O.P.JINDAL SCHOOL , SAVITRI NAGAR

PRE – BOARD – II (2025-26) (SET – A)

NOTE: -

- 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 paper in the answer-book before attempting it.
- 15 minutes time has been allotted to read the question paper. The students will read the question paper only and will not write any answer on the answer-book during this period.

CLASS - XII **PHYSICS (042)**

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 two questions in Section B, one question in Section C 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

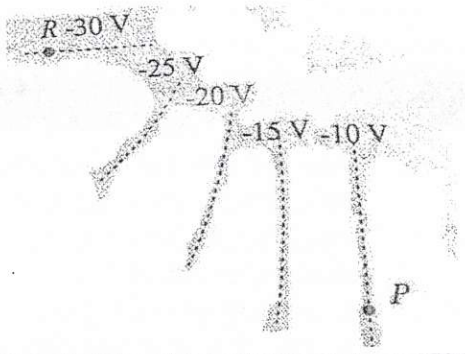
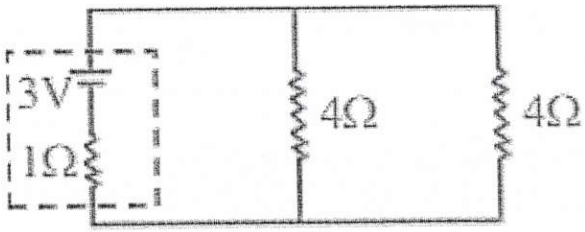
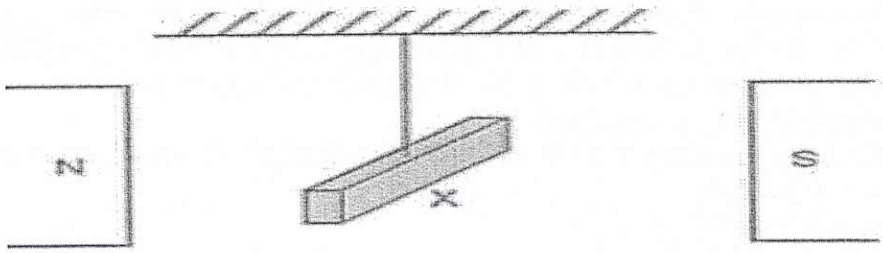
iv. $\mu_0 = 4\pi \times 10^{-7}$ T mA^{-1}

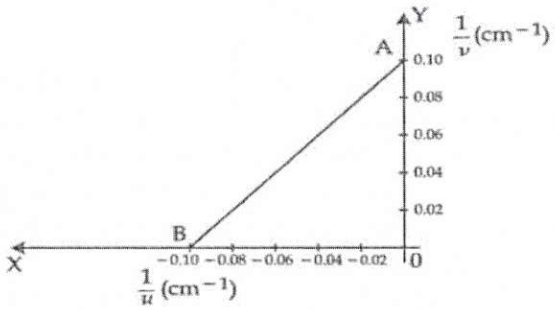
v. $h = 6.63 \times 10^{-34}$ Js

vi. $\varepsilon_0 = 8.854 \times 10^{-12}$ $C^2N^{-1}m^{-2}$

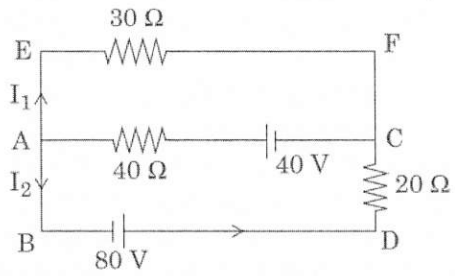
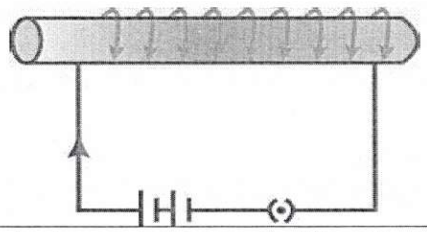
vii. Avogadro's number = 6.023 X 10^{23} per gram mole

