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Your JEE Guide

CBSE Class XII · Physics (042)

Sample Question Paper 2 · 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 net electric flux through a closed surface that encloses an electric dipole is: (A) infinite (B) $\frac{q}{\varepsilon_0}$ (C) $\frac{2q}{\varepsilon_0}$ (D) zero	1
2.	A conducting sphere of radius R carries charge Q. The potential at its centre is: (A) zero (B) $\frac{Q}{4\pi\varepsilon_0 R}$ (C) $\frac{Q}{8\pi\varepsilon_0 R}$ (D) $\frac{Q}{4\pi\varepsilon_0 R^2}$	1
3.	If the length of a wire is doubled by stretching, its resistivity: (A) becomes four times (B) doubles (C) remains the same (D) halves	1
4.	Kirchhoff's junction rule is based on the conservation of: (A) charge (B) momentum (C) energy (D) mass	1
5.	Two long parallel wires carry currents in the same direction. They: (A) attract each other (B) exert no force on each other (C) rotate (D) repel each other	1

6.	Which material is most suitable for making a permanent magnet? (A) copper (B) steel (C) aluminium (D) soft iron	1
7.	If the number of turns of a solenoid is doubled, keeping its length and area unchanged, its self-inductance becomes: (A) twice (B) unchanged (C) half (D) four times	1
8.	The rms value of an alternating voltage with peak value 311 V is about: (A) 311 V (B) 440 V (C) 220 V (D) 155 V	1
9.	A displacement current exists: (A) only in a vacuum with no fields (B) in a resistor connected to a battery (C) between the plates of a capacitor while it is charging (D) in a conductor carrying steady current	1
10.	For a real object, a convex mirror always forms an image that is: (A) real, erect and of the same size (B) virtual, erect and enlarged (C) real, inverted and diminished (D) virtual, erect and diminished	1
11.	In the photoelectric effect, the stopping potential depends on the: (A) intensity of the incident light (B) frequency of the incident light (C) area of the cathode (D) time for which light falls	1
12.	In the Bohr model of hydrogen, the ratio of the radii of the first and second orbits is: (A) 1 : 4 (B) 4 : 1 (C) 2 : 1 (D) 1 : 2	1
13.	**Assertion (A):** An ammeter is always connected in series with the circuit. **Reason (R):** An ammeter has a very low resistance. (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):** Microwaves are used in radar systems. **Reason (R):** Microwaves have short wavelengths, so they can be sent as narrow, directed beams. (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):** In a p-type semiconductor, holes are the majority carriers. **Reason (R):** A p-type semiconductor is made by doping with a pentavalent impurity. (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 magnetic field inside a long ideal solenoid is zero. **Reason (R):** The field lines outside a long solenoid are crowded together. (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

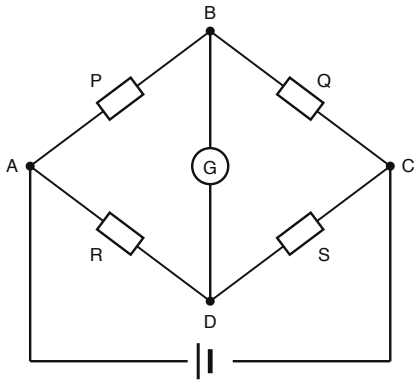
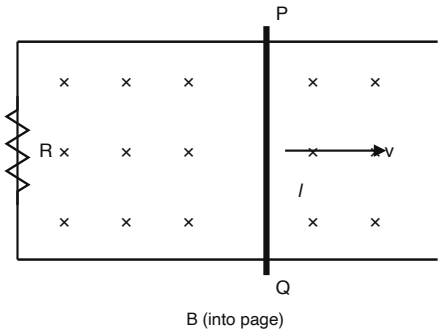
Section B

17.	Find the electric potential at a point 9 cm from a charge of 4×10^{-7} C. How much work is done in bringing a charge of 2×10^{-9} C from infinity to that point?	2
18.	A wire of resistance 10 Ω is stretched uniformly to twice its length. Find its new resistance. Does its resistivity change? **OR** Define drift velocity. How is it related to the current in a conductor?	2
19.	A straight wire 0.5 m long carrying 2 A is placed in a uniform magnetic field of 0.3 T, making an angle of 30° with it. Find the force on the wire.	2
20.	The current through a coil of self-inductance 0.2 H falls from 5 A to 1 A in 0.1 s. Find the average emf induced. **OR** What is mutual inductance? Give its SI unit and two factors on which it depends.	2
21.	Find the energy (in eV) and the momentum of a photon of wavelength 500 nm.	2

Section C

22.	Draw the field lines and equipotential surfaces for (i) a positive point charge, (ii) a uniform electric field. Why is no work done in moving a charge along an equipotential surface?	3

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23.	Using Kirchhoff's rules, obtain the balance condition of a Wheatstone bridge.  **OR** Two cells of emf 1.5 V and 2.0 V, with internal resistances 0.5 Ω and 1.0 Ω, are connected in parallel (positive to positive). Find the emf and internal resistance of the equivalent cell.	3
24.	Using Ampere's circuital law, find the magnetic field inside a long solenoid. Calculate it for a solenoid with 500 turns per metre carrying 5 A.	3
25.	A conducting rod PQ of length 0.5 m slides at 10 m/s on smooth parallel rails joined by a 2 Ω resistor, in a uniform field of 0.4 T perpendicular to the plane of the rails. Find the induced emf, the current and the force needed to keep the rod moving at constant speed.  	3
26.	A 100 μF capacitor is connected to a 220 V, 50 Hz supply. Find its reactance and the rms current. What is the phase relation between current and voltage?	3
27.	A double convex lens of glass (n = 1.5) has both radii of curvature equal to 20 cm. Find its focal length in air, and in water (n = 1.33).	3
28.	Draw the graph of stopping potential against frequency for two metals of different work functions. What do the slope and the intercepts represent?	3

Section D

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29.	**Case study.** Pure silicon is an intrinsic semiconductor with few charge carriers at room temperature. Adding a tiny amount of a suitable impurity (doping) increases its conductivity greatly. Doping with arsenic (group 15) gives an n-type semiconductor; doping with boron (group 13) gives a p-type semiconductor. (i) In an intrinsic semiconductor, the number of free electrons is: (A) greater than the number of holes (B) equal to the number of holes (C) less than the number of holes (D) zero *[1]* (ii) In silicon doped with arsenic, the majority carriers are: (A) holes (B) electrons (C) protons (D) ions *[1]* (iii) Is a p-type semiconductor positively charged? Explain. *[1]* (iv) What happens to the resistance of a semiconductor when its temperature rises? *[1]*	4
30.	**Case study.** Electromagnetic waves are produced by accelerated charges and carry energy and momentum. They travel in vacuum at 3×10^8 m/s. In order of increasing frequency, the spectrum includes radio waves, microwaves, infrared, visible light, ultraviolet, X-rays and gamma rays. (i) Which waves are used to treat muscular strain and in remote controls? (A) microwaves (B) infrared (C) ultraviolet (D) X-rays *[1]* (ii) Which radiation is absorbed by the ozone layer? (A) infrared (B) visible light (C) ultraviolet (D) radio waves *[1]* (iii) Find the wavelength of radio waves of frequency 100 MHz. *[1]* (iv) How are the directions of the electric field, magnetic field and propagation related in an EM wave? *[1]*	4

Section E

31.	(a) Derive an expression for the electric field at a point on the axis of an electric dipole. (b) A dipole consists of charges ±10 μC separated by 2 mm. Find the field at 15 cm from its centre, on its axis. **OR** (a) Derive an expression for the energy stored in a charged capacitor. (b) Capacitors of 4 μF and 6 μF are connected in series to a 10 V battery. Find the charge on each and the total energy stored.	5
32.	(a) Draw a ray diagram for a compound microscope and write the expression for its magnifying power when the final image is at the near point. (b) A compound microscope has an objective of focal length 2 cm and an eyepiece of focal length 6.25 cm, 15 cm apart. Find the object distance and the magnifying power when the final image is at 25 cm. **OR** (a) Describe the single-slit diffraction pattern and draw its intensity distribution. (b) Light of wavelength 500 nm falls on a slit 0.2 mm wide, and the screen is 2 m away. Find the angular and linear widths of the central maximum.	5

