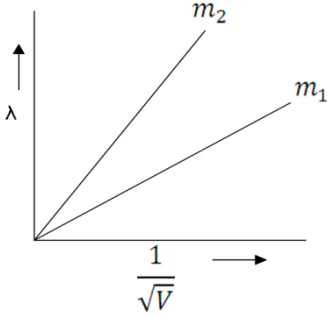
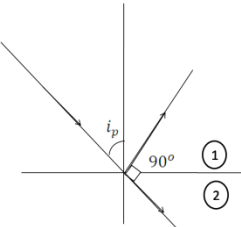


MARKING SCHEME

Q. No.	Expected Answer / Value Points	Marks	Total Marks						
	<u>SECTION (A)</u>								
Set1,Q1 Set2,Q4 Set3,Q2	Positive	1	1						
Set1,Q2 Set2,Q5 Set3,Q3	Electric flux remains unaffected. [NOTE: (As per the Hindi translation), change in Electric field is being asked, hence give credit if student writes answer as decreases]	1	1						
Set1,Q3 Set2,Q1 Set3,Q5	A current carrying coil, in the presence of magnetic field, experiences a torque, which produces proportionate deflection. [Alternatively (deflection) $\theta \propto \tau$ (Torque)]	1	1						
Set1,Q4 Set2,Q2 Set3,Q4	Due to their short wavelengths, (they are suitable for radar system used in aircraft navigation).	1	1						
Set1,Q5 Set2,Q3 Set3,Q1	Quality factor $Q = \frac{\omega_0}{2\Delta\omega}$, [Alternatively Quality factor $Q = \frac{\omega_0 L}{R}$, Alternatively, It gives the sharpness of the resonance circuit.] It has no unit.	$\frac{1}{2}$ $\frac{1}{2}$	 1						
Set1,Q6 Set2,Q9 Set3,Q7	<u>SECTION (B)</u>								
	<table border="1" style="width: 100%;"> <tr> <td colspan="2">Explanation of the terms</td> </tr> <tr> <td>(i) Attenuation</td> <td style="text-align: right;">1</td> </tr> <tr> <td>(ii) Demodulation</td> <td style="text-align: right;">1</td> </tr> </table> <p>(i) The loss of strength of a signal while propagating through a medium. (ii) The process of retrieval of information, from the carrier wave, at the receiver.</p>	Explanation of the terms		(i) Attenuation	1	(ii) Demodulation	1	1 1	2
Explanation of the terms									
(i) Attenuation	1								
(ii) Demodulation	1								
Set1,Q7 Set2,Q10 Set3,Q8	<table border="1" style="width: 100%;"> <tr> <td>Plotting of graph</td> <td style="text-align: right;">$\frac{1}{2} + \frac{1}{2}$</td> </tr> <tr> <td>Identification of line representing lower mass</td> <td style="text-align: right;">$\frac{1}{2}$</td> </tr> <tr> <td>Reason</td> <td style="text-align: right;">$\frac{1}{2}$</td> </tr> </table>	Plotting of graph	$\frac{1}{2} + \frac{1}{2}$	Identification of line representing lower mass	$\frac{1}{2}$	Reason	$\frac{1}{2}$		
Plotting of graph	$\frac{1}{2} + \frac{1}{2}$								
Identification of line representing lower mass	$\frac{1}{2}$								
Reason	$\frac{1}{2}$								

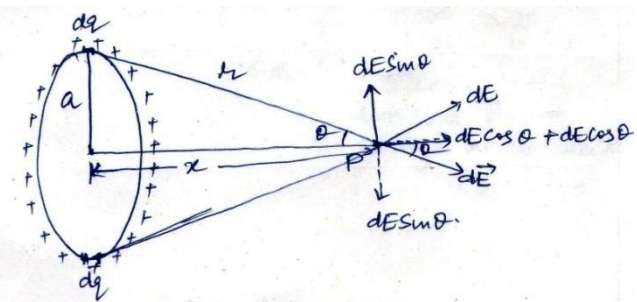
	 <p>As $\lambda = \frac{h}{\sqrt{2mqV}}$</p> <p>As the charge of two particles is same , therefore</p> $\frac{\lambda}{(\frac{1}{\sqrt{V}})} \propto \frac{1}{\sqrt{m}} \quad \text{i.e.} \quad \text{Slope} \propto \frac{1}{\sqrt{m}}$ <p>Hence, particle with lower mass (m_2) will have greater slope.</p>	<p>$\frac{1}{2} + \frac{1}{2}$</p> <p>$\frac{1}{2}$</p> <p>$\frac{1}{2}$</p>	<p>2</p>
<p>Set1,Q8 Set2,Q6 Set3,Q10</p>	<div style="border: 1px solid black; padding: 5px; margin-bottom: 10px; display: flex; justify-content: space-between;"> Calculation of Energy released 2 </div> <p>Binding energy of nucleus with mass number 240, $E_{bn} = 240 \times 7.6 \text{ MeV}$</p> <p>Binding energy of two fragments $= 2 \times 120 \times 8.5 \text{ MeV}$</p> <p>Energy released = $240 (8.5 - 7.6) \text{ MeV}$ $= 240 \times 0.9$ $= 216 \text{ MeV}$</p> <p style="text-align: center;">OR</p> <div style="border: 1px solid black; padding: 5px; margin-bottom: 10px; display: flex; justify-content: space-between;"> Calculation of Energy in the fusion Reaction 2 </div> <p>Total Binding energy of Initial System</p> <p>i.e. ${}^2_1\text{H} + {}^2_1\text{H} = (2.23 + 2.23) \text{ MeV}$ $= 4.46 \text{ MeV}$</p> <p>Binding energy of Final System i.e. ${}^3_2\text{He}$ $= 7.73 \text{ MeV}$</p> <p>Hence energy released = $7.73 \text{ MeV} - 4.46 \text{ MeV}$ $= 3.27 \text{ MeV}$</p>	<p>$\frac{1}{2}$</p> <p>$\frac{1}{2}$</p> <p>$\frac{1}{2}$</p> <p>$\frac{1}{2}$</p> <p>$\frac{1}{2}$</p> <p>$\frac{1}{2}$</p> <p>1</p>	<p>2</p> <p>2</p>

