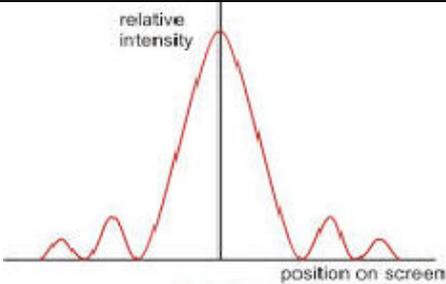


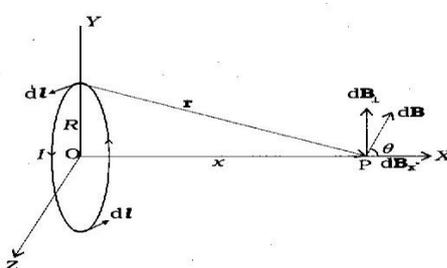
Q.NO.	VALUE POINTS/ EXPECTED ANSWERS	MARKS	TOTAL MARKS												
<b>SECTION A</b>															
1		1	1												
2	Normal : Circular At an angle of $30^\circ$ it will follow helical path	$\frac{1}{2}$ $\frac{1}{2}$	1												
3	The power of a lens equals to the reciprocal of its focal length( in meter). Also accept $P = \frac{1}{f(\text{meter})}$ Do not deduct mark if student does not write the word meter. ( Alternatively Power of a lens is the ability of conversion /diversion of the rays incident on the lens.) SI Unit: Dioptre(D)	$\frac{1}{2}$ $\frac{1}{2}$	1												
4	From few MHz to 30-40 MHz		1												
5	$v = \sqrt{\frac{2eV}{m}}$	1	1												
<b>SECTION B</b>															
6	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 10%;"></td> <td style="width: 60%;">Formula</td> <td style="width: 30%; text-align: right;"><math>\frac{1}{2}</math></td> </tr> <tr> <td>(i)</td> <td>Frequency of first case</td> <td style="text-align: right;"><math>\frac{1}{2}</math></td> </tr> <tr> <td>(ii)</td> <td>Frequency of second case</td> <td style="text-align: right;"><math>\frac{1}{2}</math></td> </tr> <tr> <td></td> <td>Ratio</td> <td style="text-align: right;"><math>\frac{1}{2}</math></td> </tr> </table>		Formula	$\frac{1}{2}$	(i)	Frequency of first case	$\frac{1}{2}$	(ii)	Frequency of second case	$\frac{1}{2}$		Ratio	$\frac{1}{2}$		
	Formula	$\frac{1}{2}$													
(i)	Frequency of first case	$\frac{1}{2}$													
(ii)	Frequency of second case	$\frac{1}{2}$													
	Ratio	$\frac{1}{2}$													

