

Alternating Current — Assignment 1

Class 12 Physics · Topic-wise question bank covering every concept of the chapter · Narayan Gurukul Academy

Instructions: (1) Attempt all questions. This worksheet walks through every concept of the chapter, topic by topic.
(2) The interactive MCQ version of these questions (with instant answer reveal) is available on the notes page.
(3) Universal values: $g = 10 \text{ m/s}^2$ unless stated. Give answers with correct SI units.

RMS and Average Values

MCQ Questions (choose the correct option)

- The RMS value of an alternating current is
 - $I_0/\sqrt{2}$
 - $I_0\sqrt{2}$
 - $I_0/2$
 - $2I_0$
- The average value of an alternating current over a full cycle is
 - zero
 - $I_0/\sqrt{2}$
 - $I_0/2$
 - $2I_0/\pi$
- The peak value and the RMS value of an AC are related by
 - $I_0 = \sqrt{2} I_{\text{rms}}$
 - $I_0 = I_{\text{rms}}/\sqrt{2}$
 - $I_0 = 2 I_{\text{rms}}$
 - $I_0 = I_{\text{rms}}$
- The RMS value of AC is also called its
 - effective value
 - peak value
 - average value
 - instantaneous value

1 Mark Questions

- Define the RMS value of an alternating current.
- Write the relation between the peak and RMS values of an AC.
- What is the average value of an alternating current over one complete cycle?

2 Mark Questions

- Define the RMS value of an alternating current and derive $I_{\text{rms}} = I_0/\sqrt{2}$.
- An AC has a peak value of 14.14 A. Find its RMS value. (Ans: 10 A)

3 Mark Questions

- Derive the expression for the RMS value of an alternating current, and explain why it is called the effective value.
- Derive the expressions for the average and RMS values of an alternating voltage over a half cycle.

Reactance and Impedance

MCQ Questions (choose the correct option)

- The inductive reactance of a coil carrying AC of frequency ω is
 - ωL
 - $1/\omega L$
 - ω/L
 - L/ω
- The capacitive reactance of a capacitor at angular frequency ω is
 - $1/\omega C$
 - ωC
 - ω/C
 - C/ω
- The impedance of an LCR series circuit is
 - $\sqrt{R^2 + (X_L - X_C)^2}$
 - $R + X_L + X_C$
 - $\sqrt{R^2 + X_L^2 + X_C^2}$
 - $R - X_L + X_C$
- In a purely inductive AC circuit, the current
 - lags the voltage by $\pi/2$
 - leads the voltage by $\pi/2$
 - is in phase with the voltage
 - leads the voltage by π

1 Mark Questions

- Define inductive reactance and give its SI unit.
- Define capacitive reactance.
- Write the expression for the impedance of a series LCR circuit.

2 Mark Questions

- Define inductive and capacitive reactance, and state how each varies with frequency.
- A 0.1 H inductor is connected to an AC source of angular frequency 100 rad/s. Find the inductive reactance. (Ans: 10 Ω)

3 Mark Questions

- Draw the phasor diagram for a series LCR circuit and derive the expression for its impedance and the phase angle.
- Derive the expression for the impedance of a series LCR circuit and discuss the special cases of a pure inductor and a pure capacitor.

Resonance

MCQ Questions (choose the correct option)

- At resonance in a series LCR circuit, the impedance is
 - minimum and equal to R
 - maximum
 - zero
 - infinite

2. The resonant angular frequency of a series LCR circuit is
 - (A) $1/\sqrt{LC}$
 - (B) $\sqrt{LC}$
 - (C) LC
 - (D) $1/LC$
3. At resonance, the current in a series LCR circuit is
 - (A) maximum
 - (B) minimum
 - (C) zero
 - (D) infinite
4. At resonance, the phase difference between voltage and current is
 - (A) zero
 - (B) $\pi/2$
 - (C) π
 - (D) $\pi/4$

1 Mark Questions

1. Define resonance in a series LCR circuit.
2. Write the expression for the resonant angular frequency.
3. What is the impedance of a series LCR circuit at resonance?

2 Mark Questions

1. Define resonance and derive the condition for resonance in a series LCR circuit.
2. An LCR circuit has $L = 0.5 \text{ H}$ and $C = 20 \mu\text{F}$. Find its resonant frequency. (Ans: $\approx 50.3 \text{ Hz}$)

3 Mark Questions

1. Explain resonance in a series LCR circuit, derive the resonant frequency, and sketch the variation of current with frequency.
2. Define the quality factor Q of a series LCR circuit, derive its expression, and explain its physical significance.

Power and Power Factor

MCQ Questions (choose the correct option)

1. The average power in an AC circuit is
 - (A) $V_{\text{rms}} I_{\text{rms}} \cos\phi$
 - (B) $V_{\text{rms}} I_{\text{rms}}$
 - (C) $V_{\text{rms}} I_{\text{rms}} \sin\phi$
 - (D) $V_{\text{rms}}/I_{\text{rms}}$
2. The power factor of a purely inductive circuit is
 - (A) zero
 - (B) one
 - (C) 0.5
 - (D) 0.707
3. The power factor of a purely resistive circuit is
 - (A) one

- (B) zero
 - (C) 0.5
 - (D) 0.707
4. The term $\cos\phi$ in the power equation is called the
- (A) power factor
 - (B) form factor
 - (C) quality factor
 - (D) peak factor

1 Mark Questions

1. Write the expression for the average power in an AC circuit.
2. What is the power factor of a purely inductive circuit?
3. Define the power factor.

2 Mark Questions

1. Define the power factor of an AC circuit and state its value for pure resistance, pure inductance and pure capacitance.
2. An AC circuit has a power factor of 0.8 and draws $V_{\text{rms}} = 200 \text{ V}$, $I_{\text{rms}} = 5 \text{ A}$. Find the average power. (Ans: 800 W)

3 Mark Questions

1. Derive the expression for the average power dissipated in a series LCR circuit and explain the significance of the power factor.
2. Show that the average power consumed in a pure inductor or a pure capacitor over a complete cycle is zero.

LC Oscillations

MCQ Questions (choose the correct option)

1. In an LC oscillator, energy oscillates between
 - (A) the electric field of the capacitor and the magnetic field of the inductor
 - (B) two capacitors
 - (C) two inductors
 - (D) the resistor and the capacitor
2. The frequency of LC oscillations is
 - (A) $1/2\pi\sqrt{LC}$
 - (B) $2\pi\sqrt{LC}$
 - (C) $1/LC$
 - (D) $\sqrt{LC}/2\pi$
3. At the instant the capacitor is fully charged in an LC circuit, the current is
 - (A) zero
 - (B) maximum
 - (C) half maximum
 - (D) infinite
4. The total energy in an ideal LC oscillator is
 - (A) constant
 - (B) zero
 - (C) increasing

(D) decreasing

1 Mark Questions

1. What is an LC oscillator?
2. Write the expression for the frequency of LC oscillations.
3. What is the total energy in an ideal LC circuit at any instant?

2 Mark Questions

1. Explain the analogy between an LC oscillator and a mechanical oscillator.
2. An LC circuit has $L = 2 \text{ mH}$ and $C = 8 \text{ }\mu\text{F}$. Find the frequency of oscillation. (Ans: $\approx 1258 \text{ Hz}$)

3 Mark Questions

1. Describe the energy changes in an LC oscillator and show that the total energy remains constant.
2. For an LC oscillator, show the analogy between electrical quantities (q , i) and mechanical quantities (x , v), and derive the frequency of oscillation.