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Your JEE Guide

CBSE Class XII · Physics (042)

Sample Question Paper 1 · 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.	Charges +q and −q are placed a distance 2a apart. The electric field at the midpoint between them is: (A) $\frac{q}{4\pi\varepsilon_0 a^2}$, directed towards −q (B) $\frac{2q}{4\pi\varepsilon_0 a^2}$, directed towards −q (C) $\frac{2q}{4\pi\varepsilon_0 a^2}$, directed towards +q (D) zero	1
2.	A parallel plate capacitor of capacitance C_0 is completely filled with a dielectric of constant K. Its capacitance becomes: (A) KC_0 (B) C_0 (C) K^2C_0 (D) $\frac{C_0}{K}$	1
3.	If the current through a metallic wire is doubled, the drift speed of its electrons: (A) becomes four times (B) stays the same (C) halves (D) doubles	1
4.	Three 2 Ω resistors are connected in parallel, and this combination is joined in series with another 2 Ω resistor. The equivalent resistance is: (A) 6 Ω (B) 8 Ω (C) $\frac{8}{3}$ Ω (D) $\frac{2}{3}$ Ω	1

5.	A proton enters a uniform magnetic field at right angles to it. Its path in the field is: (A) a straight line (B) a parabola (C) a circle (D) a helix	1
6.	The SI unit of magnetic dipole moment is: (A) Wb (B) A m^2 (C) T m (D) A/m	1
7.	Lenz's law is a consequence of the law of conservation of: (A) mass (B) momentum (C) charge (D) energy	1
8.	In an AC circuit containing only an inductor, the current: (A) lags the voltage by $\frac{\pi}{2}$ (B) is in phase with the voltage (C) leads the voltage by $\frac{\pi}{2}$ (D) lags the voltage by π	1
9.	Which of these electromagnetic waves has the shortest wavelength? (A) X-rays (B) microwaves (C) ultraviolet rays (D) gamma rays	1
10.	A convex lens of focal length 10 cm is in contact with a concave lens of focal length 20 cm. The power of the combination is: (A) −5 D (B) +5 D (C) +3.3 D (D) +15 D	1
11.	In Young's double-slit experiment, if the separation between the slits is halved (other things unchanged), the fringe width: (A) halves (B) stays the same (C) doubles (D) becomes four times	1
12.	The de Broglie wavelength of an electron accelerated through a potential difference of 100 V is about: (A) 0.123 nm (B) 1.23 nm (C) 12.3 nm (D) 0.0123 nm	1
13.	**Assertion (A):** Two electric field lines never cross each other. **Reason (R):** At a crossing point, the field would have two directions at once. (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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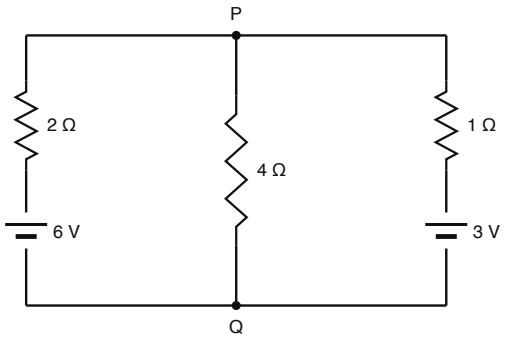
14.	**Assertion (A):** A p-n junction diode conducts current in one direction only. **Reason (R):** In forward bias, the depletion layer becomes wider. (A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A. (B) Both A and R are true but R is not the correct explanation of A. (C) A is true but R is false. (D) Both A and R are false.	1
15.	**Assertion (A):** The density of nuclear matter is nearly the same for all nuclei. **Reason (R):** The nuclear radius is proportional to $A^{1/3}$. (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 resistance of a semiconductor increases with temperature. **Reason (R):** The number of charge carriers in a semiconductor decreases as the temperature rises. (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.	An electric dipole of moment 4×10^{-9} C m is placed at 30° to a uniform electric field of 5×10^{4} N/C. Find the torque on it. **OR** State Gauss's law in electrostatics. Find the electric flux through a closed surface that encloses a charge of 8.85 μC.	2
18.	A cell of emf 12 V and internal resistance 0.4 Ω supplies a current of 2 A. Find (i) the terminal voltage, (ii) the maximum current the cell can supply.	2
19.	A long straight wire carries a current of 35 A. Find the magnetic field 20 cm from it.	2
20.	An inductor of 0.5 H is connected to a 220 V, 50 Hz supply. Find its reactance and the rms current. **OR** Define power factor. Why is no average power used in a purely capacitive AC circuit?	2
21.	The work function of a metal is 2.14 eV. Find its threshold frequency.	2

