Roll Number						

Set - 01

SAHODAYA PREBOARD EXAMINATION, 2024-25

- Please check that this question paper contains 09 printed pages.
- Please check that this question paper contains 33 questions.
- Please write down the Serial Number of the question before attempting it.
- 15 minute time has been allotted to read this question paper. The students will read the question paper only during this time and will not write any answer on the answer-book during this period.

PHYSICS (042)

MARKING SCHEME

Time Allowed: 3 hours *Maximum Marks: 70*

General Instructions:

(1) There are 33 questions in all. All questions are compulsory.

(2) This question paper has five sections: Section A, Section B, Section C, Section D and Section E.

(3) All the sections are compulsory.

(4) Section A contains sixteen questions, twelve MCQ and four Assertion Reasoning based of 1 mark each, Section B contains five questions of two marks each, Section C contains seven questions of three marks each, Section D contains two case study-based questions of four marks each and Section E contains three long answer questions of five marks each.

(5) There is no overall choice. However, an internal choice has been provided in one question in Section B, one question in Section C, one question in each CBQ in Section D and all three questions in Section E. You must attempt only one of the choices in such questions.

(6) Use of calculators is not allowed.

(7) You may use the following values of physical constants wherever necessary

i. $c = 3 \times 10^8$ m/s

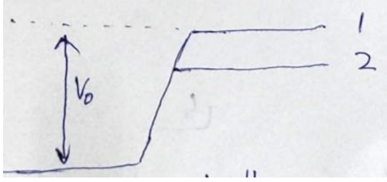
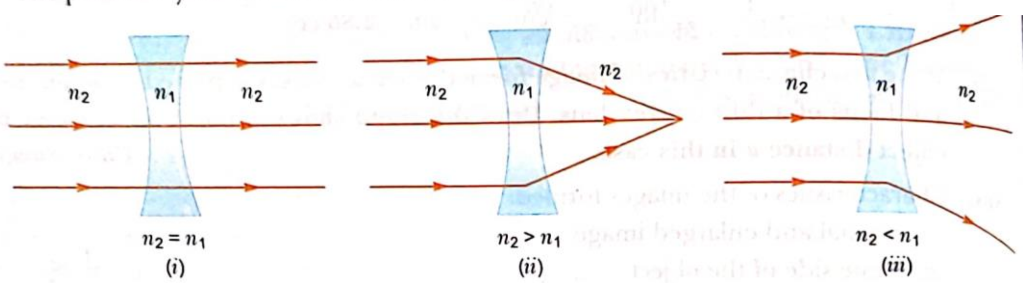
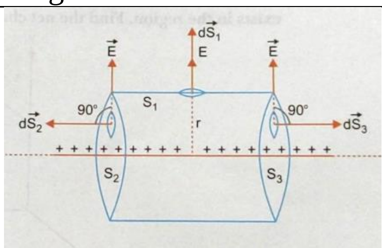
ii. $m_e = 9.1 \times 10^{-31}$ kg

iii. $m_p = 1.7 \times 10_{-27}$ kg

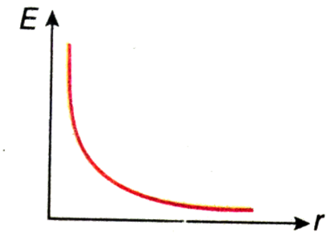
iv. e = 1.6 x 10^{-19} C
v. μ_0 = 4π x 10^{-7} T m A^{-1}
vi. h = 6.63 x10^{-34} J s
vii. ε_0 = 8.854 x10^{-12} $C^2N^{-1}M^{-2}$
viii. Avogadro's number = 6.023 X 10^{23}per gram mole
(8) No overwriting and cutting in MCQs answers are allowed. If so zero mark will be awarded in that question. Write the correct options with answers in MCQs clearly. Draw the relevant diagrams wherever necessary with required derivations.

	SECTION - A	
1.	(a) $V_A = V_B = V_C$	1
2.	(b) $\frac{x_2}{x_1}$	1
3.	(b) The magnitude of magnetic moment now decreases.	1
4.	(c) the intensity increases	1
5.	(b) 2.2 A	1
6.	(c) A_3	1
7.	(d) 1-R, 2-P, 3-S, 4-Q	1
8.	(a) $\frac{V}{3}$ volt	1
9.	(a) $\frac{60}{8} cm$	1
10.	(d) $\frac{2x\lambda}{y}$	1
11.	(a)Diffusion current is equal to drift current	1
12.	(c) 0.5 Ω	1
13.	D. If both Assertion and Reason are false.	1
14.	A. If both Assertion and Reason are true and Reason is the correct explanation of Assertion.	1
15.	C. If Assertion is true but Reason is false.	1
16.	A. If both Assertion and Reason are true and Reason is the correct explanation of Assertion.	1
	SECTION - B	
17.	$eV_0 = \frac{hc}{\lambda} - \phi$ $e(V_1 - V_2) = 1.3eV \quad \Delta V_0 = 1.3V$	2
18.	$2\times 4\beta = 2.4 cm$ $8\times\frac{D\lambda}{d} = 2.4\times10^{-2} m$ $8\times\frac{Dc}{d\nu} = 2.4\times10^{-2} m$ $\nu = 5\times10^{14} Hz$	2

	OR For first violet fringe, $y_1 = \frac{D\lambda_1}{d}$ 0.5 For first violet fringe, $y_2 = \frac{D\lambda_2}{d}$ 0.5 $\therefore \lambda_2 - \lambda_1 = (y_2 - y_1)\frac{d}{D} = 300\, nm$ 1	
19.	$\frac{1}{2}mv^2 = eV \quad or \quad v = \sqrt{\frac{2eV}{m}}$ $\frac{mv^2}{r} = e\,v\,B$ Or, $r = \frac{mv}{eB} = \sqrt{\frac{2meV}{eB}} = 8.43\, mm$	2
20.	(i) ${}^{6}Li < {}^{238}U < {}^{16}O < {}^{56}Fe$ (ii) (a) $\frac{BE}{A}$ $of \ {}^{12}C = 7.6\, MeV$ $\frac{BE}{A}$ $of \ {}^{4}He = 6.8\, MeV$ Total BE = 118.4 MeV (b) $\frac{BE}{A}$ $of \ {}^{4}He = 6.8\, MeV$ Total BE = 108.8 MeV Maximum energy is released in case of formation of $one\, {}^{12}C \ and \ one \ {}^{4}He \ nucleus$.	2
21.	$\frac{\lambda_4}{\lambda_1} = \frac{2\pi a_0 \times 4}{2\pi a_0 \times 1} \Rightarrow \lambda_4 = 4\lambda_1$	2
	SECTION - C	
22.	(i)A-transformer 0.5 B-Junction diode 0.5 C- Resistor 0.5 (ii) In half wave rectification, output frequency = 50 Hz 1 In full wave rectification, output frequency = 100 Hz 0.5	3
23.	Diagram of parallel plate capacitor 0.5 In the inner regions, $E = \frac{\sigma}{2\epsilon_0} + \frac{\sigma}{2\epsilon_0} = \frac{\sigma}{\epsilon_0} = \frac{Q}{\epsilon_0 A}$ 0.5 $V = Ed = \frac{1}{\epsilon_0}\frac{Qd}{A}$ 0.5 $C = \frac{Q}{V} = \frac{\epsilon_0 A}{d}$ 0.5 If dielectric is introduced completely, then $C' = \frac{\epsilon A}{d} = \frac{\epsilon_r \epsilon_0 A}{d}$ 0.5 Or $C' = KC$ 0.5	3

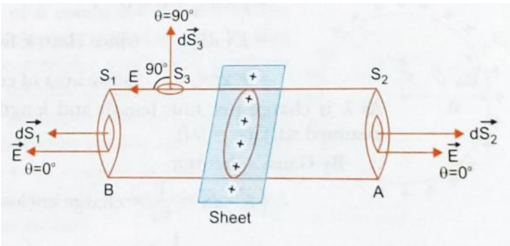
24.	Ray diagram of reflecting telescope (9.29 page-246, NCERT) Advantages: (any two) Free from spherical aberration Free from chromatic aberration Brighter images Easy to handle	2 0.5+0.5	3
25.	(i)  (1) without battery (2) Low battery voltage in forward bias (ii) Fig. 14.6 (a) (page-328 NCERT) (iii) Fig. 14.9 (b) (page-332) NCERT) (deduct ½ mark if labelling is not done)	1 1 1	3
26.	(a)magnitude of counter torque = magnitude of deflecting torque = NIBA sin θ =30 x 6 x 1 x (3.14 x 0.08 x 0.08) sin 60° =30 x 6 x 3.14x 64 x 10^{-4} x 0.866 = 3.1 Nm (b)No, the answer would not change	0.5 0.5 0.5 0.5 0.5 0.5	3
27.	From lens maker's formula, $\frac{1}{f}=\left(\frac{n_1}{n_2}-1\right)\left(-\frac{1}{R_2}-\frac{1}{R_2}\right)$ (i) for $n_1 = n_2 \Rightarrow f = \infty$ (ii) for $n_1 < n_2 \Rightarrow f > 0$ (iii) for $n_1 > n_2 \Rightarrow f < 0$ The path of rays in three cases is shown in fig.  Justification 3 fig.	1.5 1.5	3
28.	 $\oiint \vec{E}.\vec{ds} = \int_{s_1} \vec{ds_1} + \int_{s_2} \vec{ds_2} + \int_{s_3} \vec{ds_3}$ $= \int E\, ds_1 + 0 + 0$ $= E2\pi rl$	1 0.5 0.5	3

$E = \dfrac{\lambda}{2\pi \in_0 r}$ 0.5



0.5

OR



1

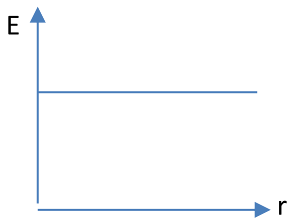
$\oint \vec{E}.\vec{ds} = \int_{s_1} \vec{ds_1} + \int_{s_2} \vec{ds_2} + \int_{s_3} \vec{ds_3}$

$= Ea + Ea + 0$

=2Ea 0.5

Total electric flux = $\dfrac{1}{\in_0}$ (total charge enclosed) 0.5

$E = \dfrac{\sigma}{2 \in_0}$ 0.5



0.5

SECTION - D

29.	(i)(b) $r = \dfrac{mv}{qB}$ $r' = \dfrac{m(2v_0)}{qB} = 2r_0$ (ii) (c)The time period is independent of the speed v. (iii) (b) $\vec{F} \cdot \vec{B} = 0 \Rightarrow \vec{a}.\vec{B} = 0 \Rightarrow x = -4\,ms^{-2}$ (iv) (c) The path of the electron becomes helical **OR** (d) The magnetic force on the particle is zero, since $\theta = 0^0$.	4
30.	(i) (d) When the de-Broglie wavelength is λ_2, the particle is nearer the origin than when its value is λ_1 (ii) (d) (iii) (b) 10^{-9} m	4