<p>Set1,Q9 Set2,Q7 Set3,Q9</p>	<div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;"> <p>Calculation of emf 1 Calculation of internal resistance 1</p> </div> $\text{emf} = \frac{E_1 r_2 + E_2 r_1}{r_1 + r_2}$ $= \frac{1.5 \times 0.3 + 2 \times 0.2}{0.2 + 0.3} \text{ V}$ $= \frac{0.45 + 0.40}{0.5} \text{ V} = 1.7 \text{ V}$ $r = \frac{r_1 r_2}{r_1 + r_2}$ $= \frac{0.2 \times 0.3}{0.2 + 0.3} \Omega$ $= \frac{0.06}{0.5} \Omega$ $= 0.12 \Omega$	<p>1/2 1/2 1/2 1/2</p>	<p>2</p>
<p>Set1,Q10 Set2,Q8 Set3,Q6</p>	<div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;"> <p>Statement of Brewster's Law 1 Reason of different value 1</p> </div> <p>When unpolarised light is incident on the surface separating two media, the reflected light gets (completely) polarized only when the reflected light and refracted light become perpendicular to each other.</p> <p>[Alternatively If the student draws the diagram, as shown, and writes i_p as the polarizing angle, award this 1 mark. If the student just writes $\mu = \tan i_p$, award half mark only.]</p> <div style="text-align: center;">  </div> <p>The refractive index of denser medium, with respect to rarer medium, is given by $\mu = \tan i_p$</p> <p>Since Refractive index (μ) of a transparent medium is different for different colours, hence Brewster angle is different for different colours.</p>	<p>1 1/2 1/2</p>	<p>2</p>

SECTION (C)

Set1,Q11
Set2,Q14
Set3,Q12

Obtaining an expression for Electric field intensity	2
Showing behavior at large distance	1



Net Electric Field at point P = $\int_0^{2\pi a} dE \cos \theta$

$dE = \text{Electric field due to a small element having charge } dq$
 $= \frac{1}{4\pi\epsilon_0} \frac{dq}{r^2}$

Let $\lambda = \text{Linear charge density}$

$= \frac{dq}{dl}$
 $dq = \lambda dl$

Hence $E = \int_0^{2\pi a} \frac{1}{4\pi\epsilon_0} \cdot \frac{\lambda dl}{r^2} \times \frac{x}{r}$, where $\cos \theta = \frac{x}{r}$

$= \frac{\lambda x}{4\pi\epsilon_0 r^3} (2\pi a)$

$= \frac{1}{4\pi\epsilon_0} \frac{Qx}{(x^2+a^2)^{\frac{3}{2}}}$, where total charge $Q = \lambda \times 2\pi a$

At large distance i.e. $x \gg a$

$E \approx \frac{1}{4\pi\epsilon_0} \cdot \frac{Q}{x^2}$

This is the Electric field due to a point charge at distance x .

(NOTE: Award two marks for this question, if a student attempts this question but does not give the complete answer)

1/2

1/2

1/2

1/2

1/2

1/2

3

Set1,Q12
Set2,Q15
Set3,Q13

Three Characteristic features	1+1+1
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The three characteristic features which can't be explained by wave theory are:

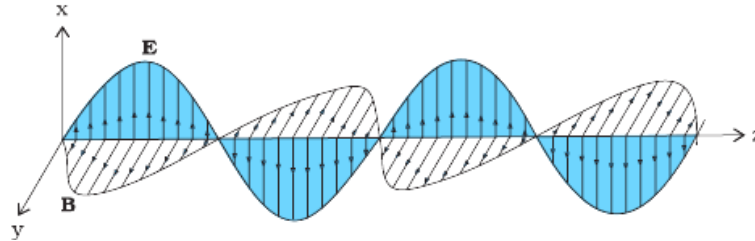
- i. Kinetic energy of emitted electrons are found to be independent of intensity of incident light.

