

MARKING SCHEME: PHYSICS (042) Session: 2025–26			
Code: 55/5/1			
Q. No.	VALUE POINTS/EXPECTED ANSWERS	Marks	Total Marks
SECTION A			
1	(B) repel with a force $F/2$	1	1
2	(D) S	1	1
3	(C) $\frac{\mu_0 I}{\pi a} \sqrt{2}$ and directed along OB	1	1
4	(D) any one or more of the factors given in option (A), (B) and (C)	1	1
5	(D) ac is less dangerous	1	1
6	(C) $7.5 \times 10^2 \text{ m}^{-1}$	1	1
7	(D) Blue light	1	1
8	(B) Isotone	1	1
9	(A) 6.0 fm (Note. Award full marks for Attempt)	1	1
10	(C) $\frac{h}{\pi}$	1	1
11	(A) high resistance in reverse bias and low resistance in forward bias	1	1
12	(C) $\frac{V_0}{\sqrt{2}}, 0$	1	1
13	(D) Both Assertion(A) and reason (R) are false.	1	1
14	(A) Both Assertion(A) and reason (R) are true, reason (R) is the correct explanation of the assertion(A).	1	1
15	(C) Assertion(A) is true, but reason(R) is false.	1	1
16	(B) Both Assertion(A) and reason (R) are true, but reason (R) is not the correct explanation of the assertion(A).	1	1

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18.

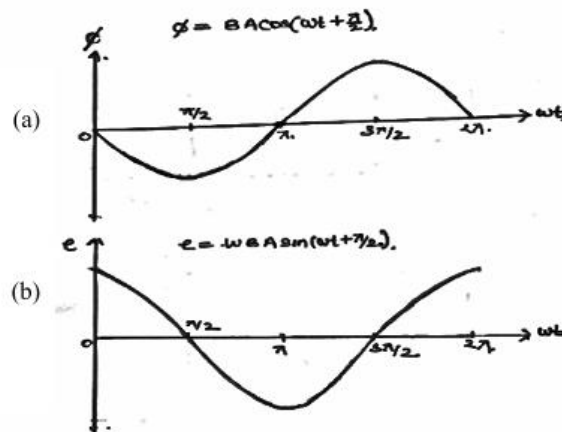
Drawing plot showing variation of

a. magnetic flux linked with a coil.

1

b. emf induced in the coil as a function of ωt .

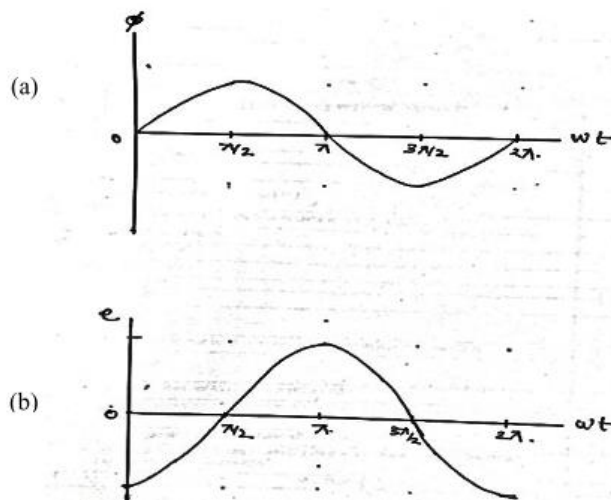
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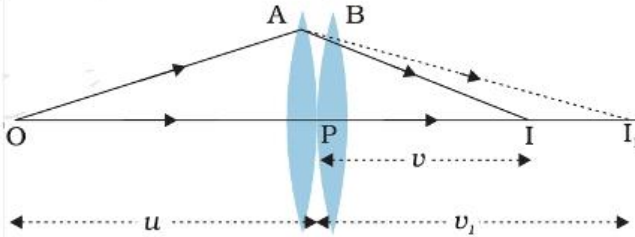
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Alternatively,