	<p>We have</p> $h\nu = E_f - E_i$ $= \frac{E_0}{n_f^2} - \frac{E_0}{n_i^2}$ <p>(i) <math>h\nu_1 = E_0 \left( \frac{1}{1^2} - \frac{1}{2^2} \right) = E_0 \times \frac{3}{4}</math></p> <p>(ii) <math>h\nu_2 = E_0 \left( \frac{1}{2^2} - \frac{1}{\infty^2} \right) = E_0 \times \frac{1}{4}</math></p> $\therefore \frac{\nu_1}{\nu_2} = 3$	<p>½</p> <p>½</p> <p>½</p> <p>½</p>	<p>2</p>								
<p>7</p>	<table border="1" data-bbox="220 645 1161 788"> <tbody> <tr> <td>(a) Definition</td> <td>½</td> </tr> <tr> <td>Relation</td> <td>½</td> </tr> <tr> <td>(b) Identification of A and B</td> <td>½+ ½</td> </tr> </tbody> </table> <p>(a) Measure of the response of magnetic material to an external magnetic field. Also accept</p> $\chi = \frac{ M }{ H }$ <p>We have</p> $\chi = (\mu_r - 1)$ <p>(b) 0.96 : Diamagnetic 500 : Ferromagnetic</p>	(a) Definition	½	Relation	½	(b) Identification of A and B	½+ ½	<p>½</p> <p>½</p> <p>½</p>	<p>2</p>		
(a) Definition	½										
Relation	½										
(b) Identification of A and B	½+ ½										
<p>8</p>	<table border="1" data-bbox="220 1220 1161 1361"> <tbody> <tr> <td>SHM nature of oscillation of the wire AB</td> <td>½</td> </tr> <tr> <td>Expression for instantaneous magnetic flux</td> <td>½</td> </tr> <tr> <td>Expression for instantaneous induced emf</td> <td>½</td> </tr> <tr> <td>Qualitative explanation</td> <td>½</td> </tr> </tbody> </table> <p>The wire AB would oscillate in a simple harmonic way</p> <p>We can write</p> $x = -a \cos \omega t$ <p>(as <math>x = -a</math> at <math>t = 0</math>)</p> <p>Therefore Instantaneous magnetic Flux</p> $\phi(t) = Blx \quad (l = AB)$ <p>Instantaneous induced emf</p> $e(t) = -\frac{d\phi}{dt} = aBl\omega \sin \omega t$ <p>The induced emf, therefore varies with time sinusoidally.</p> <p>( Alternatively Arm AB executes SHM under the influence of restoring force developed in the spring, consequently an induced emfis produced across the ends of moving armAB which varies sinusoidally.)</p>	SHM nature of oscillation of the wire AB	½	Expression for instantaneous magnetic flux	½	Expression for instantaneous induced emf	½	Qualitative explanation	½	<p>½</p> <p>½</p> <p>½</p> <p>½</p>	<p>2</p>
SHM nature of oscillation of the wire AB	½										
Expression for instantaneous magnetic flux	½										
Expression for instantaneous induced emf	½										
Qualitative explanation	½										



	<p>For <math>r &gt; r_0</math>, the force is attractive</p> <p>For <math>r &lt; r_0</math>, the force is repulsive</p> <p>a) We have,  <math>1 + 235 = a + 94 + 2 \times 1</math>  <math>\therefore a = 236 - 96 = 140</math></p> <p>Also  <math>0 + 92 = 54 + b + 2 \times 0</math>  <math>\therefore b = 92 - 54 = 38</math></p>	<p><math>\frac{1}{2}</math></p> <p><math>\frac{1}{2}</math></p> <p><math>\frac{1}{2}</math></p> <p><math>\frac{1}{2}</math></p>	<p>3</p>
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<p>12</p>	<div data-bbox="215 571 1157 638" style="border: 1px solid black; padding: 5px;"> <p>Labelled circuit diagram - 1              Working as a voltage amplifier - 2</p> </div> <div data-bbox="207 672 941 952" style="text-align: center;"> </div> <p>Working as a voltage amplifier:</p> <p>When a small sinusoidal voltage (with amplitude <math>v_s</math>) is connected in series with the dc bias voltage supply, <math>V_{BB}</math>, the base current will have sinusoidal variations super imposed on the value of <math>I_B</math>.</p> <p>As a result, the collector current will also have sinusoidal variations super imposed on the value of <math>I_C</math>.</p> <p>This results in corresponding sinusoidal variations in the value of the output voltage <math>V_o</math>.</p> <p>These sinusoidal variations in output voltage are an amplified version of the corresponding variations in the input voltage. This implies that the transistor can be used as a voltage amplifier.</p> <p>(Note : Give 1 mark to those students also who only draw either this circuit diagram or the circuit diagram given below:</p> <div data-bbox="438 1579 965 1960" style="text-align: center;"> </div>	<p>1</p> <p><math>\frac{1}{2}</math></p> <p><math>\frac{1}{2}</math></p> <p><math>\frac{1}{2}</math></p> <p><math>\frac{1}{2}</math></p>	<p>3</p>
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<p>13</p>	<p>(a) Statement of Biot-Savart law                      ½ Mark</p> <p>      Its vector form                                        ½ Mark</p> <p>(b) Obtaining the required expression              2 Mark</p>		
	<p>(a) According to Biot Savart law :</p> <p>The magnitude of magnetic field <math>d\vec{B}</math>, due to a current element <math>d\vec{l}</math>, is</p> <p>(i) proportional to current <math>I</math> and element length, <math>dl</math></p> <p>(ii) inversely proportional to the square of the distance <math>r</math>.</p> <p>Its direction is perpendicular to the plane containing <math>d\vec{l}</math> and <math>\vec{r}</math>.</p> <p>In vector notation,</p> $\vec{dB} = \frac{\mu_0}{4\pi} I \frac{d\vec{l} \times \vec{r}}{r^3}$ <p>(b)</p>  <p>We have <math>\vec{dB} = \frac{\mu_0}{4\pi} I \frac{d\vec{l} \times \vec{r}}{r^3}</math></p> $r^2 = x^2 + R^2$ $\therefore dB = \frac{\mu_0 I}{4\pi} \frac{dl}{(x^2 + R^2)^{3/2}}$ <p>We need to add only the components of <math>d\vec{B}</math> along the axis of the coil.</p> <p>Hence, <math>B = \int \frac{\mu_0}{4\pi} \frac{Idl}{(x^2 + R^2)^{3/2}} \cos\theta.</math></p> $= \int \frac{\mu_0}{4\pi} \frac{(Idl) R}{(x^2 + R^2)^{3/2}}.$ $= \frac{\mu_0 I R^2}{2(x^2 + R^2)^{3/2}}.$ $\therefore B = \frac{\mu_0 I R^2}{2(x^2 + R^2)^{3/2}} \hat{i}$	<p>½</p> <p>½</p> <p>½</p> <p>½</p> <p>½</p>	<p>3</p>

