# CBSE Class 12 Physics: Sample Paper 2

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 beam of light passes from glass into air. The quantity that does not change is its [1]

(a) frequency
(b) wavelength
(c) speed
(d) direction of travel, for oblique incidence

**2.** With $\varepsilon_0$ the permittivity and $\mu_0$ the permeability of free space, and c the speed of light in vacuum, [1] the product $\varepsilon_0\mu_0$ equals

(a) 1/c
(b) $c^2$
(c) $1/c^2$
(d) c

**3.** To plot the reverse-bias characteristic of a silicon diode, the current should be measured with [1]

(a) a milliammeter, since the reverse current is large
(b) a microammeter, since the reverse current is of the order of microamperes
(c) an ammeter reading in amperes, since breakdown may occur
(d) a voltmeter in series with the diode

**4.** A solid has an electrical conductivity of $2.0 \times 10^{-3}$ S $m^{-1}$ at room temperature. On the indicative ranges of resistivity, the solid is [1]

(a) a metal, since its resistivity is $2.0 \times 10^{-3}$ Ω m
(b) a semiconductor, since its resistivity is 500 Ω m
(c) an insulator, since its resistivity is 500 Ω m
(d) a metal, since its resistivity is 500 Ω m

**5.** The binding energy of the $^4_2$He nucleus is 28.3 MeV. Its mass defect is (take 1 u = 931.5 MeV/$c^2$) [1]

(a) 0.304 u
(b) 0.0304 u
(c) 0.0152 u
(d) 0.0076 u

**6.** The SI unit of magnetisation M is [1]

(a) T m $A^{-1}$
(b) A $m^2$
(c) T
(d) A $m^{-1}$

**7.** Equal point charges +Q are fixed at two vertices of an equilateral triangle of side a in vacuum. The magnitude of the electric field at the third vertex is ($k = 1/4\pi\varepsilon_0$) [1]

(a) $2kQ/a^2$ (b) $\sqrt{3}\ kQ/a^2$
(c) $kQ/a^2$ (d) zero

**8.** The SI unit of resistivity is [1]

(a) $S\ m^{-1}$ (b) $\Omega\ m^{-1}$
(c) $\Omega\ m^{-2}$ (d) $\Omega\ m$

**9.** In a spark plug, electrons are pulled out of a metal electrode by an electric field of the order of $10^8\ V\ m^{-1}$. This process is called [1]

(a) thermionic emission (b) photoelectric emission
(c) secondary emission (d) field emission

**10.** An ac voltage is applied across an ideal inductor. The current in the inductor [1]

(a) lags the voltage by $\pi/2$ (b) leads the voltage by $\pi/2$
(c) is in phase with the voltage (d) lags the voltage by $\pi$

**11.** Infrared waves are often called heat waves because they [1]

(a) ionise the molecules they strike (b) travel faster than visible light in vacuum
(c) are produced only by the sun (d) set entire atoms and molecules vibrating, raising the internal energy of matter

**12.** An object on the axis of a concave mirror of focal length 10 cm is moved from 30 cm to 20 cm in front of the mirror. During this move the image shifts through [1]

(a) 5 cm, towards the mirror (b) 10 cm, away from the mirror
(c) 10 cm, towards the mirror (d) 5 cm, away from the mirror

**13.** Assertion (A): The binding energy per nucleon is nearly constant for nuclei with $30 < A < 170$. Reason (R): The nuclear force between two nucleons does not depend on their electric charge. [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): While a storage cell is being charged, the voltmeter across its terminals reads more than its emf. Reason (R): During charging, the current flows through the cell from its positive terminal to its negative terminal, so $V = \varepsilon + Ir$. [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): A convex lens of glass of refractive index 1.5 behaves as a diverging lens when immersed in a liquid of refractive index 1.7. Reason (R): For a lens of index $n_2$ in a medium of index $n_1$, $1/f = (n_2/n_1 - 1)(1/R_1 - 1/R_2)$, and the factor $(n_2/n_1 - 1)$ is negative when $n_2 < n_1$. [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): The average power supplied by an ac source to an ideal inductor over a complete cycle is zero. Reason (R): In an ideal inductor the current lags the voltage by π/2, so the instantaneous power $p = -(i_m v_m/2) \sin 2\omega t$ is positive for half the time and negative for the other half. [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.** On the wave picture of light, how long would one expect an electron to take to escape from a metal under very dim light? How does this compare with what is observed? [2]