	(iv) (d) $\frac{1}{\nu}$ **OR** (c) momentum	
	SECTION - E	
31.	(i) Statement & Derivation of $J = \sigma E$ 2 (ii) (a) Current remains same. As per Kirchhoff's junction rule 3 (b) Current density J varies inversely with A (c) Potential drop at narrower end will be more than at broader end as R is inversely proportional to A and V=IR **OR** (i) Statement of Kirchhoff's laws & explanation 2 (ii) In closed mesh ABDC: $I_1 r_2 + (I_1 + I_2) R = 12$ 0.5 $3I_1 + 2I_2 = 6$ (i) In closed mesh BDFE: $(I_1 + I_2) R = 6$ $2I_1 + 2I_2 = 3$ (ii) 0.5 (1) On solving $I_1 = 3$ A (2) Putting the value of I_1 in equation (i) $I_2 = -1.5$ A $I = I_1 + I_2 = 1.5$ A 1.5 Power $I^2 R = 9$ W 0.5	
32.	(i) Principle and working 2 obtain an expression for the instantaneous value of the emf generated. 1 (ii) $e_0 = NBA \times 2\pi f = 15085V$ 1 Maximum current = $I_0 = \frac{15085}{100} = 150.85\,A$ 0.5 Power generated $e_0 I_0 = 2275.5\ kW$ 0.5 **OR** (i) Diagram of step down transformer 1 Deduce the expression for its working principle and explain. 2 (ii) Total resistance of the wire, R = (20 + 20) 0.5 = 20 Ω 0.5 Input voltage $V_1 = 4000$ V Output voltage $V_2 = 220$ V RMS current in the wire lines is given as: $I = \frac{P}{V_1} = \frac{1200 \times 10^3}{4000} = 300\,A$ 1 Line power loss = $I^2 R = 1800\,kW$ 0.5	5
33.	(i) Ray diagram showing the image formation by a compound microscope when the final image is formed at the least distance vision 1 Derive an expression for the total magnification when the final image is formed at the near point. 2 (ii) Given the focal length of objective $f_0 = 1.25cm$ Focal length of eyepiece $f_e = 5cm$	5

For objective $\frac{1}{v_0} - \frac{1}{(-2.5)} = \frac{1}{1.25}$

$\Rightarrow v_0 = 2.5\ cm$ 1

For eyepiece $\frac{1}{f_e} = \frac{1}{(-\infty)} - \frac{1}{(-u_e)} = \frac{1}{5}$

u_e = 5 cm. 0.5

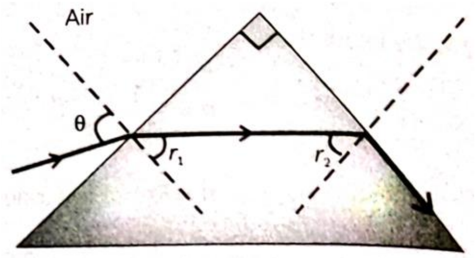
The distance between the objective and the eyepiece is

$(v_0 + u_e)$ = 7.5 cm.

0.5

OR

(i)



At the 1st surface, using Snell's law 0.5

$\sin\theta = n \sin r_1$

$\sin r_1 = \frac{\sin\theta}{n}$

$r_2 = A - r_1 = 90^o - r_1$

At the second interface, 0.5

$\sin r_2 = \frac{\sin 90^0}{n}$

$\sin r_2 = \frac{1}{n}$

$\sin(90^o - r_1) = \frac{1}{n}$

$\cos r_1 = \frac{1}{n}$ 1

Squaring both sides

$\cos^2 r_1 = \frac{1}{n^2}$

$1 - \sin^2 r_1 = \frac{1}{n^2}$

$1 - \left(\frac{\sin^2\theta}{n^2}\right) = \frac{1}{n^2}$

Solving, $n = \sqrt{(1 + \sin^2\theta)}$ 1

(ii) For an equilateral prism $A = 60^o$

Using Snell's law at the first surface, 0.5

sin i = μ sin r

	At minimum deviation $r = \frac{A}{2} = \frac{60^o}{2} = 30^o$ $\sin r = \mu \sin 30^o$ $\sin i = \mu\left(\frac{1}{2}\right)$ $i = \sin^{-1}\left(\frac{\mu}{2}\right)$	0.5 1	

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