SET – III

Subject Code: 042

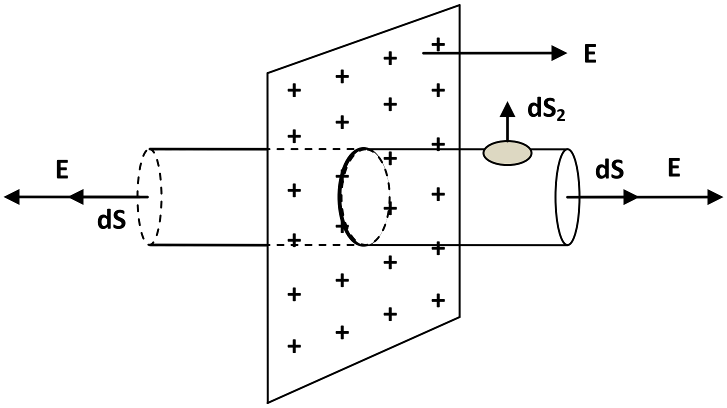
COMMON PRE-BOARD EXAMINATION 2017-2018

PHYSICS

1.	Balance point will get shifted to B, Increase in diameter of the wire will cause decrease in potential drop per unit length	½ ½	1
2.	Current per unit area (taken normal to the current) is called current density. Unit – A/m^2	½ ½	1
3.	$\omega = \frac{1}{\sqrt{LC}}$ L should be changed to L/2	½ ½	1
4.	1. Used in radars 2. Used in communication. (Any two uses) ½ each	½ X 2	1
5.	Collector current - decreases Base current – increases	½ ½	1
6.	We know that $u_E = \frac{1}{2}\varepsilon_0 {E_{rms}}^2$ $= \frac{1}{2}\varepsilon_0 c^2 {B_{rms}}^2$ [$E_{rms} = c\, B_{rms}$] $= \frac{1}{2}\varepsilon_0 \frac{1}{\varepsilon_0\mu_0} {B_{rms}}^2$ [$c = \frac{1}{\sqrt{\varepsilon_0\mu_0}}$] $= \frac{1}{2}\frac{1}{\mu_0} {B_{rms}}^2$ $u_E = u_B$	½ ½ ½ ½	2

7.

2



½

Consider an infinitely large plane sheet of charge density λ. We have to find the electric field at a point P distant 'r' from this plane sheet of charge. For this imagine a Gaussian cylinder of small area of cross section **A** with one end passing through the point P, penetrating the sheet and extending to both sides equally.

$$\text{Total electric flux } = \varphi = \oint \vec{\mathbf{E}}.\overrightarrow{\mathbf{ds}}$$

$$\varphi = \int_{\substack{\text{Curved}\\ \text{surface}}} \vec{\mathbf{E}}.\overrightarrow{\mathbf{ds_2}} + \int_{\substack{\text{End}\\ \text{faces}}} \vec{\mathbf{E}}\,.\overrightarrow{\mathbf{ds}}$$

$$\varphi = \int_{\substack{\text{Curved}\\ \text{surface}}} \mathrm{E\,ds_2}\ \cos 90\ + \int_{\substack{\text{End}\\ \text{faces}}} \mathrm{Eds}\cos 0$$

$$\varphi = \int_{\substack{\text{End}\\ \text{faces}}} \mathrm{Eds}$$

$$\boldsymbol{\varphi} = \ \boldsymbol{E\ 2A} - - - - (\boldsymbol{i})$$

½

The charge enclosed by the Gaussian cylinder, **q = Aσ**

Applying Gauss's theorem

$$\varphi = \frac{q}{\varepsilon_o}$$

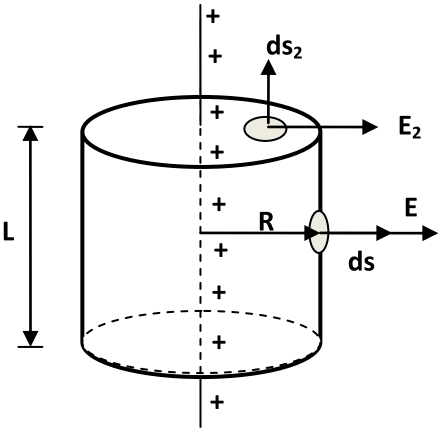
$$\varphi = \frac{\mathbf{A\sigma}}{\varepsilon_o} - - - - - - - - - (ii)$$

½

From (i) & (ii)

