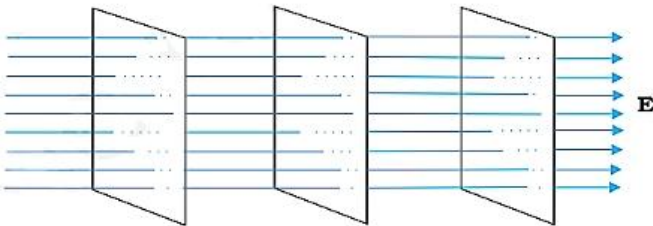
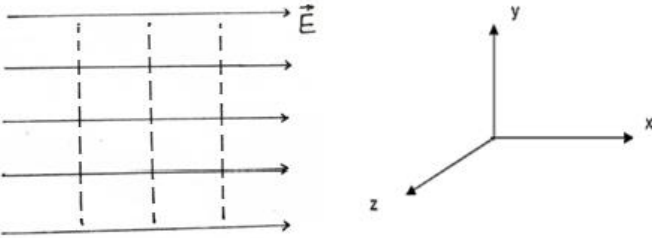
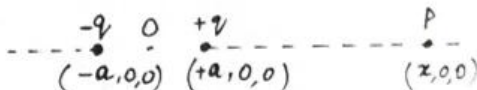


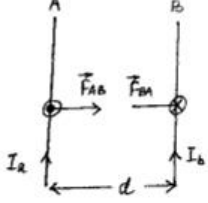
MARKING SCHEME: PHYSICS (042)																	
Session: 2025–26																	
Code: 55/ 2 /1																	
Q. No.	VALUE POINTS/EXPECTED ANSWERS	Marks	Total Marks														
SECTION – A																	
1.	(D) $\frac{-q^2}{\pi\epsilon_0 l}$	1	1														
2.	(D) The final potential of the system equals $\frac{1}{4\pi\epsilon_0} \frac{(q_1 + q_2)(r_1 + r_2)}{r_1 r_2}$	1	1														
3.	(D) Both ϕ_0 and ν	1	1														
4.	(B) n	1	1														
5.	(A) z -axis	1	1														
6.	(B) Al	1	1														
7.	(C) 1 mA	1	1														
8.	(C) Wbs^{-2} , Wbs^{-1}	1	1														
9.	(D) $\frac{1}{\sqrt{3}}$	1	1														
10.	(A) The induced current will flow in the anticlockwise direction	1	1														
11.	(A) Zero	1	1														
12.	(D) $\frac{32}{7}\lambda$	1	1														
13.	(B) Both assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of Assertion (A)	1	1														
14.	(D) Assertion (A) is false and Reason (R) is also false.	1	1														
15.	(A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A)	1	1														
16.	(C) Assertion (A) is true but Reason (R) is false	1	1														
SECTION – B																	
17.	(a) Writing two differences between intrinsic and extrinsic semiconductors 2 <table><tr><td>Intrinsic semiconductors</td><td>Extrinsic semiconductors</td></tr><tr><td>1. $n_e = n_h$</td><td>1. $n_e \neq n_h$ (Alternatively $n_e \gg n_h$ or $n_e \ll n_h$)</td></tr><tr><td>2. Low conductivity</td><td>2. high conductivity</td></tr><tr><td>3. Semiconductor without any impurity atoms added/ Pure semiconductor.</td><td>3. Semiconductor with doping/ Impure Semiconductor.</td></tr><tr><td>4. Its conductivity depends only on temperature</td><td>4. Its conductivity depends on temperature and concentration of dopants</td></tr><tr><td>5. They are naturally occurring semiconductors</td><td>5. They are manufactured semiconductors.</td></tr><tr><td colspan="2">(Any two) or (Any other relevant differences)</td></tr></table>	Intrinsic semiconductors	Extrinsic semiconductors	1. $n_e = n_h$	1. $n_e \neq n_h$ (Alternatively $n_e \gg n_h$ or $n_e \ll n_h$)	2. Low conductivity	2. high conductivity	3. Semiconductor without any impurity atoms added/ Pure semiconductor.	3. Semiconductor with doping/ Impure Semiconductor.	4. Its conductivity depends only on temperature	4. Its conductivity depends on temperature and concentration of dopants	5. They are naturally occurring semiconductors	5. They are manufactured semiconductors.	(Any two) or (Any other relevant differences)		1+1	2
Intrinsic semiconductors	Extrinsic semiconductors																
1. $n_e = n_h$	1. $n_e \neq n_h$ (Alternatively $n_e \gg n_h$ or $n_e \ll n_h$)																
2. Low conductivity	2. high conductivity																
3. Semiconductor without any impurity atoms added/ Pure semiconductor.	3. Semiconductor with doping/ Impure Semiconductor.																
4. Its conductivity depends only on temperature	4. Its conductivity depends on temperature and concentration of dopants																
5. They are naturally occurring semiconductors	5. They are manufactured semiconductors.																
(Any two) or (Any other relevant differences)																	

