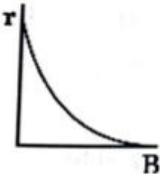
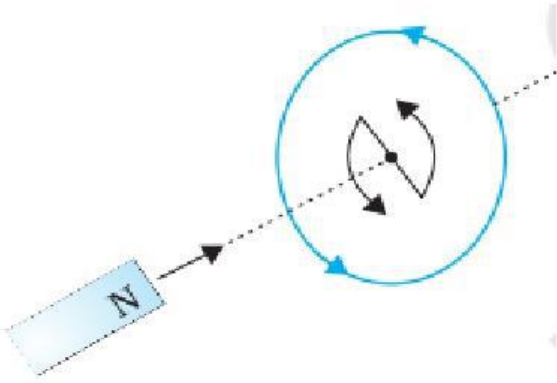
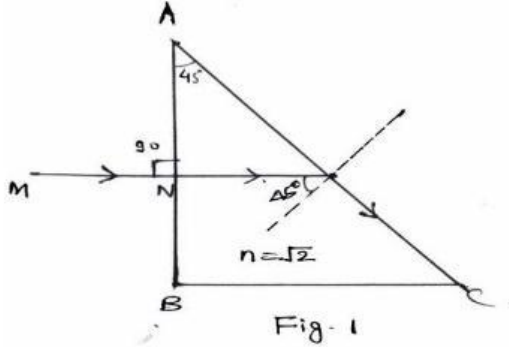
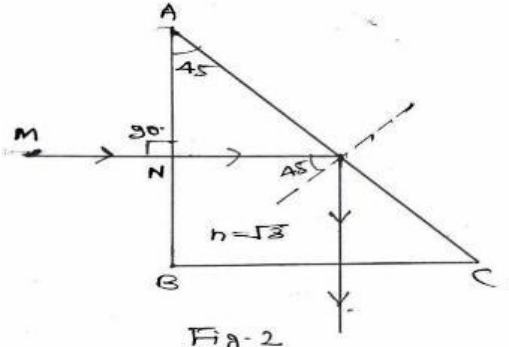


Code: 55/5 /3

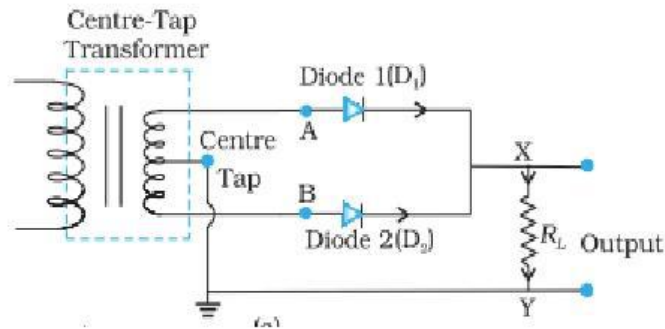
Q. No.	VALUE POINTS/EXPECTED ANSWERS	Marks	Total Marks
SECTION A			
1	(C) $2.65 \times 10^{-27} \text{kg m s}^{-1}$	1	1
2	(A) high resistance in reverse bias and low resistance in forward bias	1	1
3	Award full mark for attempt	1	1
4	(C) $7.5 \times 10^2 \text{m}^{-1}$	1	1
5	(B) 	1	1
6	(D) ac is less dangerous	1	1
7	(C) $\frac{h}{\pi}$	1	1
8	(C) $\frac{V_0}{\sqrt{2}}, 0$	1	1
9	(C) $\frac{q}{2\pi\epsilon_0 l^2}$ pointing along AM	1	1
10	(C) $M_x > (M_y + M_z)$	1	1
11	(A) Zero	1	1
12	(A) 6.0 fm (Note. Award full marks for Attempt)S	1	1
13	(A) Both Assertion(A) and reason (R) is true , reason (R) is the correct explanation of the assertion(A).	1	1

14	(C) Assertion(A)is true, but reason(R) is false.	1	1
15	(B) Both Assertion(A) and reason (R) is 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	Explaining the effect on the motion and position of the ring. 1+1 Current is induced in the ring Reason- Due to electromagnetic induction. The ring will be repelled. Reason- As per Lenz's law, Current is induced in the anticlockwise direction and magnetic moment associated with this current has north polarity. Note: Award 1 mark if the student draws diagram showing current in anticlockwise direction. 	$\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$	2

