Prachand NEET 2025

Physics

Alternating Current

DPP : 01

Q1 For an alternating current varying with time according to the relation $I = I_0 \sin \omega t$, identify the correct relation between I_0, I_{rms} and I_{av}. (I_0 is the peak value, I_{rms} is the root mean square value and I_{av} is the average value).
(1) $I_0 = I_{\text{rms}} = I_{\text{av}}$
(2) $I_0 > I_{\text{rms}} > I_{\text{av}}$
(3) $I_0 < I_{\text{rms}} = I_{\text{av}}$
(4) $I_0 < I_{\text{rms}} < I_{\text{av}}$

Q2 If alternating current in a circuit is given by: $I = I_0 \sin 2\pi nt$, then the minimum time taken by the current to change from rms value to zero is equal to;
(1) $\left(\frac{1}{n}\right)$
(2) $\left(\frac{1}{2n}\right)$
(3) $\left(\frac{1}{4n}\right)$
(4) $\left(\frac{1}{8n}\right)$

Q3 The peak value of an alternating e.m.f. $E = E_0 \sin \omega t$ is 10 volt and its frequency is 50 Hz. At a time $t = \frac{1}{600}$ s, the instantaneous value of the e. m. f. is
(1) 1 volt
(2) $5\sqrt{3}$ volt
(3) 5 volt
(4) 10 volt

Q4 An alternating voltage is represented as $E = 20 \sin 300t$. The average value of voltage over one cycle will be:
(1) Zero
(2) 10 volt
(3) $20\sqrt{2}$ volt
(4) $\frac{20}{\sqrt{2}}$ volt

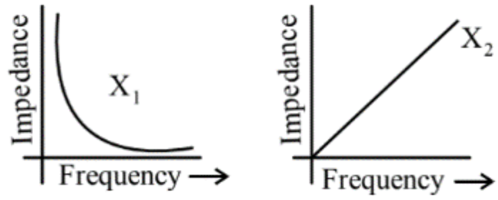
Q5 In a purely resistive a.c circuit, the current
(1) lags behind the e.m.f. in phase
(2) is in phase with the e.m.f.
(3) leads the e.m.f. in phase
(4) leads the e.m.f. in half the cycle and lags behind it in the other half

Q6 The inductive reactance of an inductor of $\frac{1}{\pi}$ henry at 50 Hz frequency is
(1) $\frac{50}{\pi}$ ohm
(2) $\frac{\pi}{50}$ ohm
(3) 100 ohm
(4) 50 ohm

Q7 **Statement-I:** The r.m.s value of alternating current is defined as the square root of the average of I^2 during a complete cycle.
Statement-II: For sinusoidal a.c. $(I = I_0 \sin \omega t)$ $I_{rms} = \frac{I_0}{\sqrt{2}}$.
(1) Statement I and Statement II both are correct.
(2) Statement I is correct but Statement II is incorrect.
(3) Statement I is incorrect but Statement II is correct.
(4) Statement I and Statement II both are incorrect.

Q8 An alternating voltage E (in volts) $= 200\sqrt{2} \sin 100t$ is connected to one micro farad capacitor through an a.c. ammeter. The reading of the ammeter shall be
(1) 100 mA
(2) 20 mA
(3) 40 mA
(4) 80 mA

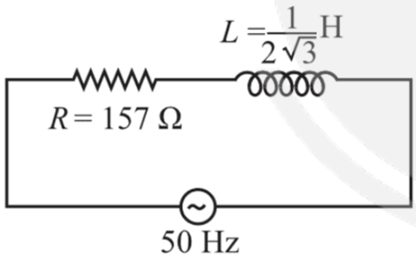
Q9 The graphs given below depict the dependence of two reactive impedances X_1 and X_2 on the frequency of the alternating e.m.f. applied individually to them. We can then say that:



(1) X_1 is an inductor and X_2 is a capacitor
(2) X_1 is a resistor and X_2 is a capacitor
(3) X_1 is a capacitor and X_2 is an inductor
(4) X_1 is an inductor and X_2 is a resistor

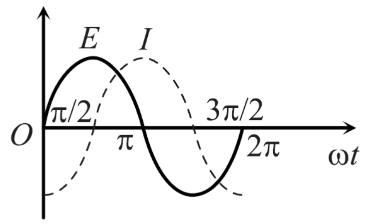
Q10 Power factor of an ideal choke coil (i.e., $R=0$) is
(1) Near about zero
(2) Zero
(3) Near about one
(4) One

Q11 In an $L-R$ circuit, AC source of frequency $50 \mathrm{~Hz}$ is connected as shown in the figure. The phase difference between voltage and current is



(1) 90°
(2) 60°
(3) 45°
(4) 30°

Q12 The variation of the instantaneous current (I) and the instantaneous emf (E) in a circuit is as shown in fig. Which of the following statements is correct ?



(1) The voltage lags behind the current by $\pi / 2$
(2) The voltage leads the current by $\pi / 2$
(3) The voltage and the current are in phase
(4) The voltage leads the current by π

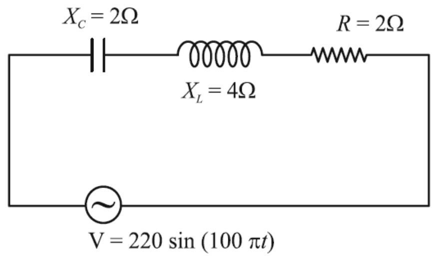
Q13 A direct current of $10 \mathrm{~A}$ is superimposed on an alternating current $I=40 \cos \omega t$ (A) flowing through a wire. The effective value of the resulting current will be
(1) $10 \sqrt{2} \mathrm{~A}$
(2) $20 \sqrt{2} \mathrm{~A}$
(3) $20 \sqrt{3} \mathrm{~A}$
(4) $30 \mathrm{~A}$

Q14 In an ac circuit, the current lags behind the voltage by $\pi / 3$. The components in the circuit are
(1) R and L
(2) R and C
(3) L and C
(4) Only R

Q15 An $L C R$ circuit contains $R=50\ \Omega, L=1 \mathrm{~mH}$ and $C=0.1\ \mu F$. The impedance of the circuit will be minimum for a frequency of
(1) $\frac{10^{5}}{2 \pi} \mathrm{~s}^{-1}$
(2) $\frac{10^{6}}{2 \pi} \mathrm{~s}^{-1}$
(3) $2 \pi \times 10^{5} \mathrm{~s}^{-1}$
(4) $2 \pi \times 10^{6} \mathrm{~s}^{-1}$

Q16 A coil has resistance $30\ \Omega$ and inductive reactance $20\ \Omega$ at $50 \mathrm{~Hz}$ frequency. If an ac source, of $200 \mathrm{~V}, 100 \mathrm{~Hz}$ is connected across the coil, the current in the coil will be
(1) $\frac{20}{\sqrt{13}} \mathrm{~A}$
(2) $2.0 \mathrm{~A}$
(3) $4.0 \mathrm{~A}$
(4) $8.0 \mathrm{~A}$

Q17 In the following A.C. circuit, the rms value of the current through the source will be;



(1) $60\ \mathrm{A}$
(2) $55\ \mathrm{A}$
(3) $78\ \mathrm{A}$
(4) $96\ \mathrm{A}$

Q18 Which of the following statements are **CORRECT** regarding series LCR AC circuit?
Statement I: The current and voltage are in same phase at resonance.
Statement II: The current at resonance does not depend on resistance.
(1) I only
(2) II only
(3) I and II
(4) Neither I nor II

Q19 **Assertion (A):** If the frequency of alternating current in an ac circuit consisting of an inductance coil is increased then current gets decreased.
Reason (R): The current is inversely proportional to frequency of alternating current.
(1) Both Assertion (A) and Reason (R) are true, and Reason (R) is a correct explanation of Assertion (A).
(2) Both Assertion (A) and Reason (R) are true, but Reason (R) is not a correct explanation of Assertion (A).
(3) Assertion (A) is true, and Reason (R) is false.
(4) Assertion (A) is false, and Reason (R) is true.

