CLASS 12 PHYSICS NCERT SOLUTIONS

NCERT Solutions for Class 12 Physics Chapter 7: Alternating Current – Free PDF Download

Chapter 7 moves from steady currents to alternating current (AC) circuits -- how resistors, inductors, and capacitors respond to a sinusoidally varying voltage, and how resonance in an LCR circuit and transformers underpin power transmission. These worked solutions cover rms values, reactance, resonance, and the Q-f...

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NCERT Exercise Solutions

7.1 A 100Ω resistor is connected to a 220V, 50Hz ac supply. (a) What is the rms value of current in the circuit? (b) What is the net power consumed over a full cycle?
Ans: (a) $I_{rms}=V_{rms}/R=220/100=$**2.2A**. (b) Net power $P=V_{rms}I_{rms}=220\times2.2=$**484W**.

7.2 (a) The peak voltage of an ac supply is 300V. What is the rms voltage? (b) The rms value of current in an ac circuit is 10A. What is the peak current?
Ans: (a) $V_{rms}=V_0/\sqrt{2}=300/1.414\approx$**212.1V**. (b) $I_0=I_{rms}\times\sqrt{2}=10\times1.414\approx$**14.14A**.

7.3 A 44mH inductor is connected to 220V, 50Hz ac supply. Determine the rms value of the current in the circuit.
Ans: Inductive reactance $X_L=2\pi fL=2\pi\times50\times0.044\approx13.82\Omega$. $I_{rms}=V_{rms}/X_L=220/13.82\approx$**15.92A**.

7.4 A 60μF capacitor is connected to a 110V, 60Hz ac supply. Determine the rms value of the current in the circuit.
Ans: Capacitive reactance $X_C=1/(2\pi fC)=1/(2\pi\times60\times0.00006)\approx44.21\Omega$. $I_{rms}=V_{rms}/X_C=110/44.21\approx$**2.49A**.

7.5 In Exercises 7.3 and 7.4, what is the net power absorbed by each circuit over a complete cycle? Explain your answer.
Ans: The average power absorbed over a complete cycle is **zero for both circuits**. In a purely inductive or purely capacitive ac circuit, the current and voltage are 90° out of phase, so the average of $P=V_{rms}I_{rms}\cos\varphi$ over a cycle is zero ($\cos90°=0$) — the energy delivered to the reactive element during one quarter-cycle is returned to the source during the next, with no net energy dissipated.

7.6 Obtain the resonant frequency ω_r of a series LCR circuit with L=2.0H, C=32μF and R=10Ω. What is the Q-value of this circuit?
Ans: $\omega_r=1/\sqrt{(LC)}=1/\sqrt{(2.0\times0.000032)}=$**125 rad/s**. Q-factor $Q=(1/R)\sqrt{(L/C)}=(1/10)\sqrt{(2.0/0.000032)}=$**25**.

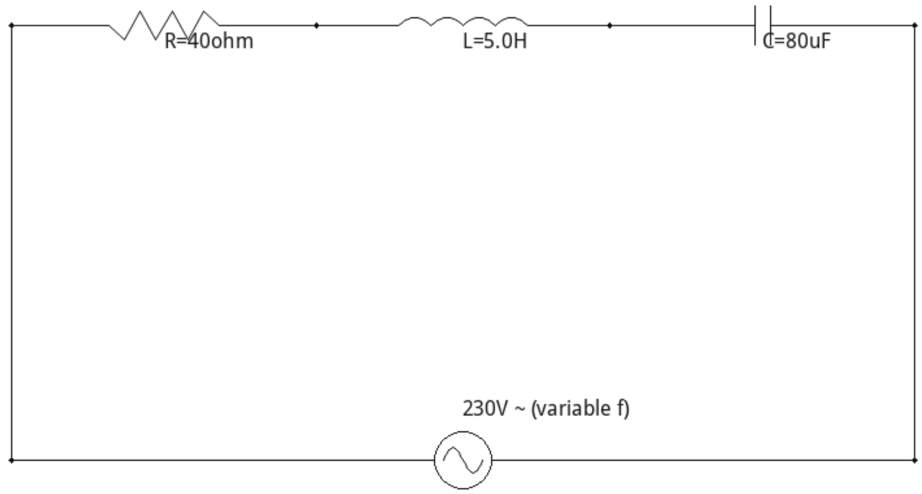
7.7 A charged 30μF capacitor is connected to a 27mH inductor. What is the angular frequency of free oscillations of the circuit?
Ans: $\omega=1/\sqrt{(LC)}=1/\sqrt{(0.027\times0.00003)}\approx$**1111 rad/s**.