**14**

Definition of Electric flux	1
SI unit	½
Formula (Gauss's Law)	½
Calculation of Charge within the cube	1

Electric Flux is the dot product of electric field and area vector.

1

Also Accept

$$\phi = \oint \vec{E} \cdot d\vec{s}$$

SI Unit : Nm<sup>2</sup>/C or volt -meter

½

For a given case

$$\phi = \phi_1 + \phi_2 = [E_x(\text{at } x = 2a) - E_x(\text{at } x = a)]a^2$$

$$= [\alpha(2a) - \alpha(a)]a^2$$

$$= \alpha a^3$$

$$= 100 \times (0.1)^3 = 0.1 \text{ Nm}^2 / \text{C}$$

½

But

$$\phi = \frac{q}{\epsilon_0}$$

½

$$\therefore q = \epsilon_0 \phi = 8.854 \times 10^{-12} \times 10^{-1} \text{ C}$$

½

$$= 0.8854 \text{ pC}$$

**OR**

Relevant formulae	1
Calculation of time taken by the electron	1
Calculation of time taken by the proton	1

We have

Force = qE

Acceleration  $a = \frac{qE}{m}$

½

Also

$$s = \frac{1}{2} at^2 \quad \text{as } u = 0$$

$$\therefore t = \sqrt{\frac{2s}{a}}$$

½

(i) For the electron

$$a = \frac{eE}{m}$$

½

$$\therefore t = \sqrt{\frac{3 \times 10^{-2} \times 9.1 \times 10^{-31}}{1.6 \times 10^{-19} \times 2.0 \times 10^4}}$$

$$= 2.92 \text{ ns}$$

½

(ii) for proton

$$t = \sqrt{\frac{2 \times 1.5 \times 10^{-2} \times 1.67 \times 10^{-27}}{1.6 \times 10^{-19} \times 2 \times 10^4}}$$

½

$$= 0.125 \mu\text{s}$$

½

3

15

Writing the two loop equations	½ + ½ Mark
Finding the current through DB	1½ Marks
Finding the p.d. between B and D	½ Mark

Using Kirchoff's voltage rule, we have :

