Roll No.

SET-1

KENDRIYA VIDYALAYA SANGTHAN BHOPAL REGION
PRE-BOARD EXAMINATION (2025-26)
CLASS-XII
SUBJECT: PHYSICS (Theory)

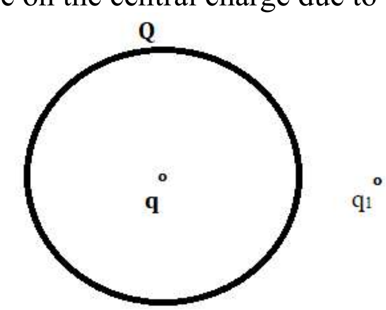
Time allowed: 3 Hours ` Maximum Marks: 70

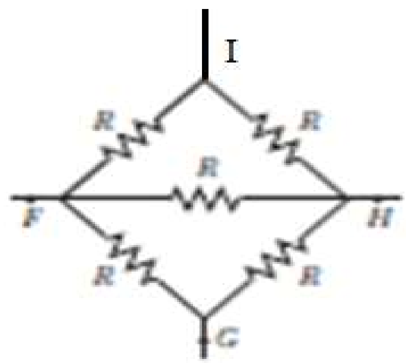
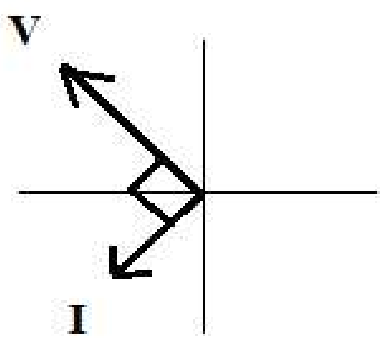
General Instructions:

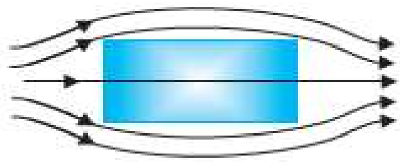
(i) There are 33 questions in all. All questions are compulsory.
(ii) This question paper has five sections: Section A, Section B, Section C, Section D and Section E.
(iii) All the sections are compulsory.
(iv) Section A contains sixteen questions, twelve MCQ and four assertion reasoning based of one 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.
(v) There is no overall choice. However, an internal choice has been provide in two questions in Section B, one question in Section C and all the three questions in Section E. You have to attempt only one of the choices in such questions.
(vi) Use of calculators is not allowed.
(vii) You may use the following values of physical constants wherever necessary:

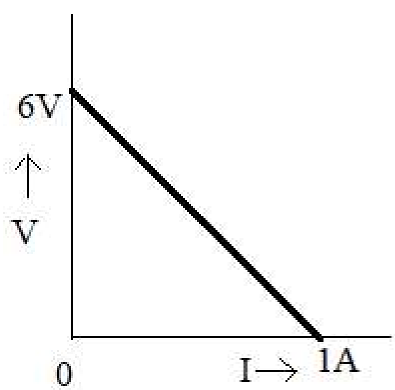
$c = 3 \times 10^8$ m/s | Mass of electron (m_e) = 9.1×10^{-31} kg
$h = 6.63 \times 10^{-34}$ Js | Mass of neutron = 1.675×10^{-27}kg
$e = 1.6 \times 10^{-19}$ C | Mass of proton = 1.673×10^{-27} kg
$\mu_0 = 4\pi \times 10^{-7}$ Tm/A | Avogadro's number = 6.023×10^{23} per gram mole
$\epsilon_0 = 8.854 \times 10^{-12}\ C^2N^{-1}m^{-2}$ | Boltzmann constant = 1.38×10^{-23} J/K
$1/4\pi\epsilon_0 = 9 \times 10^9\ Nm^2/C^2$

SECTION A

Q. No.	Question	Marks
1.	A thin metallic spherical shell contains a charge Q on it. A point charge q is placed at the center of the shell and another charge q_1 is placed outside it as shown in figure. All the three charges are positive. The force on the central charge due to the shell is  (a) towards left (b) towards right (c) upward (d) zero	1