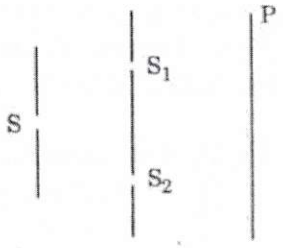
Section A		
Q. No	**Questions**	**Marks**
1	If two charges q_1 and q_2 are separated with distance 'd' and placed in a medium of dielectric constant K. What will be the equivalent distance between charges in air for the same electrostatic force? (A) $2d\sqrt{K}$ (B) $K\sqrt{d}$ (C) $1.5\, d\sqrt{K}$ (D) $d\sqrt{K}$	1
2	The given figure, shows various equipotential surfaces. Which of the following statements correctly represents the direction of the electric field **E** at point P and R?	1

	(A) At P, E is to the left and at R, E is upward (B) At P, E is to the right and at *R*, E is downward (C) At P, E is to downward and at R, E is to the left (D) At P, E is to upward and at R, E is to the right 	
3	In the given circuit, the terminal potential difference of the cell is  (A) 2 V (B) 4 V (C) 1.5 V (D) 3 V	1
4	A rod X when suspended in a uniform magnetic field aligns itself perpendicular to the magnetic field as shown in figure.  Which of the following statements is/are true for the rod? P) Every atom in the rod, has a zero magnetic moment. Q) The rod is attracted when taken near the poles of a strong magnet. R) The relative permeability of the material of the rod is slightly less than 1 S) The susceptibility of the material of the rod is directly proportional to temperature. (A) only Q (B) only P and R (C) only Q and S (D) only R and S	1
5	A coil having area A_0 is placed in a magnetic field which changes from B_0 to $4B_0$ in time interval t. The magnitude of emf induced in the coil will be (A) - $\frac{3A_0B_0}{t}$ (B) - $\frac{4A_0B_0}{t}$ (D) - $\frac{3B_0}{A_0t}$ (C) - $\frac{4B_0}{A_0t}$	1

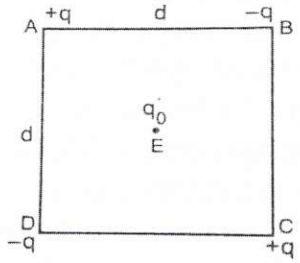
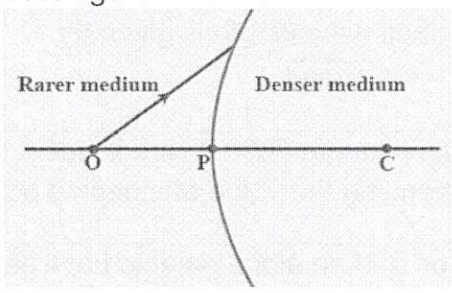
6	An alternating emf $\varepsilon = 440\sin 100\pi t$ is applied to a circuit containing an inductance of $\frac{\sqrt{2}}{\pi}$ H. If an a.c. ammeter is connected in the circuit, its reading will be (A)4.4 A (B)1.55A (C)2.2A (D)3.11A	1
7	In a series LCR-circuit, the capacitance is changed from C to 4C. To keep the resonance frequency unchanged, the new inductance should be: (A) increased by 2 L (B) reduced by (¼) L (C) reduced by (3/4) L (D) increased to 4 L	1
8	In the four regions I, II, III and IV, the electric fields are described as : **Region I : $E_x = E_0\sin(kz-\omega t)$** **Region II : $E_x = E_0$** **Region III : $E_x = E_0\sin kz$** **Region IV : $E_x = E_0\cos kz$** The displacement current will exist in the region: (A) IV (B) III (C) II (D) I	1
9	The graph between $\frac{1}{u}$ and $\frac{1}{v}$ for a thin convex lens in order to determine its focal length is plotted as shown in the figure. The refractive index of lens is 1.5 and its both the surfaces have same radius of curvature R. The value of R will be ___cm. (where u= object distance, v= image distance)  (A)5 cm (B) 10 cm (C) 15 cm (D) 20 cm	1
10	Consider the diffraction pattern obtained from the sunlight incident on a pinhole of diameter 0.1 μm. If the diameter of the pinhole is slightly increased, it will affect the diffraction pattern such that: (A) its size decreases, and intensity decreases (B) its size increases, and intensity increases (C) its size increases, but intensity decreases (D) its size decreases, but intensity increases	1
11	The electron in a hydrogen atom makes a transition from an excited state to the ground state. Which of the following statements is true? (A)Its kinetic energy increases and its potential and total energies decrease. (B)Its kinetic energy decreases, potential increases and its total energy remain the same (C)Its kinetic energy and total energies decrease, and its potential, energy increases. (D)Its kinetic potential and total energies decrease.	1

