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Alternating Current — CBSE Class 12 Physics Chapter Test

FREE CHAPTER TEST · CLASS XII · PHYSICS (042) · PATTERN OF THE CBSE SAMPLE QUESTION PAPER 2026-27

TIME ALLOWED	MAXIMUM MARKS	QUESTIONS	NAME / ROLL NO.
1½ hours	37	17 (A 8 · B 3 · C 3 · D 1 · E 2)	

GENERAL INSTRUCTIONS

Read the following instructions very carefully and strictly follow them:

1. This question paper contains 17 questions. All questions are compulsory.
2. This question paper is divided into five sections: A, B, C, D and E.
3. Section A (Q1–8) contains 6 multiple choice questions and 2 assertion-reason based questions of 1 mark each.
4. Section B (Q9–11) contains short answer questions of 2 marks each.
5. Section C (Q12–14) contains short answer questions of 3 marks each.
6. Section D (Q15) contains case study based questions of 4 marks each, with four sub-parts of 1 mark.
7. Section E (Q16–17) contains long answer questions of 5 marks each.
8. There is no overall choice. However, an internal choice has been provided in 1 question in Section B, 1 question in Section C, 2 questions in Section E. Attempt only one of the alternatives in such questions.
9. Use of calculators is not allowed.
10. This chapter test follows the section structure, question types and marks per question of the CBSE Class XII Physics (042) Sample Question Paper 2026-27, at about half the length of the 70-mark board paper: 37 marks in 1½ hours.
11. The answer key and the marking scheme are at the end of this booklet. Attempt the paper in 1½ hours before you look at them.

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Chapter: Alternating Current · **Topics:** Peak and rms values · AC through a resistor, an inductor and a capacitor · Phasors and the series LCR circuit · Resonance and quality factor · Power and power factor · Transformer

SECTION A

This section comprises 8 questions of 1 mark each: 6 multiple choice questions (MCQs) and 2 assertion-reason based questions.

1. The rms value of the household AC voltage is 220 V. Its peak value is about 1

(A) 156 V (B) 220 V

(C) 311 V (D) 440 V

2. The reactance of a 100 μF capacitor at 50 Hz is about 1

(A) 31.8 Ω (B) 3.18 Ω

(C) 318 Ω (D) 0.0314 Ω

3. In a purely inductive AC circuit, the current 1

(A) leads the voltage by π/2 (B) is in phase with the voltage

(C) leads the voltage by π (D) lags the voltage by π/2

4. A series LCR circuit has L = 0.10 H and C = 10 μF. Its resonant angular frequency is 1

(A) 100 rad s^{-1} (B) 1000 rad s^{-1}

(C) 10 rad s^{-1} (D) 10^4 rad s^{-1}

5. The power factor of a series LCR circuit at resonance is 1

(A) 1 (B) 0

(C) 0.5 (D) 0.707

6. An ideal transformer has 100 turns in its primary and 2000 turns in its secondary. If the primary is connected to 220 V AC, the secondary voltage is 1

(A) 11 V (B) 440 V

(C) 2200 V (D) 4400 V

7. **Assertion (A) :** A capacitor allows an alternating current to flow in a circuit but blocks a steady direct current. 1

Reason (R) : The reactance of an inductor increases with the frequency of the AC.

(A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A).

(B) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of Assertion (A).

(C) Assertion (A) is true, but Reason (R) is false.

(D) Assertion (A) is false and Reason (R) is also false.

8. **Assertion (A) :** The average power in a purely inductive AC circuit is the largest possible for a given voltage. 1

Reason (R) : In a purely inductive AC circuit, the current and the voltage are in phase.

(A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A).

(B) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of Assertion (A).

(C) Assertion (A) is true, but Reason (R) is false.

(D) Assertion (A) is false and Reason (R) is also false.

SECTION B

This section comprises 3 short answer questions of 2 marks each.

9. A 60 Ω resistor and an inductor of reactance 80 Ω are connected in series to a 200 V (rms) AC supply. Find the rms current, the power factor and the average power. 2

10. (a) Show that the average power consumed over a cycle by a pure capacitor connected to an AC source is zero. 2

OR

(b) A bulb rated 100 W, 220 V (treated as a pure resistor) is connected to a 220 V (rms), 50 Hz supply. Find the peak voltage, the resistance of the bulb and the rms current.

11. An ideal step-down transformer with 2000 turns in its primary changes 220 V to 11 V. Find the number of turns in its secondary. If the secondary delivers a current of 4.0 A, find the current in the primary. 2

SECTION C

This section comprises 3 short answer questions of 3 marks each.