For loop DABD

$$I_1 \times 1 + (1) + (-2) + 2I_1 + 2(I_1 + I_2) = 0$$

$$\text{Or } 5I_1 + 2I_2 = 1 \quad \dots\dots (i)$$

For loop DCBD

$$+ I_2 \times 3 + (3) + (-1) + I_2 + 2(I_1 + I_2) = 0$$

$$\text{Or } 2I_1 + 6I_2 = -2 \quad \dots\dots(ii)$$

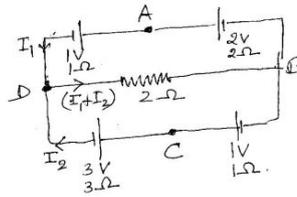
Solving (i) and (ii), we get

$$I_1 = \frac{5}{13} \text{ A}$$

$$I_2 = \frac{-6}{13} \text{ A}$$

$$\therefore \text{Current through DB} = I_1 + I_2 = \frac{-1}{13} \text{ A}$$

$$\therefore \text{P.D. between B and D} = 0.154 \text{ V}$$



½

½

½

½

½

½

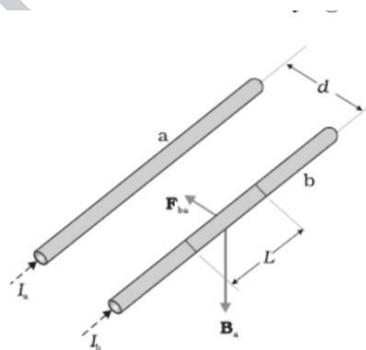
3

16

(a) Definition of SI unit Of current	1
(b) Explanation of the force of attraction	½
Finding the resultant force acting on the third conductor	1½

(a) The ampere is the value of that steady current which, when maintained in each of the two very long, straight, parallel conductors of negligible cross-section, and placed one metre apart in vacuum, would produce on each of these conductors a force equal to  $2 \times 10^{-7}$  newton per metre of length.

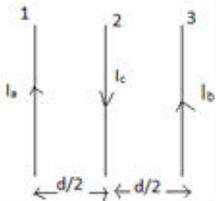
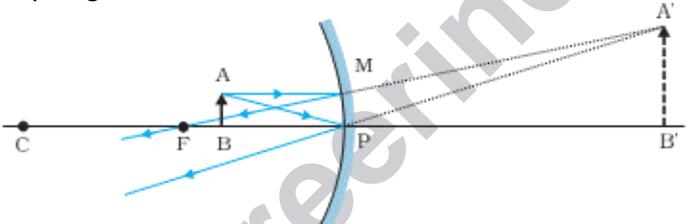
(b) The wire (b) experiences a force due to the magnetic field caused by the current flowing in wire (a).



The magnetic field at any point on the wire (b) due to the current in wire (a) is perpendicular to the plane of two wires and pointing inwards and hence force on it will be towards wire (a). Similarly force on wire (a) will be towards wire (b). Hence two wires carrying currents in same direction attract each other.

1

½

	<p>Force on wire (3) due to wire (1)  <math>= \frac{\mu_0 I_a I_c}{2\pi \left(\frac{d}{2}\right)}</math> towards right</p> <p>Force on wire 3 due to wire 2  <math>\left( \frac{\mu_0 I_b I_c}{2\pi \left(\frac{d}{2}\right)} \right)</math> towards left</p> <p>Net force on wire 3  <math>= \frac{\mu_0 I_c}{\pi d} [I_a - I_b]</math> towards right</p> <p>Also accept  <math>= \frac{\mu_0 I_c}{\pi d} [I_b - I_a]</math> towards left</p> <p>Note: please do not deduct last 1/2 mark if the student does not write the direction of force.</p>	<p></p> <p>1/2</p> <p>1/2</p> <p>1/2</p>	<p>3</p>
<p>17</p>	<p>a) Ray diagram - 1</p> <p>b) Obtaining</p> <p>i. mirror formula - 1 1/2</p> <p>ii. expression for liner magnification - 1/2</p> <p>a) Ray Diagram</p>  <p>From similar triangles <math>A'B'F</math> and <math>MPF</math>, we have  <math>\frac{B'A'}{PM} = \frac{B'F}{FP}</math> or <math>\frac{B'A'}{BA} = \frac{B'F}{FP}</math> (since <math>PM = BA</math>)</p> <p>From similar triangles <math>A'B'P</math> and <math>ABP</math>, we have  <math>\frac{B'A'}{BA} = \frac{B'P}{BP}</math></p> <p>Hence <math>\frac{B'F}{FP} = \frac{B'P}{BP}</math></p> <p>Now <math>B'F = B'P + PF = (+v) + (-f)</math>  <math>= v - f</math>  <math>BP = -u</math></p> <p><math>\therefore \frac{v - f}{-f} = \frac{+v}{-u}</math>  or <math>\frac{v - f}{f} + 1 = \frac{-v}{u}</math></p>	<p>1</p> <p>1/2</p> <p>1/2</p>	<p>3</p>

$$\therefore \frac{1}{v} + \frac{1}{u} = \frac{1}{f}$$

This is the mirror formula.

$$\text{Linear magnification} = \frac{B'A'}{BA}$$

From similar triangles  $A'B'P$  and  $ABP$ , we get

$$\frac{B'A'}{BA} = \frac{B'P}{BP}$$

$\therefore$  Linear magnification

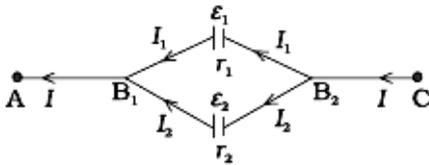
$$\frac{B'P}{BP} = \frac{+v}{-u} = -\frac{v}{u}$$

$\frac{1}{2}$

18

Obtaining Expression for the equivalent

- |                |   |
|----------------|---|
| (i) resistance | 1 |
| (ii) emf       | 2 |



$$\frac{1}{r} = \frac{1}{r_1} + \frac{1}{r_2}$$

$$\therefore r = \frac{r_1 r_2}{r_1 + r_2}$$

$$I = I_1 + I_2$$

$$V = E_1 - I_1 r_1 \quad \text{and} \quad V = E_2 - I_2 r_2$$

$$\therefore I = \left( \frac{E_1 - V}{r_1} \right) + \left( \frac{E_2 - V}{r_2} \right)$$

$$V = \left( \frac{E_1 r_2 + E_2 r_1}{r_1 + r_2} \right) - I \left( \frac{r_1 r_2}{r_1 + r_2} \right)$$

$$\text{also } V = E_{\text{eq}} - I r_{\text{eq}}$$

$$\Rightarrow \frac{E_{\text{eq}}}{r_{\text{eq}}} = \frac{E_1}{r_1} + \frac{E_2}{r_2}$$

$\frac{1}{2}$

$\frac{1}{2}$

$\frac{1}{2}$

$\frac{1}{2}$

$\frac{1}{2}$

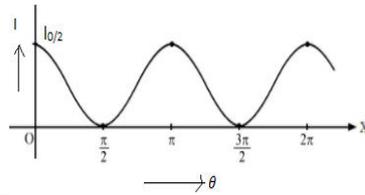
$\frac{1}{2}$

3

19

- |                              |                                  |
|------------------------------|----------------------------------|
| (a) Two points of difference | $\frac{1}{2} + \frac{1}{2}$ Mark |
| (b) Formula                  | $\frac{1}{2}$ Marks              |
| Calculation of wavelength    | $1\frac{1}{2}$ Mark              |