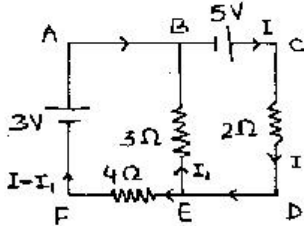
18.	Finding the ratio λ_a/λ_p (i) For same kinetic energy (ii) For same accelerating potential (i) $\lambda = \frac{h}{\sqrt{2mK}}$ $\frac{\lambda_a}{\lambda_p} = \sqrt{\frac{m_p}{m_a}} = \sqrt{\frac{m}{4m}}$ $= \frac{1}{2}$ (ii) $\lambda = \frac{h}{\sqrt{2mqV}}$ $\frac{\lambda_a}{\lambda_p} = \sqrt{\frac{m_p q_p}{m_a q_a}} = \sqrt{\frac{m}{4m} \cdot \frac{e}{2e}}$ $= \frac{1}{2\sqrt{2}}$	1 1 $1/2$ $1/2$ $1/2$ $1/2$ 2	
19.	Calculating the speed of light in the prism. Angle of incidence $i = \frac{3}{4}A = 45^\circ$ At minimum deviation $r = \frac{A}{2} = 30^\circ$ $n = \frac{\sin i}{\sin r} = \frac{\sin 45^\circ}{\sin 30^\circ}$ $n = \sqrt{2}$ $n = \frac{c}{v}$ $v = \frac{3}{\sqrt{2}} \times 10^8 \text{ m/s} = 2.12 \times 10^8 \text{ m/s}$	2 $1/2$ $1/2$ $1/2$ $1/2$ 2	
20.	Finding steady temperature of heating element $R_1 = \frac{V}{I_1} = \frac{220}{2.9} \Omega$ at temperature t_1 $R_2 = \frac{V}{I_2} = \frac{220}{2.5} \Omega$ at temperature t_2 $R_2 = R_1[1 + \alpha(t_2 - t_1)]$	2 $1/2$ $1/2$ $1/2$	

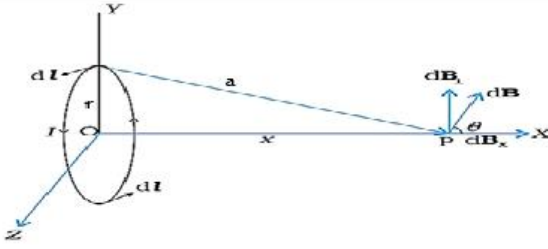
SECTION – C			
22.	(a) Identifying - Isotopes $\frac{1}{2}$ - Isotones $\frac{1}{2}$ (b) • Writing dependence of size of nucleus on its mass number (A) $\frac{1}{2}$ • Proving that density of nucleus is independent of A $1\frac{1}{2}$ (a) • Isotopes: $^{12}_6\text{C}$, $^{14}_6\text{C}$ $\frac{1}{2}$ • Isotones: $^{198}_{80}\text{Hg}$, $^{197}_{79}\text{Au}$ $\frac{1}{2}$ (b) • Size of nucleus $\propto A^{1/3}$ $\frac{1}{2}$ Alternatively: $R = R_0 A^{1/3}$ • Suppose m is the average mass of a nucleon, density of nucleus $\rho = \frac{\text{Mass}}{\text{Volume}}$ $\rho = \frac{mA}{\frac{4}{3}\pi(R_0 A^{1/3})^3}$ $\rho = \frac{3m}{4\pi R_0^3} = \text{constant}$ $\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$ 3		
23.	(a) Drawing three equipotential surfaces 1 (b) Finding the electrostatic potential at a point (x, 0, 0) where $x \gg a$ 2 (a)  Alternatively:  1		