**Or** *On the wave picture of light, how should the maximum kinetic energy of photoelectrons change when the intensity of light is increased? How does this compare with what is observed?*

**18.** Two coherent sources each produce an intensity $I_0$ at a point on a screen. Find the resultant intensity at points where the phase difference between the two waves is (i) π/2, (ii) 5π/3. [2]

**Or** *In a double-slit experiment, light of wavelength 600 nm falls on slits 0.30 mm apart and the screen is 1.5 m away. Each slit alone gives an intensity $I_0$ on the screen. Find the resultant intensity at points (i) 0.50 mm, (ii) 4.5 mm from the central bright fringe.*

**19.** A proton and an alpha particle (charge 2e, mass four times the proton's) enter the same uniform magnetic field with the same speed, perpendicular to the field. Find the ratio of the radius of the alpha particle's path to that of the proton's. [2]

**20.** A plastic comb run through dry hair attracts small bits of neutral paper. Explain why. [2]

**21.** In a half-wave rectifier, why must the diode's reverse breakdown voltage be sufficiently higher than the peak of the ac voltage from the transformer? [2]

## Section C (7 × 3 marks)

**22.** An iron nail is made of many magnetic domains, yet on its own it attracts nothing. (a) Explain why it shows no net magnetisation. (b) Explain how it becomes strongly magnetised when a magnet is brought near. (c) Why does it stay magnetised for only a short time after the magnet is removed, while a lodestone stays magnetised? [3]

**Or** *Describe the state of the domains in a ferromagnetic sample (a) with no external field, (b) in a strong external field $B_0$, and (c) after the field is removed, for a hard and for a soft ferromagnet.*

**23.** A coil of metal X (temperature coefficient of resistivity $5.0 \times 10^{-3}\ °C^{-1}$, referred to 20 °C) and a manganin coil Y each have a resistance of 10.0 Ω at 20 °C. Treat the resistance of Y as constant and ignore changes in dimensions. (a) At what temperature is the resistance of X 1.5 times that of Y? (b) What is the resistance of X and Y in parallel at that temperature? [3]

**24.** An aluminium ring rests on the top of a vertical coil wound on a soft-iron core. When the switch in the coil's circuit is closed, the ring jumps up. (a) Explain why. (b) Why does it fall back while the switch is kept closed? (c) What would happen if the ring had a narrow cut in it? [3]

**25.** Two germanium samples, X and Y, are doped with indium and kept at the same temperature: X at 1 atom in $10^7$ and Y at 1 atom in $10^6$. Taking every acceptor as ionised and $n_h \approx N_a$, (a) by what factor is the ratio $n_h/n_e$ in Y larger than in X? (b) Find the ratio of the electron concentration in Y to that in X. (c) Explain why heavier doping lowers the minority concentration. [3]

**26.** A parallel plate capacitor has plates of area A a distance d apart ($d^2$ much smaller than A), carrying charges +Q and −Q. Using the field of a large plane sheet of charge, find the field inside and outside the plates and show that $C = \varepsilon_0 A/d$. [3]

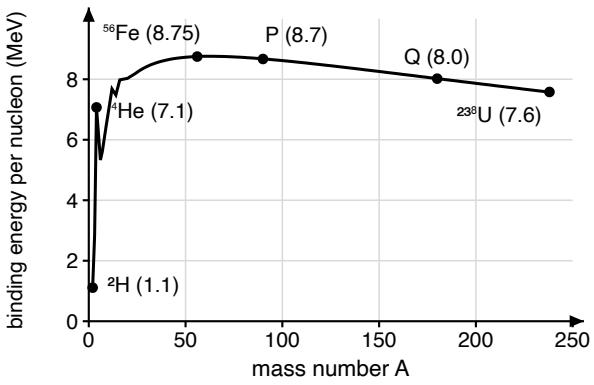
**27.** A capacitor with circular plates of radius R is being charged by a current i, the electric field between the plates being uniform. Using the Ampere–Maxwell law, obtain the magnetic field at a distance r ($r \le R$) from the axis, between the plates. How does it vary from the axis to the rim? [3]

