CBSE Class 12 Physics: Sample Paper 1

Based on NCERT · the board's 2026-27 pattern | Time: 3 hours · **Maximum marks: 70**

1. There are 33 questions in all. All questions are compulsory.
2. Section A has 16 questions of 1 mark each: 12 multiple-choice and 4 assertion-reason. Section B has 5 questions of 2 marks, Section C 7 questions of 3 marks, Section D 2 case study-based questions of 4 marks and Section E 3 long answer questions of 5 marks.
3. There is no overall choice. Internal choice is given in two questions in Section B, one in Section C and all three in Section E; attempt only one of the alternatives.
4. Calculators are not allowed. Use the values of physical constants given in a question wherever they are needed.
5. For the assertion-reason questions, choose: (a) Both A and R are true, and R is the correct explanation of A. (b) Both A and R are true, but R is not the correct explanation of A. (c) A is true, but R is false. (d) A is false, but R is true.

Section A (16 × 1 mark)

1. A crystal of germanium is to be made p-type. Of the following, the suitable dopant is [1]

(a) antimony (Sb) (b) arsenic (As)
(c) indium (In) (d) phosphorus (P)

2. A small sphere carries a charge of +5.0 nC. Take $1/(4\pi\varepsilon_0) = 9 \times 10^9$ N m^2 C^{-2}. Taking the potential at infinity as zero, the electrostatic potential at a point 15 cm from its centre is [1]

(a) 300 V (b) 2000 V
(c) 45 V (d) 3000 V

3. A charged particle moves with velocity v through a region of uniform magnetic field B. The magnetic force on it is zero when [1]

(a) v is parallel or anti-parallel to B (b) v is perpendicular to B
(c) v makes 45° with B (d) the particle is an electron and v is perpendicular to B

4. A standard resistor in a laboratory should keep its value when the room warms up. The best material for its coil is [1]

(a) manganin (b) copper
(c) silicon (d) aluminium

5. A long solenoid with an air core has a self-inductance of 2.0 mH. It is filled completely with a material of relative permeability 400, everything else unchanged. Its self-inductance becomes [1]

(a) 0.0050 H (b) 0.80 H
(c) 0.040 H (d) 320 H

6. The radius of a nucleus is about 10^{-4} times the radius of its atom. The fraction of the atom's volume occupied by the nucleus is about [1]

(a) 10^{-12} (b) 10^{-16}
(c) 10^{-4} (d) 10^{-8}

7. The current in a 50 Ω heating element is i = 2.0 sin(100πt) A. The average power dissipated in the element is [1]

(a) 200 W
(b) 100 W
(c) 50 W
(d) 0 W

8. Ritu sits all afternoon in a sunlit room behind closed glass windows, yet her skin does not tan. This is because ordinary glass [1]

(a) absorbs infrared radiation
(b) absorbs ultraviolet radiation
(c) reflects all visible light
(d) absorbs X-rays from the sun

9. A p-n junction has a built-in barrier potential V_0 = 0.60 V. When a reverse bias of 2.0 V is applied, the barrier height and the depletion region become [1]

(a) 2.6 V; the depletion region narrows
(b) 1.4 V; the depletion region narrows
(c) 2.6 V; the depletion region widens
(d) 0.60 V; the depletion region is unchanged

10. Point charges +2 μC and +8 μC are fixed 12 cm apart in vacuum. A third charge placed on the line between them feels no net force. Its distance from the +2 μC charge is [1]

(a) 2.4 cm
(b) 8 cm
(c) 6 cm
(d) 4 cm

11. An α-particle and a proton, each of kinetic energy K, are in turn aimed head-on at the same nucleus. The ratio of the distance of closest approach of the α-particle to that of the proton is (charge of α-particle = 2e, charge of proton = e) [1]

(a) 1/2
(b) 1
(c) 4
(d) 2

12. The refractive index of a piece of glass with respect to air depends on [1]

(a) the wavelength of the light
(b) the angle of incidence
(c) the thickness of the glass
(d) the angle of refraction

13. Assertion (A): The objective of a reflecting telescope has no chromatic aberration. Reason (R): A mirror objective can be supported over its whole back surface. [1]

(a) Both A and R are true, and R is the correct explanation of A.
(b) Both A and R are true, but R is not the correct explanation of A.
(c) A is true, but R is false.
(d) A is false, but R is true.