12. (a) Using a phasor diagram, derive the expression for the impedance of a series LCR circuit connected to an AC source, and find the phase difference between the current and the voltage. Write the condition for resonance. 3

OR

(b) A 40 Ω resistor and a capacitor of reactance 30 Ω are connected in series to a 100 V (rms) AC source. Find the rms current and the phase difference between the current and the voltage (stating which leads). Find the rms voltages across the resistor and the capacitor, and explain why they do not add up to 100 V.

13. A series circuit has R = 30 Ω, X_L = 80 Ω and X_C = 40 Ω, connected to a 250 V (rms) AC source. Find (i) the impedance, (ii) the rms current, (iii) the phase angle (stating whether the current leads or lags) and the average power. 3

14. (i) Show that the average power in an AC circuit is $V_{rms}I_{rms}\cos\varphi$, where φ is the phase difference between the voltage and the current. 3

(ii) Why is a choke coil (an inductor of small resistance) preferred to a resistor for reducing the current in an AC circuit?

SECTION D

This section comprises 1 case study based question of 4 marks, with four sub-parts of 1 mark each.

15. A power station sends 600 kW of electrical power to a town through a line of total resistance 4.0 Ω. If it is sent at 2000 V, the current in the line is 300 A and 360 kW is lost as heat. So the voltage is first stepped up to 30 kV by a transformer, and stepped down again near the town.

(I) The current in the line at 30 kV is
(A) 300 A (B) 20 A (C) 2.0 A (D) 200 A [1]

(II) The power lost in the line at 30 kV is
(A) 160 W (B) 16 kW (C) 1.6 kW (D) 360 kW [1]

(III) The ratio of primary to secondary turns of the ideal step-up transformer (2000 V to 30 kV) is
(A) 1 : 15 (B) 15 : 1 (C) 1 : 30 (D) 30 : 1 [1]

(IV) A transformer cannot be used with a steady DC supply because
(A) DC is too weak (B) the core would melt (C) DC has no rms value (D) a steady current produces no changing flux [1]

SECTION E

This section comprises 2 long answer questions of 5 marks each.

16. (a) (i) An AC voltage $v = v_0 \sin \omega t$ is applied across a capacitor C. Derive the expression for the current, and show that it leads the voltage by $\pi/2$. Define capacitive reactance. 5
(ii) A 50 μF capacitor is connected to a 220 V (rms), 50 Hz supply. Find its reactance and the rms and peak currents. What happens to the current if the frequency is doubled?

OR

(b) (i) Explain resonance in a series LCR circuit and obtain the resonant frequency. What is meant by the quality factor of the circuit?
(ii) A series LCR circuit with R = 10 Ω, L = 0.20 H and C = 50 μF is connected to a 100 V (rms) source of variable frequency. Find the resonant angular frequency, the current at resonance, the quality factor and the rms voltage across the inductor at resonance.

17. (a) (i) Explain the principle and working of a transformer. For an ideal transformer, derive the relations between the primary and secondary voltages and currents and the numbers of turns. 5
(ii) An ideal step-up transformer changes 230 V to 4600 V and has 50 turns in its primary. Find the turns in its secondary. If it delivers 2.3 kW, find the primary and secondary currents.

OR

(b) (i) An AC voltage $v = v_0 \sin \omega t$ is applied across an inductor L of negligible resistance. Derive the expression for the current and show that it lags the voltage by $\pi/2$. Show that the average power over a cycle is zero.
(ii) An inductor of 0.10 H is connected to a 220 V (rms) supply. Find the rms current at 50 Hz and at 500 Hz.

END OF THE QUESTION PAPER

ANSWER KEY — SECTION A

Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8
(C)	(A)	(D)	(B)	(A)	(D)	(B)	(D)

MARKING SCHEME AND WORKED SOLUTIONS

Marks for each step are shown in brackets, as in the CBSE marking scheme. Any correct alternative method earns full marks.

Q1. Answer (C). $V_0 = \sqrt{2}\, V_{rms} = 1.414 \times 220 \approx 311$ V.

Q2. Answer (A). $X_C = 1/(2\pi fC) = 1/(2\pi \times 50 \times 10^{-4}) \approx 31.8\ \Omega$.

Q3. Answer (D). $v = L\, di/dt$: for $v = v_0 \sin \omega t$, $i = -(v_0/\omega L)\cos \omega t = i_0 \sin(\omega t - \pi/2)$, lagging by $\pi/2$.