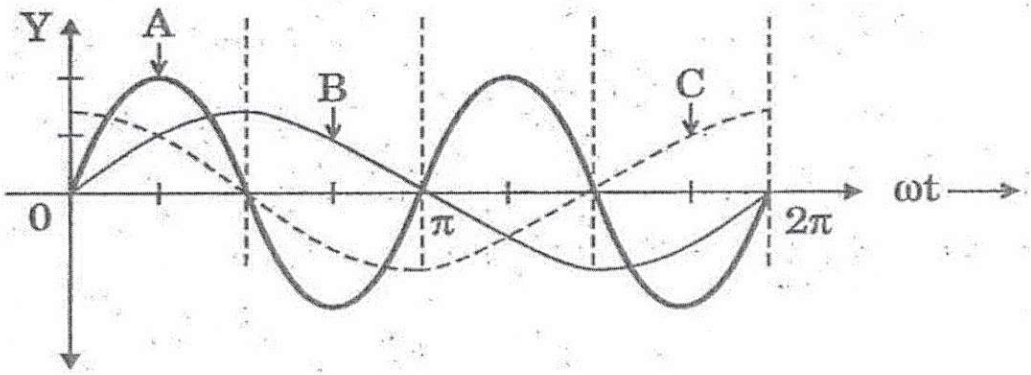
12	Which of the following statements is **not true** for nuclear forces? (A) They are stronger than Coulomb forces. (B) They have about the same magnitude for different pairs of nucleons. (C) They are always attractive. (D) They saturate as the separation between two nucleons increases.	1
	For Questions 13 to 16, two statements are given one labelled Assertion (A) and other labelled Reason (R). Select the correct answer to these questions from the options as given below. (A) Both Assertion and Reason are true and Reason is the correct explanation of Assertion. (B) Both Assertion and Reason are true but Reason is not the correct explanation of Assertion. (C) Assertion is true but Reason is false. (D) Both Assertion and Reason are false.	
13	**Assertion (A)**: The work function of a given material increases with an increase in the frequency of the incident radiation. **Reason (R)**: As per Einstein's photoelectric equation $h\nu = \varphi + KE$, work function φ is directly proportional to the frequency ν of the incident radiation.	1
14	**Assertion (A):** In interference and diffraction of light, light energy reduces in one region producing a dark fringe. It increases in another region and produces a bright fringe. **Reason(R):** This happens because energy is not conserved in the phenomena of interference and diffraction.	1
15	**Assertion (A):** A convex lens may be diverging. **Reason (B):** The nature of a lens depends upon the refractive index of material of the lens and the surroundings.	1
16	**Assertion (A)**: A positive charge in an electric field moves along the direction of the electric field. **Reason (R):** On a positive charge a force acts in the direction of the electric field.	1
	Section B	
17	A sphere S_1 of radius r_1 enclosing a charge Q_1 is surrounded by another concentric sphere S_2 of radius r_2 ($r_2 > r_1$). If there is a charge $-Q_2$ in the space between S_1 and S_2, find the ratio of electric flux through S_1 and S_2.	2
18	A Potential difference of V volts is applied to a conductor of length L and diameter D. How will the drift velocity of electrons change when? (i) V is doubled (ii) L is halved and (iii) D is halved, where in each case, the other two factors remain same.	2
19 (I)	Write an expression for the magnetic force per unit length between two parallel thin current carrying wires with diagram. Hence define one ampere. **OR**	2
19 (II)	Define magnetic susceptibility of a material. Name two elements, one having Positive susceptibility and the other are having negative susceptibility.	2