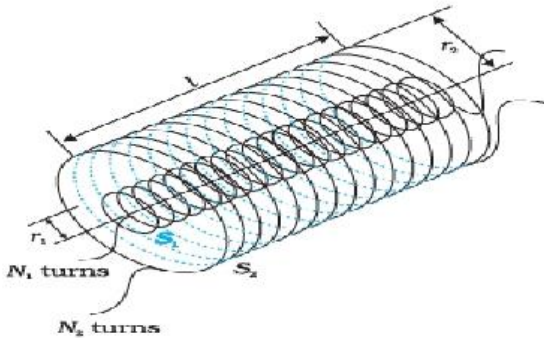
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Note: Award full marks even if formula is not written by student.

19.	Calculating the speed of light in liquid. 2 $n = \frac{\text{speed of light in vacuum}(c)}{\text{speed of light in medium}(v)} \dots\dots (i)$ $n = \frac{\text{real depth}}{\text{apparent depth}}$ $n = \frac{12.5}{9} \dots\dots\dots(ii)$ From (i) and (ii) $v = \frac{3 \times 10^8 \times 9}{12.5}$ $= 2.16 \times 10^8 \text{ m/s}$	1/2 1/2 1/2 1/2	2
20.	Proving the focal length of combination is $f = \frac{f_1 f_2}{f_1 + f_2}$ 2  For the image formed by lens A $\frac{1}{v_1} - \frac{1}{u} = \frac{1}{f_1} \dots\dots\dots(i)$ For the image formed by second lens B $\frac{1}{v} - \frac{1}{v_1} = \frac{1}{f_2} \dots\dots\dots(ii)$ Adding (i) and (ii) $\frac{1}{v} - \frac{1}{u} = \frac{1}{f_2} + \frac{1}{f_1}$ $\frac{1}{f} = \frac{1}{f_1} + \frac{1}{f_2}$ $f = \frac{f_1 f_2}{f_1 + f_2}$	1/2 1/2 1/2 1/2	2

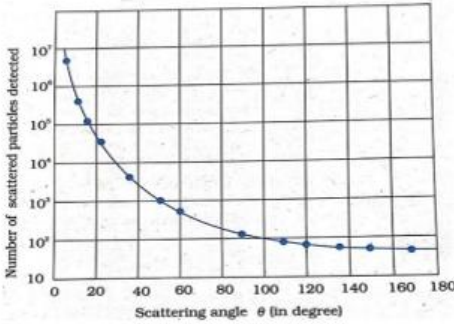
21.	Calculating: Majority carrier concentration ½ Minority carrier concentration 1 ½ Majority carrier concentration = Doping concentration $\therefore$ Majority carrier concentration (n_c) = 5×10^{22} atoms per m^3 $n_i^2 = n_e n_h$ $n_h = \frac{n_i^2}{n_e}$ $n_h = \frac{(1.5 \times 10^{16})^2}{5 \times 10^{22}}$ $= 4.5 \times 10^9 \text{ atoms per } m^3$ Minority carrier concentration = 4.5×10^9 atoms per m^3		HOME ½ ½ ½ ½ 2
	SECTION C		
22.	(a) Calculating the capacitance of X & Y. 1 ½ (b) Calculating the potential difference across plates of X & Y 1 ½ (a) $C_X = C$, $C_Y = KC = 4C$ $\frac{1}{C_{eq}} = \frac{1}{C_X} + \frac{1}{C_Y}$ $C_{eq} = \frac{C_X C_Y}{C_X + C_Y}$ $4 = \frac{C \cdot 4C}{C + 4C}$ $C = 5\mu F$ $C_X = 5\mu F$ $C_Y = 20\mu F$ (b) Total charge $Q = C_{eq} V$ $= 4 \times 10^{-6} \times 6$ $= 24 \times 10^{-6} C$		HOME ½ ½ ½