Q20 A series LCR circuit is connected across a source of emf $E = 20\sin\left(50\pi t - \frac{\pi}{3}\right)\mathrm{V}$. If a current $= 10\sin(50\pi t)\ \mathrm{A}$ flows in the circuit, then the power dissipated through circuit is (t is in s):
(1) $50\sqrt{2}\ \mathrm{W}$
(2) $50\ \mathrm{W}$
(3) $50\sqrt{3}\ \mathrm{W}$
(4) $100\ \mathrm{W}$

Q21 An inductor of inductance L and resistor of resistance R are joined in series and connected to a source of frequency ω and voltage V. Power dissipated in the circuit is
(1) $\frac{(R^2+\omega^2L^2)}{V}$
(2) $\frac{V^2R}{(R^2+\omega^2L^2)}$
(3) $\frac{V}{(R^2+\omega^2L^2)}$
(4) $\frac{\sqrt{R^2+\omega^2L^2}}{V^2}$

Q22 A transformer has 2000 turns in the primary coil and carries $1\ \mathrm{A}$ current. If the input power is 2.5 kW then the number of turns in the secondary coil to have $1000\ \mathrm{V}$ output will be:
(1) 600
(2) 8000
(3) 800
(4) 100

Q23 In LCR circuit, the capacitance is changed from C to $4C$. For the same resonant frequency, the inductance should be changed from L to
(1) $2L$
(2) $L/2$
(3) $L/4$
(4) $4L$

Q24 In a series LCR circuit, resistance $R = 10\ \Omega$ and the impedance $Z = 20\ \Omega$. The phase difference between the current and the voltage is
(1) 30°
(2) 45°
(3) 60°
(4) 90°

Q25 The output voltage of an ideal transformer, connected to a $220\ \mathrm{V}$ a.c. mains is $22\ \mathrm{V}$. When this transformer is used to light a bulb with rating $22\ \mathrm{V}$, $22\ \mathrm{W}$, then the current in the primary coil of the circuit is;
(1) $0.1\ \mathrm{A}$
(2) $0.2\ \mathrm{A}$
(3) $0.4\ \mathrm{A}$
(4) $0.6\ \mathrm{A}$

Q26 An AC voltage source of variable angular frequency ω and fixed amplitude V is connected in series with a capacitance C and an electric bulb of resistance R (inductance zero). When ω

is increased;

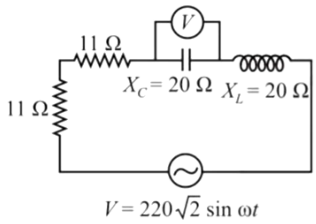
(1) the bulb glows dimmer

(2) the bulb glows brighter

(3) total impedance of the circuit is unchanged

(4) total impedance of the circuit increases

Q27 The reading of the A.C. voltmeter in the network shown in figure is: (where V is in volt)



(1) 400 V

(2) 220 V

(3) 200 V

(4) Zero

Q28 In an a.c circuit, $I = 100\sin 200\pi t$. The time required for the current to achieve its peak value will be:

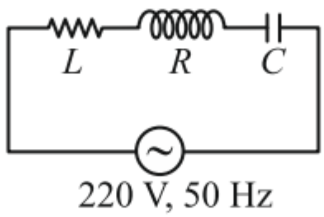
(1) $\frac{1}{100}$ sec

(2) $\frac{1}{200}$ sec

(3) $\frac{1}{300}$ sec

(4) $\frac{1}{400}$ sec

Q29 In series LCR circuit, $R = 100\Omega, C = \frac{200}{\pi}\mu\text{F}$, and $L = \frac{500}{\pi}\text{mH}$ are connected to an A.C. source as shown in figure.