7.8 Suppose the initial charge on the capacitor in Exercise 7.7 is 6mC. What is the total energy stored in the circuit initially? What is the total energy at a later time?
Ans: Initial energy (stored entirely in the capacitor, since the inductor carries no current yet) $E=Q^2/(2C)=(0.006)^2/(2\times0.00003)=$**0.6J**. Since this is an ideal LC circuit with no resistance, **no energy is dissipated**: the total energy remains 0.6J at all later times too, continuously exchanging between the capacitor (electrical energy) and the inductor (magnetic energy) as the circuit oscillates.

7.9 A series LCR circuit with R=20Ω, L=1.5H and C=35μF is connected to a variable-frequency 200V ac supply. When the frequency of the supply equals the natural frequency of the circuit, what is the average power transferred to the circuit in one complete cycle?
Ans: At resonance (supply frequency = natural frequency), the inductive and capacitive reactances cancel, so the circuit is purely resistive (Z=R) and power transfer is maximum: $P=V_{rms}^2/R=200^2/20=$**2000W**.

7.10 A radio can tune over the frequency range of a portion of MW broadcast band: (800kHz to 1200kHz). If its LC circuit has an effective inductance of 200μH, what must be the range of its variable capacitor?
Ans: Using $C=1/(\omega^2L)$ with $\omega=2\pi f$: at f=800kHz, C≈**197.9pF**; at f=1200kHz, C≈**88.0pF**. So the variable capacitor must range from about **88pF to 198pF** (capacitance decreases as the tuned frequency increases).

7.11 Figure 7.21 shows a series LCR circuit connected to a variable frequency 230V source. L=5.0H, C=80μF, R=40Ω. (a) Determine the source frequency which drives the circuit into resonance. (b) Obtain the impedance of the circuit and the amplitude of current at the resonating frequency. (c) Determine the rms potential drops across the three elements of the circuit.
Ans: (a) $\omega_0=1/\sqrt{(LC)}=1/\sqrt{(5.0\times0.00008)}=50$ rad/s, so $f_0=\omega_0/2\pi\approx$**7.96Hz**. (b) At resonance the impedance is purely resistive: **Z=R=40Ω**. Current amplitude $I_0=V_0/Z=(230\times\sqrt{2})/40\approx$**8.13A**. (c) $I_{rms}=V_{rms}/R=230/40=5.75$A. Drop across R: $V_R=I_{rms}R=$**230V** (equal to the source, as expected at resonance). $X_L=X_C=\omega_0L=50\times5.0=250\Omega$ at resonance, so the drops across L and C are equal: $V_L=V_C=I_{rms}\times250\approx$**1437.5V** each — individually far larger than the source voltage, but exactly cancelling each other (180° out of phase), so the net LC drop is zero and the full 230V appears across R alone.



Series LCR circuit: R=40ohm, L=5.0H, C=80uF, variable-frequency 230V ac source.

Class 12 Physics Chapter 7 – Notes and Extra Questions

Along with these NCERT Solutions, students can also use the Class 12 Physics Chapter 7 Extra Questions and Class 12 Physics Chapter 7 Revision Notes for quick revision and extra practice.

See also: Chapter 1 | Chapter 2 | Chapter 3 | Chapter 4 | Chapter 5 | Chapter 6

Practice more: Chapter 1 | Chapter 2 | Chapter 3 | Chapter 4 | Chapter 5 | Chapter 6

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