	$V_x = \frac{Q}{C_x} = \frac{24 \times 10^{-6}}{5 \times 10^{-6}}$ $= 4.8 \text{ V}$ $V_y = \frac{Q}{C_y} = \frac{24 \times 10^{-6}}{20 \times 10^{-6}}$ $= 1.2 \text{ V}$ Alternatively, $V_y = V - V_x$ $= 6 - 4.8 \text{ V}$ $= 1.2 \text{ V}$	$\frac{1}{2}$ $\frac{1}{2}$	3
23.	Writing the expression for magnetic field in vector form. 1 Calculating magnetic field $\vec{B}$ at a given point. 2 Magnetic field due to a current element ($d\vec{l}$) at a distance r, $d\vec{B} = \frac{\mu_0}{4\pi} \frac{I(d\vec{l} \times \vec{r})}{r^3}$ $dB = \frac{\mu_0 i dl \sin\theta}{4\pi r^2}$ $r = \sqrt{2} \text{ m}$ $dB = 10^{-7} \times \frac{10 \times 10^{-2} \sin 45^\circ}{2}$ $dB = 3.53 \times 10^{-9} \text{ T}$ Direction : along +ve Z-axis	1 $\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$	3

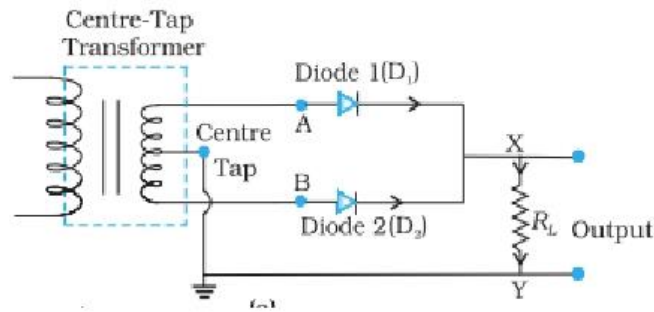
	Alternatively $\vec{r} = (\hat{i} + \hat{j})m, r = \sqrt{2} m$ $d\vec{l} = 10^{-2} m$ $I d\vec{l} = 10 \times 10^{-2} \hat{i} \text{ Am}$ $d\vec{B} = \frac{\mu_0 I (d\vec{l} \times \vec{r})}{4\pi r^3}$ $= \frac{4\pi \times 10^{-7}}{4\pi} \times \frac{10[(10^{-2})\hat{i} \times (\hat{i} + \hat{j})]}{(\sqrt{2})^3}$ $= \frac{10^{-7}}{2\sqrt{2}} (0.1)(0 + \hat{k})$ $= \frac{5}{\sqrt{2}} \times 10^{-9} \hat{k}$ $\vec{dB} = 3.53 \times 10^{-9} \hat{k} \text{ T}$			HOME
24.	Deriving the expression for mutual inductance of solenoid and coil. Validating $M_{12} = M_{21}$ 2 1 			HOME

