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Your JEE Guide

CBSE Class XII · Physics (042)

Sample Question Paper 7 · Session 2026-27

Time allowed: 3 hours **Maximum marks: 70**

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This is an original practice paper written to the official CBSE 2026-27 design; it is not issued by CBSE.

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. Section A contains sixteen questions: twelve MCQs and four Assertion–Reasoning questions of 1 mark each. Section B contains five questions of two marks each, Section C seven questions of three marks each, Section D two case study based questions of four marks each and Section E three long answer questions of five marks each.
4. 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.
5. Use of calculators is not allowed.
6. You may use: $c = 3 \times 10^{8}$ m/s, $m_e = 9.1 \times 10^{-31}$ kg, $e = 1.6 \times 10^{-19}$ C, $\mu_0 = 4\pi \times 10^{-7}$ T m A^{-1}, $h = 6.63 \times 10^{-34}$ J s, $\varepsilon_0 = 8.854 \times 10^{-12}$ C^2 N^{-1} m^{-2}.

Section A

1.	The SI unit of electric flux is: (A) C m^{-2} (B) N m C^{-1} (C) N C^{-1} (D) N m^2 C^{-1}	1
2.	The dielectric constant of a metal is taken to be: (A) between 1 and 10 (B) infinite (C) 1 (D) zero	1
3.	When the temperature of a metallic conductor rises, the relaxation time of its free electrons: (A) decreases (B) increases (C) stays the same (D) becomes zero	1
4.	The power used in a 6 Ω resistor connected across 12 V is: (A) 12 W (B) 72 W (C) 24 W (D) 2 W	1
5.	If the current in a circular coil is doubled, the magnetic field at its centre: (A) is unchanged (B) becomes four times (C) doubles (D) halves	1

6.	Inside a bar magnet, the magnetic field lines go from: (A) the S-pole to the N-pole (B) the middle to both ends (C) the N-pole to the S-pole (D) nowhere, as there is no field inside	1
7.	The SI unit of magnetic flux is the: (A) tesla (B) henry (C) gauss (D) weber	1
8.	In a step-up transformer: (A) the secondary current is greater than the primary current (B) $N_s > N_p$ (C) $N_s < N_p$ (D) $N_s = N_p$	1
9.	An electromagnetic wave of frequency 10^{14} Hz belongs to the: (A) infrared region (B) ultraviolet region (C) X-ray region (D) radio region	1
10.	The magnifying power of a simple microscope of focal length 5 cm, with the image at the near point (25 cm), is: (A) 5 (B) 6 (C) 4 (D) 25	1
11.	A medium has a critical angle of about 41.8° with air. Its refractive index is about: (A) 1.33 (B) 1.2 (C) 2.42 (D) 1.5	1
12.	The energy needed to excite a hydrogen atom from n = 1 to n = 2 is: (A) 3.4 eV (B) 12.1 eV (C) 10.2 eV (D) 13.6 eV	1
13.	**Assertion (A):** A charged capacitor stores energy in the electric field between its plates. **Reason (R):** The energy per unit volume of an electric field is $\frac{1}{2}\varepsilon_0 E^2$. (A) Both Assertion (A) and Reason (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) Both A and R are false.	1
14.	**Assertion (A):** An ideal ammeter has zero resistance. **Reason (R):** An ammeter is connected in parallel with the device whose current it measures. (A) Both Assertion (A) and Reason (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) Both A and R are false.	1

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15.	**Assertion (A):** Diamond is an insulator. **Reason (R):** The band gap of diamond is large, about 5.4 eV. (A) Both Assertion (A) and Reason (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) Both A and R are false.	1
16.	**Assertion (A):** Light from two independent bulbs gives a steady interference pattern. **Reason (R):** Two independent light sources are coherent. (A) Both Assertion (A) and Reason (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) Both A and R are false.	1

Section B

17.	Find the electric field and the electric potential at a point 30 cm from a charge of 1 μC in air. **OR** What is electrostatic shielding? Give one practical use of it.	2
18.	Resistors of 3 Ω and 6 Ω are connected in parallel across a 12 V battery of negligible internal resistance. Find the equivalent resistance and the power used in the 6 Ω resistor.	2
19.	A circular coil of 10 turns and radius 5 cm carries a current of 1 A. Find the magnetic field at its centre.	2
20.	The magnetic flux through a loop decreases uniformly by 0.04 Wb in 0.2 s. Find the induced emf. How would it change if the loop had 50 turns? **OR** What are eddy currents? Give two useful applications.	2
21.	Find the de Broglie wavelength of an electron accelerated from rest through a potential difference of 54 V.	2