The rms value of A.C. voltage is 220 V and its frequency is 50 Hz. In List I, some physical quantities are mentioned, while in List II, information about quantities are provided. Match the entries of List I with entries of List II.

	List I		List II
(i)	Impedence of the circuit	(a)	Zero
(ii)	Average power dissipated in the inductor is	(b)	484 SI units
(iii)	Average power dissipated in the capacitor is	(c)	100 SI units
(iv)	Rms value of voltage across the resistor	(d)	220 SI units

(1) (i)-(b); (ii)-(d); (iii)-(a); (iv)-(c)

(2) (i)-(c); (ii)-(a); (iii)-(a); (iv)-(d)

(3) (i)-(d); (ii)-(a); (iii)-(a); (iv)-(b)

(4) (i)-(d); (ii)-(c); (iii)-(a); (iv)-(c)

Q30 The core of a transformer is laminated so that:

(1) Ratio of voltage in primary and secondary may be increased

(2) Energy losses due to eddy currents may be minimised

(3) The weight of the transformer may be reduced

(4) Rusting of the core may be prevented

Answer Key

Q1	(2)
Q2	(4)
Q3	(3)
Q4	(1)
Q5	(2)
Q6	(3)
Q7	(1)
Q8	(2)
Q9	(3)
Q10	(2)
Q11	(4)
Q12	(2)
Q13	(4)
Q14	(1)
Q15	(1)
Q16	(3)
Q17	(2)
Q18	(1)
Q19	(1)
Q20	(2)
Q21	(2)
Q22	(3)
Q23	(3)
Q24	(3)
Q25	(1)
Q26	(2)
Q27	(3)
Q28	(4)
Q29	(2)
Q30	(2)

Hints & Solutions

Note: scan the QR code to watch video solution

Q1 Text Solution:

(2)

$I_{rms} = \frac{I_0}{\sqrt{2}} = 0.707 I_0;$

$I_{av} = \frac{2I_0}{\pi} = 0.636\ I_0$

$So,$

$I_0 > I_{rms} > I_{av}$

Video Solution:

Q2 Text Solution:

(4)

Minimum time taken to change from rms value to zero is equal to time taken to change from zero to rms value.

$$I_{rms} = \frac{I_0}{\sqrt{2}} = I_0 \sin 2\pi n t$$

$$\sin \frac{\pi}{4} = \sin 2\pi n t$$

$$\Rightarrow 2\pi n t = \frac{\pi}{4}$$

$$\Rightarrow t = \frac{1}{8n}$$

Video Solution:

Q3 Text Solution:

(3)

Here we have

$E = E_0\ \sin\ \omega t$

$= 10\ \sin\ [2\pi f t]$

At t $= \frac{1}{600}$s

$\mathrm{E} = 10\ \sin\ \left[2 \times \pi \times 50 \times \frac{1}{600}\right]$

$= 10\ \sin\ \left(\frac{\pi}{6}\right)$

$= 10 \times \frac{1}{2} = 5\ \mathrm{V}$

Video Solution:

Q4 Text Solution:

(1)

Over one cycle average value of any sinusoidal source is equal to zero.

Video Solution:

Q5 Text Solution:

(2)

In purely resistive circuit, current and voltage always remain in phase.

Video Solution:

Q6 Text Solution:

(3)

$$X_L = 2\pi\nu L = 2 \times \pi \times 50 \times \frac{1}{\pi} = 100\ \Omega$$

Video Solution:

Q7 Text Solution:

(1)

Definition of rms current, $I_{rms} = \sqrt{\frac{\int_0^T I^2 dt}{\int_0^T dt}}$

If $I = I_0 \sin \omega t$ then $I_{rms} = \sqrt{\frac{1}{T} \int_0^T I^2 dt};$

$$I_{rms} = \sqrt{\frac{1}{T} \int_0^T I_0^2 \sin^2 \omega t \, dt} = \frac{I_0}{\sqrt{2}}$$

So, both statements are true.