	Let n_1 and n_2 be the total no. of turns per unit length of solenoid S_1 and coil S_2 respectively $N_1 = n_1 L, \quad N_2 = n_2 L$ When current I_2 is set up in S_2, flux linkage with S_1 is: $N_1 \phi_1 = N_1 A_1 B_2 \dots\dots\dots (i)$ $N_1 \phi_1 = (n_1 L)(\pi r_1^2)(\mu_o n_2 I_2)$ $N_1 \phi_1 = (\mu_o n_1 n_2 \pi r_1^2 L I_2) \dots\dots\dots (ii)$ $N_1 \phi_1 = M_{12} I_2 \dots\dots\dots (iii)$ From (ii) and (iii) $M_{12} = (\mu_o n_1 n_2 \pi r_1^2 L)$ Considering the reverse case, when I_1 current is set up in S_1, flux linkage with S_2, is $N_2 \phi_2 = N_2 A_1 B_1 \dots\dots\dots (iv)$ $N_2 \phi_2 = (n_2 L)(\pi r_1^2)(\mu_o n_1 I_1) \dots\dots\dots (v)$ $N_2 \phi_2 = M_{21} I_1 \dots\dots\dots (vi)$ From (v) and (vi) $M_{21} = (\mu_o n_1 n_2 \pi r_1^2 L)$ Therefore, $M_{12} = M_{21}$ Alternatively, $M_{12} = M_{21} = \frac{(\mu_o N_1 N_2 \pi r_1^2)}{L}$	$\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$	HOME HOME 3
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25.	Defining displacement current. 1 Showing $i_d = \epsilon_0 \frac{d\phi_e}{dt}$ 1½ Writing value of i_d when constant voltage is applied. ½ Displacement current arises due to time varying electric field and hence the time varying electric flux in a region. 1 The plates of the capacitor have an area A & a total charge Q, the magnitude of electric field between the plates: $E = \frac{Q/A}{\epsilon_0} \dots\dots\dots(i)$ $\phi_e = EA \dots\dots\dots(ii)$ Substituting (i) in (ii) $\phi_e = \frac{Q}{\epsilon_0}$ $\frac{d\phi_e}{dt} = \frac{d}{dt} \left(\frac{Q}{\epsilon_0} \right) = \frac{1}{\epsilon_0} \frac{dQ}{dt}$ $\epsilon_0 \frac{d\phi_e}{dt} = \frac{dQ}{dt} \dots\dots\dots(iii)$ If charge Q changes with time, the current i_d $i_d = \frac{dQ}{dt}$ From eq. (iii) and (iv) $i_d = \epsilon_0 \frac{d\phi_e}{dt}$ For constant voltage $E = \text{constant}$, so $\phi_e = 0$ $\therefore i_d = 0$	1 ½ ½ ½ ½	3
26.	(a) (i) Writing two features of nuclear force. 2 (ii) Explaining how mass converted into energy. (or vice versa) in a nuclear reaction 1 (i) Features of Nuclear force: 1) charge independent 2) strongest force. 3) short-range force /saturated force 4) does not follow inverse square law. Note: Award full marks for any two valid points. (ii) The total mass of the nuclei on the left-hand side need not be same as that on right hand side of nuclear reaction. Since Binding energy contributes to mass, the difference in these binding energies appear as energy released or absorbed in a nuclear reaction. 1	1+1	3

	OR (b) (i) Drawing the graph between scattered particles & scattering angle. 1 Writing two important conclusions. 1 (ii) Explaining invalidity for Bohr Quantisation postulate for planetary motion. 1 (i)  Important conclusions: 1. Most of the space in the atom is empty. 2. Most part of mass of atom and its positive charge were tightly concentrated at its centre. Note: No marks to be deducted for scale on the axis (ii) According to Bohr Quantisation postulate $L = mvr = nh/2\pi$ Since mass of planets is very large as compared to mass of atomic particles, angular momentum (L) will be very large. Therefore, Principal quantum number (n) will be very large. For large quantum number, the difference in successive energy levels will be negligible. Hence quantization fails.	1 1 1 3	HOME
27	Calculating a) Energy of a photon in the incident light. 1 b) Maximum kinetic energy emitted. 1 c) Stopping potential. 1 (a) $E = h\nu$ $= \frac{6.626 \times 10^{-34} \times 6.4 \times 10^{14}}{1.6 \times 10^{-19}}$ $= 2.64 \text{ eV or } 42.24 \times 10^{-20} \text{ J}$ (b) $K_{\max} = E - \phi_0$ $= 2.64 - 1.96 = 0.68 \text{ eV or } (10.88 \times 10^{-20} \text{ J})$ (c) $eV_0 = K_{\max}$ $V_0 = K_{\max}/e$ $= 0.68 \text{ V}$	$\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$ 3	