18	Tracing the path of ray through prism when refractive index is: (i) $n_1 = \sqrt{2}$ 1 (ii) $n_1 = \sqrt{3}$ 1 (i) $\sin i_c = \frac{1}{\mu} = \frac{1}{\sqrt{2}}$ $i_c = 45^\circ$  Fig-1 Since $i = i_c$ so the emergent ray grazes alongside AC. (ii)  Fig-2 $\sin i_c = \frac{1}{\mu} = \frac{1}{\sqrt{3}}$ $i_c < 45^\circ$ Since $i > i_c$ so, the ray suffers from Total Internal Reflection (TIR)	1	HOME
19.	Explaining the reason for Frequency of incident light is same as reflected and refracted light. 1 Wavelength of incident light is different than that of refracted light. 1 The frequency of light depends on the source and does not change when light passes through different media. i.e. frequency is the characteristic property of the source. The wavelength depends on the speed of light in the medium. ($v = \nu\lambda$)	1 1	HOME 2

	SECTION C		HOME
22	Defining displacement current. 1 Justifying continuity and constancy of current. 2 Displacement current: The current due to varying electric field between the plates of capacitor. Ampere-Maxwell Law $\oint \vec{B} \cdot d\vec{l} = \mu_0 (I_c + I_d)$ Outside the capacitor, $I_d = 0$ $\therefore I = I_c$ Inside the capacitor $I_c = 0$ $I = I_d = \epsilon_0 \frac{d\phi_e}{dt}$ $= \epsilon_0 \frac{d}{dt} \left(\frac{Q}{\epsilon_0} \right)$ $I = \frac{dQ}{dt} = I_c$ Hence, $I_c + I_d$ has the same value at all points of current.	1 $\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$	HOME
23	Answering (a) whether the transformer can step up and down dc power supply. 1 (b) whether a step up transformer works as step down. 1 (c) Contradicting the principle of conservation of energy. 1 (a) No Transformers work on the principle of mutual induction. Because D.C. provides a constant current, there will be no change in magnetic flux. (b) Yes By reversing the connections, the secondary winding can be used as the primary. (c) No A step-up transformer changes low voltage into high voltage, and the current is reduced by the same proportion.	$\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$	3

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



Working:

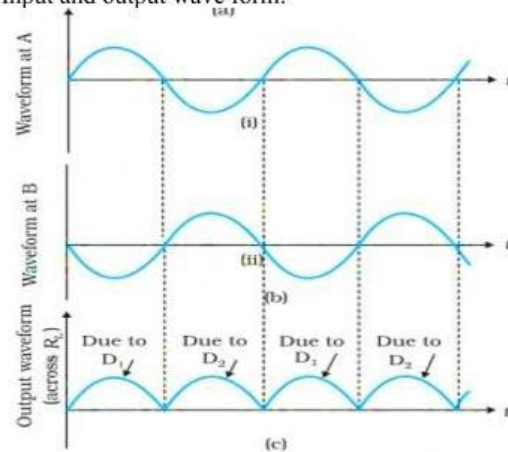
Suppose the input voltage to A w.r.t centre tap at any instant is positive.

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 tap, 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:



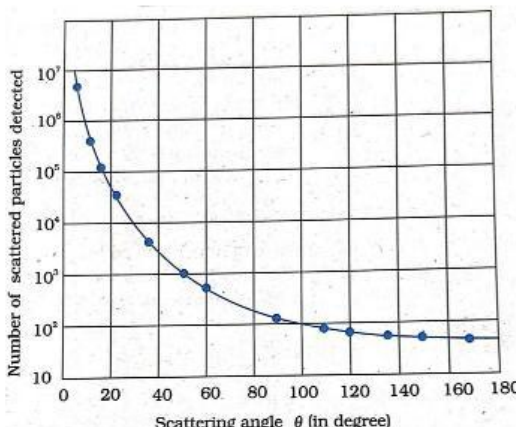
1

1

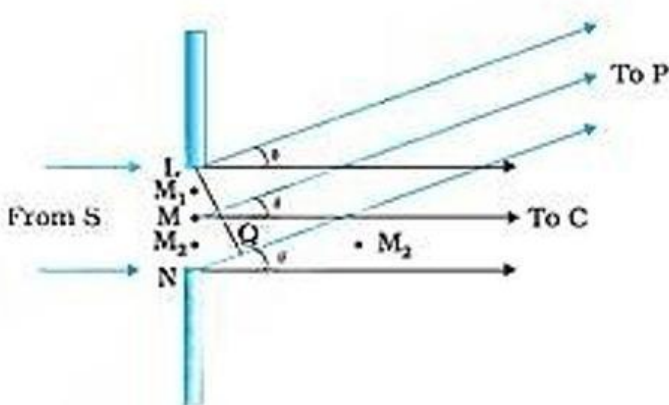
 $\frac{1}{2}$ $\frac{1}{2}$

3

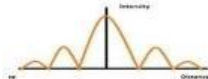
25	Finding (a) The electric dipole moment of the system. 1 (b) The magnitude & direction of electric field at the origin. 2 (a) $p = q \times 2a$ $= 2.5 \times 10^{-7} \times 30 \times 10^{-2}$ $= 75 \times 10^{-9} \text{ Cm}$ (b) $E = \frac{1}{4\pi \epsilon_0} \frac{q}{r^2}$ $ \vec{E}_1 = \vec{E}_2 = \frac{9 \times 10^9 \times 2.5 \times 10^{-7}}{(15 \times 10^{-2})^2} = 1 \times 10^5 \text{ N/C}$ $\vec{E} = \vec{E}_1 + \vec{E}_2 = 2\vec{E}_1 = 2\vec{E}_2 = 2 \times 10^5 \text{ N/C}$ Direction: Along positive z-axis	$\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$	3	HOME
26	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) $eV_0 = K_{\max}$ $V_0 = K_{\max}/e$ $= 0.68 \text{ V}$	$\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$	3	HOME

27	(a) (i) Writing two features of nuclear force.2 (ii)Explaining how mass converted into energy. (or vice versa) in a nuclear reaction1 (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. 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) 	1+1 1 1	HOME HOME
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	$\vec{dl} = 10^{-2} m$ $I\vec{dl} = 10 \times 10^{-2} \text{ i Am}$ $\vec{dB} = \frac{\mu_0 I(\vec{dl} \times \vec{r})}{4\pi r^3}$ $= \frac{4\pi \times 10^{-7}}{4\pi} \times \frac{10[(10^{-2})\hat{i} \times (\hat{i} + \hat{j})]}{(\sqrt{2})^3}$ $= \frac{10^{-7}}{2\sqrt{2}} (0.1)(0 + k)$ $= \frac{5}{\sqrt{2}} \times 10^{-9} k$ $\vec{dB} = 3.53 \times 10^{-9} k_T$		HOME	3
	SECTION D			
29	(i) (D) $(-2 \times 10^4 \text{ V/m})$ <i>k</i> (ii) (B) $(3.5 \times 10^{15} \text{ m/s}^2)$ <i>k</i> (iii) (a) (C) $1.67 \times 10^{-9} \text{ s}$ OR (b) (B) 4.9 nm (iv) (B) b	1 1 1 1	HOME	4
30	(i) (A) wave nature of light. (ii) (a). (C) 480 nm OR (b) (A) 1.2mm (iii) (B) $7.2 \times 10^{-7} \text{ m}$ (iv) (D) be compressed	1 1 1 1		4

SECTION E			HOME
31	(a) (i) (I). Explaining the formation of maxima and minima in the diffraction pattern 2 (II) Explaining the reason for weakening of maxima with increasing number(n) 1 (ii) Writing two points of difference between interference and diffraction pattern 2 (i) (I)  Path difference between the waves originating from points L and N superimposed at P on the screen is, $NQ = a \sin \theta$ Secondary minima $a \sin \theta = n\lambda \quad n = \pm 1, \pm 2, \dots$ Secondary maxima $a \sin \theta = (2n + 1) \lambda / 2 \quad n = \pm 1, \pm 2, \dots$ Alternatively, The light coming from the slit superimposes at the center of screen forms central maxima with maximum intensity. For secondary maxima on screen light coming from a part (one-third, one-fifth, one-seventh....) of whole slit contribute for giving intensity on screen. For Secondary minimas, contribution from two halves of whole slit cancel each other, so the intensity falls to zero. 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, ..) contribute to the intensity at a point.	1/2 1/2 1/2 1	HOME

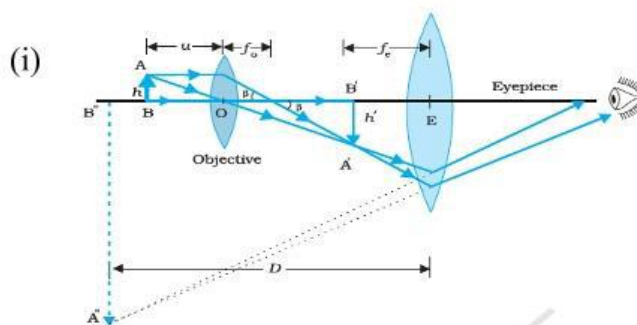
(ii)

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 fringe 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)

(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



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

HOME

1

1

½

½

½

½

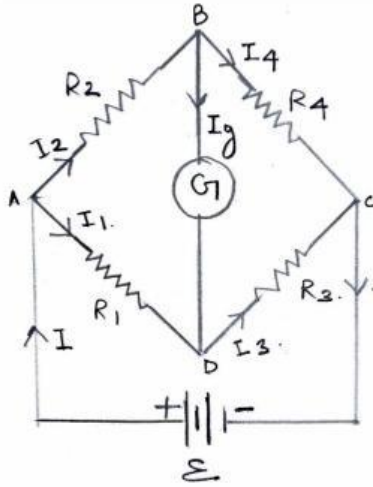
5

32 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 ADDBA.