14. Assertion (A): Work has to be done to push the north pole of a bar magnet towards a closed coil. Reason (R): The current induced in the coil makes its face towards the magnet a north pole, which repels the approaching magnet. [1]

(a) Both A and R are true, and R is the correct explanation of A.
(b) Both A and R are true, but R is not the correct explanation of A.
(c) A is true, but R is false.
(d) A is false, but R is true.

15. Assertion (A): In the energy level diagram of hydrogen, the levels come closer together as n increases. Reason (R): The total energy of the electron in a hydrogen atom is negative, showing that the electron is bound to the nucleus. [1]

(a) Both A and R are true, and R is the correct explanation of A.
(b) Both A and R are true, but R is not the correct explanation of A.
(c) A is true, but R is false.
(d) A is false, but R is true.

16. Assertion (A): Ultraviolet lamps are used to kill germs in water purifiers. Reason (R): Ordinary glass absorbs ultraviolet radiation. [1]

(a) Both A and R are true, and R is the correct explanation of A.
(b) Both A and R are true, but R is not the correct explanation of A.
(c) A is true, but R is false.
(d) A is false, but R is true.

Section B (5 × 2 marks)

17. A uniform wire of resistance 32 Ω is cut into four pieces of equal length, and the four pieces are joined in parallel. Find the resistance of the combination. [2]

Or *Wires A and B are made of the same metal. A has length l and diameter d; B has length 3l and diameter 2d. Find the ratio $R_A : R_B$ of their resistances.*

18. A thin lens of power +6 D is to be placed in contact with a second thin lens so that the combination has a focal length of +50 cm. Find the power and the focal length of the second lens, and name its type. [2]

Or *A thin lens of power +5 D is to be placed in contact with a second thin lens so that the combination diverges light with a focal length of 50 cm. Find the power and the focal length of the second lens, and name its type.*

19. Name two causes of energy loss in an actual transformer and state how each is reduced. [2]

20. A student says that the line marked E_C in a band diagram shows the place in the crystal where conduction electrons are found. Correct the statement, and say what E_C stands for. [2]

21. State whether each pair is a pair of isotopes, isobars or isotones: (i) $^{40}_{18}Ar$ and $^{40}_{20}Ca$ (ii) $^{13}_{6}C$ and $^{14}_{7}N$ (iii) $^{35}_{17}Cl$ and $^{37}_{17}Cl$ (iv) ^{2}H and ^{3}H. [2]

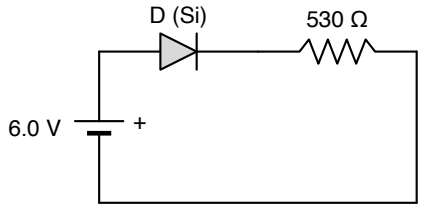
Section C (7 × 3 marks)

22. A 10 μF parallel plate capacitor is charged to 100 V and kept connected to the 100 V battery. A slab of dielectric constant 3 is slid in to fill the gap completely. Find (a) the extra charge that flows from the battery, (b) the increase in the energy stored in the capacitor, and (c) the work done by the battery in sending this charge round, and compare it with (b). [3]

23. The electric field at a point on the axis of a short dipole, 10 cm from its centre, is 3.2×10^3 N C^{-1}. Find (a) the dipole moment, (b) the magnitude and direction of the field at a point on the equatorial plane 20 cm from the centre. (Take $1/4\pi\varepsilon_0 = 9 \times 10^9$ N m^2 C^{-2}.) [3]

Or *The electric field at a point on the equatorial plane of a short dipole, 5.0 cm from its centre, is 8.0×10^3 N C^{-1}. Find (a) the dipole moment, (b) the magnitude and direction of the field at a point on its axis 10 cm from the centre. (Take $1/4\pi\varepsilon_0 = 9 \times 10^9$ N m^2 C^{-2}.)*

24. In the circuit shown, the silicon diode may be taken to drop a constant 0.7 V once it conducts. (a) Find the current in the circuit and the voltage across the 530 Ω resistor. (b) The diode is now turned round. What current flows, and across which component does almost all of the 6.0 V appear? [3]