20	Electromagnetic waves with frequency (i) v_1 is suitable for used in remote control of T.V. (ii) v_2 is used for detecting the speed of a cricket ball. (iii) v_3 is used for destroying bacteria and sterilizing surgical instrument. Identify and name the part of the electromagnetic spectrum to which these radiations belong. Also arrange these frequencies in ascending order of their magnitude.	2
21 (I)	Prove that the speed with which the electron revolves in n^{th} orbit is proportional to (1/n). **OR**	2
21 (II)	Justify how does the stopping potential in photoelectric emission depends upon (i) Intensity of the incident radiation (ii) frequency of incident radiation	2
	Section C	
22	Use Kirchhoff's rule to calculate the current in arm AC of the given circuit. 	3
23 (I)	State Ampere's circuital law. Using this law, derive an expression for the magnetic field due to the infinitely long straight current carrying wire. **OR**	3
23 (II)	Draw the magnetic field lines inside the core of a current carrying solenoid when a rod made of (a) copper, (b) aluminum (c) iron is inserted with in the solenoid as shown in fig. 	3
24	Define self-inductance and give its SI unit. Derive an expression for the self-inductance of a long, air-cored solenoid of length l, cross-sectional area A and having N number of turns.	3
25	Explain briefly, with the help of a circuit diagram, how a *p-n* junction diode works as a full wave rectifier. Explain its working. Draw the input and output waveforms.	3
26	A ray of light is refracted by a glass prism. Obtain an expression for the refractive index of the glass in term of the angle of prism A and the angle of minimum deviation δ_m.	3

27	(a) Define mass defect. (b) Calculate the mass defect and binding energy per nucleon of a nitrogen nucleus ($^{14}_{7}N$) from the following data: - Mass of proton=1.00727 u, mass of neutron =1.00866 u and mass of Nitrogen nucleus ($^{14}_{7}N$) = 14.00307 u	3
28	In a Young's double-slit experiment $SS_2 - SS_1 = \frac{\lambda}{4}$ where S_1 and S_2 are the two slits as shown in the figure. Find the path difference ($S_2P - S_1P$) for constructive and destructive interference at P. 	3
	Section D	
29	A pure semiconductor like Ge or Si , when doped with a small amount of suitable impurity, becomes an extrinsic semiconductor. In thermal equilibrium, the electron and hole concentration in it are related to the concentration of intrinsic charge carriers. A p-type or n-type semiconductor can be converted into a p-n junction by doping it with suitable impurity. Two processes: diffusion and drift, take place during formation of a p-n junction. A semiconductor diode is basically a p-n junction with metallic contacts provided at the ends for the application of an external voltage. A p-n junction diode allows currents to pass only in one direction when it is forward biased. Due to this property, a diode is widely used to rectify alternating voltages in half-wave or full wave configuration. **I)** When Ge is doped with pentavalent impurity, the energy required to free the weakly bound electron from the dopant is about (a) 0.001 eV (b) 0.01 eV (c) 0.72 eV (d) 1.1 eV **II)** At a given temperature, the number of intrinsic charge carriers in a semiconductor is 2.0×10^{10} cm^{-3}. It is doped with pentavalent impurity atoms. As a result, the number of holes in it becomes 8×10^{3} cm^{-3}. The number of electrons in the semiconductor is (a) 2×10^{24} m^{-3} (b) 1×10^{22} m^{-3} (c) 4×10^{23} m^{-3} (d) 5×10^{22} m^{-3} **(III)** During the formation of a p-n junction, (a) electrons diffuse from p-region into n-region and holes diffuse from n -region into p -region. (b) both electrons and holes diffuse from n -region into p-region. (c) electrons diffuse from n-region into p-region and holes diffuse from p-region into n-region. (d) both electrons and holes diffuse from p-region into n-region. **(IV)** Initially during the formation of p-n junction: (a) Diffusion current is large and drift current is small. (b) Diffusion current is small and drift current is large. (c) Both the diffusion and the drift currents are large. (d) Both the diffusion and the drift currents are small.	4 (1 Mark each)

