Marking Scheme
Strictly Confidential
(For Internal and Restricted use only)
Senior School Certificate Examination, 2023
SUBJECT: PHYSICS (042) (PAPER CODE 55/1/1)

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.

2 **"Evaluation policy is a confidential policy as it is related to the confidentiality of the examinations conducted, Evaluation done and several other aspects. Its' leakage to public in any manner could lead to derailment of the examination system and affect the life and future of millions of candidates. Sharing this policy/document to anyone, publishing in any magazine and printing in News Paper/Website etc may invite action under various rules of the Board and IPC."**

3 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 due marks be awarded to them. In class-X, while evaluating two competency-based questions, please try to understand given answer and even if reply is not from marking scheme but correct competency is enumerated by the candidate, due marks should be awarded.**

4 The Marking scheme carries only suggested value points for the answers

These are in the nature of Guidelines only and do not constitute the complete answer. The students can have their own expression and if the expression is correct, the due marks should be awarded accordingly.

5 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. If there is any variation, the same should be zero after delibration and discussion. 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.

6 Evaluators will mark(√) wherever answer is correct. For wrong answer CROSS 'X" be marked. Evaluators will not put right (✓)while evaluating which gives an impression that answer is correct and no marks are awarded. **This is most common mistake which evaluators are committing.**

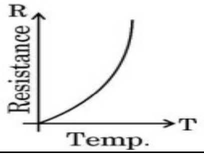
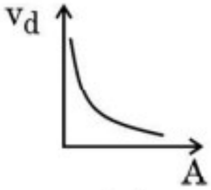
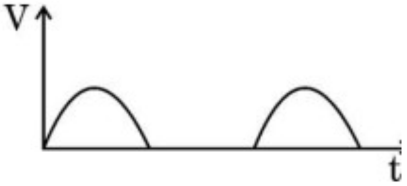
7 If a question has parts, please award marks on the right-hand side for each part. Marks awarded for different parts of the question should then be totaled up and written in the left-hand margin and encircled. This may be followed strictly.

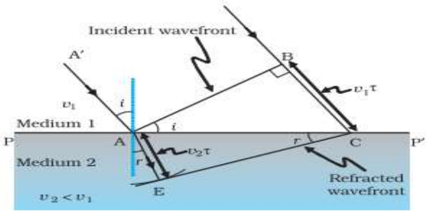
8 If a question does not have any parts, marks must be awarded in the left-hand margin and encircled. This may also be followed strictly.

9	If a student has attempted an extra question, answer of the question deserving more marks should be retained and the other answer scored out with a note **“Extra Question”**.
10	No marks to be deducted for the cumulative effect of an error. It should be penalized only once.
11	A full scale of marks 0 - 70(example 0 to 80/70/60/50/40/30 marks as given in Question Paper) has to be used. Please do not hesitate to award full marks if the answer deserves it.
12	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).This is in view of the reduced syllabus and number of questions in question paper.
13	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 an answer. ● 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/not same. ● 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.
14	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.
15	Any un assessed 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.
16	The Examiners should acquaint themselves with the guidelines given in the “**Guidelines for spot Evaluation**” before starting the actual evaluation.
17	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.
18	The candidates are entitled to obtain photocopy of the Answer Book on request on payment of the prescribed processing fee. All Examiners/Additional Head Examiners/Head Examiners are once again reminded that they must ensure that evaluation is carried out strictly as per value points for each answer as given in the Marking Scheme.

MARKING SCHEME: PHYSICS(042)

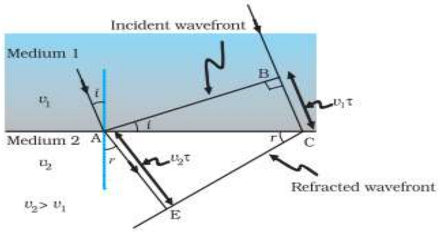
Code: 55/1/1

Q.No.	VALUE POINTS/EXPECTED ANSWERS	Marks	Total Marks
	SECTION –A		
1.	(b) $\frac{\vec{F}}{8}$	1	1
2.	(d) 	1	1
3.	(d) 1 Ω	1	1
4.	(a) 	1	1
5.	(a) Repelled by both the poles.	1	1
6.	(c) 0.19 V	1	1
7.	(c) Resistance (r)	1	1
8.	(c) $\in_o \frac{d\phi_E}{dt}$	1	1
9.	(a) Zero	1	1
10.	(c) n^2	1	1
11.	(d) 95 nm	1	1
12.	(d) Independent of A	1	1
13.	(c) 	1	1
14.	(b) it becomes a p-type semiconductor	1	1
15.	(d) 0.01 eV	1	1
16.	(d) Assertion (A) is false and Reason (R) is also false.	1	1
17.	(a) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A).	1	1
18.	(b) Both Assertion (A) and Reason (R) are true but reason (R) is the **not** correct explanation of the Assertion (A)	1	1
	SECTION-B		