Section C

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22.	Capacitors of 2 μF, 3 μF and 6 μF are connected (i) in series, (ii) in parallel. Find the equivalent capacitance in each case. If the series combination is connected to a 10 V battery, find the charge on each capacitor.	3
23.	Use Kirchhoff's rules to find the currents in the three branches of the circuit shown. The cells have negligible internal resistance.  	3
24.	Write the expression for the magnetic field at the centre of a circular coil. Find the field at the centre of a coil of 100 turns, radius 8 cm, carrying 0.4 A.	3
25.	A galvanometer of resistance 12 Ω gives full-scale deflection for 3 mA. How can it be converted into a voltmeter of range 0–18 V? **OR** Distinguish between diamagnetic, paramagnetic and ferromagnetic substances on the basis of (i) relative permeability, (ii) behaviour in a non-uniform magnetic field, (iii) one example each.	3
26.	State Lenz's law. A metallic rod 1.0 m long rotates at 400 rad/s about an axis through one end, perpendicular to the rod, in a uniform magnetic field of 0.5 T parallel to the axis. Find the emf induced between its ends.	3
27.	The angle of a glass prism is 60° and its angle of minimum deviation is 30°. Find the refractive index of the glass, and draw a ray diagram for refraction through a prism.	3
28.	Using the Bohr model, the energy of the electron in the nth orbit of hydrogen is $E_n = -\frac{13.6}{n^2}$ eV. Find the wavelength of the photon emitted when the electron jumps from n = 3 to n = 2. To which series does this line belong?	3

Section D

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29.	**Case study.** An optical fibre guides light by repeated total internal reflection. It has a core of glass of refractive index 1.5 surrounded by a cladding of lower refractive index. Light entering one end within a certain cone is trapped and travels long distances with very little loss. (i) State two conditions for total internal reflection. *[1]* (ii) Find the critical angle for the glass–air boundary (n = 1.5). (A) about 30° (B) about 42° (C) about 49° (D) about 60° *[1]* (iii) Why must the cladding have a lower refractive index than the core? *[1]* (iv) Give one use of optical fibres. *[1]*	4
30.	**Case study.** The mass of a nucleus is always less than the total mass of its protons and neutrons. This mass defect, Δm, is equivalent to the binding energy of the nucleus, $E = \Delta mc^2$. The binding energy per nucleon is highest (about 8.75 MeV) for nuclei around iron (A ≈ 56) and smaller for very light and very heavy nuclei. (i) What is meant by the binding energy of a nucleus? *[1]* (ii) Which nucleus is the most stable? (A) ^{2}H (B) ^{56}Fe (C) ^{235}U (D) ^{4}He *[1]* (iii) A nucleus has a mass defect of 0.1 u. Find its binding energy (1 u = 931.5 MeV/c^2). *[1]* (iv) Why does the fission of a heavy nucleus release energy? *[1]*	4

Section E

31.	(a) Using Gauss's law, derive an expression for the electric field due to an infinitely long, straight wire with uniform linear charge density λ. (b) Find the field 10 cm from such a wire with λ = 2 μC/m. **OR** (a) Derive an expression for the capacitance of a parallel plate capacitor. (b) A 900 pF capacitor is charged by a 100 V battery. Find the energy stored in it.	5
32.	(a) In Young's double-slit experiment, derive an expression for the fringe width. (b) Light of wavelength 600 nm falls on slits 0.5 mm apart, and the screen is 1 m away. Find the fringe width and the distance of the third bright fringe from the central one. **OR** (a) Draw a ray diagram of an astronomical telescope in normal adjustment and write the expression for its magnifying power. (b) A telescope has an objective of focal length 140 cm and an eyepiece of 5 cm. Find its magnifying power in normal adjustment, and when the final image is at 25 cm.	5

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33.	(a) With a labelled circuit diagram, explain how a full-wave rectifier works, and draw its input and output waveforms. (b) Draw the I–V characteristics of a p-n junction diode. **OR** (a) For a series LCR circuit, write the expression for the impedance and the condition for resonance. (b) A series LCR circuit with L = 5.0 H, C = 80 μF and R = 40 Ω is connected to a 230 V variable-frequency supply. Find the resonant angular frequency, and the impedance and current at resonance.	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. **(B)** $\frac{2q}{4\pi\varepsilon_0 a^2}$, directed towards –q. *Working:* Both fields point from +q towards –q at the midpoint and add.

