Strictly Confidential: (For Internal and Restricted use only)
Senior School Certificate Examination-2020
Marking Scheme – PHYSICS THEORY (042)

(55/1/3)

General Instructions: -

1. You are aware that evaluation is the most important process in the actual and correct assessment of the candidates. A small mistake in evaluation may lead to serious problems which may affect the future of the candidates, education system and teaching profession. To avoid mistakes, it is requested that before starting evaluation, you must read and understand the spot evaluation guidelines carefully. **Evaluation is a 10-12 days mission for all of us. Hence, it is necessary that you put in your best efforts in this process.**
2. Evaluation is to be done as per instructions provided in the Marking Scheme. It should not be done according to one's own interpretation or any other consideration. Marking Scheme should be strictly adhered to and religiously followed. **However, while evaluating, answers which are based on latest information or knowledge and/or are innovative, they may be assessed for their correctness otherwise and marks be awarded to them.**
3. The Head-Examiner must go through the first five answer books evaluated by each evaluator on the first day, to ensure that evaluation has been carried out as per the instructions given in the Marking Scheme. The remaining answer books meant for evaluation shall be given only after ensuring that there is no significant variation in the marking of individual evaluators.
4. Evaluators will mark(√) wherever answer is correct. For wrong answer 'X"be marked. Evaluators will not put right kind of mark while evaluating which gives an impression that answer is correct and no marks are awarded. **This is most common mistake which evaluators are committing.**
5. If a question has parts, please award marks on the right-hand side for each part. Marks awarded for different parts of the question should then be totaled up and written in the left-hand margin and encircled. This may be followed strictly.
6. If a question does not have any parts, marks must be awarded in the left-hand margin and encircled. This may also be followed strictly.
7. If a student has attempted an extra question, answer of the question deserving more marks should be retained and the other answer scored out.
8. No marks to be deducted for the cumulative effect of an error. It should be penalized only once.
9. A full scale of marks 0-70 has to be used. Please do not hesitate to award full marks if the answer deserves it.
10. Every examiner has to necessarily do evaluation work for full working hours i.e. 8 hours every day and evaluate 20 answer books per day in main subjects and 25 answer books per day in other subjects (Details are given in Spot Guidelines).
11. Ensure that you do not make the following common types of errors committed by the Examiner in the past:-
    - Leaving answer or part thereof unassessed in an answer book.
    - Giving more marks for an answer than assigned to it.
    - Wrong totaling of marks awarded on a reply.
    - Wrong transfer of marks from the inside pages of the answer book to the title page.
    - Wrong question wise totaling on the title page.
    - Wrong totaling of marks of the two columns on the title page.

- Wrong grand total.
- Marks in words and figures not tallying.
- Wrong transfer of marks from the answer book to online award list.
- Answers marked as correct, but marks not awarded. (Ensure that the right tick mark is correctly and clearly indicated. It should merely be a line. Same is with the X for incorrect answer.)
- Half or a part of answer marked correct and the rest as wrong, but no marks awarded.

12. While evaluating the answer books if the answer is found to be totally incorrect, it should be marked as cross (X) and awarded zero (0)Marks.

13. Any unassessed portion, non-carrying over of marks to the title page, or totaling error detected by the candidate shall damage the prestige of all the personnel engaged in the evaluation work as also of the Board. Hence, in order to uphold the prestige of all concerned, it is again reiterated that the instructions be followed meticulously and judiciously.

14. The Examiners should acquaint themselves with the guidelines given in the Guidelines for spot Evaluation before starting the actual evaluation.

15. Every Examiner shall also ensure that all the answers are evaluated, marks carried over to the title page, correctly totaled and written in figures and words.

16. The Board permits candidates to obtain photocopy of the Answer Book on request in an RTI application and also separately as a part of the re-evaluation process on payment of the processing charges.

