinsic and extrinsic semiconductors. 2	1+1	2

Intrinsic Semiconductor	Extrinsic Semiconductor
1. Pure Semiconductor	1. Doped with impurity atoms
2.Low electrical conductivity	2.High electrical conductivity
3.Number of free electrons is equal to number of holes	3.Number of free electrons is not equal to number of holes
4.Conductivity depends on temperature only.	4.Conductivity depends on temperature and concentration of doping.

(Any two)

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18.	Explanation Mass defect ΔM ½ Binding energy (E) ½ Relation between ΔM and E 1 The difference in mass of a nucleus and its constituents is called mass defect. If a certain number of neutrons and protons are brought together to form a nucleus of a certain mass and charge, the energy released is called binding energy. $E_b = \Delta Mc^2$ $= [[Zm_p + (A-Z)m_n] - M]c^2$	½ ½ ½ ½	2
19.	Calculating threshold frequency 2 $K.E = hv - hv_0$ $v_0 = \frac{hv - K.E}{h}$ $= \frac{(6.63 \times 10^{-34} \times 5 \times 10^{14}) - \left(\frac{1}{2} \times 9.1 \times 10^{-31}\right) \times (6.63)^2 \times 10^{10})}{6.63 \times 10^{-34}}$ $= \frac{(5 \times 10^{-20}) - (3 \times 10^{-20})}{10^{-34}}$ $= 2 \times 10^{14}$ Hz	½ ½ ½ ½	2
20.	(a) Finding potential difference between points B and C. 2 $I = \frac{\varepsilon_{net}}{R_{net}}$ $= \frac{2}{4}$ $= 0.5$ A $V_{BC=} - \varepsilon_2 - Ir_2$ $= -4 - (0.5 \times 3)$ $= -5.5$ V **OR** (b) Finding i) Resistance of the resistor 1 ii) Terminal voltage of the battery 1 i) $IR = \varepsilon - Ir$ $R = \frac{21 - (3 \times 3)}{3}$ $= 4\Omega$	½ ½ ½ ½ ½ ½	

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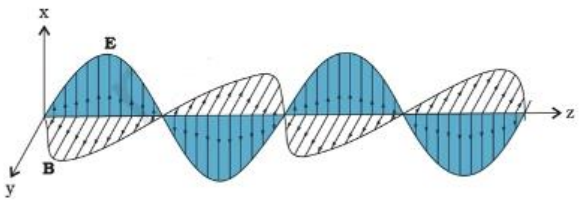
	ii) V = IR = 3 × 4 = 12 V	½ ½	2
21.	Effect on central maximum with justification when (a) Light waves have initial phase of π radian 1 (b) One of the slits is closed 1 (a) The central maximum will be shifted by π radian / Centre will become dark. The condition for constructive interference is Phase difference between two waves = 2nπ For initial phase difference π radian, Phase difference = $2n\pi \pm \pi$ $= (2n \pm 1)\pi$ For central maximum, n = 0 Hence, phase difference = $\pm\pi$ radian **(Alternatively)** The path difference between interfering waves will become λ/2. (b) Interference pattern disappears/uniform illumination will be observed. Two coherent sources are required for interference to take place.	½ ½ ½ ½	2
	SECTION C		
22.	(a) Depicting the variation of electric and magnetic field 1 Writing two important characteristics ½ + ½ (b) Showing $\frac{1}{\sqrt{\varepsilon_0 \mu_0}}$ gives velocity of Electromagnetic wave in free space 1 (a)  Characteristics of Electromagnetic wave. (i) Electric and magnetic fields are perpendicular to each other. (ii) Speed of Electromagnetic wave in free space or vacuum is equal to 3×10^8 ms^{-1}. (iii) Electric and magnetic fields are in same phase. (iv) Electromagnetic waves are transverse in nature. (v) Electromagnetic waves can travel in vacuum. **(any two)**	1 ½ +½	

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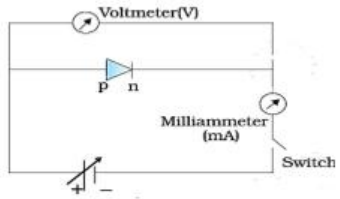
	(b) $\frac{1}{\sqrt{\mu_0 \varepsilon_0}}$ $= \frac{1}{\sqrt{4\pi \times 10^{-7} \times \frac{1}{4\pi \times 9 \times 10^9}}}$ $= \sqrt{9 \times 10^{16}}$ $= 3 \times 10^8$ m/s = Velocity of electromagnetic wave in free space.	½ ½	3
23.	Finding (a) Angle of minimum deviation of prism 1½ (b) Refractive index of the material of the prism 1½ (a) As ray of light passes symmetrically through the prism $\angle r_1 = \angle r_2 = r$, $i = e$ $\delta_m = 2i - A$ $= 2 \times 45° - 60°$ $= 30°$ (b) $r = \frac{A}{2} = 30°$ $\mu = \sin \frac{(\frac{A+\delta_m}{2})}{\sin\frac{A}{2}}$ $= \sin \frac{(\frac{60° + 30°}{2})}{\sin 30°}$ $= \frac{\sin 45°}{\sin 30°}$ $= \sqrt{2}$ **(Alternatively)** $\mu_a \sin i = \mu_g \sin r$ $1 \times \sin 45° = \mu_g \times \sin 30°$ $\mu_g = \sqrt{2}$	½ ½ ½ ½ ½ ½	3
24.	Explanation of Forward biasing 1½ Explanation of Reverse biasing 1½ **Forward biasing**  The p-side of the diode is connected to positive terminal and the n-side is connected to the negative terminal of the battery.	1 ½	