Q4. Answer (B). $\omega_0 = 1/\sqrt{(LC)} = 1/\sqrt{(0.10 \times 10 \times 10^{-6})} = 1/10^{-3} = 1000$ rad s^{-1}.

Q5. Answer (A). At resonance $X_L = X_C$, $Z = R$ and $\cos \varphi = R/Z = 1$.

Q6. Answer (D). $V_s = V_p\, N_s/N_p = 220 \times 20 = 4400$ V.

Q7. Answer (B). A is true ($X_C = 1/\omega C$ is infinite for $\omega = 0$). R is true ($X_L = \omega L$) but is about an inductor and does not explain A. Answer (B).

Q8. Answer (D). The phase difference is $\pi/2$, so $\cos \varphi = 0$ and the average power is zero. Both statements are false. Answer (D).

Q9. (2 marks) Answer: 2.0 A; 0.60; 240 W.
$Z = \sqrt{(60^2 + 80^2)} = 100\ \Omega$; $I_{rms} = 200/100 = 2.0$ A. [1]
$\cos \varphi = R/Z = 0.60$; $P = I_{rms}^2 R = 4.0 \times 60 = 240$ W. [1]

Q10. (2 marks) Answer: (a) average of $\sin 2\omega t$ is zero; (b) ≈ 311 V; 484 Ω; ≈ 0.45 A.
(a) For $v = v_0 \sin \omega t$ the current $i = i_0 \cos \omega t$ (leads by $\pi/2$), so $p = vi = v_0 i_0 \sin \omega t \cos \omega t = \tfrac{1}{2} v_0 i_0 \sin 2\omega t$. [1]
The average of $\sin 2\omega t$ over a complete cycle is zero, so the average power is zero (the capacitor stores energy for one quarter cycle and returns it in the next). [1]
OR (b) $V_0 = \sqrt{2} \times 220 \approx 311$ V. $R = V^2/P = 220^2/100 = 484\ \Omega$. [1]
$I_{rms} = P/V_{rms} = 100/220 \approx 0.45$ A. [1]

Q11. (2 marks) Answer: 100 turns; 0.20 A.
$N_s = N_p V_s/V_p = 2000 \times 11/220 = 100$ turns. [1]
Ideal: $V_p I_p = V_s I_s$, so $I_p = 11 \times 4.0/220 = 0.20$ A. [1]

Q12. (3 marks) Answer: (a) $Z = \sqrt{(R^2 + (X_L - X_C)^2)}$; (b) 2.0 A; ≈ 37°, current leads.
(a) The same current i flows through all three. Phasors: $V_R = iR$ along i, $V_L = iX_L$ ahead of i by $\pi/2$, $V_C = iX_C$ behind i by $\pi/2$. [1]
V_L and V_C are opposite, so $V^2 = V_R^2 + (V_L - V_C)^2 = i^2[R^2 + (X_L - X_C)^2]$, giving $Z = \sqrt{(R^2 + (X_L - X_C)^2)}$. [1]
$\tan \varphi = (X_L - X_C)/R$. Resonance when $X_L = X_C$, i.e. $\omega_0 = 1/\sqrt{(LC)}$: $Z = R$ is the least and the current the largest. [1]
OR (b) $Z = \sqrt{(R^2 + X_C^2)} = \sqrt{(40^2 + 30^2)} = 50\ \Omega$; $I_{rms} = 100/50 = 2.0$ A. [1]
$\tan \varphi = X_C/R = 0.75$, $\varphi \approx 37°$, the current leading the voltage. [1]
$V_R = 80$ V and $V_C = 60$ V; they add as phasors (at right angles), $\sqrt{(80^2 + 60^2)} = 100$ V, not as numbers. [1]

Q13. (3 marks) Answer: (i) 50 Ω; (ii) 5.0 A; (iii) ≈ 53°, lags; 750 W.

(i) $Z = \sqrt{(30^2 + (80 - 40)^2)} = 50\ \Omega$. [1]

(ii) $I_{rms} = 250/50 = 5.0$ A. [1]

(iii) $\tan\varphi = 40/30$, $\varphi \approx 53°$; $X_L > X_C$, so the current lags. $P = I_{rms}^2 R = 25 \times 30 = 750$ W. [1]

Q14. (3 marks) Answer: (i) $P = V_{rms} I_{rms} \cos\varphi$.