MARKING SCHEME: PHYSICS			
QUESTION PAPER CODE: 55/1/3			
Q.No.	**Value Points/Expected Answer**	**Marks**	**Total Marks**
	SECTION A		
1	(A) 1.47	1	1
2	(A) Red colour	1	1
3	(D) The stability of atom was established by the model	1	1
4	(C) 1:3	1	1
5	(D)Material of the turns of the coil	1	1
6	(C) Decrease in relaxation time	1	1
7	(C) Potential difference across the bigger resistor is greater	1	1
8	(D) F/8	1	1
9	(A) No net charge is enclosed in the surface	1	1
10	(B) lesser than the focal length of the eyepiece	1	1
11	Four times	1	1
12	Integral OR Nucleon	1	1
13	$\sqrt{3}$	1	1
14	Attracted/ Concentrated	1	1
15	Eddy	1	1
16	4.8 fm OR 1/1836	1	1
17	M_2	1	1
18	Si & Ge cannot be used for fabrication of visible LED because their energy gap is less 1.8eV	1	1
19	Conduction current is due to the flow of charges whereas the displacement current due to the change of electric field/ flux between the capacitor plates or due to changing electric field/ flux.	1	1
20	Decreases	1	1
	SECTION B		
21	Explanation of depletion layer and potential barrier — ½ + ½ mark Effect on depletion layer — ½ mark Effect on Potential barrier — ½ mark The small region in the vicinity of the junction which is depleted of free charge carrier and has only immobile ions is called depletion region/ layer. The accumulation of negative charges in p - region and positive charges in n- region set up a potential difference across the junction, which acts as a barrier and is called barrier potential. In forward bias (a) width of depletion layer decreases (b) value of potential decreases	 ½ ½ ½ ½	2

<table>
<tr><td>22</td><td>

Equation of Bohr's postulates	½ +½
Expression of velocity	1

Centripetal force is provided by electrostatic force

$$F_c = F_e$$
$$\frac{m_e {v_n}^2}{r_n} = \frac{kZe^2}{{r_n}^2}$$
$$m_e v_n^2 r_n = kZe^2$$
$$but$$
$$m_e v_n r_n = \frac{nh}{2\pi}$$

$$v_n = \frac{2\pi kZe^2}{nh}$$

$For\ H\ atom\ Z = 1$

$$v_n = \frac{2\pi ke^2}{nh}$$
$$= \frac{e^2}{2\epsilon_o nh}$$

OR

Two differences between process of emission of photoelectrons and process of emission of β particles ½+½+½+½

Emission of photoelectron takes place due to the incident photons on the surface of metal whereas emission of β particles takes place in radioactive nucleus spontaneously.
Photoelectrons are not accompanied by emission of any other particle whereas β particles accompanied by emission of followed by neutrino or antineutrino.
(Note: award full marks for any other two relevant differences.)
</td><td>½
½
½
½

½+½
½+½</td><td>2

2</td></tr>
<tr><td>23</td><td>

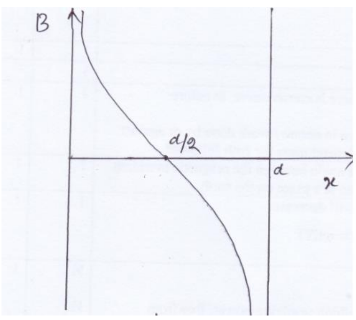
Magnetic field at point P	1 ½ mark
Curve	½ mark

a)

$$B = \frac{\mu_o I}{2\pi x}$$

$$B_P = B_1 - B_2 = \frac{\mu_o I}{2\pi x} - \frac{\mu_0 I}{2\pi(d-x)} = \frac{\mu_o I(d-2x)}{2\pi(d-x)x}$$

b)



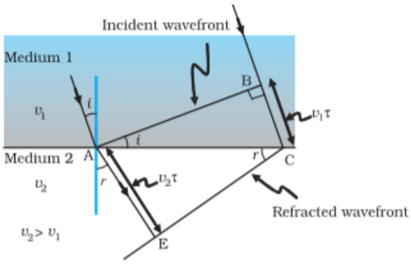
</td><td>½
1
½</td><td>2</td></tr>
</table>