25. Light travels at 2.25×10^8 m s^{-1} in a liquid. It meets the plane surface between the liquid and air from inside the liquid. Taking c = 3.00×10^8 m s^{-1}, find (i) the refractive index of the liquid, (ii) the critical angle for the liquid–air surface. (iii) Using the Huygens construction, explain why there is no refracted wavefront when the angle of incidence exceeds the critical angle. [3]

26. Yellow light of wavelength 589 nm falls on the emitter of a photocell. Only one photon in every 1000 ejects an electron, and the saturation photocurrent is 0.40 µA. Find (a) the number of electrons emitted per second, (b) the number of photons falling on the emitter per second, and (c) the power of the light falling on the emitter. ($h = 6.63 \times 10^{-34}$ J s, $e = 1.6 \times 10^{-19}$ C, $c = 3 \times 10^8$ m s^{-1}) [3]

27. Give two observations that support treating a bar magnet as equivalent to a current-carrying solenoid. What happens when each of them is cut in half across its length? [3]

28. A galvanometer of resistance 30 Ω gives full-scale deflection for 4.0 mA. Find (a) the shunt that converts it into an ammeter of range 0 to 1.0 A, (b) the resistance of this ammeter, (c) the series resistance that converts it into a voltmeter of range 0 to 6.0 V. [3]

Section D (2 × 4 marks)

29. Read the passage and answer the questions that follow. [4]

A student repeats the essentials of the Geiger–Marsden experiment in a simulation. A beam of α-particles, each of kinetic energy 5.0 MeV, falls on a very thin foil of silver (Z = 47). The simulation treats each α-particle as being scattered by at most one nucleus, and holds the silver nucleus fixed during the encounter, since it is many times heavier than the α-particle. It reports that nearly all the α-particles pass with little or no deflection, while a very small number are turned back, and that an α-particle aimed head-on comes momentarily to rest 27 fm from the centre of the nucleus before reversing.

(a) The very small number of α-particles turned back shows that [1]

(a) the silver atom has no electrons
(b) the positive charge and most of the mass of the atom are concentrated in a very small volume
(c) the α-particles lose all their charge in the foil
(d) the positive charge is spread uniformly over the atom

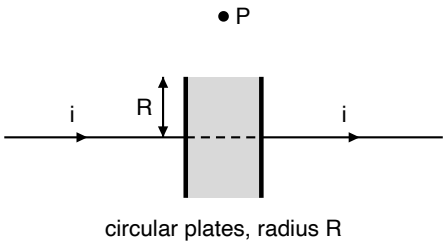
(b) If the kinetic energy of the α-particles is raised to 7.5 MeV, the distance of closest approach in a head-on encounter becomes [1]

(a) 40.5 fm
(b) 12 fm
(c) 22 fm
(d) 18 fm

(c) Why is it reasonable to treat each α-particle as scattered by at most one nucleus, and why do the electrons of the silver atoms play no appreciable part in the scattering? [2]

30. Read the passage and answer the questions that follow. [4]

In a laboratory, Kabir charges a capacitor whose circular plates, each of radius R = 5.0 cm, face each other across a small air gap, as shown. At one instant the current in the connecting wires is 0.40 A. A sensitive probe measures the magnetic field in the plane midway between the plates: inside the gap, and at the point P, 10 cm from the axis and outside the plates. Take $\mu_0 = 4\pi \times 10^{-7}$ T m A^{-1} and $\varepsilon_0 = 8.85 \times 10^{-12}$ C^2 N^{-1} m^{-2}; ignore the spreading of the field at the edges.



circular plates, radius R

(a) The magnetic field at the rim of the plates, 5.0 cm from the axis, at that instant is [1]

(a) 1.6×10^{-6} T
(b) 8.0×10^{-7} T
(c) 5.0×10^{-6} T
(d) zero, as no charge flows across the gap

(b) The magnetic field on the axis, midway between the plates, is [1]

(a) zero
(b) 1.6×10^{-6} T
(c) 3.2×10^{-6} T
(d) 8.0×10^{-7} T

(c) Find the distance from the axis, inside the gap, at which the magnetic field equals the field at P. [2]

