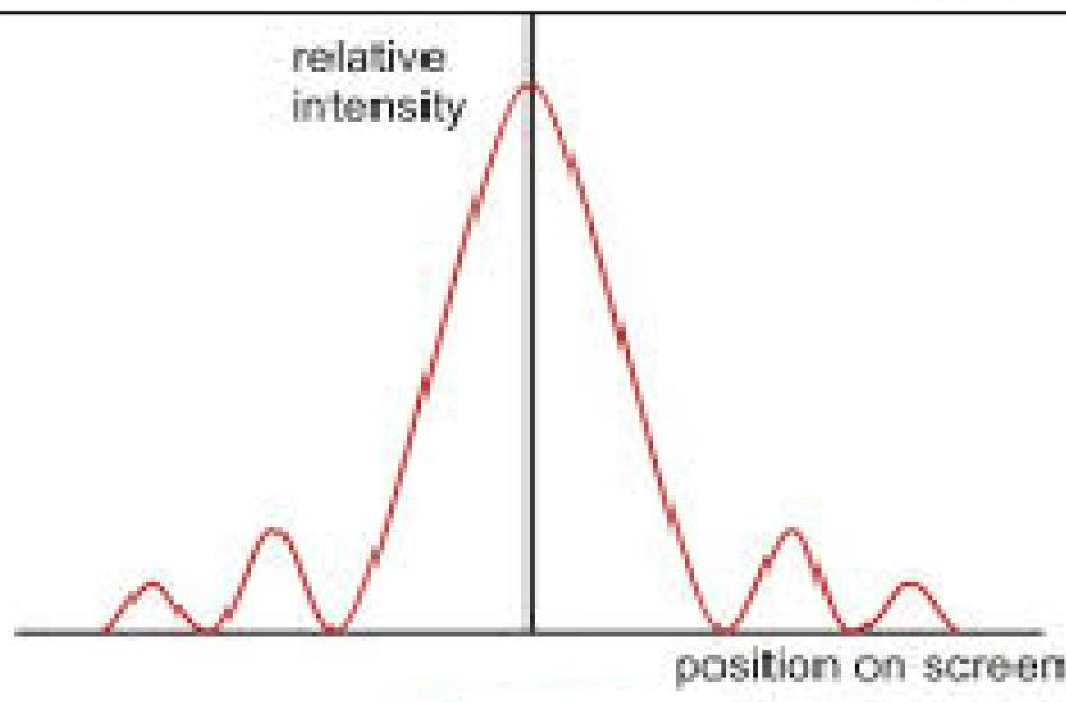
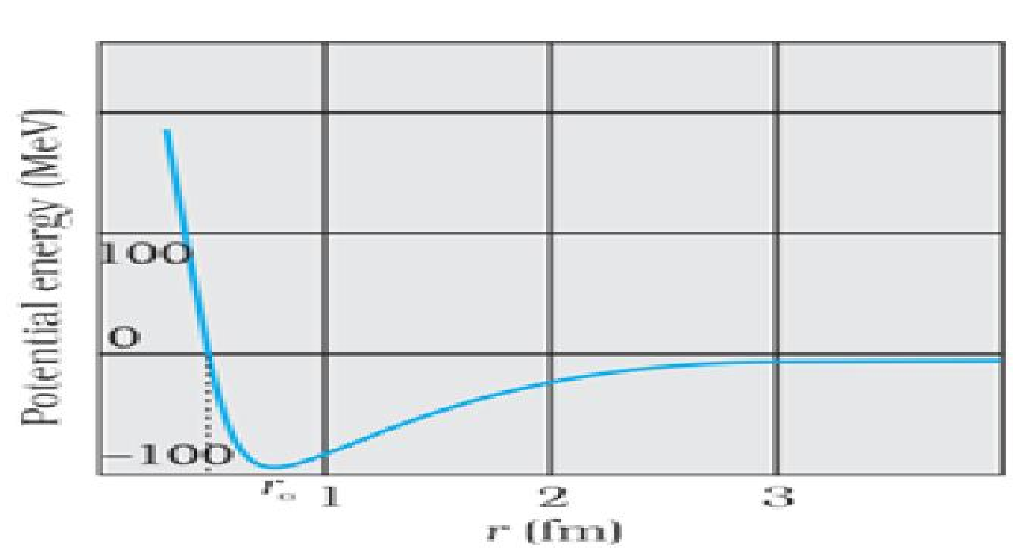
MARKING SCHEME(COMPARTMENT) 2018