$$\boldsymbol{E} = \frac{\boldsymbol{\sigma}}{2\varepsilon_o}$$

½

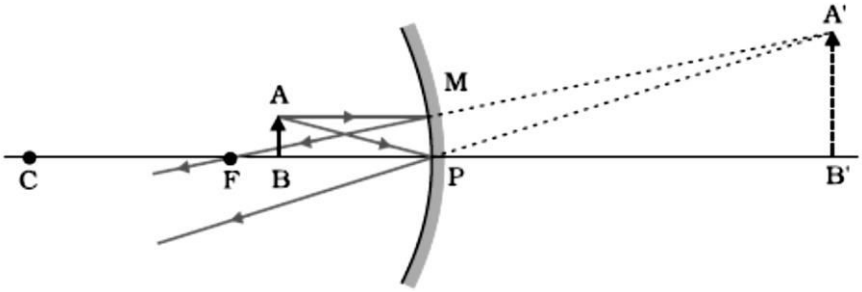
	OR		
OR	Consider an infinitely long straight wire of charge density **λ**. To find the electric field at a point P distant **R** from this line charge. For this imagine a Gaussian cylinder of radius **R** and length **L** with the line charge as the axis.		**2**
		½	
	Total electric flux $= \varphi = \oint \vec{\mathbf{E}}.\overrightarrow{\mathbf{ds}}$ $\varphi = \int_{\substack{\text{Curved}\\ \text{surface}}} \mathrm{E\,ds\,\cos 0} + \int_{\substack{\text{End}\\ \text{faces}}} \mathrm{E_2 ds_2 \cos 90}$ $\varphi = \int_{\substack{\text{Curved}\\ \text{surface}}} \mathrm{E\,ds}$ $\varphi = \mathrm{E} \int_{\mathrm{CS}} \mathrm{ds} = \mathrm{E\,2\pi RL}$ $\boldsymbol{\varphi} = \mathbf{E\,2\pi RL} ------(i)$	½	
	The charge enclosed by the Gaussian cylinder, **q = λL** Applying Gauss's theorem $\varphi = \frac{q}{\varepsilon_o} ---------(ii)$	½	
	From (i) & (ii) $\mathrm{E\,2\pi RL} = \frac{q}{\varepsilon_o} = \frac{\lambda \mathrm{L}}{\varepsilon_o}$ $\mathbf{E} = \frac{\boldsymbol{\lambda}}{\mathbf{2\pi}\varepsilon_o\mathbf{R}}$	½	

8.	Attenuation: The loss of strength of a signal while propagating through a medium is known as attenuation.	1	2
	Transducer: Any device that converts one form of energy into another form is known as transducer. In communication system transducer converts some physical variables into electrical signals or optical signals and vice versa.	1	
9.	(i) Frequency	½	2
	(ii) All same.	½	
	Stopping potential is same for radiation	½	
	Kinetic energy is directly proportional to the frequency/ Stopping potential is directly proportional to the frequency.	½	
10.	$E = hc/\lambda$	½	2
	$= 4.5 \text{ eV}$	½	
	Therefore transition B will give photon of wavelength 275 nm	½	
	Transition A corresponds to emission of maximum wavelength	½	
11.	**Principle:** Mutual induction	½	3
	Working: When an alternating voltage is applied to the primary, the resulting current produces an alternating magnetic flux which links the secondary and induces an emf in it.	½	
	Let φ be the flux in each turn in the core at time t due to current in the primary when a voltage v_p is applied to it. induced emf in the with Ns turns = ε_s $\varepsilon_s = N_s \frac{d\varphi}{dt}$	½	
	If the secondary is an open circuit or the current taken from it is small,		

	then $\varepsilon_s = v_s$ $\therefore\ v_s = N_s \frac{d\varphi}{dt} \quad ----(i)$ Back emf produced in the primary $= \varepsilon_p$ $\varepsilon_p = N_p \frac{d\varphi}{dt}$	½	
	But $\varepsilon_p = v_p$ If this were not so, the primary current would be infinite $\therefore\ v_p = N_p \frac{d\varphi}{dt} \quad ----(ii)$ From (i) and (ii) we get $\frac{v_s}{v_p} = \frac{N_s}{N_p}$	½	
	$\frac{N_s}{N_p}$ is known as transformation ratio For step – up transformer $v_s > v_p$ Therefore $\frac{N_s}{N_p} > 1$	½	
12.	(i) 12μF and 6μF are connected in parallel therefore they have a common potential difference. We know that, $U_6 = \frac{1}{2} C_6 V^2$	½	**3**
	$U_{12} = \frac{1}{2} C_{12} V^2$ $\frac{U_6}{U_{12}} = \frac{C_6}{C_{12}}$	½	

	Therefore $U_{12} = 2E$		
	(ii) Equivalent capacitance of the 12μF and 3μF		
	$C_{18} = C_6 + C_{12} = 12\mu F + 6\mu F = 18\mu F$	½	
	Total energy possessed by $C_{18} = 2E + E = 3E$		
	C_{18} and C_3 are connected in series therefore they have same charge		
	$U_{18} = \frac{1}{2}\frac{Q^2}{C_{18}}$	½	
	$U_3 = \frac{1}{2}\frac{Q^2}{C_3}$		
	$\frac{U_{18}}{U_3} = \frac{C_3}{C_{18}}$	½	
	Therefore $U_3 = 18E$		
	(iii) Total energy possessed by the combination $= 18E + 3E = 21E$	½	
13.	(a) Resolving power of a microscope is define as the reciprocal of the minimum distance between the two objects, such that the objects can be seen as two separate objects when observed through the microscope	1	3
	$R.P = \frac{2\mu \sin\beta}{1.22\,\lambda}$	½	
	(b)		
	(i) Wavelength of electron beam is smaller than visible light, therefore resolving power of electron microscope is more than that of the optical microscope	1	
	(ii) Refractive index of the oil is greater than that of air.	½	
14.	Potential energy = –mBcosθ		
	(a) Configuration Q_1 and Q_2 $\theta = 90^0$	½+½	3
	(b) (i) Stable Q_3 and Q_6 $\theta = 0^0$	½	
	(ii) Unstable Q_4 and Q_5 $\theta = 0^0$	½	
	(c) Lowest potential energy for configuration Q_6 = – mB	½+½	