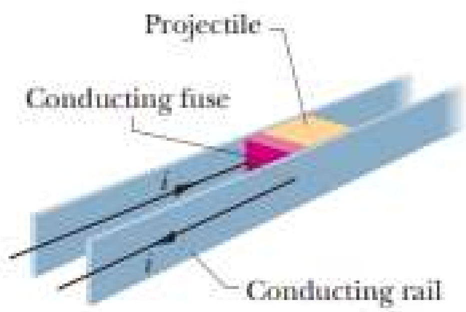
2.	When the separation between two charges is increased, the electric potential energy of the charges (a) increases (b) decreases (c) remains the same (d) may increase or decrease	1
3.	Figure shows five 5 Ω resistors. The equivalent resistances between points (i) *F* and *H* and (ii) G and I are respectively  (a) 2.5 Ω, 5 Ω (b) 2.5 Ω, 2.5 Ω (c) 5 Ω, 5 Ω (d) 5 Ω, 2.5 Ω	1
4.	If the phasor diagram for a device connected to ac supply is as shown in the fig., then which of the following statements is true?  (a) When the frequency of the ac source is increased than the impedance of the device decreases. (b) This device behaves as conducting wire when connected across dc source. (c) When the frequency of the ac source is decreased than the impedance of the device decreases. (d) This device stores energy in the form of magnetic potential energy.	1
5.	Two coherent sources of different intensities send waves which interfere. The ratio of maximum intensity to the minimum intensity is 25. The intensities of the sources are in the ratio (a) 25 : 1 (b) 5 : 1 (c) 9 : 4 (d) 625 : 1	1

6.	The magnetic field lines near a substance are as shown in the figure. The substance is:  (a) Copper (b) Iron (c) Sodium (d) Aluminium	1
7.	A point object is placed at a distance of 20 cm from a convex mirror of focal length 20 cm. The image will form at (a) infinity (b) pole (c) focus (d) 10 cm behind the mirror	1
8.	A double convex lens has two surfaces of equal radii R. Refractive index of the material of the lens is 1.5. Focal length 'f' of the lens is equal to (a) R/2 (b) R (c) –R (d) 2R	1
9.	If the frequency of light in a photoelectric experiment is doubled, the stopping potential will (a) be doubled (b) be halved (c) become more than double (d) become less than double	1
10.	The ratio of the nuclear densities of two nuclei having the mass numbers 8 and 27 is (a) 8 : 27 (b) 3 : 2 (c) 2 : 3 (d) 1 : 1	1
11.	In which of the following transitions will the wavelength of the emitted photon be maximum in a hydrogen atom? (a) n = 4 to n = 3 (b) n = 3 to n = 2 (c) n = 2 to n =1 (d) n = 3 to n = 1	1
12.	Germanium crystal is doped at room temperature with a minute quantity of boron. The charge carriers in the doped semiconductor will be: (a) electrons only (b) holes only (c) holes and few electrons (d) electrons and few holes	1

	For questions 13 to 16, two statements are given --- one labelled Assertion (A) and other labelled Reason (R). Select the correct answer from the codes (a), (b), (c) and (d) as given below. (a) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A). (b) Both Assertion (A) and Reason (R) are true, but Reason (R) is **not** the correct explanation of the Assertion (A). (c) Assertion (A) is true, but Reason (R) is false. (d) Both Assertion (A) and Reason (R) are false.	
13.	**Assertion (A):** Kirchhoff's junction law follows from conservation of charge. **Reason (R):** Kirchhoff's loop law follows from conservative nature of electric field.	1
14.	**Assertion (A):** The critical angle of light passing from glass to air is minimum for violet colour. **Reason (R):** The wavelength of violet light is greater than the light of other colours.	1
15.	**Assertion (A):** The magnitudes of the nuclear forces by a proton on a proton, by a proton on a neutron and by a neutron on a neutron are same when the separation is 1 fm. **Reason (R):** Nuclear forces are independent of charge.	1
16.	**Assertion (A):** The number of photons emitted by a red bulb in a given time interval is equal to the number of photons emitted by a blue bulb of same power in the same time interval. **Reason (R):** When the intensity of a light source is increased, the total energy of the photons emitted by the source per unit time does not change.	1
	SECTION B	
17(I).	A capacitor of capacitance C is charged by a V volt supply. It is then disconnected from the supply and is connected to another uncharged identical capacitor. How much electrostatic energy is lost in the process? **OR**	2
17(II).	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?	2
18.	The plot of the variation of potential difference V across a combination of three identical cells in series, versus current I drawn from the combination of the cells, is shown. What is the emf and internal resistance of each cell? 	2
19.	Write Einstein's photoelectric equation. State clearly the three salient features observed in photoelectric effect which can be explained on the basis of the above equation.	2

20(I).	Show that the wavelength of electromagnetic radiation is equal to the de Broglie wavelength of its quantum (photon). **OR**	2
20(II).	Plot a graph showing variation of de-Broglie wavelength λ versus $1/\sqrt{V}$, where V is accelerating potential for a particle of mass m and charge q. Obtain the slope of this graph.	2
21.	Write two differences in the patterns of double slit interference experiment and single slit diffraction experiment. Light waves from two pinholes illuminated by two sodium lamps do not produce interference patterns. Explain why.	2
	SECTION C	
22.	Define drift velocity of the free electrons in a conductor. How is it related to relaxation time of the free electrons drifting in a conductor? Use this relation to deduce the expression for the electrical resistivity of the material of a conductor.	3
23.	Using Ampere's circuital law, obtain an expression for the magnetic field due to a long current carrying solenoid. How is the magnetic field inside a current carrying solenoid made strong? Explain your answer.	3
24.	Draw a schematic diagram of a step up transformer. State its working principle. Deduce the expression for the ratio of secondary to primary voltage in terms of the number of turns in the two coils.	3
25.	(a) Identify the electromagnetic radiation having frequency 10^{18} Hz. Write its one application. (b) The amplitude of the magnetic field of a plane electromagnetic wave propagating along negative X axis in vacuum is 510 n T $\hat{\mathbf{k}}$ and its angular frequency is 60 x 10^6 rad/sec. Write the expression for the electric field **E**.	1+2
26(I).	Using Bohr's postulates, prove that for an electron revolving in the n^{th} orbit, (a) the radius of the orbit is proportional to n^2, and (b) the velocity of the electron in n^{th} orbit is proportional to 1/n. **OR**	2+1
26(II).	(a) Plot a graph showing the variation of binding energy per nucleon as a function of mass number. Which property of nuclear force explains the approximate constancy of binding energy in the range 30<A<170? (b) A fast moving neutron collides with the nucleus of Plutonium ($^{239}_{94}Pu$), thereby producing Xenon ($^{134}_{54}Xe$) and Zirconium ($^{103}_{40}Zr$) along with neutrons. Write the nuclear fission reaction.	2+1
27.	Draw a circuit diagram of a full wave rectifier. Explain its working. Draw the input and output waveforms.	3
28.	(a) Draw energy band diagram of n-type semiconductor at temperature T > 0 K. Show the donor energy level with the order of difference of its energy from the bands. (b) Name the two important processes that occur during the formation of a p-n junction. Define the term depletion region.	1+2
	SECTION D	
29.	The basics of a rail gun are shown in Figure. A large current is sent out along one of two parallel conducting rails, across a conducting "fuse" (such as a narrow piece of copper) between the rails, and then back to the current source along the second rail. The projectile to be fired lies on the far side of the fuse and fits loosely between the rails.	