Drawing a circuit diagram.	1
Explaining its working	1
Showing the input and output waveforms	1



Working:

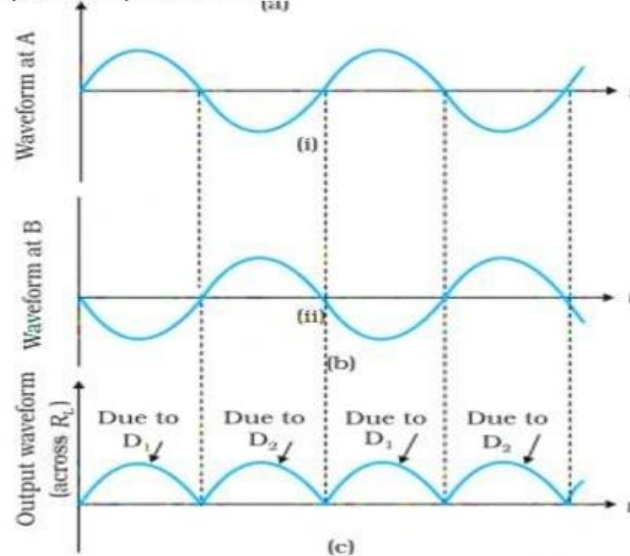
Suppose the input voltage to A w.r.t centre top at any instant is positive.

At that instant voltage at B being out of phase will be negative.

So, diode D_1 gets forward biased and conducts while D_2 being reverse biased is not conducting. Hence, during this positive half cycle we get an output current and output voltage across the load.

When the voltage at A becomes negative w.r.t centre top, the voltage at B would be positive, the diode D_1 would not conduct but D_2 conduct and giving an output current and voltage across the load.

Input and output wave form:



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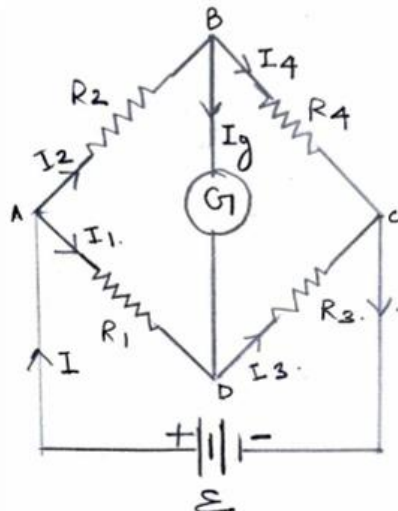
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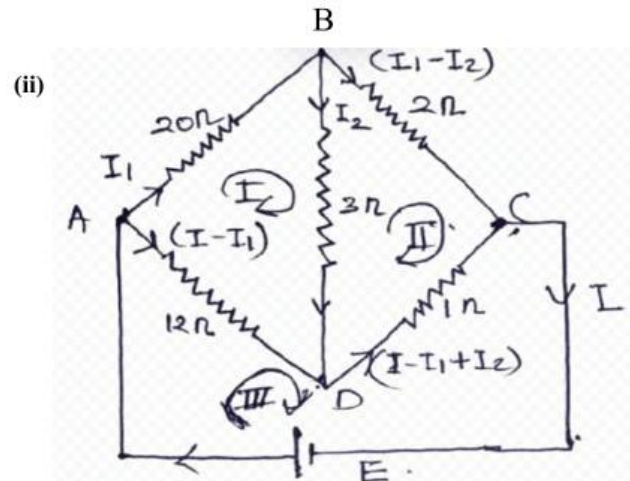
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3