19.	Calculation of acceleration of alpha particle 2 $\vec{F}=q(\vec{v}\times\vec{B})$ $= q(3\times10^5\hat{i}\times(0.4\hat{i}+0.3\hat{j}))N$ $\vec{F} = q(0.9\times10^5\hat{k})N$ $\vec{F} = m\vec{a} = q(0.9\times10^5\hat{k})N$ $\vec{a}=\frac{q}{m}(0.9\times10^5\hat{k})ms^{-2}$ $= 4.8\times10^7\times0.9\times10^5\ \hat{k}\ ms^{-2}$ $= 4.32\times10^{12}\ \hat{k}\ ms^{-2}$ Note: Deduct ½ mark if a student does not mention the direction of acceleration.	½ ½ ½ ½	2
20.	Identification 1 Justification 1 Induced electric field due to changing magnetic field is easily observed. Induced electric field due to changing magnetic field can be easily produced by various ways like rotating/moving a coil in magnetic field, changing the shape of coil in magnetic field, bringing bar magnet near a coil etc.	1 1	2
21.	(a) Ray diagram 1 Proof of Snell's law of refraction 1  AB is incident wave front, incident at an angle i. Let τ be time taken by the wave front to travel distance BC. BC= $v_1\tau$ where v_1 is speed of wave in medium 1. To determine shape of refracted wave front, we draw a sphere of radius $v_2\tau$, where v_2 is speed of wave in medium 2. CE represents a tangent drawn from point C on sphere, CE is the refracted wave front. $\sin i = \frac{BC}{AC} = \frac{v_1\tau}{AC}$ $\sin r = \frac{AE}{AC} = \frac{v_2\tau}{AC}$	1 ½	

$$\frac{\sin i}{\sin r} = \frac{v_1}{v_2} = n_{21}$$ ½

Note: Give full credit if student derives Snell's law by taking incident wavefront in denser medium.



OR

(b)

Reason for preferring reflecting type telescope over refracting telescope	½ + ½
Justification	½ + ½

1. No Chromatic Aberration - No refraction in mirrors
2. No Spherical Aberration - Due to use of parabolic reflector
3. Easy mechanical support required - Mirrors weigh less and can be supported over entire back surface.
4. High resolving power – Due to Mirror with large diameter.
5. Brighter image – Large mirrors gather more light waves.

(Any two) 1+1 2

22.

Finding the ratio of maximum and minimum intensities	2

$$\frac{I_{\max}}{I_{\min}} = \frac{(\sqrt{I_1}+\sqrt{I_2})^2}{(\sqrt{I_1}-\sqrt{I_2})^2}$$ ½

$$= \frac{I_1 + I_2 + 2\sqrt{I_1 I_2}}{I_1 + I_2 - 2\sqrt{I_1 I_2}}$$ ½

$$= \frac{5I + 4I}{5I - 4I}$$ ½

$$= \frac{9}{1}$$ ½

Alternatively

$$\frac{I_1}{I_2} = \frac{a^2}{b^2} = \frac{4I}{I} = \frac{4}{1}$$ ½

$$\frac{a}{b} = \frac{2}{1}$$ ½

<table>
<tr>
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$$\frac{I_{\max}}{I_{\min}} = \frac{(a+b)^2}{(a-b)^2}$$

$$\frac{I_{\max}}{I_{\min}} = \frac{(2+1)^2}{(2-1)^2} = \frac{9}{1}$$

</td>
<td>½
½</td>
<td>2</td>
</tr>
<tr>
<td>23.</td>
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Calculation of potential energy of electron 1
Calculation of kinetic energy of electron 1

$E_n = \frac{-13.6}{n^2} eV$ = Total energy

For third excited state n=4

$E_4 = \frac{-13.6}{4^2} = \frac{-13.6}{16}$ = -0.85 eV

Potential Energy = 2 × Total Energy = 2 × E_4
= 2 ×(-0.85) eV
= - 1.70 eV

Kinetic energy = - (Total Energy) = $-E_4$
= 0.85 eV

</td>
<td>½
½
½
½</td>
<td>2</td>
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<td>24.</td>
<td>

(a)

Difference between intrinsic and extrinsic semiconductor 2

<table>
<tr><th>Intrinsic semiconductor</th><th>Extrinsic semiconductor</th></tr>
<tr><td>1. Pure semiconductor.</td><td>Semiconductor is Doped with impurities.</td></tr>
<tr><td>2. Low conductivity at room temperature.</td><td>High conductivity at room temperature.</td></tr>
<tr><td>3. $n_e = n_h$</td><td>$n_e \neq n_h$</td></tr>
</table>

(Any one)

Note: Give full credit if a student writes any other relevant correct answer.