(b)	 Potential at P due to -q charge $V_{-q} = -\frac{1}{4\pi\epsilon_0} \frac{q}{(x+a)}$ Potential at P due to +q charge $V_{+q} = \frac{1}{4\pi\epsilon_0} \frac{q}{(x-a)}$ Net potential at P $V = V_{-q} + V_{+q}$ $V = \frac{-1}{4\pi\epsilon_0} \frac{q}{(x+a)} + \frac{1}{4\pi\epsilon_0} \frac{q}{(x-a)}$ $V = \frac{1}{4\pi\epsilon_0} \cdot \frac{q(2a)}{(x^2-a^2)}$ For $x \gg a$ $V = \frac{1}{4\pi\epsilon_0} \frac{q(2a)}{x^2}$	$1/2$ $1/2$ $1/2$ $1/2$ $1/2$	3						
24.	Naming the electromagnetic wave and writing their wavelength range <table> <tr> <td>(i) Detection of fracture in bones</td> <td>$1/2 + 1/2$</td> </tr> <tr> <td>(ii) Physiotherapy</td> <td>$1/2 + 1/2$</td> </tr> <tr> <td>(iii) Radar systems</td> <td>$1/2 + 1/2$</td> </tr> </table> (i) X-rays Wavelength range: 1 nm to 10^{-3} nm (ii) Infrared waves Wavelength range: 1 mm to 700 nm (iii) Microwaves Wavelength range: 0.1 m to 1 mm	(i) Detection of fracture in bones	$1/2 + 1/2$	(ii) Physiotherapy	$1/2 + 1/2$	(iii) Radar systems	$1/2 + 1/2$	$1/2$ $1/2$ $1/2$ $1/2$ $1/2$	3
(i) Detection of fracture in bones	$1/2 + 1/2$								
(ii) Physiotherapy	$1/2 + 1/2$								
(iii) Radar systems	$1/2 + 1/2$								

25.	(i) • Defining mutual inductance of a pair of coils. 1 • Writing SI unit $\frac{1}{2}$ (ii) Obtaining an expression for mutual inductance. $1\frac{1}{2}$ (i) It is the ratio of the magnetic flux linked with a coil to the current flowing in the neighbouring coil. 1 Alternatively: It is the ratio of magnitude of induced emf in a coil to the rate of change of current in the neighbouring coil. Note: Award ($\frac{1}{2}$) mark if a student writes $M = \frac{\phi}{I}$ OR $M = \frac{ \epsilon }{di/dt}$ SI unit: henry(H) Or Tm^2A^{-1} Or WbA^{-1} or VsA^{-1} $\frac{1}{2}$ (ii) If current I is setup through the solenoid, the magnetic field inside at its center $\frac{1}{2}$ $B = \mu_0 nI$ Flux linked with the circular loop of radius $r(< R)$ $\frac{1}{2}$ $\phi_B = BA$ $\phi_B = (\mu_0 nI)(\pi r^2)$ Mutual Inductance $\frac{1}{2}$ $M = \frac{\phi_B}{I}$ $M = \mu_0 n\pi r^2$ OR • Deducing the expression for force acting on conductor B and showing the direction of force. $1\frac{1}{2} + \frac{1}{2}$ • Writing the expression for force acting on conductor A $\frac{1}{2}$ • Showing that Newton's third law is obeyed $\frac{1}{2}$ Note: Deduct $\frac{1}{2}$ mark if direction of force on conductor B is not shown. 1	
-----	--	--

	Magnetic field due to current carrying conductor A at all points along the conductor B $\vec{B}_a = \frac{\mu_0 I_a}{2\pi d} (-\hat{k})$ Force experienced by a segment of length L of conductor B $\vec{F}_{BA} = I_b \vec{L} \times \vec{B}_a$ $\vec{F}_{BA} = I_b L \left(\frac{\mu_0 I_a}{2\pi d} \right) [\hat{i} \times (-\hat{k})]$ $\vec{F}_{BA} = \frac{\mu_0 I_a I_b L}{2\pi d} \hat{j}$ Similarly $\vec{F}_{AB} = \frac{\mu_0 I_a I_b L}{2\pi d} (-\hat{j})$ $\vec{F}_{BA} = -\vec{F}_{AB}$ It follows Newton's third law Alternatively: $B_a = \frac{\mu_0 I_a}{2\pi d} \quad \text{Vertically inward}$ $F_{BA} = I_b L B_a = \frac{\mu_0 I_a I_b}{2\pi d} L \quad \text{directed towards A}$ $F_{AB} = I_a L B_b$ $F_{AB} = \frac{\mu_0 I_a I_b L}{2\pi d}$ It is equal in magnitude to F_{BA} but directed towards the conductor 'B'. Thus $\vec{F}_{BA} = -\vec{F}_{AB}$ Thus, they follow Newton's third law. Note: Award 1 mark for the diagram, if the directions are not indicated in the diagram but written 	1/2 1/2 1/2 1/2 3	
26.	(a) • Stating Bohr's second postulate. 1 • Mentioning its significance 1/2 (b) Proving that the energy levels get closer and closer with increasing principal quantum number 1 1/2 (a) The electron revolves around the nucleus only in those orbits for which angular momentum is some integral multiple of $\frac{h}{2\pi}$ where h is Planck's constant. <u>Alternatively:</u> $L = n \left(\frac{h}{2\pi} \right)$ • It defines stable / stationary orbits <u>Alternatively</u> Angular momentum is quantised	1 1/2	