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Section E		HOME
31	a. (i) Deriving the condition for balanced wheat stone bridge. 2 ½ (ii) Determining the current in 3Ω branch. 2 ½ (i)  Applying Kirchoff's rule to closed loop ADBA. For balanced condition $I_g=0$. $-I_1R_1 + 0 + I_2R_2 = 0 \dots\dots\dots(i)$ Applying Kirchoff's rule to closed loop CBDC using $I_3=I_1$, $I_4=I_2$ $I_2R_4 + 0 - I_1R_3 = 0 \dots\dots\dots(ii)$ From eq.(i). $\frac{I_1}{I_2} = \frac{R_2}{R_1}$ and from eq.(ii) $\frac{I_1}{I_2} = \frac{R_4}{R_3}$ hence $\frac{R_2}{R_1} = \frac{R_4}{R_3}$	½ HOME ½ ½ ½



Applying Kirchoff's rule to loop I (ABDA)

$$-20 I_1 - 3 I_2 + 12 (I - I_1) = 0 \dots\dots\dots(i)$$

Applying Kirchoff's rule to loop II (BCDB)

$$-2 (I_1 - I_2) + 1(I - I_1 + I_2) + 3I_2 = 0 \dots\dots\dots(ii)$$

Applying Kirchoff's rule loop III (EADCE)

$$-12 (I - I_1) - 1 (I - I_1 + I_2) = -6 \dots\dots\dots(iii)$$

After solving eq. (i), (ii), (iii)...

$$I_2 = 12/821 \approx 0.014A$$

Note: Award full marks if student takes another appropriate current distribution in the circuit.

1/2

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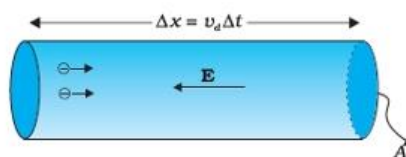
1/2

OR

(b)

- | | |
|--|---|
| (i). Showing the conductivity of material. $\sigma = ne^2\tau / m$ | 3 |
| (ii). Determining the temperature coefficient of resistivity. | 2 |

(i)



The amount of charge crossing the area in time Δt is

$$Q = Ne$$

$$Q = (nAl)e$$

$$I = \frac{Q}{\Delta t}$$

$$I = \frac{nAle}{\Delta t}$$

$$I = nAe |\vec{v}_d| \dots\dots\dots(i)$$

Substituting the value of $|\vec{v}_d|$ in eq.(i)

$$\frac{I}{A} = ne \left(\frac{e |\vec{E}| \tau}{m} \right)$$

$$|\vec{J}| = \frac{ne^2 \tau |\vec{E}|}{m} \dots\dots\dots(ii)$$

where $\vec{J}$ is current density and parallel to $\vec{E}$, and

$$\vec{J} = \sigma \vec{E} \dots\dots\dots(iii)$$

From eq.(ii) and (iii)

$$\sigma = ne^2\tau/m$$

(ii)

$$\alpha = \frac{(R_2 - R_1)}{[R_1 (T_2 - T_1)]}$$

$$\alpha = \frac{(1.38 - 1.05)}{[1.05 \times (100 - 20)]}$$

$$\alpha = \frac{0.33}{(1.05 \times 80)} \\ = 0.0039 \text{ } ^\circ\text{C}^{-1}$$

1 HOME

 $\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$

5

Alternatively

$$R_1 = R_0(1 + \alpha \Delta T_1) \dots\dots\dots(i)$$

$$R_2 = R_0(1 + \alpha \Delta T_2) \dots\dots\dots(ii)$$

$$\frac{R_1}{R_2} = \frac{(1 + \alpha \Delta T_1)}{(1 + \alpha \Delta T_2)}$$

$$\frac{1.05}{1.38} = \frac{1 + 20\alpha}{1 + 100\alpha}$$

On solving

$$\alpha = \frac{11}{2580} ^\circ\text{C}^{-1}$$

$$= 0.0042 ^\circ\text{C}^{-1}$$

32

(a)

(i). Showing the torque acting on the loop. $\vec{\tau} = \vec{m} \times \vec{B}$

3

(ii)(I) Calculating magnetic dipole moment of the coil.

1

(II) Calculating the magnitude of counter torque.