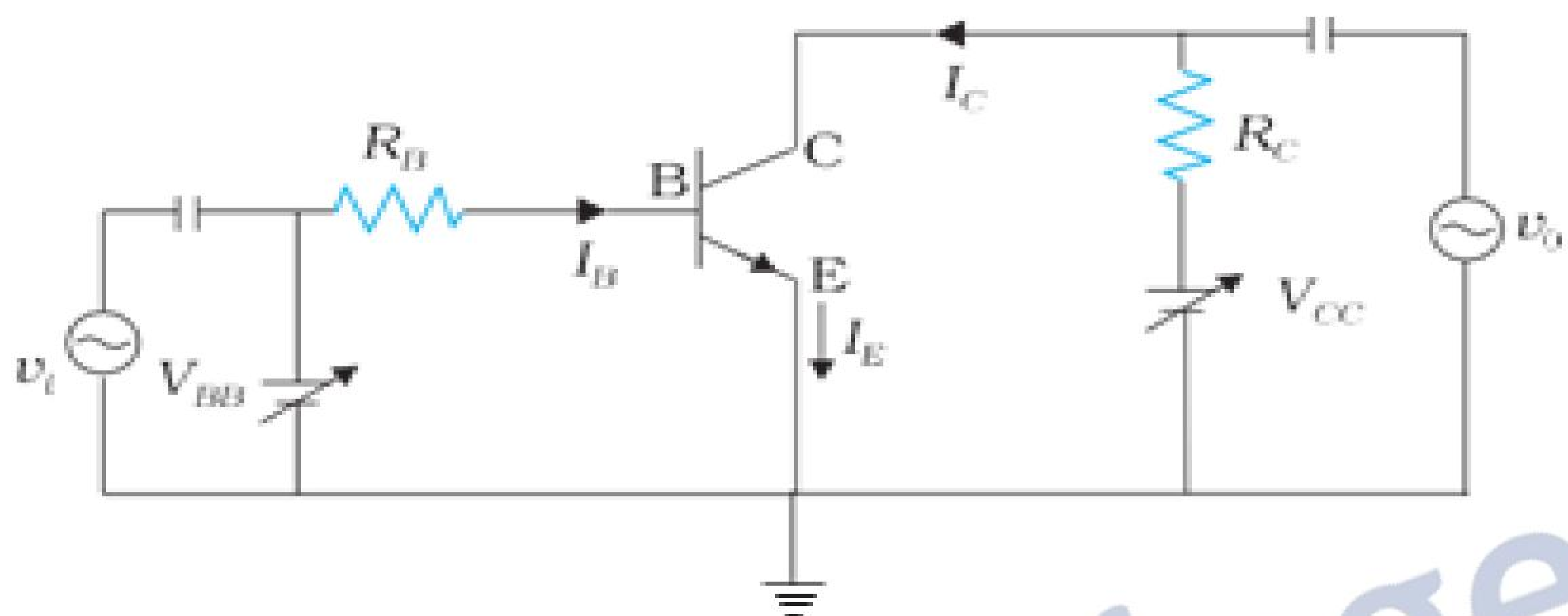
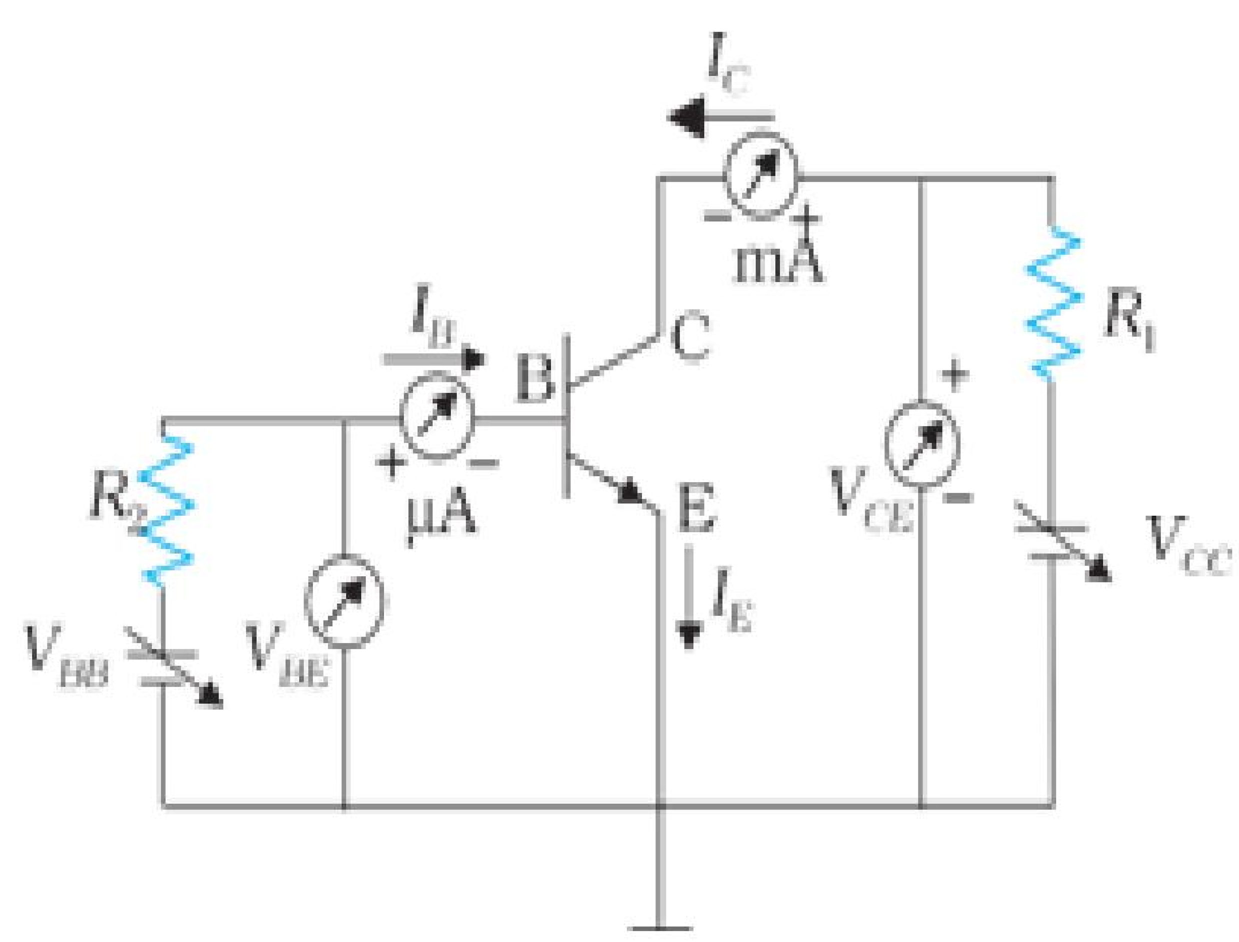
SET 55/2

Q.NO.	VALUE POINTS/ EXPECTED ANSWERS	MARKS	TOTAL MARKS
	SECTION A		
1		1	1
2	Normal : Circular At an angle of 30^0 it will follow helical path	½ ½	1
3	The power of a lens equals to the reciprocal of its focal length(in meter). Also accept $p = \frac{1}{f\,(meter)}$ 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)	½ ½	1
4	From few MHz to 30-40 MHz		1
5	v $= \sqrt{\frac{2eV}{m}}$	1	1
	SECTION B		
6	Formula ½ (i) Frequency of first case ½ (ii) Frequency of second case ½ Ratio ½		

These answers are meant to be used by evaluators

	We have $hv = E_f - E_i$ $= \frac{E_0}{n_f^{\,2}} - \frac{E_0}{n_i^{\,2}}$ $(i)\, hv_1 = E_0(\frac{1}{1^2} - \frac{1}{2^2}) = E_0 \times \frac{3}{4}$ $(ii)\, hv_2 = E_0(\frac{1}{2^2} - \frac{1}{\infty^2}) = E_0 \times \frac{1}{4}$ $\therefore \frac{v_1}{v_2} = 3$	½ ½ ½ ½	2
7	(a)Definition ½ Relation ½ (b) Identification of A and B ½+ ½ (a) Measure of the response of magnetic material to an external magnetic field. Also accept $\chi = \frac{\lvert M \rvert}{\lvert H \rvert}$ We have $\chi = (\mu_r - 1)$ (b) 0.96 : Diamagnetic 500 : Ferromagnetic	½ ½ ½ ½	2
8	SHM nature of oscillation of the wire AB ½ Expression for instantaneous magnetic flux ½ Expression for instantaneous induced emf ½ Qualitative explanation ½ The wire AB would oscillate in a simple harmonic way We can write $x = -a\cos\omega t$ $(as\ x = -a\ at\ t = 0)$ Therefore Instantaneous magnetic Flux $\phi(t) = Blx \quad (l = AB)$ Instantaneous induced emf $e(t) = -\frac{d\phi}{dt} = aBl\omega\ \sin\omega t$ The induced emf, therefore varies with time sinusoidally. (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.)	½ ½ ½ ½	2

	(Give full credit for the above part if the student explains qualitatively without using mathematical equations)		
9	Formula ½ (iii) Frequency of first case ½ (iv) Frequency of second case ½ Ratio ½		
	We have		
	$h\nu = E_f - E_i$	½	
	$= \frac{E_0}{n_f^2} - \frac{E_0}{n_i^2}$		
	$(i)\, h\nu_1 = E_0(\frac{1}{1^2} - \frac{1}{2^2}) = E_0 \times \frac{3}{4}$	½	
	$(ii)\, h\nu_2 = E_0(\frac{1}{2^2} - \frac{1}{\infty^2}) = E_0 \times \frac{1}{4}$	½	
	$\therefore \frac{\nu_1}{\nu_2} = 3$	½	2
10	(a) One use 1 (b) One example each ½+ ½		
	(a) used to destroy cancer cells	1	
	(b) (i)The region, between the plates of a capacitor, connected to time varying voltage source,has a displacement current but no conduction current.	½	
	(ii) The wires, connected to the plates of a capacitor, joined to a time varying or steady voltage source, carry a conduction current but no displacement current. (Alternatively A circuit, having no capacitor in it, and carrying a current has conduction current but no displacement current.)	½	2
	SECTION C		
11	a) Drawing the plot – 1 Marking the relevant regions - ½ + ½ b) Finding values of a and b – ½+ ½		
	a) 	1	

