KENDRIYA VIDYALAYA SANGATHAN – AHMEDABAD REGION

केन्द्रीय विद्यालय संगठन - अहमदाबाद संभाग

प्री बोर्ड परीक्षा 2022-23

PRE BOARD EXAM 2022-23

SUBJECT: PHYSICS SET-A Maximum Marks: 70Marks
Class: XII Time Allowed: 3 hours.

General Instructions:
(1) There are 35 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. All the sections are compulsory.
(3) Section A contains eighteen MCQ of 1 mark each, Section B contains seven questions of two marks each, Section C contains five questions of three marks each, section D contains three long questions of five marks each and Section E contains two case study based questions of 4 marks each.
(4) There is no overall choice. However, an internal choice has been provided in section B, C, D and E. You have to attempt only one of the choices in such questions.

SECTION A

Q NO	
1	At the Centre of a cubical box, + Q charge is placed. The value of total Electric flux that is coming out of any two opposite faces is
	(a) Q / ϵ_0 (b) Q / 3 ϵ_0 (c) Q / 4 ϵ_0 (d) Q / 6 ϵ_0
2	The surface charged density on the copper sphere is σ. The electric field strength on the surface of the sphere is
	(a) σ (b) σ/2 (c) σ/2 ϵ_0 (d) σ/ ϵ_0
3	The electric potential V is given as a function of distance x (metre) by $V = (5x^2 + 10x - 9)$. Value of electric field a x = 1 m is
	(a) 20 V/m (b) 6 V/m (c) 11 V/m (d) -23 V/m

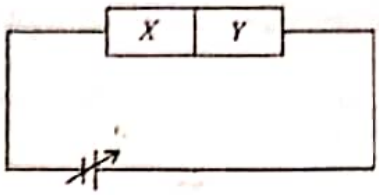
4	A strip of copper and another of germanium are cooled from room temperature to 80 K. The resistance of
	(a) Each of these increases (b) Each of these decreases (c) Copper strip increases and that of germanium decreases. (d) Copper strip decreases and that of germanium increases.
5	A particle of mass m, charge Q and kinetic energy T enters a transverse uniform magnetic field of induction. After 3 seconds the kinetic energy of the particle will be:
	(a) T (b) 4T (c) 3T (d) 2T
6	A charged particle is released from rest in a region of steady uniform electric and magnetic fields which are parallel to each other then the particle will move in a
	(a) Circle (b) Helical (c) Straight line (d) Ellipse
7	In which type of material the magnetic susceptibility does not depend on temperature?
	(a) Diamagnetic (b) Paramagnetic (c) Ferromagnetic (d) Ferrite
8	When current in a coil changes from 5 A to 2 A in 0.1 s, average voltage of 50 V is produced. The self-inductance of the coil is
	(a) 1.67 H (b) 6 H (c) 3 H (d) 0.67 H
9	A magnet is moved towards a coil (i) quickly & (ii) slowly, then the induced e.m.f. is
	(a) larger in case (ii) (b) larger in case (i) (c) equal in both the cases (d) larger or smaller depending upon the radius of the coil
10	An inductor of reactance 2 Ω is connected to the terminals of a 6 V (rms) a.c. source. The power dissipated in the circuit is
	(a) 3 W (b) 12 W (c) 14.4 W (d) zero

11	A Charge particle oscillates with frequency of 10^9 Hz. The frequency of EM wave generated is
	(a) 10^9 Hz (b) 2×10^9 Hz (c) 3×10^9 Hz (d) 10^{18} Hz
12	A double convex air bubble in water behaves as
	(a) Convergent lens (b) divergent lens (c) plane slab (d) concave mirror
13	The photoelectric effect can be understood on the basis of
	(a) wave theory of light only (b) electromagnetic theory of light only (c) quantum(photon) theory of light only (d) none of these
14	The significant result deduced from the Rutherford's scattering experiment is that
	(a) Whole of the positive charge is concentrated at the centre of atom (b) there are neutrons inside the nucleus. (c) electrons are embedded in the atom. (d) electrons are revolving around the nucleus.
15	Two nuclei have mass numbers in the ratio 1:8. What is the ratio of their nuclear radii?
	(a) 1:8 (b) 1:4 (c) 1:2 (d) 1:1
16	Two statements are given-one labelled Assertion (A) and the other labelled Reason (R). Select the correct answer to these questions from the codes (a), (b), (c) and (d) as given below. (a) Both A and R are true and R is the correct explanation of A (b) Both A and R are true and R is NOT the correct explanation of A (c) A is true but R is false (d) A is false and R is also false **Assertion:** No interference pattern is detected when two coherent sources are infinitely close to each other. **Reason:** The fringe width is inversely proportional to the distance between the two sources.
17	Two statements are given-one labelled Assertion (A) and the other labelled Reason (R). Select the correct answer to these questions from the codes (a), (b), (c) and (d) as given below. (a) Both A and R are true and R is the correct explanation of A (b) Both A and R are true and R is NOT the correct explanation of A (c) A is true but R is false (d) A is false and R is also false **Assertion:** The de Broglie wavelength of a particle varies inversely as the square root of its kinetic energy. **Reason:** de Broglie wavelength of a particle is inversely proportional to momentum.

18	Two statements are given-one labelled Assertion (A) and the other labelled Reason (R). Select the correct answer to these questions from the codes (a), (b), (c) and (d) as given below. (a) Both A and R are true and R is the correct explanation of A (b) Both A and R are true and R is NOT the correct explanation of A (c) A is true but R is false (d) A is false and R is also false **Assertion:** The electrical conductivity of a semiconductor increases on doping. **Reason:** Doping always increases the number of electrons in the semiconductor.

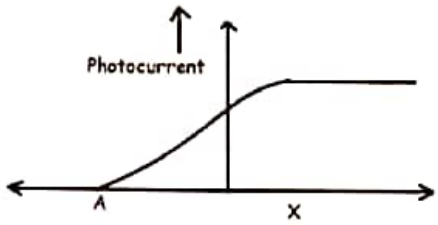
SECTION – B

19	Given a uniform electric field $\mathbf{E} = 5 \times 10^3\ \mathbf{i}$ N/C, find the electric flux of this field through a square of 10 cm on a side whose plane is parallel to the Y-Z plane. What would be the flux through the same square if the plane makes a 30° angle with the X-axis?
20	A bar magnet of magnetic moment 6 J/T is aligned at 60° with a uniform external magnetic field of 0.44 T. Calculate the work done in turning the magnet to align its magnetic moment (i) normal to the magnetic field, (ii) opposite to the magnetic field.
21	Electric part of an EM wave in vacuum is $\mathbf{E} = [3.1 \cos \{1.8(\text{rad/m})\, x + (5.4 \times 10^6 \text{rad/s})t\}]\ \mathbf{j}$ N/C. (a) What is wavelength of wave? (b) what is the amplitude of magnetic field vector?
22	In a single slit diffraction experiment, the first minima for red light (660nm) coincide with first maxima of some other wavelength λ'. Find the value of λ'.
23	Draw a labeled ray diagram of a reflecting telescope. Mention its two advantages over the refracting telescope.
24	Draw a plot of potential energy of a pair of nucleons as a function of their separation. Write two important conclusions which you can draw regarding the nature of nuclear forces. **OR** The electron in a given Bohr orbit of Hydrogen atom has a total energy of –1.51 eV. Calculate its (i) kinetic energy, (ii) potential energy and (iii) Wavelength of radiation emitted, when this electron makes a transition to the ground state of the atom.

25	Two semiconductor materials X and Y shown in the figure are made by doping a Ge-crystal with indium and arsenic respectively. The two are joined end to end and connected to a battery as shown:  (i) Will the junction be forward biased or reverse biased. (ii) Sketch a I-V graph for this arrangement. **OR** A semiconductor has equal electron and hole concentrations of $2 \times 10^{8}/m^{3}$. On doping with a certain impurity, the hole concentration increases to $4 \times 10^{10}/m^{3}$. (i) What type of semiconductor is obtained from doping? (ii) Calculate the new electron concentration of the semiconductor.

SECTON C

26	Using Biot- Savart law, derive an expression for the magnetic field in the vector form at a point on the axis of a circular current loop.
27	Describe, the working principle of a step up transformer with the help of a suitable diagram. Obtain the relation between input and output voltages in terms of the number of turns of primary and secondary windings and the currents in the input and output circuits. A step up transformer converts a low voltage into high voltage. Does it not violate the principle of conservation of energy? Explain.
28	Define mutual inductance between two long coaxial solenoids. Find out the expression for the mutual inductance of inner solenoid of length l having the radius r_1 and the number of turns per unit length 'n_1' due to the second outer solenoid of same length, radius r_2 and number of turns per unit length 'n_2'. **OR** State the working principle of an a.c. generator with the help of a labelled diagram. The coils of a.c. generator have N turns, each of area A, is rotated with a constant angular velocity 'ω'. Deduce the expression for the alternating emf generated in the coil.

29	State two important properties of photons which are used to write Einstein's photoelectric equation. The following graph shows the variation of photocurrent for a photosensitive metal:  (a) Identify the variable X on the horizontal axis. (b) What does the point A on the horizontal axis represent ? (c) Draw this graph for three different values of frequencies of incident radiations υ_1, υ_2 and υ_3 ($\upsilon_1 > \upsilon_2 > \upsilon_3$) for same intensity. **OR** Find the ratio of the de Broglie wavelengths associated with an alpha particle and a proton, if both (i) have the same kinetic energy. (ii) are accelerated through same potential.
30	Draw a schematic arrangement of Geiger – Marsden experiment. How did the scattering of α- particle by a thin foil of gold provide an important way to determine an upper limit on the size of the nucleus ? Briefly explain.

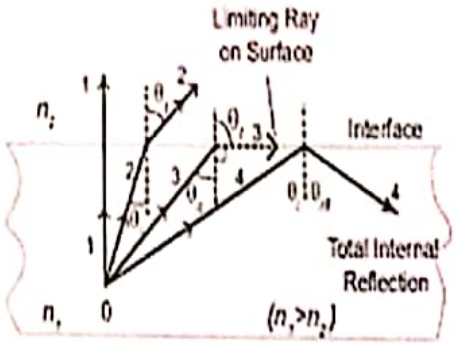
SECTION D

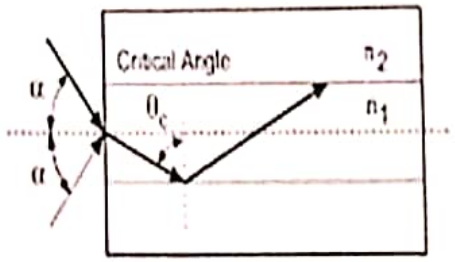
31	(a) Using Gauss's law obtain the expression for the electric field due to a uniformly charged thin spherical shell of radius R at a point outside the shell. Draw a graph showing the variation of electric field with r, for r > R and r < R (b) Draw equipotential surface due to an isolated point charge (- q) and depict the electric field lines. **OR** (a) Define the capacitance of a capacitor. Obtain the expression for the capacitance of a parallel plate capacitor in vacuum in in term of plate area and separation d between the plates. (b) A slab of material of dielectric constant K has the same area as the plates of a parallel-plate capacitor but has a thickness (3/4)d, where d is the separation of the plates. How is the capacitance changed when the slab is inserted between the plates?

32	(a)Two cells of emf E_1 and E_2 have their internal resistance r_1 and r_2 respectively. Deduce an expression for the equivalent emf and internal resistance of their parallel combination when connected across an external resistance R. Assume that the two cells are supporting each other. (b) In Case the cells are identical, each of emf = 5V and internal resistance r = 2 Ω, calculate the voltage across the external resistance R = 10 Ω. **OR** (a) Using the concept of free electrons in the conductor , derive the expression for the conductivity of a wire in terms of the number density and relaxation time. Hence obtain the relation between current density and the applied electric field E. (b) A storage battery of emf 8.0 V and internal resistance 0.5 Ω is being charged by a 120 V dc supply using a series resistor of 15.5 Ω. What is the terminal voltage of the battery during charging?
33	Trace the rays of light showing the formation of an image due to a point object placed on the axis of a spherical surface separating the two media of refractive indices n_1 and n_2. Establish the relation between the distances of the object, the image and the radius of curvature from the central point of the spherical surface. Hence derive the expression of the lens maker's formula. OR (a) State the importance of coherent sources in the phenomenon of interference. (b) In Young's double slit experiment, the two slits 0.15 mm apart are illuminated by monochromatic light of wavelength 450 nm. The screen is 1.0 m away from the slits. (i) Find the distance of the second bright fringe and second dark fringe from the central maximum. (ii) How will the fringe pattern change if the screen is moved away from the slits? Explain.

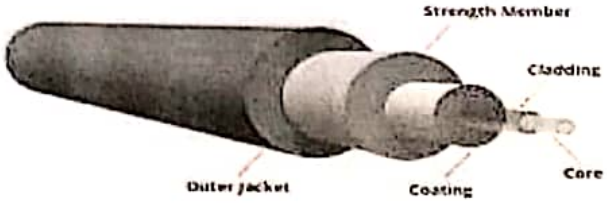
SECTION E

34 **Optical fibre:**





$$NA = \sin\alpha = \sqrt{n_1^2 - n_2^2}$$



An optical fibre is a structure comprising of thin rod of high-quality glass of refractive index n_1 surrounded by a medium of refractive index n_2. Very little light is absorbed by the glass. Light getting in at one end undergoes repeated total internal reflection, even when the fibre is bent, and emerges at the other end. All rays with angle of incidence θ_i less than critical angle θ_c is confined inside optical fibre. Numerical aperture (NA) of structure is defined as sin α.

(i) Which has greater refractive index - core or cladding of optical fibre?

(ii) Write any two uses of optical fibres?

(iii) What are the necessary conditions for total Internal Reflection to take place?

OR

For a ray of light travelling from a denser medium of refractive index n_1 to rarer medium of refractive index n_2, prove that $\frac{n_2}{n_1} = \sin i_c$, where i_c is the critical angle of incidence for the media.

35	**Case study: p-n junction diode:** Read the following paragraph and answer the questions A p–n junction is a boundary or interface between two types of semiconductor materials, p-type and n-type, inside a single crystal of semiconductor. The "p" (positive) side contains an excess of holes, while the "n" (negative) side contains an excess of electrons in the outer shells of the electrically neutral atoms there. This allows electrical current to pass through the junction only in one direction. The p-n junction is created by doping, for example by ion implantation, diffusion of dopants, or by epitaxy (growing a layer of crystal doped with one type of dopant on top of a layer of crystal doped with another type of dopant). If two separate pieces of material were used, this would introduce a grain boundary between the semiconductors that would severely inhibit its utility by scattering the electrons and holes. (i) Name the two important processes that occur during the formation of a p-n junction. (ii) Can we take one slab of p-type semiconductor and physically join it to another n-type semiconductor to get p-n junction? Give reason. (iii) Explain how the width of depletion region in a p-n junction diode change, when the junction is- (a) forward biased (b) reverse biased. **OR** What is net charge on n- type semiconductor? Explain.