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Your JEE Guide

CBSE Class XII · Physics (042)

Sample Question Paper 6 · 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.	A body carries a charge of $+3.2 \times 10^{-19}$ C. This means it has: (A) lost 2 electrons (B) gained 2 electrons (C) gained 2 protons (D) lost 3 electrons	1
2.	Which of the following is a vector quantity? (A) electric flux (B) electric field (C) charge (D) electric potential	1
3.	The energy density of an electric field E in vacuum is: (A) $\varepsilon_0 E^2$ (B) $\frac{1}{2}\varepsilon_0 E$ (C) $\frac{E^2}{2\varepsilon_0}$ (D) $\frac{1}{2}\varepsilon_0 E^2$	1
4.	Kirchhoff's loop rule is based on the conservation of: (A) momentum (B) charge (C) energy (D) mass	1
5.	An ideal voltmeter has: (A) negative resistance (B) infinite resistance (C) resistance equal to that of the circuit (D) zero resistance	1

6.	The magnetic moment of a loop of area A carrying current I is: (A) IA^2 (B) I/A (C) I^2A (D) IA	1
7.	A superconductor placed in a magnetic field: (A) expels the field from its interior (B) has no effect on the field (C) concentrates the field inside (D) becomes a permanent magnet	1
8.	One henry is equivalent to: (A) 1 T m^2 (B) 1 Wb A (C) 1 Wb A^{-1} (D) 1 V A	1
9.	At resonance in a series LCR circuit, the current is: (A) minimum (B) equal to that at very high frequency (C) maximum (D) zero	1
10.	X-rays are used to: (A) take images of bones (B) carry TV signals (C) see in the dark (D) heat food	1
11.	The bending of light around the edges of an obstacle comparable in size to its wavelength is called: (A) reflection (B) diffraction (C) refraction (D) dispersion	1
12.	In a reverse-biased p-n junction, the small current is due to: (A) both equally (B) ions in the depletion layer (C) majority carriers (D) minority carriers	1
13.	**Assertion (A):** The electric field inside a conductor in electrostatic equilibrium is zero. **Reason (R):** Free charges in a conductor move until the field inside vanishes. (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):** Mica is used as a dielectric in capacitors. **Reason (R):** Mica is transparent. (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):** The binding energy per nucleon is about the highest for iron. **Reason (R):** Iron has the largest atomic mass of all elements. (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):** The maximum kinetic energy of photoelectrons increases with the intensity of light. **Reason (R):** The number of photons arriving per second does not depend on intensity. (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.	A charge of 2 μC is at the centre of a cube of side 10 cm. Find the electric flux through one face of the cube. **OR** A parallel plate capacitor has plates of area 6×10^{-3} m² that are 3 mm apart. Find its capacitance and the charge on each plate when it is connected to a 100 V supply.	2
18.	In a balanced Wheatstone bridge all four arms have resistance 2 Ω. Find the resistance between the two junctions to which the cell is connected, and explain why the galvanometer arm can be ignored.	2
19.	A circular coil of 20 turns and radius 10 cm carries 5 A and lies with its plane perpendicular to a uniform field of 0.10 T. Find the total torque and the net force on the coil.	2
20.	Find the energy stored in an inductor of 0.5 H carrying a current of 2 A. **OR** Define self-inductance and give its SI unit. On what factors does the self-inductance of a solenoid depend?	2
21.	Find the de Broglie wavelength of a ball of mass 0.06 kg moving at 1 m/s. Why is its wave nature not observed?	2

Section C

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22.	Using Gauss's law, derive the expression for the electric field due to a point charge, and hence obtain Coulomb's law. **OR** Two 4 μF capacitors are connected in series, and this pair is connected in parallel with a 2 μF capacitor across a 12 V supply. Find the equivalent capacitance, the total charge, and the charge on the 2 μF capacitor.	3
23.	Show that the resistivity of a conductor is $\rho = \frac{m}{ne^2\tau}$, where τ is the relaxation time.	3
24.	State the Biot–Savart law in vector form. Find the magnetic field at the centre of a semicircular wire of radius r carrying current I (ignore the straight leads).	3
25.	Draw the pattern of magnetic field lines when (i) a diamagnetic and (ii) a paramagnetic sample is placed in a uniform magnetic field. Explain the difference.	3
26.	A 40 Ω resistor and a capacitor of reactance 30 Ω are connected in series to a 100 V AC supply. Find the impedance, the current and the phase difference between current and voltage.	3
27.	An object is 30 cm from a concave lens of focal length 20 cm. Find the position and magnification of the image, and draw the ray diagram.	3
28.	Find the binding energy per nucleon of ^{56}Fe. (Masses: ^{56}Fe 55.934939 u, ^{1}H 1.007825 u, neutron 1.008665 u; 1 u = 931.5 MeV/c².)	3

Section D

29.	**Case study.** A moving coil galvanometer has a coil suspended in a radial magnetic field. A current I in the coil produces a torque NIAB, balanced by the restoring torque kϕ of a spring, so the deflection is $\varphi = \frac{NAB}{k} I$. (i) Why is the magnetic field made radial? *[1]* (ii) The current sensitivity of the galvanometer is: (A) NAB/k (B) k/NAB (C) NAB (D) NABk *[1]* (iii) What is the purpose of the soft-iron core inside the coil? *[1]* (iv) Why can a galvanometer not measure large currents directly? *[1]*	4
30.	**Case study.** Total internal reflection explains why diamonds sparkle, how mirages form on hot roads, and how optical fibres carry light. Diamond has a very high refractive index of 2.42. (i) Find the critical angle of diamond. (A) about 24° (B) about 42° (C) about 49° (D) about 60° *[1]* (ii) Why does a well-cut diamond sparkle? *[1]* (iii) Why does a mirage appear on a hot road? *[1]* (iv) Can total internal reflection occur when light goes from air into glass? Why? *[1]*	4

Section E

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31.	(a) Derive an expression for the potential energy of a system of three point charges. (b) Three charges of 1 μC each are at the corners of an equilateral triangle of side 10 cm. Find the potential energy of the system. **OR** (a) Derive the expressions for the equivalent capacitance of capacitors in series and in parallel. (b) Find the equivalent capacitance of three capacitors of 2 μF, 3 μF and 6 μF in series.	5
32.	(a) Derive the expression for the torque on a rectangular current loop in a uniform magnetic field, and define its magnetic moment. (b) Define the current sensitivity and voltage sensitivity of a galvanometer. Why does increasing the current sensitivity not always increase the voltage sensitivity? **OR** (a) Derive the force per unit length between two long parallel straight conductors carrying currents, and use it to define the ampere. (b) Two long wires 4 cm apart carry 8 A and 5 A in opposite directions. Find the force per metre between them.	5
33.	(a) Describe the interference pattern in Young's double-slit experiment and explain why white light produces coloured fringes. (b) The fringe width is 0.4 mm. Find the new fringe width if the screen distance is halved and the slit separation doubled. **OR** (a) State the laws of photoelectric emission and explain them using Einstein's equation. (b) Light of wavelength 400 nm falls on caesium (work function 2.14 eV). Find the maximum kinetic energy of the photoelectrons and the stopping potential.	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. **(A)** lost 2 electrons. *Working:* q = ne gives n = 2; a positive charge means electrons were lost.

2. **(B)** electric field. *Working:* Field has magnitude and direction.

3. **(D)** $\frac{1}{2}\varepsilon_0 E^2$. *Working:* Energy per unit volume.

4. **(C)** energy. *Working:* The net change in potential around a closed loop is zero.

5. **(B)** infinite resistance. *Working:* It should draw no current.

6. **(D)** IA. *Working:* m = IA, normal to the loop.

7. **(A)** expels the field from its interior. *Working:* It behaves as a perfect diamagnet (Meissner effect).

8. **(C)** 1 Wb A^{-1}. *Working:* L = NΦ/I.

9. **(C)** maximum. *Working:* Z = R is least.

10. **(A)** take images of bones. *Working:* They pass through soft tissue but are absorbed by bone.

11. **(B)** diffraction. *Working:* Definition.

12. **(D)** minority carriers. *Working:* Minority carriers are swept across by the junction field.

13. **(A)** Both Assertion (A) and Reason (R) are true and R is the correct explanation of A. *Working:* If a field remained, charges would keep moving.

14. **(B)** Both A and R are true but R is not the correct explanation of A. *Working:* Both are true, but mica is used because of its high dielectric strength and constant, not its transparency.

15. **(C)** A is true but R is false. *Working:* A is true. R is false: many elements are heavier than iron.

16. **(D)** Both A and R are false. *Working:* Both are false: Kmax depends on frequency, and intensity decides the number of photons per second.

Section B

17. Total flux = q/ε_0; by symmetry each face gets one-sixth (1). $\phi = \frac{2\times10^{-6}}{6\times8.854\times10^{-12}} \approx 3.8\times10^{4}$ N m² C^{-1} (1).

OR $C = \frac{\varepsilon_0 A}{d} = \frac{8.85\times10^{-12}\times6\times10^{-3}}{3\times10^{-3}} \approx 17.7$ pF (1). Q = CV ≈ 1.8 × 10^{-9} C (1).

18. At balance B and D are at the same potential, so no current flows through the galvanometer (1). The arms form two 4 Ω paths in parallel: 2 Ω (1).

19. The magnetic moment is parallel to the field, so τ = mB sin 0° = 0 (1). The forces on opposite elements cancel in a uniform field, so the net force is 0 (1).

20. $U = \frac{1}{2}LI^2$ (1) $= \frac{1}{2}\times0.5\times4 = 1$ J (1).

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OR The flux linked per unit current through the coil itself, L = NΦ/I; unit henry (1). It depends on the number of turns, the area and length of the solenoid, and the core material (1).

21. λ = h/mv = 6.63 × 10^{-34} / 0.06 ≈ 1.1 × 10^{-32} m (1). This is far smaller than any object or gap, so no diffraction or interference can be detected (1).

Section C

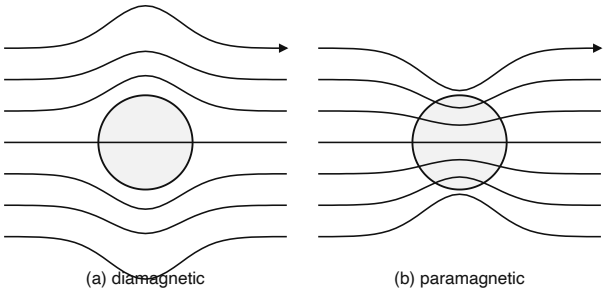
22. Take a sphere of radius r centred on q; E is radial and the same at every point of it (1). $E \cdot 4\pi r^2 = \frac{q}{\varepsilon_0}$, so $E = \frac{q}{4\pi\varepsilon_0 r^2}$ (1). The force on a charge q_0 at that point is $F = q_0 E = \frac{qq_0}{4\pi\varepsilon_0 r^2}$, which is Coulomb's law (1).

OR Series pair: 2 μF; with 2 μF in parallel, C = 4 μF (1). Total charge = 48 μC (1). The 2 μF capacitor has 12 V across it, so it holds 24 μC (1).

23. $v_d = \frac{eE\tau}{m}$ (1). $I = neAv_d = \frac{ne^2 A\tau}{m}E$ and $E = \frac{V}{l}$ (1). So $R = \frac{V}{I} = \frac{m}{ne^2\tau}\cdot\frac{l}{A}$, giving $\rho = \frac{m}{ne^2\tau}$ (1).

24. $d\vec{B} = \frac{\mu_0}{4\pi}\frac{I\,d\vec{l}\times\hat{r}}{r^2}$ (1). Every element is perpendicular to r, so $B = \frac{\mu_0 I}{4\pi r^2} \times \pi r$ (1) $= \frac{\mu_0 I}{4r}$ (1).

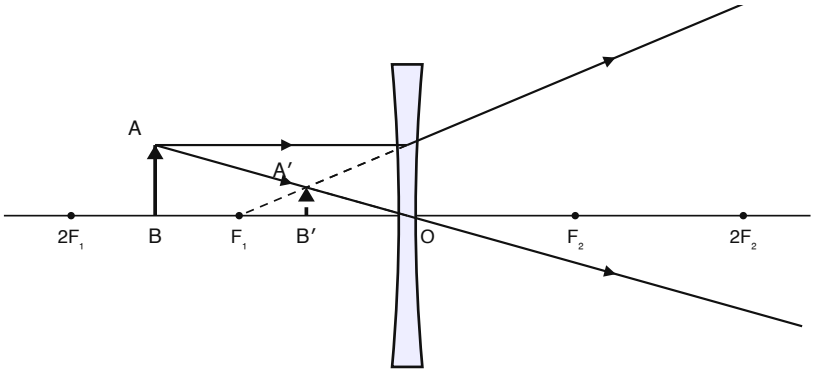
25. Diagrams (2):



A diamagnetic substance is magnetised opposite to the field, so lines are pushed out; a paramagnetic substance is weakly magnetised along the field, so lines are drawn in (1).

26. Z = √(40² + 30²) = 50 Ω (1). I = 100/50 = 2 A (1). The current leads by $\tan^{-1}\frac{30}{40} \approx 37^\circ$ (1).