1

(i)

(a)

(b)

According to Right Hand Screw Rule,

Forces on BC & DA are equal and opposite in direction with same line of action, hence they cancel out each other.

Force on arm AB & CD, are also equal and opposite in direction but there is a difference in line of action so, a torque will act on it.

$$F_1 = F_2 = I b B$$

$\tau = \text{Force} \times \text{perpendicular distance}$

$$\tau = F_1 (a/2) \sin\theta + F_2 (a/2) \sin\theta$$

$$= (IbB) a \sin\theta$$

$$\tau = I A B \sin\theta$$

$$\vec{m} = I \vec{A}$$

$$\tau = m B \sin\theta$$

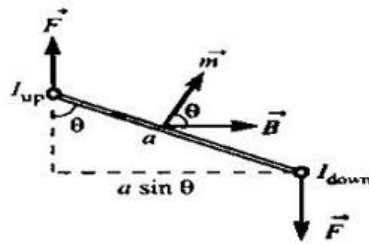
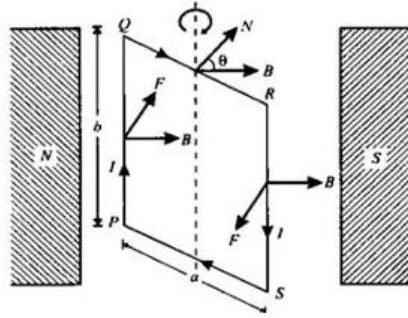
$$\vec{\tau} = \vec{m} \times \vec{B}$$

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32.

Alternatively,



According to Fleming's left-hand rule, the magnitude of force on sides PS and QR are equal and opposite to each other, so they cancel each other.

The side PQ experiences a normal inward force equal to IbB while the side RS experiences an equal normal outward force. These two forces form a couple which exerts a torque given by:

$$\begin{aligned}\tau &= \text{Force} \times \text{perpendicular distance} \\ &= IbB \times a \sin \theta \\ &= IA B \sin \theta\end{aligned}$$

But $IA = m$, the magnetic moment of the loop

$$\begin{aligned}\tau &= mB \sin \theta \\ \vec{\tau} &= \vec{m} \times \vec{B}\end{aligned}$$

(ii) (I)

$$\begin{aligned}m &= NIA \\ &= 100 \times 5 \times \pi \left(\frac{10 \times 10^{-2}}{\sqrt{\pi}} \right)^2 = 5 \text{ Am}^2\end{aligned}$$

(II)

$$\begin{aligned}\tau &= mB \sin \theta \\ &= 5 \times 2 \times \sin 30^\circ \\ &= 5 \text{ Nm}\end{aligned}$$