	(b) $E_n = \frac{-13.6}{n^2} \text{eV}$ For any two consecutive energy levels, the energy difference is: $\Delta E = E_n - E_{n-1}$ $\Delta E = 13.6 \left[\frac{1}{(n-1)^2} - \frac{1}{n^2} \right]$ $\Delta E = 13.6 \frac{(2n-1)}{n^2(n-1)^2}$ For large value of n $\Delta E = \frac{27.2}{n^3} \text{eV}$ Thus as n increase, ΔE decrease i.e., energy levels get closer and closer.	$1/2$ $1/2$ $1/2$	3
27.	(a) Explaining the statement 1 (b) Finding the current through 3Ω resistor in the circuit 2 (a) Electric current is a scalar quantity because it does not obey law of vector addition. The current with an arrow is only to signify the direction of conventional current. Alternatively: Current do not follow the law of vector addition. The current through an area of cross-section is given by the scalar product of two vectors. $I = \vec{j} \cdot \vec{\Delta S}$ (b)  In Loop ABEFA $3 + 3I_1 - 4(I - I_1) = 0$ $4I - 7I_1 = 3 \dots \dots \dots (1)$ In loop BCDEB $5 - 2I - 3I_1 = 0$ $2I + 3I_1 = 5 \dots \dots \dots (2)$ Solving equations (1) and (2), we get Current through 3Ω resistor is $I_1 = \frac{7}{13} \text{A}$ Note: Award full marks if a student solves by another appropriate current distribution in the circuit.	1 $1/2$ $1/2$ $1/2$	3

28.	Deriving an expression for the magnetic field 3  The magnitude of magnetic field (dB) due to current element Idl is $dB = \frac{\mu_0}{4\pi} \frac{I \vec{dl} \times \vec{a} }{a^3}$ $dB = \frac{\mu_0}{4\pi} \frac{I dl}{(r^2 + x^2)^{3/2}}$ The components of the magnetic field perpendicular to the x-axis ($dB_{\perp}$) are summed over and get cancelled. The components of the magnetic field along the x-axis contribute towards the net magnetic field $B_x = \int dB \cos \theta$ $= \int \frac{\mu_0}{4\pi} \frac{I dl}{(x^2 + r^2)^{3/2}} \cdot \frac{r}{\sqrt{x^2 + r^2}}$ $\vec{B} = B_x \hat{i} = \frac{\mu_0 I r^2}{2(x^2 + r^2)^{3/2}} (\hat{i})$ For N number of turns, net magnetic field $\vec{B}_{\text{net}} = \frac{\mu_0 N I r^2}{2(x^2 + r^2)^{3/2}} (\hat{i})$	1/2	
	SECTION - D		
29.	(i) (C) Boron (ii) (D) $4.5 \times 10^9 \text{ m}^{-3}$ (iii) Award 1 mark to each student, who has attempted this part. (iv) (C) 0.7V OR (A) 0.01 eV	1 1 1 1	4
30.	(i) (A) $\sqrt{D(D - 4f)}$ (ii) (D) Enlarged, reduced (iii) (B) 18.75 cm (iv) (D) 65cm OR (A) -15 cm	1 1 1 1	4