Section C

22.	Derive an expression for the torque on an electric dipole in a uniform electric field. When is the dipole in stable equilibrium?	3

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23.	A 6 V battery of internal resistance 0.5 Ω is connected to a 2.5 Ω resistor. Find the current, the terminal voltage and the power wasted inside the battery. **OR** A cell of emf E and internal resistance r is connected to an external resistance R. Show that the power delivered to R is greatest when R = r, and find this maximum power.	3
24.	A beam of charged particles passes undeflected through crossed electric and magnetic fields of 3×10^4 V/m and 0.1 T. Explain why, and find the speed of the particles.	3
25.	Explain why a bar magnet behaves like a current-carrying solenoid. Write the expression for the field on the axis of a short bar magnet of moment m at a large distance r.	3
26.	A series LCR circuit has L = 0.5 H, C = 20 μF and R = 100 Ω, connected to a 220 V, 50 Hz supply. Find X_L, X_C, the current, and the resonant frequency.	3
27.	Write the magnifying power of a simple microscope when the image is (i) at the near point, (ii) at infinity. Find both for a lens of focal length 5 cm (D = 25 cm).	3
28.	In the fission of a ^{235}U nucleus, about 200 MeV of energy is released. Find the energy released if all the nuclei in 1 g of ^{235}U undergo fission.	3

Section D

29.	**Case study.** In a thunderstorm, the safest place is inside a closed car. The charges on a conductor reside on its outer surface, and the electric field inside a closed hollow conductor is zero. Tall buildings are protected by lightning conductors that carry charge safely to the earth. (i) Where does the charge on a conductor reside? (A) throughout its volume (B) on its outer surface (C) at its centre (D) on its inner surface only *[1]* (ii) Why is a person inside a car safe during lightning? *[1]* (iii) At which parts of a charged conductor is the surface charge density highest? *[1]* (iv) Why does a lightning conductor have pointed ends? *[1]*	4

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30.	**Case study.** Photocells use the photoelectric effect. When light of suitable frequency falls on the cathode, electrons are emitted and a current flows; the current stops when the light is blocked. They are used in automatic doors, burglar alarms and light meters. (i) Which property of light decides whether electrons are emitted? (A) intensity (B) frequency (C) speed (D) polarisation *[1]* (ii) What happens to the photocurrent if the intensity of light is increased? *[1]* (iii) Why is there almost no time lag between switching on the light and the start of emission? *[1]* (iv) In an automatic door, what does the photocell detect? *[1]*	4

Section E

31.	(a) Explain the polarisation of a dielectric and define dielectric constant. (b) A 10 pF air capacitor is filled with a dielectric of constant 5 while it stays connected to a battery. Find the new capacitance and state how the stored energy changes. **OR** (a) Show that the electric field is the negative of the potential gradient, $E = -\frac{dV}{dr}$. (b) The potential in a region is V = 5x² + 10 volts (x in metres). Find the electric field at x = 1 m.	5
32.	(a) Using Ampere's circuital law, find the magnetic field inside and outside a long straight wire of radius a carrying a current I distributed uniformly over its cross-section. (b) For a = 2 mm and I = 10 A, find the field at 1 mm and at 4 mm from the axis. **OR** (a) Derive the emf induced in a rod of length l moving with velocity v perpendicular to a field B on rails joined by a resistor R. Find the force needed to keep it moving and the power. (b) For l = 1 m, v = 5 m/s, B = 0.2 T and R = 2 Ω, find the emf, current and power.	5
33.	(a) For refraction at a convex spherical surface separating media of refractive indices n_1 and n_2, derive $\frac{n_2}{v} - \frac{n_1}{u} = \frac{n_2 - n_1}{R}$. (b) A point object in air is 30 cm in front of a convex glass surface (n = 1.5) of radius of curvature 20 cm. Find the position of the image. **OR** (a) Distinguish between intrinsic and extrinsic semiconductors, and draw the energy band diagrams of n-type and p-type semiconductors. (b) Silicon is doped so that it has 5×10^{22} electrons per m³. If $n_i = 1.5 \times 10^{16}$ m^{-3}, find the hole concentration.	5

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Answers and Marking Scheme

Marks for each step are shown in brackets. Any correct alternative method gets full credit.