30	The phenomenon of emission of electrons from a metal surface, when electromagnetic radiation of suitable frequency is incident on it. Is known as Photo electric effect. The photo generated electrons are called photoelectrons. The current constituted by photoelectrons is depends on (i) the intensity of incident light, (ii) P.D. applied between the two electrodes, and (iii) the nature of emitter material. When a radiation of frequency v is incident on a metal surface, it is absorbed in the form of discrete photons each of energy hv. Photoelectric emission occurs because of single collision of a photon with a free electron. The energy of the photon is used to $E = \phi_0 + (K.E.)_{max} \Rightarrow (K.E.)_{max} = E - \phi_0 = eV_0$ This is Einstein's photoelectric equation. This equation correctly explains all the experimentally observed features of photo electric effect. On the other hand, De-Broglie hypothesis explain dual nature of matter. According to De-Broglie hypothesis, material particles in motion display wave like properties. This hypothesis was based on (i) De-Broglie concept of nature loves symmetry, and (ii) matter can be converted into energy and vice versa. So, moving particles like protons, neutrons, electrons etc. are associated with De-Broglie waves and their wavelength is given by $\lambda = h / p = h / mv \rightarrow \lambda = h / \sqrt{2mqV}$	
	(I) If the radiations of wavelength 5000 A° are incident on a surface having work function 1.2 eV then find the value of stopping potential.	**2**
	(II) A proton, an electron and an alpha particle have same velocity. Then arrange these particles in the ascending order of their De-Broglie wavelength. (where De-Broglie wavelengths of proton, electron and alpha particles are is λ_p , λ_e ,λ_α respectively.	**1**
	(III) Show graphically, the variation of the De- Broglie wavelength (λ) with the potential (V) through which an electron is accelerated from rest.	**1**
	Section E	
31 (I)	(i)An electric dipole is held in a uniform electric field. Using suitable diagram show that it does not undergo any motion. Derive the expression for the torque acting on it. (ii) What would happen if the field is non-uniform? (iii) What would happen if the external electric field is increasing (a) parallel to Electric dipole moment and (b) anti-parallel to Electric dipole moment? **OR**	**3+1 +1**

31 (II)	Four charges are arranged at the corners of a square ABCD of side d, as shown in Fig. (i)Find the work required to put together this arrangement. (ii) A charge q_0 is brought to the center E of the square, the four charges being held fixed at the corners. How much extra work is needed to do this? (iii) Compute the work done by the charges in rearranging this arrangement to another similar square arrangement of the charges such that the side of the square now becomes 2d.  	**2+1 +2**
32 (I)	(i)Draw a labelled ray diagram to show the image formation by an astronomical telescope in normal adjustment. (ii) Define magnifying power of an astronomical telescope in normal adjustment (i,e, when the final image is formed at infinity). (iii) A small telescope has an objective lens of focal length 144cm and an eyepiece of focal length 6cm.What is the magnifying power of the telescope? What is the separation between objective and eyepiece? **OR**	**1+2 +2**
32 (II)	A spherical surface of radius of curvature R, separates a rarer and a denser medium as shown in the figure.  Complete the path of the incident ray of light, showing the formation of a real image. Hence derive the relation connecting object distance 'u', image distance 'v' radius of curvature R and the refractive indices n_1 and n_2 of two media. Briefly explain, how the focal length of a convex lens changes, with increase in wavelength of incident light.	**1+3 +1**
33 (I)	(a)With the help of a diagram, show how a moving coil galvanometer can be converted into voltmeter of a given range. (b)A galvanometer can be converted into a voltmeter to measure up to (i)V volt by connecting a resistance of 2 KΩ in series with the galvanometer. (ii)2V volt by connecting a resistance of 5 KΩ in series with the galvanometer Calculate the resistance to be connected in series with the galvanometer to convert it into a voltmeter to measure up to V/2 volt. **OR**	**2+3**

33 (II)	A device 'X' is connected to an ac source $V = V_0 \sin \omega t$. The variation of voltage, current and power in one cycle is shown in the following graph:  **(a)** Identify the device 'X'. **(b)** Which of the curves A, B and C represent the voltage, current and the power consumed in the circuit? **(c)** How does its impedance vary with frequency of the ac source? Show graphically. (d) Obtain an expression for the current in the circuit and its phase relation with ac voltage.	1+1 +1 +2
	End of Paper	