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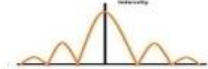
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	OR	HOME
	(b) (i). Deriving expression for the force acting on a conductor placed in magnetic field. 2½ (ii) Calculating the magnitude of net force acting on the wire. 2½ (i) Let the number density of the free electron in the conductor be n. So, the total charge of conductor, $q = nALe$ Total force acting on q placed in field B, moving with velocity v_d $\vec{F} = q (\vec{v} \times \vec{B})$ $\vec{F} = n(AL)e(\vec{v}_d \times \vec{B})$ Here, $ne \vec{v}_d$ is current density ($\vec{J}$) and $ne \vec{v}_d A$ is current in the conductor, Therefore $\vec{F} = [\vec{J}(AL)] \times \vec{B}$ $\vec{F} = I (\vec{L} \times \vec{B})$ (ii) The force acting on the wire l_1 (50cm) placed along x-axis $\vec{F}_1 = I (\vec{l}_1 \times \vec{B})$ $= 2 (50 \times 10^{-2}) \hat{i} \times (-0.5) \hat{k}$ $= 0.5 \hat{j} \text{ N}$ The force acting on the wire l_2 (20cm) placed along y-axis $\vec{F}_2 = I (\vec{l}_2 \times \vec{B})$ $= 2 (20 \times 10^{-2}) \hat{j} \times (-0.5) \hat{k}$ $= 0.2 \hat{i} \text{ N}$ As F_1 and F_2 are perpendicular to each other, the resultant force on the wire will be $F = \sqrt{(F_1^2 + F_2^2)}$ $= \sqrt{(0.25 + 0.04)}$ $= \sqrt{0.29} \text{ N}$ Alternatively, $\vec{F} = \vec{F}_1 + \vec{F}_2$ $\vec{F} = I (\vec{l}_1 \times \vec{B}) + I (\vec{l}_2 \times \vec{B})$ $= \{2 (50 \times 10^{-2}) \hat{i} \times (-0.5) \hat{k}\} + \{2 (20 \times 10^{-2}) \hat{j} \times (-0.5) \hat{k}\}$ $= 0.5 \hat{j} + 0.2 \hat{i}$ $F = \sqrt{(F_1^2 + F_2^2)} = \sqrt{(0.25 + 0.04)} = \sqrt{0.29} \text{ N}$	½ ½ 1 ½ ½ ½ ½ ½ ½ ½
		HOME
		5

II.

As n increases, maxima goes on becoming weaker, since the light coming from a fraction of the slit (one-third, one-fifth, one-seventh, ...) contributes to the intensity at a point.

(ii)

Interference	Diffraction
The width of bright and dark bands is equal.	The width of central maxima is twice the width of secondary maxima or minima
Intensity of all bright fringes is same	Intensity of bright fringe decreases with distance from central maxima.
There is a good contrast between bright and dark fringes	There is a poor contrast between bright and dark fringes.
Intensity distribution curve:	Intensity distribution curve:
	

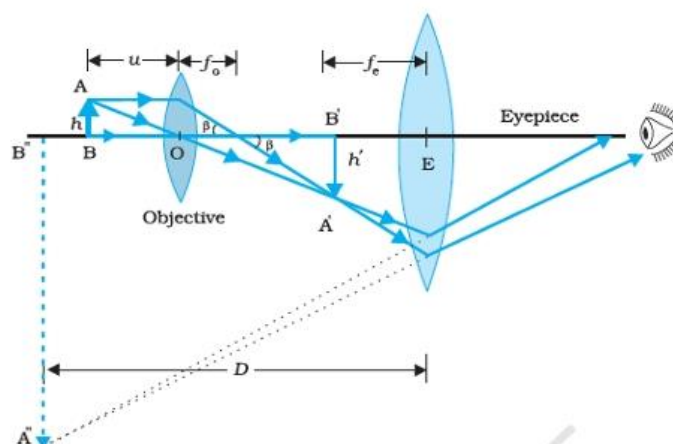
Note: Award full marks for any two correct differences.

OR

(b)

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|---|-----|
| (i) Construction/labelling using ray diagram. | 1+1 |
| Working of a compound microscope with help of ray diagram | 1 |
| (ii) | |
| (I). Explaining the formation of real image if the screen is removed. | 1 |
| (II) Explaining the circumstances for formation of real image. | 1 |

(i)



Construction: It consists of two convex lenses, objective lens with small aperture placed near the object and the eye piece with large aperture placed near the eye. Both lenses have small focal length. These lenses are placed coaxially in a narrow tube with rack and pinion arrangement.

	Working: The lens near to the object called objective forms a real, inverted & magnified image of the object. This serves as the object for eye piece which produces the final image, enlarged & virtual. (ii) I Yes Real image is formed by actual intersection of rays. II Yes If the object is virtual. Note: 1. If students do not write construction award full marks for well-labelled diagram representing objective lens, eye piece, along with image position at near point or normal adjustment. 2. Deduct ½ mark if arrows are not drawn.	1 ½ ½ ½ ½	HOME 5 HOME
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