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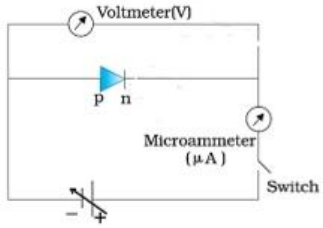
	Reverse biasing  The p-side of the diode is connected to negative terminal and n-side is connected to the positive terminal of the battery.	1 ½	3
25.	(a) Establishing the relation between drift velocity and electric current 2 (b) Effect on drift velocity when length of conductor is doubled. 1 (a) For 'n' number of free electrons per unit volume in a conductor of cross section area A, the total charge transported across the area in time Δt $Q = -ne A v_d \Delta t$ As electrons move in a direction opposite to that of electric field $I \Delta t = ne A v_d \Delta t$ $I = Anev_d$ (b) $v_d = \frac{eV\tau}{ml}$ Length is doubled, drift velocity is halved.	1 ½ ½ ½ ½	3
26.	(a) Calculating the magnitude of external torque 2 Effect on torque if circular coil is replaced by planar coil 1 $\tau = NIBA \sin\theta$ $= 30 \times 6 \times 1 \times 3.14 \times (8 \times 10^{-2})^2 \times \sin 60^\circ$ $= 90 \times 64 \times 3.14 \times 1.73 \times 10^{-4}$ $= 3.13$ Nm Torque will remain the same. **OR** (b) Finding the radius of circular path 2 Mentioning condition for which the particle i) describes helical path ½ ii) goes straight un-deviated ½ $K.E = \frac{q^2B^2r^2}{2m}$ $r = \frac{\sqrt{2 \times K.E. \times m}}{qB}$	½ ½ ½ ½ 1 ½	

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	$= \frac{\sqrt{2 \times 8 \times 1.6 \times 10^{-19} \times 10^{6} \times 6.4 \times 10^{-27}}}{3.2 \times 10^{-19} \times 0.5}$ $= \frac{12.8 \times 10^{-20}}{1.6 \times 10^{-19}}$ $= 8 \times 10^{-1}$m = 80 cm (i) Particle enters the magnetic field at angle $0^o < \theta < 90^o$ **(Alternatively)** If a component of velocity is parallel or antiparallel to the magnetic field and another component is perpendicular to the magnetic field. (ii) Particle moves parallel or antiparallel to the magnetic field.	½ ½ ½ ½ ½	3
27.	Statement of Faraday's Law 1 Two methods of producing induced emf 1+1 The magnitude of the induced emf in a circuit is equal to the time rate of change of magnetic flux through the circuit. Magnetic flux = ϕ = BA $\cos\theta$ $\varepsilon = \frac{-d\phi}{dt}$ Methods of producing induced emf: i) By changing magnetic field with time. ii) By changing area of the coil with time in the magnetic field. iii) By changing the angle between magnetic field and normal to the coil with time i.e by rotating the coil in the magnetic field. **(Any two)**	1 1 1+1	3
28.	Finding ratio of distance of closest approach (a) For same velocity 1½ (b) For same momentum 1½ $\frac{1}{2}mv^2 = \frac{kq_1q_2}{d}$ (a) $d \propto \frac{q}{m}$ (for same velocity) $\frac{d_{deutron}}{d_\alpha} = \frac{q_{deutron}}{q_\alpha} \times \frac{m_\alpha}{m_{deutron}}$ $= \frac{e}{2e} \times \frac{4m}{2m}$ $= 1$ $= d_{deutron} : d_\alpha = 1:1$	 ½ ½ ½	