15. 3



½

$\Delta\, \text{ABP} \approx \Delta\, \text{A}'\text{B}'\text{P}$

$\therefore \; \frac{AB}{\text{A}'\text{B}'} = \frac{BP}{\text{B}'\text{P}} \qquad ------ \text{(i)}$

$\Delta\, \text{MPF} \approx \Delta\, \text{A}'\text{B}'\text{F}$

$\therefore \; \frac{MP}{\text{A}'\text{B}'} = \frac{FP}{\text{FB}'}$ ----------------------(ii)

But $MP = AB$ [aperture of the mirror is very samll & AM is paraxial ray]

∴ equ (ii) becomes

$\frac{AB}{\text{A}'\text{B}'} = \frac{FP}{\text{FB}'}$ ----------------------(iii)

Comparing equ (i) and (iii)

$\frac{FP}{\text{FB}'} = \frac{BP}{\text{B}'\text{P}}$ -------------------------(iv)

From the ray diagram $\text{FB}' = \text{FP} + \text{B}'\text{P}$

∴ equ (iv) becomes

$\frac{FP}{\text{FP} + \text{B}'\text{P}} = \frac{BP}{\text{B}'\text{P}}$ -------------------------(v) ½

Using sign convention, we hve

$\text{FP} = -\text{f}, \; \text{B}'\text{P} = \text{v} \;\; \& \; BP = -u.$

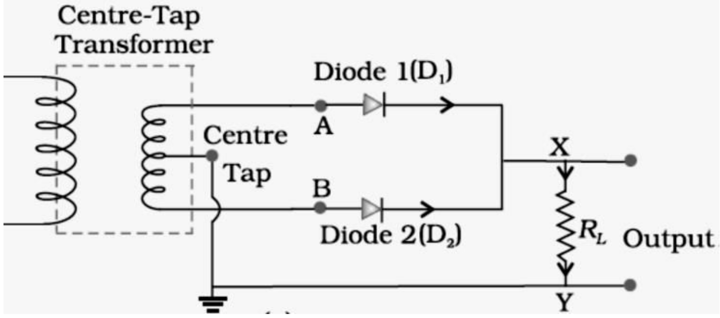
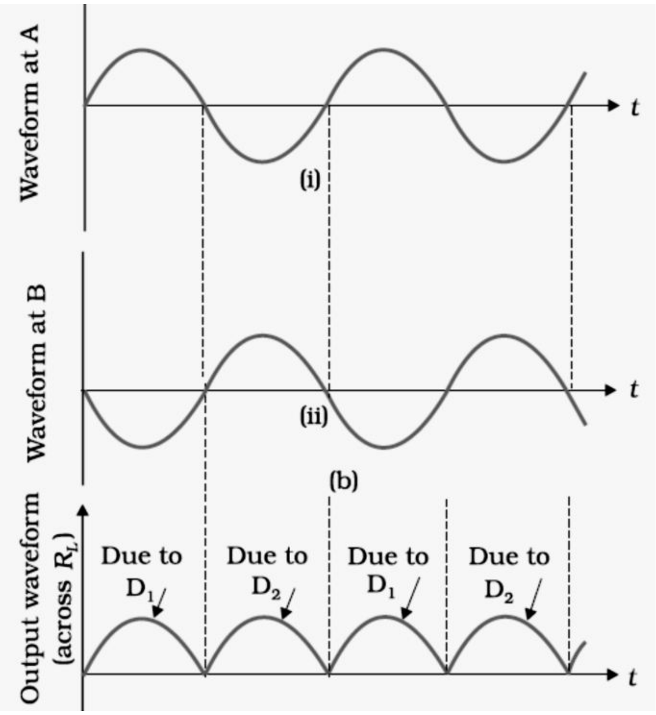
∴ equ (v) becomes

$\frac{f}{\text{v} + (-\text{f})} = \frac{-u}{\text{v}}$ ½

Rearranging the terms we get

$$\frac{1}{f} = \frac{1}{u} + \frac{1}{v}$$ ½

	Assumptions used 1. aperture of the mirror is very samll 2. Incident rays are paraxial rays	½ ½	
16.	(i) Total charge $Q = -2 + 8 = 6\mu C$ Therefore charge on each sphere $= 6\mu C/2 = 3\mu C$ (ii) Repulsion (iii) $V_A = V_B$ $\frac{kQ_A}{R} = \frac{kQ_B}{2R}$ $Q_A + Q_B = 6\mu C$ $Q_A = 2\ \mu C$ $Q_B = 4\ \mu C$ (iv) 1. Charge is conserved, 2. Charge is additive in nature	½ ½ ½ ½ ½ ½	3
17.	(i) Angular separation of the fringes remains constant ($= \lambda/d$). The actual separation of the fringes increases in proportion to the distance of the screen from the plane of the two slits. (ii) Let s be the size of the source and S its distance from the plane of the two slits. For interference fringes to be seen, the condition $s/S < \lambda/d$ should be satisfied; otherwise, interference patterns produced by different parts of the source overlap and no fringes are seen. Thus, as S decreases, the interference pattern gets less and less sharp, and when the source is brought too close for this condition to be valid, the fringes disappear. Till this happens, the fringe separation remains fixed. (iii) The interference patterns due to different component colours of white light overlap (incoherently). The central bright fringes for different colours are at the same position. The fringe closest on either side of the central white fringe is red and the farthest will appear blue. After a few fringes, no clear fringe pattern is seen.	1 1 1	3

18.		1	3
	During the positive cycle of out-put at the secondary of the transformer, terminal A is positive and B is negative with respect to the centre of the secondary. So, diode D_1 gets forward biased and conducts and while D_2 gets reverse biased and does not conduct. Hence, during this positive half cycle we get output voltage across the load resistor R_L as shown in Fig.	1	
	In the negative cycle of the ac, diode D_1 would not conduct but diode D_2 would, giving an output current and output voltage across R_L. Thus, we get output voltage during both the positive as well as the negative half of the cycle.		
		½ ½	

19.	**Observations**		**3**
	1. Intensity of scattered electrons is maximum at scattering angle $\varphi = 50^0$.	½	
	2. When accelerating voltage is 54V intensity of scattered electrons obtains maximum	½	
	Explanation The selective reflection of the 54 V electrons at an angle of 50^0 is due to the diffraction of electrons from the regularly spaced electrons of the nickel crystal by virtue of their wave nature.	½	
	$\theta = \frac{1}{2}(180 - \varphi)$ $\varphi = 50^0$, $\theta = \frac{1}{2}(180 - 50^0) = 65^0$ According to Braggs law $2d \sin\theta = n\lambda$ For first order diffraction n = 1 For nickel , the distance between atomic planes , d = $0.91 \text{ x } 10^{-10}$ m Therefore $\lambda = 2 \times 0.91 \times 10^{-10} \sin 65$ $= 1.66 \times 10^{-10}\, m$ --------(i)	½	
	According to de – Broglie wavelength of the electron accelerated through 54V $\lambda = \frac{12.27 \times 10^{-10}}{\sqrt{54}}$ $= 1.65 \times 10^{-10}\, m$ ---------(ii)	1	
	As the two results (i) and (ii) are in agreement, the experiment establishes the wave nature of an electron.		
	OR		

<table>
<tr>
<td>OR</td>
<td>

$$\lambda = \frac{h}{p}$$

Where p is momentum of the particle of mass 'm' and charge 'q'

We know that

$$p = \sqrt{2\,mE_k}$$

Where E_k is kinetic energy of the particle accelerated by through a potential difference of V

We know that

$E_k = Vq$

$\therefore\ p = \sqrt{2\,mVq}$

$\therefore\ \lambda = \frac{h}{\sqrt{2\,mVq}}$

For an electron $m = 9.1 \times 10^{-31}\,kg$ and $q = 1.6 \times 10^{-19}\,C$

$\lambda = \frac{12.27 \times 10^{-10}}{\sqrt{V}}\ m$

</td>
<td>½
½
½
½
½
½</td>
<td>3</td>
</tr>
<tr>
<td>20.</td>
<td>

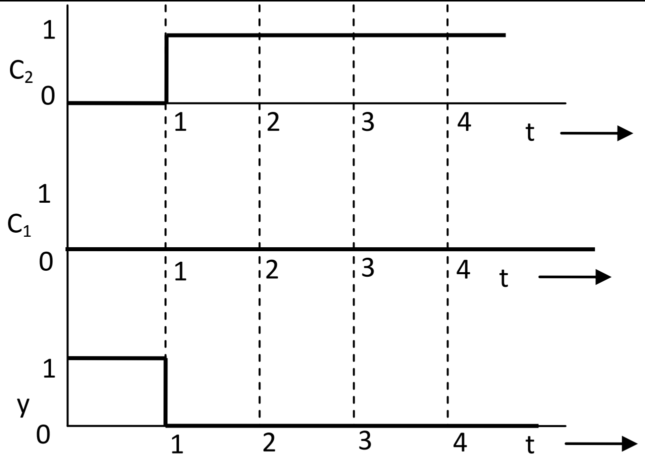
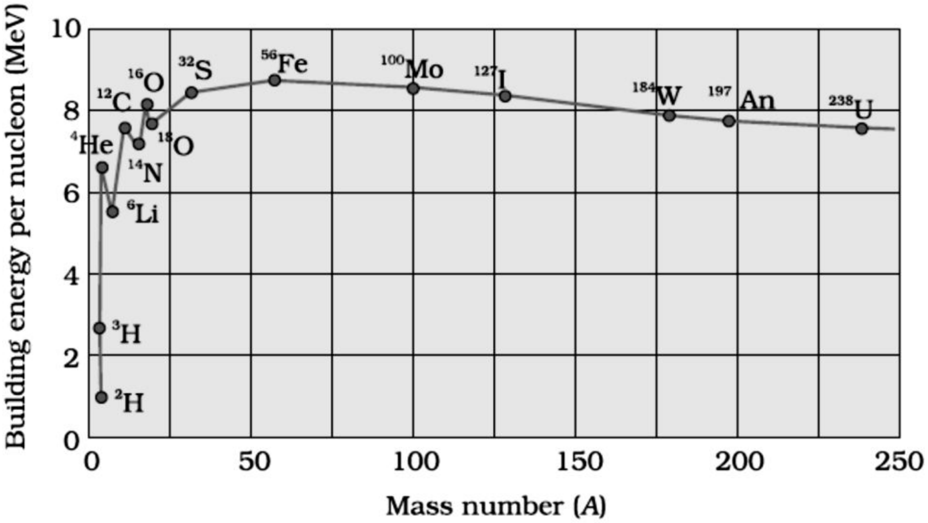
Truth table for the given logic circuit is as given below