**28.** An α-particle (charge 2e) of kinetic energy K is aimed head-on at a nucleus of charge Ze. (a) Show that its distance of closest approach is $d = 2Ze^2/(4\pi\varepsilon_0 K)$, stating the assumption made about the nucleus. (b) The radius of a gold nucleus (Z = 79) is about 6 fm. Neglecting the size of the α-particle, find the least kinetic energy, in MeV, with which an α-particle must approach head-on to just reach the surface of the gold nucleus. ($1/4\pi\varepsilon_0 = 9 \times 10^9$ N m$^2$ C$^{-2}$, $e = 1.6 \times 10^{-19}$ C, 1 MeV = $1.6 \times 10^{-13}$ J) [3]

## Section D (2 × 4 marks)

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

Ananya, a student in Kochi, plots the binding energy per nucleon $E_{bn}$ of stable nuclei against mass number A from a table of data. Her graph is shown, with a few points marked and their $E_{bn}$ values in MeV in brackets. P and Q are nuclei of mass numbers 90 and 180. She wants to compare the energy available from fusing very light nuclei with that from splitting heavy ones, reading the values from her graph.




(a) The curve is nearly flat between A = 30 and A = 170 because the nuclear force [1]

(a) is much stronger than the gravitational force
(b) is short-ranged, so an interior nucleon is bound only by its near neighbours
(c) does not depend on electric charge
(d) becomes repulsive below 0.8 fm

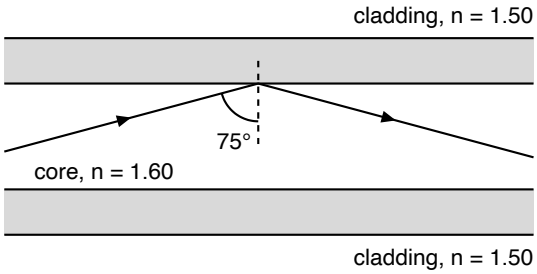
(b) Using the marked values, the energy released per nucleon of fuel when two $^{2}$H nuclei fuse into $^{4}$He is about how many times that released per nucleon when nucleus Q splits into two nuclei like P? [1]

(a) 1.0
(b) 0.19
(c) 8.6
(d) 12

(c) Explain, using the graph, why neither the fission nor the fusion of nuclei near $^{56}$Fe can release energy. [2]

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

A doctor in a Chennai hospital examines a patient's stomach with an endoscope, a bundle of thin optical fibres. Each fibre has a glass core of refractive index 1.60 inside a cladding of refractive index 1.50 (see figure). Light sent into one end meets the core–cladding boundary again and again, and travels along the fibre even where the bundle bends. In good silica fibres more than 95% of the light comes through a kilometre of fibre, which is why such fibres also carry telephone and video signals between cities.




(a) The critical angle at the core–cladding boundary is about [1]

(a) 38.7° (b) 41.8°
(c) 69.6° (d) 20.4°

(b) If the cladding were replaced by glass of refractive index 1.60, the same as the core, light would [1]

(a) pass into the cladding, since total internal reflection at the boundary could not occur (b) still be totally reflected, since the core is glass
(c) be totally reflected only where the fibre bends (d) travel faster in the core than in the cladding

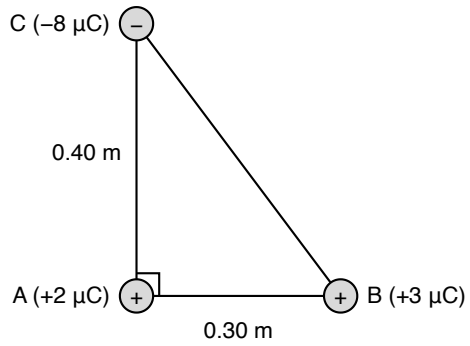
(c) In the figure a ray meets the boundary at 75°. Is it totally reflected? What happens to a ray that meets the boundary at 60°? [2]