	<p>(a) <b>Any two point of difference :</b></p> <table border="1" data-bbox="212 197 1098 721"> <tbody> <tr> <td>Interference</td> <td>Diffraction</td> </tr> <tr> <td>Fringes are equally spaced.</td> <td>Fringes are not equally spaced.</td> </tr> <tr> <td>Intensity is same for all maxima</td> <td>Intensity falls as we go to successive maxima away from the centre.</td> </tr> <tr> <td>Superposition of two waves originating from two narrow slits.</td> <td>Superposition of a continuous family of waves originating from each point on a single slit.</td> </tr> <tr> <td>Maxima along an angle <math>\lambda/a</math> for two narrow slits separated by a distance a.</td> <td>Minima at an angle of <math>\lambda/a</math> for a single slit of width a.</td> </tr> </tbody> </table> <p>(b) Let D be the distance of the screen from the plane of the slits. We have Fring width <math>\beta = \frac{\lambda D}{d}</math> In the first case <math>\beta = \frac{\lambda D}{d}</math> or <math>\beta d = \lambda D</math> ..... (i) In the second case <math>(\beta - 30 \times 10^{-6}) = \frac{\lambda(D - 0.05)}{d}</math> or <math>(\beta - 30 \times 10^{-6})d = \lambda(D - 0.05)</math> ..... (ii) Subtracting (ii) from (i) we get <math>30 \times 10^{-6} \times d = \lambda \times 0.05</math> <math>\therefore \lambda = \frac{30 \times 10^{-6} \times 10^{-3}}{5 \times 10^{-2}} \text{ m}</math> <math>\therefore \lambda = 6 \times 10^{-7} \text{ m} = 600 \text{ nm}</math></p>	Interference	Diffraction	Fringes are equally spaced.	Fringes are not equally spaced.	Intensity is same for all maxima	Intensity falls as we go to successive maxima away from the centre.	Superposition of two waves originating from two narrow slits.	Superposition of a continuous family of waves originating from each point on a single slit.	Maxima along an angle $\lambda/a$ for two narrow slits separated by a distance a.	Minima at an angle of $\lambda/a$ for a single slit of width a.	<p><math>\frac{1}{2} + \frac{1}{2}</math></p> <p><math>\frac{1}{2}</math></p> <p><math>\frac{1}{2}</math></p> <p><math>\frac{1}{2}</math></p> <p>3</p> <p><math>\frac{1}{2}</math></p>	
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20	<table border="1" data-bbox="212 1368 1161 1507"> <tbody> <tr> <td>a) Intensity of linearly polarized light – <math>\frac{1}{2}</math></td> <td></td> </tr> <tr> <td>Dependence on orientation – <math>\frac{1}{2}</math></td> <td></td> </tr> <tr> <td>Explanation – 1</td> <td></td> </tr> <tr> <td>b) Graphical representation – 1</td> <td></td> </tr> </tbody> </table> <p>a) The intensity of the linearly polarized light would be <math>I_0/2</math>. No; it does not depend on the orientation.</p> <p>Explanation : The polaroid will let the component of the unpolarized light, parallel to its pass axis, to pass through it irrespective of its orientation.</p> <p>b) We have <math>I = I_0 \cos^2 \theta</math> <math>\therefore</math> The graph is as shown below</p>	a) Intensity of linearly polarized light – $\frac{1}{2}$		Dependence on orientation – $\frac{1}{2}$		Explanation – 1		b) Graphical representation – 1		<p><math>\frac{1}{2}</math></p> <p><math>\frac{1}{2}</math></p> <p>1</p>			
a) Intensity of linearly polarized light – $\frac{1}{2}$													
Dependence on orientation – $\frac{1}{2}$													
Explanation – 1													
b) Graphical representation – 1													



1

3

21

- a) Writing the truth table – 1  
b) Photodiode and its operation – 1 + 1

(a) The inputs of the third gate are  $\bar{A}$  and  $\bar{B}$ . Hence the truth table is as given below.

A	B	$\bar{A}$	$\bar{B}$	C
0	0	1	1	0
0	1	1	0	0
1	0	0	1	0
1	1	0	0	1

(Note: The student need not write the columns for  $\bar{A}$  and  $\bar{B}$  in her/ his answer)

(b) A photodiode is a special purpose  $p - n$  junction diode fabricated with a transparent window to allow light to fall on the diode.

Incident light, with photon energy greater than the energy gap of the semiconductor, generates electron -hole pairs. The magnitude of the photo current depends on the intensity of intensity of incident light.

The photodiode is usually operated under reverse bias conditions.

This is because this makes it easier to detect changes in light intensity and makes the photodiode work as a detector of optical signals.