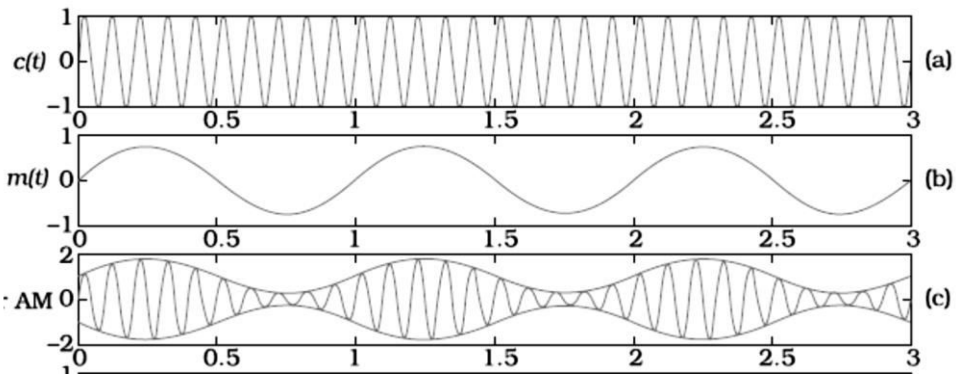
<table>
<tr><td>A</td><td>B</td><td>C_1</td><td>C_2</td><td>y</td></tr>
<tr><td>0</td><td>0</td><td>1</td><td>1</td><td>0</td></tr>
<tr><td>0</td><td>1</td><td>1</td><td>0</td><td>1</td></tr>
<tr><td>1</td><td>0</td><td>0</td><td>1</td><td>1</td></tr>
<tr><td>1</td><td>1</td><td>1</td><td>1</td><td>0</td></tr>
</table>

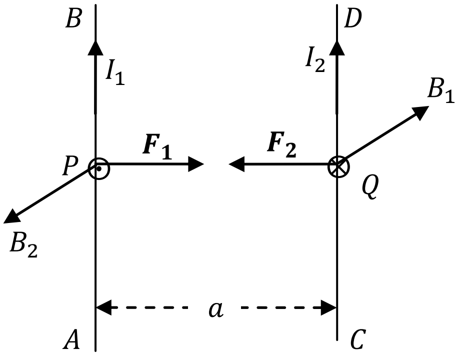
This truth table can be used to write the values of the signals C1 and C2 for the given input signals

<table>
<tr><td>A</td><td>B</td><td>C_1</td><td>C_2</td><td>y</td></tr>
<tr><td>1</td><td>0</td><td>0</td><td>1</td><td>1</td></tr>
<tr><td>1</td><td>1</td><td>1</td><td>1</td><td>0</td></tr>
<tr><td>1</td><td>1</td><td>1</td><td>1</td><td>0</td></tr>
<tr><td>0</td><td>0</td><td>1</td><td>1</td><td>0</td></tr>
</table>

</td>
<td>1
1</td>
<td>3</td>
</tr>
</table>

		1	
21.		1	3
	A very heavy nucleus, say A = 240, has lower binding energy per nucleon compared to that of a nucleus with A = 120. Thus if a nucleus A = 240 breaks into two A = 120 nuclei, nucleons get more tightly bound. This implies energy would be released in the process. [fission]	1	
	Consider two very light nuclei ($A \leq 10$) joining to form a heavier nucleus. The binding energy per nucleon of the fused heavier nuclei is more than the binding energy per nucleon of the lighter nuclei. This means that the final system is more tightly bound than the initial system. Again energy would be released in such a process of fusion.	1	

22.	(a) (i) Practical antenna height For efficient transmission and reception, the antennas must have a length equal to quarter wavelength of message signal. i.e. L= λ/4. For an audio signal of frequency 15 kHz, the length of antenna is approximately 5000 m. This height of antenna is not practical. (ii) Effective power radiated by an antenna It is found that power radiated by an antenna α (l/ λ)^2. From this equation it is clear that for the same antenna height, the power radiated by the short wavelength or high frequency would be large. For the effective transmission, we need high power. (iii) Mixing up of signals from different transmitters. If all transmitters are transmitting baseband information simultaneously then all signals will get mixed up and there is no way to distinguish between them **(Any two points)**	1+1	3
	(b)  	1	
23.	(a) Respect and value for human life, Presence of mind or mentally aware of the situation happening around him.	1+1	4
	(b) Current passes only when there is difference in potential.	½	
	(c) $P=V_{rms}I_{rms}\cos\phi$, Where $\cos\phi$ is the power factor. To transmit power at a given voltage V_{rms}, if $\cos\phi$ is small then	½	

