

Marking Scheme
Strictly Confidential
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Senior School Certificate Examination, 2025
SUBJECT NAME PHYSICS (PAPER CODE 55/1/2)

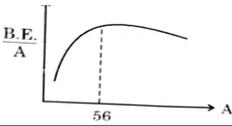
General Instructions: -

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 deliberation 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 <u>70</u> (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	<p>Ensure that you do not make the following common types of errors committed by the Examiner in the past:-</p> <ul style="list-style-type: none"> ● 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: 55/1/2

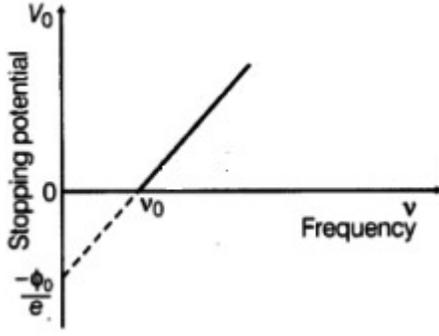
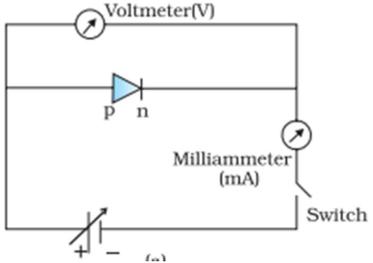
Q.No.	VALUE POINTS/EXPECTED ANSWERS	Marks	Total Marks				
	SECTION A						
1	(C) C	1	1				
2	(B) Using a wire of same radius and half length.	1	1				
3	(B) $(-3\hat{j}+2\hat{k})\mu\text{N}$	1	1				
4	(C) 2	1	1				
5	(B) 2866	1	1				
6	(D) $\frac{i_0 v_0}{2} \cos \phi$	1	1				
7	(B) Speed Wavelength Frequency Remains same Decreases Increases	1	1				
8	(A) medium '1' and at an angle greater than $\sin^{-1} \left(\frac{v_1}{v_2} \right)$	1	1				
9	(A) 10^{16}	1	1				
10	(A) 	1	1				
11	(C) The barrier height and the depletion layer width both decrease.	1	1				
12	(B) $\lambda_e > \lambda_p > \lambda_d$	1	1				
13	(D) Assertion (A) is false and Reason (R) is also false.	1	1				
14	(C) Assertion (A) is true but Reason (R) is false.	1	1				
15	(A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion(A).	1	1				
16	A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion(A).	1	1				
	SECTION - B						
17	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="padding: 5px;">Obtaining Ohm's law from $\vec{E} = \rho \vec{j}$</td> <td align="right" style="padding: 5px;">1 ½</td> </tr> <tr> <td style="padding: 5px;">Writing the condition</td> <td align="right" style="padding: 5px;">½</td> </tr> </table> $\vec{E} = \rho \vec{j}$ $\frac{V}{l} = \rho \frac{I}{A}$	Obtaining Ohm's law from $\vec{E} = \rho \vec{j}$	1 ½	Writing the condition	½	½ ½	
Obtaining Ohm's law from $\vec{E} = \rho \vec{j}$	1 ½						
Writing the condition	½						

