CBSE Class 12 Physics Question Paper Solution 2017

SET 55/1

Q. No.	Expected Answer/ Value Points	Marks	Total Marks
	Section A	-	
Q1	i. Nichrome	1/2	
	ii. $R_{Ni} > R_{Cu}$ (or Resistivity _{Ni} > Resistivity _{Cu})	1/2	1
Q2	Yes	1	
			1
Q3	i. Decreases	1/2	
	ii. $n_{\text{Violet}} > n_{\text{Red}}$	1/2	
	(Also accept if the student writes $\lambda_V < \lambda_R$)		1
Q4	Photoelectric Effect (/Raman Effect/ Compton Effect)	1	
		-	S
05		1/	1
QS	A is positive and B is reportive	1/2 1/2	1
	B is negative (Also accept: A is pagative and B is positive)	72	I
	(Also accept. A is negative and B is positive)		
	SECTION B		
Q6	Interference pattern ¹ / ₂		
	Diffraction pattern ¹ / ₂		
	Two Differences $\frac{1}{2} + \frac{1}{2}$		
	I I I I I I I I I I	1/2	

MARKING SCHEME



07			
۷'	(a) Identification $\frac{1}{2} + \frac{1}{2}$		
	(b) Uses $\frac{1}{2} + \frac{1}{2}$		
	(a) $X - rays$	1/2	
	Used for medical purposes.	72	
	(Also accept UV rays and gamma rays and	1/2	
	Any one use of the e.m. wave named)	/2	
		1/2	
	(b) Microwaves	, -	
	Used in radar systems	1/2	
	(Also accept short radio waves and		
	Any one use of the e.m. wave named)		2
Q8			
	Condition $\rightarrow \rightarrow$		
	i. For directions of E, B, \vec{v} 1		
	ii. For magnitudes of \vec{E} , \vec{B} , \vec{v} 1		
	(i) The velocity \vec{v} , of the charged particles, and the \vec{E} and \vec{B}	1/	
	vectors, should be mutually perpendicular.	1/2	0
	Also the forces on q , due to \vec{E} and \vec{B} , must be	1/	
	oppositely directed.	1/2	
	(Also accept if the student draws a diagram to show the		
	directions.)		
	↓ ₽		
	F ↓↑E		
	"B		
	$/ \xrightarrow{1} \times \times$		
	B		
	F _B		
	z		
	(ii) $aE = anP$		
	(ii) $q_L = q_V B_E$	1/2	
	$or v = \frac{L}{D}$	1/2	
	В		
	Alternatively. The student may write:		
	Force due to electric field = $a\vec{E}$	1/2	
	Force due to magnetic field $-a(\vec{n} \times \vec{R})$	1/2	
	The required condition is		
	$\vec{r} = \vec{r} (\vec{r} \times \vec{p})$		
	$ \begin{array}{ccc} & q_{E} = -q \left(\mathcal{V} \times \mathcal{B} \right) \\ & [\overrightarrow{H} & (\overrightarrow{\rightarrow} & \overrightarrow{B}) & (\overrightarrow{\overrightarrow{\rightarrow}} & \overrightarrow{\rightarrow})] \end{array} $	1/2	
	$[or E = -(v \times B) = (B \times v)]$	1/2	
	(Note: Award 1 mark only if the student just writes:		
	"The forces, on the charged particle, due to the electric and		•
1	magnetic fields, must be equal and opposite to each other")]		2

00			
Q9	i. Writing		
	$E_n \propto \frac{1}{r^2}$ $\frac{1}{2}$		
	ii. Identifying the level to which the $\frac{1}{2}$		
	electron is emitted.		
	iii. Calculating the wavelengths and $\frac{1}{2} + \frac{1}{2}$		
	identifying the series of atleast one of the		
	three possible lines, that can be emitted.		
	i. We have $E_n \propto \frac{1}{n^2}$	1⁄2	
	ii. \therefore The energy levels are -13.6 eV; -3.4 eV; -1.5 eV	1/2	
	: The 12.5 eV electron beam can excite the electron up to $n=3$ level only.		
	iii. Energy values, of the emitted photons, of the three possible lines are $3 \rightarrow 1: (-1.5 + 13.6) eV = 12.1 eV$ $2 \rightarrow 1: (-3.4 + 13.6) eV = 10.2 eV$ $3 \rightarrow 2: (-1.5 + 3.4) eV = 1.9 eV$	P.O	5
	The corresponding wavelengths are: 102 nm, 122 nm and 653 nm $\left(\lambda = \frac{hc}{E}\right)$	1/2 + 1/2	
	(Award this 1 mark if the student draws the energy level diagram and shows (and names the series) the three lines that can be		
	emitted) / (Award these $(\frac{1}{2} + \frac{1}{2})$ marks if the student calculates the energies of the three photons that can be emitted		
	and names their series also.)		
			2
Q10			
	a) Two properties for making permanent $\frac{1}{2} + \frac{1}{2}$		
	magnet		
	b) I wo properties for making an $\frac{1}{2} + \frac{1}{2}$		

