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PREBOARD EXAMINATION 2023-24
CLASS: XII
SUBJECT: PHYSICS (SET1)

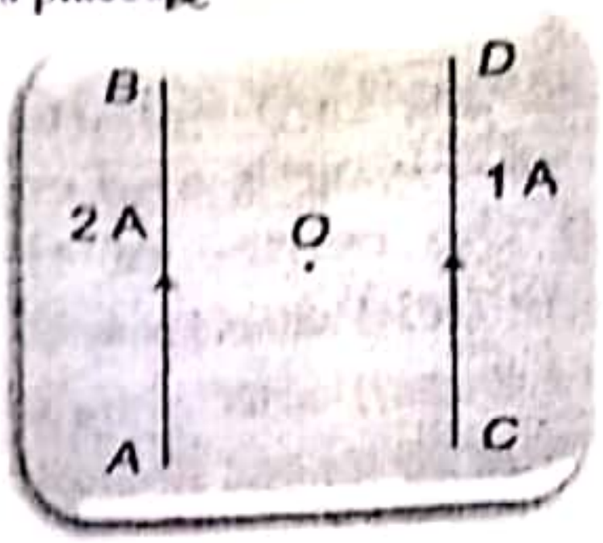
TIME: 3 HRS **M.M: 70**

No. of pages:7

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 have to 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 where ever necessary
i. $c = 3 \times 10^8$ m/s
ii. $m_e = 9.1 \times 10^{-31}$ kg
iii. $e = 1.6 \times 10^{-19}$ C
iv. $\mu_0 = 4\pi \times 10^{-7}$ TmA^{-1}
v. $h = 6.63 \times 10^{-34}$ Js
vi. $\varepsilon_0 = 8.854 \times 10^{-12}$ $C^2N^{-1}m^{-2}$
vii. Avogadro's number = 6.023×10^{23} per gram mole

Q. NO.	SECTION – A	M
1	The potential at a point x (m) is due to some charge situated on the X axis is given by $V(x) = 6(x^3+2)$ volt. What will be electric field at x=2m? (a) 10 V/m (b) 15 V/m (c) 30 V/m (d) 72 V/m	1
2	The total flux through the faces of the cube with side of length a if a charge q is placed at centre of a face of the cube (a) $q/8\varepsilon_0$ (b) $q/4\varepsilon_0$ (c) $q/2\varepsilon_0$ (d) q/ε_0	1
3	Two concentric circular loops of radii a and b. Currents flowing in them I, anticlock wise and clockwise respectively. If a<b, the resultant magnetic field at the centre of circular loops: (a) $\frac{\mu o}{4\pi} 2\pi I \left[\frac{1}{a} - \frac{1}{b}\right]$ outward (b) $\frac{\mu o}{4\pi} 2\pi I \left[\frac{1}{b} + \frac{1}{a}\right]$ outward (c) $\frac{\mu o}{4\pi} 2\pi I \left[\frac{1}{b} - \frac{1}{a}\right]$ Inward (d) zero	1
4	An electron is projected with uniform velocity along the axis of a current carrying long solenoid. Which of the following is true? (a) The electron will be accelerated along the axis. (b) The electron path will be circular about the axis. (c) The electron will experience a force at 45° to the axis and hence execute a helical path. (d) The electron will continue to move with uniform velocity along the axis of the solenoid.	1

5	Which of the following material has negative susceptibility (a) Paramagnetic (b) Ferromagnetic (c) Diamagnetic (d) AlNiCo	1
6	AB and CD are long parallel wires placed 20 cm apart. Magnetic field midway between them is  (a) $4X10^{-6}\,T$ (b) $2X10^{-6}\,T$ (c) $1X10^{-6}\,T$ (d) $6X10^{-6}\,T$	1
7	A magnetic dipole moment (a) is directed from S pole to N pole (b) is directed from N pole to S pole (c) doesn't have any fixed direction (d) is a scalar quantity	1
8	The output of a step-down transformer is measured to be 24 V when connected to a 12 watt light bulb. The value of the peak current is (a) $1/\sqrt{2}$ A. (b) $\sqrt{2}$ A. (c) 2 A. (d) $2\sqrt{2}$ A.	1
9	A plane wavefront is incident on a concave mirror . The reflected wavefront will be (a) Plane (b) Cylindrical (c) Spherical (d)Irregular shape	1
10	A proton, a neutron, an electron and an α-particle have same energy. Then their de Broglie wavelengths compare as (a) $\lambda_p = \lambda_n > \lambda_e > \lambda_\alpha$ (b) $\lambda_\alpha < \lambda_p = \lambda_n < \lambda_e$ (c) $\lambda_e < \lambda_p = \lambda_n > \lambda_\alpha$ (d) $\lambda_e = \lambda_p = \lambda_n = \lambda_\alpha$	1
11	Taking the Bohr radius as a_0 = 53pm, the radius of Hydrogen atom in its first excitation state, on the basis of Bohr's model, will be about (a) 53 pm (b) 27 pm (c) 212 pm (d) 277 pm	1
12	Which of the hydrogen line spectrum series belongs to Ultraviolet region of electromagnetic spectrum (a) Balmer series (b) Lyman Series (c) Paschen series (d) Brackett series	1

Directions for Q13 to Q16:

In the following questions, a statement of assertion is followed by a statement of reason, Mark the correct choice as:

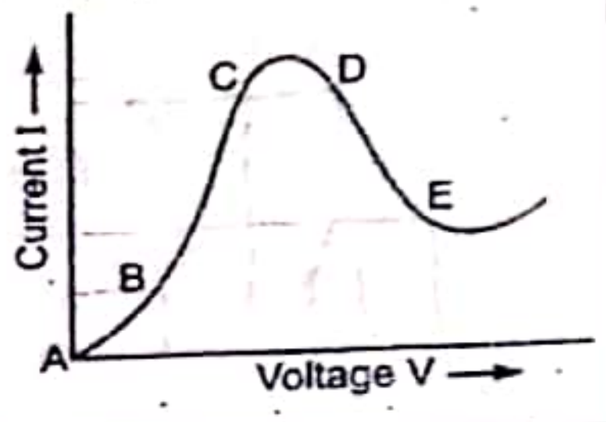
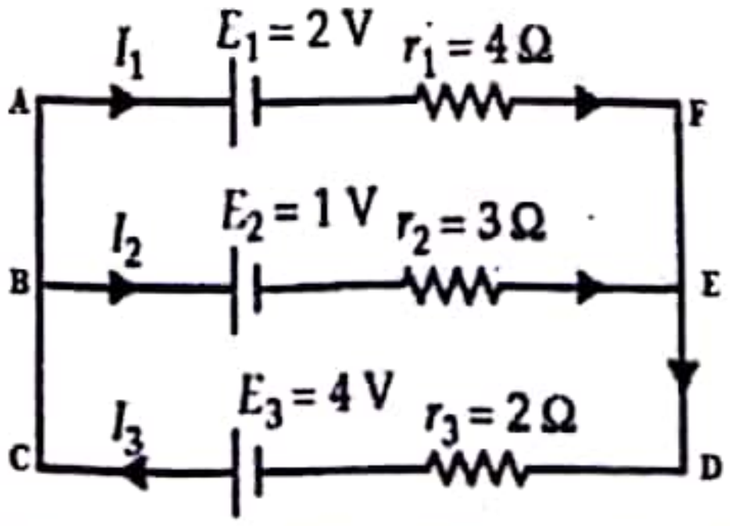
A) If both assertion and reason are true and reason is the correct explanation of the assertion.