24

Definition of wavefront	½ mark
Figure	½ mark
Derivation of law of refraction	1 mark

Wavefront is defined as the surface of constant phase;
Alternatively
It is a locus of all the points in the same phase of disturbance

½



½

$$\sin i = \frac{BC}{AC} = \frac{v_1 t}{AC}$$

½

$$\sin r = \frac{AE}{AC} = \frac{v_2 t}{AC}$$

$$\frac{\sin i}{\sin r} = \frac{v_1}{v_2}$$

½

2

OR

Lens Maker's formula	1 mark
Derivation of focal length of three lenses	1 mark

$$\because \frac{1}{v} - \frac{1}{u} = (n-1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right) - - - - - - - 1$$

1

When u=∞ and $v = f$

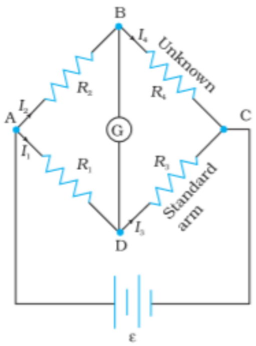
$$\frac{1}{f} = (n-1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right) - - - - - - - - - - - 2$$

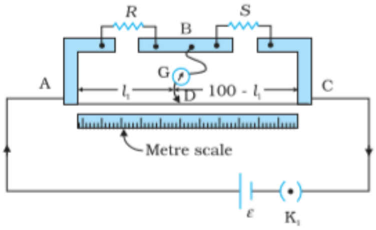
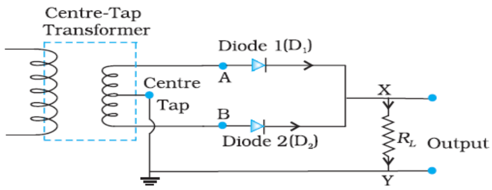
½

$$\left[n = \frac{n_2}{n_1}\right]$$

From Eq 1 and 2

$$\frac{1}{f} = \frac{1}{v} - \frac{1}{u} \; then\ lens\ formula$$

	[Even if the student derives $\frac{1}{f}=\frac{1}{v}-\frac{1}{u}$ for biconvex lens, award 1 ½ marks]	½	2
25	Definition of half life 1 mark Determination of ratio R_1 and R_2 1 mark The time interval in which the number of radioactive nuclei reduced / disintegrated to half of initial value Let R_1 and R_2 be their activities then $R_1 = \lambda_1 N_1$ $R_2 = \lambda_2 N_2$ $\frac{R_1}{R_2} = \frac{\lambda_1 N_1}{\lambda_2 N_2} = \frac{\frac{N_1}{T_1}}{\frac{N_2}{T_2}} = \frac{N_1 T_2}{N_2 T_1}$	1 ½ ½	2
26.	Calculation of capacitance in case 1 ½ Calculation of capacitance in case 2 ½+½ Relationship between K, K_1 and K_2 ½ $C_1 = \frac{K\varepsilon_0 A}{d}$ $C_2 = C' + C''$ $where\ C' = \frac{K_1\varepsilon_0 A}{2d}$ $C'' = \frac{K_2\varepsilon_0 A}{2d}$ $\frac{K\varepsilon_0 A}{d} = \frac{K_1\varepsilon_0 A}{2d} + \frac{K_2\varepsilon_0 A}{2d}$ $K = \frac{K_1+K_2}{2}$	½ ½ ½ ½	2
27	(a) Principle 1 mark (b) Circuit diagram for determining unknown resistance of meter bridge 1 mark 	½	