	 a) For making permanent magnet: (i) High retentivity (ii) High coercitivity (iii) High permeability 	1/2 + 1/2	
	 (Any two) b) For making electromagnet: (i) High permeability (ii) Low retentivity (iii) Low coercivity 	1/2 + 1/2	
			2
Q11	SECTION C a) The factor by which the potential difference changes 1 b) Voltmeter reading 1 Ammeter Reading 1 a) $H = \frac{V^2}{R}$ $\therefore V$ increases by a factor of $\sqrt{9} = 3$ b) Ammeter Reading $I = \frac{V}{R+r}$ $= \frac{12}{4+2}A = 2A$ Voltmeter Reading $V = E - Ir$ $= [12 - (2 \times 2)] V = 8V$ (Alternatively, $V = iR = 2 \times 4V = 8V$)	1/2 1/2 1/2 1/2 1/2 1/2	3
Q12	 a) Achieving amplitude Modulation 1 b) Stating the formulae 1/2 Calculation of v_c and v_m 1/2 + 1/2 Calculation of bandwidth 1/2 a) Amplitude modulation can be achieved by applying the message signal, and the carrier wave, to a non linear (square law device) followed by a band pass filter. 		



	<u>Working</u> : The diode D_1 is forward biased during one half cycle and current flows through the resistor, but diode D_2 is reverse biased and no current flows through it. During the other half of the signal, D_1 gets reverse biased and no current passes through it, D_2 gets forward biased and current flows through it. In both half cycles current, through the resistor, flows in the same direction.	1	
	(Note: If the student just draws the following graphs (but does not draw the circuit diagram), award $\frac{1}{2}$ mark only.	- A 6	3
Q14	Photon picture plus Einstein's photoelectric equation $\frac{1}{2} + \frac{1}{2}$ Two features $\frac{1}{2} + \frac{1}{2}$		
	In the photon picture , energy of the light is assumed to be in the form of photons , each carrying an energy hv .	1⁄2	
	Einstein assumed that photoelectric emission occurs because of a single collision of a photon with a free electron.	1⁄2	
	The energy of the photon is used to		
	 (i) free the electrons from the metal. [For this, a minimum energy, called the work function (=W) is needed]. 		
	(ii) provide kinetic energy to the emitted electrons.	1/2	

	Hence		
	$(K. E.)_{max} = hv - W$		
	$\left(\frac{1}{2}mv_{max}^{2}=hv-W\right)$	1.	
	This is Einstein's photoelectric equation	1/2	
	Two features (which cannot be explained by wave theory):		
	 i) 'Instantaneous' emission of photoelectrons ii) Existence of a threshold frequency iii) 'Maximum kinetic energy' of the emitted photoelectrons, is independent of the intensity of incident light (Any two) 	1/2 + 1/2	3
Q15	a Calculation of wavelength frequency	0	2
	and speed $\frac{1}{2} + \frac{1}{2} + \frac{1}{2}$	100	
	b. Lens Maker's Formula ¹ / ₂).	
	Calculation of R I		
	a) $\lambda = \frac{589 \text{ nm}}{1.33} = 442.8 \text{ nm}$	1/2	
	Frequency $\nu = \frac{3 \times 10^8 \text{ ms}^{-1}}{589 \text{ nm}} = 5.09 \times 10^{12} \text{Hz}$	1/2	
	Speed $v = \frac{3 \times 10^8}{1.33}$ m/s = 2.25 × 10 ⁸ m/s	1/2	
	b) $\frac{1}{f} = \left[\frac{\mu_2}{\mu_1} - 1\right] \left[\frac{1}{R_1} - \frac{1}{R_2}\right]$	1/2	
	$\therefore \frac{1}{20} = \left[\frac{1.55}{1} - 1\right] \frac{2}{R}$	1/2	
	$\therefore R = (20 \times 1.10) \text{cm} = 22 \text{ cm}$	1/2	3
Q16	Definition of mutual inductance1Derivation of mutual inductance for two1long solenoids2		



	(i)	Self inductance, of a coil, is numerically equal to the		
		emf induced in that coil when the current in it changes	1	
		at a unit rate.		
		(Alternatively: The self inductance of a coil equals the		
		flux linked with it when a unit current flows through		
		it.)		
	(ii)	The work done against back /induced emf is stored as		
		magnetic potential energy.	1/2	
		The rate of work done, when a current <i>i</i> is passing		
		through the coil, is	1/2	
		$\frac{dW}{dt} = \varepsilon i = \left(L\frac{di}{dt}\right)i$		
		at (at)		
			1/2	>
		$\therefore W = \int dW = \int_0 Lidi$	1/2	
		$=\frac{1}{2}Li^2$		3
Q17				5
	a)	Principle of meter bridge 1		
	b)	Relation between l_1, l_2 , and S 2		
	a)	The principle of working of a meter bridge is same as		
		that of a balanced Wheatstone bridge.		
		(Alternatively:		
		P ru Zz a		
		R LI INTS	1	
		When $i_g=0$, then $\frac{P}{Q}=\frac{R}{S}$)		







	(b) $B_p = \frac{\mu_0 \times 1}{2R} = \frac{\mu_0}{2R}$ (along z – direction)	1/2	
	$B_Q = \frac{\mu_0 \times \sqrt{3}}{2R} = \frac{\mu_0 \sqrt{3}}{2R} \text{(along x - direction)}$		
	$\therefore B = \sqrt{B_p^2 + B_Q^2} = \frac{\mu_0}{R}$	1/2	
	This net magnetic field B , is inclined to the field \mathbf{B}_{p} , at an angle Θ , where	72	
	$\tan \theta = \sqrt{3}$ $\left(/\theta = \tan^{-1}\sqrt{3} = 60^{0}\right)$	1/2	
	(in XZ plane)		3
Q22	Formula for energy stored1/2Energy stored before1Energy stored after1Ratio1/2	A	Ş.
	Energy stored = $\frac{1}{2} CV^2 \left(=\frac{1}{2}\frac{Q^2}{C}\right)$	1/2	
	Net capacitance with switch S closed = $C + C = 2C$	1/2	
	$\therefore \text{ Energy stored} = \frac{1}{2} \times 2C \times V^2 = CV^2$	1/2	
	After the switch S is opened, capacitance of each capacitor= KC		
	$\therefore \text{ Energy stored in capacitor A} = \frac{1}{2} K C V^2$		
	For capacitor B, $1 a^2 u^2 = 1 a^2 u^2$	1/2	
	Energy stored = $\frac{1}{2} \frac{Q^2}{KC} = \frac{1}{2} \frac{C^2 V^2}{KC} = \frac{1}{2} \frac{C V^2}{K}$		
	$\therefore \text{ Total Energy stored} = \frac{1}{2}KCV^2 + \frac{1}{2}\frac{CV^2}{K} = \frac{1}{2}CV^2\left(K + \frac{1}{K}\right)$		
	$=\frac{1}{2}CV^2\left(\frac{K^2+1}{K}\right)$	1/2	

	$\therefore \text{ Required ratio} = \frac{2CV^2 \cdot K}{CV^2(K^2 + 1)} = \frac{2K}{(K^2 + 1)}$	1/2	3
	SECTION D		
Q23	 a) Name of the installation, the cause of disaster ¹/₂ + ¹/₂ b) Energy release process 1 c) Values shown by Asha and mother 1+1 a) (i) Nuclear Power Plant:/'Set-up' for releasing Nuclear Energy/Energy Plant (Also accept any other such term) 	1⁄2	
	 (ii)Leakage in the cooling unit/ Some defect in the set up. (ii)Leakage in the cooling unit/ Some defect in the set up. (ii)Leakage in the cooling unit/ Some defect in the set up. (ii)Leakage in the cooling unit/ Some defect in the set up. (ii)Leakage in the cooling unit/ Some defect in the set up. (ii)Leakage in the cooling unit/ Some defect in the set up. (ii)Leakage in the cooling unit/ Some defect in the set up. (ii)Leakage in the cooling unit/ Some defect in the set up. (ii)Leakage in the cooling unit/ Some defect in the set up. (ii)Leakage in the cooling unit/ Some defect in the set up. (ii)Leakage in the cooling unit/ Some defect in the set up. (ii)Leakage in the cooling unit/ Some defect in the set up. (ii)Leakage in the cooling unit/ Some defect in the set up. (ii)Leakage in the cooling unit/ Some defect in the set up. (ii)Leakage in the cooling unit/ Some defect in the set up. (ii)Leakage in the cooling unit/ Some defect in the set up. (ii)Leakage in the cooling unit/ Some defect in the set up. (ii)Leakage in the cooling unit/ Some defect in the set up. (ii)Leakage in the cooling unit/ Some defect in the set up. (ii)Leakage in the cooling unit/ Some defect in the set up. (ii)Leakage in the cooling unit/ Some defect in the set up. (ii)Leakage in the cooling unit/ Some defect in the set up. (ii)Leakage in the cooling unit/ Some defect in the set up. (ii)Leakage in the cooling unit/ Some defect in the set up. (ii)Leakage in the cooling unit/ Some defect in the set up. (ii)Leakage in the cooling up.<!--</td--><td>1/2 1 1 1</td><td>4</td>	1/2 1 1 1	4
			0
Q24	(a) Derivation of <i>E</i> along the axial line of dipole 2 (b) Graph between <i>E</i> vs r 1 (c) (i) Diagrams for stable and unstable $\frac{1}{2} + \frac{1}{2}$ equilibrium of dipole (ii) Torque on the dipole in the two cases $\frac{1}{2} + \frac{1}{2}$ (a) $E_{+q} = E_{-q}$ -q = +q = P	28	
	Electric field at P due to charge $(+q) = E_1 = \frac{1}{4\pi\varepsilon_0} \frac{q}{(r-a)^2}$	1⁄2	
	Electric field at P due to charge $(-q) = E_2 = \frac{1}{4\pi\varepsilon_0} \frac{q}{(r+a)^2}$	1/2	
	Net electric Field at P= $E_1 - E_2 = \frac{1}{4\pi\varepsilon_0} \frac{q}{(r-a)^2} - \frac{1}{4\pi\varepsilon_0} \frac{q}{(r+a)^2}$	1/2	
	$=\frac{1}{4\pi\varepsilon_{0}}\frac{2pr}{(r^{2}-a^{2})^{2}} \qquad (p=q.2a)$		
	Its direction is parallel to \vec{p} .	1/2	













Let the final image be at I. We then have		
$\frac{1}{f_1} = \frac{1}{v_1} - \frac{1}{u}$ $\frac{1}{f_2} = \frac{1}{v} - \frac{1}{v_1}$	1⁄2	
Adding , we get $\frac{1}{f_1} + \frac{1}{f_2} = \frac{1}{v} - \frac{1}{u} = \frac{1}{f}$	1/2	
$\therefore \frac{1}{f} = \frac{1}{f_1} + \frac{1}{f_2}$	17	
$\therefore P = P_1 + P_2$ b) At minimum deviation $r = \frac{A}{2} = 30^{\circ}$	1/2 1/2	
We are given that $i = \frac{3}{4}A = 45^{\circ}$	1⁄2	2
$\therefore \mu = \frac{\sin 45^{\circ}}{\sin 30^{\circ}} = \sqrt{2}$	1/2	
∴ Speed of light in the prism = $\frac{c}{\sqrt{2}}$ (≅ 2.1 × 10 ⁸ ms ⁻¹)	1/2	
[Award ¹ / ₂ mark if the student writes the formula: $\mu = \frac{\sin(A + D_m)/2}{\sin(A/2)}$		
but does not do any calculations.]		5

MARKING SCHEME

Q. No.	Expected Answer/ Value Points	Marks	Total Marks
	Section A		1
Q1	Q to P through ammeter and D to C through ammeter (Alternatively: Anticlockwise as seen from left in coil PQ clockwise as seen from left in coil CD)	1/2 1/2	1
Q2	Speed of electromagnetic wave, $c = \frac{E_0}{B_0}$.	1	1
Q3	i. Nichrome ii. $R_{Ni} > R_{Cu}$ (or Resistivity _{Ni} > Resistivity _{Cu})	1/2 1/2	1
Q4	i. Decreases ii. $n_{\text{Violet}} > n_{\text{Red}}$ (Also accept if the student writes $\lambda_V < \lambda_R$)	1/2 1/2	2
Q5	Photoelectric Effect (/Raman Effect/ Compton Effect) SECTION B	1	1
Q6	Condition i. For directions of \vec{E} , \vec{B} , \vec{v} 1 ii. For magnitudes of \vec{E} , \vec{B} , \vec{v} 1 i. The velocity \vec{v} , of the charged particles, and the \vec{E} and \vec{B} vectors, should be mutually perpendicular. Also the forces on q , due to \vec{E} and \vec{B} , must be oppositely directed. (Also accept if the student draws a diagram to show the directions.) $\vec{F_{B}} + \vec{F_{B}} + F_$	1/2 1/2	

	ii. $qE = qvB$	1/2	
	E	1/2	
	$V V = \frac{1}{B}$		
	[Alternatively, The student may write:	1/2	
	Force due to electric field = $q\vec{E}$	1/2	
	Force due to magnetic field = $a(\vec{v} \times \vec{B})$		
	The required condition is		
	$a\vec{E} = a(\vec{x} \times \vec{P})$	1/2	
	$qL = -q (V \times B)$ $\begin{bmatrix} \vec{x} & (\vec{y} \times \vec{x}) & (\vec{y} \times \vec{y}) \end{bmatrix}$	1/2	
	$[or E = -(v \times B) = (B \times v)]$		
	(Note: Award 1 mark only if the student just writes:		
	"The forces, on the charged particle, due to the electric and		2
	magnetic fields, must be equal and opposite to each other")]		
Q7			
	(a) Identification $\frac{1}{2} + \frac{1}{2}$		
	(b) One use each $\frac{1}{2} + \frac{1}{2}$		
	a) X-rays/ Gamma rays	1/2	S
	One use of the name given	1/2	C - 1
	b) Infrared/Visible/Microwave	1/2	
	One use of the name given	1/2	
	(Note: Award ¹ / ₂ mark for each correct use (relevant to		
	the name chosen) even if the names chosen are		
	incorrect.)		•
			2
00	Interference pattern ¹ / ₂		
Qo			
	Diffraction pattern ¹ / ₂		
	Two Differences $\frac{1}{2} + \frac{1}{2}$		
	I		
		1/2	
	Imax	72	
	$\land \land \land \land \land \land \land$		
	3×2×1× 0 1×2×3×		
	> Path Difference		



Q9	Formula1/2Calculation11/2		
	$\frac{1}{\lambda} = R\left(\frac{1}{{n_1}^2} - \frac{1}{{n_2}^2}\right)$	1/2	
	\therefore For Balmer Series: $(\lambda_B)_{short} = \frac{4}{R}$	1/2	
	and For Lyman Series: $(\lambda_L)_{short} = 1/R$	1/2	
	$ \therefore \lambda_B = 913.4 \times 4 \mathrm{A}^0 = 3653.6 \mathrm{A}^0 $	1/2	2
Q10	 a) Two properties for making permanent ¹/₂ + ¹/₂ magnet b) Two properties for making an ¹/₂ + ¹/₂ electromagnet 	b,	2
	a) For making permanent magnet:	PX	
	(i) High retentivity	$\frac{1}{2} + \frac{1}{2}$	
	(ii) High coercitivity	, , _	
	(iii) High permeability		
	(Any two)		
	b) For making electromagnet:		
	(i) High permeability	$\frac{1}{2} + \frac{1}{2}$	
	(ii) Low retentivity		
	(iii) Low coercivity		
	(Any two)		
			2
	SECTION C		
Q11	a. Calculation of wavelength, frequency and speed $\frac{1}{2} + \frac{1}{2} + \frac{1}{2}$		
	b. Lens Maker's Formula ¹ / ₂		
	Calculation of <i>R</i> 1		







	(ii) The work done against back /induced emf is stored as		
	magnetic potential energy.		
	The rate of work done, when a current i is passing	1⁄2	
	through the coil, is		
	$\frac{dW}{dt} = \varepsilon i = \left(L\frac{di}{dt}\right)i$	1/2	
	$\therefore W = \int dW = \int_0^I Lidi$	1⁄2	
	$=\frac{1}{2}Li^2$	1⁄2	
			3
Q15	 (a) Variation of photocurrent with intensity 1 of radiation (b) Stopping potential versus frequency for 1 different materials (c) Independence of maximum kinetic energy 1 of the emitted photoelectrons (a) The collision of a photon can cause emission of a photoelectron(above the threshold frequency). As intensity increases, number of photons increases. Hence the current increases. 	1	2
	(b) We have, $eV_s = h(v - v_0)$	1/2	
	$\therefore v_s = -\frac{1}{e}(v) + \left(-\frac{1}{e}\right)$		
	\therefore Graph of v_s with v is a straight line and slope $\left(=\frac{n}{e}\right)$	1⁄2	
	is a constant.		
	(c) Maximum for different surfaces $K = h(v - v_0)$	1⁄2	
	Hence, it depends on the frequency and not on the intensity of the incident radiation.	1⁄2	
			3





	(Alternatively, Amplitude modulation is achieved by superposing a message signal on a carrier wave in a wa causes the amplitude of the carrier wave to change in a with the message signal.)	ay that accordan	ce	1	
	b) Frequencies of side bands are: $(\upsilon_c + \upsilon_m)$ and $(\upsilon_c - \upsilon_m)$			1/2	
	$\therefore \upsilon_{c} + \upsilon_{m} = 660 \text{ kHz}$				
	and $\upsilon_c - \upsilon_m = 640 \text{ kHz}$				
	$\therefore \upsilon_{c} = 650 \text{ kHz}$			1/2	
	$\therefore \upsilon_{\rm m} = 10 \text{kHz}$			1/2	
	Bandwidth = $(660 - 640)$ kHz = 20 kHz	2	1	1/2	3
Q19	a) Circuit diagram Input characteristics Output characteristics b) Output pulse wave form Truth table/Logic symbol I_{L} I_{D} I_{L} V_{EB} V_{BE} V_{AE}	1 1/2 1/2 1/2 1/2		1	



	Field at the centre of a circular coil $=$ $\frac{\mu_0 I}{2R}$	1/2	
	Field due to coil $P = \frac{\mu_0 \times 3}{2 \times 5 \times 10^{-2}}$ tesla		
	$= 12\pi \times 10^{-6}$ tesla	1⁄2	
	Field due to coil Q = $\frac{\mu_0 \times 4}{2 \times 5 \times 10^{-2}}$ tesla		
	$= 16\pi \times 10^{-6}$ tesla	1/2	
	$\therefore \text{ Resultant Field} = (\pi \sqrt{12^2 + 16^2}) \mu \text{T}$		
	$= (20 \pi) \mu T$	1	
	Let the field make an angle θ with the vertical	1	
	$\tan\theta = \frac{12\pi \times 10^{-6}}{16\pi \times 10^{-6}} = \frac{3}{4}$	20	
	$\theta = \tan^{-1}\frac{3}{4}$	1/2	3
	(Alternatively: $\theta' = \tan^{-1}\frac{4}{3}$, $\theta' = $ angle with the horizontal)		
	[Note1: Award 2 marks if the student directly calculates B without calculating B_P and B_Q separately.]		
	[Note 2: Some students may calculate the field B_Q and state that it also represents the resultant magnetic field (as coil P has been shown 'broken' and , therefore, cannot produce a magnetic field); They may be given 2 ½ marks for their (correct) calculation of B_Q]		
Q21	Diagram of generalized communication system $1\frac{1}{2}$ Function of (a) transmitter (b) channel (c) receiver $\frac{1}{2} + \frac{1}{2} + \frac{1}{2}$		

	The electric field E points outwards normal to the sheet. The field lines are parallel to the Gaussian surface except for surfaces 1 and 2. Hence the net flux = $\oint E \cdot ds = EA + EA$ where A is the area of each of the surface 1 and 2. $\therefore \oint E \cdot ds = \frac{q}{\varepsilon_0} = \frac{\sigma A}{\varepsilon_0} = 2EA;$ $E = \frac{\sigma}{2\varepsilon_0}$ b) $W = q \int_{\infty}^{r} \vec{E} \cdot d\vec{r}$ $= q \int_{\infty}^{r} (-Edr)$ $= -q \int_{\infty}^{r} (\frac{\sigma}{2\varepsilon_0}) dr$ $= \frac{q\sigma}{2\varepsilon} \infty - r $	1 1 1/2 1/2 1/2 1/2	
	\Rightarrow (∞)		5
Q26	 a) Identification 1/2 b) Identifying the curves 1 Justification 1/2 c) Variation of Impedance with frequency 1/2 Graph 1/2 d) Expression for current 11/2 Phase relation 1/2 a) The device X is a capacitor b) Curve B → voltage Curve C → current Curve A → power 	1/2 1/2 1/2	

Q. No.	Expected Answer/ Value Points	Marks	Total Marks
	Section A	1	
Q1	i. Decreases	1/2	
	ii. $n_{\text{Violet}} > n_{\text{Red}}$	1/2	
	(Also accept if the student writes $\lambda_V < \lambda_R$)		1
Q2	Photoelectric Effect (/Raman Effect/ Compton Effect)	1	
			1
Q3	Clockwise in loop 1	1/2	
	Anticlockwise in loop 2	1/2	
			1
Q4		~)
	\vec{E} along y- axis and \vec{B} along z-axis	$\frac{1}{2} + \frac{1}{2}$	
	(Alternatively : \vec{E} along z-axis and \vec{B} along y-axis)	0	1
Q5	i. Nichrome	1/2	
	ii. $R_{Ni} > R_{Cu}$ (or Resistivity _{Ni} > Resistivity _{Cu})	1/2	1
	SECTION B		
06	SECTION B		
	a) Two properties for making permanent $\frac{1}{2} + \frac{1}{2}$		
	b) Two properties for making an $\frac{1}{2} + \frac{1}{2}$ electromagnet		
	a) For making permanent magnet:		
	(i) High retentivity	$\frac{1}{2} + \frac{1}{2}$	
	(ii) High coercitivity		
	(iii) High permeability		
	(Any two)		

MARKING SCHEME

	Differences				
	Interference All maxima have equal intensity	DiffractionMaxima have different(/rapidly decreasing)intensity	-	16 + 16	
	All fringes have equal width. Superposition of two wavefronts	Different (/changing) width. Superposition of wavelets from the same wavefront		72 + 72	
		(Any two)			2
	Expression for intensity	of polarized beam	1		
	Plot of intensity variatio	n with angle	1		
	Intensity is $\frac{I_0}{2} \cos^2 \theta$ (if I_0 Intensity is $ \cos^2 \theta$ (if I is to (Award $\frac{1}{2}$ mark if the stude)	is the intensity of unpolarised the intensity of polarized lightent writes the expression as I_0	d light.) ht.) $_{0}\cos^{2}\theta$)	1	2
Q8	a) Reason for r b) Reason for r	no flow of current momentary current	1 1		
	In the steady state, the displaced conduction current, is zero constant.	lacement current and hence t as $ \vec{E} $, between the plates , is	he S	1	
	During charging / dischargi hence the conduction curren plates , is changing with tim	ing, the displacement current nt is non zero as $ \vec{E} $, between ne.	and the	1	

	Energy difference = $3.4 \text{ eV} - 1.51 \text{ eV} = 1.89 \text{ eV} = 3.024 \times 10^{-19} \text{ J}$	1/2	
	Energy = $\frac{hc}{\lambda}$ = 3.024×10 ⁻¹⁹ J	1/2	
	Wavelength = 6.57×10^{-7} m	1/2	
	Series is Balmer series	1/2	2
Q10	Condition i. For directions of \vec{E} , \vec{B} , \vec{v} 1 ii. For magnitudes of \vec{E} , \vec{B} , \vec{v} 1 (i) The velocity \vec{v} , of the charged particles, and the \vec{E} and \vec{B} vectors, should be mutually perpendicular. Also the forces on q , due to \vec{E} and \vec{B} , must be oppositely directed. (Also accept if the student draws a diagram to show the directions.) $\vec{F_{E}}$ $\vec{F_{E}}$ $\vec{F_{E}}$ $\vec{F_{E}}$ $\vec{F_{E}}$ (ii) $q\vec{E} = qv\vec{B}$ $or v = \frac{\vec{E}}{\vec{B}}$ [Alternatively, The student may write: Force due to electric field $= q\vec{E}$ Force due to magnetic field $= q(\vec{v} \times \vec{B})$ The required condition is $q\vec{E} = -q(\vec{v} \times \vec{B}) = (\vec{B} \times \vec{v})$] (Note: Award 1 mark only if the student just writes:	1/2 1/2 1/2 1/2 1/2 1/2 1/2 1/2 1/2 1/2 1/2	2
	"The forces, on the charged particle, due to the electric and magnetic fields, must be equal and opposite to each other")]		2

	SECTION C		
Q11	a. Calculation of wavelength, frequency and speed $\frac{1}{2} + \frac{1}{2} + \frac{1}{2}$ b. Lens Maker's Formula $\frac{1}{2}$ Calculation of R 1		
	a) $\lambda = \frac{589 \text{ nm}}{1.33} = 442.8 \text{ nm}$	1/2	
	Frequency $v = \frac{3 \times 10^8 \text{ ms}^{-1}}{589 \text{ nm}} = 5.09 \times 10^{12} \text{Hz}$	1/2	
	Speed $v = \frac{3 \times 10^8}{1.33}$ m/s = 2.25 × 10 ⁸ m/s	1/2	
	b) $\frac{1}{f} = \left[\frac{\mu_2}{\mu_1} - 1\right] \left[\frac{1}{R_1} - \frac{1}{R_2}\right]$	1/2	5
	$\therefore \ \frac{1}{20} = \left[\frac{1.55}{1} - 1\right] \frac{2}{R}$	1/2	
	$\therefore R = (20 \times 1.10) \text{cm} = 22 \text{ cm}$	1/2	3
Q12	Definition of mutual inductance1Derivation of mutual inductance for two1long solenoids2		
	 Mutual inductance is numerically equal to the induced emf in the secondary coil when the current in the primary coil changes by unity. <u>Alternatively:</u> Mutual inductance is numerically equal to the magnetic flux linked with one coil/secondary coil when unit current flows through the other coil /primary coil. 	1	

Q19	Formula for energy stored1/2Energy stored before1Energy stored after1Ratio1/2		
	Energy stored = $\frac{1}{2}CV^2$ (= $\frac{1}{2}\frac{Q^2}{C}$)	1/2	
	Net capacitance with switch S closed = $C + C = 2C$	1/2	
	$\therefore \text{ Energy stored} = \frac{1}{2} \times 2C \times V^2 = CV^2$	1⁄2	
	After the switch S is opened, capacitance of each capacitor= KC		
	$\therefore \text{ Energy stored in capacitor A} = \frac{1}{2} K C V^2$	5	
	For capacitor B,	1/2	2
	Energy stored = $\frac{1}{2} \frac{Q^2}{KC} = \frac{1}{2} \frac{C^2 V^2}{KC} = \frac{1}{2} \frac{C V^2}{K}$	72	
	$\therefore \text{ Total Energy stored} = \frac{1}{2}KCV^2 + \frac{1}{2}\frac{CV^2}{K} = \frac{1}{2}CV^2\left(K + \frac{1}{K}\right)$	2	
	$=\frac{1}{2}CV^2\left(\frac{K^2+1}{K}\right)$	1/2	
	: Required ratio = $\frac{2CV^2 \cdot K}{CV^2(K^2 + 1)} = \frac{2K}{(K^2 + 1)}$	1/2	3
Q20	Formula for energy stored1/2Energy stored before1Energy stored after1Ratio1/2		
	Energy stored = $\frac{1}{2} CV^2 \left(=\frac{1}{2}\frac{Q^2}{C}\right)$	1/2	
	Net capacitance with switch S closed = $C + C = 2C$	1/2	
	$\therefore \text{ Energy stored} = \frac{1}{2} \times 2C \times V^2 = CV^2$	1/2	
	After the switch S is opened, capacitance of each capacitor= KC		

	$\therefore \text{ Energy stored in capacitor A} = \frac{1}{2} K C V^2$		
	For capacitor B,		
	Energy stored = $\frac{1}{2} \frac{Q^2}{KC} = \frac{1}{2} \frac{C^2 V^2}{KC} = \frac{1}{2} \frac{C V^2}{K}$	1/2	
	$\therefore \text{ Total Energy stored} = \frac{1}{2}KCV^2 + \frac{1}{2}\frac{CV^2}{K} = \frac{1}{2}CV^2\left(K + \frac{1}{K}\right)$		
	$=\frac{1}{2}CV^2\left(\frac{K^2+1}{K}\right)$	1/2	
	: Required ratio = $\frac{2CV^2 \cdot K}{CV^2(K^2 + 1)} = \frac{2K}{(K^2 + 1)}$	1/2	3
Q21	a) Correct Choice of R $\frac{1}{2}$ B) Circuit Diagram1Working $\frac{1}{2}$ $I - V$ characteristics $\frac{1}{2}$ a) R would be increased.Resistance of S (a semi conductor) decreases on heating.b) Photodiode diagramImage: Image: Im	1/2 1/2 1	5
	semiconductor), then electron-hole pairs are generated due to the		