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33.	(a) State the main observations of Rutherford's alpha-particle scattering experiment and the conclusions drawn from them. (b) An alpha particle of kinetic energy 7.7 MeV is directed head-on at a gold nucleus (Z = 79). Find its distance of closest approach. **OR** (a) Draw the curve of binding energy per nucleon against mass number and state two conclusions from it. (b) Find the binding energy and binding energy per nucleon of ^{4}He. (Masses: ^{1}H 1.007825 u, neutron 1.008665 u, ^{4}He 4.002603 u; 1 u = 931.5 MeV/c^2.)	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)** zero. *Working:* The net charge enclosed is zero.

2. **(B)** $\frac{Q}{4\pi\varepsilon_0 R}$. *Working:* The field inside is zero, so the potential everywhere inside equals that on the surface.

3. **(C)** remains the same. *Working:* Resistivity is a property of the material at a given temperature.

4. **(A)** charge. *Working:* Charge does not accumulate at a junction.

5. **(A)** attract each other. *Working:* Like currents attract.

6. **(B)** steel. *Working:* Steel has high retentivity and high coercivity.

7. **(D)** four times. *Working:* $L = \mu_0 n^2 A l$ and n doubles.

8. **(C)** 220 V. *Working:* $V_{rms} = \frac{V_0}{\sqrt{2}}$.

9. **(C)** between the plates of a capacitor while it is charging. *Working:* It arises from a changing electric field.

10. **(D)** virtual, erect and diminished. *Working:* Rays diverge after reflection from a convex mirror.

11. **(B)** frequency of the incident light. *Working:* $eV_0 = h\nu - \phi_0$.

12. **(A)** 1 : 4. *Working:* $r \propto n^2$.

13. **(B)** Both A and R are true but R is not the correct explanation of A. *Working:* Both are true. It is connected in series because it must carry the current to be measured; its low resistance only ensures that it hardly changes that current.

14. **(A)** Both Assertion (A) and Reason (R) are true and R is the correct explanation of A. *Working:* The short wavelength explains their use in radar.

15. **(C)** A is true but R is false. *Working:* A is true. R is false: a trivalent impurity is used.

16. **(D)** Both A and R are false. *Working:* Both are false: the field inside is strong and uniform, and outside it is very weak.

Section B

17. $V = \frac{9\times10^{9}\times4\times10^{-7}}{0.09} = 4\times10^{4}$ V (1). W = qV = 2 × 10^{-9} × 4 × 10^{4} = 8 × 10^{-5} J (1).

18. The volume is unchanged, so the area halves; $R \propto \frac{l}{A}$ becomes 4 times: 40 Ω (1). Resistivity is unchanged, as it depends only on the material and temperature (1).

OR The average velocity with which free electrons drift opposite to the applied field (1). $I = neAv_d$, where n is the number of free electrons per unit volume and A the area of cross-section (1).

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19. F = BIL sin θ (1) = 0.3 × 2 × 0.5 × ½ = 0.15 N (1).

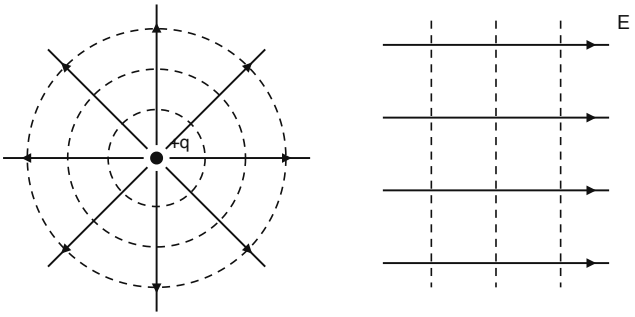
20. $\varepsilon = L\frac{\Delta I}{\Delta t}$ (1) $= 0.2 \times \frac{4}{0.1} = 8$ V (1).

OR The property by which a change of current in one coil induces an emf in a nearby coil; $\Phi_2 = MI_1$ (1). Unit: henry (H). It depends on the number of turns, the area and separation of the coils, and the core material (any two) (1).