Video Solution:

Q8 Text Solution:

(2)

$I_{rms} = \frac{E_{rms}}{X_C} = \frac{E_0/\sqrt{2}}{1/\omega C} = \omega C \frac{E_0}{\sqrt{2}}$

$= 100 \times 1 \times 10^{-6} \times \frac{200\sqrt{2}}{\sqrt{2}}$

$= 2 \times 10^{-2}\ A \ = \ 20\ mA$

Video Solution:

Q9 Text Solution:

(3)

For inductor, $X_L = \omega L \Rightarrow X_L \propto \omega$

For capacitor, $X_C = \frac{1}{\omega C} \Rightarrow X_C \propto \frac{1}{\omega}$

X_1 is capacitor and X_2 is inductor.

Video Solution:

Q10 Text Solution:

(2)

Power factor,

$\cos \phi = \frac{R}{Z} = 0$

Video Solution:

Q11 Text Solution:

(4)

$$\tan \phi = \frac{2\pi f L}{R} = \frac{2 \times 3.14 \times 50}{157} \times \frac{1}{2\sqrt{3}}$$

$$= \frac{1}{\sqrt{3}}$$

$\phi = 30^\circ$

Video Solution:

Q12 Text Solution:

(2)

At $t = 0$, phase of the voltage is zero, while phase of the current is $-\frac{\pi}{2}$ i.e., voltage leads by $\frac{\pi}{2}$

Video Solution:

Q13 Text Solution:

(4)

$$I_{\text{net}} = \sqrt{(10)^2 + \left(\frac{40}{\sqrt{2}}\right)^2}$$
$$I_{\text{net}} = \sqrt{100 + 800}$$
$$= \sqrt{900} = 30 \text{ A}$$

Video Solution:

Q14 Text Solution:

(1)

In an inductive circuit current lags behind voltage by $\frac{\pi}{2}$. But to have a phase of $\frac{\pi}{3}$ between voltage and current, it may consist L and R or L, C and R such that $X_L > X_C$ since L, C and R is not in option so correct option is (1).

Video Solution:

Q15 Text Solution:

(1)

Impedance of LCR circuit will be minimum at resonant frequency, so

$$v_0 = \frac{1}{2\pi\sqrt{LC}}$$
$$= \frac{1}{2\pi\sqrt{1 \times 10^{-3} \times 0.1 \times 10^{-6}}}$$
$$= \frac{10^5}{2\pi}\text{Hz}$$

Video Solution:

Q16 Text Solution:

(3)

At 50 Hz frequency, $X_L = 20\ \Omega$

$20 = 100\pi L$

$\frac{1}{5\pi} = L$

When an ac source of 200 V and 100 Hz is connected,

$X_L = \omega L = 2\pi(100)\left(\frac{1}{5\pi}\right) = 40\Omega$

and $R = 30\Omega$

$$\Rightarrow Z = \sqrt{R^2 + X_L^2} = \sqrt{(30)^2 + (40)^2}$$
$$= 50\Omega$$

So $I = \frac{200}{50} = 4 \text{ A}$

Video Solution:

Q17 Text Solution:

(2)

$$i_{rms} = \frac{V_{rms}}{Z}$$

$$Z = \sqrt{R^2 + (X_L - X_C)^2}$$

$$Z = \sqrt{2^2 + (4-2)^2} = 2\sqrt{2}\Omega$$

$$\Rightarrow i_{rms} = \frac{220/\sqrt{2}}{2\sqrt{2}} = \frac{220}{4} = 55 \text{ A}$$

Video Solution:

Q18 Text Solution:

(1)

At resonance, $X_L = X_C$

$$\Rightarrow Z = R$$

Hence, $I = \frac{V}{Z} = \frac{V}{R}$

So, current at resonance depends on R.