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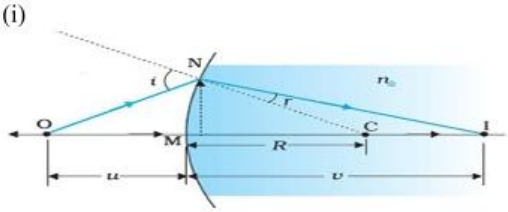
	(b) $\frac{p^2}{2m} = \frac{kq_1q_2}{d}$ $d \propto q\,m$ (for same momemtum) $\frac{d_{deutron}}{d_\alpha} = \frac{q_{deutron} \times m_{deutron}}{q_\alpha \times m_\alpha}$ $= \frac{e \times 2m}{2e \times 4m}$ $= \frac{1}{4}$ $d_{deutron} : d_\alpha = 1 : 4$	½ ½ ½	3
	SECTION D		
29.	(i) (D) 2μF (ii) (C) 0.2 A (iii) (A) 2V (iv) (a) (B) 4μC **OR** (b) (C) remain the same	1 1 1 1	4
30.	(i) (A) $\frac{1}{2}$ (ii) (D) 2 (iii) (D) Particle 1 revolves anticlockwise while particle 2 revolves clockwise (iv) (a) (A) 1s **OR** (b) (B) $p_1 = p_2$	1 1 1 1	4
	SECTION E		
31.	(a) (i) Drawing ray diagram 1 Deriving relation between u, v, n and R 2 (ii) Finding position and nature of image 1½ + ½ (i)  For small angles $\tan\angle NOM = \frac{MN}{MO}$ $\tan\angle NCM = \frac{MN}{MC}$ $\tan\angle NIM = \frac{MN}{MI}$ $i = \angle NOM + \angle NCM$	1	

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$= \frac{MN}{MO} + \frac{MN}{OC}$ ----------(1) ½

Similarly

$r = \angle NCM - \angle NIM$

$= \frac{MN}{MC} - \frac{MN}{MI}$ ----------(2) ½

By Snell's law for small angles

$1 \times i = n \times r$

substituting i and r from (1) and (2)

$\frac{1}{M0} + \frac{n}{MI} = \frac{n-1}{MC}$ ----------(3) ½

Using cartesian sign conventions

MO = -u, MI = +v, MC = +R

Substituting in (3)

$$\frac{n}{v} - \frac{1}{u} = \frac{n-1}{R}$$ ½

(Note : Give full credit of this part if student derives the relation by forming virtual image.)

(ii) $\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$ ½

$\frac{1}{20} = \frac{1}{v} - \frac{1}{-30}$ ½

v = 60 cm ½

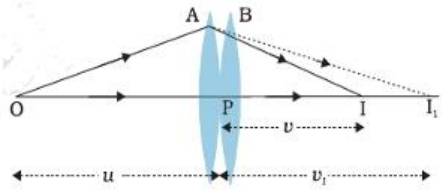
Nature of image: Real and inverted ½

OR

(b)

(i) Deriving expression for focal length of combination of lens		2
(ii) Calculating		
(I)	Fringe width	1
(II)	Distance of second dark fringe from central maximum	1
(III)	Effect on immersion in water	1

(i)



½

For image formed by first lens A

$$\frac{1}{v_1} - \frac{1}{u} = \frac{1}{f_1}$$ ½

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	For image formed by second lens B $\frac{1}{v} - \frac{1}{v_1} = \frac{1}{f_2}$ Adding and comparing with lens formula $\frac{1}{f} = \frac{1}{f_1} + \frac{1}{f_2}$ (ii) (I) $\beta = \frac{\lambda D}{d}$ $= \frac{550 \times 10^{-9} \times 2.2}{1.1 \times 10^{-3}}$ $= 1.1$ mm (II) $x = \frac{(2n-1)\lambda D}{2d}$ $n = 2$ $x = 1.65$ mm (III) Fringe width decreases. **(Alternatively)** $\beta' = \frac{\beta}{n}$	½ ½ ½ ½ ½ ½ 1	5
32.	(a) (i) (I) Identifying nature of two charges ½ + ½ (II) Finding value of $\left(\frac{Q_1}{Q_2}\right)$ 1 Justification 1 (ii) Finding electrostatic potential energy 2 (i) (I) Q_1 - Positive Q_2 – Negative (II) $\frac{Q_1}{Q_2} = \frac{\text{Slope of A}}{\text{Slope of B}}$ $= \frac{\tan 60°}{\tan 30°}$ $= \frac{3}{1}$ **(ii)** $V(r) = -\int E\,dx = -\int \frac{A}{x^2}\,dx$ $= \frac{A}{x}$ $U = q_1 V(x_1) + q_2 V(x_2) + \frac{q_1 q_2}{4\pi\epsilon_0 x_{12}}$ $= q_1 \frac{A}{x_1} + q_2 \frac{A}{x_2} + \frac{q_1 q_2}{4\pi\epsilon_0 x_{12}}$ $= \frac{-2 \times 10^{-6} \times 9 \times 10^5}{30 \times 10^{-2}} + \frac{5 \times 10^{-6} \times 9 \times 10^5}{30 \times 10^{-2}} - \frac{5 \times 2 \times 10^{-12} \times 9 \times 10^9}{60 \times 10^{-2}}$	½ ½ 1 1 ½ ½ ½	