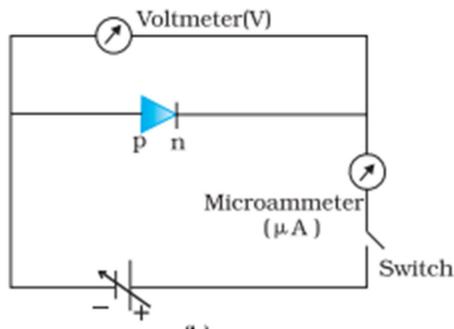
	<p>Phase difference = $\frac{2\pi}{\lambda} \times \text{path difference}$</p> $\Delta\phi = \frac{2\pi}{\lambda} \Delta x$ $\therefore \Delta x = \frac{\lambda}{8} \text{ (given)}$ $\Delta\phi = \frac{2\pi}{\lambda} \times \frac{\lambda}{8}$ $\Delta\phi = \frac{\pi}{4}$ $I = 4I_0 \cos^2\left(\frac{\phi}{2}\right)$ $I = 4I_0 \cos^2\left(\frac{\pi}{8}\right)$	1/2						
19	<table border="1" style="margin-left: auto; margin-right: auto;"> <tbody> <tr> <td>Finding the position</td> <td>1 1/2</td> </tr> <tr> <td>Nature of the Image formed</td> <td>1/2</td> </tr> </tbody> </table> <p>Refraction from rarer to denser medium</p> $\frac{n_1}{-u} + \frac{n_2}{v} = \frac{n_2 - n_1}{R}$ $u = -\frac{R}{2}, n_1 = 1, n_2 = 1.5$ $\frac{2}{R} + \frac{1.5}{v} = \frac{1.5 - 1}{R}$ $\frac{1.5}{v} = \frac{0.5}{R} - \frac{2}{R}$ $\frac{1.5}{v} = -\frac{1.5}{R}$ $v = -R$ <p>The image is virtual in air at distance R.</p>	Finding the position	1 1/2	Nature of the Image formed	1/2	1/2	1/2	2
Finding the position	1 1/2							
Nature of the Image formed	1/2							
20	<table border="1" style="margin-left: auto; margin-right: auto;"> <tbody> <tr> <td>Finding the Angular momentum</td> <td>2</td> </tr> </tbody> </table> $E_n = -\frac{13.6}{n^2} eV$ $n^2 = \frac{-13.6}{-3.4} = 4$ $n = 2$ <p>Angular momentum</p>	Finding the Angular momentum	2	1/2	1/2			
Finding the Angular momentum	2							

	$L = \frac{nh}{2\pi}$ $L = \frac{h}{\pi} = \frac{6.63 \times 10^{-34}}{3.14} = 2.11 \times 10^{-34} \text{ Js}$	1/2									
	$L = \frac{h}{\pi} = \frac{6.63 \times 10^{-34}}{3.14} = 2.11 \times 10^{-34} \text{ Js}$	1/2	2								
21	<table border="1" style="margin-left: auto; margin-right: auto;"> <tbody> <tr> <td>Finding the number of holes</td> <td style="text-align: right;">1</td> </tr> <tr> <td>One example</td> <td style="text-align: right;">1</td> </tr> </tbody> </table> <p>1 dopant atom for 5×10^7 Si atoms and number density of Si atoms = $5 \times 10^{28} \frac{\text{atoms}}{\text{m}^3}$ (given)</p> <p>No. of holes created per $\text{m}^3 = \frac{5 \times 10^{28}}{5 \times 10^7} = 10^{21}$</p> <p>Number of holes created per cubic centimeter $= \frac{10^{21}}{10^6} = 10^{15}$</p> <p>Any one example of dopant - Aluminium / Indium / Gallium</p>	Finding the number of holes	1	One example	1	1					
Finding the number of holes	1										
One example	1										
	SECTION - C										
22	<p>(a)</p> <table border="1" style="margin-left: auto; margin-right: auto;"> <tbody> <tr> <td>Finding</td> <td></td> </tr> <tr> <td>(i) Equivalent emf of combination</td> <td style="text-align: right;">1</td> </tr> <tr> <td>(ii) Equivalent internal resistance of combination</td> <td style="text-align: right;">1</td> </tr> <tr> <td>(iii) Current drawn from combination</td> <td style="text-align: right;">1</td> </tr> </tbody> </table> <p>(i) Because $E_{eq} = \frac{E_1 r_2 + E_2 r_1}{r_1 + r_2}$</p> $E_{eq} = \frac{3 \times 0.4 + 6 \times 0.2}{0.6} = 4 \text{ V}$ <p>(ii) $r_{eq} = \frac{r_1 r_2}{r_1 + r_2}$</p> $r_{eq} = \frac{0.2 \times 0.4}{0.2 + 0.4} = 0.133 \Omega$ <p>(iii) $I = \frac{E}{R + r_{eq}}$</p> $I = \frac{4}{4 + 0.13} = \frac{4}{4.13} \text{ A}$ <p>$I = 0.9 \text{ A}$</p> <p style="text-align: center;">OR</p>	Finding		(i) Equivalent emf of combination	1	(ii) Equivalent internal resistance of combination	1	(iii) Current drawn from combination	1	1/2	
Finding											
(i) Equivalent emf of combination	1										
(ii) Equivalent internal resistance of combination	1										
(iii) Current drawn from combination	1										
		1/2									
		1/2									
		1/2									
		1/2									
		1/2									