Section A

1. **(D)** N m² C⁻¹. *Working:* Φ = E × area.

2. **(B)** infinite. *Working:* The field inside a conductor is reduced to zero.

3. **(A)** decreases. *Working:* Collisions with vibrating ions become more frequent.

4. **(C)** 24 W. *Working:* P = V²/R.

5. **(C)** doubles. *Working:* B ∝ I.

6. **(A)** the S-pole to the N-pole. *Working:* The lines form closed loops.

7. **(D)** weber. *Working:* 1 Wb = 1 T m².

8. **(B)** $N_s > N_p$. *Working:* $V_s/V_p = N_s/N_p > 1$.

9. **(A)** infrared region. *Working:* λ = 3 μm.

10. **(B)** 6. *Working:* m = 1 + D/f.

11. **(D)** 1.5. *Working:* n = 1/sin C.

12. **(C)** 10.2 eV. *Working:* 13.6 − 3.4.

13. **(A)** Both Assertion (A) and Reason (R) are true and R is the correct explanation of A. *Working:* The field energy density accounts for the stored energy.

14. **(C)** A is true but R is false. *Working:* A is true. R is false: an ammeter is connected in series.

15. **(A)** Both Assertion (A) and Reason (R) are true and R is the correct explanation of A. *Working:* At room temperature electrons cannot cross such a large gap.

16. **(D)** Both A and R are false. *Working:* Both are false: independent sources have randomly changing phases, so no steady pattern forms.

Section B

17. $E = \frac{9\times10^{9}\times10^{-6}}{(0.3)^2} = 1\times10^{5}$ N/C (1). $V = \frac{9\times10^{9}\times10^{-6}}{0.3} = 3\times10^{4}$ V (1).

OR The electric field inside a closed conducting shell is zero whatever the field outside, so the region inside is shielded (1). Sensitive instruments are kept in metal casings, and it is safer to stay inside a car during a thunderstorm (1).

18. R = (3 × 6)/9 = 2 Ω (1). The 6 Ω resistor has 12 V across it: P = 144/6 = 24 W (1).

19. $B = \frac{\mu_0 N I}{2R}$ (1) $= \frac{4\pi\times10^{-7}\times10\times1}{0.1} \approx 1.26\times10^{-4}$ T (1).

20. ε = ΔΦ/Δt = 0.04/0.2 = 0.2 V (1). With 50 turns it is 50 times larger, 10 V (1).

OR Currents induced in a solid conductor when the magnetic flux through it changes (1). Any two: electromagnetic braking in trains, induction furnaces, electromagnetic damping in galvanometers (1).

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21. $\lambda = \frac{1.227}{\sqrt{V}}$ nm (1) $= \frac{1.227}{\sqrt{54}} \approx 0.167$ nm (1).

Section C

22. The forces qE and −qE on the charges form a couple (1). Torque = qE × 2a sin θ = pE sin θ, i.e. $\vec{\tau} = \vec{p} \times \vec{E}$ (1). The dipole is in stable equilibrium when $\vec{p}$ is along $\vec{E}$ (θ = 0) (1).

23. I = 6/(2.5 + 0.5) = 2 A (1). V = 6 − 2 × 0.5 = 5 V (1). Power lost = I^2r = 2 W (1).

OR $P = \frac{E^2 R}{(R+r)^2}$ (1). $\frac{dP}{dR} = 0$ gives $(R + r) - 2R = 0$, so R = r (1). $P_{max} = \frac{E^2}{4r}$ (1).

24. The electric force qE and magnetic force qvB act in opposite directions (1). They balance when qE = qvB (1), so v = E/B = 3×10^5 m/s (1).

25. Each turn of a solenoid behaves like a tiny magnetic dipole; together they produce the same field pattern as a bar magnet, with one end acting as N and the other as S (2). $B = \frac{\mu_0}{4\pi}\frac{2m}{r^3}$ along the axis (1).

26. $X_L = 2\pi \times 50 \times 0.5 \approx 157\ \Omega$; $X_C = \frac{1}{2\pi \times 50 \times 20 \times 10^{-6}} \approx 159\ \Omega$ (1). $Z = \sqrt{100^2 + 2^2} \approx 100\ \Omega$, so I ≈ 2.2 A (1). $f_0 = \frac{1}{2\pi\sqrt{LC}} \approx 50.3$ Hz; the circuit is very close to resonance (1).