	I_{rms} has to be increased accordingly. Hence the power loss $I^2_{rms} R$ in transmission will increase. Hence to avoid the electric power from a power plant is set, to a very high voltage before transmitting so as to avoid the power loss.	1	
24.	(a) AB and CD are two straight very long parallel conductors placed in air at a distance a. They carry currents I_1 and I_2 respectively.		5
		½	
	The magnetic field due to current I_1 in AB at a distance a is $B_1 = \frac{\mu_o I_1}{2\pi a} \quad --- (1)$	½	
	This magnetic field acts perpendicular to the plane of the paper and inwards. The conductor CD with current I_2 is situated in this magnetic field. Force on a segment of length l of CD due to magnetic field B_1 is		
	$F_2 = B_1 I_2 \, l \qquad (along\ QP)$	½	
	$F_2 = \frac{\mu_o I_1 I_2 \, l}{2\pi a} \qquad (along\ QP) \quad --- (2)$	½	
	The magnetic field due to current I_2 in CD at a distance a is $B_2 = \frac{\mu_o I_2}{2\pi a} \quad --- (3)$ This magnetic field acts perpendicular to the plane of the paper and inwards.		

The conductor AB with current I_1 is situated in this magnetic field. Force on a segment of length l of AB due to magnetic field B_2 is

$$F_1 = B_2 I_1 l \qquad (along\ PQ)$$ ½

$$F_1 = \frac{\mu_o I_2 I_1 l}{2\pi a} \qquad (along\ PQ) \ --- (4)$$

These two forces given in equations (2) and (4) are equal in magnitude and opposite in direction. Hence, two parallel wires carrying currents in the same direction attract each other. ½

(b) Definition of ampere

Force per unit length of the conductor is

$$\frac{F}{l} = \frac{\mu_o I_2 I_1}{2\pi a}$$

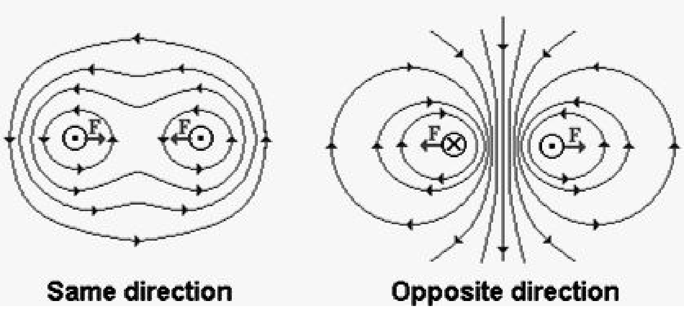
$If \quad I_1 = 1\,A, \ I_2 = 1A \qquad and \quad a = 1m$

$$\frac{F}{l} = \frac{\mu_o \times 1 \times 1}{2\pi \times 1} = \frac{\mu_o}{2\pi}$$

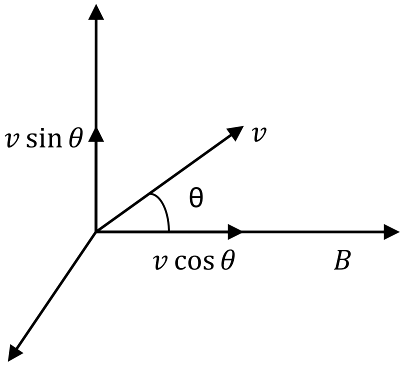
$$\frac{F}{l} = 2 \times 10^{-7} N/m$$ ½

Ampere is defined as that constant current which when flowing through two parallel infinitely long straight conductors of negligible cross section and placed in air or vacuum at a distance of one metre apart, experience a force of 2×10^{-7} *newton per unit length of the conductor.* ½

(c) **Magnetic field lines due two long parallel current-carrying conductors.** 1

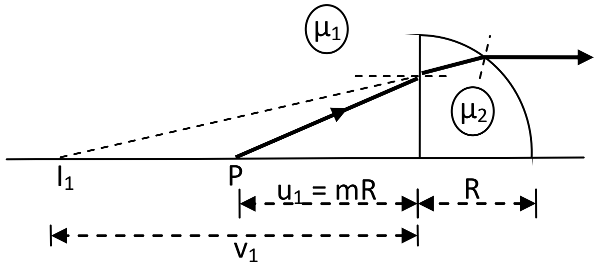


	OR		
OR	(a) Since the magnetic force experienced by the charged particle is perpendicular to its velocity, this force acts as centripetal force and charged particle will move along a circular path of radius $\boldsymbol{r}$. $F_c = F_m$	½	**5**
	$\frac{mv^2}{r} = qvB\sin\theta$ $\frac{mv}{r} = qB \qquad [\sin 90 \ = 1]$ $\boldsymbol{r} = \boldsymbol{\frac{mv}{qB}}$	½	
	(i) **Time Period:** $Time\ Period \ = \frac{Distance\ covered\ in\ one\ cycle}{Speed\ of\ the\ paricle}$ $T = \frac{2\pi r}{v}$ $T = \frac{2\pi m}{qB}$	½	
	(ii) **Kinetic energy** $E = \frac{1}{2}mv^2$ $E \ = \frac{1}{2}\frac{q^2B^2r^2}{m}$	½	
	(b) **Velocity is inclined to the magnetic field** When velocity makes angle θ with magnetic field, there will be one component of velocity parallel to the field and another component perpendicular to the field as shown in the figure.	1	