1

	$d\phi = M dI$ $= 1.5 \times (20-0)W$ $= 30 \text{ weber}$	1 ½ ½	3						
Set1,Q15 Set2,Q12 Set3,Q14	<table border="1"><tr><td>(i) Calculation of capacitance of each capacitor</td><td>½ + ½</td></tr><tr><td>(ii) Calculation of potential difference</td><td>½ + ½</td></tr><tr><td>(iii) Estimation of ratio of electrostatic energy</td><td>1</td></tr></table> <p>i) Let $C_X = C$</p> <p>$C_Y = 4C$ (as it has a dielectric medium of $\epsilon_r = 4$)</p> <p>For series combination of two capacitors</p> $\frac{1}{C} = \frac{1}{C_X} + \frac{1}{C_Y}$ $\Rightarrow \frac{1}{4\mu F} = \frac{1}{C} + \frac{1}{4C}$ $\frac{1}{4\mu F} = \frac{5}{4C}$ $\Rightarrow C = 5\mu F$ <p>Hence $C_X = 5\mu F$ $C_Y = 20\mu F$</p> <p>ii) Total charge $Q = CV$</p> $= 4\mu F \times 15 V = 60\mu C$ $V_X = \frac{Q}{C_X} = \frac{60\mu C}{5\mu F} = 12 V$ $V_Y = \frac{Q}{C_Y} = \frac{60\mu C}{20\mu F} = 3 V$ <p>iii) $\frac{E_x}{E_y} = \frac{\frac{Q^2}{2C_X}}{\frac{Q^2}{2C_Y}} = \frac{C_Y}{C_X} = \frac{20}{5} = 4 : 1$</p> <p>(Also accept any other correct alternative method)</p>	(i) Calculation of capacitance of each capacitor	½ + ½	(ii) Calculation of potential difference	½ + ½	(iii) Estimation of ratio of electrostatic energy	1	½ ½ ½ ½ 1	3
(i) Calculation of capacitance of each capacitor	½ + ½								
(ii) Calculation of potential difference	½ + ½								
(iii) Estimation of ratio of electrostatic energy	1								

Set1,Q16 Set2,Q13 Set3,Q17	<table border="1"> <tr> <td>Diagram showing attractive force on other wire.</td> <td>1</td> </tr> <tr> <td>Obtaining an expression for force.</td> <td>1</td> </tr> <tr> <td>Definition of one ampere.</td> <td>1</td> </tr> </table>	Diagram showing attractive force on other wire.	1	Obtaining an expression for force.	1	Definition of one ampere.	1		
Diagram showing attractive force on other wire.	1								
Obtaining an expression for force.	1								
Definition of one ampere.	1								
		1/2							
	<p>As shown in Figure, the direction of force on conductor b is attractive [Alternatively: \vec{B} at a point on wire 2, is along $-\hat{k}$ $\therefore \vec{F}$, on wire 2, due to the \vec{B}, is along $-\hat{i}$, i.e. towards wire1. Hence the force is attractive.</p>	1/2							
	Magnetic field, due to current in conductor a,								
	$B_1 = \frac{\mu_0 I_1}{2\pi d}$	1/2							
	The magnitude of force on a length L of conductor b,								
	$F_2 = I_2 L B_1$	1/2							
	$F_2 = \frac{\mu_0 I_1 I_2 L}{2\pi d}$								
	One ampere is that steady current which, when maintained in each of the two very long, straight, parallel conductors, placed one meter apart in vacuum, would produce on each of these conductors a force equal to 2×10^{-7} newton per meter of their length.	1	3						
Set1,Q17 Set2,Q20 Set3,Q18	<table border="1"> <tr> <td>Production of em waves</td> <td>1</td> </tr> <tr> <td>Drawing of sketch of linearly polarized em waves</td> <td>1</td> </tr> <tr> <td>Indication of directions of oscillating electric and magnetic fields</td> <td>1/2 + 1/2</td> </tr> </table>	Production of em waves	1	Drawing of sketch of linearly polarized em waves	1	Indication of directions of oscillating electric and magnetic fields	1/2 + 1/2		
Production of em waves	1								
Drawing of sketch of linearly polarized em waves	1								
Indication of directions of oscillating electric and magnetic fields	1/2 + 1/2								
	A charge oscillating with some frequency, produces an oscillating electric field in space, which in turn produces an oscillating magnetic								

field perpendicular to the electric field, this process goes on repeating , producing em waves in space perpendicular to both the fields.