For balanced condition $I_g = 0$.

$$-I_1 R_1 + 0 + I_2 R_2 = 0 \dots \dots \dots (i)$$

Applying Kirchoff's rule to closed loop CBDC using $I_3 = I_1$, $I_4 = I_2$

$$I_2 R_4 + 0 - I_1 R_3 = 0 \dots \dots \dots (ii)$$

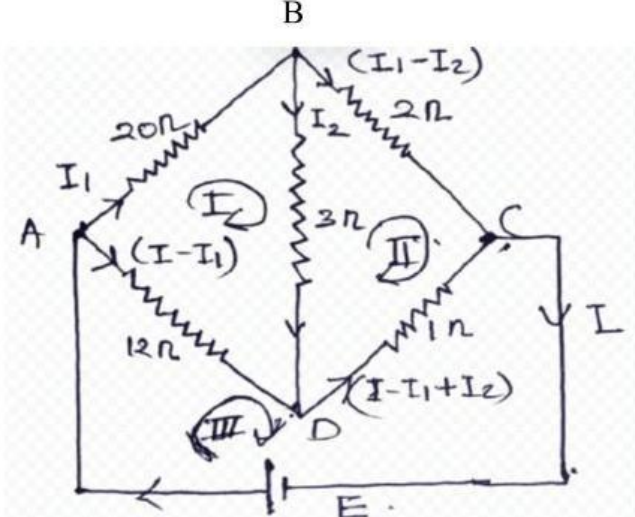
From eq.(i).

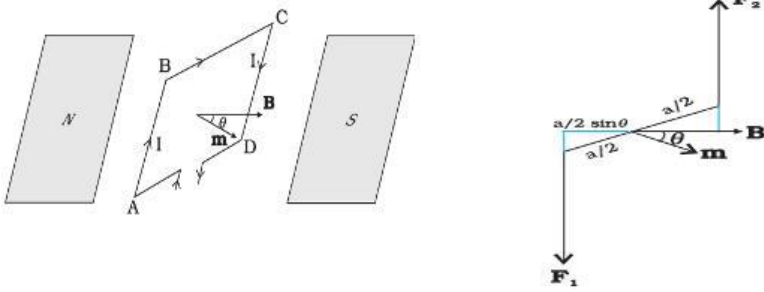
$$\frac{I_1}{I_2} = \frac{R_2}{R_1}$$

and from eq.(ii)

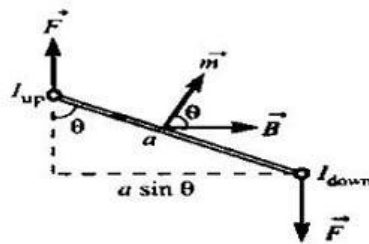
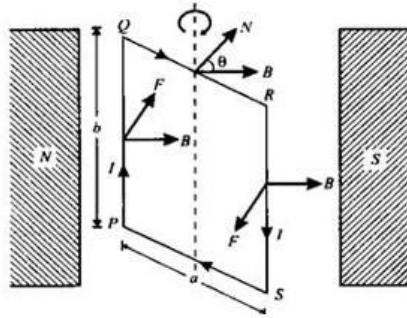
$$\frac{I_1}{I_2} = \frac{R_4}{R_3}$$

hence $\frac{R_2}{R_1} = \frac{R_4}{R_3}$

	(ii)  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)... $I_2 = 12/821 \text{ A}$ Note: Award full marks if student takes another appropriate current distribution in the circuit.	HOME 1/2 HOME 1/2 1/2 1/2 5
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	Alternatively $R_1=R_0(1+\alpha \Delta T_1) \dots\dots\dots(i)$ $R_2=R_0(1+\alpha \Delta T_2) \dots\dots\dots(ii)$ $R_1/R_2=\frac{(1+\alpha \Delta T_1)}{(1+\alpha \Delta T_2)}$ $\frac{1.05}{1.38}=\frac{1+20\alpha}{1+100\alpha}$ On solving $\alpha=\frac{11}{2580}^{\circ}C^{-1}$ $=0.0042^{\circ}C^{-1}$		HOME						
33	(a) <table><tr><td>(i). Showing the torque acting on the loop. $\vec{\tau}=\vec{m} \times \vec{B}$</td><td>3</td></tr><tr><td>(ii)(I) Calculating magnetic dipole moment of the coil.</td><td>1</td></tr><tr><td>(II) Calculating the magnitude of counter torque.</td><td>1</td></tr></table> (i) 	(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	1/2 1/2 1/2 1/2 1/2 1/2	HOME
(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								

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)

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

1/2

1/2

1/2

1/2

	OR (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 & 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	HOME HOME 5
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