		½	
	For r > r_0, the force is attractive	½	
	For r < r_0, the force is repulsive		
	a) We have, 1 + 235 = a + 94 + 2 X 1 ∴ a = 236 – 96 = 140	½	
	Also 0 + 92 = 54 + b + 2 X 0 ∴ b = 92 – 54 = 38	½	3
12	Labelled circuit diagram – 1 Working as a voltage amplifier - 2		
	 	1	
	Working as a voltage amplifier:		
	When a small sinusoidal voltage (with amplitude v_s) is connected in series with the dc bias voltage supply, V_{BB}, the base current will have sinusoidal variations super imposed on the value of I_B.	½	
	As a result, the collector current will also have sinusoidal variations super imposed on the value of I_c.	½	
	This results in corresponding sinusoidal variations in the value of the output voltage V_o.	½	
	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.	½	
	(Note : Give 1 mark to those students also who only draw either this circuit diagram or the circuit diagram given below:		3
	 		

*These answers are meant to be used by evaluators

13

(a) Statement of Biot-Savart law	½ Mark
Its vector form	½ Mark
(b) Obtaining the required expression	2 Mark

(a) According to Biot Savart law :

The magnitude of magnetic field $d\vec{B}$, due to a current element $d\vec{l}$, is

(i) proportional to current I and element length, dl

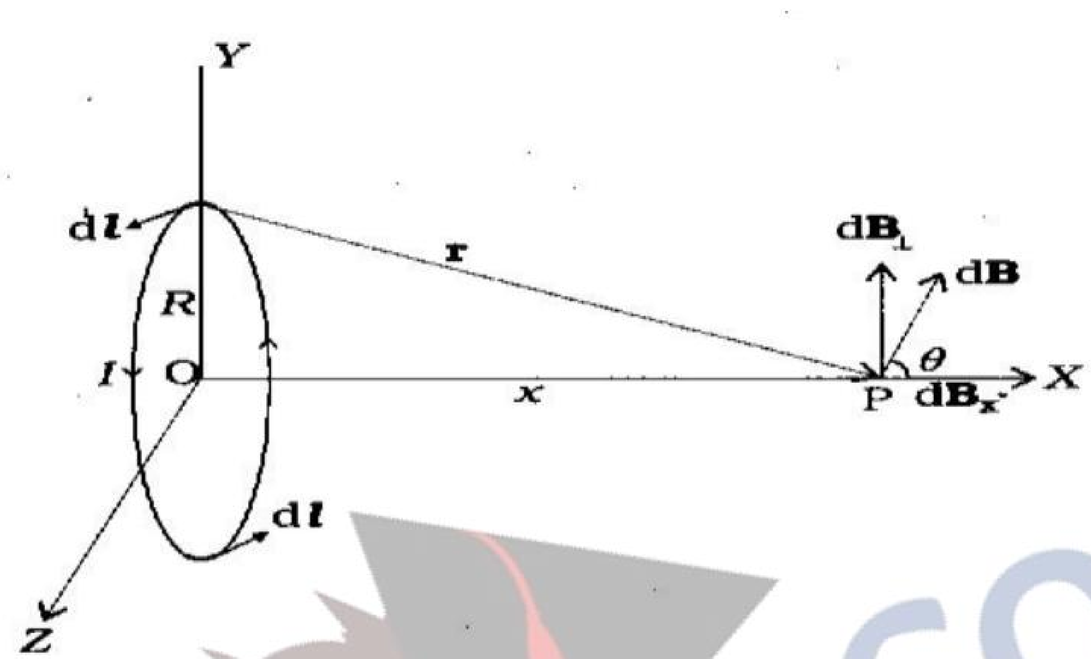
(ii) inversely proportional to the square of the distance r. ½

Its direction is perpendicular to the plane containing $d\vec{l}$ and $\vec{r}$.

In vector notation,

$$\overrightarrow{dB} = \frac{\mu_0}{4\pi} I \frac{d\vec{l} \times \vec{r}}{r^3}$$ ½

(b)



½

We have $\overrightarrow{dB} = \frac{\mu_0}{4\pi} I \frac{\left|d\vec{l} \times \vec{r}\right|}{r^3}$

$r^2 = x^2 + R^2$

$$\therefore \; dB = \frac{\mu_0 I}{4\pi} \frac{dl}{(x^2 + R^2)^{3/2}}$$ ½

We need to add only the components of $d\vec{B}$ along the axis of the coil.

Hence, $B = \int \frac{\mu_0}{4\pi} \frac{Idl}{(x^2 + R^2)^{3/2}} \cos\theta$.

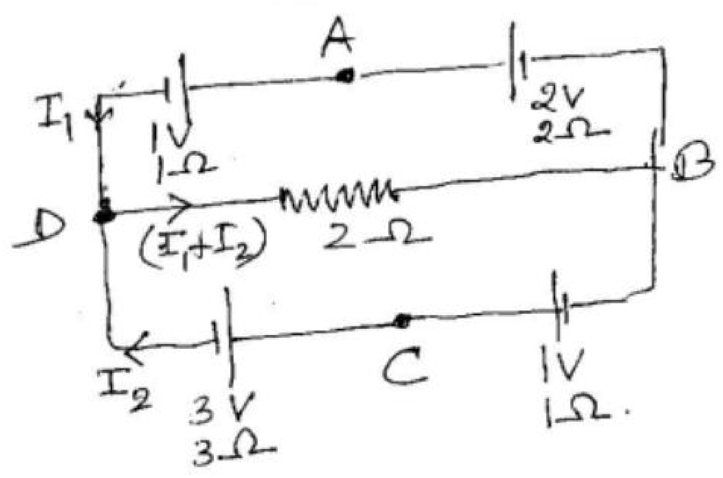
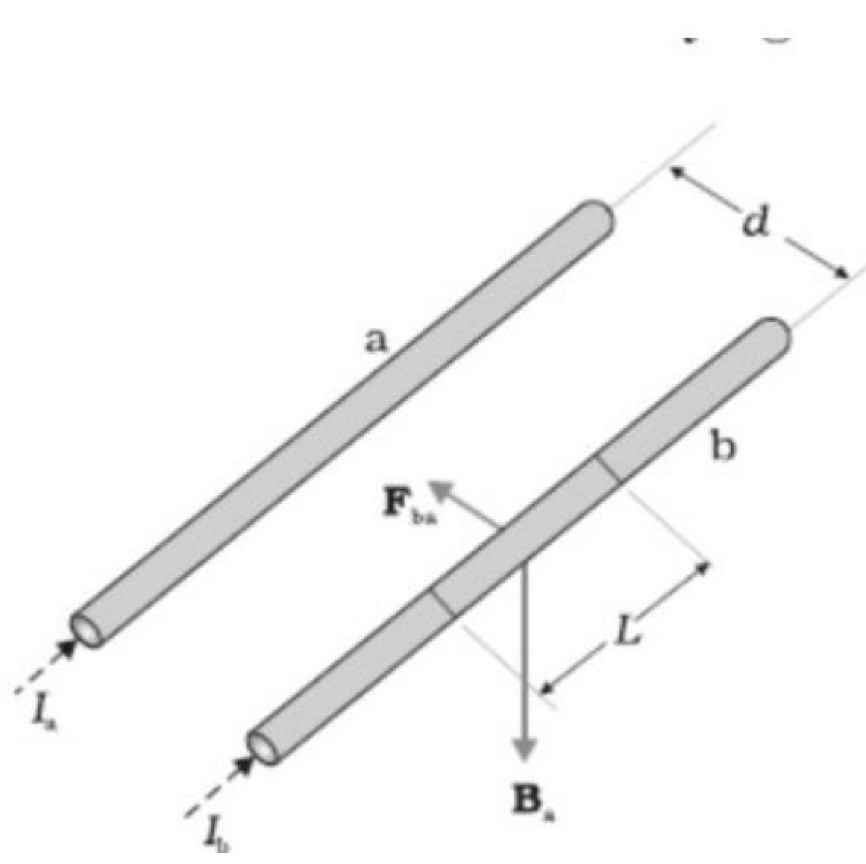
$$= \int \frac{\mu_0}{4\pi} \frac{(I\,dl)\,R}{(x^2 + R^2)^{3/2}} .$$ ½

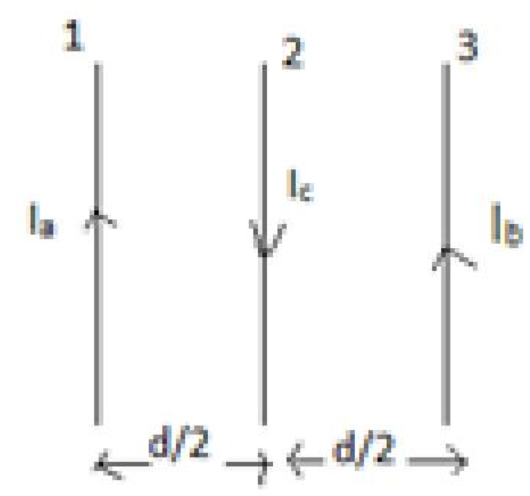
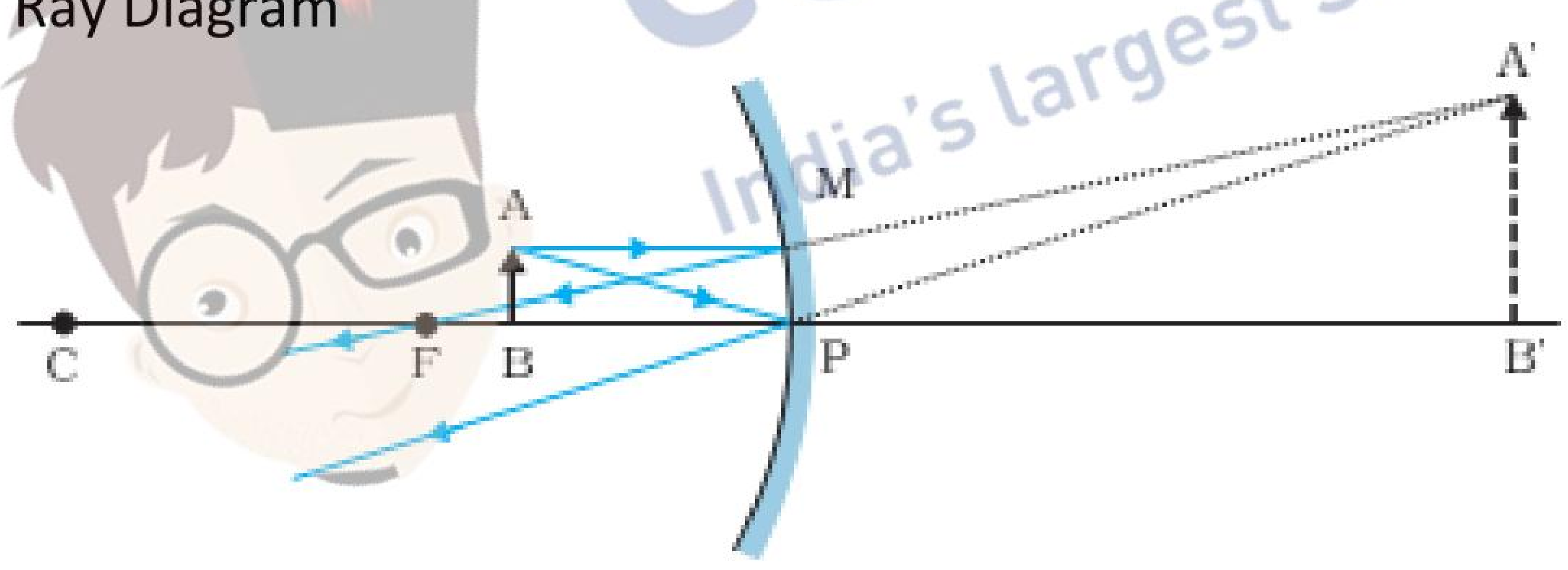
$$= \frac{\mu_0 I R^2}{2(x^2 + R^2)^{3/2}} .$$

$$\therefore \; B = \frac{\mu_0 I R^2}{2(x^2 + R^2)^{3/2}} \hat{i}$$ ½

3

Q.No.	Value Points/Expected Points	Marks	Total Marks
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 $\varphi = \oint \vec{E}.\vec{ds}$ SI Unit : Nm^2/C or volt -meter	½	
	For a given case $\phi = \phi_1 + \phi_2 = \left[E_x(at\, x = 2a) - E_x\left(at\, x = a\right)\right]a^2$ $= \left[\alpha\left(2a\right) - \alpha\left(a\right)\right]a^2$ $= \alpha a^3$ $= 100 \times \left(0.1\right)^3 = 0.1\, Nm^2 / C$	½	
	But $\phi = \dfrac{q}{\varepsilon_0}$	½	
	$\therefore q = \varepsilon_0 \phi = 8.854 \times 10^{-12} \times 10^{-1} C$ $= 0.8854\, pC$	½	
	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 = $\dfrac{qE}{m}$	½	
	Also $s = \dfrac{1}{2}at^2 \quad as\, u = 0$ $\therefore t = \sqrt{\dfrac{2s}{a}}$	½	
	(i) For the electron $a = \dfrac{eE}{m}$	½	
	$\therefore t = \sqrt{\dfrac{3 \times 10^{-2} \times 9.1 \times 10^{-31}}{1.6 \times 10^{-19} \times 2.0 \times 10^{4}}}$ $= 2.92\, ns$	½	
	(ii) for proton $t = \sqrt{\dfrac{2 \times 1.5 \times 10^{-2} \times 1.67 \times 10^{-27}}{1.6 \times 10^{-19} \times 2 \times 10^{4}}}$	½	
	$= 0.125\, \mu s$	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	½	
	 		
	$I_1 \times 1 + (1) + (-2) + 2I_1 + 2(I_1 + I_2) = 0$ Or $5I_1 + 2I_2 = 1$ ...... (i)	½	
	For loop DCBD $+ I_2 \times 3 + (3) + (-1) + I_2 + 2(I_1 + I_2) = 0$ Or $2I_1 + 6 I_2 = -2$ ....(ii) Solving (i) and (ii), we get		
	$I_1 = \frac{5}{13}$ A	½	
	$I_2 = \frac{-6}{13}$ A	½	
	$\therefore$ Current through DB = $I_1 + I_2 = \frac{-1}{13}$ A	½	3
	$\therefore$ P.D. between B and D = 0.154 V	½	
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 2×10^{-7} newton per metre of length.	1	
	(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 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.	½	