Immediately after the current begins, the fuse element melts and vaporizes, creating a conducting gas between the rails where the fuse had been. As the gas is forced it pushes the projectile, accelerating it by as much as 5 x 10^6 g, and then launches it with a speed of 10 km/s, all within 1 m s. Someday rail guns may be used to launch materials into space from mining operations on the Moon or an asteroid.
To find the force on a current-carrying wire due to a second current-carrying wire, first find the field due to the second wire at the site of the first wire. Then find the force on the first wire due to that field.



(i) With the help of diagram, show that antiparallel currents repel each other. 2
(ii) What is the direction of the magnetic field between the rails produced by the currents in the rails? 1
(iii) Give the direction of the force acting on the conducting gas between the rails. 1

30. The photograph in Figure 1a shows an example of light waves traveling in approximately straight lines. A narrow beam of light (the *incident* beam), angled downward from the left and traveling through air, encounters a *plane* (flat) water surface. Part of the light is **reflected** by the surface, forming a beam directed upward toward the right, traveling as if the original beam had bounced from the surface. The rest of the light travels through the surface and into the water, forming a beam directed downward to the right.
In Figure *1b*, the beams of light in the photograph are represented with an *incident ray,* a *reflected ray,* and a *refracted ray* (and wave fronts). Each ray is oriented with respect to a line, called the *normal* that is perpendicular to the surface at the point of reflection and refraction. In Figure 1b the **angle of incidence** is Θ_1, the **angle of reflection** is Θ'_1, and the **angle of refraction** is Θ_2, all measured *relative to the normal.* The plane containing the incident ray and the normal is the *plane of incidence,* which is in the plane of the page in Figure1b.

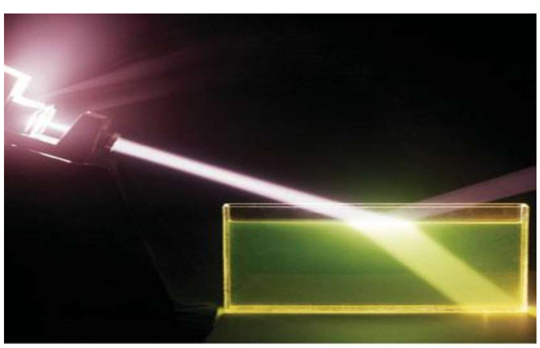


Figure 1a

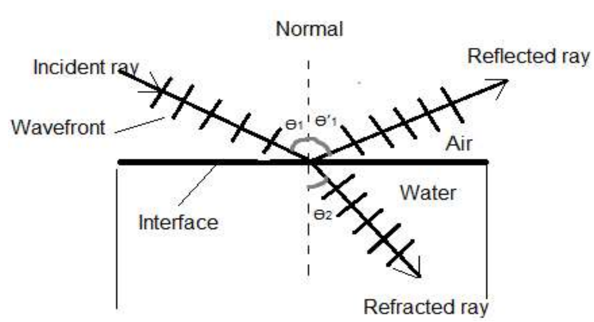
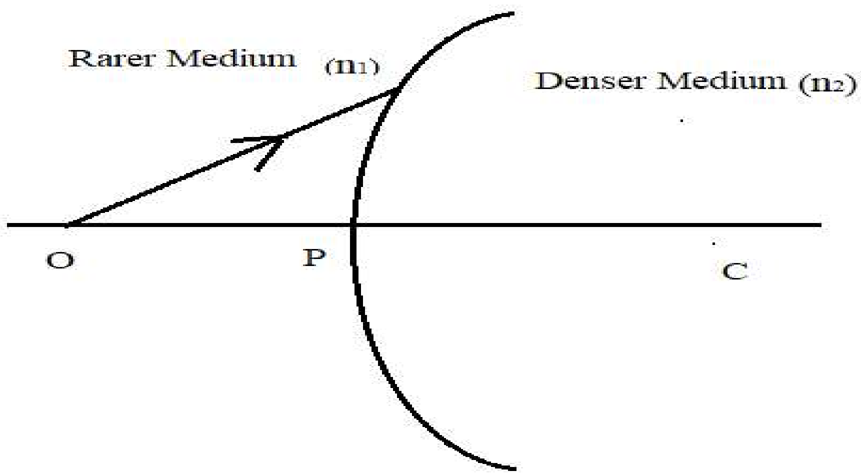