## Section E (3 × 5 marks)

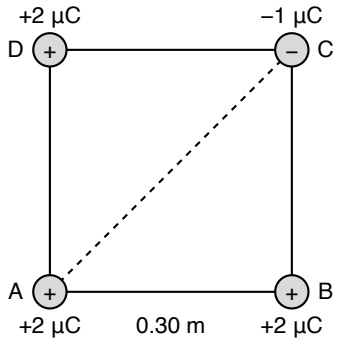
**31.** (a) What is a polaroid? Describe an experiment with two polaroids which shows that light is a transverse wave. (b) Unpolarised light of intensity 64 W $m^{-2}$ passes through three polaroids $P_1$, $P_2$, $P_3$ in turn. The pass-axis of $P_2$ is at 30° to that of $P_1$, and the pass-axis of $P_3$ is at a further 30° beyond $P_2$, that is at 60° to $P_1$. Find the intensity emerging from $P_3$. Then find the intensity when $P_2$ is removed, and comment on the result. [5]

**Or** *(a) Light polarised by a polaroid $P_1$ falls on a polaroid $P_2$ whose pass-axis makes an angle $\theta$ with that of $P_1$. Show that the intensity transmitted by $P_2$ is $I = I_0 \cos^2\theta$, where $I_0$ is the intensity between them, and state between what limits two polaroids can control the intensity of unpolarised light. (b) Unpolarised light of intensity 48 W $m^{-2}$ falls on $P_1$. (i) Find $\theta$ for which the light emerging from $P_2$ is one-eighth of the incident intensity. (ii) With $P_2$ at this angle, a third polaroid $P_3$ is placed after $P_2$ with its pass-axis parallel to that of $P_1$. Find the intensity emerging from $P_3$. (iii) Would the light from $P_2$ change if $P_3$ were placed instead between $P_1$ and $P_2$, still parallel to $P_1$? Give a reason.*

**32.** Point charges +2 μC, +3 μC and −8 μC are placed in vacuum at the vertices A, B and C of a right-angled triangle, with the right angle at A, AB = 0.30 m and AC = 0.40 m (see figure). (a) Find the force on the +2 μC charge due to each of the other two. (b) Find the magnitude and direction of the net force on it. (c) Find the electric field at A due to the charges at B and C. (Take $1/4\pi\varepsilon_0 = 9 \times 10^9$ N m$^2$ C$^{-2}$.) [5]




**Or** *Charges +2 μC are placed at three corners A, B and D of a square ABCD of side 0.30 m, and −1 μC at the fourth corner C (see figure). (a) Find the force on the −1 μC charge due to each of the other three. (b) Find the magnitude and direction of the net force on it. (c) Find the electric field at C due to the three +2 μC charges. (Take $1/4\pi\varepsilon_0 = 9 \times 10^9$ N m$^2$ C$^{-2}$.)*




**33.** (a) A series LCR circuit is connected to an ac source $v = v_m \sin \omega t$. Draw its phasor diagram for $X_L > X_C$, and use it to obtain the impedance of the circuit and the phase angle between the current and the source voltage. (b) A circuit with R = 50 Ω, $X_L$ = 150 Ω and $X_C$ = 30 Ω is connected to a 130 V (rms) supply. Find the rms current and the power factor. [5]

**Or** *(a) In a series LCR circuit the source voltage is $v = v_m \sin \omega t$ and the current is $i = i_m \sin(\omega t + \phi)$. Show that the average power over a cycle is $P = VI \cos \phi$, V and I being rms values. (b) A circuit with R = 50 Ω, $X_L$ = 40 Ω and $X_C$ = 160 Ω is connected to a 260 V (rms) supply. Find the average power and state whether the current leads or lags.*