Section E (3 × 5 marks)

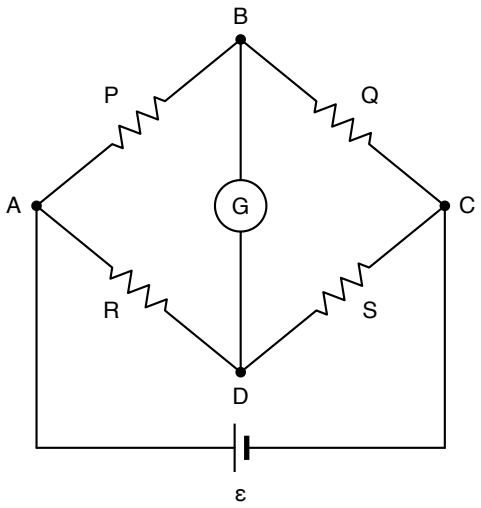
31. Two long co-axial solenoids have the same length l. The inner one has radius r_1 and n_1 turns per unit length; the outer has n_2 turns per unit length. (a) Derive the mutual inductance M_{12} of the inner solenoid with respect to the outer. (b) State M_{21} and the relation between the two. (c) Take l = 0.60 m, r_1 = 1.5 cm, n_1 = 2000 m^{-1}, n_2 = 1000 m^{-1} and $\mu_0 = 4\pi \times 10^{-7}$ T m A^{-1}. Find M, and the emf induced in the inner solenoid when the current in the outer one rises steadily from 0 to 3.0 A in 0.15 s. (d) How would M change if the space inside were filled with a material of relative permeability μ_r? [5]

Or *Two long co-axial solenoids have the same length l. The inner one has radius r_1 and n_1 turns per unit length; the outer has n_2 turns per unit length. (a) Derive the mutual inductance M_{12} of the inner solenoid with respect to the outer. (b) Explain why M_{21}, found by passing a current through the inner solenoid, comes out the same. (c) Take l = 0.80 m, r_1 = 2.0 cm, n_1 = 1200 m^{-1}, n_2 = 600 m^{-1}, $\mu_0 = 4\pi \times 10^{-7}$ T m A^{-1}. Find M, and the average emf induced in the outer solenoid when a current of 4.0 A in the inner one is switched off in 0.020 s. (d) Find M if the inside is filled with a material of relative permeability 200.*

32. (a) Draw a ray diagram for the refraction of a ray through a triangular prism of angle A. Show that the deviation is δ = i + e − A, and use the condition of minimum deviation to obtain n = sin[(A + Dm)/2]/sin(A/2). (b) Sketch how δ varies with the angle of incidence i, and explain why a deviation greater than Dm occurs for two angles of incidence. (c) A ray falls at 60° on one face of a prism of angle 60° and refractive index √3. Show that it passes through the prism at minimum deviation, and find Dm. [5]

Or *(a) A ray passes through a triangular prism of angle A, entering at angle i and leaving at angle e. With a ray diagram, show that r1 + r2 = A and that the deviation is δ = i + e − A. (b) Using the symmetry of i and e in this relation, explain why the deviation is least when i = e, and obtain n = sin[(A + Dm)/2]/sin(A/2). (c) For a prism of angle 60° and refractive index √2, find the angle of incidence for minimum deviation and the angle of minimum deviation.*

33. (a) For the Wheatstone bridge shown, use Kirchhoff's rules to derive the condition for no current through the galvanometer. (b) With P = 12 Ω and Q = 18 Ω, balance is obtained when R = 8.0 Ω. Find S. (c) Show that the bridge stays balanced if the cell and the galvanometer are interchanged. [5]



Or *(a) State the balance condition for the Wheatstone bridge shown and explain why it is a null method. (b) A 9.0 V cell of negligible internal resistance is connected across A and C, with P = 6.0 Ω, Q = 3.0 Ω, R = 8.0 Ω, S = 4.0 Ω and a 5.0 Ω galvanometer. Find the current drawn from the cell. (c) If S is changed to 6.0 Ω, find which of B and D is at the higher potential, and hence the direction of the galvanometer current.*