Video Solution:

Q19 Text Solution:

(1)

When frequency of alternating current is increased, the inductive reactance ($X_L = \omega L = 2\pi f L$) of the inductive coil increases.

Current in the circuit containing inductor is given by

$I = \frac{V}{X_L} = \frac{V}{2\pi f L}$. As f increases, current in the circuit decreases.

Video Solution:

Q20 Text Solution:

(2)

$$P = E_{rms} I_{rms} \cos\phi$$

$$= \frac{20}{\sqrt{2}} \times \frac{10}{\sqrt{2}} \times \cos\frac{\pi}{3}$$

$$= 100 \times \frac{1}{2} = 50 \text{ W}$$

Video Solution:

Q21 Text Solution:

(2)

$$P = Vi\cos\phi = V\left(\frac{V}{Z}\right)\left(\frac{R}{Z}\right) = \frac{V^2 R}{Z^2}$$

$$= \frac{V^2 R}{(R^2 + \omega^2 L^2)}$$

Video Solution:

Q22 Text Solution:

(3)

$$P_0 = I_s V_s$$
$$I_s = \frac{2500}{1000} = 2.5 \text{ A}$$
$$N_s = N_p \times \frac{I_p}{I_s} = 2000 \times \frac{1}{2.5}$$
$$N_s = 800$$

Video Solution:

Q23 Text Solution:

(3)

$$\omega = \frac{1}{\sqrt{L_1 C_1}} = \frac{1}{\sqrt{L_2 C_2}}$$
$$\Rightarrow \quad L_2 = \frac{L_1}{4}$$

Video Solution:

Q24 Text Solution:

(3)

$$\cos\phi = \frac{R}{Z} = \frac{10}{20} = \frac{1}{2} \Rightarrow \phi = 60^\circ$$

Video Solution:

Q25 Text Solution:

(1)

$$V_p = 220 \text{ V}$$
$$V_s = 22 \text{ V},$$
$$P_s = V_s I_s = 22 \text{ W}$$

Current in primary coil

$$I_p = \frac{V_s I_S}{V_p} = \frac{22}{220} = 0.1 \text{ A}$$

Video Solution:

Q26 Text Solution:

(2)

On increasing ω, capacitive reactance decreases, so impedence of the circuit decreases and therefore, current in the circuit is increased and hence brightness increases.

Video Solution:

Q27 Text Solution:

(3)

At resonance $X_L = X_C$

$$\therefore Z = R$$
$$I_{\text{rms}} = \frac{V_{\text{rms}}}{R} = \frac{220}{22} = 10 \text{ A}$$
$$V_C = I_{rms} \times X_C = 10 \times 20 = 200 \text{ V}$$

Video Solution:

Q28 Text Solution:

(4)

The current takes $\frac{T}{4}$sec to reach the peak value.

In the given question

$\frac{2\pi}{T} = 200\pi \Rightarrow T = \frac{1}{100}\text{sec}$

$\therefore$ Time to reach the peak value $= \frac{1}{400}\text{sec}$

Video Solution:

Q29 Text Solution:

(2)

$$X_L = \omega L = 2\pi \times 50 \times \frac{500}{\pi} \times 10^{-3} = 50\Omega$$

$$X_C = \frac{1}{\omega C} = \frac{1}{2\pi \times 50 \times \frac{200}{\pi} \times 10^{-6}}\Omega$$

$$= 50\Omega$$

Impedence of the circuit is

$$Z = \sqrt{R^2 + (X_L - X_C)^2} = 100\Omega$$

rms value of the current through the circuit is

$$I_{\text{rms}} = \frac{220}{Z} = 2.2\text{ A}$$

Average power dissipated in inductor and capacitor would be zero.

Video Solution:

Q30 Text Solution:

(2)

The core of a transformer is laminated so that energy losses due to eddy currents may be minimised.

Video Solution: