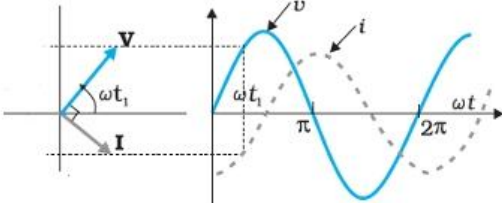
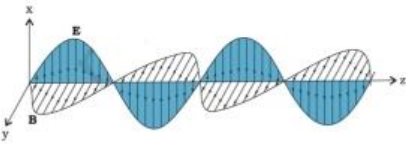


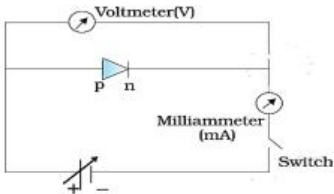
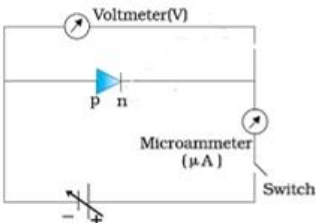
MARKING SCHEME: PHYSICS (042)			
Session: 2025–26			
Code: 55/3/1			
Q. No	VALUE POINTS/EXPECTED ANSWERS	Marks	Total Marks
SECTION A			
1.	(B) $qE_0 x$	1	1
2.	No option is correct (Award full credit for attempting)	1	1
3.	(A) $2.0 \times 10^8 \text{ ms}^{-1}$	1	1
4.	(B) $\frac{-R}{\mu-1}$	1	1
5.	(A) $2n\pi$	1	1
6.	(A) 24, 150 cm	1	1
7.	(A) Twinkling of stars	1	1
8.	(D) 2.0 eV	1	1
9.	(C) 4, 1	1	1
10.	(B) $\frac{4}{3}$	1	1
11.	(C) 100 Ω	1	1
12.	(A) forward biasing	1	1
13.	(A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A)	1	1
14.	(D) Both Assertion (A) and Reason (R) are false	1	1
15.	(B) Both Assertion (A) and Reason (R) are true but Reason (R) is not the correct explanation of the Assertion (A)	1	1
16.	(D) Both Assertion (A) and Reason (R) are false	1	1
SECTION B			
17.	(a) Finding potential difference between points B and C. 2 $I = \frac{\varepsilon_{net}}{R_{net}}$ $= \frac{2}{4}$ $= 0.5 \text{ A}$ $V_{BC} = -\varepsilon_2 - Ir_2$ $= -4 - (0.5 \times 3)$ $= -5.5 \text{ V}$ OR (b) Finding i) Resistance of the resistor 1 ii) Terminal voltage of the battery 1 i) $IR = \varepsilon - Ir$ $R = \frac{21 - (3 \times 3)}{3}$ $= 4\Omega$	1/2 1/2 1/2 1/2 1/2 1/2	

	ii) $V = IR$ $= 3 \times 4$ $= 12 \text{ V}$	$\frac{1}{2}$	
		$\frac{1}{2}$	2
18.	Explanation 2 For diffraction to take place, the size of obstacle has to be comparable to the wavelength of the wave. In case of sound wave, the wavelength is almost comparable to the size of the obstacles around us, while wavelength of light is much smaller than the dimensions of most obstacles around us. Hence diffraction of sound is more common in daily experience than that of light.	2	2
19.	Explanation Mass defect ΔM $\frac{1}{2}$ Binding energy (E) $\frac{1}{2}$ 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. $E_b = \Delta M c^2$ $= [[Zm_p + (A - Z)m_n] - M] c^2$	$\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$	2
20.	Calculating the ratio of de-Broglie wavelengths 2 According to law of conservation of momentum $m_1 v_1 - m_2 v_2 = 0$ $m_1 v_1 = m_2 v_2$ $\frac{v_1}{v_2} = \frac{m_2}{m_1} \quad \text{-----(1)}$ $\frac{\lambda_1}{\lambda_2} = \frac{h}{m_1 v_1} \times \frac{m_2 v_2}{h}$ $= \frac{m_2 v_2}{m_1 v_1}$ $= \frac{m_2}{m_1} \times \frac{m_1}{m_2} \quad \text{from (1)}$ $= 1$ $\lambda_1 : \lambda_2 = 1 : 1$	$\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$	2

21.	Explanation of creation of charge carriers in intrinsic semiconductor. 2 At low temperatures, all the covalent bonds in an intrinsic semiconductor remain intact. As temperature increases, thermal energy becomes available and electrons may break away, becoming free electrons available for conduction. The neighbourhood from which the free electron has come out leaves a vacancy with an effective positive charge. This vacancy is called as hole. Hence charge carriers are created.	1	2
SECTION C			
22	(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 $I \Delta t = ne A v_d \Delta t$ $I = Ane v_d$ (b) $v_d = \frac{eV\tau}{ml}$ Length is doubled, drift velocity is halved.	1 $\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$	3
23	(a) Calculating the magnitude of external torque 2 Effect on torque if circular coil is replaced by planar coil 1 $\tau = NIBA \sin\theta$ $= 30 \times 6 \times 1 \times 3.14 \times (8 \times 10^{-2})^2 \times \sin 60^\circ$ $= 90 \times 64 \times 3.14 \times 1.73 \times 10^{-4}$ $= 3.13 \text{ Nm}$ Torque will remain the same. OR (b) Finding the radius of circular path 2 Mentioning condition for which the particle i) describes helical path $\frac{1}{2}$ ii) goes straight undeviated $\frac{1}{2}$ $K.E = \frac{q^2 B^2 r^2}{2m}$ $r = \frac{\sqrt{2 \times K.E \times m}}{qB}$ $= \frac{\sqrt{2 \times 8 \times 1.6 \times 10^{-19} \times 10^6 \times 6.4 \times 10^{-27}}}{3.2 \times 10^{-19} \times 0.5}$	$\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$	

	$= \frac{12.8 \times 10^{-20}}{1.6 \times 10^{-19}}$ $= 8 \times 10^{-1} \text{ m}$ $= 80 \text{ cm}$ (i) Particle enters the magnetic field at angle $0^\circ < \theta < 90^\circ$ (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.	$\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$	
24	(a) Discussion of behaviour of inductor connected to i) dc source $\frac{1}{2}$ ii) high frequency ac source $\frac{1}{2}$ (b) Phase relation between current and voltage 1 Drawing phasor diagram 1 (a) (i) Initially inductor opposes the change in current and gradually current becomes steady. (Alternatively) Inductor behaves like a conductor. (ii) The magnetic field changes continuously around inductor and induces the back emf. At high frequency, the reactance becomes high, blocking the flow of current. (b) Current lags behind the voltage by an angle $\frac{\pi}{2}$ radian. 	$\frac{1}{2}$ $\frac{1}{2}$ 1 1	3
25	(a) Depicting the variation of electric and magnetic field 1 Writing two important characteristics $\frac{1}{2} + \frac{1}{2}$ (b) Showing $\frac{1}{\sqrt{\epsilon_0 \mu_0}}$ 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 $3 \times 10^8 \text{ ms}^{-1}$. (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) (b) $\frac{1}{\sqrt{\mu_0 \epsilon_0}}$ $= \frac{1}{\sqrt{4\pi \times 10^{-7} \times \frac{1}{4\pi \times 9 \times 10^9}}}$ $= \sqrt{9 \times 10^{16}}$ $= 3 \times 10^8 \text{ m/s} = \text{Velocity of electromagnetic wave in free space.}$	1	
26	Finding angle of emergence at water – air surface 3 $\sin i_c = \frac{1}{n}$ $= \frac{2}{3}$ For glass – water surface $\frac{3}{2} \sin i_c = \frac{4}{3} \sin r$ $\frac{3}{2} \times \frac{2}{3} = \frac{4}{3} \sin r$ $\sin r = \frac{3}{4}$ For water – air surface. $\frac{4}{3} \sin r = \sin e$ $\frac{4}{3} \times \frac{3}{4} = \sin e$ $\sin e = 1$ $e = 90^\circ$	1 $\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$	3
27	Difference between nuclear fission and nuclear fusion 1 Example of each with nuclear reaction 1+1 Nuclear fission is decay of heavy nucleus into two or more intermediate mass fragments whereas in nuclear fusion, light nuclei fuse into a heavier nucleus.	1	

	Nuclear Fission: ${}_0^1\text{n} + {}_{92}^{235}\text{U} \rightarrow {}_{56}^{144}\text{Ba} + {}_{36}^{89}\text{Kr} + 3{}_0^1\text{n}$ Nuclear Fusion: ${}_1^1\text{H} + {}_1^1\text{H} \rightarrow {}_1^2\text{H} + e^+ + \nu + Q$	1	
		1	3
28	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. 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 1 ½	
	SECTION D		
29	(i) (D) $2\mu\text{F}$ (ii) (C) 0.2 A (iii) (A) 2V (iv) (a) (B) $4\mu\text{C}$ (b) (C) remain the same OR	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 (b) (B) $p_1 = p_2$ OR	1 1 1 1	4

SECTION E

31

(a)

(i)	(I) Identifying nature of two charges	$\frac{1}{2} + \frac{1}{2}$
	(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 $\frac{1}{2}$
 Q_2 - Negative $\frac{1}{2}$

(II) $\frac{Q_1}{Q_2} = \frac{\text{Slope of A}}{\text{Slope of B}}$ 1
 $= \frac{\tan 60^\circ}{\tan 30^\circ}$
 $= \frac{3}{1}$ 1

(ii) $V(r) = -\int E \, dx = -\int \frac{A}{x^2} \, dx$ $\frac{1}{2}$
 $= \frac{A}{x}$
 $U = q_1 V(x_1) + q_2 V(x_2) + \frac{q_1 q_2}{4\pi\epsilon_0 x_{12}}$ $\frac{1}{2}$
 $= q_1 \frac{A}{x_1} + q_2 \frac{A}{x_2} + \frac{q_1 q_2}{4\pi\epsilon_0 x_{12}}$
 $= \frac{-2 \times 10^{-6} \times 9 \times 10^5}{30 \times 10^{-2}} + \frac{5 \times 10^{-6} \times 9 \times 10^5}{30 \times 10^{-2}} - \frac{5 \times 2 \times 10^{-12} \times 9 \times 10^9}{60 \times 10^{-2}}$ $\frac{1}{2}$
 $= (-6 + 15 - 0.15) \, \text{J}$
 $= 8.85 \, \text{J}$ $\frac{1}{2}$

OR

(i)	Finding nature of force	$\frac{1}{2}$
	Finding magnitude of force/length	$1\frac{1}{2}$

(ii) Finding $\frac{1}{2}$
(I) electric flux through Gaussian surfaces $\frac{1}{2} + \frac{1}{2}$
(II) electric field at points $\frac{1}{2} + \frac{1}{2}$
(III) surface charge density on inner surfaces $\frac{1}{2} + \frac{1}{2}$

(i) Nature of force: Attractive $\frac{1}{2}$
 $dq = \lambda dl$
Electric field on wire 2 due to wire 1, $E = \frac{-\lambda}{2\pi\epsilon_0 r}$ $\frac{1}{2}$
Force on wire 2 = qE
 $\frac{\text{Force}}{\text{length}} = \frac{F_1}{l} = \frac{-\lambda \times 3\lambda}{2\pi\epsilon_0 r}$ $\frac{1}{2}$

$\frac{1}{2}$

$\frac{1}{2}$

1

1

$\frac{1}{2}$

$\frac{1}{2}$

$\frac{1}{2}$

$\frac{1}{2}$

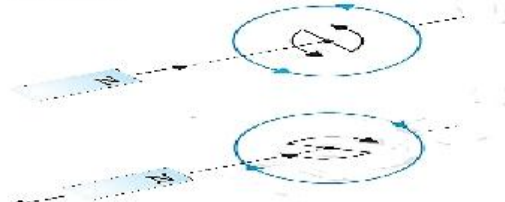
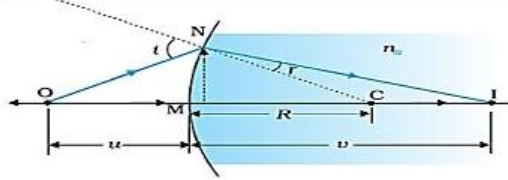
$\frac{1}{2}$

$\frac{1}{2}$

$\frac{1}{2}$

	$= \frac{-3\lambda^2}{2\pi\epsilon_0 r}$ Similarly, $\frac{F_2}{l} = \frac{-3\lambda^2}{2\pi\epsilon_0 r}$	$\frac{1}{2}$	
	(ii) (I) (1) $x < r_1$ $\phi = \frac{2q}{\epsilon_0}$ (2) $r_1 < x < r_2$ $\phi = \frac{(Q+2q)}{\epsilon_0}$ (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) $\sigma = \frac{-(Q+2q)}{4\pi r_2^2}$	$\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$	5
32	(a) (i) Effect on glow of bulb when (I) Iron bar is inserted $\frac{1}{2}$ Justification $\frac{1}{2}$ (II) Frequency of source is decreased $\frac{1}{2}$ Justification $\frac{1}{2}$ (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 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. (Alternatively) $L' = \mu_r L$, L increases, $X_L = \omega L$ increases, current decreases. (II) Brightness of the bulb increases. As frequency of the source decreases, inductive reactance of coil	$\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$	