	<p>(b)</p> <table border="1" data-bbox="373 241 1299 462"> <tbody> <tr> <td>(i) Finding the relation</td> <td></td> </tr> <tr> <td>(i) between R' and R</td> <td>1</td> </tr> <tr> <td>(ii) between v_d' and v_d</td> <td>1</td> </tr> <tr> <td>(ii) To identify whether all free electrons are moving in the same direction.</td> <td>1</td> </tr> </tbody> </table> <p>(i) $l' = 2l$ $Al = A'l' = \text{volume of the wire}$ $Al = A'(2l)$</p> $\frac{A}{2} = A'$ $R = \frac{\rho l}{A}$ $R' = \frac{\rho l'}{A'}$ $R' = \frac{\rho(2l)}{A/2}$ $\frac{R'}{R} = 4$ <p>Alternatively</p> $R' = n^2 R$ $n = 2$ $R' = 4R$ <p>(ii) $v_d = \frac{eE}{m} \tau$</p> $v_d = \frac{eV}{ml} \tau$ $v_d' = \frac{eV}{ml'} \tau$ $\frac{v_d'}{v_d} = \frac{l}{l'} = \frac{1}{2}$ <p>(ii) No</p>	(i) Finding the relation		(i) between R' and R	1	(ii) between v_d' and v_d	1	(ii) To identify whether all free electrons are moving in the same direction.	1	<p>$\frac{1}{2}$</p> <p>$\frac{1}{2}$</p> <p>$\frac{1}{2}$</p> <p>$\frac{1}{2}$</p> <p>$\frac{1}{2}$</p> <p>$\frac{1}{2}$</p> <p>1</p>	<p>3</p>
(i) Finding the relation											
(i) between R' and R	1										
(ii) between v_d' and v_d	1										
(ii) To identify whether all free electrons are moving in the same direction.	1										
23	<table border="1" data-bbox="349 1701 1153 1837"> <tbody> <tr> <td>a) Defining magnetic moment</td> <td>1</td> </tr> <tr> <td>SI unit of magnetic moment</td> <td>$\frac{1}{2}$</td> </tr> <tr> <td>b) Finding the magnitude of magnetic field</td> <td>$1\frac{1}{2}$</td> </tr> </tbody> </table> <p>a) Magnetic moment of a current carrying coil is defined as the product of</p>	a) Defining magnetic moment	1	SI unit of magnetic moment	$\frac{1}{2}$	b) Finding the magnitude of magnetic field	$1\frac{1}{2}$	<p>1</p>			
a) Defining magnetic moment	1										
SI unit of magnetic moment	$\frac{1}{2}$										
b) Finding the magnitude of magnetic field	$1\frac{1}{2}$										