2. **(A)** KC_0. *Working:* $C = \frac{K\varepsilon_0 A}{d}$.

3. **(D)** doubles. *Working:* $I = neAv_d$, so $v_d \propto I$.

4. **(C)** $\frac{8}{3}$ Ω. *Working:* $\frac{2}{3} + 2 = \frac{8}{3}$ Ω.

5. **(C)** a circle. *Working:* The magnetic force is perpendicular to the velocity and constant in size.

6. **(B)** A m². *Working:* m = NIA.

7. **(D)** energy. *Working:* The induced current opposes the change, so work must be done to produce it.

8. **(A)** lags the voltage by $\frac{\pi}{2}$. *Working:* For a pure inductor, the current lags by 90°.

9. **(D)** gamma rays. *Working:* Gamma rays are at the high-frequency end of the spectrum.

10. **(B)** +5 D. *Working:* P = 10 − 5 = +5 D.

11. **(C)** doubles. *Working:* $\beta = \frac{\lambda D}{d}$.

12. **(A)** 0.123 nm. *Working:* $\lambda = \frac{1.227}{\sqrt{V}}$ nm.

13. **(A)** Both Assertion (A) and Reason (R) are true and R is the correct explanation of A. *Working:* The field at a point has a single direction, which explains A.

14. **(C)** A is true but R is false. *Working:* A is true. R is false: forward bias makes the depletion layer narrower.

15. **(A)** Both Assertion (A) and Reason (R) are true and R is the correct explanation of A. *Working:* Volume ∝ A and mass ∝ A, so the density is independent of A.

16. **(D)** Both A and R are false. *Working:* Both are false: more carriers are freed at higher temperature, so the resistance falls.

Section B

17. τ = pE sin θ (1) = 4 × 10⁻⁹ × 5 × 10⁴ × ½ = 1 × 10⁻⁴ N m (1).

OR The flux through a closed surface is $\frac{1}{\varepsilon_0}$ times the charge enclosed (1). $\phi = \frac{8.85\times10^{-6}}{8.854\times10^{-12}} \approx 1.0 \times 10^{6}$ N m² C⁻¹ (1).

18. (i) V = E − Ir = 12 − 0.8 = 11.2 V (1). (ii) Short circuit: $I = \frac{E}{r} = 30$ A (1).

19. $B = \frac{\mu_0 I}{2\pi r}$ (1) $= \frac{2\times10^{-7}\times35}{0.2} = 3.5 \times 10^{-5}$ T (1).

20. $X_L = 2\pi f L = 2 \times 3.14 \times 50 \times 0.5 \approx 157\ \Omega$ (1). $I = \frac{220}{157} \approx 1.4$ A (1).

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OR Power factor = cos ϕ, where ϕ is the phase difference between voltage and current (1). For a pure capacitor ϕ = 90°, so cos ϕ = 0 and the average power $V_{rms} I_{rms} \cos\varphi = 0$ (1).

21. $\nu_0 = \frac{\phi_0}{h}$ (1) $= \frac{2.14\times1.6\times10^{-19}}{6.63\times10^{-34}} \approx 5.2 \times 10^{14}$ Hz (1).

Section C

22. (i) $\frac{1}{C} = \frac{1}{2} + \frac{1}{3} + \frac{1}{6} = 1$, so C = 1 μF (1). (ii) C = 11 μF (1). In series each carries the same charge Q = CV = 1 μF × 10 V = 10 μC (1).

23. Let the potential of P above Q be V. By the junction rule at P: $\frac{6-V}{2} + \frac{3-V}{1} = \frac{V}{4}$ (1). So 24 = 7V, $V = \frac{24}{7}$ V (1). Currents: $\frac{9}{7}$ A through the 6 V cell, $\frac{6}{7}$ A through 4 Ω, and $\frac{3}{7}$ A flowing into the + terminal of the 3 V cell (it is being charged) (1).