		½	
	Because of these two component particle will move along a **helical path** inside the field Parallel component $\boldsymbol{v_\parallel = v\cos\theta}$ will cause the particle to move in the direction of field without experiencing any force. Perpendicular component $\boldsymbol{v_\perp = v\sin\theta}$ will cause the particle to move perpendicular to the field and experience a centripetal force. ***Radius*** *of the circular path* $r = \frac{mv_\perp}{qB} = \frac{mv\sin\theta}{qB}$	½	
	Time period of revolution $T = \frac{2\pi r}{v_\perp} = \frac{2\pi}{v\sin\theta}\frac{mv\sin\theta}{qB}$ $T = \frac{2\pi m}{qB}$	1	
	Time period of revolution of charge particle is **independent of angle between $\boldsymbol{v}$ *and* $\boldsymbol{B}$.**		
25.	(a) Focal length increases	1	5
	We know that $\frac{1}{f} = (n_g - 1)\left[\frac{1}{R_1} - \frac{1}{R_2}\right]$	½	
	Since refractive index of the in water is less than that in air, focal length increases.	½	

<table>
<tr>
<td></td>
<td>

(b)



Refraction at plane surface

$$-\frac{1}{u_1}+\frac{\mu}{v_1}=\frac{\mu-1}{R_1}$$

$u_1 = -mR\,;\quad R_1 = \infty\,;\ \mu = 1.5 \quad \therefore\ v_1 = -1.5mR$

Refraction at curved surface

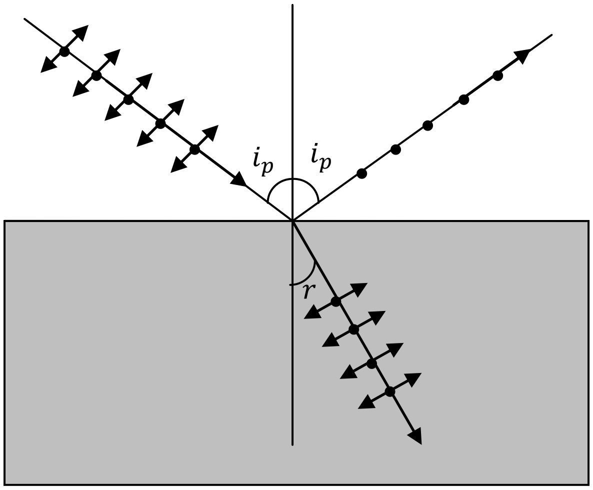
$$-\frac{1}{u_2}+\frac{\mu}{v_2}=\frac{\mu-1}{R_2}$$

$u_2 = -(v_1+R) = -(1.5mR+R);\quad R_1 = -R\,;\ ;v_2 = \infty;\ \mu = 1.5$

$\therefore\ m = \frac{4}{3}$

</td>
<td>½
½
½+½
½
½</td>
<td></td>
</tr>
<tr>
<td></td>
<td>OR</td>
<td></td>
<td></td>
</tr>
<tr>
<td>OR</td>
<td>

(a)



Brewster's law

When light is incident at polarizing angle at the interface of a refracting medium, the refractive index of the medium is equal to the tangent of the polarizing angle.

</td>
<td>½
1</td>
<td>5</td>
</tr>
</table>

$$\mu = \tan i_p \qquad ----(i)$$

$$\mu = \frac{\sin i_p}{\sin r} \qquad ------(ii)$$ ½

Using (i) & (ii)

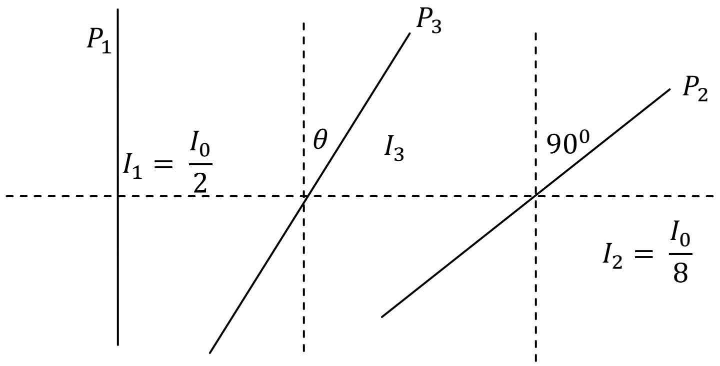
$$\frac{\sin i_p}{\sin r} = \tan i_p \Rightarrow \frac{\sin i_p}{\sin r} = \frac{\sin i_p}{\cos i_p}$$ ½

$$\sin r = \cos i_p \Rightarrow \sin r = \sin(90^o - i_p)$$

$$r = 90^0 - i_p \Rightarrow 90^0 = r + i_p$$ ½

Hence reflected and the refracted ray are perpendicular to each other, when the angle of incidence is equal to polarizing angle.