27. (i) m = 1 + D/f (1); (ii) m = D/f (1). For f = 5 cm: 6 and 5 (1).

28. Number of nuclei = (6.023×10^{23} / 235) ≈ 2.56×10^{21} (1). Energy = $2.56 \times 10^{21} \times 200$ MeV ≈ 5.1×10^{23} MeV (1) = $5.1 \times 10^{23} \times 1.6 \times 10^{-13}$ J ≈ 8.2×10^{10} J (1).

Section D

29. (i) (B) on its outer surface.
(ii) The car body acts as a closed conducting shell; the field inside it is zero.
(iii) At sharp points and edges, where the radius of curvature is smallest.
(iv) Charge leaks off quickly from sharp points, which helps neutralise charged clouds and guide discharges safely to earth.

30. (i) (B) frequency, which must exceed the threshold frequency.
(ii) It increases, because more photons eject more electrons each second.
(iii) Each photon gives all its energy to one electron at once.
(iv) The interruption of a light beam when a person passes, which switches the door circuit.

Section E

31. (a) An external field displaces the charges in the molecules (or aligns permanent dipoles), producing a dipole moment per unit volume, the polarisation, which reduces the field inside (2). Dielectric constant K = C/C_0, the factor by which capacitance increases (1). (b) C = 50 pF (1). V is fixed, so U = ½CV^2 becomes 5 times larger (1).

OR (a) Work done against the field in moving a unit charge through dr is −E dr, which equals the change in potential dV (2), so $E = -\frac{dV}{dr}$: the field points towards decreasing potential (1). (b) E = −dV/dx = −10x = −10 V/m, i.e. 10 V/m in the −x direction (2).

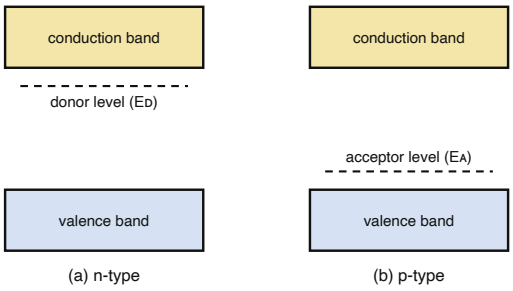
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32. (a) Inside (r < a): the current enclosed is $I\frac{r^2}{a^2}$, so $B = \frac{\mu_0 I r}{2\pi a^2}$ (1½). Outside (r > a): $B = \frac{\mu_0 I}{2\pi r}$ (1½). (b) At 1 mm: $B = \frac{4\pi\times10^{-7}\times10\times10^{-3}}{2\pi\times(2\times10^{-3})^2} = 5\times10^{-4}$ T (1). At 4 mm: $B = \frac{2\times10^{-7}\times10}{4\times10^{-3}} = 5\times10^{-4}$ T (1).

OR (a) In time dt the area swept is lv dt, so ε = Blv (1); I = Blv/R (½); force F = BIl = B²l²v/R (½); power P = Fv = B²l²v²/R (1). (b) ε = 1 V, I = 0.5 A, P = 0.5 W (2).

33. (a) Let a ray from O meet the surface at N, with angles α, β, γ that ON, NI and the radius CN make with the axis; for small angles $\alpha = \frac{MN}{-u}$, $\beta = \frac{MN}{v}$, $\gamma = \frac{MN}{R}$ (1). Then i = α + γ and r = γ − β, and Snell's law gives $n_1 i = n_2 r$ (1). Substituting, $n_1\left(\frac{1}{-u}+\frac{1}{R}\right) = n_2\left(\frac{1}{R}-\frac{1}{v}\right)$, i.e. $\frac{n_2}{v} - \frac{n_1}{u} = \frac{n_2-n_1}{R}$ (1). (b) $\frac{1.5}{v} - \frac{1}{-30} = \frac{0.5}{20}$, so $\frac{1.5}{v} = -\frac{1}{120}$ and v = −180 cm: a virtual image 180 cm in front of the surface (2).

OR (a) Intrinsic: pure, $n_e = n_h$; extrinsic: doped, with one type of carrier in majority (1). n-type has a donor level just below the conduction band; p-type has an acceptor level just above the valence band (2):



(b) $n_h = \frac{n_i^2}{n_e} = \frac{(1.5\times10^{16})^2}{5\times10^{22}} = 4.5\times10^{9}$ m⁻³ (2).

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