OR

(b)

Circuit diagram for forward and reverse biased p-n junction diode ½ + ½
V-I characteristic (Forward and Reverse bias) ½ + ½

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<td>1+1</td>
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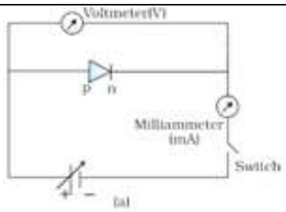
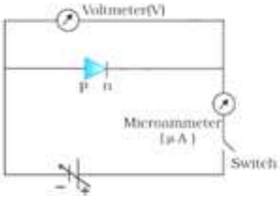
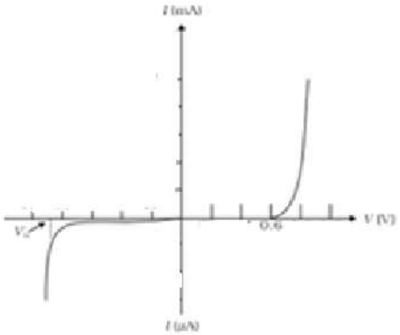
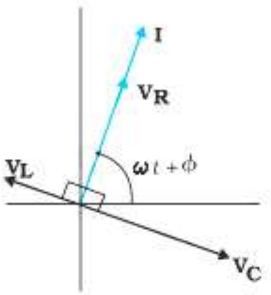
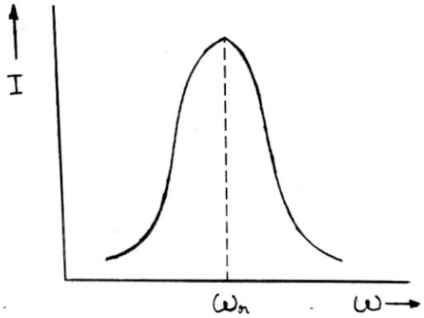
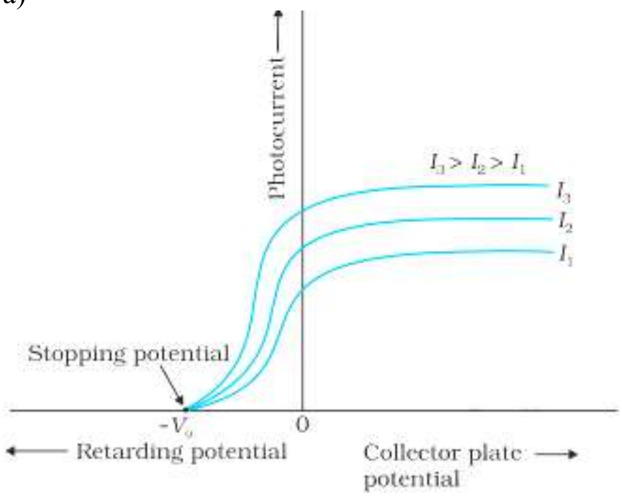
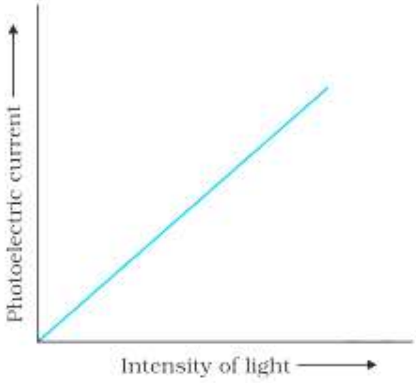
	 Forward Bias  Reverse Bias  Characteristics of silicon Diode	½ + ½ ½ + ½	2
25.	Formation of potential barrier 2 The diffusion current due to concentration gradient at the junction forms a space charge region consisting of immobile charge carriers. Due to this an electric field is generated at the junction giving rise to drift current in a direction opposite to diffusion current. The potential at which diffusion current becomes equal to drift current is called potential barrier.	2	2
	SECTION –C		
26.	a) Finding electric potential at the centre 1 Finding electric field at the centre 1 b) Finding electric potential at the centre 1 (a) Electric potential due to point charge V= $\frac{kq}{R}$ Value of each charge = - q , Total charge = -12q Total potential V = $\frac{k(-12q)}{R}$ V = $\frac{-12kq}{R} = \frac{-12q}{4\pi \in_0 R}$ By symmetry the resultant of all electric field vectors becomes zero. So electric field is zero.	½ ½ 1	

	(b) Electric potential is a scalar quantity and does not depend on placement of charges Therefore $V=\frac{-12kq}{R}=\frac{-12q}{4\pi\in_0 R}$	1	3
27.	(a) Difference between resistance and impedance 1 Obtaining expression for impedance 2		
	1. Resistance is the opposition offered to both alternating current and direct current while impedance is the opposition offered to alternating current only. 2. Resistance is independent of frequency of source while impedance depends on frequency. 3. Resistance is opposition offered by material of the conductor while impedance is combined opposition offered by different electrical components such as resistor, inductor or capacitor. **(Any One)** (Note: Give credit of this part if a student writes any other correct answer.)	1	
		½	
	$V_R = i_mR$, $V_c = i_m X_c$, $V_L = i_mX_L$ i_m = Peak value of current in the circuit. $\vec{V_L}+\vec{V_R}+\vec{V_C}=\vec{V_m}$	½	
	$(V_m)^2 = V_R^2 + (V_C - V_L)^2$ $= (i_mR)^2 + (i_mX_c - i_mX_L)^2$ $= i_m [R^2 + (X_c - X_L)^2]$	½	
	$i_m = \frac{V_m}{\sqrt{R^2+(X_c-X_L)^2}}$ $i_m = \frac{V_m}{Z}$ where $Z = \sqrt{R^2+(X_c-X_L)^2}$ = impedance	½	

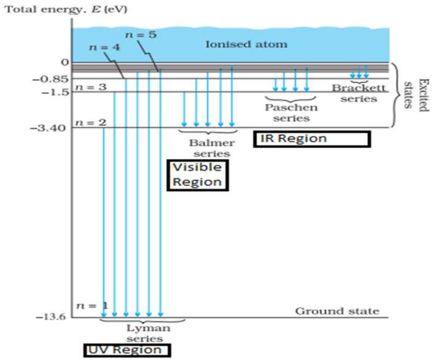
	OR		
	(b)		
	Finding condition for resonance 1 Factors affecting resonant frequency 1 Graph 1		
	$Z = \sqrt{R^2+(X_L-X_c)^2}$	½	
	For maximum current, Z should be minimum therefore to minimize Z $X_L = X_C$	½	
	Alternatively	½	
	$X_L = X_C$		
	$\omega L = \frac{1}{\omega C}$		
	$\omega_r = \frac{1}{\sqrt{LC}}$	½	
	Resonant Frequency depends on value of Inductance and Capacitance	½ + ½	
		1	3
28.	Finding a) Induced emf 2 b) Mutual inductance between solenoid and coil 1		
	a) magnetic field produced in the solenoid near the center		
	$B= \mu_o nI$	½	
	Flux linked with the coil wound over solenoid		
	$\phi = NBA= N \pi r^2 B$		
	$= N \pi r^2 \mu_o nI$	½	
	Induced emf $e = \frac{-d\phi}{dt} = -\pi r^2 Nn\mu_o \frac{dI}{dt}$ (i)	½	
	$= - \mu_o\pi r^2 nN I_o\omega \cos \omega t$	½	

	b) comparing Eq (i) with $e = -M \frac{dI}{dt}$ M = $\mu_o \pi r^2 nN$	½ ½	3
29.	Explanation of emission of electron 1 a) variation of photocurrent with collector plate potential for different intensity 1 b) variation of photo current with intensity of incident radiation 1 According to Einstein's photoelectric equation An electron absorbs a quantum of energy 'hυ' of incident radiation. If the energy of absorbed quantum exceeds the minimum energy needed by the electron to escape from the metal surface (work function φ_o), the electron is emitted. $K_{max} = h\upsilon - \varphi_o$ a)  b) 	1 1 1	3

30.

a)

Energy level diagram for hydrogen atom	1 ½
Transitions corresponding to ultraviolet region, visible region and infrared region	½ + ½ + ½



1 ½

½

½

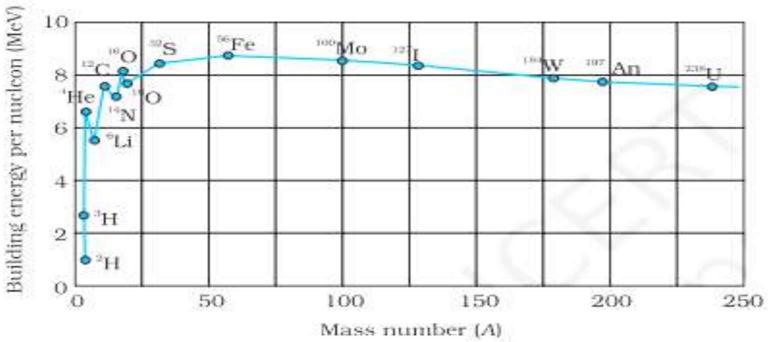
½

Note: Award 1 ½ mark for energy level diagram if the student does not show the transitions.

OR

b)

Diagram to show variation	1
Two features of diagram	½ + ½
Reason for nuclear fusion	1



1

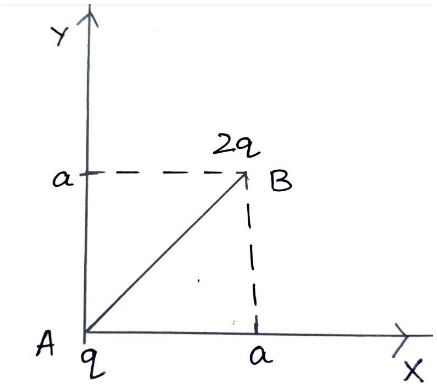
(Note: Award full credit even if a student does not mark so many elements and does not mention the values of E_{bn}.)

Features of diagram **(any two)**

1. Binding energy per nucleon is practically independent of atomic number for nuclei of middle mass number (30 <A < 170)
2. The curve has maximum of about 8.75 MeV for A= 56 and has a value of 7.6 MeV for A= 238
3. Binding energy per nucleon is lower for both light nuclei (A<30) and heavy nuclei (A>170)

½ + ½

Two lighter nuclei fuse together to form heavier nuclei as the binding energy per nucleon of fused heavier nuclei is more than the binding energy per nucleon of the lighter nuclei. Thus the final system is more tightly bound

	than initial system. **Alternatively** To attain the stability	1	3
	SECTION –D		
31.	(a)		
	i) Statement of coulomb's law and vector form 1+1 ii) Explanation of Gauss's law based on coulomb's law 1 iii) Force exerted by charge A on charge B 2		
	i) Force between two point charges varies inversely with the square of distance between the charges and is directly proportional to the product of magnitude of the two charges and acts along the line joining the two charges.	1	
	$\overrightarrow{F_{12}} = \frac{1}{4\pi \in_o} \frac{q_1 q_2}{r_{12}^{2}} \widehat{r_{12}}$	1	
	Alternatively $\overrightarrow{F_{12}} = \frac{1}{4\pi \in_o} \frac{q_1 q_2}{r_{12}^{3}} \overrightarrow{r_{12}}$ Where $\overrightarrow{r_{12}}$ is a vector from charge q_2 to charge q_1.		
	ii) In derivation of Gauss's law, flux is calculated using Coulomb's law and surface area. Here coulomb's law involves $\frac{1}{r^2}$ factor and surface area involves r^2 factor. When product is taken, the two factors cancel out and flux becomes independent of r.	1	
	iii)  	½	
	$\vec{r} = \overrightarrow{AB} = a\hat{i} + a\hat{j}$ r = $\left\|\overrightarrow{AB}\right\| = \sqrt{a^2 + a^2} = \sqrt{2}a$ $\vec{F} = \frac{1}{4\pi \in_o} \frac{q_1 q_2}{r^2} \hat{r}$	½	

$$\vec{F} = \frac{1}{4\pi \in_o} \times \frac{q \times 2q}{(\sqrt{2}a)^2} \times \frac{(a\hat{i} + a\widehat{j})}{\sqrt{2}a}$$

$$\vec{F} = \frac{1}{4\pi \in_o} \times \frac{2q^2}{2a^2} \times \frac{(\hat{i} + \widehat{j})}{\sqrt{2}}$$ ½

$$\vec{F} = \frac{1}{4\pi \in_o} \times \frac{q^2}{\sqrt{2}a^2} \times (\hat{i} + \widehat{j})$$

$$\vec{F} = \frac{q^2}{4\sqrt{2}\pi \in_o a^2}(\hat{i} + \widehat{j})$$ ½

Note: Award 1 mark if a student calculates the magnitude of force only.

$$\left|\vec{F}\right| = \frac{1}{4\pi \in_o}\frac{q^2}{a^2}$$

Alternatively

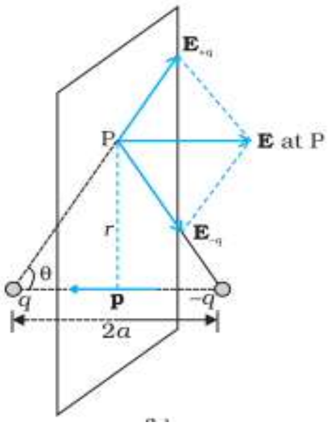
Give full credit if a student uses component method to solve the question.

OR

(b)

i) Derivation of electric field	2
ii) Effect on electric field	1
iii) Finding magnitude and direction of electric field	2

i)



½

$$E_{+q} = \frac{q}{4\pi \in_o} \times \frac{1}{r^2 + a^2}$$

$$E_{-q} = \frac{q}{4\pi \in_o} \times \frac{1}{r^2 + a^2}$$ ½

The components normal to dipole axis cancel away. The components along the dipole axis add up. ½

Total electric field is opposite to dipole moment.

$$\vec{E} = -(E_{+q} + E_{-q})\cos\theta\,\widehat{p}$$

$$= \frac{-2qa}{4\pi \in_o (r^2 + a^2)^{3/2}}\hat{p}$$

$$= \frac{-\vec{p}}{4\pi \in_o (r^2 + a^2)^{3/2}}$$ ½

Deduct ½ mark if the expression of electric field is not in vector form.

ii) At far off point r >> a

$$\vec{E} = \frac{-\vec{p}}{4\pi \in_o r^3}$$

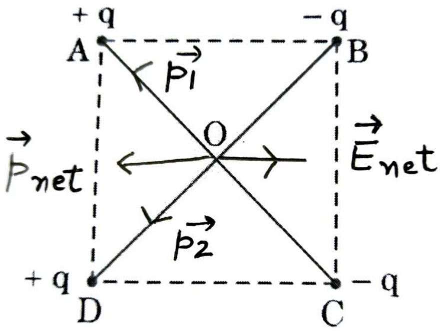
When distance is halved.

$$\vec{E} = \frac{-\vec{p}}{4\pi \in_o (\frac{r}{2})^3}$$ ½

$$= \frac{-8\vec{p}}{4\pi \in_o r^3}$$

$\vec{E}$ becomes 8 times ½

iii)



$p_1 = q \times 2Cm$ (along OA)

$p_2 = q \times 2Cm$ (along OD)

$p_{net} = \sqrt{p_1{}^2 + p_2{}^2}$ ½

$= 2\sqrt{2}\, q\, Cm$

Electric field at centre O

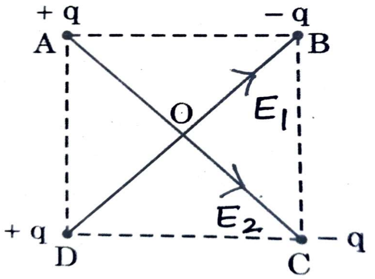
$$E = \frac{kp_{net}}{(r^2+a^2)^{3/2}}$$ ½

at point O, r = 0 , a = 1 m

$$E = \frac{k \times 2\sqrt{2}q}{1^3} = 2\sqrt{2}kq = \frac{2\sqrt{2}q}{4\pi \in_o}$$ ½

Along DC ½

Alternatively



$E = \frac{kq}{r^2}$ ½

AC= BD= 2m

r = OA =OB= OC=OD=1m

Electric field at O due to charges at B and D

$E_1 = E_B + E_D$

$E_1 = \frac{kq}{1^2} + \frac{kq}{1^2}$ along OB

$= 2kq$ ½

Electric field at O due to charges at A and C

$E_2 = E_A + E_C$

$E_2 = \frac{kq}{1^2} + \frac{kq}{1^2}$

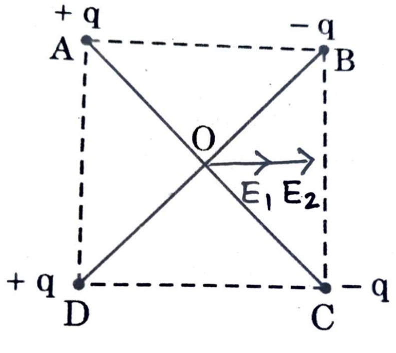
$= 2kq$ along OC ½

$E_{net} = \sqrt{E_1^{\ 2} + E_2^{\ 2}}$

$= 2\sqrt{2}\ kq = \frac{2\sqrt{2}q}{4\pi \in_o}$ ½

Along DC

Alternatively



Considering AB as dipole, electric field at O

$E_1 = \frac{2kq \times a}{((\frac{1}{\sqrt{2}})^2 + (\frac{1}{\sqrt{2}})^2)^{3/2}} = \frac{2kqa}{(\frac{1}{2}+\frac{1}{2})^{3/2}} = 2kqa$ ½

Similarly considering DC as another dipole, electric field at O

$$E_2 = \frac{2kq \times a}{((\frac{1}{\sqrt{2}})^2 + (\frac{1}{\sqrt{2}})^2)^{3/2}} = \frac{2kqa}{(\frac{1}{2}+\frac{1}{2})^{3/2}} = 2kqa$$ ½

$$E_{net} = E_1 + E_2 = 4kqa = \frac{1}{4\pi\in_o} \times 4 \times \frac{1}{\sqrt{2}} \times q$$ ½

$$= 2\sqrt{2}kq = \frac{2\sqrt{2}q}{4\pi\in_o}$$ ½

Along DC

5

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32. (a)

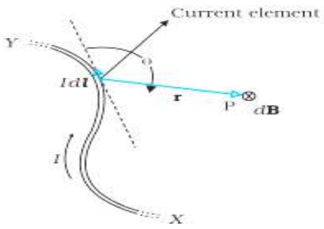
i) Statement of Biot-Savart's law	1
Expression for magnetic field	2
Diagram for magnetic field lines	½
ii) Finding current by revolving electron	1 ½

(i)

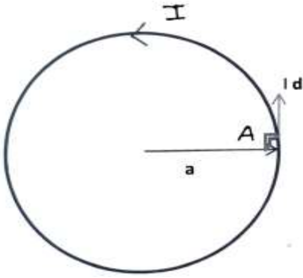
The magnetic field at a point due to a current carrying element is proportional to magnitude of current, element length and inversely proportional to the square of the distance from the element. 1

$$\overrightarrow{dB} = \frac{\mu_o}{4\pi} I \frac{\overrightarrow{dl} \times \vec{r}}{r^3}$$

$$|dB| = \frac{\mu_o}{4\pi} \frac{Idl\sin\theta}{r^2}$$



Consider a circular coil of radius a carrying current I.



½

According to Biot-Savart's law

$$|\overrightarrow{dB}| = \frac{\mu_o}{4\pi} \frac{Idl\sin\theta}{r^2}$$ ½

At point A I $\overrightarrow{dl} \perp \vec{a}$

$\therefore \theta = 90^o, \sin 90^o = 1$

Hence dB= $\frac{\mu_o}{4\pi}\frac{Idl}{a^2}$

Magnetic field at centre

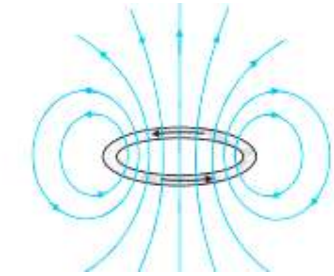
B= $\int_o^{2\pi a} dB = \int_0^{2\pi a} \frac{\mu_o}{4\pi}\frac{Idl}{a^2}$ ½

B= $\frac{\mu_o}{4\pi} \times \frac{I}{a^2} \times 2\pi a$

½

B = $\frac{\mu_o I}{2a}$

Note: Give full credit of 2 marks if a student derives the expression for magnetic field at the axis of the loop and then puts the distance of point as 0 from the centre.



½

ii) q=e , v=10^7ms^{-1},r=10^{-10}m

i= $\frac{q}{T}$ ½

= $\frac{qv}{2\pi r}$

= $\frac{ev}{2\pi r}$

½

= $\frac{1.6 \times 10^{-19} \times 10^7}{2 \times \pi \times 10^{-10}}$

= $\frac{0.8}{\pi} \times 10^{-2} A$ ½

= $0.255 \times 10^{-2} A$ = 2.55 mA

OR

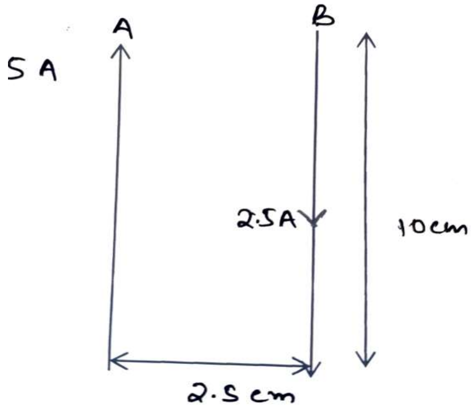
b)

i) Derivation of expression for force	2
Statement of Rule	½
Conditions for maximum and minimum force	½ + ½
ii) Calculation of magnitude of force	1 ½

Consider a rod of uniform cross sectional area A and length *l*. Let the number density of mobile charge carriers in it be n.

Thus the total number of mobile charge carriers in it is n *l* A. ½

For steady current I, drift velocity of electrons $\overrightarrow{v_d}$, in the presence of

	external magnetic field $\vec{B}$, the force on these carriers is $\vec{F}=n\,l\,Aq(\overrightarrow{v_d}\times\vec{B})$	½	
	$= \left[\vec{j}Al\right]\times\vec{B}$	½	
	$= I(\vec{l}\times\vec{B})$ Where $nq\overrightarrow{v_d}$ is current density ($\vec{j}$) and $\left\|\vec{j}A\right\|$ is current (I) Fleming's left hand Rule: If forefinger, middle finger and thumb are stretched in mutually perpendicular directions, such that forefinger indicates the direction of magnetic field, middle finger indicates the direction of current in the conductor, then thumb indicates the direction of force on the conductor. **Alternatively**	½	
	Right Hand Thumb Rule : If the fingers of right hand are made to rotate from $\vec{l}$ to $\vec{B}$ through angle θ, the thumb points in the direction of force on the current carrying conductor.	½	
	Condition for maximum force $\theta = 90^0$ $\left\|\vec{F}\right\| = IlB\sin\theta$ = IlB	½	
	Condition for minimum force $\theta = 0^o$ or 180^0 $\left\|\vec{F}\right\| = 0$	½	
	ii)  F= $\frac{\mu_o}{4\pi}\frac{2I_1I_2}{d}l$	½	
	$= \frac{10^{-7}\times2\times5\times2.5}{2.5\times10^{-2}}\times10\times10^{-2}N$	½	
	$= 10^{-5}$ N	½	5

33. a)

i) (1) Difference between interference pattern and diffraction pattern	1+1
(2) Two factors affecting fringe width in young's double slit experiment	½ + ½
ii) (1) calculation of angular separation	1
(2) calculation of distance between two maxima	1

(i) (1)

(a) The interference pattern has a number of equally spaced bright and dark bands while diffraction pattern has a central bright maximum which is twice as wide as the other maxima.

(b) Interference pattern is obtained by superposing two waves originating from two narrow slits, while diffraction pattern is a superposition of a continuous family of waves originating from each point on a single slit.

(c) The maxima in interference pattern is obtained at angle λ / a, while the first minima is obtained at same angle λ / a for diffraction pattern.

(d) In interference pattern the intensity of bright fringes remain same while in diffraction the intensity falls as we go to successive maxima away from the center on either side. 1+1

(any two)

(2) Factors affecting fringes width

Wave length (λ) / distance of screen from slits (D) / separation between slits (d). ½ + ½

(any two)

(ii) (1) $d \sin\theta = n\lambda$ ½

$n=1$

$$\sin\theta = \frac{\lambda}{d}$$

For small angle $\sin\theta \approx \theta = \frac{\lambda}{100\lambda} = \frac{1}{100}$ radian. ½