	SECTION - E		HOME
31.	(a) - Defining coherent sources - Necessity for observing stable interference pattern - Drawing graph showing the variation of intensity of light with the position on the screen (b) Finding the intensity of light for path difference (i) $\frac{\lambda}{4}$ (ii) $\frac{\lambda}{3}$	1 1 1 1 1	
	(a) • Two sources of light emitting waves of same frequency and constant phase or zero phase difference are said to be coherent.	1	
	• If the sources are incoherent, interference pattern will change with time. Hence the positions of maxima and minima will also vary rapidly with time and we obtain 'time averaged' intensity distribution. <u>Alternatively:</u> If the two sources are coherent then the phase difference at any point will not change with time and we will have a stable interference pattern.	1	
		1	HOME
	(b) (i) $I = 4I_0 \cos^2\left(\frac{\phi}{2}\right)$ $\Delta p = \frac{\lambda}{4}$ $\phi = \frac{2\pi}{\lambda} \cdot \frac{\lambda}{4}$ $\phi = \frac{\pi}{2}$ $I = 4I_0 \cos^2 \frac{\pi}{4}$ $= 2 I_0$	$\frac{1}{2}$ $\frac{1}{2}$	
	(ii) $\Delta p = \frac{\lambda}{3}$ $\phi = \frac{2\pi}{\lambda} \cdot \frac{\lambda}{3}$ $\phi = \frac{2\pi}{3}$	$\frac{1}{2}$	

$$I = 4I_0 \cos^2 \frac{\pi}{3}$$

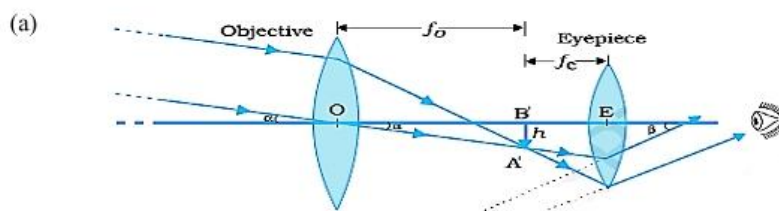
$$= \mathbf{I}_0$$

Note: Award (1/2) mark if the student writes $I = 4I_0 \cos^2\left(\frac{\phi}{2}\right)$

OR

 $1/2$ [HOME](#)

- | | | |
|-----|--|---|
| (a) | • Drawing labelled ray diagram of refracting telescope | 1 |
| | • Deriving expression for its magnifying power | 2 |
| (b) | (i) Giving reason for the larger aperture of objective | 1 |
| | (ii) Writing two advantages of reflecting telescope | 1 |



- $$m = \frac{\beta}{\alpha} \approx \frac{\tan \beta}{\tan \alpha}$$

$$= \frac{h/f_c}{h/f_o}$$

$$= \frac{f_o}{f_c}$$

- (b) (i) With larger aperture even the fainter objects can be observed clearly.

Alternatively:

With larger aperture, the light gathering power and its resolution / resolving power increases.

Alternatively:

Large aperture helps in correcting more light from distant object which forms a sharper/ brighter images.

- (ii)
 - There is no chromatic aberration in a mirror.
 - Spherical aberration in case of parabolic reflectors is removed.
 - Requires less mechanical support
 - Cost effective
 - Brighter / sharper image is formed

(Any two from above or any other appropriate advantages)

1

1

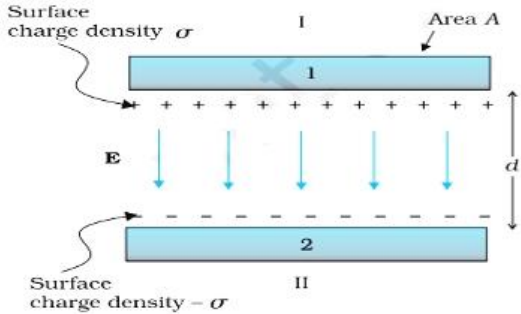
 $1/2$ $1/2$

1

 $(1/2+1/2)$

5

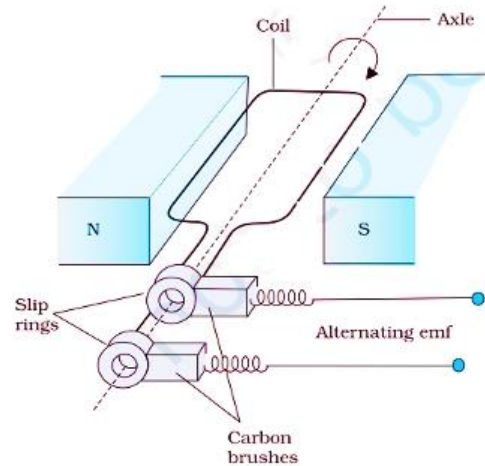
[HOME](#)[HOME](#)