	Force on wire (3) due to wire (1) $= \frac{\mu_0 I_a I_c}{2\pi\left(\frac{d}{2}\right)}$ towards right  Force on wire 3 due to wire 2 $\left(\frac{\mu_0 I_b I_c}{2\pi\left(\frac{d}{2}\right)}\right)$ towards left Net force on wire 3 $= \frac{\mu_0 I_c}{\pi d}\left[I_a - I_b\right]$ towards right Also accept $= \frac{\mu_0 I_c}{\pi d}\left[I_b - I_a\right]$ towards left Note: please do not deduct last 1/2 mark if the student does not write the direction of force.	½ ½ ½	3
17	a) Ray diagram – 1 b) Obtaining i. mirror formula – 1 ½ ii. expression for liner magnification – ½ a) Ray Diagram  From similar triangles $A'B'F$ and MPF, we have $\frac{B'A'}{PM} = \frac{B'F}{FP}$ or $\frac{B'A'}{BA} = \frac{B'F}{FP}$ (since PM = BA) From similar triangles $A'B'P$ and ABP, we have $\frac{B'A'}{BA} = \frac{B'P}{BP}$ Hence $\frac{B'F}{FP} = \frac{B'P}{BP}$ Now $B'F = B'P + PF = (+v) + (-f)$ $= v - f$ BP = $-u$ $\therefore \frac{v - f}{-f} = \frac{+v}{-u}$ $or\ \frac{-v}{f} + 1 = \frac{-v}{u}$	1 ½ ½ ½	3

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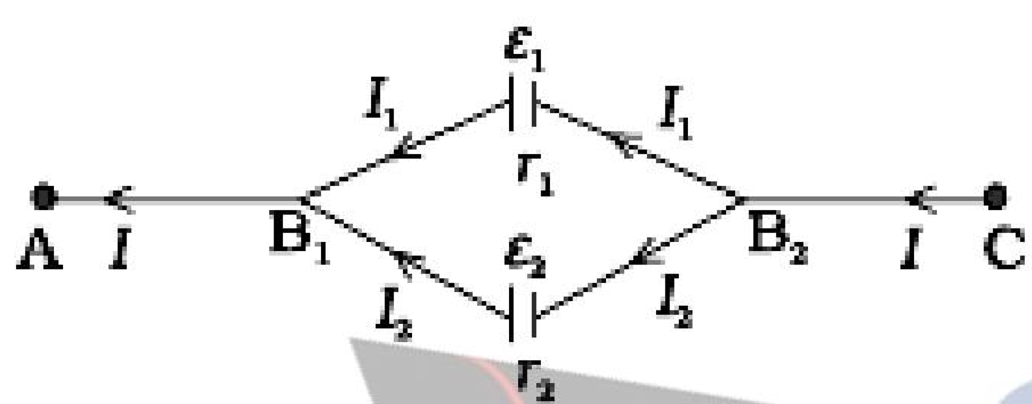
	$\therefore \frac{1}{v}+\frac{1}{u}=\frac{1}{f}$		
	This is the mirror formula.		
	Linear magnification = $\frac{B'A'}{BA}$		
	From similar triangles $A'B'P$ and ABP, we get $\frac{B'A'}{BA}=\frac{B'P}{BP}$		
	∴ Linear magnification $\frac{B'P}{BP}=\frac{+v}{-u}=-\frac{v}{u}$	½	
18	Obtaining Expression for the equivalent (i) resistance 1 (ii) emf 2		
		½	
	$\frac{1}{r}=\frac{1}{r_1}+\frac{1}{r_2}$		
	$\therefore r=\frac{r_1 r_2}{r_1+r_2}$	½	
	$I=I_1+I_2$		
	$V=E_1-I_1r_1 \quad and \quad V=E_2-I_2r_2$	½	
	$\therefore I=\left(\frac{E_1-V}{r_1}\right)+\left(\frac{E_2-V}{r_2}\right)$		
	$V=\left(\frac{E_1r_2+E_2r_2}{r_1+r_2}\right)-I\left(\frac{r_1r_2}{r_1+r_2}\right)$	½	
	$also\ V=E_{eq}-Ir_{eq}$	½	
	$\Rightarrow \frac{E_{eq}}{r_{eq}}=\frac{E_1}{r_1}+\frac{E_2}{r_2}$	½	
			3
19	(a) Two points of difference ½ + ½ Mark (b) Formula ½ Marks Calculation of wavelength 1½ Mark		

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(a)

Any two point of difference :

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 λ/a for two narrow slits separated by a distance a.	Minima at an angle of λ/a for a single slit of width a.

½ + ½

(b)

Let D be the distnce of the screen from the plane of the slits.

We have

Fring width $\beta = \frac{\lambda D}{d}$ ½

In the first case

$\beta = \frac{\lambda D}{d}$ or $\beta d = \lambda D$ .... (i) ½

In the second case

$(\beta - 30 \times 10^{-6}) = \frac{\lambda(D - 0.05)}{d}$ or $(\beta - 30 \times 10^{-6})d = \lambda(D - 0.05)$ .... (ii) ½

Subtracting (ii) from (i) we get

$30 \times 10^{-6} \times d = \lambda \times 0.05$

$\therefore \lambda = \frac{30 \times 10^{-6} \times 10^{-3}}{5 \times 10^{-2}} m$

$\therefore \lambda = 6 \times 10^{-7} m = 600\ nm$ ½

3

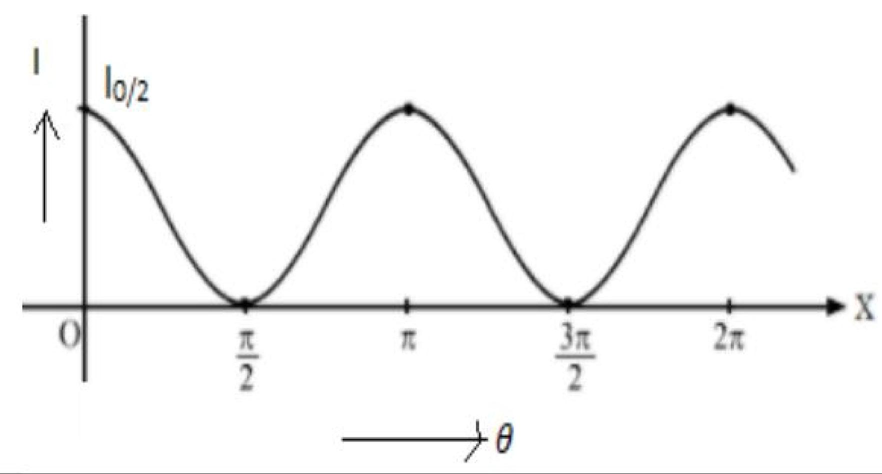
20

a) Intensity of linearly polarized light	– ½
Dependence on orientation	– ½
Explanation	- 1
b) Graphical representation	- 1

a) The intensity of the linearly polarized light would be $I_0/2$. ½
No; it does not depend on the orientation. ½

Explanation : The polaroid will let the component of the unpolarized light, parallel to its pass axis, to pass through it irrespective of its orientation. 1

b) We have $I = I_0 cos^2\theta$
$\therefore$ The graph is as shown below



1

3

21

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

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

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

1

(Note: The student need not write the columns for $\bar{A}$ and $\overline{B}$ 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. ½

Incident light, with photon energy greater than the energy gap of the semi-conductor, generates electron -hole pairs. The magnitude of the photo current depends on the intensity of intensity of incident light. ½

The photodiode is usually operated under reverse bias conditions. ½ 3

This is because this makes it easier to detect changes in light intensity and makes the photodiode work as a detector of optical signals. ½