(i) $v = v_0 \sin\omega t$, $i = i_0 \sin(\omega t - \varphi)$: $vi = \tfrac{1}{2} v_0 i_0 [\cos\varphi - \cos(2\omega t - \varphi)]$. [1] The second term averages to zero over a cycle, so $P = \tfrac{1}{2} v_0 i_0 \cos\varphi = V_{rms} I_{rms} \cos\varphi$. [1]

(ii) For a choke $\varphi \approx 90°$, so $\cos\varphi \approx 0$ and it reduces the current while wasting almost no power; a resistor would waste power as heat. [1]

Q15. (4 marks) Answer: (I) B; (II) C; (III) A; (IV) D.

(I) (B) $I = P/V = 600 \times 10^3 / 30 \times 10^3 = 20$ A. [1]

(II) (C) $I^2R = 20^2 \times 4.0 = 1600$ W $= 1.6$ kW. [1]

(III) (A) $N_p/N_s = V_p/V_s = 2000/30\,000 = 1 : 15$. [1]

(IV) (D) A transformer works by mutual induction, which needs a changing flux. [1]

Q16. (5 marks) Answer: (a) $X_C \approx 63.7\ \Omega$; ≈ 3.5 A; ≈ 4.9 A; doubles; (b) ≈ 316 rad s^{-1}; 10 A; Q ≈ 6.3; ≈ 630 V.

(a) (i) $q = Cv = Cv_0 \sin\omega t$, so $i = dq/dt = \omega C v_0 \cos\omega t = i_0 \sin(\omega t + \pi/2)$, with $i_0 = v_0/(1/\omega C)$. [2] The current leads by $\pi/2$; $X_C = 1/\omega C$ plays the part of resistance. [1]

(ii) $X_C = 1/(2\pi \times 50 \times 50 \times 10^{-6}) \approx 63.7\ \Omega$; $I_{rms} = 220/63.7 \approx 3.5$ A; $I_0 = \sqrt{2} \times 3.46 \approx 4.9$ A. [1] Doubling f halves X_C, so the current doubles. [1]

OR (b) (i) $I = V/\sqrt{(R^2 + (\omega L - 1/\omega C)^2)}$ is largest when $\omega L = 1/\omega C$, i.e. $\omega_0 = 1/\sqrt{(LC)}$; the current against ω curve peaks there, sharply for small R. [2] Quality factor $Q = \omega_0 L/R = (1/R)\sqrt{(L/C)}$ measures the sharpness: a larger Q gives a narrower peak. [1]

(ii) $\omega_0 = 1/\sqrt{(0.20 \times 50 \times 10^{-6})} \approx 316$ rad s^{-1}; $I_{rms} = V/R = 10$ A. [1] $Q = \omega_0 L/R \approx 6.3$; $V_L = I\omega L \approx 10 \times 63 \approx 630$ V, more than the supply voltage (V_L and V_C cancel each other). [1]

Q17. (5 marks) Answer: (a) 1000 turns; 10 A; 0.50 A; (b) $X_L = \omega L$; ≈ 7.0 A; ≈ 0.70 A.

(a) (i) Principle: mutual induction. Two coils are wound on a common soft-iron core; an alternating current in the primary sets up an alternating flux which links the secondary and induces an emf in it. [1] With the same flux Φ per turn in both: $\varepsilon_p = -N_p\, d\Phi/dt$ and $\varepsilon_s = -N_s\, d\Phi/dt$, so $V_s/V_p = N_s/N_p$. [1] With no losses $V_p I_p = V_s I_s$, so $I_p/I_s = N_s/N_p$. [1]

(ii) $N_s = 50 \times 4600/230 = 1000$ turns. [1] $I_p = 2300/230 = 10$ A; $I_s = 2300/4600 = 0.50$ A. [1]

OR (b) (i) Kirchhoff: $v_0 \sin\omega t = L\, di/dt$, so $i = -(v_0/\omega L)\cos\omega t = i_0 \sin(\omega t - \pi/2)$: the current lags by $\pi/2$, with $X_L = \omega L$. [2] $p = vi = -\tfrac{1}{2} v_0 i_0 \sin 2\omega t$, whose average over a cycle is zero. [1]

(ii) At 50 Hz: $X_L = 2\pi \times 50 \times 0.10 \approx 31.4\ \Omega$, $I = 220/31.4 \approx 7.0$ A. [1] At 500 Hz X_L is 10 times larger: $I \approx 0.70$ A. [1]

All questions are original and © Master Testing Agency. Free to download and use for personal practice; not for resale. Every answer in this paper was checked independently by computer: impedances and phases with complex numbers, average powers by integrating v × i over a cycle, the resonance by scanning the frequency for the largest current.