Directions of \vec{E} and \vec{B} are perpendicular to each other and also perpendicular to direction of propagation of em waves.

OR

Maxwell's generalization of Ampere's Circuital law	1
Showing that current produced, within the plates of a capacitor is $i = \epsilon_0 \frac{d\phi_\epsilon}{dt}$	2

Ampere's circuital law is given by as $\oint \vec{B} \cdot d\vec{l} = \mu_0 i_c$

But for a circuit containing capacitor, during its charging / discharging the current within the plates of the capacitor varies, (producing displacement current i_d). Therefore, the above equation, as generalized by Maxwell, is given as $\oint \vec{B} \cdot d\vec{l} = \mu_0 i_c + \mu_0 i_d$

During the process of charging of capacitor, electric flux (ϕ_ϵ) between the plates of capacitor changes with time, which produces the current within the plates of capacitor. This current, being proportional to $\frac{d\phi_\epsilon}{dt}$, we have

$$i = \epsilon_0 \frac{d\phi_\epsilon}{dt}$$

1

1

1/2 + 1/2

1

1

1

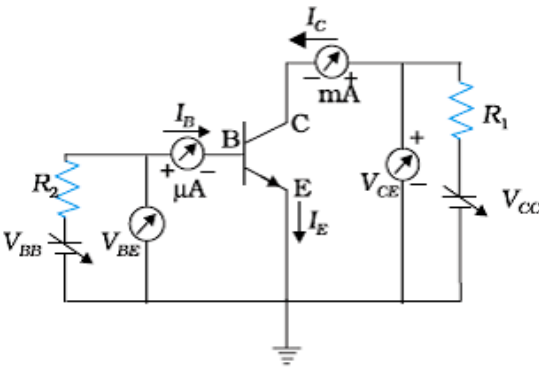
3

Set1,Q18
Set2,Q21
Set3,Q16

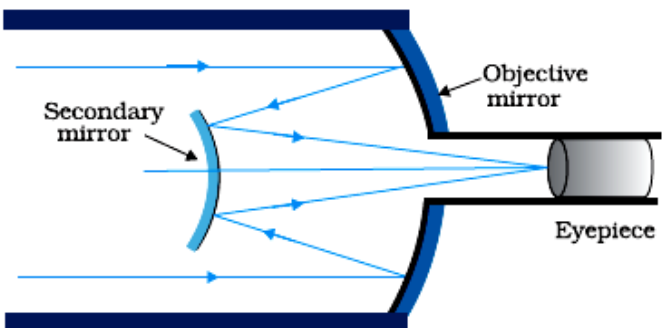
a) Explanation of any two factors justifying the need of modulation	1+ 1
b) Two advantages of FM over AM	1/2 + 1/2

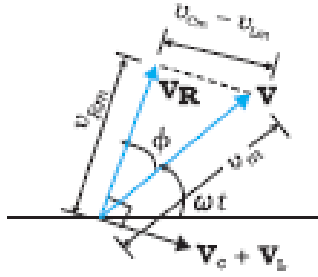
a) A low frequency signal is modulated for the following purposes:
(i) It reduces the wavelength of transmitted signal, and the minimum height of antenna for effective communication is $\lambda/4$. Therefore height of antenna becomes practically achievable.

1

	<p>(ii) Power radiated into the space by an antenna is inversely proportional to λ^2. Therefore, the power radiated into the space increases and signal can travel larger distance. (Give full credit of this part for any other correct answer)</p> <p>b)</p> <p>(i) High efficiency (ii) Less noise (iii) Maximum use of transmitted power (any two)</p>	<p>1</p> <p>$\frac{1}{2} + \frac{1}{2}$</p>	<p>3</p>						
<p>Set1,Q19 Set2,Q22 Set3,Q20</p>	<table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td>(i) Function of three segments</td> <td>$\frac{1}{2} + \frac{1}{2} + \frac{1}{2}$</td> </tr> <tr> <td>(ii) Circuit diagram</td> <td>1</td> </tr> <tr> <td>Input and output characteristics</td> <td>$\frac{1}{2}$</td> </tr> </table> <p>i)</p> <p>Emitter : Supplies the large number of majority charge carriers for the flow of current through the transistor. Base : Controls the movement of charge carriers coming from emitter region Collector: Collects a major portion of the majority carriers supplied by the emitter.</p> <p>(NOTE: Also accept the following explanation of these parts of the transistor as asked in Hindi translation)</p> <p>Emitter: Heavily doped and of moderate size. Base: Central region, thin and lightly doped. Collector: Moderately doped and large sized.</p> <p>ii)</p>  <p>Input characteristics are obtained by recording the values of base current I_B, for different values of V_{BE} at constant V_{CE} Output characteristics are obtained by recording the values of I_C for different values of V_{CE} at constant I_B</p>	(i) Function of three segments	$\frac{1}{2} + \frac{1}{2} + \frac{1}{2}$	(ii) Circuit diagram	1	Input and output characteristics	$\frac{1}{2}$	<p>$\frac{1}{2}$</p> <p>$\frac{1}{2}$</p> <p>$\frac{1}{2}$</p> <p>1</p> <p>$\frac{1}{2}$</p>	
(i) Function of three segments	$\frac{1}{2} + \frac{1}{2} + \frac{1}{2}$								
(ii) Circuit diagram	1								
Input and output characteristics	$\frac{1}{2}$								