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

$$h\nu = h\nu_0\,(=W) + \frac{1}{2}m v_{max}^2$$ ½

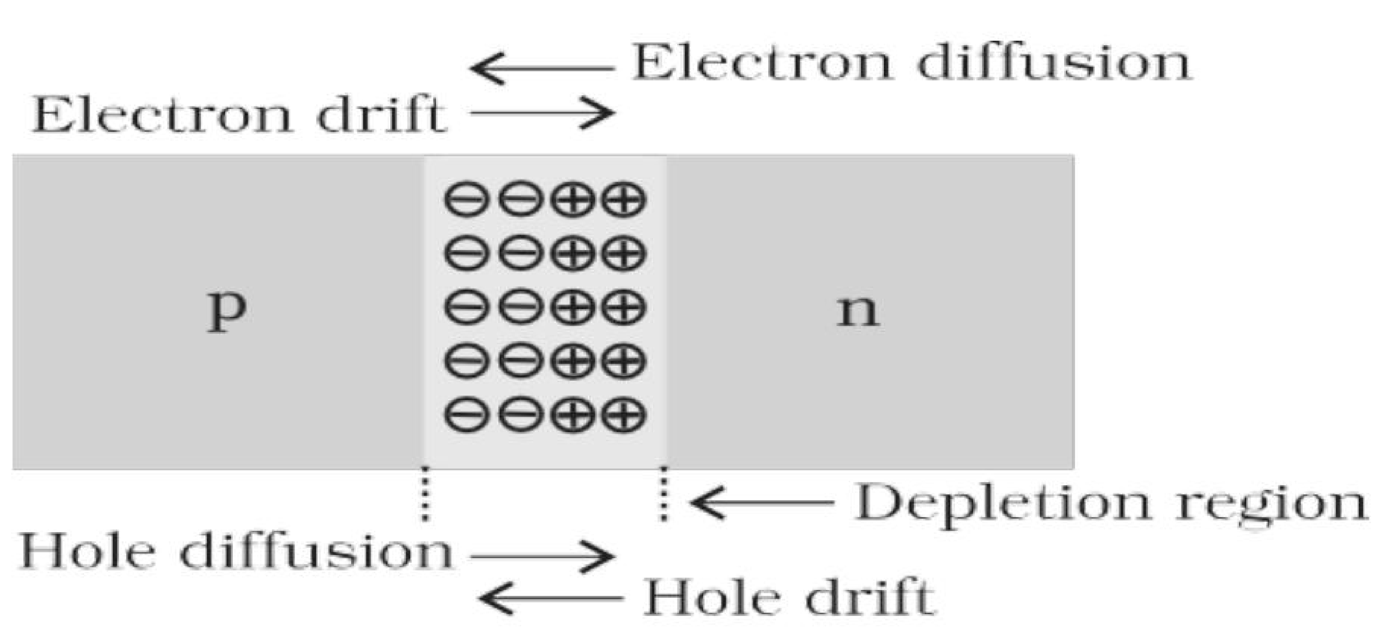
$\nu = frequency\ of\ incident\ light$
$\nu_0 = threshold\ frequency\ of\ photo\ sensitive\ material$
$W = work\ function$
$\frac{1}{2}\,m v_{max}^2 = max.kinetic\ energy\ of\ the\ emitted\ photoelectrons$ ½

(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

	$$hv = W + \frac{1}{2}\, mv_{max}^2$$ $$\therefore\ v_{max}^2 = \frac{2}{m}(hv - W)$$ $$= \left(\frac{2h}{m}\right)\nu + \left(\frac{-2W}{m}\right)$$ Slope of the given graph = $\frac{l}{n}$ Intercept on the y – axis = $-\,l$ $\therefore \frac{2h}{m} = \frac{\ell}{n}$ or $h = \frac{m\ell}{2n}$ and - $\ell = \frac{-2W}{m}$ or $W = \frac{m\ell}{2}$	½ ½ ½ ½	3
	SECTION D		
23	(a) Name of e.m. radiation ½ Mark (b) Method of production ½ Mark (c) Range of wavelength 1 Mark (d) Two values 1 + 1 Marks (a) (b) (Alternatively : By bombarding a metal target with high energy electrons) (c) Wave length range of X-rays is from about (10 nm to 10^{-4} nm) (d) Alertness, empathy; concern for her mother, knowledgeable (any two)	 ½ ½ 1 (1 + 1)	4
	Section E		
24	a) Explaining the two processes- 1 + 1 Defining the two terms - ½ + ½ b) Circuit diagram – 1 Working – 1 a) The two important processes are diffusion and drift Due to concentration gradient, the electrons diffuse from the n side to the p side and holes diffuse from the p side to the n side.  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.	 ½ ½ ½ ½	