32.	(a) Deriving an expression for capacitance of a parallel plate capacitor 3 (b) Effect of inserting a dielectric slab on (i) Charge on each capacitor 1 (ii) Energy stored in the capacitor 1 (a)  Electric field between the plates $E = \frac{\sigma}{\epsilon_0}$ $E = \frac{q}{A\epsilon_0}$ Potential difference $V = Ed$ $= \frac{qd}{A\epsilon_0}$ Capacitance $C = \frac{q}{V}$ $C = \frac{A\epsilon_0}{d}$ (b) (i) In parallel combination the potential difference is same across the capacitors. On insertion of dielectric slab capacitance of each capacitor becomes K (dielectric constant) times. Alternatively: $C' = KC$ Hence final charge on each capacitor becomes K times. Alternatively: $q' = C'V$ $q' = KCV$ $q' = Kq$ Alternatively: $q'_1 = KC_1V = Kq_1$ $q'_2 = KC_2V = Kq_2$		HOME
			HOME

(ii) Energy stored by capacitor, $U = \frac{1}{2} CV^2$ As the capacitance becomes K times energy stored by each capacitor also increases by factor K Alternatively: $U' = KU$ Alternatively: $U'_1 = \frac{1}{2} KC_1 V^2 = KU_1$ $U'_2 = \frac{1}{2} KC_2 V^2 = KU_2$ OR	1													
<table border="1"> <tr> <td>(a)</td> <td>• Explanation for the time independence of average velocity.</td> <td>1</td> </tr> <tr> <td></td> <td>• Obtaining relation between current and average velocity.</td> <td>2</td> </tr> <tr> <td>(b) (i)</td> <td>Reason for instantaneously establishment of current</td> <td>1</td> </tr> <tr> <td>(ii)</td> <td>Finding the ratio of drift velocities</td> <td>1</td> </tr> </table> (a) • $\vec{v}_d = \frac{-e\vec{E}\tau}{m}$, where τ is the average time between two successive collisions, which is constant. Distance covered by electrons between two successive collisions is almost same. Hence $S = \frac{1}{2} at^2$ where $a = \text{constant}$, $s = \text{almost constant}$ So t is constant. Alternatively At any instant some of the electrons would have spent time more than τ and some less than τ. Thus averaging over all the times we get a constant time. This way we get average velocity independent of time. • Let n is the number of free electrons per unit volume in the conductor of length L and cross-sectional area A. Total charge crossing area A in time Δt is $q = -neA \vec{v}_d \Delta t$ Where negative sign indicates direction of flow of electrons is opposite to direction of electric field. By definition, electric current is opposite to flow of electrons. $\therefore I\Delta t = neA \vec{v}_d \Delta t$ $I = neA \vec{v}_d$	(a)	• Explanation for the time independence of average velocity.	1		• Obtaining relation between current and average velocity.	2	(b) (i)	Reason for instantaneously establishment of current	1	(ii)	Finding the ratio of drift velocities	1	1	
(a)	• Explanation for the time independence of average velocity.	1												
	• Obtaining relation between current and average velocity.	2												
(b) (i)	Reason for instantaneously establishment of current	1												
(ii)	Finding the ratio of drift velocities	1												
(b) (i) Electric field is established throughout the circuit, almost instantly causing at every point a local electron drift. As a result the current is established instantaneously.	1													
(ii) $v_d = \frac{1}{ne\pi r^2}$	$\frac{1}{2}$													
$\frac{v_{d1}}{v_{d2}} = \left(\frac{r_2}{r_1}\right)^2$	$\frac{1}{2}$													
$= \frac{4}{9}$	$\frac{1}{2}$	5												

- | | | |
|-------|--|---|
| (i) | For ac generator | |
| | • labelled diagram / construction | 1 |
| | • Principle | 1 |
| | • Working | 1 |
| (ii) | Deducing expression for induced emf | 1 |
| (iii) | Giving the times at which emf generated is maximum in terms of T | 1 |

(i)



1

• Principle: It is based on the principle of electromagnetic induction. When the magnetic flux passing through a coil changes continuously, emf is induced.

Working: When coil is rotated in magnetic field, magnetic flux linked with it changes and emf is induced in the coil.

1

- (ii) Flux linked with a coil at any instant of time placed in magnetic field rotating with angular speed ω

$$\phi_B = BA \cos \omega t$$

From faraday's law

$$\varepsilon = -N \frac{d\phi_B}{dt}$$

$$\varepsilon = NBA\omega \sin \omega t$$

1/2

1/2

- (iii) EMF generated is maximum at $\frac{T}{4}$ and $\frac{3T}{4}$

1

5