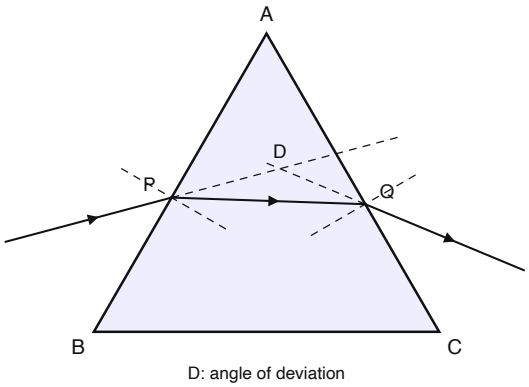
24. $B = \frac{\mu_0 N I}{2R}$ (1). $B = \frac{4\pi\times10^{-7}\times100\times0.4}{2\times0.08}$ (1) $\approx 3.1 \times 10^{-4}$ T (1).

25. A high resistance R is connected in series (1). $R = \frac{V}{I_g} - G = \frac{18}{3\times10^{-3}} - 12$ (1) $= 5988\ \Omega$ (1).

OR (i) μ_r slightly less than 1; slightly more than 1; much greater than 1 (1). (ii) Move from stronger to weaker field; weakly from weaker to stronger; strongly attracted towards the stronger field (1). (iii) Bismuth or copper; aluminium or sodium; iron, cobalt or nickel (1).

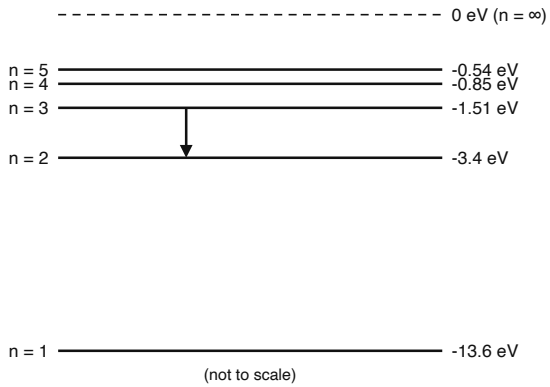
26. The induced emf opposes the change in flux that produces it (1). $\varepsilon = \frac{1}{2} B\omega L^2$ (1) $= \frac{1}{2} \times 0.5 \times 400 \times 1 = 100$ V (1).

27. $n = \frac{\sin\frac{A+\delta_m}{2}}{\sin\frac{A}{2}} = \frac{\sin 45^\circ}{\sin 30^\circ}$ (1) $= \sqrt{2}$ (1). Diagram (1):



D: angle of deviation

28. $\Delta E = 13.6\left(\frac{1}{4} - \frac{1}{9}\right) = 1.89$ eV (1). $\lambda = \frac{hc}{\Delta E} = \frac{1240}{1.89}$ nm ≈ 656 nm (1). It is the first line (Hα) of the Balmer series (1).



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Section D

29. (i) Light must travel from a denser to a rarer medium, and the angle of incidence must exceed the critical angle.
(ii) (B): sin C = 1/1.5 = 2/3, so C ≈ 42°.
(iii) Total internal reflection at the core–cladding boundary is possible only if light passes from a denser to a rarer medium.
(iv) Any one: transmitting telephone and internet signals; endoscopy; decorative lighting.

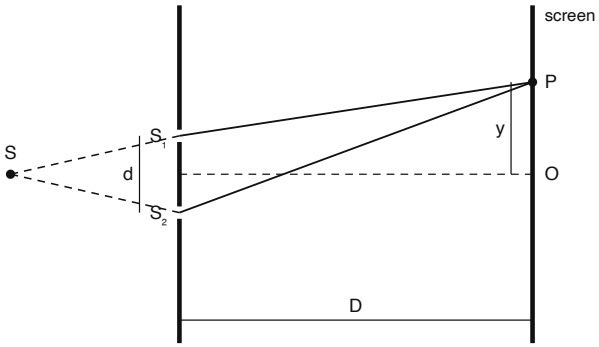
30. (i) The energy needed to separate a nucleus into its individual protons and neutrons.
(ii) (B) ^{56}Fe, which has the highest binding energy per nucleon.
(iii) 0.1 × 931.5 = 93.15 MeV.
(iv) The fragments have a higher binding energy per nucleon than the heavy nucleus, so the total binding energy increases and the difference is released.