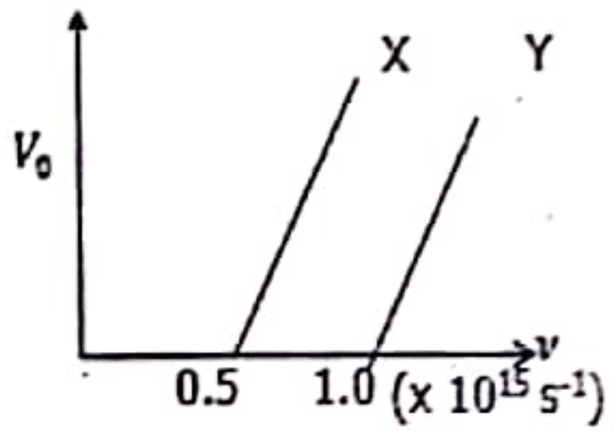
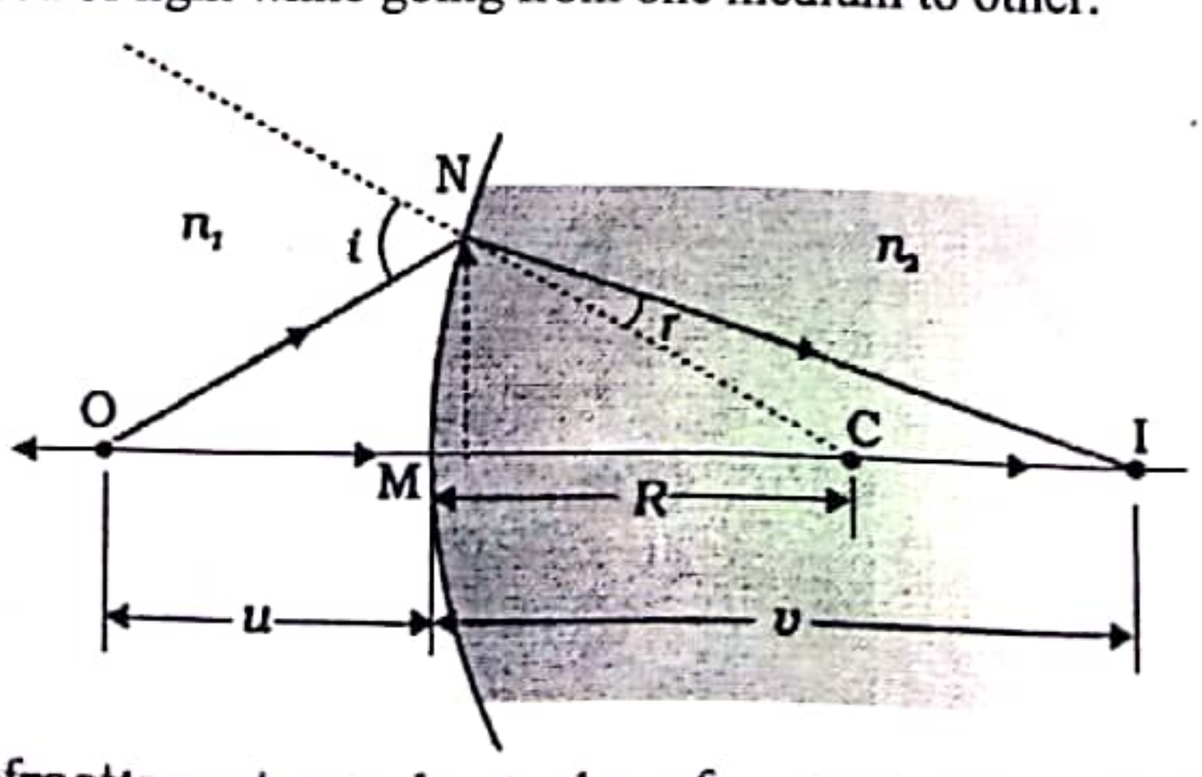
B) If both assertion and reason are true but reason is not correct explanation of assertion.

C) If assertion is true, but reason is false.

D) If both assertion and reason are false.

13	Assertion : In electrostatic field, a charged particle is moving from point P to point Q. The net work done is independent of the path connecting points P and Q. Reason : The net work done by a conservative force in moving an object is independent on path and along a closed loop is not zero.	1
14	Assertion: The focal length of an equi-convex lens of radius of curvature R made of material of refractive index μ = 1.5, is equal to 2R. Reason : The radius of curvature of both the surfaces of equi-convex lens is positive.	1

15	**Assertion:** On increasing the intensity of light, the number of photoelectrons emitted is more. Also the kinetic energy of each photon increases but the photoelectric current is constant. **Reason:** Photoelectric current is independent of intensity but increases with increasing frequency of incident radiation.	1
16	**Assertion:** The energy gap between the valence band and conduction band is greater in silicon than in germanium. **Reason:** Thermal energy produces fewer majority carriers in silicon than in germanium.	1
	SECTION – B	
17	Graph showing the variation of current versus voltage for a material GaAs as shown in figure. Identify the region (i) of Negative resistance (ii) Where Ohm's law is obeyed. Also justify your answer. 	2
18	A convex lens of focal length 25 cm is placed coaxially in contact with a concave lens of focal length 10 cm. Determine the power of the combination. Will the system be converging or diverging in nature? OR Ray of light passing through an equilateral triangular glass prism from air undergoes minimum deviation when angle of incidence is 3/2 times the angle of prism. Calculate the speed of light in the prism.	2
19	Draw a schematic ray diagram of a compound microscope showing how rays coming from an object are received at the eye piece for normal view. Write its magnification expression.	2
20	Write two important features of Rutherford's planetary model? Write two reasons for its rejection.	2
21	Explain formation of potential barrier in p-n junction diode? Explain how the depletion layer changes in forward and reverse bias.	2
	SECTION - C	
22	State Gauss theorem. Find the relation for electric field intensity at a point due to an infinitely large thin charged plate.	3
23	Define electromotive force for a cell. How is it different from potential difference? The internal resistance of a cell of emf 2 V is 0.1 Ω. It is connected to a resistance of 3.9 Ω. Find the potential difference of cell? **Or** Use Kirchhoff's rules to find the currents I_1, I_2 and I_3 in the circuit diagram shown. 	3