21. $E = \frac{1240}{500}$ eV = 2.48 eV (1). $p = \frac{h}{\lambda} = \frac{6.63\times10^{-34}}{500\times10^{-9}} \approx 1.33 \times 10^{-27}$ kg m/s (1).

Section C

22. Diagrams (2):



(a) point charge (b) uniform field

solid lines: field lines; dashed lines: equipotential surfaces

The potential difference between any two points of an equipotential surface is zero, so W = qΔV = 0 (1).

23. At balance no current flows through G, so B and D are at the same potential (1). Applying the loop rule to ABDA and BCDB with currents I_1 (through P, Q) and I_2 (through R, S): $I_1P = I_2R$ and $I_1Q = I_2S$ (1). Dividing: $\frac{P}{Q} = \frac{R}{S}$ (1).

OR $\varepsilon_{eq} = \frac{\varepsilon_1 r_2 + \varepsilon_2 r_1}{r_1 + r_2} = \frac{1.5\times1 + 2\times0.5}{1.5}$ (1) ≈ 1.67 V (1). $r_{eq} = \frac{r_1 r_2}{r_1 + r_2} = \frac{1}{3}\ \Omega$ (1).

24. Take a rectangular loop with one side of length h inside the solenoid; only that side contributes: $Bh = \mu_0(nh)I$ (1), so $B = \mu_0 nI$ (1). $B = 4\pi \times 10^{-7} \times 500 \times 5 \approx 3.14 \times 10^{-3}$ T (1).

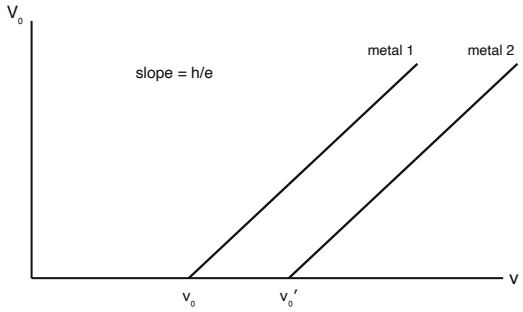
25. ε = Bvl = 0.4 × 10 × 0.5 = 2 V (1). I = ε/R = 1 A (1). F = BIl = 0.4 × 1 × 0.5 = 0.2 N (1).

26. $X_C = \frac{1}{2\pi f C} = \frac{1}{2\pi\times50\times10^{-4}} \approx 31.8\ \Omega$ (1). I = 220/31.8 ≈ 6.9 A (1). The current leads the voltage by π/2 (1).

27. $\frac{1}{f} = (n-1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right) = 0.5 \times \frac{2}{20}$, f = 20 cm (1½). In water, $\frac{1}{f_w} = \left(\frac{1.5}{1.33} - 1\right)\frac{2}{20}$, $f_w \approx 78$ cm (1½).

28. Graph (1½):

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The lines are parallel with slope h/e, the same for all metals (½). The intercepts on the frequency axis are the threshold frequencies ν_0 of the metals; the metal with the larger ν_0 has the larger work function (1).

Section D

29. (i) (B) equal to the number of holes.
(ii) (B) electrons.
(iii) No. Each acceptor atom is neutral when added; the crystal as a whole remains electrically neutral.
(iv) It decreases, because more electron–hole pairs are produced.

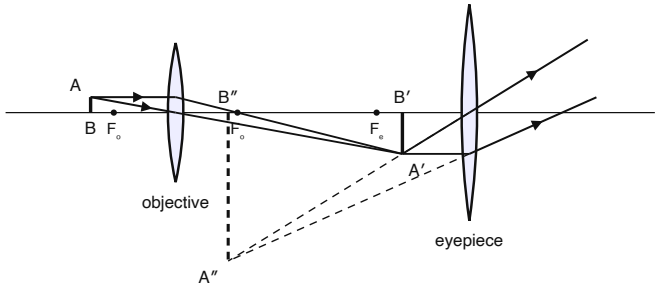
30. (i) (B) infrared.
(ii) (C) ultraviolet.
(iii) $\lambda = c/f = 3 \times 10^8 / 10^8 = 3$ m.
(iv) They are mutually perpendicular; the wave travels along $\vec{E} \times \vec{B}$.