1

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

3

22

Statement of equation with explanation of symbols – 1

Expression for

- i. Planck's constant – 1  
ii. Work function – 1

Einstein's photoelectric equation is

$$h\nu = h\nu_0 (= W) + \frac{1}{2}mv_{max}^2$$

$\nu$  = frequency of incident light

$\nu_0$  = threshold frequency of photo sensitive material

$W$  = work function

$\frac{1}{2}mv_{max}^2$  = max. kinetic energy of the emitted photoelectrons

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

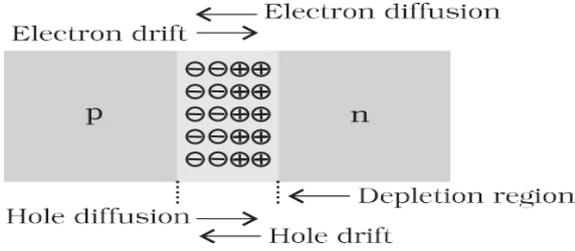
(Also accept if the student writes

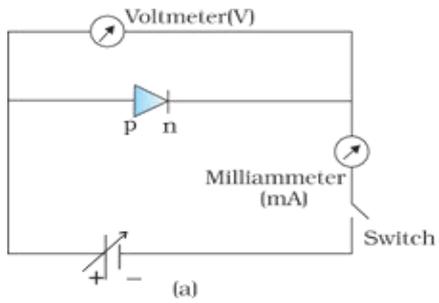
$$h\nu = W + eV_s$$

$W$  = work function of photosensitive material

$V_s$  = Stopping Potential)

From Einstein's photoelectric equation, we have

	$h\nu = W + \frac{1}{2} m v_{max}^2$ $\therefore v_{max}^2 = \frac{2}{m} (h\nu - W)$ $= \left(\frac{2h}{m}\right) \nu + \left(\frac{-2W}{m}\right)$ <p>Slope of the given graph = <math>\frac{l}{n}</math> Intercept on the y – axis = <math>-l</math></p> $\therefore \frac{2h}{m} = \frac{l}{n} \text{ or } h = \frac{m l}{2n}$ <p>and <math>-l = \frac{-2W}{m}</math> or <math>W = \frac{m l}{2}</math></p>	<p><math>\frac{1}{2}</math> <math>\frac{1}{2}</math> <math>\frac{1}{2}</math> <math>\frac{1}{2}</math></p>	<p>3</p>								
<b>SECTION D</b>											
<p>23</p>	<table border="1" data-bbox="252 678 839 954"> <tbody> <tr> <td>(a) Name of e.m. radiation</td> <td><math>\frac{1}{2}</math> Mark</td> </tr> <tr> <td>(b) Method of production</td> <td><math>\frac{1}{2}</math> Mark</td> </tr> <tr> <td>(c) Range of wavelength</td> <td>1 Mark</td> </tr> <tr> <td>(d) Two values</td> <td>1 + 1 Marks</td> </tr> </tbody> </table> <p>(a) (b) (Alternatively : By bombarding a metal target with high energy electrons)</p> <p>(c) Wave length range of X-rays is from about (10 nm to <math>10^{-4}</math> nm)</p> <p>(d) Alertness, empathy; concern for her mother, knowledgeable (any two)</p>	(a) Name of e.m. radiation	$\frac{1}{2}$ Mark	(b) Method of production	$\frac{1}{2}$ Mark	(c) Range of wavelength	1 Mark	(d) Two values	1 + 1 Marks	<p><math>\frac{1}{2}</math> <math>\frac{1}{2}</math> 1 (1 + 1)</p>	<p>4</p>
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<p>24</p>	<table border="1" data-bbox="213 1279 1160 1417"> <tbody> <tr> <td>a) Explaining the two processes-</td> <td>1 + 1</td> </tr> <tr> <td>Defining the two terms -</td> <td><math>\frac{1}{2} + \frac{1}{2}</math></td> </tr> <tr> <td>b) Circuit diagram</td> <td>- 1</td> </tr> <tr> <td>Working</td> <td>- 1</td> </tr> </tbody> </table> <p>a) The two important processes are diffusion and drift Due to concentration gradient, the electrons diffuse from the <math>n</math> side to the <math>p</math> side and holes diffuse from the <math>p</math> side to the <math>n</math> side.</p> <div style="text-align: center;">  </div> <p>Due to the diffusion, an electric field develops across the junction. Due to the field, an electron moves from the p-side to the n -side, a hole moves from the n-side to the p-side. The flow of the charge carriers due to the electric field, is called drift.</p>	a) Explaining the two processes-	1 + 1	Defining the two terms -	$\frac{1}{2} + \frac{1}{2}$	b) Circuit diagram	- 1	Working	- 1	<p><math>\frac{1}{2}</math> <math>\frac{1}{2}</math> <math>\frac{1}{2}</math> <math>\frac{1}{2}</math></p>	
a) Explaining the two processes-	1 + 1										
Defining the two terms -	$\frac{1}{2} + \frac{1}{2}$										
b) Circuit diagram	- 1										
Working	- 1										