24	In a moving coil galvanometer. (i)What is the function of radial magnetic field and how is it produced in a moving coil galvanometer? (ii)What is importance of phosphor bronze wire? (iii) Define current sensitivity. How can it be increased?	3
25	Two concentric circular coils, one of small radius r_1 and the other of large radius r_2 such that $r_1 \ll r_2$ are placed co-axially with centres coinciding. Obtain the mutual inductance of the arrangement. Give two factors on which the coefficient of mutual inductance between a pair of coils depends. **Or,** Define self-inductance of a coil. A long solenoid has 500 turns. When current of 2A flows through it, the magnetic flux linked with each turn of the solenoid 4×10^{-3}Wb. Find the self-Inductance of the solenoid.	3
26	Which constituent radiations of electromagnetic spectrum is used - (i) in RADAR systems used in aircraft navigation (ii) in photographs of internal parts of human body/as a diagnostic tool in medicine (iii) for taking photographs of sky, during night and fog conditions. Give reason for your answer in each case.	3
27	The following graph shows the variation of stopping potential (V_0) with frequency (ν) of the incident radiation for two photosensitive surfaces X and Y. (i) Which of the metals has larger threshold wavelength? Give reason. (ii) Explain giving reason, which metal gives out electrons having larger kinetic energy, for the same wavelength of incident radiation? (iii) If the distance between the light source and metal X is halved, how will the kinetic energy of electron emitted from it change? Give reason 	3
28	(a)Draw a plot of binding energy per nucleon (B.E/A) as a function of mass number A. Write any two important features of this graph . (b) Use this graph to explain the release of energy in both the processes of nuclear fission and fusion.	3
	SECTION - D	
29	Refraction is the phenomenon of change in the path of light while going from one medium to another. This change in path occurs at the boundary of two media. Refraction is caused due to change in the speed of light while going from one medium to other.  Refraction at a spherical surface separating two media.	

	while considering the refraction at spherical surfaces, we assume: (i) The object taken here is point sized and is lying on the principal axis of the spherical refracting surface. (ii) The aperture of the spherical refracting surface is small. (iii) The incident and the refracted rays make small angles with the principal axis of the spherical surface so that $sin\ i \approx i$ and $sin\ r \approx r$ Due to refraction, many such phenomena occur in nature, like the twinkling of stars, advanced sunrise, delayed sunset, etc. The fact that lenses can converge or diverge rays of light passing through them is due to the phenomenon of refraction. Due to refraction, we see a pencil broken when dipped in a beaker filled with water. If we look around, we can spot many such occurrences due to refraction.	
29(a)	In the above diagram if the value of angle 'i' and 'r' are 45^0 and 30^0, then refractive index of first medium with respect to second medium. (i) $\sqrt{2}$ (ii) $\frac{\sqrt{3}}{2}$ (iii) $\frac{1}{\sqrt{2}}$ (iv) $\frac{3}{2}$ **Or** For a plano-concave lens of radius of curvature 10 cm the focal length in air is 25 cm. The refractive index of the material of the lens is (i) 2.0 (ii)1.4 (iii) 1.33 (iv) 1.5	1
29(b)	Focal length of an equi-convex lens of glass(refractive index 1.5) in air is 20 cm. Which of the following is correct 1. When immersed in water its power increases. 2. When immersed in oil of refractive index 1.6 its nature changes. 3. When immersed in glycerin (refractive index 1.5) its power becomes zero. 4. When immersed in oil of refractive index 1.6 it will always form a real image. (i) 1 and 2 (ii) 2 and 3 (iii) 3 and 1 (iv) 1 and 4	1
29(c)	Light from a point source in air falls on a spherical glass surface (n = 1.5 and radius of curvature = 20 cm). The distance of the light source from the glass surface is 100 cm. At what position the image is formed? (i) -100 cm (ii) + 100 cm (iii) + 10 cm (iv) -10 cm	1
29(d)	The radii of curvature of the faces of a double convex lens are 10 cm and 15 cm. If focal length is 12 cm, then refractive index of glass is (i) 1.5 (ii) 1.78 (iii) 2.0 (iv) 2.52	1
30	Consider a thin p-type silicon (p-Si) semiconductor wafer. By adding precisely, a small quantity of pentavalent impurity, part of the p-Si wafer can be converted into n-Si. There are several processes by which a semiconductor can be formed. The wafer now contains p-region and n-region and a metallurgical junction between p-, and n- region. Two important processes occur during the formation of a p-n junction: diffusion and drift. We know that in an n-type semiconductor, the concentration of electrons (number of electrons per unit volume) is more compared to the concentration of holes. Similarly, in a p-type semiconductor, the concentration of holes is more than the concentration of electrons. During the formation of p-n junction, and due to the concentration gradient across p-, and n- sides, holes diffuse from p-side to n-side (p → n) and electrons diffuse from n-side to p-side (n → p). This motion of charge carries gives rise to diffusion current across the junction.	