	(b) $B_p = \frac{\mu_0 \times 1}{2R} = \frac{\mu_0}{2R}$ (along z – direction)	1⁄2	
	$B_Q = \frac{\mu_0 \times \sqrt{3}}{2R} = \frac{\mu_0 \sqrt{3}}{2R}$ (along x – direction)		
	$\therefore B = \sqrt{B_p^2 + B_Q^2} = \frac{\mu_0}{R}$	1/2	
	This net magnetic field B , is inclined to the field $\mathbf{B}_{\mathbf{p}}$, at an angle Θ , where		
	$\tan \theta = \sqrt{3}$ $\left(/\theta = \tan^{-1}\sqrt{3} = 60^{0}\right)$	1/2	
	(in XZ plane)		2
	SECTION D		3
		1	
Q23	a) Name of the installation, the cause of disaster $\frac{72 + 72}{1}$ b) Energy release process	-	5 C
	c) Values shown by Asha and mother 1+1	~~~	
	a) (i) Nuclear Power Plant:/'Set-up' for releasing Nuclear	1/2	
	Energy/Energy Plant	, -	
	(Also accept any other such term)		
	(ii)Leakage in the cooling unit/ Some defect in the set up.	1/2	
	b) Nuclear Fission/Nuclear Energy Break up (/ Fission) of Uranium nucleus into fragments	1	
	c) Asha: Helpful Considerate Keen to Learn Modest	1	
	Mother: Curious, Sensitive, Eager to Learn, Has no airs	1	
	(Any one such value in each case)		
			4
	SECTION E		
024	a) Identification ¹ / ₂		
221	b) Identifying the curves 1		
	Justification ¹ / ₂		
	c) Variation of Impedance		
	with frequency ¹ / ₂		
	Graph ¹ / ₂		
	d) Expression for current $1\frac{1}{2}$		
	Phase relation ¹ / ₂		
	a) The device X is a capacitor	1⁄2	

	b) At minimum deviation		
	$r = A/2 = 30^{\circ}$	1/2	
	We are given that		
	3		
	$i = \frac{1}{4}A = 45^{\circ}$	1/2	
	$\sin 45^{\circ}$	17	
	$\therefore \mu = \frac{1}{\sin 30^0} = \sqrt{2}$	1/2	
	C		
	\therefore Speed of light in the prism $=\frac{c}{\sqrt{2}}$		
	$(\cong 2.1 \times 10^8 \text{ms}^{-1})$	1/2	
	[Award $\frac{1}{2}$ mark if the student writes the formula:		
	$\mu = \frac{\sin(A + D_m)/2}{2}$		
	$\mu^{\mu} = \sin(A/2)$		
	but does not do any calculations.]		
			5
		0	<
Q26	(a) Derivation of <i>E</i> along the axial line of dipole $\frac{2}{1}$	222	
	(b) Graph between E vs r 1		
	(c) (1) Diagrams for stable and unstable $\frac{1}{2} + \frac{1}{2}$		
	equilibrium of dipole		
	(ii) Torque on the dipole in the two cases $\frac{1}{2} + \frac{1}{2}$		
	(a)		
	\leftarrow 2a \rightarrow E_{+q} E_{-q}		
	••		
	-q +q P		
	← r →		
	Electric field at P due to charge $(+q) = E_1 = \frac{1}{4\pi\epsilon_0} \frac{q}{(r-q)^2}$	1/2	
	$4\pi\varepsilon_0 (r-a)$		
	Electric field at P due to charge $(-q) = E_2 = \frac{1}{q}$	1/2	
	$\frac{1}{2} \frac{1}{2} \frac{1}$		
	Not electric Field at $\mathbf{D} = \mathbf{E} = \begin{bmatrix} 1 & q & 1 & q \end{bmatrix}$	1/2	
	There electric field at $r = E_1 - E_2 = \frac{1}{4\pi\varepsilon_0} \frac{1}{(r-a)^2} - \frac{1}{4\pi\varepsilon_0} \frac{1}{(r+a)^2}$	14	
	1 Onr		
	$=\frac{1}{4\pi c_{0}}\frac{2pi}{(r^{2}-r^{2})^{2}}$ $(p=q.2a)$		
	$4\pi\varepsilon_0(r^2-u^2)^2$		
	Its direction is parallel to \vec{p} .	1/-	
	1 1	72	

