

**Marking Scheme**  
**Strictly Confidential**  
**(For Internal and Restricted use only)**  
**Senior School Certificate Examination, 2024**  
**SUBJECT NAME PHYSICS [PAPER CODE 55/S/3]**

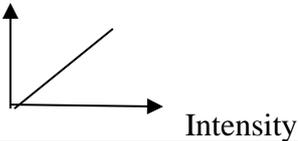
**General Instructions: -**

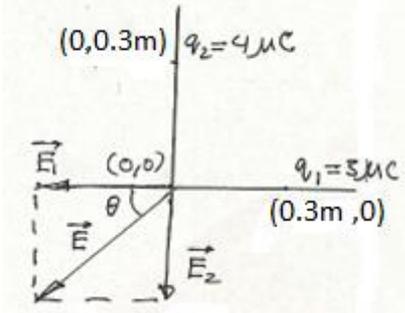
<b>1</b>	You are aware that evaluation is the most important process in the actual and correct assessment of the candidates. A small mistake in evaluation may lead to serious problems which may affect the future of the candidates, education system and teaching profession. To avoid mistakes, it is requested that before starting evaluation, you must read and understand the spot evaluation guidelines carefully.
<b>2</b>	<b>“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.”</b>
<b>3</b>	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. <b>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.</b>
<b>4</b>	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.
<b>5</b>	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.
<b>6</b>	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. <b>This is most common mistake which evaluators are committing.</b>
<b>7</b>	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.
<b>8</b>	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.
<b>9</b>	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 <b>“Extra Question”</b> .
<b>10</b>	No marks to be deducted for the cumulative effect of an error. It should be penalized only once.
<b>11</b>	A full scale of marks <u>0-70</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.
<b>12</b>	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

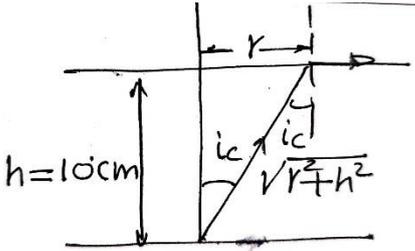
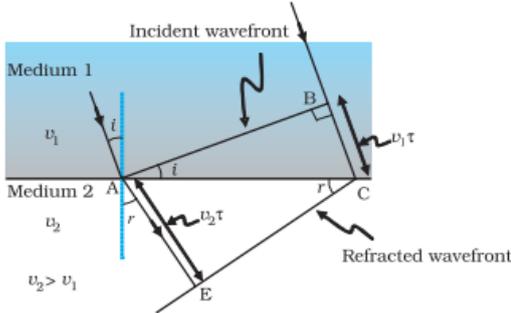
	day in other subjects (Details are given in Spot Guidelines). This is in view of the reduced syllabus and number of questions in question paper.
<b>13</b>	<p>Ensure that you do not make the following common types of errors committed by the Examiner in the past:-</p> <ul style="list-style-type: none"> <li>● Leaving answer or part thereof unassessed in an answer book.</li> <li>● Giving more marks for an answer than assigned to it.</li> <li>● Wrong totaling of marks awarded on an answer.</li> <li>● Wrong transfer of marks from the inside pages of the answer book to the title page.</li> <li>● Wrong question wise totaling on the title page.</li> <li>● Wrong totaling of marks of the two columns on the title page.</li> <li>● Wrong grand total.</li> <li>● Marks in words and figures not tallying/not same.</li> <li>● Wrong transfer of marks from the answer book to online award list.</li> <li>● 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.)</li> <li>● Half or a part of answer marked correct and the rest as wrong, but no marks awarded.</li> </ul>
<b>14</b>	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.
<b>15</b>	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.
<b>16</b>	The Examiners should acquaint themselves with the guidelines given in the “ <b>Guidelines for spot Evaluation</b> ” before starting the actual evaluation.
<b>17</b>	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.
<b>18</b>	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)**