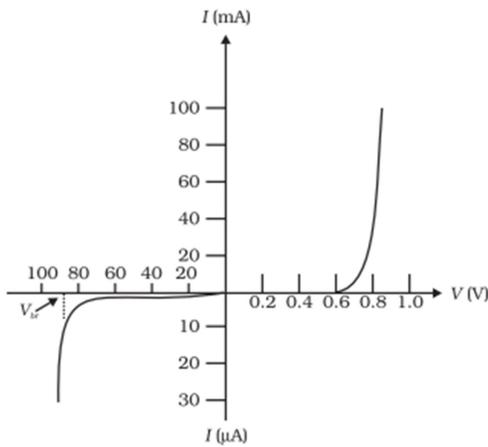
	<p>Considering Reverse case, when I_1 current is set up in S_1, flux linkage with S_2 is –</p> $N_2\phi_2 = M_{21}I_1 \quad \text{--(iii)}$ $N_2\phi_2 = (n_2l)(\mu r_1^2)(\mu_0 n_1 I_1) \quad \text{--(iv)}$ <p>From (iii) and (iv)</p> $M_{21} = n_1 n_2 \mu r_1^2 l$ $\therefore M_{12} = M_{21}$	<p>$\frac{1}{2}$</p> <p>$\frac{1}{2}$</p>	<p>3</p>				
25	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="padding: 5px;">a) Showing that ($I_c + I_d$) has the same value.</td> <td style="text-align: right; padding: 5px;">2</td> </tr> <tr> <td style="padding: 5px;">b) Explanation of Kirchoff's first rule at each plate of capacitor.</td> <td style="text-align: right; padding: 5px;">1</td> </tr> </table> <p>a) \therefore Total current $I = I_c + I_d$ outside the capacitor $I_d = 0$ $\therefore I = I_c$ Inside the capacitor $I_c = 0$</p> $\therefore I = I_d = \epsilon_0 \frac{d\phi_E}{dt}$ $= \epsilon_0 \frac{d}{dt} [EA]$ $= \epsilon_0 \frac{d}{dt} \left[\frac{\sigma}{\epsilon_0} A \right]$ $= \frac{\epsilon_0}{\epsilon_0} A \frac{d}{dt} \left[\frac{Q}{A} \right]$ $I = \frac{dQ}{dt} = I_c$ <p>Alternatively \therefore Total current $I = I_c + I_d$ outside the capacitor $I_d = 0$ $\therefore I = I_c$ Inside the capacitor $I_c = 0$</p> $I = I_d = \epsilon_0 \frac{d\phi_E}{dt}$ $= \epsilon_0 \frac{d}{dt} \left[\frac{Q}{\epsilon_0} \right]$ $I = \frac{dQ}{dt} = I_c$ <p>hence $I_c + I_d$ has the same value at all points of the circuit.</p>	a) Showing that ($I_c + I_d$) has the same value.	2	b) Explanation of Kirchoff's first rule at each plate of capacitor.	1	<p>$\frac{1}{2}$</p> <p>$\frac{1}{2}$</p> <p>$\frac{1}{2}$</p> <p>$\frac{1}{2}$</p> <p>$\frac{1}{2}$</p> <p>$\frac{1}{2}$</p> <p>$\frac{1}{2}$</p>	
a) Showing that ($I_c + I_d$) has the same value.	2						
b) Explanation of Kirchoff's first rule at each plate of capacitor.	1						

	<p>b) Yes Current entering the capacitor is (I_c) and between the plates capacitor is (I_d) $I_c = I_d$ which validates Kirchoff's junction rule.</p>	1	3
26	<div style="border: 1px solid black; padding: 5px;"> <p>a) Drawing a plot of frequency(ν) as a function of stopping potential (V_0) 1 Obtaining information from intercept $\frac{1}{2}$</p> <p>b) Calculating i) the momentum 1 ii) de Broglie wavelength $\frac{1}{2}$</p> </div> <p>a)</p>  <p>Value of work function can be obtained from intercept.</p> <p>b) i) $p = \sqrt{2mK}$ $= \sqrt{2 \times 9.1 \times 10^{-31} \times 80 \times 1.6 \times 10^{-19}}$ $= 4.8 \times 10^{-24} \text{ kg m/s}$</p> <p>ii) $\lambda = \frac{h}{p} = \frac{6.63 \times 10^{-34}}{4.8 \times 10^{-25}} = 1.38 \times 10^{-9} \text{ m}$</p>	1 $\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$	3
27	<div style="border: 1px solid black; padding: 5px;"> <p>a) Circuit Arrangement for studying V–I characteristics. 1 b) Showing the shape of characteristic curves. 1 c) Two informations from the characteristics $\frac{1}{2} + \frac{1}{2}$</p> </div> <p>a)</p>  <p>Circuit diagram for forward characteristics</p>	$\frac{1}{2}$	



Circuit diagram for Reverse characteristics

b)



Note : Please do not deduct marks for not writing values.

c) Any two informations

Knee voltage / reverse saturation current / Breakdown voltage / very low resistance in forward biasing / very high resistance in Reverse biasing.

1/2

1

1/2 + 1/2

3

28

- | | | |
|----|----------------------------|-----|
| a) | Defining Mass Defect | 1/2 |
| | Defining Binding Energy | 1/2 |
| | Describing Fission Process | 1/2 |
| b) | Calculation of Mass Defect | 1 |
| | Calculation of Energy | 1/2 |

a) Difference in the mass of the nucleus and its constituents is defined as mass defect.

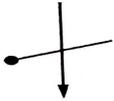
Binding Energy is the energy required to separate the nucleons from the nucleus.

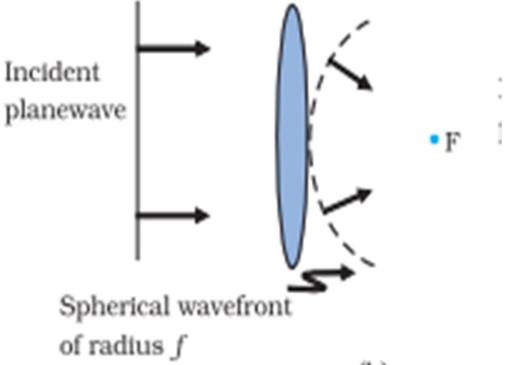
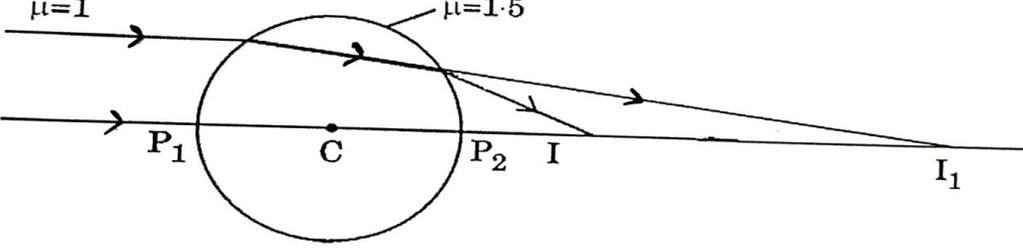
In Fission process a heavy nucleus splits into lighter nuclei and energy is released. As a result the Binding Energy per nucleon increases.

1/2

1/2

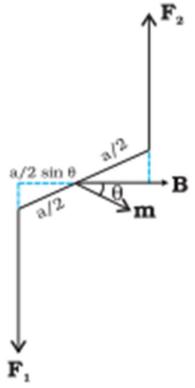
1/2

	b) $\Delta m = (m_p + m_n) - m_d$ $\Delta m = (1.007277 + 1.008665) - 2.013553$ $\Delta m = 0.002389 \text{ u}$ Energy released = $\Delta m \times c^2$ Energy released = 0.002389×931.5 $= 2.2253 \text{ MeV} \approx 2.22 \text{ MeV}$	$\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$	3										
SECTION - D													
29	i) (C)  ii) (A) For a convex mirror magnification is always negative iii) (B) 2f OR (B) 12 cm iv) (C) $\sqrt{X_1 X_2}$	1 1 1 1	4										
30	i) (B) 5mC ii) (A) zero iii) (D) $[M^0L^0TA^0]$ iv) (A) $\frac{1}{2\sqrt{e}} \text{ mA}$ Note: 1 mark for this part may be given to all the students who have attempted other parts of the question. OR (B) 0.5 mA	1 1 1 1	4										
SECTION - E													
31	a) <table border="1" style="margin-left: 20px;"> <tbody> <tr> <td>i) 1) Definition of coherent sources.</td> <td style="text-align: right;">1</td> </tr> <tr> <td> Necessity of coherent sources for sustained interference pattern</td> <td style="text-align: right;">1</td> </tr> <tr> <td>2) Explanation</td> <td style="text-align: right;">1</td> </tr> <tr> <td>ii) 1) Finding distance between adjacent bright fringes.</td> <td style="text-align: right;">1</td> </tr> <tr> <td> 2) Finding angular width</td> <td style="text-align: right;">1</td> </tr> </tbody> </table> i) 1) If the phase difference between the displacement produced by each of the wave from two sources does not change with time then two sources are said to be coherent. Alternatively Two sources are said to be coherent if they emit light continuously of same frequency / wavelength and having zero or constant phase difference. Coherent sources are required to get constant phase difference. 2) Two independent sources will never be coherent because phase difference between them will not be constant. ii) 1) Distance between adjacent bright fringe = fringe width	i) 1) Definition of coherent sources.	1	Necessity of coherent sources for sustained interference pattern	1	2) Explanation	1	ii) 1) Finding distance between adjacent bright fringes.	1	2) Finding angular width	1	1 1 1	
i) 1) Definition of coherent sources.	1												
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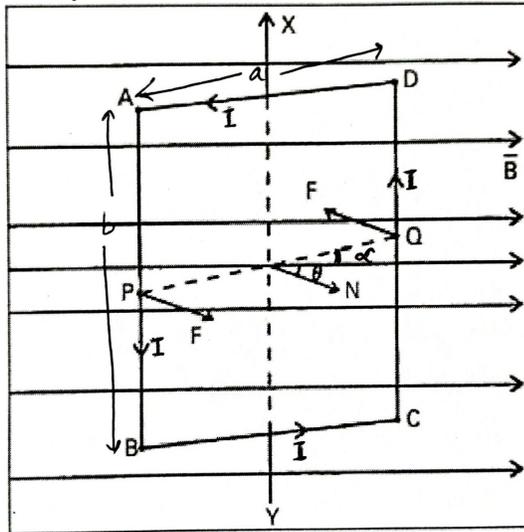
	$\beta = \frac{\lambda D}{d}$ $= \frac{600 \times 10^{-9} \times 1.2}{0.1 \times 10^{-3}} = 7.2 \text{ mm}$ <p>2) $\theta = \frac{\lambda}{d}$</p> $= \frac{600 \times 10^{-9}}{0.1 \times 10^{-3}} = 6 \times 10^{-3} \text{ rad} = 0.34^\circ$ <p>Give full marks if the student writes the answer in radians only. OR</p> <p>b)</p> <table border="1" data-bbox="378 615 1247 779"> <tr> <td>i) Definition of wave front.</td> <td>1</td> </tr> <tr> <td>Drawing the incident and refracted wave front</td> <td>$\frac{1}{2} + \frac{1}{2}$</td> </tr> <tr> <td>ii) Drawing the ray diagram</td> <td>1</td> </tr> <tr> <td>Obtaining the position of final image</td> <td>2</td> </tr> </table> <p>i) A wavefront is a locus of all the points which oscillate in phase.</p>  <p>ii)</p>  <p>From Ist surface, Refraction is from rarer to denser medium and object is at ∞ $n_1 = 1, n_2 = 1.5, R = 15 \text{ cm}, u = \infty$</p> $\frac{n_2}{v} - \frac{n_1}{u} = \frac{n_2 - n_1}{R}$	i) Definition of wave front.	1	Drawing the incident and refracted wave front	$\frac{1}{2} + \frac{1}{2}$	ii) Drawing the ray diagram	1	Obtaining the position of final image	2	<p>$\frac{1}{2}$</p> <p>$\frac{1}{2}$</p> <p>$\frac{1}{2}$</p> <p>$\frac{1}{2}$</p> <p>1</p> <p>$\frac{1}{2} + \frac{1}{2}$</p> <p>1</p> <p>$\frac{1}{2}$</p>	
i) Definition of wave front.	1										
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ii) Drawing the ray diagram	1										
Obtaining the position of final image	2										

	$\frac{1.5}{v} - \frac{1}{\infty} = \frac{1.5 - 1}{15}$ $v = 45 \text{ cm}$ <p>From 2nd surface, Refraction is from denser to rarer medium and object is at 15 cm</p> $n_1 = 1, \quad n_2 = 1.5, \quad R = -15 \text{ cm}, \quad u = 15 \text{ cm}$ $\frac{n_1}{v} - \frac{n_2}{u} = \frac{n_1 - n_2}{R}$ $\frac{1}{v} - \frac{1.5}{15} = \frac{1 - 1.5}{-15}$ $v = 7.5 \text{ cm}$	<p>1/2</p> <p>1/2</p> <p>1/2</p>	5								
32	<p>a)</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <tbody> <tr> <td>i) Calculating the change in electrostatic energy of the system</td> <td style="text-align: right;">2</td> </tr> <tr> <td>ii) (1) Finding the capacitance.</td> <td style="text-align: right;">1</td> </tr> <tr> <td> (2) Finding the potential difference.</td> <td style="text-align: right;">1</td> </tr> <tr> <td> (3) Answering and Reason</td> <td style="text-align: right;">1/2 + 1/2</td> </tr> </tbody> </table> <p>(i) $\vec{E} = \frac{3 \times 10^5}{r^2} \hat{r}$ (Given) $dV = -\vec{E} \cdot d\vec{r}$</p> $V = 3 \times 10^5 / r$ <p>Electrostatic energy of the system in the absence of the field</p> $U_i = \frac{Kq_1q_2}{r_{12}}$ <p>Electrostatic energy in the presence of the field</p> $U_f = \frac{Kq_1q_2}{r_{12}} + q_1V(\vec{r}_1) + q_2V(\vec{r}_2)$ $\Delta U = U_f - U_i = q_1V(\vec{r}_1) + q_2V(\vec{r}_2)$ $\Delta U = \frac{5 \times 10^{-6} \times 3 \times 10^5}{3 \times 10^{-2}} - \frac{1 \times 10^{-6} \times 3 \times 10^5}{3 \times 10^{-2}}$ $= 40 \text{ J}$ <p>ii) 1) $C = \frac{Q}{V} = \frac{80}{16} = 5 \mu\text{F}$</p> <p>2) $C' = KC$ $= 3 \times 5 \mu\text{F} = 15 \mu\text{F}$ $V' = \frac{Q}{C'} = \frac{80 \mu\text{C}}{15 \mu\text{F}} = 5.33 \text{ V}$</p> <p>3) No, The capacitance of the system depends on its geometry.</p> <p style="text-align: center;">OR</p>	i) Calculating the change in electrostatic energy of the system	2	ii) (1) Finding the capacitance.	1	(2) Finding the potential difference.	1	(3) Answering and Reason	1/2 + 1/2	<p>1/2</p> <p>1/2</p> <p>1/2</p> <p>1/2</p> <p>1</p> <p>1/2</p> <p>1/2</p> <p>1/2</p> <p>1/2</p>	
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	<p>b)</p> <table border="1" style="margin-left: 20px;"> <tbody> <tr> <td>i) Comparing the magnitude of the Electric fields</td> <td style="text-align: right;">2</td> </tr> <tr> <td>ii) Calculating the work done on the charge</td> <td style="text-align: right;">3</td> </tr> </tbody> </table> <p>Total charge for A = Total charge for B = Total charge for C = +4q</p> <p>As, $E = \frac{kQ}{r^2}$</p> <p>Since $Q = 4q$ and $r = 3R$</p> $E = \frac{k(4q)}{9R^2} = \frac{4kq}{9R^2}$ <p>$\therefore E_A = E_B = E_C$</p> <p>ii) $V_c = \left[\frac{k \times 6 \times 10^{-6}}{5 \times 10^{-2}} - \frac{k \times 6 \times 10^{-6}}{5 \times 10^{-2}} \right]$</p> $= 0$ $V_A = \left[\frac{k \times 6 \times 10^{-6}}{15 \times 10^{-2}} - \frac{k \times 6 \times 10^{-6}}{5 \times 10^{-2}} \right]$ $= \frac{k \times 6 \times 10^{-6}}{10^{-2}} \left[\frac{1-3}{15} \right]$ $= -\frac{9 \times 10^9 \times 6 \times 10^{-6} \times 2}{15 \times 10^{-2}}$ $= -7.2 \times 10^5 \text{ V}$ $W = q[V_A - V_c]$ $= 5 \times 10^{-6} [-7.2 \times 10^5 - 0]$ $W = -3.6 \text{ J}$	i) Comparing the magnitude of the Electric fields	2	ii) Calculating the work done on the charge	3	<p>1</p> <p>$\frac{1}{2}$</p> <p>$\frac{1}{2}$</p> <p>1</p> <p>$\frac{1}{2}$</p> <p>$\frac{1}{2}$</p> <p>$\frac{1}{2}$</p> <p>$\frac{1}{2}$</p> <p>5</p>			