(2) $\beta = \frac{\lambda D}{d} = \theta D$ ½

$$= \frac{1}{100} \times 50 \times 10^{-2}$$

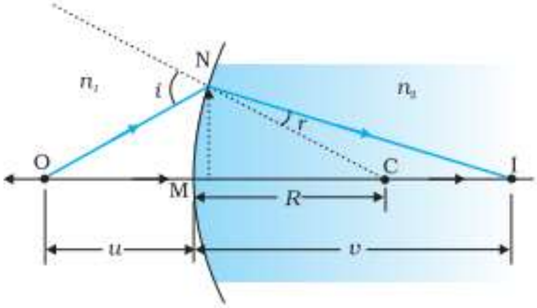
$$= 50 \times 10^{-4} m$$

$= 5$ mm ½

OR

(b)

i) Derivation of relation between u and v	3
ii) Finding apparent position	2

		1	
	Assume that the aperture of the surface is small as compared to other distance involved, so that small angle approximation can be made.		
	For small angles		
	for ΔNOC, i is the exterior angle		
	$\therefore$ i = $\angle NOM + \angle NCM$		
	i= $\frac{MN}{OM}+\frac{MN}{MC}$ (i)	½	
	Similarly r = $\angle NCM - \angle NIM$		
	$= \frac{MN}{MC}-\frac{MN}{MI}$ (ii)		
	By Snell's law		
	$n_1 \sin i = n_2 \sin r$		
	for small angles	½	
	$n_1 i = n_2 r$		
	substituting i and r from (i) and (ii) we get		
	$\frac{n_1}{OM}+\frac{n_2}{MI}=\frac{n_2-n_1}{MC}$	½	
	Applying Cartesian coordinates		
	OM= -u, MI= + v , MC= +R		
	$\frac{n_2}{\text{v}}-\frac{n_1}{u}=\frac{n_2-n_1}{R}$	½	
	(ii) $\frac{n_2}{\text{v}}-\frac{n_1}{u}=\frac{n_2-n_1}{R}$		
	R= - 6 cm, u = - 3cm , n_1 =1.5 n_2 = 1		
	$\frac{1}{\text{v}}+\frac{1.5}{3}=\frac{1-1.5}{-6}$	½	
	$\frac{1}{\text{v}}=\frac{0.5}{6}-\frac{1.5}{3}$	½	
	$\frac{1}{\text{v}}=\frac{0.5-3}{6}$	½	
	$\frac{1}{\text{v}}=\frac{-2.5}{6}$	½	
	v = - 2.4 cm		5
	from the left surface inside the sphere		

SECTION -E

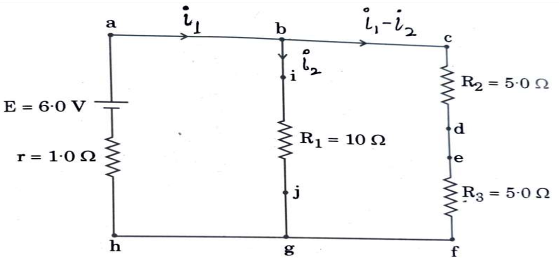
34.

a) Points at same potential	1
b) Current through arm bg	1
c) Potential difference across R_3 OR c) Power dissipated in R_2	2

a) Points (a, b, c)
(d, e)
(j, f, g ,h)
are at same potential 1

Note: Give full credit if a student mentions any two points at same potential from the above.

b)



According to Kirchhoff’s loop rule
for closed loop abgha
$- 6 + 10\ I_2 + I_1 = 0$
$I_1 + 10\ I_2 = 6$ (i)
for closed loop acfha
$- 6 + 10\ (I_1 – I_2) + I_1 = 0$
$11\ I_1 - 10\ I_2 = 6$ (ii) ½
Adding (i) and (ii)
$12\ I_1 = 12$
$I_1 = 1$ A
$I_2 = 0.5$ A ½
= current through arm bg
Note: Award 1 mark if a student calculates the current by any other method.

c) $V_{R3} = (I_1 - I_2) \times R_3$ 1
$= 0.5 \times 5$
$= 2.5$ V 1

OR

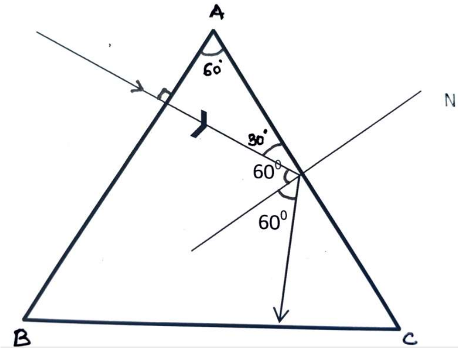
(c) $P = (I_1 - I_2)^2 \times R_2 = (0.5)^2 \times 5$ 1
$= 1.25$ W 1

4

35.

a) Tracing of path of ray	1
b) Finding velocity of light	1
c) Explanation of two application of TIR	2
OR	
c) Definition of TIR	1
Mentioning two conditions of TIR	½ + ½

a)



1

From fig. angle of incidence on second face $\angle i = 60^0$

critical angle $\angle i_c = 24.5^o$

$(\angle i) > (\angle i_c)$

$\therefore$ TIR takes place

b) n= $\frac{c}{v}$

v = $\frac{c}{n} = \frac{3\times10^8}{2.41} = 1.24 \times 10^8$ m/s 1

c) Optical Fibre / Brilliance of diamond / mirage (any two)

Note: Give full credit if students mention the names of applications only. 1+1

OR

c) When light travels from optically denser medium to rarer medium at an interface and gets reflected back into the same medium the phenomenon is called as total internal reflection. 1

Conditions for TIR

1. Light must travel from optically denser medium to rarer medium.
2. Angle of incidence at the interface must be greater than the critical angle for the pair of media. ½ + ½

4