	<p>[Alternatively Also accept input/output characteristic curves for this part of the question.]</p>		3
Set1,Q20 Set2,Q17 Set3,Q19	<div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;"> <p>(i) Calculation of distance of an object and location of image 2 (ii) Reason for virtual image, through convex mirror 1</p> </div> <p>a) Given $R = -20$ cm, and magnification $m = -2$</p> <p>Focal length of the mirror $f = \frac{R}{2} = -10$ cm</p> <p>Magnification (m) = $-\frac{v}{u}$</p> $-2 = -\frac{v}{u}$ $\Rightarrow v = 2u$ <p>Using mirror formula</p> $\frac{1}{f} = \frac{1}{v} + \frac{1}{u}$ $\Rightarrow -\frac{1}{10} = \frac{1}{2u} + \frac{1}{u}$ $\Rightarrow u = -15$ cm <p>$\therefore v = 2 \times -15$ cm = -30 cm</p> <p>b)</p> $\frac{1}{f} = \frac{1}{v} + \frac{1}{u}$ <p>Using sign convention, for convex mirror, we have $f > 0, u < 0$</p> <p>From the formula</p> $\frac{1}{v} = \frac{1}{f} - \frac{1}{u}$ <p>$\therefore f$ is positive and u is negative, $\Rightarrow v$ is always positive, hence image is always virtual.</p>	<p style="text-align: center;">$\frac{1}{2}$</p> <p style="text-align: center;">$\frac{1}{2}$</p> <p style="text-align: center;">$\frac{1}{2}$</p> <p style="text-align: center;">$\frac{1}{2}$</p> <p style="text-align: center;">$\frac{1}{2}$</p> <p style="text-align: center;">$\frac{1}{2}$</p>	<p style="text-align: center;">3</p>
Set1,Q21 Set2,Q18 Set3,Q22	<div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;"> <p>(i) Statement of Bohr's quantization condition $\frac{1}{2}$ de- Broglie explanation of stationary orbits 1 (ii) Relation between $\lambda_1, \lambda_2, \lambda_3$ $1 \frac{1}{2}$</p> </div> <p>(i) Only those orbits are stable for which the angular momentum, of revolving electron, is an integral multiple of $\frac{h}{2\pi}$.</p>		

	<p>[Alternatively</p> $L = \frac{nh}{2\pi} \text{ i.e. angular momentum of orbiting electron is quantised.}]$ <p>According to de Broglie hypothesis Linear momentum (p) = $\frac{h}{\lambda}$ And for circular orbit $L = r_n p$ where 'r_n' is the radius of quantized orbits.</p> $= \frac{rh}{\lambda}$ <p>Also $L = \frac{nh}{2\pi}$</p> $\therefore \frac{rh}{\lambda} = \frac{nh}{2\pi}$ $\Rightarrow 2\pi r_n = n\lambda$ <p>\therefore Circumference of permitted orbits are integral multiples of the wavelength λ</p> <p>ii) $E_C - E_B = \frac{hc}{\lambda_1}$(i) $E_B - E_A = \frac{hc}{\lambda_2}$(ii)</p> $E_C - E_A = \frac{hc}{\lambda_3}$(iii) <p>Adding (i) & (ii)</p> $E_C - E_A = \frac{hc}{\lambda_1} + \frac{hc}{\lambda_2}$(iv) <p>Using equation (iii) and (iv)</p> $\frac{hc}{\lambda_3} = \frac{hc}{\lambda_1} + \frac{hc}{\lambda_2} \Rightarrow \frac{1}{\lambda_3} = \frac{1}{\lambda_1} + \frac{1}{\lambda_2}$	<p>1/2</p> <p>1/2</p> <p>1/2</p> <p>1/2</p> <p>1/2</p> <p>1/2</p> <p>1/2</p>	<p>3</p>				
<p>Set1,Q22 Set2,Q19 Set3,Q21</p>	<table border="1" style="width: 100%;"> <tr> <td style="width: 80%;">Drawing of Schematic ray diagram</td> <td style="width: 20%;">2</td> </tr> <tr> <td>Two advantages</td> <td>1/2 + 1/2</td> </tr> </table> 	Drawing of Schematic ray diagram	2	Two advantages	1/2 + 1/2	<p>2</p>	
Drawing of Schematic ray diagram	2						
Two advantages	1/2 + 1/2						