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33	<p>a)</p> <table border="1" style="margin-left: 20px;"> <tbody> <tr> <td>i) Finding the direction of magnetic field near points P,Q and R</td> <td style="text-align: right;">$\frac{1}{2} + \frac{1}{2} + \frac{1}{2}$</td> </tr> <tr> <td>Conclusion about the relative magnitude of magnetic field.</td> <td style="text-align: right;">$\frac{1}{2} + \frac{1}{2} + \frac{1}{2}$</td> </tr> <tr> <td>ii) Showing the given expression of magnetic moment.</td> <td style="text-align: right;">2</td> </tr> </tbody> </table> <p>i) <u>Near point P</u> Magnetic field is acting into the plane of the paper as Force is acting upwards. $\frac{1}{2}$</p> <p><u>Near point Q</u> Magnetic field is into the plane of paper as force is acting upwards. $\frac{1}{2}$</p> <p><u>Near point R</u> Magnetic field is acting out of the plane of the paper as \vec{F} is acting downwards. $\frac{1}{2}$</p> <p><u>Relative Magnitude of the Magnetic field.</u></p> <p>As $B \propto \frac{1}{r}$</p> <p>Therefore,</p> <p>Near point P, magnitude of B is small. $\frac{1}{2}$</p> <p>Near point Q, B is relatively smaller than point P. $\frac{1}{2}$</p>	i) Finding the direction of magnetic field near points P,Q and R	$\frac{1}{2} + \frac{1}{2} + \frac{1}{2}$	Conclusion about the relative magnitude of magnetic field.	$\frac{1}{2} + \frac{1}{2} + \frac{1}{2}$	ii) Showing the given expression of magnetic moment.	2	<p>$\frac{1}{2}$</p> <p>$\frac{1}{2}$</p> <p>$\frac{1}{2}$</p> <p>$\frac{1}{2}$</p> <p>$\frac{1}{2}$</p>	
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<p>Near point R, B is relatively larger than point P. ($B_Q < B_P < B_R$)</p>	<p>1/2</p>						
<p>ii) Let r be the radius of the circular coil and I is the current in the coil then</p>	<p>1/2</p>						
$B = \frac{\mu_0 I}{2r} \quad \text{or} \quad I = \frac{2Br}{\mu_0}$	<p>1/2</p>						
$A = \pi r^2 \quad r = \sqrt{\frac{A}{\pi}}$	<p>1/2</p>						
$M = IA$	<p>1/2</p>						
$= \frac{2Br}{\mu_0} A$							
$= \frac{2BA}{\mu_0} \sqrt{\frac{A}{\pi}}$	<p>1/2</p>						
OR							
<p>b)</p> <table border="1" style="margin-left: 40px;"> <tr> <td>i) Deriving the expression for the torque.</td> <td style="text-align: right;">3</td> </tr> <tr> <td>ii) 1) Finding the change in radius.</td> <td style="text-align: right;">1</td> </tr> <tr> <td> 2) Finding the change in time period of Revolution.</td> <td style="text-align: right;">1</td> </tr> </table>	i) Deriving the expression for the torque.	3	ii) 1) Finding the change in radius.	1	2) Finding the change in time period of Revolution.	1	
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<p>i)</p>							
	<p>1/2</p>						
<p>\vec{F}_1 and \vec{F}_2 are the forces acting on two arms of the rectangular coil having sides a and b.</p>							
$ \vec{F}_1 = \vec{F}_2 = I b B \quad (\text{b = length of the arm})$	<p>1</p>						
<p>Forces constitute a couple. The magnitude of Torque on the loop is –</p>							
$\tau = F_1 \frac{a}{2} \sin \theta + F_2 \frac{a}{2} \sin \theta$	<p>1/2</p>						
$= I a b B \sin \theta$							
$= I A B \sin \theta$	<p>1/2</p>						
$\vec{\tau} = I \vec{A} \times \vec{B}$	<p>1/2</p>						