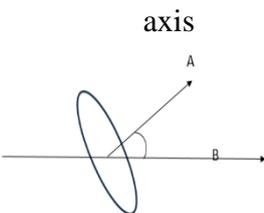
**Code: 55/S/3**

Q. No.	VALUE POINTS/EXPECTED ANSWERS	Marks	Total Marks
<b>SECTION A</b>			
1.	(A) The wave is propagating along +x-axis.	1	1
2.	(D) 45°	1	1
3.	(A) $M < (A - Z)m_n + Zm_p$	1	1
4.	(D) $\frac{B^2 l^2 v}{R}$	1	1
5.	(B) Behave like a paramagnetic material	1	1
6.	(D) first real and then virtual.	1	1
7.	(A) 30°	1	1
8.	(D) 4	1	1
9.	(C) The number of alpha particles undergoing head on collision is small.	1	1
10.	(C) Current 	1	1
11.	(B) increase the number of holes in the valence bond.	1	1
12.	(C) $\frac{7}{3}V, \frac{2}{3}\Omega$	1	1
13.	(A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion(A).	1	1
14.	(B) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of the Assertion(A).	1	1
15.	(D) Both Assertion (A) and Reason (R) are false.	1	1
16.	(B) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of the Assertion(A).	1	1
<b>SECTION B</b>			
17.	<div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;"> <p>Explanation and formation of terms</p> <p>Depletion layers <span style="float: right;">1</span></p> <p>Potential barrier <span style="float: right;">1</span></p> </div> <p>During the formation of p-n junction due to the concentration gradient holes diffuse from p- side to n-side leaving behind an immobile ionized acceptor (negative charge), hence forming a layer of negative charge (negative space-charge region) on p- side.</p> <p>Similarly, a layer of positive charge is developed on the n-side of the junction (positive space-charge region). This space – charge region on either side of the junction together is known as depletion layer.</p> <p>Due to the positive space- charge region on the n-side of the junction &amp; negative space – charge region on the p- side of the junction a potential difference is developed across the junction of the two regions, which is called potential barrier.</p>	1	2

18.	<div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;">           Condition for experiencing no force on electron in            (a) Only magnetic field and justification <span style="float: right;">1/2 + 1/2</span>            (b) In electric and magnetic field both and justification <span style="float: right;">1/2 + 1/2</span> </div> <p>(a) Force on an electron in magnetic field is zero when it moves parallel/ antiparallel to the direction of magnetic field.  <math>F = qvB \sin\theta</math>            Hence <math>F = 0</math>, when <math>\theta = 0^\circ, \theta = 180^\circ</math></p> <p>(b) Force is zero when electron moves in a crossed field of electric and magnetic fields with condition.  <math>\vec{F}_E + \vec{F}_B = 0</math>  <math display="block">v = \frac{E}{B}</math></p>	1/2 1/2 1/2 1/2	2
19 (a)	<div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;">           (i) Calculating e.m.f of cell <span style="float: right;">1</span>            (ii) Calculating internal resistance of cell <span style="float: right;">1</span> </div> $I = \frac{\mathcal{E}}{R+r}$ $0.25 = \frac{\mathcal{E}}{12+r} \quad \text{----- (1)}$ $0.2 = \frac{\mathcal{E}}{16+r} \quad \text{----- (2)}$ <p>On solving eq (1) and (2)  <math>r = 4\Omega</math>  <math>\mathcal{E} = 4V</math></p> <p style="text-align: center;">OR</p> <p>(b)</p> <div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;">           Finding the magnitude of electric field <span style="float: right;">1 1/2</span>            Finding the direction of electric field <span style="float: right;">1/2</span> </div> <div style="text-align: center; margin-bottom: 10px;">  </div> $\vec{E}_1 = \frac{kq_1}{r_1^2} (-\hat{i}) = \frac{9 \times 10^9 \times 3 \times 10^{-6}}{(0.3)^2} (-\hat{i}) = 3 \times 10^5 (-\hat{i}) \text{ NC}^{-1}$ $\vec{E}_2 = \frac{kq_2}{r_2^2} (-\hat{j}) = \frac{9 \times 10^9 \times 4 \times 10^{-6}}{(0.3)^2} (-\hat{j}) = 4 \times 10^5 (-\hat{j}) \text{ NC}^{-1}$	1/2 1/2 1/2 1/2	

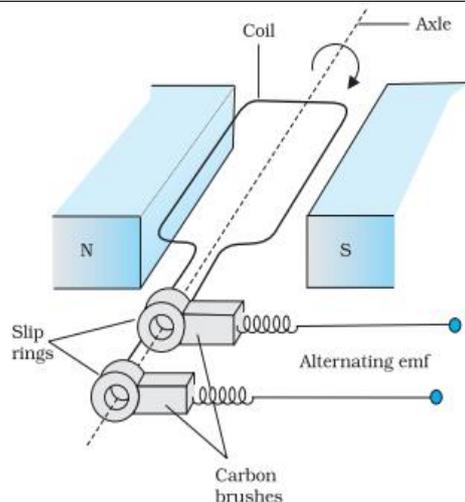
	$\vec{E} = \vec{E}_1 + \vec{E}_2$ $E = \sqrt{E_1^2 + E_2^2}$ $E = 5 \times 10^5 \text{ NC}^{-1}$ $\tan \theta = \frac{4}{3}$ $\theta = \tan^{-1}\left(\frac{4}{3}\right) \text{ inclination with respect to the x-axis (in III quadrant).}$	1/2					
20.	<table border="1" style="width: 100%;"> <tbody> <tr> <td>(a) Calculation of critical angle</td> <td style="text-align: right;">1</td> </tr> <tr> <td>(b) Calculation of radius of circular light patch</td> <td style="text-align: right;">1</td> </tr> </tbody> </table> <p>(a) <math>\sin i_c = \frac{1}{\mu}</math></p> <p><math>\sin i_c = \frac{4}{5} \quad (\because \mu = 1.25 = \frac{5}{4})</math></p> <p><math>i_c = \sin^{-1}\left(\frac{4}{5}\right)</math></p> <p>or <math>i_c = 53^\circ</math></p> <p>(b) <math>\sin i_c = \frac{r}{\sqrt{r^2 + h^2}}</math></p> <p><math>\frac{r^2}{r^2 + h^2} = \left(\frac{4}{5}\right)^2</math></p> <p><math>25r^2 = 16r^2 + 16h^2</math></p> <p><math>9r^2 = 1600</math></p> <p><math>r = \frac{40}{3} \text{ cm}</math></p> <div style="text-align: center;">  </div>	(a) Calculation of critical angle	1	(b) Calculation of radius of circular light patch	1	1/2	
(a) Calculation of critical angle	1						
(b) Calculation of radius of circular light patch	1						
21.	<table border="1" style="width: 100%;"> <tbody> <tr> <td>• Stating Huygens Principle</td> <td style="text-align: right;">1</td> </tr> <tr> <td>• Diagram</td> <td style="text-align: right;">1</td> </tr> </tbody> </table> <p><b>Huygens Principle :</b> Each point of the wavefront is the source of a secondary disturbance and the wavelets emanating from these points spread out in all directions with the speed of the wave. These wavelets emanating from the wavefront are usually referred to as secondary wavelets and if we draw a common tangent to all these spheres, we obtain the new position of the wavefront at a later time.</p> <div style="text-align: center;">  </div>	• Stating Huygens Principle	1	• Diagram	1	1	
• Stating Huygens Principle	1						
• Diagram	1						
		1	2				

		SECTION- C		
22.	(a)	<div style="border: 1px solid black; padding: 5px;">           (i) Variation of electric field and justification <span style="float: right;">1/2 + 1/2</span>            (ii) Variation of current density and justification <span style="float: right;">1/2 + 1/2</span>            (iii) Variation of mobility of electrons and justification <span style="float: right;">1/2 + 1/2</span> </div> <p>With the decrease in area of cross-section.</p> (i) $E = \frac{I}{A} \rho$ , electric field increases <span style="float: right;">1/2+1/2</span> (ii) $j = \frac{I}{A}$ , current density increases <span style="float: right;">1/2+1/2</span> (iii) $\mu_e = \frac{e\tau}{m}$ , mobility remains same <span style="float: right;">1/2+1/2</span>		
	(b)	<div style="border: 1px solid black; padding: 5px; text-align: center;">           Finding the net electric field (E) at points A,B &amp; C <span style="float: right;">1+1+1</span> </div> <p>Electric field at A (<math>\vec{E}_A</math>)</p> $\vec{E}_A = \vec{E}_1 + \vec{E}_2$ $= \frac{\sigma}{2\epsilon_0} (-\hat{i}) + \frac{3\sigma}{2\epsilon_0} (\hat{i})$ $\vec{E}_A = \frac{\sigma}{\epsilon_0} (\hat{i})$ <p>Electric field at B (<math>\vec{E}_B</math>)</p> $\vec{E}_B = \vec{E}_1 + \vec{E}_2$ $= \frac{\sigma}{2\epsilon_0} \hat{i} + \frac{3\sigma}{2\epsilon_0} \hat{i}$ $= \frac{2\sigma}{\epsilon_0} \hat{i}$ <p>Electric field at C (<math>\vec{E}_C</math>)</p> $\vec{E}_C = \vec{E}_1 + \vec{E}_2$ $= \frac{\sigma}{2\epsilon_0} \hat{i} + \frac{3\sigma}{2\epsilon_0} (-\hat{i})$ $= \frac{\sigma}{\epsilon_0} (-\hat{i})$	1/2 1/2 1/2 1/2 1/2 1/2	3
23.		<div style="border: 1px solid black; padding: 5px;">           Calculating electrostatic potential energy of the system <span style="float: right;">3</span> </div> <p>Electrostatic potential energy of the system :</p> $U = \frac{kq_1q_2}{r_{12}} + q_1V_1 + q_2V_2$ $\frac{kq_1q_2}{r_{12}} = \frac{9 \times 10^9 \times 10 \times 10^{-6} \times 20 \times 10^{-6}}{9 \times 10^{-2}} = 20J$	1 1/2	

	$q_1 V_1 = q_1 \frac{A}{r_1} = \frac{10 \times 10^{-6} \times 2 \times 10^6}{4 \times 10^{-2}} = 500 \text{ J}$ $q_2 V_2 = q_2 \frac{A}{r_2} = \frac{20 \times 10^{-6} \times 2 \times 10^6}{5 \times 10^{-2}} = 800 \text{ J}$ $U = (20 + 500 + 800) \text{ J}$ $U = 1320 \text{ J}$	1/2	
		1/2	
		1/2	3
24.	<div style="border: 1px solid black; padding: 5px; width: fit-content; margin: 0 auto;">           Explanation of (a),(b) and (c) with reason <span style="float: right;">1+1+1</span> </div> <p>(a) <math>i_d = \epsilon_0 \frac{d\phi_E}{dt}</math>            Displacement current is due to changing electric flux.            During charging of capacitor, there is change in electric flux.            When fully charged the electric field does not change hence electric flux also does not change. Hence no displacement current.</p> <p>(b) The frequency of the microwaves is selected to match the resonant frequency of water molecules so that energy from the waves is transferred efficiently to the kinetic energy of the molecules.</p> <p>(c) Infrared waves are also known as heat waves, because water molecules present in most materials readily absorb infrared waves and their thermal motion increases and heat up.</p>	1	
		1	
		1	3
25.	<div style="border: 1px solid black; padding: 5px; width: fit-content; margin: 0 auto;">           Calculating            (a) Work Function <span style="float: right;">1 1/2</span>            (b) maximum Kinetic energy <span style="float: right;">1 1/2</span> </div> <p>(a) <math>\phi_0 = h\nu_0</math>  <math>= 6.63 \times 10^{-34} \times 1.0 \times 10^{15}</math>  <math>= 6.63 \times 10^{-19} \text{ J}</math>  <math>= 4.14 \text{ eV}</math></p> <p>(b) <math>K.E._{\text{max}} = h(\nu - \nu_0)</math>  <math>= 6.63 \times 10^{-34} [3.0 \times 10^{15} - 1.0 \times 10^{15}]</math>  <math>= 13.26 \times 10^{-19} \text{ J}</math>  <math>= 8.29 \text{ eV}</math></p>	1/2	
		1/2	
		1/2	
		1/2	3
26.	<div style="border: 1px solid black; padding: 5px; width: fit-content; margin: 0 auto;">           Calculation of e.m.f induced in the loop <span style="float: right;">3</span> </div> <p>E.m.f induced in the circular loop:</p> $ \mathcal{E}  = \frac{d\phi}{dt}$ $= \frac{d}{dt}(BA \cos\theta)$ $= \frac{d}{dt}(\mu_0 n I A \cos\theta)$ <div style="text-align: center; margin-top: 10px;">  </div>	1/2	
		1	



	$\frac{1}{v_1} - \frac{1}{u} = \frac{1}{f_1} \quad \text{-----(1)}$ <p>For the image formed by the second lens B, we get</p> $\frac{1}{v} - \frac{1}{v_1} = \frac{1}{f_2} \quad \text{-----(2)}$ <p>Adding eqs (1) and (2) we get</p> $\frac{1}{v} - \frac{1}{u} = \frac{1}{f_1} + \frac{1}{f_2} \quad \text{-----(3)}$ <p>If the two lens system is regarded as equivalent to a single lens of focal length <math>f</math>, we have</p> $\frac{1}{v} - \frac{1}{u} = \frac{1}{f} \quad \text{-----(4)}$ <p>From eqs (3) &amp; (4)</p> $\frac{1}{f} = \frac{1}{f_1} + \frac{1}{f_2}$ <p>As, <math>P = \frac{1}{f}</math></p> <p>Hence, <math>P = P_1 + P_2</math></p>	<p>1/2</p> <p>1/2</p> <p>1/2</p>	<p>3</p>												
<b>SECTION - D</b>															
29.	(A) B <sub>1</sub> only	1	4												
	(a) (ii) (B) A, C OR	1													
	(b) (C) unidirectional with ripple														
	(iii) (D) holes, electrons	1													
	(iv) (C) 100 Hz	1													
30.	(i) (B) $qd(\hat{i} + \hat{j})$	1	4												
	(ii) (C) 2	1													
	(iii) (A) $2.5 \times 10^{-5}$ Nm	1													
	(a) (iv) (C) $\frac{1}{2} evr$ OR	1													
(b)	(B) $5.0 \times 10^{-3} \text{ Am}^2$														
<b>SECTION - E</b>															
31. (a)	<table border="1" style="width: 100%; border-collapse: collapse;"> <tbody> <tr> <td>(i)</td> <td>Labelled diagram of ac generator</td> <td style="text-align: right;">1</td> </tr> <tr> <td></td> <td>Working of ac generator</td> <td style="text-align: right;">1</td> </tr> <tr> <td></td> <td>Obtaining expression for e.m.f</td> <td style="text-align: right;">1</td> </tr> <tr> <td>(ii)</td> <td>Finding magnitude of force and direction</td> <td style="text-align: right;">2</td> </tr> </tbody> </table>	(i)	Labelled diagram of ac generator	1		Working of ac generator	1		Obtaining expression for e.m.f	1	(ii)	Finding magnitude of force and direction	2		
(i)	Labelled diagram of ac generator	1													
	Working of ac generator	1													
	Obtaining expression for e.m.f	1													
(ii)	Finding magnitude of force and direction	2													



1

**Working of ac generator**

When coil is rotated in a uniform magnetic field with a constant angular speed  $\omega$ , magnetic flux through it changes. As a result, an e.m.f is induced in the coil.

1

Flux linked with the coil at any instant 't' is

$$\phi_B = BA \cos \omega t$$

1/2

$$\varepsilon = -N \frac{d\phi_B}{dt}$$

$$\varepsilon = NBA\omega \sin \omega t$$

1/2

(ii) 
$$F = \frac{\mu_0 I_1 I_2 l}{2\pi r}$$

force on arm MN of the loop

$$F_1 = \frac{4\pi \times 10^{-7} \times 3 \times 1 \times 10 \times 10^{-2}}{2\pi \times 20 \times 10^{-2}}$$

$$F_1 = 3 \times 10^{-7} \text{ N}$$

1/2

Force is directed away from the wire

Force on arm SP of the loop

$$F_2 = \frac{4\pi \times 10^{-7} \times 3 \times 1 \times 10 \times 10^{-2}}{2\pi \times 30 \times 10^{-2}}$$

$$F_2 = 2 \times 10^{-7} \text{ N}$$

1/2

Force directed towards the wire

Net force on the loop

$$F = F_1 - F_2 = 10^{-7} \text{ N}$$

1/2

Net force on the loop is away from the wire.

1/2

(b)

OR

(i) Statement of Faraday's law of electromagnetic induction	1/2
Utility of Lenz's law	1/2
Obtaining expression for self inductance	2
(ii) (1) calculating angular frequency	1
(2) calculating impedance of the circuit	1

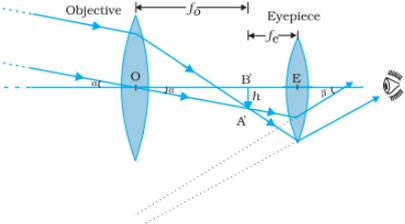
(i) The magnitude of induced e.m.f in a circuit is equal to the time rate of change of magnetic flux through the circuit

1/2

**Utility of Lenz's law**

It give polarity of the induced e.m.f .

1/2

	<p><b>Expression for self inductance</b>  Consider a long solenoid of cross-sectional area <math>A</math> and length <math>l</math>, having <math>n</math> turns per unit length. If <math>I</math> is the current flowing in the solenoid, magnetic field inside the solenoid is</p> $B = \mu_0 n I$ <p>Total magnetic flux linked with the solenoid is</p> $N\phi_B = (nl)(\mu_0 n I)(A)$ $N\phi_B = \mu_0 n^2 A l I$ <p>Self inductance</p> $L = \frac{N\phi_B}{I}$ $L = \mu_0 n^2 A l$ <p>If solenoid is filled with a material of relative permeability <math>\mu_r</math>, then</p> $L = \mu_r \mu_0 n^2 A l$ <p>(ii) (1) Resonant angular frequency is</p> $\omega_0 = \frac{1}{\sqrt{LC}}$ $\omega_0 = \frac{1}{\sqrt{50 \times 10^{-3} \times 80 \times 10^{-6}}} = 500 \text{ rad s}^{-1}$ <p>(2) When frequency of supply is equal to natural frequency of the circuit</p> $Z = R$ $Z = 20 \Omega$	<p>1/2</p>	<p>5</p>										
<p>32. (a)</p>	<table border="1" data-bbox="363 1146 1295 1361"> <tbody> <tr> <td>(i) Two main considerations for designing objective and eye piece</td> <td>1</td> </tr> <tr> <td>Obtaining expression for magnifying power of telescope</td> <td>2</td> </tr> <tr> <td>(ii) Calculating</td> <td></td> </tr> <tr> <td>(1) Angle of deviation</td> <td>1</td> </tr> <tr> <td>(2) Refractive index</td> <td>1</td> </tr> </tbody> </table> <p><b>Two main considerations</b>  Objective should have</p> <ol style="list-style-type: none"> <li>1. Larger diameter</li> <li>2. Larger focal length</li> </ol> <p>Eye piece should have</p> <ol style="list-style-type: none"> <li>1. Smaller diameter</li> <li>2. Smaller focal length</li> </ol>  <p><b>Magnifying power of telescope</b>  Magnifying power is the ratio of the angle <math>\beta</math> subtended at the eye by the final images to the angle <math>\alpha</math> which the object subtends at the lens or eye</p>	(i) Two main considerations for designing objective and eye piece	1	Obtaining expression for magnifying power of telescope	2	(ii) Calculating		(1) Angle of deviation	1	(2) Refractive index	1	<p>1/2</p> <p>1/2</p> <p>1</p>	
(i) Two main considerations for designing objective and eye piece	1												
Obtaining expression for magnifying power of telescope	2												
(ii) Calculating													
(1) Angle of deviation	1												
(2) Refractive index	1												

$$m \approx \frac{\beta}{\alpha} \approx \frac{h}{f_e} \cdot \frac{f_0}{h} = \frac{f_0}{f_e}$$

1

(ii)  $i+e = D+A$   
 at  $D = D_m$  ,  $i = e$

$$2i = D_m + A$$

$$2 \times 45 = D_m + 60^\circ$$

$$D_m = 30^\circ$$

$$\mu = \frac{\sin\left(\frac{A+D_m}{2}\right)}{\sin\left(\frac{A}{2}\right)}$$

$$\mu = \frac{\sin\left(\frac{60^\circ + 30^\circ}{2}\right)}{\sin\left(\frac{60^\circ}{2}\right)}$$

$$= \sqrt{2}$$

1

1

(b)

OR

(i) Describing activity to observe diffraction pattern due to a single slit

2

(ii) Finding refractive index of the liquid

3

(i) We hold two razor blades in such a way that their edges are parallel and with a narrow slit in between. Keep the slit parallel to the filament of electric bulb, right in front of the eye.

2

A diffraction is seen with its bright and dark bands.

(ii)  $\frac{1}{f} = (\mu - 1) \left[ \frac{1}{R_1} - \frac{1}{R_2} \right]$

 $\frac{1}{2}$ 

Focal length of convex lens,  $f_1 = 30\text{cm}$

$$\frac{1}{30} = (1.5 - 1) \left[ \frac{1}{R} - \frac{1}{(-R)} \right]$$

 $\frac{1}{2}$ 

$$R = 30\text{cm}$$

 $\frac{1}{2}$ 

focal length of combination,  $f = 45\text{cm}$

focal length of plane concave lens of liquid.

$$\frac{1}{f_2} = \frac{1}{f} - \frac{1}{f_1}$$

 $\frac{1}{2}$ 

$$\frac{1}{f_2} = \frac{1}{45} - \frac{1}{30}$$

$$f_2 = -90\text{cm}$$

Using lens maker's formula

 $\frac{1}{2}$ 

$$\frac{1}{-90} = (\mu_l - 1) \left[ \frac{1}{-30} - \frac{1}{\infty} \right]$$

	$\mu_l = \frac{4}{3}$	½	5								
33. (a)	<table border="1"> <tr> <td>(i) Defining matter waves</td> <td>1</td> </tr> <tr> <td>Obtaining expression for de- Broglie wavelength</td> <td>2</td> </tr> <tr> <td>(ii) (1) Calculating energy of photon</td> <td>1</td> </tr> <tr> <td>(2) Calculating number of photons per second</td> <td>1</td> </tr> </table> <p>(i) Wave associated with a mass in motion is called matter wave. Particle of mass m and charge q gains energy in the form of kinetic energy.</p> $\frac{1}{2}mv^2 = qV$ $(mv)^2 = 2qVm$ $mv = \sqrt{2mqV}$ <p>Accordingly to de-Broglie relation</p> $\lambda = \frac{h}{mv}$ $\lambda = \frac{h}{\sqrt{2mqV}}$ <p>(ii) (1)</p> $E = hv$ $= 6.63 \times 10^{-34} \times 5 \times 10^{14}$ $= 3.315 \times 10^{-19} \text{ J}$ <p>(2)</p> $n = \frac{P}{E}$ $= \frac{3.315 \times 10^{-3}}{3.315 \times 10^{-19}} = 10^{16} \text{ s}^{-1}$ <p style="text-align: center;">OR</p>	(i) Defining matter waves	1	Obtaining expression for de- Broglie wavelength	2	(ii) (1) Calculating energy of photon	1	(2) Calculating number of photons per second	1	1 ½ ½ ½ ½ ½ ½	
(i) Defining matter waves	1										
Obtaining expression for de- Broglie wavelength	2										
(ii) (1) Calculating energy of photon	1										
(2) Calculating number of photons per second	1										
(b)	<table border="1"> <tr> <td>(i) Bohr's postulates</td> <td>½ x 3</td> </tr> <tr> <td>Deriving expression for energy of electron in n<sup>th</sup> orbit of hydrogen atom</td> <td>2</td> </tr> <tr> <td>(ii) Calculating Binding Energy per nucleon</td> <td>1 ½</td> </tr> </table> <p>(i) <b>Bohr's Postulates</b></p> <p>(a) Bohr's first postulate was that an electron in an atom could revolve in certain stable orbits without the emission of radiant energy,</p> <p>(b) Bohr's second postulate defines these stable orbits. This postulate states that the electron revolves around the nucleus only in those orbits for which the angular momentum is some integral multiple of <math>h/2\pi</math> where h is the Planck's constant.</p>	(i) Bohr's postulates	½ x 3	Deriving expression for energy of electron in n <sup>th</sup> orbit of hydrogen atom	2	(ii) Calculating Binding Energy per nucleon	1 ½	½ ½			
(i) Bohr's postulates	½ x 3										
Deriving expression for energy of electron in n <sup>th</sup> orbit of hydrogen atom	2										
(ii) Calculating Binding Energy per nucleon	1 ½										

	<p>(c) Bohr's third postulate states that an electron might make a transition from one of its specified non-radiating orbits to another of lower energy. When it does so, a photon is emitted having energy equal to the energy difference between the initial and final states.</p> <p><b>Derivation</b></p> <p>Total energy of electron in the stationary state of hydrogen atoms is</p> $E = -\frac{e^2}{8\pi\epsilon_0 r_n} \text{-----(1)}$ <p>Where <math>r_n</math> is radius of <math>n^{\text{th}}</math> orbit</p> $r_n = \frac{n^2 h^2 \epsilon_0}{\pi m e^2} \text{-----(2)}$ <p>Substituting eq (2) in eq (1)</p> $E_n = -\frac{m e^4}{8 n^2 \epsilon_0^2 h^2}$ <p>(ii)</p> <p>Mass defect, <math>\Delta m = [6m({}_0^1n) + 6m({}_1^1H)] - m({}_6^{12}C)</math></p> $\Delta m = (6 \times 1.008665 + 6 \times 1.007825) - 12.000000$ $\Delta m = 0.09894 \text{ u}$ $B.E. = \Delta m \times 931.5 \text{ MeV}$ $= 92.16 \text{ MeV}$ <p>Binding energy per nucleon, <math>E_{bn} = \frac{E_b}{A}</math></p> $= \frac{92.16}{12}$ $= 7.68 \text{ MeV}$	<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>5</p>
--	--	--	----------