From Figure

$$\vec{V} = \vec{V}_L + \vec{V}_R + \vec{V}_C$$

$$\text{where } |\vec{V}_R| = i_m R$$

$$\begin{aligned} |\vec{V}_L + \vec{V}_C| &= V_{Cm} - V_{Lm} \\ &= i_m (X_C - X_L) \end{aligned}$$

$$\Rightarrow V_m^2 = V_{Rm}^2 + (V_{Cm} - V_{Lm})^2$$

$$l_m^2 Z^2 = l_m^2 R^2 + i_m^2 (X_C - X_L)^2$$

$$\Rightarrow Z = \sqrt{R^2 + (X_C - X_L)^2}$$

From Figure

$$\tan \phi = \frac{V_{Cm} - V_{Lm}}{V_{Rm}} = \frac{i_m (X_C - X_L)}{i_m R}$$

$$\phi = \tan^{-1} \left(\frac{X_C - X_L}{R} \right)$$

Condition for current and voltage are in phase :

$$V_L = V_C \quad \text{or} \quad X_L = X_C$$

Circuit is called Resonant circuit.

$$\text{ii) Power factor } P_1 = \frac{R}{Z} = \frac{R}{\sqrt{R^2 + R^2}} = \frac{1}{\sqrt{2}}$$

(as $X_L = R$)

Power factor when capacitor C of Reactance $X_C = X_L$ is put in series in the circuit

1/2

1/2

1/2

1/2

1/2

1/2

1/2

1/2

$$P_2 = \frac{R}{Z} = \frac{R}{R} = 1$$

as $Z=R$ at resonance

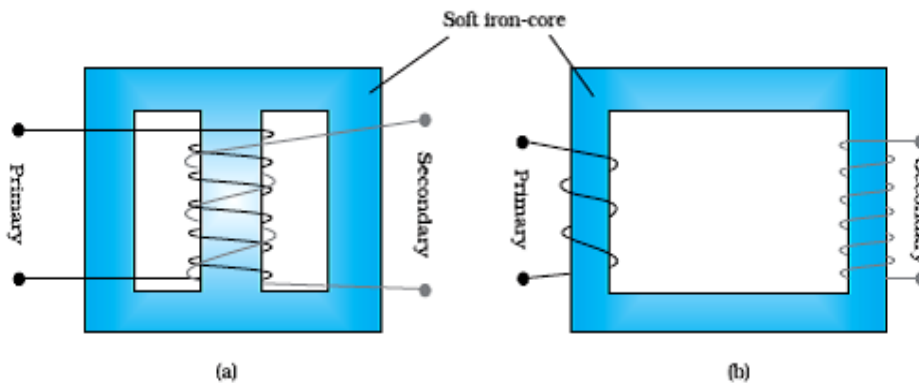
$$\therefore \frac{P_1}{P_2} = \frac{1}{\sqrt{2}} = \frac{1}{\sqrt{2}}$$

OR

(i)	Function of transformer	1/2
	Working principle and diagram	1/2 + 1/2
	Various energy losses (two)	1/2 + 1/2
(ii)	Calculation of part (a) , (b), (c), (d) & (e)	2 1/2

(i) Conversion of ac of low voltage into ac of high voltage & vice versa

Mutual induction: When alternating voltage is applied to primary windings, emf is induced in the secondary windings.



(Any one of the above diagram)

Energy losses:

- a. Leakage of magnetic flux
- b. Eddy currents
- c. Hysterisis loss
- d. Copper loss

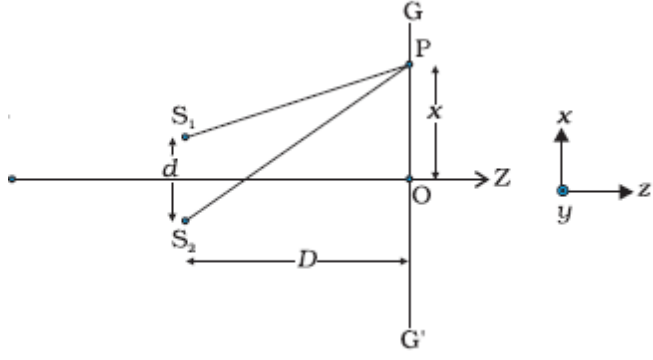
(Any two)

ii)