30(a)	The drift current is set up during formation of p-n junction in a diode due to - (i)movement of electrons from N side to P side (ii) movement of electrons from P side to N side and of holes from N side to P side (iii) Only(i) (iv) both (i) and (ii)	1
30(b)	Due to diffusion of majority charge carriers (i) region of negative immovable ions is formed on p side (ii) a positive space charge region is formed on p side (iii) an electric field is set up across p-n junction from p-side to n-side (iv) a negative space charge region is formed on n side	1
30(c)	In a pure Si crystal Indium is added as dopant. Which of the following is not true about the new crystal formed (i) It becomes p-type extrinsic semiconductor (ii) Majority charge carriers are holes (iii) Dopant atom becomes a positive ion (iv) An acceptor level is created in forbidden energy gap.	1
30(d)	Pure Silicon at 300 K has equal electron and hole concentrations of $1.5\times10^{16}/m^3$. Doping by Indium increases the hole concentration to $4.5 \times 10^{22}/ m^3$. Calculate the new electron concentration in the doped silicon. **Or,** A diode is fabricated from a semiconductor with a band gap of 2.8 eV. Can it detect a wave of frequency $5X10^{14}$ Hz.	1
	SECTION – E	
31	(a) Define electric dipole. Derive an expression for the electric field on the axial line due to an electric dipole. (b) An electric dipole of length 4cm, when placed with its axis making an angle of 60^0 with a uniform electric field, experiences a torque of $4\sqrt{3}$ Nm. Calculate the potential energy of the dipole, if it has a charge of $\pm 8nC$. **Or,** (a) A capacitor of capacity C is charged fully by connecting it to a battery of emf E. It is then disconnected from the battery. If the separation between the plates of the capacitor is doubled then how the following parameters will change: - i) Charge stored in the capacitor ii) Field strength between the plates iii) Energy stored by the capacitor (b) Two small conducting spherical balls A and B of radii r_1 and r_2 have charges q_1 and q_2 respectively. They are connected by a conducting wire. Obtain the expression for charges on A and B in equilibrium.	5
32	(a) An ac source of voltage $V = V_0 \sin \omega t$ is connected to a series combination of L, C and R. Use the phasor diagram to obtain the expressions for impedance of the circuit and phase angle between voltage and current. Show the graphical variation of impedance with frequency. What is minimum impedance? What is the circuit in this condition called? b) In a series LR circuit, $X_L = R$ and power factor of the circuit is P_1. When capacitor with capacitance C is connected in series to LR such that $X_L = X_C$, the power factor becomes P_2. Calculate P_1/P_2. **Or,**	5

	OR (a) State the working principle of an AC generator. With the help of a neat and labelled diagram, explain its working, obtain the expression for the emf generated in the coil. (b) A circular ring of radius R meter lies in X-Y plane in a region where the magnetic field is given by $B = B_0(\hat{\imath} - 2\hat{\jmath} + 4\hat{k})tesla$ where B_0 is constant. Find the magnetic flux passing through the ring.	
33	(a) Define interference. What is the need for coherent sources and how are they obtained in Young's double slit experiment? Also write the conditions for constructive and destructive interference in terms of the phase angle ϕ. (b) Two harmonic waves of monochromatic light $y_1 = a\cos\omega t$ and $y_2 = a\cos(\omega t + \phi)$, are superimposed on each other. Show that the maximum intensity in interference pattern is four times the intensity due to each slit. **OR** (a) A plane wavefront is incident at the interface of the two media when it propagates from a rarer to a denser medium. Using Huygens's principle construct refracted wavefront and hence verify Snell's law. (b) With the help of a diagram show the shape of a wavefront emerging from a convex lens when a point source is placed at its focus. (c) With the help of a diagram show the shape of a wave front emerging from a convex lens when a plane wavefront which is normal to its principal axis is incident on it.	5