	decreases. Less fraction of applied AC voltage appears across inductor. Hence higher voltage appears across the bulb.	$\frac{1}{2}$													
	(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)	$Z = \sqrt{R^2 + (X_L - X_C)^2}$ $= \sqrt{(400)^2 + (300)^2}$ $= 500 \Omega$	$\frac{1}{2}$ $\frac{1}{2}$													
(II)	$I_{\text{rms}} = \left(\frac{V_0}{Z\sqrt{2}} \right) = \frac{280}{500 \times 1.4}$ $= 0.4 \text{ A}$	$\frac{1}{2}$ $\frac{1}{2}$													
(III)	Power factor $= \cos \phi = R/Z$ $= 400/500$ $= 0.8$	$\frac{1}{2}$ $\frac{1}{2}$													
	OR														
(b)	<table border="1"> <tr> <td>(i)</td> <td>Statement of Lenz's law</td> <td>1</td> </tr> <tr> <td></td> <td>Explanation</td> <td>1</td> </tr> <tr> <td>(ii)</td> <td>Writing dimensional formula</td> <td>1</td> </tr> <tr> <td></td> <td>Calculating self-inductance of coil</td> <td>2</td> </tr> </table>	(i)	Statement of Lenz's law	1		Explanation	1	(ii)	Writing dimensional formula	1		Calculating self-inductance of coil	2		
(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. 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 1													

	Alternatively  (Note: Award full credit for this part if a student draws the diagram and explains conservation of energy.) (ii) $[ML^2T^{-2}A^{-2}]$ $\varepsilon = -L \frac{dI}{dt}$ $L = \frac{-(50) \times 0.6}{(2 - 8)}$ $= 5 \text{ H}$	HOME 1 1/2 1 1/2 5									
33	(a) <table border="1"> <tr> <td>(i)</td> <td>Drawing ray diagram</td> <td>1</td> </tr> <tr> <td></td> <td>Deriving relation between u, v, n and R</td> <td>2</td> </tr> <tr> <td>(ii)</td> <td>Finding position and nature of image</td> <td>1 1/2 + 1/2</td> </tr> </table> (i)  For small angles $\tan \angle NOM = \frac{MN}{MO}$ $\tan \angle NCM = \frac{MC}{MN}$ $\tan \angle NIM = \frac{MN}{MI}$ $i = \angle NOM + \angle NCM$ $= \frac{MN}{MO} + \frac{MN}{OC}$ -----(1) Similarly $r = \angle NCM - \angle NIM$ $= \frac{MN}{MC} - \frac{MN}{MI}$ -----(2) By Snell's law for small angles $1 \times i = n \times r$ substituting i and r from (1) and (2) $\frac{1}{MO} + \frac{n}{MI} = \frac{n-1}{MC}$ -----(3)	(i)	Drawing ray diagram	1		Deriving relation between u, v, n and R	2	(ii)	Finding position and nature of image	1 1/2 + 1/2	HOME 1 1/2 1/2 1/2
(i)	Drawing ray diagram	1									
	Deriving relation between u, v, n and R	2									
(ii)	Finding position and nature of image	1 1/2 + 1/2									

Using cartesian sign conventions

$$MO = -u, \quad MI = +v, \quad MC = +R$$

Substituting in (3)

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

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

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

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

$$v = 60 \text{ cm}$$

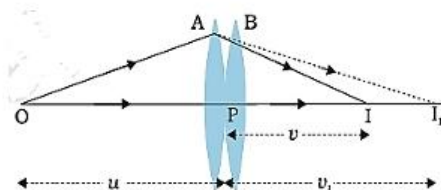
Nature of image: Real and inverted

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)



For image formed by first lens A

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

For image formed by second lens B

$$\frac{1}{v} - \frac{1}{v_1} = \frac{1}{f_2}$$

Adding and comparing with lens formula

$$\frac{1}{f} = \frac{1}{f_1} + \frac{1}{f_2}$$

1/2

1/2

1/2

1/2

1/2

1/2

1/2

1/2

1/2

	(ii) (I)	$\beta = \frac{\lambda D}{d}$ $= \frac{550 \times 10^{-9} \times 2.2}{1.1 \times 10^{-3}}$ $= 1.1 \text{ mm}$	$\frac{1}{2}$	HOME
	(II)	$x = \frac{(2n-1)\lambda D}{2d}$ $n = 2$ $x = 1.65 \text{ mm}$	$\frac{1}{2}$	5
			$\frac{1}{2}$	
	(III)	Fringe width decreases (Alternatively)	1	
		$\beta' = \frac{\beta}{n}$		

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