$$N_p = 100$$

Transformation ratio= 100

a) Number of turns in secondary coil

	<p>$N_s = 100 \times 100 = 10000$</p> <p>b) Input Power = Input voltage x current in primary $1100 = 220 \times I_p$ $\Rightarrow I_p = 5A$</p> <p>c) $\frac{V_s}{V_p} = \frac{N_s}{N_p}$ $\frac{V_s}{220} = 100$ $\Rightarrow V_s = 2.2 \times 10^4$ volts</p> <p>d) $\frac{I_p}{I_s} = \frac{N_s}{N_p}$ $\frac{5}{I_s} = 100$ $\Rightarrow I_s = \frac{5}{100} = 0.05$ A</p> <p>e) Power in secondary = Power in Primary $= 1100$ W</p>	<p>$\frac{1}{2}$</p> <p>$\frac{1}{2}$</p> <p>$\frac{1}{2}$</p> <p>$\frac{1}{2}$</p> <p>$\frac{1}{2}$</p>	<p>5</p>
<p>Set1,Q25 Set2,Q26 Set3,Q25</p>	<div style="border: 1px solid black; padding: 10px; margin-bottom: 10px;"> <p>i) Deduce the conditions for a) constructive and b) destructive interference 2 $\frac{1}{2}$</p> <p>Graph showing the variation of intensity 1</p> <p>ii) Three distinguishing features 1 $\frac{1}{2}$</p> </div> <p>i)</p>  <p>From figure Path difference = $(S_2P - S_1P)$</p> $(S_2P)^2 - (S_1P)^2 = [D^2 + (x + \frac{d}{2})^2] - [D^2 + (x - \frac{d}{2})^2]$ $(S_2P + S_1P)(S_2P - S_1P) = 2xd$	<p>$\frac{1}{2}$</p>	

$$S_2P - S_1P = \frac{2xd}{S_2P + S_1P}$$

For $x, d \ll D$

$$S_2P + S_1P = 2D$$

$$\therefore S_2P - S_1P = \frac{2xd}{2D} = \frac{xd}{D}$$

For constructive interference $S_2P - S_1P = n\lambda, n=0,1,2,\dots$

$$\Rightarrow \frac{xd}{D} = n\lambda$$

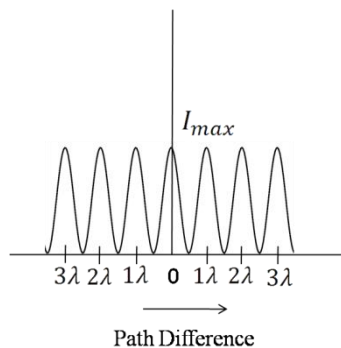
$$\Rightarrow x = \frac{n\lambda D}{d}$$

For destructive interference $S_2P - S_1P = (2n + 1)\frac{\lambda}{2}$

$$n = 0, 1, 2, \dots$$

$$\frac{xd}{D} = (2n + 1)\frac{\lambda}{2}$$

$$\Rightarrow x = (2n + 1)\frac{\lambda D}{2d}$$



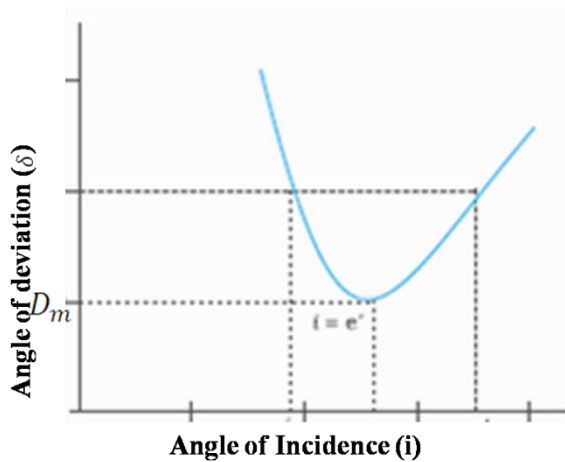
ii)

- (a) The Interference pattern has number of equally spaced bright and dark bands, while in the diffraction pattern the width of the central maximum is twice the width of other maxima.
- (b) In Interference all bright fringes are of equal intensity, whereas in the diffraction pattern the intensity falls as order of maxima increases.
- (c) In Interference pattern, maxima occurs at an angle $\frac{\lambda}{a}$, where a is the slit width, whereas in diffraction pattern, at the same angle, first minimum occurs. (Here 'a' is the size of the slit)

(Any other distinguishing feature)

OR

i)	Plot showing the variation of the angle of deviation as a function of angle of incidence	1
	Derivation of expression of refractive index	1 ½
ii)	Definition of Dispersion and its cause	½ + ½
iii)	Calculation of minimum value of refractive index	1 ½



1

From figure $\delta = D_m, i = e$ which implies $r_1 = r_2$

$$2r = A, \text{ or } r = A/2$$

½

Using $\delta = i + e - A$

$$D_m = 2i - A$$

$$i = \frac{A + D_m}{2}$$

½

$$\mu = \frac{\sin i}{\sin r} = \frac{\sin\left(\frac{A + D_m}{2}\right)}{\sin A/2}$$

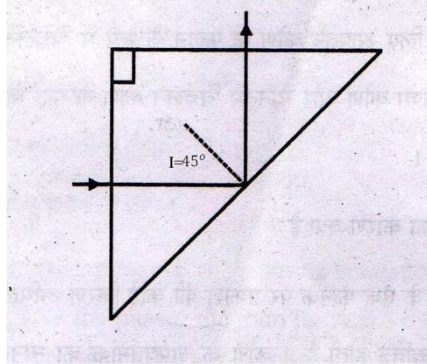
½

(ii) The phenomenon of splitting of white light into its constituent colours.