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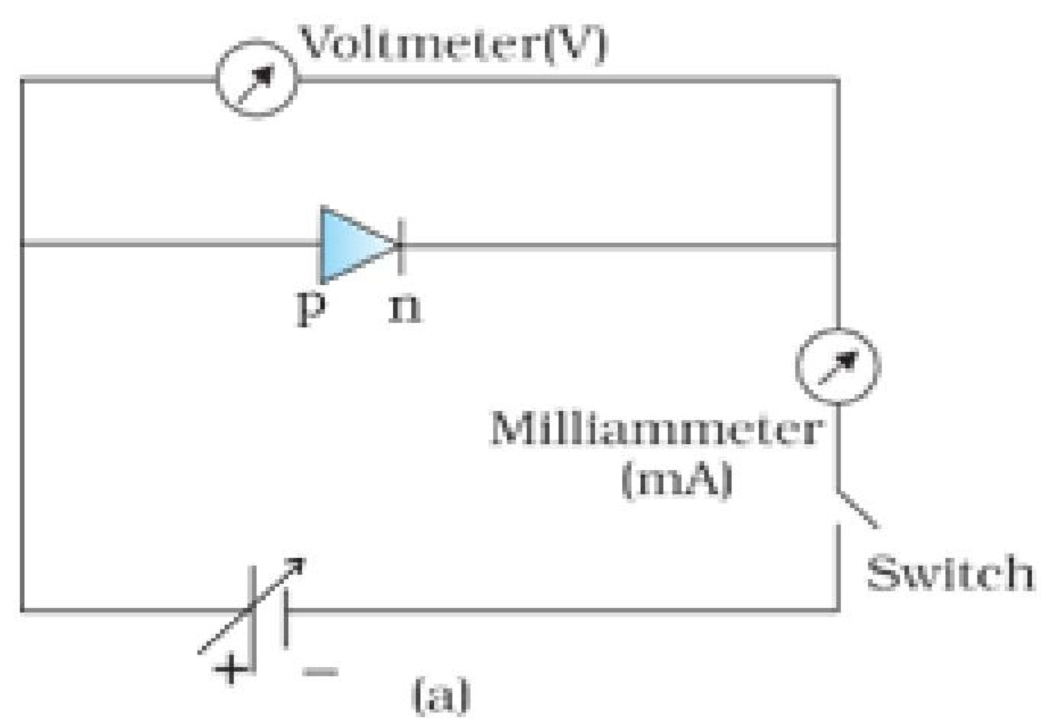
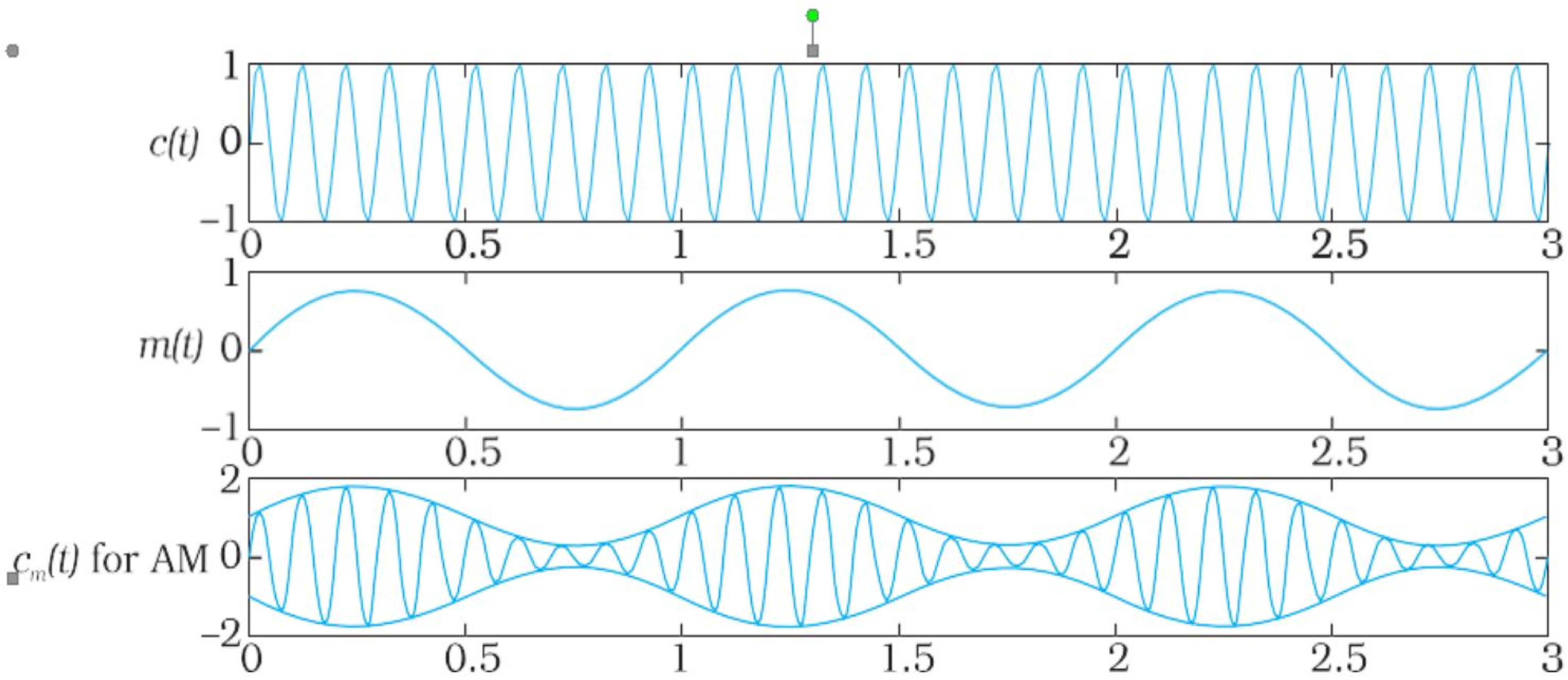
	Depletion region: It is the space charge region on either side of the junction, that gets depleted of free charges, is known as the depletion region. Potential Barrier The potential difference, that gets developed across the junction and opposes the diffusion of charge carries and brings about a condition of equilibrium, is known as the barrier potential. b) The circuit diagram is as shown  Working 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.	½ ½ 1 1	5
	OR a) Describing the three factors – 3 b) Drawing the wave forms – 2 a) It is necessary to modulate the audio frequency signals because of the following three reasons: 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. ii. <u>Effective power readiated</u> Power radiated, being proportional to $\left(\frac{\ell}{\lambda}\right)^2$ would be very small for a audio frequency signal. iii. <u>Mixing up of different signals</u> The audible frequency range is quite small. Hence if transformisson is done at audio frequencies, the chances of mixing up of different signals are very high. b) The required wave forms are as shown i. Carrier wave ii. Modulating Signal iii. Amplitude Modulated wave	½ ½ ½ ½ ½ ½	

	 	½ ½ 1	5
25	(a) Finding the electrostatic potential 2 Marks (b) Finding the work done 1 Mark (c) Effect of change of path 1 Mark (d) Potential energy of the system 1 Mark (with justification in each case) (V = - 4 (i) At point (0, 0, z) : Potential due to the charge (+q), $V_+ = \frac{1}{4\pi \in_0} \frac{q}{(z+a)}$ Potential due to the charge (-q), $V_- = \frac{1}{4\pi \in_0} \frac{(-q)}{(z-a)}$ Total potential at (0, 0, z) = $\frac{q}{4\pi \in_0}\left[\frac{1}{z+a} - \frac{1}{z-a}\right]$ $= \frac{-2qa}{4\pi \in_0 (z^2 - a^2)}$ (ii) At point (x, y, 0) Potential due to the charge + q $V_+ = \frac{1}{4\pi \in_0} \frac{q}{\sqrt{x^2+y^2+a^2}}$ Potential due to the charge (-q) $V_- = \frac{1}{4\pi \in_0} \frac{-q}{\sqrt{x^2+y^2+a^2}}$ Total potential at (x, y, 0) $= \frac{q}{4\pi \in_0}\left(\frac{1}{\sqrt{x^2+y^2+a^2}} - \frac{1}{\sqrt{x^2+y^2+a^2}}\right) = 0$	½ ½ ½ ½	

Give full credit of part (ii) if a student writes that the point (x,y,0) is equidistant from charges +q and –q, Hence total potential due to them at the given point will be zero.

(b) Work done = q $[V_1 - V_2]$

$V_1 = 0$ and $V_2 = 0$ ½

$\therefore$ work done = 0 ½

Where V_1 and V_2 are the total potential due to dipole at point (5,0,0) and (-7,0,0)

(c) There would be no change ½

This is because the electrostatic field is a conservative field. ½

(**Alternatively :** The work done, in moving a test charge between two given points is independent of the path taken)

(d) The two given charges make an electric dipole of dipole moment $\vec{p} = q.\overrightarrow{2a}$ ½

P.E. in position of unstable equilibrium (where $\vec{p}$ and $\vec{E}$ are antiparallel to each other)

$= + pE = 2\,aq\,E$ ½ 5

OR

(a)	Finding the total energy before the capacitors are connected	1 Mark
(b)	Finding the total energy in the parallel combination	3 Marks
(c)	Reason for difference	1 Mark

(a) We have

Energy Stored in a capacitor = $\frac{1}{2}CV^2$ ½

$\therefore$ Energy stored in the charged capacitors $E_1 = \frac{1}{2}C_1V_1^2$ And $E_2 = \frac{1}{2}C_2V_2^2$

$\therefore$ Total energy stored = $\frac{1}{2}C_1V_1^2 + C_2V_2^2$ ½

(b)Let V be the potential difference across the parallel combination.