27. $\frac{1}{v} = -\frac{1}{20} - \frac{1}{30}$, v = −12 cm (1). m = v/u = 0.4: virtual, erect, diminished (1). Diagram (1):



28. Δm = 26(1.007825) + 30(1.008665) − 55.934939 = 0.528461 u (1). BE = 0.528461 × 931.5 ≈ 492.3 MeV (1). Per nucleon ≈ 8.79 MeV (1).

Section D

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29. (i) So that the plane of the coil is always parallel to the field and the torque NIAB does not depend on the angle; the scale becomes linear.
(ii) (A) NAB/k.
(iii) It strengthens the magnetic field and makes it radial.
(iv) It is very sensitive and shows full-scale deflection for a tiny current; a large current would damage the coil.

30. (i) (A) sin C = 1/2.42, C ≈ 24°.
(ii) Its small critical angle makes light undergo repeated total internal reflection inside before coming out.
(iii) Air near the road is hotter and rarer; light from the sky bends and is totally reflected, appearing to come from a pool of water.
(iv) No; it needs light to go from a denser to a rarer medium.

Section E

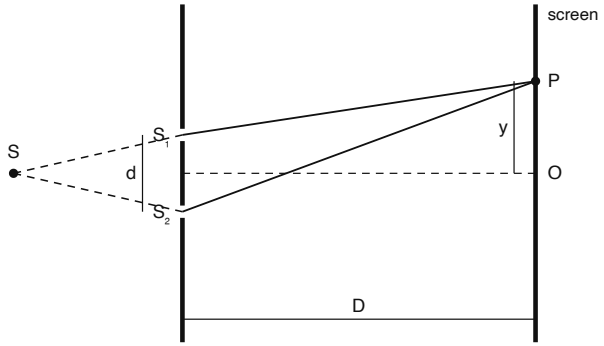
31. (a) Bringing q_1 needs no work; bringing q_2 needs $\frac{q_1 q_2}{4\pi\varepsilon_0 r_{12}}$; bringing q_3 needs $\frac{q_3}{4\pi\varepsilon_0}\left(\frac{q_1}{r_{13}}+\frac{q_2}{r_{23}}\right)$ (2). So $U=\frac{1}{4\pi\varepsilon_0}\left(\frac{q_1q_2}{r_{12}}+\frac{q_1q_3}{r_{13}}+\frac{q_2q_3}{r_{23}}\right)$ (1). (b) $U=\frac{3\times9\times10^9\times(10^{-6})^2}{0.1}=0.27$ J (2).

OR (a) Series: same charge, voltages add: $\frac{1}{C}=\frac{1}{C_1}+\frac{1}{C_2}+\cdots$ (1½). Parallel: same voltage, charges add: $C=C_1+C_2+\cdots$ (1½). (b) 1/C = 1/2 + 1/3 + 1/6 = 1, so C = 1 μF (2).

32. (a) The forces on the two sides of length b form a couple: τ = (IbB)(a sin θ) = IAB sin θ (2); with m = IA normal to the loop, $\vec{\tau}=\vec{m}\times\vec{B}$ (1). (b) Current sensitivity ϕ/I = NAB/k; voltage sensitivity ϕ/V = NAB/(kR) (1). Increasing N raises the current sensitivity but also raises R, so the voltage sensitivity may not change (1).

OR (a) Wire 1 produces $B=\frac{\mu_0 I_1}{2\pi d}$ at wire 2; force per length $f=\frac{\mu_0 I_1 I_2}{2\pi d}$ (2). One ampere is the current which, flowing in two infinitely long parallel wires 1 m apart in vacuum, produces a force of 2×10^{-7} N per metre (1). (b) f = $2\times10^{-7}\times8\times5/0.04 = 2\times10^{-4}$ N/m, repulsive (2).

33. (a) Equally spaced bright and dark fringes, with β = λD/d (1). Figure (1):



With white light the central fringe is white, but each colour has a different fringe width, so the other fringes are coloured (1). (b) β ∝ D/d, so the new width is 0.4 × ½ × ½ = 0.1 mm (2).

OR (a) Emission is instantaneous; the number of electrons is proportional to intensity; Kmax depends only on frequency; no emission below the threshold frequency (2). Einstein: $K_{max}=$

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$h\nu - \phi_0$, each photon giving its energy to one electron (1). (b) E = 1240/400 = 3.1 eV; Kmax = 0.96 eV (1); stopping potential 0.96 V (1).

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