Section E

31. (a) At distance r on the axis, $E = \frac{q}{4\pi\varepsilon_0}\left[\frac{1}{(r-a)^2} - \frac{1}{(r+a)^2}\right] = \frac{q}{4\pi\varepsilon_0}\cdot\frac{4ar}{(r^2-a^2)^2}$ (2). For r » a, $E = \frac{2p}{4\pi\varepsilon_0 r^3}$, along $\vec{p}$ (1). (b) $p = 10 \times 10^{-6} \times 2 \times 10^{-3} = 2 \times 10^{-8}$ C m; $E = \frac{2\times9\times10^9\times2\times10^{-8}}{(0.15)^3} \approx 1.07 \times 10^5$ N/C (2).

OR (a) Work to add charge dq at potential q/C is dW = (q/C)dq; integrating from 0 to Q, $U = \frac{Q^2}{2C} = \frac{1}{2}CV^2$ (3). (b) C = 2.4 μF, Q = 24 μC on each (1); U = ½QV = 1.2×10^{-4} J (1).

32. (a) Diagram (1½):

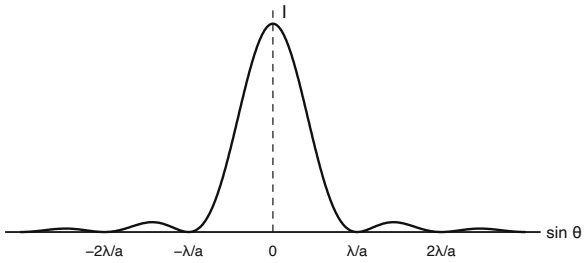


$m = \frac{v_o}{|u_o|}\left(1 + \frac{D}{f_e}\right)$ (½). (b) Eyepiece: $v_e = -25$, so $\frac{1}{u_e} = -\frac{1}{25} - \frac{1}{6.25}$, $u_e = -5$ cm (1). Objective image is at 15 – 5 = 10 cm: $\frac{1}{u_o} = \frac{1}{10} - \frac{1}{2}$, $u_o = -2.5$ cm (1). m = (10/2.5)(1 + 25/6.25)

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= 4 × 5 = 20 (1).

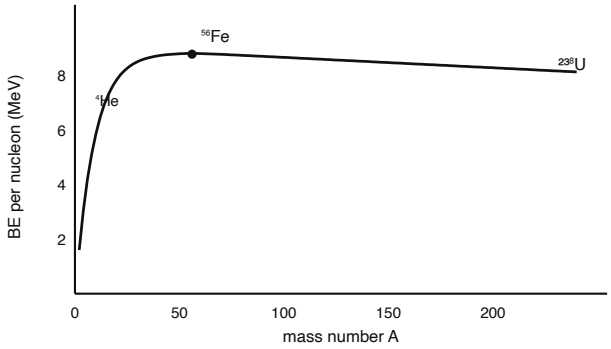
OR (a) A bright central maximum with weaker secondary maxima on both sides; minima where $a\sin\theta = n\lambda$ (2). Pattern (1):



(b) Angular width $= \frac{2\lambda}{a} = 5 \times 10^{-3}$ rad (1). Linear width = 2λD/a = 10 mm (1).

33. (a) Most alpha particles passed straight through; a few were deflected through large angles; about 1 in 8000 bounced back (1½). So most of the atom is empty space, and the positive charge and nearly all the mass are concentrated in a tiny nucleus (1½). (b) $r_0 = \frac{1}{4\pi\varepsilon_0}\cdot\frac{2Ze^2}{K} = \frac{9\times10^9\times2\times79\times(1.6\times10^{-19})^2}{7.7\times10^6\times1.6\times10^{-19}}$ ≈ 3.0 × 10^{-14} m (2).

OR (a) Curve (1):



It rises sharply for light nuclei, peaks near A = 56 (most stable nuclei), and falls slowly for heavy nuclei; so fusion of light nuclei and fission of heavy nuclei both release energy (1). (b) Δm = 2(1.007825) + 2(1.008665) − 4.002603 = 0.030377 u (1). BE = 0.030377 × 931.5 ≈ 28.3 MeV (1); per nucleon ≈ 7.07 MeV (1).

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