Alternatively



If the plane of the current carrying coil makes an angle α with the magnetic field

$$\vec{F}_{DA} = -\vec{F}_{BC} \text{ (cancel each other) .}$$

Force on the arm DC is into the plane of the paper

$$|F_{DC}| = IbB .$$

Force on the arm AB is out of the plane of the paper.

$$|F_{AB}| = IbB$$

Both of them form a couple and Torque acting on the coil is

$\tau = \text{either force} \times \text{perpendicular distance between the two forces.}$

$$\tau = IbB \times a \cos \alpha$$

$$= IabB \cos \alpha$$

$$\tau = IAB \cos \alpha$$

Let \hat{n} = outward drawn normal to the plane of the coil.

$$\theta + \alpha = 90^\circ$$

$$\alpha = 90^\circ - \theta$$

$$\tau = IAB \cos(90 - \theta)$$

$$= IAB \sin \theta$$

$$\vec{\tau} = I\vec{A} \times \vec{B}$$

$$\text{ii) 1) } r = \frac{mv}{qB} = \frac{\sqrt{2mK}}{qB}$$

$$r \propto \sqrt{K}$$

$$\frac{r'}{r} = \frac{\sqrt{K/2}}{\sqrt{K}} = \frac{1}{\sqrt{2}}$$

$$r' = \frac{r}{\sqrt{2}}$$

1/2

1/2

1/2

1/2

1/2

1/2

1/2

1/2

	<p>2) $T = \frac{2\pi m}{qB}$</p> <p>Time period does not depend on Kinetic Energy</p> <p>\therefore Time period will not change.</p>	<p>$\frac{1}{2}$</p> <p>$\frac{1}{2}$</p>	<p>5</p>
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