Section E

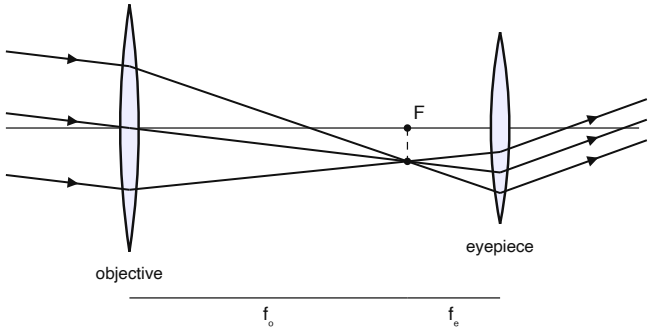
31. (a) Take a cylindrical Gaussian surface of radius r and length l, coaxial with the wire (1). Flux passes only through the curved surface: E(2πrl) = λl/ε$_0$ (1), so $E = \frac{\lambda}{2\pi\varepsilon_0 r}$, directed radially (1). (b) $E = \frac{2\times9\times10^{9}\times2\times10^{-6}}{0.1} = 3.6\times10^{5}$ N/C (2).

OR (a) With charge ±Q on plates of area A a distance d apart, $E = \frac{\sigma}{\varepsilon_0} = \frac{Q}{\varepsilon_0 A}$ (1); V = Ed (1); so $C = \frac{Q}{V} = \frac{\varepsilon_0 A}{d}$ (1). (b) $U = \frac{1}{2}CV^2 = \frac{1}{2}\times900\times10^{-12}\times10^{4} = 4.5\times10^{-6}$ J (2).

32. (a) Path difference at P is $\frac{yd}{D}$ (1). Bright fringes where $\frac{yd}{D} = n\lambda$, so $y_n = \frac{n\lambda D}{d}$ (1). Fringe width $\beta = y_{n+1} - y_n = \frac{\lambda D}{d}$ (1). (b) $\beta = \frac{600\times10^{-9}\times1}{0.5\times10^{-3}} = 1.2$ mm (1); third bright fringe at 3.6 mm (1).



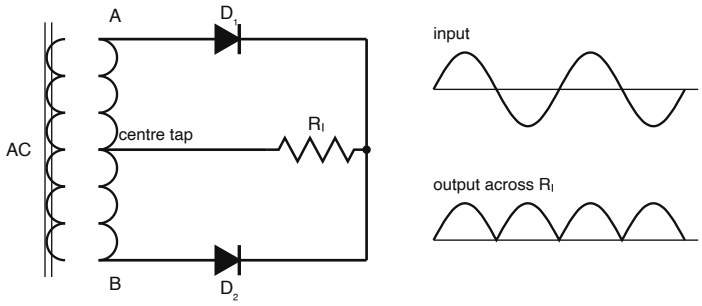
OR (a) Diagram (2):



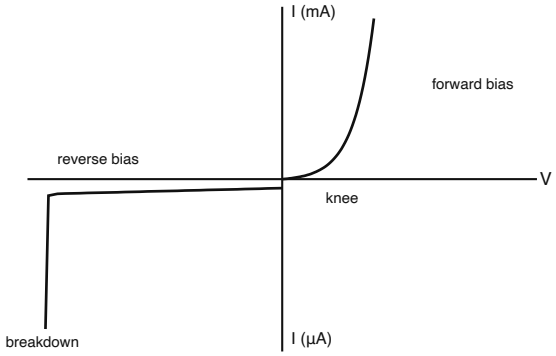
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$m = \frac{f_o}{f_e}$ (1). (b) Normal adjustment: m = 140/5 = 28 (1). Image at 25 cm: $m = \frac{f_o}{f_e}\left(1 + \frac{f_e}{D}\right) = 28 \times 1.2 = 33.6$ (1).

33. (a) Circuit and waveforms (1½):



In one half-cycle, end A is positive and D_1 conducts; in the next half-cycle B is positive and D_2 conducts. In both halves the current through R_L flows in the same direction, so both halves of the input appear at the output (1½). (b) Characteristics (2):



OR (a) $Z = \sqrt{R^2 + (X_L - X_C)^2}$ (1); resonance when $X_L = X_C$, i.e. $\omega_0 = \frac{1}{\sqrt{LC}}$ (1). (b) $\omega_0 = \frac{1}{\sqrt{5 \times 80 \times 10^{-6}}} = 50$ rad/s (1). At resonance Z = R = 40 Ω (1), and I = 230/40 = 5.75 A (1).

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