½

Cause: Refractive index of the material is different for different colours
According to the equation, $\delta \approx (\mu - 1)A$, where A is the angle of prism, different colours will deviate through different amount.

½



For total internal reflection,
 $\angle i \geq \angle i_c$ (critical angle)

$$\Rightarrow 45^\circ \geq \angle i_c, \text{ i.e., } \angle i_c \leq 45^\circ$$

$$\sin i_c \leq \sin 45^\circ$$

$$\leq \frac{1}{\sqrt{2}}$$

$$\frac{1}{\sin i_c} \geq \sqrt{2}$$

$$\Rightarrow \mu \geq \sqrt{2}$$

Hence, the minimum value of refractive index must be $\sqrt{2}$

1/2

1/2

1/2

5

Set1,Q26
 Set2,Q24
 Set3,Q24

i)	Definition of drift velocity	1
ii)	Derivation of expression of resistivity	2
	Factors affecting resistivity	1
iii)	Reason of using constantan and manganin	1

i) Average velocity acquired by the electrons in the conductor in the presence of external electric field.

[Alternatively:

$$v_d = \frac{-eE\tau}{m} \text{ where } \tau \text{ is the relaxation time.}]$$

ii) $v_d = \frac{-eE\tau}{m}$

We have $E = -\frac{V}{\ell}$, where V is potential difference across the length ' ℓ ' of the conductor

$$v_d = \frac{eV\tau}{m\ell}$$

Current flowing $I = neAv_d$

$$I = neAv_d \frac{eV\tau}{m\ell} = \frac{ne^2AV\tau}{m\ell}$$

$$\frac{I}{V} = \frac{ne^2A\tau}{m\ell} = \frac{1}{R} \text{ -----(i)}$$

1

1/2

1/2

1/2

<p>Also, $R = \rho \frac{l}{A}$ -----(ii)</p> <p>Comparing (i) and (ii)</p> $\rho = \frac{m}{ne^2\tau}$ <p>Resistivity of the material of a conductor depends on the relaxation time, i.e., temperature and the number density of electrons.</p> <p>iii) Because constantan and manganin show very weak dependence of resistivity on temperature</p> <p style="text-align: center;">OR</p>	<p>1/2</p> <p>1/2+ 1/2</p> <p>1</p>	<p>5</p>				
<table border="1" style="width: 100%;"> <tbody> <tr> <td>i) Working Principle of potentiometer</td> <td style="text-align: right;">2</td> </tr> <tr> <td>ii) Calculation of potential gradient and balance length</td> <td style="text-align: right;">3</td> </tr> </tbody> </table>	i) Working Principle of potentiometer	2	ii) Calculation of potential gradient and balance length	3		
i) Working Principle of potentiometer	2					
ii) Calculation of potential gradient and balance length	3					
<p>i) When constant current flows through a conductor of uniform area of cross section, the potential difference, across a length l of the wire, is directly proportional to that length of the wire. [$V \propto l$ (Provided current and area are constant)]</p> <p>ii) Current flowing in the potentiometer wire</p> $i = \frac{E}{R_{total}} = \frac{2.0}{15 + 10} = \frac{2}{25} \text{ A}$ <p>\therefore Potential difference across the two ends of the wire</p> $V_{AB} = \frac{2}{25} \times 10V = \frac{20}{25} = 0.8 \text{ volt}$ <p>Hence potential gradient $K = \frac{V_{AB}}{l_{AB}} = \frac{0.8}{1.0} = 0.8 \text{ V/m}$</p> <p>Current flowing in the circuit containing experimental cell,</p> $= \frac{1.5}{1.2+0.3} = 1 \text{ A}$ <p>Hence, potential difference across length AO of the wire</p> $= 0.3 \times 1V = 0.3V$ $\Rightarrow 0.3 = K \times l_{AO}$ $= 0.8 \times l_{AO}$ $\Rightarrow l_{AO} = \frac{0.3}{0.8} \text{ m} = 0.375 \text{ m}$ $= 37.5 \text{ cm}$	<p>2</p> <p>1/2</p> <p>1/2</p> <p>1/2</p> <p>1/2</p> <p>1/2</p> <p>1/2</p>	<p>5</p>				