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	= (-6 + 15 – 0.15) J = 8.85 J	½	HOME
	OR		
	(b)		
	(i) Finding nature of force ½ Finding magnitude of force/length 1½ (ii) Finding (I) electric flux through Gaussian surfaces ½ + ½ (II) electric field at points ½ + ½ (III) surface charge density on inner surfaces ½ + ½		
	(i) Nature of force: Attractive $dq = \lambda dl$ Electric field on wire 2 due to wire 1, E = $\frac{-\lambda}{2\pi\varepsilon_0 r}$ Force on wire 2 = qE $\frac{Force}{length} = \frac{F_1}{l} = \frac{-\lambda \times 3\lambda}{2\pi\varepsilon_0 r}$ $= \frac{-3\lambda^2}{2\pi\varepsilon_0 r}$ Similarly, $\frac{F_2}{l} = \frac{-3\lambda^2}{2\pi\varepsilon_0 r}$	½ ½ ½ ½	HOME
	(ii) (I) (1) $x < r_1$ $\phi = \frac{2q}{\varepsilon_0}$ (2) $r_1 < x < r_2$ $\phi = \frac{(Q+2q)}{\varepsilon_0}$ (II) (1) $x > r_3$ $E = \frac{k(Q-q)}{x^2}$ (2) $r_1 < x < r_2$ $E = \frac{k(Q+2q)}{x^2}$ (III) (1) $\sigma = \frac{-2q}{4\pi r_1^2}$ (2) $\sigma = \frac{-(Q+2q)}{4\pi r_2^2}$	½ ½ ½ ½ ½ ½	5

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33. (a)

(i) Effect on glow of bulb when	
(I) Iron bar in inserted	½
Justification	½
(II) Frequency of source is decreased	½
Justification	½
(ii) Calculating	
(I) Impedance of the circuit	1
(II) rms value of current	1
(III) Power Factor	1

(i) (I) Brightness of the bulb decreases ½

As iron bar is inserted, inductive reactance of the coil increases. Larger fraction of applied AC voltage appears across inductor, leaving less voltage across the bulb. ½

(Alternatively)

$L' = \mu_r L$, L increases, $X_L = \omega L$ increases, current decreases.

(II) Brightness of the bulb increases. ½

As frequency of the source decreases, inductive reactance of coil decreases. Less fraction of applied AC voltage appears across inductor. Hence higher voltage appears across the bulb. ½

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(Alternatively)

$X_L = \omega L$, ω decreases, X_L decreases, current increases.

(ii) $V = 280 \sin(100\pi t)$

$X_L = 100\pi \times \frac{5}{\pi} = 500\,\Omega$

$X_c = \frac{10^6}{100\pi \times \frac{50}{\pi}} = 200\,\Omega$

(I) $Z = \sqrt{R^2 + (X_L - X_C)^2}$ ½

$= \sqrt{(400)^2 + (300)^2}$

$= 500\,\Omega$ ½

(II) $I_{rms} = \left(\frac{V_0}{Z\sqrt{2}}\right) = \frac{280}{500 \times 1.4}$ ½

$= 0.4$ A ½

(III) Power factor $= \cos\phi = R/Z$ ½

$= 400/500$

$= 0.8$ ½

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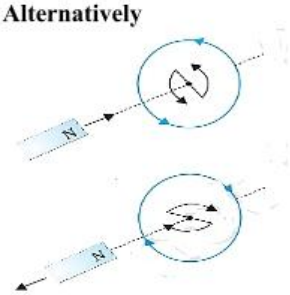
(b)

(i)	Statement of Lenz's law	1
	Explanation	1
(ii)	Writing dimensional formula	1
	Calculating self-inductance of coil	2

(i) The polarity of induced emf is such that it tends to produce a current which opposes the change in magnetic flux that produces it. — 1

Consider north pole of a magnet being moved towards a coil. The magnetic flux through the coil increases, hence current is induced in counter clockwise direction making the side of the coil behave as north pole causing repulsion. If this is not the case then bringing magnet towards a coil will construct a perpetual motion machine by a suitable arrangement.
Therefore production of induced emf in a direction which opposes the change in magnetic flux follows from law of conservation of energy. — 1

Alternatively



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(Note: Award full credit for this part if a student draws the diagram and explains conservation of energy.)

(ii) $[\,ML^2T^{-2}A^{-2}\,]$ — 1

$\varepsilon = -L\dfrac{dI}{dt}$ — ½

$L = \dfrac{-(50)\times 0.6}{(2-8)}$ — 1

$= 5\ \text{H}$ — ½ — 5

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