(b)



½

Intensity of light from Polaroid P_1

$$I_1 = \frac{I_0}{2}$$ ½

According to the law of Malu's

Intensity of light from the Polaroid P_3

$$I_3 = I_1 \cos^2 \theta$$ ½

Intensity of light from the Polaroid P_2

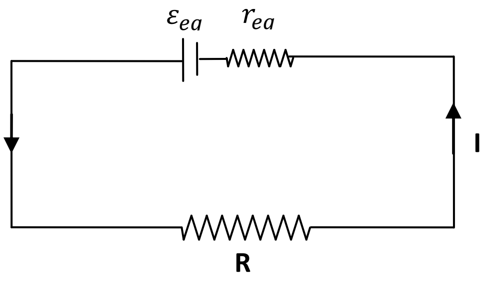
$$I_2 = I_3 \cos^2(90 - \theta)$$

$$I_2 = I_1 \cos^2 \theta \sin^2 \theta$$

$$I_2 = \frac{I_0}{4} 2 \cos^2 \theta \sin^2 \theta$$

$$I_2 = \frac{I_0}{4} \sin^2 2\,\theta$$

Given that

	$I_2 = \frac{I_0}{8}$ $\therefore\ \frac{I_0}{8} == \frac{I_0}{4}\sin^2 2\,\theta$ Solving we get $\theta = 45^o$	½	
26.	(i) Since cells are connected in parallel, voltages across the cells are same, which is equal to V and total current drawn from the combination is I.		5
	$I = I_1 + I_2 ------ (i)$	½	
	And Voltage across the first cell = $V = \varepsilon_1 - I_1 r_1$ $I_1 = \frac{\varepsilon_1}{r_1} - \frac{V}{r_1} \quad --- (ii)$	½	
	Voltage across the second cell = $V = \varepsilon_2 - I_2 r_2$ $I_2 = \frac{\varepsilon_2}{r_2} - \frac{V}{r_2} \quad --- (iii)$ Using $(i), (ii)$ *and* (iii) $V = \left(\frac{\varepsilon_1 r_2 + \varepsilon_2 r_1}{r_{2+} r_1}\right) - I\left(\frac{r_1 r_2}{r_{2+} r_1}\right) --- (iv)$	½	
	If ε_{eq} is the equivalent emf and r_{eq} is the internal resistance of the effective (equivalent) cell,  then $V = \varepsilon_{eq} - I r_{eq} ------ (v)$	½	
	Comparing (iv)& (v)		

$$\boldsymbol{\varepsilon_{eq}} = \frac{\varepsilon_1}{r_1} + \frac{\varepsilon_2}{r_2}$$

$$\boldsymbol{\varepsilon_{eq}} = \frac{\varepsilon_1 r_2 + \varepsilon_2 r_1}{r_1 + r_2}$$ ½

$$\boldsymbol{r_{eq}} = \frac{r_1 r_2}{r_{2+} r_1}$$ ½

(ii) Voltage across the resistor $V = \varepsilon_1$ ½

We know that $V = \varepsilon - Ir$

Since $V = \varepsilon_1$ Current drawn from the cell $\varepsilon_1 = 0$

$\therefore V = \varepsilon_2 - Ir_2$ ½

$$\varepsilon_1 = \varepsilon_2 - Ir_2$$

½

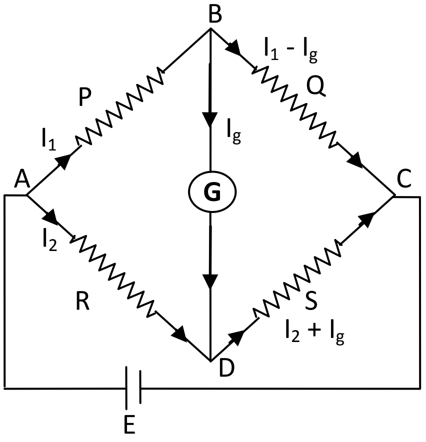
But we know

$$I = \frac{\varepsilon_2}{R + r_2}$$

$$\therefore \varepsilon_1 = \varepsilon_2 - \frac{\varepsilon_2 r_2}{R + r_2}$$

Solving the above equation we get

$$R = \frac{r_2 \varepsilon_1}{\varepsilon_2 - \varepsilon_1}$$ ½

	OR		
OR		1	**5**
	(a) Wheatstone bridge is said to be balanced, when no current is flowing through the galvanometer. i.e when potential at B = potential at D		
	Appling Kirchhoff's Loop rule in loop ABDA $-I_1P - I_gG + I_2R = 0 \quad ---(i)$	½	
	Appling Kirchhoff's Loop rule in loop BCDB $-(I_1 - I_g)Q + (I_2 + I_g)S + I_gG = 0 \quad ---(ii)$	½	
	When the bridge is balanced $I_g = 0$	½	
	$(i) \Rightarrow -I_1P + I_2R = 0$ $I_1P = I_2R \quad ----(iii)$ $(ii) \Rightarrow -I_1Q + I_2S = 0$ $I_1Q = I_2S \quad ---(iv)$ $\frac{(iii)}{(iv)} \Rightarrow \quad \frac{I_1P}{I_1Q} = \frac{I_2R}{I_2S}$		
	$\frac{P}{Q} = \frac{R}{S}$	½	
	(b) Condition for balancing		

	$\frac{R_1}{R_2}=\frac{4}{6}$ − − − − − − − − − − (i)	½	
	When 10 Ω connected in series with R_1 $\frac{R_1+10}{R_2}=\frac{6}{4}$ − − − − − − − − − − (ii)	½	
	Using (i) and (ii) $\frac{R_1}{R_1+10}=\frac{16}{36}$ − − − − − − − (iii)	½	
	Solving (iii) we get R1 = 8 Ω and R2 = 12 Ω	½	