Figure 1b

	(i) If the light moving in a straight line bends by a small but fixed angle, it may be a case of (a) reflection only (b) refraction only (c) reflection or refraction (d) diffraction (ii) Refraction changes the light's direction of travel (a) at the surface always (b) within the medium (c) at the surface if incident beam of light is not perpendicular to the surface (d) both at the surface and within the medium (iii) Total internal reflection can take place only if (a) Light goes from optically rarer medium to optically denser medium (b) Light goes from optically denser medium to optically rarer medium (c) The refractive indices of the two media are close to each other (d) The refractive indices of the two media are widely different. (iv) A ray of light travelling in water is incident on its surface open to air. The angle of incidence is Θ, which is less than the critical angle. Then there will be (a) Only a reflected ray and no refracted ray. (b) Only a refracted ray and no reflected ray. (c) A reflected ray and a refracted ray and the angle between them would be less than $\pi - \Theta$. (d) A reflected ray and a refracted ray and the angle between them would be greater than $\pi - \Theta$.	1 1 1 1
	SECTION E	
31(I).	(a) Apply Gauss' law to deduce the expression for the electric field due to a uniformly charged infinite non conducting plane sheet. (b) Two large, thin metal plates are parallel and close to each other. On their inner faces, the plates have surface charge densities of opposite signs and of magnitude 17.0×10^{-22} C/m^2. What is the electric field **E** (i) in the outer region of the first plate, (ii) in the outer region of the second plate, and (iii) between the plates? **OR**	3+2
31(II).	(a) Derive the expression for the electric field of an electric dipole at a point on the equatorial plane of the dipole. (b) Draw the equipotential surfaces in the electric field of an electric dipole. Explain why, the equipotential surface through a point is normal to the electric field at that point.	3+2
32(I).	(a) Explain briefly, with the help of a labeled diagram, the basic principle of the working of an ac generator.	3+2

	(b) In an ac generator, coil of N turns and area A is rotated at constant angular velocity ω in a uniform magnetic field B. Write the expression for the emf produced. A 100 turn coil of area 0.1 m^2 rotates at half a revolution per second. It is placed in a magnetic field of 0.01 T perpendicular to the axis of rotation of the coil. Calculate the maximum voltage generated in the coil. **OR**	
32(II).	(a) An ac source generating a voltage $v = v_m \sin\omega t$ is connected across a series combination of an inductor L, a capacitor C and a resistor R. Using phasor diagram find an expression for the current flowing in the circuit. (b) A series LCR circuit with L = 5 H, C = 80 μF and R = 40 Ω, is connected to a variable frequency 230 V source. (i) Determine the source frequency which drives the circuit in resonance. (ii) Obtain the impedance of the circuit and the amplitude of current at the resonating frequency.	3+2
33(I).	(a) Draw a labeled ray diagram to show the formation of image in an astronomical telescope for a distant object in the abnormal adjustment. Write down the expression for its magnifying power. (b) A compound microscope consists of an objective lens of focal length 2 cm and an eyepiece of focal length 6.25 cm separated by a distance of 15 cm. How far from the objective should an object be placed in order to obtain the final image at the least distance of distinct vision (25 cm)? What is the magnifying power of the microscope? **OR**	2+3
33(II).	(a) A spherical surface of radius of curvature R, separates a rarer and a denser medium as shown in fig. 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 the two media.  (b) In a single slit diffraction experiment, the aperture of the slit is 3 mm and the separation between the slit and the screen is 1.5 m. A monochromatic light of wavelength 600 nm is normally incident on the slit. Calculate the distance of (i) first order minimum, and (ii) second order maximum, from the center of the screen.	3+2