	Meter bridge works on the principle of a balanced wheatstone bridge. $\frac{R_1}{R_2} = \frac{R_3}{R_4}$ at null point when Ig=0 (unknown)  	½ 1	2
SECTION C			
28	(a) Speed of light in material medium — 1 mark (b) (i) Identification and Range — ½ + ½ mark (ii) Identification and Range — ½ + ½ mark (a) Speed of light in medium $$\upsilon = \frac{1}{\sqrt{\mu\epsilon}} = \frac{1}{\sqrt{\mu_0\mu_r\epsilon_0\epsilon_r}}$$ (b) (i) Microwave range 0.1mt – 1mm (10^{-3}m – 10^{-1}m) (ii) Infrared waves range $1\ mm - 700nm$	1 ½ + ½ ½ + ½	3
29	Reason for (a) ,(b) and (c) — 1+1+1 (a) The points where the two waves meet out of phase or with the path difference of an integral multiple of $\lambda/2$, they cancel out the contribution of each other. Alternatively Due to the destructive interference of two waves. (b) When light is passed through a polaroid the vibrations of electric field vector which are perpendicular to the pass axis of the polaroid are absorbed and only those parallel to pass axis pass, therefore the intensity of transmitted light is less than that of the incident light. (c) At any point away from the central bright fringe, path difference is different for different colours, therefore maxima for different colours are formed at different points and coloured fringes are seen.	1 1 1	3
30	Circuit diagram of full wave rectifier — 1 Working — 1 Input and output waveform — ½+½  	1	

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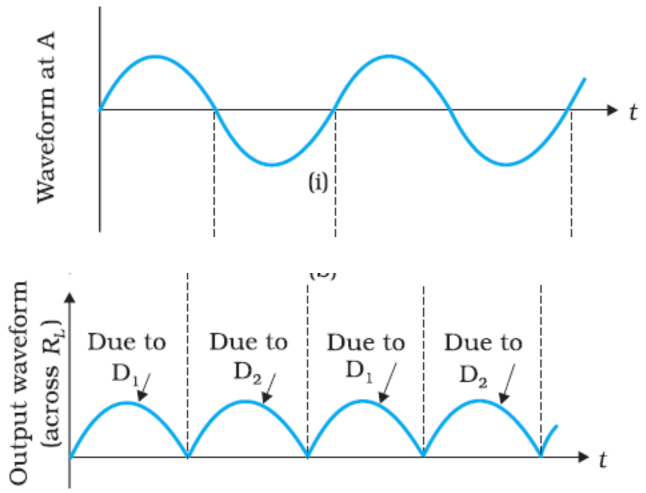
<td>Working: For positive cycle of input ac source, diode D1 gets forward biased and conducts while D2 being reverse biased is not conducting.
For the negative cycle of the ac source, diode D1 would not conduct but diode D2 would. Thus, we get output voltage during both the positive as well as the negative half of the cycle.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<td>½
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½</td>
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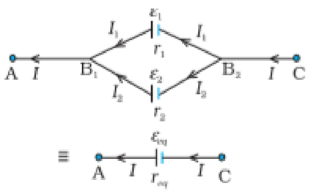
<td>31</td>
<td>a) Internal resistance 1 ½ mark
b) Voltage across R 1 ½ mark

(a)


Current drawn from cell -1
$$I_1 = \frac{E_1 - V}{r_1}$$
Current drawn from cell -2
$$I_2 = \frac{E_2 - V}{r_2}$$
Resultant current $I = I_1 + I_2$

On solving
$$\therefore I = \frac{E_1 r_2 + E_2 r_1}{r_1 r_2} - V\left(\frac{r_2 + r_1}{r_1 r_2}\right)$$
$$\therefore V = \frac{E_1 r_2 + E_2 r_1}{r_1 r_2} - I\left(\frac{r_1 r_2}{r_2 + r_1}\right)$$
$$V = E_{eq} - I r_{eq}$$
$$E_{eq} = \frac{E_1 r_2 + E_2 r_1}{r_1 + r_2}$$</td>
<td>½
½</td>
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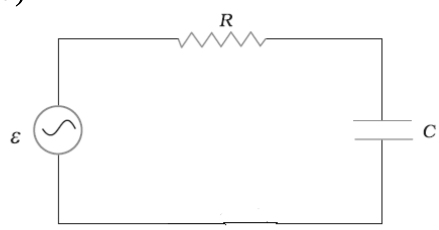
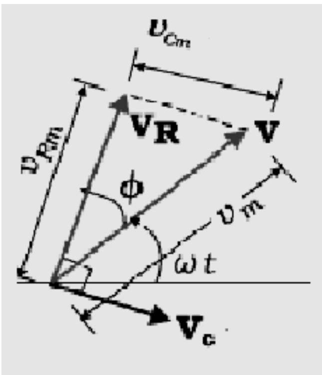
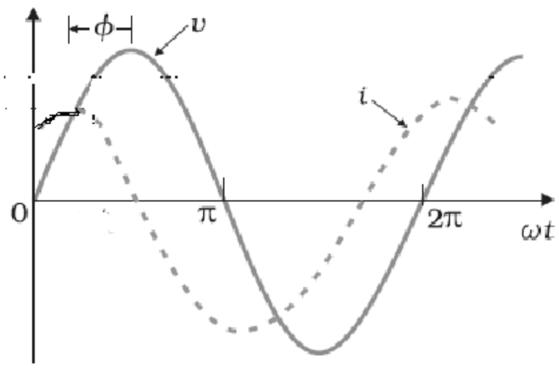
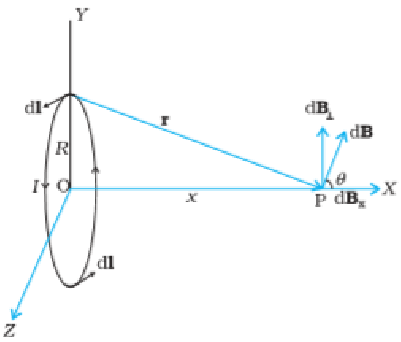
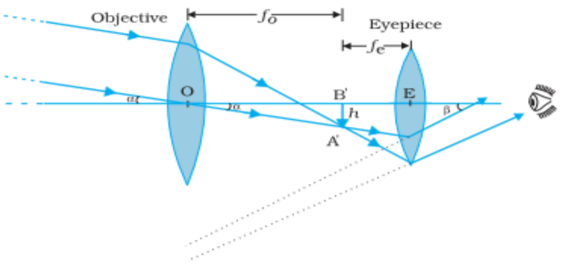
	$$r_{eq} = \frac{r_1 r_2}{r_2 + r_1}$$	½	
	$$r_{eff} = \frac{r_1 r_2}{r_1 + r_2} = \frac{2 \times 2}{2 + 2} = 1\Omega$$	½	
	Current through R $$I = \frac{E_{effect}}{R + r_{eff}} = \frac{5}{10 + 1} = \frac{5}{11} A$$	½	
	P.D across R $$= \frac{5}{11} \times 10 = 4.54\, volt$$	½	3
32	(a)Obtaining the expression for the instantaneous current 2 (b)Graphs showing the variations of V and I with ωt 1		
	(a)  	½	
	 	½	
	The length of these phasors or the amplitude of $\mathbf{V_R}$, and $\mathbf{V_C}$ are: $V_{Rm} = i_m R$, $V_{Cm} = i_m X_C$ $$I_o = \frac{V_o}{Z} = \frac{V_C}{[R^2 + (\frac{1}{\omega C})^2]^{1/2}}$$		
	In RC circuit current leads the voltage by an angle ϕ and given by $I = I_0 Sin(\omega t + \phi)$	½	
	From the phasor diagram the Phase angle $\phi = tan^{-1}\frac{X_C}{R}$, currents leads voltage $$Where X_C = \frac{1}{\omega C}$$	½	

	(b)  [Note: A student may draw two graphs separately provided they are co-related]	½+½	3
33	a) Writing expression for magnetic moment ½ mark b) Figure ½ mark Magnetic field and calculation 2 mark (a) magnetic moment = M= NIA $M = NI\pi r^2$  According to Biot-sevart law $\overrightarrow{dB} = \frac{\mu_0 I}{4\pi}\frac{\lvert\overrightarrow{dl}\times\vec{r}\rvert}{r^3}$ $dB = \frac{\mu_0 I}{4\pi}\frac{dl}{r^2}$ $dB_\perp$ components due to diametrically opposite components cancel out. Only dB_x components refrain $dB_x = \frac{\mu_0 I dl}{4\pi r^2}.cos\theta$ $B = \int dB_x$ $B = \frac{\mu_0 I R^2}{2(R^2+x^2)^{3/2}}\ (along\ x\ axis)$	½ ½ ½ ½ 1	3

	OR a) Definition and expression — 1 mark b) Conversion of Galvanometer (i) into ammeter — 1 mark (ii) Effective resistance — 1 mark a) Deflection per unit current $I_s = \frac{\theta}{I} = \frac{BNA}{K}$ b) (i) By connecting a low resistance (R_s) in parallel to galvanometer such that $(I_0 - I_g)R_s = I_g G$ (ii) effective resistance $$\frac{1}{R_A} = \frac{1}{R_s} + \frac{1}{G} = \frac{G + R_s}{R_s G}$$ $$\therefore R_A = \frac{R_s G}{G + R_s}$$	½ ½ ½ ½ 1	 3
34	KE of α particle — 1 mark Calculation — 2 marks KE of α particle $E_{k\alpha} = (m_y - m_x - m_\alpha)c^2$ $= m_y c^2 - m_x c^2 - m_\alpha c^2$ = (235 × 7.8 – 231 × 7.835 – 4 × 7.07) MeV = 1833 – 1809.885 – 28.28 = 1833 – 1838.165 = -5.165 MeV $E_k < 0$ wrong information [Award full marks till this step]	½ ½ ½ ½ 1	 3
SECTION D			
35.	a) Labelled diagram — 2 marks Figure Expression for resolving power — 1 mark b) Calculation of angular magnification — 1 mark Diameter of image formed by objective lens — 1 mark a)	 2	



Marks: 1, 1, ½

Resolving power of telescope = $\frac{D}{1.22\lambda}$

Marks: ½ (total 5)

b) (i) Angular magnification $m = \frac{\beta}{\alpha} = \frac{f_o}{f_e} = \frac{20m}{10^{-2}m} = 2000$

(ii)

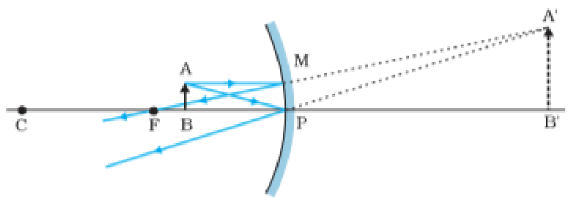
$$\frac{D}{d} = \frac{x}{f_o}$$

$$d = \frac{Df_0}{x} = \frac{3.5 \times 10^6 \times 20}{3.8 \times 10^8} = .18\text{m}$$

OR

(a) Labelled diagram	1 mark
Derivation of mirror relation	2 marks
(b) Position of image	1 ½ marks
Nature of image	1 ½ marks

Marks: 1



(a)