Equivalent capacitance = $(C_1 + C_2)$ ½

Since charge is a conserved quantity, we have

$(C_1 + C_2)V = C_1V_1 + C_2V_2$ ½

$V = \left[\frac{C_1V_1 + C_2V_2}{(C_1 + C_2)}\right]$ 1

$\therefore$

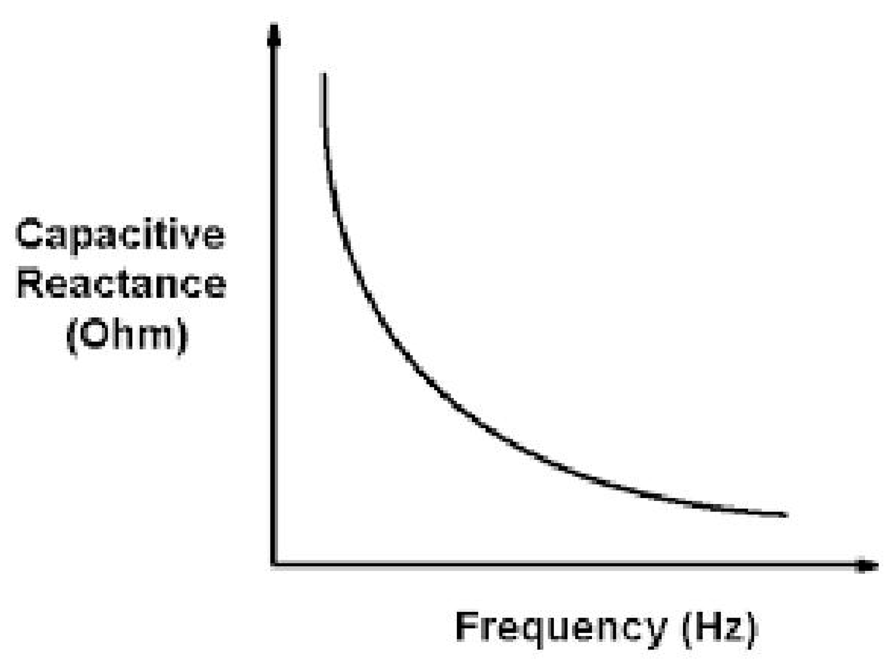
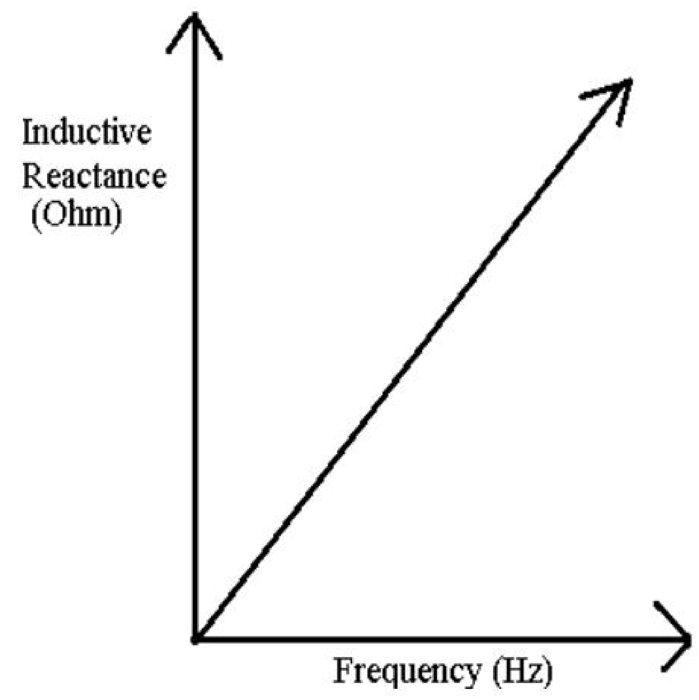
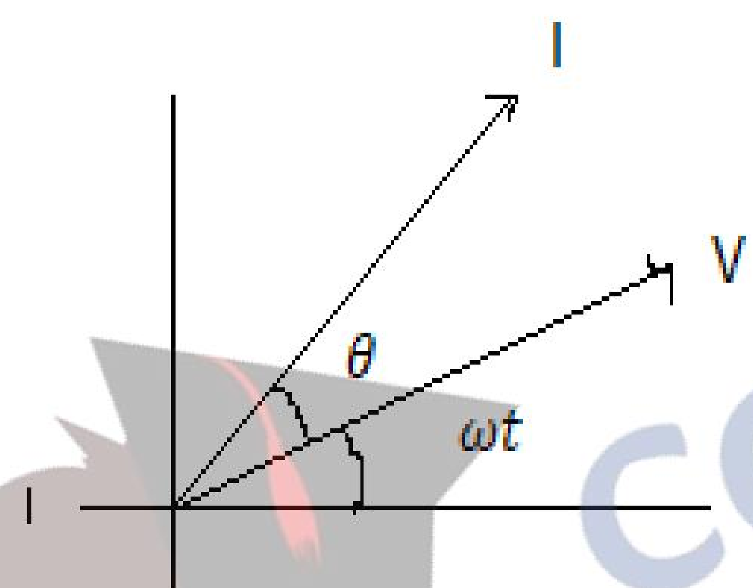
Total energy stored in the parallel combination

$= \frac{1}{2}(C_1 + C_2)V^2$ ½

$= \frac{1}{2}\frac{(C_1V_1 + C_2V_2)^2}{(C_1 + C_2)}$ ½

(c) The total energy of the parallel combination is different (less) from the total energy before the capacitors are connected. This is because some energy gets used up due to the movement of charges during sharing of charge. 1

5

26	a) Drawing the two graphs ½ + ½ b) Drawing the phaser diagram 1 c) i) Naming the devices ½+ ½ ii) Calculating the current flowing 2		
	a) The two graphs are as shown 	½ + ½	
	b) (The current leads the voltage by an angle Θ where 0 < Θ < $^{\pi}/_{2}$). The required phaser diagram is as shown. [Here Θ= tan⁻¹ $[(^{1}/_{\omega CR})]$	1	
	(C) In device X: Current lags behind the voltage by $\frac{\pi}{2}$ ∴ X is an inductor.	½	
	In device Y: Current is in phase with the applied voltage ∴ X is a resistor.	½	
	We are given that $0.25 = \frac{220}{X_L}$ or $X_L = \frac{220}{0.25}\Omega = 880\Omega$	½	
	Also $0.25 = 0.25 = \frac{220}{X_R}$ $\therefore X_R = \frac{220}{0.25}\Omega = 880\Omega$	½	
	For the series combination of X and Y, Equivalent impedance = $\sqrt{X_L^2 + X_R^2} = (880\sqrt{2})\Omega$	½	
	$\therefore$ Current flowing = $\frac{220}{880\sqrt{2}} A = 0.177\ A$	½	5

	OR		

- a) Principal of working – 1
- b) Defining efficiency – 1
- c) Any two factor – ½ + ½
- d) Calculating the current drawn - 2

a) A transformer works on the principle of mutual induction.
(Alternatively – an emf is induced in the secondary coil when the magnetic flux, linked with it changes with time due to ta (time) changing magnetic flux linked with the primary coil). — 1

b) The efficiency of a transformer equals the ratio of the output power to the input power.
$(Alteratively$:
Efficiency = $\frac{output\ power}{input\ power}$
or Efficiency $\frac{V_S\, I_S}{V_P\, I_P})$ — 1

c) i) Eddy current losses
ii) joule heat losses
iii) hysteresis losses
iv) magnetic flux leakage losses
(Any two) — ½ + ½

(d) We have
$\frac{V_S\, I_S}{V_P\, I_P}$ = 90% = 0.9 — ½

$\therefore \frac{220}{22} \frac{I_S}{I_p}$ = 0.9

$or\ \frac{I_S}{I_p} = \frac{0.9}{0.1}$ = 9 — ½

$\therefore I_p = \frac{I_S}{9} = \frac{(22/440)}{9}$ A — ½

= $\frac{1}{180}$ A

= 0.0056A — ½

Total: 5

*These answers are meant to be used by evaluators