	<p><b>Depletion region:</b> It is the space charge region on either side of the junction, that gets depleted of free charges, is known as the depletion region.</p> <p><b>Potential Barrier</b> The potential difference, that gets developed across the junction and opposes the diffusion of charge carries and brings about a condition of equilibrium, is known as the barrier potential.</p> <p>b) The circuit diagram is as shown</p>  <p>(a)</p> <p><b>Working</b> In forward bias condition, the direction of the applied voltage is opposite to the barrier potential. This reduces the width of the depletion layer as well as the height of the barrier. A current can, therefore, flow through the circuit. This current increases ( non linearly) with increase in the applied voltage.</p>	<p>½</p> <p>½</p> <p>1</p> <p>1</p>	<p>5</p>
<b>OR</b>			
	<div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;"> <p>a) Describing the three factors – 3 b) Drawing the wave forms – 2</p> </div> <p>a) It is necessary to modulate the audio frequency signals because of the following three reasons:</p> <ol style="list-style-type: none"> <li>i. <u>Size of the antenna or aerial</u> This size needs to be comparable to the wavelength of the signal. It would be unmanageably long for audio frequency signals.</li> <li>ii. <u>Effective power radiated</u> Power radiated, being proportional to <math>\left(\frac{l}{\lambda}\right)^2</math> would be very small for a audio frequency signal.</li> <li>iii. <u>Mixing up of different signals</u> The audible frequency range is quite small. Hence if transformission is done at audio frequencies, the chances of mixing up of different signals are very high.</li> </ol> <p>b) The required wave forms are as shown</p> <ol style="list-style-type: none"> <li>i. Carrier wave</li> <li>ii. Modulating Signal</li> <li>iii. Amplitude Modulated wave</li> </ol>	<p>½</p> <p>½</p> <p>½</p> <p>½</p> <p>½</p> <p>½</p>	

		1/2	
		1/2	
		1	5

25	<div style="border: 1px solid black; background-color: #e0f7fa; padding: 5px; margin-bottom: 10px;"> <p>(a) Finding the electrostatic potential      2 Marks</p> <p>(b) Finding the work done                      1 Mark</p> <p>(c) Effect of change of path                    1 Mark</p> <p>(d) Potential energy of the system          1 Mark</p> <p style="text-align: center;">(with justification in each case)</p> </div> <p>V =</p> <p>(i) At point (0, 0, z) :</p> <p>Potential due to the charge (+q),</p> $V_+ = \frac{1}{4\pi \epsilon_0} \frac{q}{(z+a)}$ <p>Potential due to the charge (-q),</p> $V_- = \frac{1}{4\pi \epsilon_0} \frac{(-q)}{(z-a)}$ <p>Total potential at (0, 0, z) = <math>\frac{q}{4\pi \epsilon_0} \left[ \frac{1}{z+a} - \frac{1}{z-a} \right]</math></p> $= \frac{-2qa}{4\pi \epsilon_0 (z^2 - a^2)}$ <p>(ii) At point (x, y, 0)</p> <p>Potential due to the charge + q</p> $V_+ = \frac{1}{4\pi \epsilon_0} \frac{q}{\sqrt{x^2 + y^2 + a^2}}$ <p>Potential due to the charge (-q)</p> $V_- = \frac{1}{4\pi \epsilon_0} \frac{-q}{\sqrt{x^2 + y^2 + a^2}}$ <p>Total potential at (x, y, 0)</p> $= \frac{q}{4\pi \epsilon_0} \left( \frac{1}{\sqrt{x^2 + y^2 + a^2}} - \frac{1}{\sqrt{x^2 + y^2 + a^2}} \right) = 0$	1/2	
		1/2	
		1/2	