Marks: ½

$$\Delta ABP \sim A'B'P$$

$$\frac{A'B'}{AB} = \frac{PB'}{PB} ----------- 1$$

Also $\Delta A'B'F \sim MNP$ (for small curvature)

$$\therefore \frac{A'B'}{MP} = \frac{B'F}{PF}$$

Marks: ½

$$\frac{A'B'}{AB} = \frac{B'F}{PF} ------------- 2$$

Marks: ½

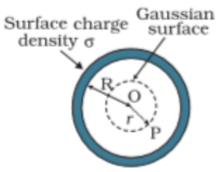
From 1 and 2

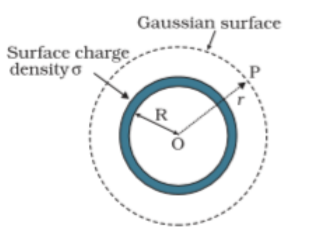
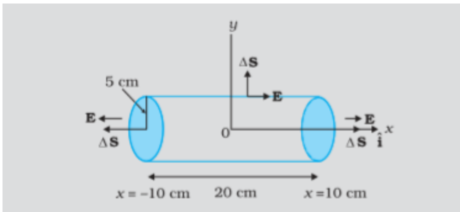
$$\frac{PB'}{PB} = \frac{B'F}{PF} ------------- 3$$

$$\frac{PB'}{PB} = \frac{B'P + PF}{PF} ----------4$$

Marks: ½

$PB = -u$ $\quad PB' = v$ $\quad PF = -f$

	$\frac{v}{-u}=\frac{v-f}{-f}$ $-vf=-vu+uf$ $\frac{1}{f}=\frac{1}{v}+\frac{1}{u}$ (b) According to lens maker's formula $\frac{1}{f}=(\mu-1)\left(\frac{1}{R_1}-\frac{1}{R_2}\right)$ for plano convex lens $R_1 \rightarrow R$ and $R_2 \rightarrow \infty$ $\frac{1}{f}=\frac{(\mu-1)}{R}=\frac{1.5-1}{20}$ ∴f=40 cm $\frac{1}{f}=\frac{1}{v}-\frac{1}{u}$ $\frac{1}{40}=\frac{1}{v}-\frac{1}{-30}$ $v=-12\ cm$ Nature: virtual	½ ½ ½ ½	5
36.	(a) (i) Electric Field inside hollow sphere 1½ mark (ii) Electric Field outside hollow sphere 1½ mark (b) (i) The net outward flux through cylinder 1 mark (ii) The net charge present inside the cylinder 1 mark (a) (i)  According to Gauss's Law $\oint \vec{E}.\overrightarrow{dA}=\frac{q_{in}}{\epsilon_0}$ $\because$ *inside hollow sphere* $q_{in}=0$ $\therefore \oint \vec{E}\,.\overrightarrow{dA}=0$ E = 0 (ii)	½ ½ ½ ½	

	 	½	
	$q = \sigma 4\pi R^2$ $\oint \vec{E}.\overrightarrow{dA} = \frac{q}{\epsilon_0}$ $E\oint dA = \frac{q}{\epsilon_0}$	½	
	$E.4\pi x^2 = \frac{\sigma 4\pi R^2}{\epsilon_0}$ $E = \frac{\sigma R^2}{\epsilon_0 x}$ b)		
	 	½	
	(i) The net outward flux through cylinder $\phi = EA + EA = 2EA \qquad A = \pi r^2$	½	
	= 2 ×200 × 3.14 × 0.05 × 0.05 $= 3.14 \frac{N}{C} m^2$	½	
	(ii) The net charge present inside the cylinder	½	5
	$q = \epsilon_0 \phi$ q= 8.854 × 3.14 × 10^{-12} = 2.78×10^{-11} C OR a) Expression for potential energy — 3 marks b) Equipotential surface due to isolated -ve charge — 1 mark c) Work done in assembling the charge — 1 mark	1	
	(a) Work done in bringing q from infinity against the field E= $q_1 V\|\overrightarrow{r_1}\|$	1	
	Work done on q_2 against the field E= $q_2 V\|\overrightarrow{r_2}\|$ Work done on q_2 against the field due to q_1 $= \frac{q_1 q_2}{4\pi\epsilon_0 (r_{12})}$	½	
		½	

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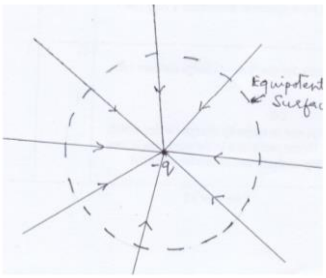
<td>Potential energy of the system= Total work done in assembling the system

$$= q_1V(\vec{r_1}) + q_2V(\vec{r_2}) + \frac{q_1q_2}{4\pi\epsilon_0 r_{12}}$$

b)



c) Work done= charge in potential energy

$$= \frac{kq_1q_2}{r_{12}} + \frac{kq_1q_3}{r_{13}} + \frac{kq_2q_{31}}{r_{23}}$$

$$= \frac{9 \times 10^9 \times 10^{-12}}{0.1}\ [1\ \times\ -1 +\ -1 \times 2 + 1\ \times 2]$$

$$= 9 \times 10^{-2}[-1 - 2 + 2]$$

$$= -9 \times 10^{-2} J$$
</td>
<td>1
½
½</td>
<td>5</td>
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<td>37</td>
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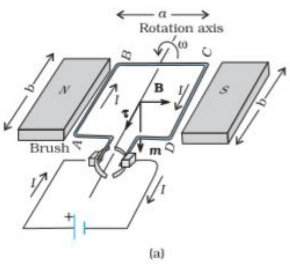
a) Labelled diagram	1 mark
Derivation for torque	1 mark
Justification of radial magnetic field	1 marks
(b) Calculation of radius of the path	2 marks



Magnetic forces of AB and CD are equal and opposite and have different line of action so constitute torque
Force acting on current carrying arms AB and CD

$$F_1 = F_2 = BIl = F\ (say)$$

$$\therefore \tau = F\ \times perpendiclar\ distance\ between\ two\ force\ arm$$

$$\therefore \tau = BIlbsin\theta$$

$$lb = A$$

$$\tau = BIA\ sin\theta$$
</td>
<td>1
½</td>
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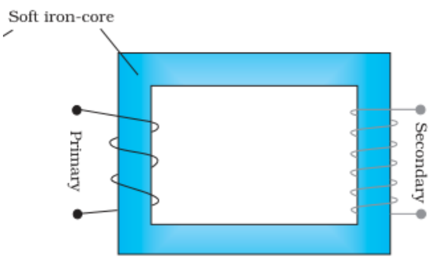
	For N turn		
	$\tau = BINA\ sin\theta$	½	
	Radial fields always produce maximum torque and removes the dependence of torque on θ	1	
	(b) Radius of circular path $= \frac{mv}{Bq} = \frac{\sqrt{2mE_k}}{Bq}$	1	
	$= \frac{1}{B}\sqrt{\frac{2mqV}{q^2}}$		
	$= \frac{1}{B}\sqrt{\frac{2mV}{q}} = \frac{1}{2 \times 10^{-3}}$		
	r = 10m	1	5
	OR		
	(a) Labelled diagram — 1 mark Working — 1 mark (i) & (ii) Reason/justification — ½ + ½ mark (b) (i) External force required — 1 mark (ii) Power required — 1 mark		
		1	
	[Note: Diagram with different windings can also be drawn] 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		
	Induced emf across primary coil	½	
	$e_P = -N_p \frac{d\emptyset}{dt}$		
	Induced emf across secondary coil		
	$e_s = -N_s \frac{d\emptyset}{dt}$	½	
	$\frac{e_s}{e_p} = \frac{N_s}{N_p} = r$	½ ½	
	(i) to minimise the eddy currents (ii) To reduce the heat loss (b)(i)		
	F=BIl	½	

	$I = \frac{E}{R} = \frac{Bvl}{R}$ $F = \frac{B^2vl^2}{R}$ $= \frac{0.4 \times 0.4 \times 0.1 \times 0.2 \times 0.2}{0.1}$ $= 6.4 \times 10^{-3}$ N $P = F.v = 6.4 \times 10^{-3} \times 0.1$ $= .64 \times 10^{-3} W$	½ ½ ½	5