Alternating Current

EXERCISE-I

Average peak and RMS value

Q.1 The r.m.s. value of alternating current is :

(1) Double of peak value
(2) Half of peak value
(3*) $\frac{1}{\sqrt{2}}$ times of peak value
(4) Equal to peak value

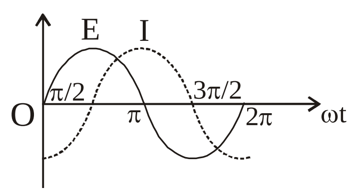
Q.2 The r.m.s. value of alternating current is 10 amp. having frequency of 50 Hz. The time taken by the current to increase from zero to maximum and the maximum value of current will be :

(1) 2×10^{-2} s and 14.14 amp.
(2) 1×10^{-2} s and 7.07 amp.
(3) 5×10^{-3} s and 7.07 amp.
(4*) 5×10^{-3} s and 14.14 amp.

Q.3 The peak value of alternating potential is E_0 then r.m.s. value of the same will be :

(1) $\frac{E_0}{2}$
(2) $\sqrt{E_0}$
(3*) $\frac{E_0}{\sqrt{2}}$
(4) $E_0\sqrt{2}$

Q.4 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 π/2
(2*) the voltage leads the current by π/2
(3) the voltage and the current are in phase
(4) the voltage leads the current by π

Q.5 In ac circuit when ac ammeter is connected it reads i current if a student uses dc ammeter in place of ac ammeter the reading in the dc ammeter will be:

(1) $\frac{i}{\sqrt{2}}$
(2) $\sqrt{2}\, i$
(3) 0.637 i
(4*) zero

Q.6 In an AC generator, a coil with N turns, all of the same area A and total resistance R, rotates with frequency ω in a magnetic field B. The maximum value of emf generated in the coil is –

(1) N.A.B.R.
(2*) N.A.B.ω
(3) N.A.B.R.ω
(4) N.A.B.

Q.7 If an A.C. main supply is given to be 220 V. What would be the average e.m.f. during a positive half cycle

(1*) 198 V
(2) 386 V
(3) 256 V
(4) None of these

AC source with RLC connected in Series

Q.8 In an A.C. circuit, the reactive reactance X_L is :

(1*) $2\pi f L$
(2) $\frac{1}{(2\pi f L)}$
(3) $\frac{\pi f L}{2}$
(4) $\frac{2}{\pi f L}$

Q.9 If an inductive circuit the equation of A.C., is $i = i_0 \sin \omega t$ then :

(1*) $E = E_0 \sin\left(\omega t + \frac{\pi}{2}\right)$ (2) $E = E_0 \sin\left(\omega t - \frac{\pi}{2}\right)$

(3) $E = E_0 \sin \omega t$ (4) None of the above

Q.10 A coil has reactance of 100Ω. When frequency is 50Hz. If the frequency becomes 150 Hz., then the reactance will be :

(1) 100 Ω (2*) 300 Ω (3) 450 Ω (4) 600 Ω

Q.11 An alternating voltage $E = 200\sqrt{2} \sin(100\,t)$ volt is connected to a $1\mu F$ capacitor through an A.C. ammeter. The reading of ammeter is :

(1) 10 mA (2*) 20 mA (3) 40 mA (4) 80 mA

Q.12 In the condition of resonance what is the value of frequency in Hz. When C = 1μF and L = 1μH :

(1) 10^6 (2*) $\frac{10^6}{2\pi}$ (3) $2\pi \times 10^{-6}$ (4) $2\pi \times 10^6$

Q.13 In a circuit the frequency is $f = \frac{1000}{2\pi}$ Hz and the inductance is 2 henry, then the reactance will be :

(1) 200 Ω (2) 200 μΩ (3*) 2000 Ω (4) 2000 μΩ

Q.14 In pure inductance the current is :

(1) Leading, potential by $\frac{\pi}{2}$ (2*) Lagging, potential by $\frac{\pi}{2}$

(3) in same phase with potential (4) With a phase difference of π with potential

Q.15 In an A.C. circuit inductance, capacitance and resistance are connected. If the effective voltage across inductance is V_L, across capacitance is V_c and across resistance is V_R, then the total effective value of voltage is :

(1) $V_R + V_L + V_c$ (2) $V_R + V_L - V_c$

(3*) $\sqrt{V_R^2 + (V_L - V_C)^2}$ (4) $\sqrt{V_R^2 - (V_L - V_C)^2}$

Q.16 Which one of the following has not the same unit

(1) $\sqrt{LC}$ (2*) $\frac{1}{\sqrt{LC}}$ (3) RC (4) $\frac{L}{R}$

Q.17 Which of the following statements is correct, of an LCR series combination having the resonating condition as :

(1) the current is minimum

(2) the phase difference between the current an e.m.f. is $\frac{\pi}{2}$

(3*) the impedance is equal to R

(4) the value of power factor is minimum

Q.18 A choke coil has :

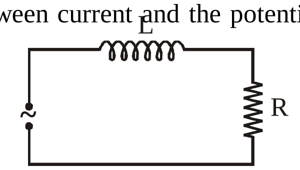
(1) Low resistance and high inductance (2) High resistance and high inductance

(3*) Low resistance and low inductance (4) High resistance and low inductance

Q.19 A bulb and a capacitor are connected in series to a source of alternating current. If its frequency is increased, while keeping the voltage of the source constant, then

(1*) Bulb will give more intense light
(2) Bulb will give less intense light
(3) Bulb will give light of same intensity as before
(4) Bulb will stop radiating light

Q.20 An inductor and a resistor in series are connected to an A.C. supply of variable frequency. As the frequency of the source is increased, the phase angle between current and the potential difference across source



will be :

(1) First increase and then decrease
(2) First decrease and then increase
(3) Go on decreasing
(4*) Go on increasing

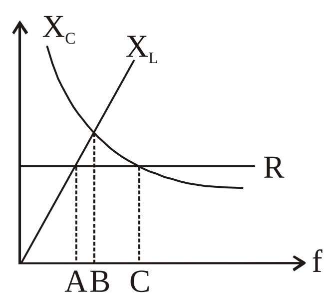
Q.21 If the current through an inductor of inductance I, is given by $I = I_0 \sin \omega t$, then the voltage across inductor will be :

(1) $I_0\, \omega L \sin\left(\omega t - \frac{\pi}{2}\right)$
(2*) $I_0\, \omega L \sin\left(\omega t + \frac{\pi}{2}\right)$
(3) $I_0\, \omega L \sin(\omega t - \pi)$
(4) None of these

Q.22 The power factor of L–R circuit is

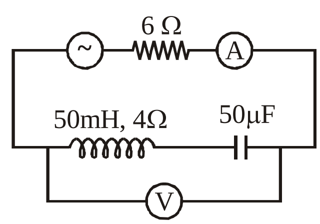
(1) $\frac{\omega L}{R}$
(2*) $\frac{R}{\sqrt{(\omega L)^2 + R^2}}$
(3) ωLR
(4) $\sqrt{\omega LR}$

Q.23 The figure shows variation of R, X_L and X_C with frequency f in a series L, C, R circuit. Then for what frequency point, the circuit is inductive



(1) A
(2) B
(3*) C
(4) All points

Q.24 In the circuit shown in the figure, the A.C. source gives a voltage V = 20 cos(2000 t) volt neglecting source resistance, the voltmeter and ammeter reading will be :



(1) 0V, 1.4 A
(2*) 5.6 V, 1.4 A
(3) 0 V, 0.47 A
(4) 1.68 V, 0.47 A

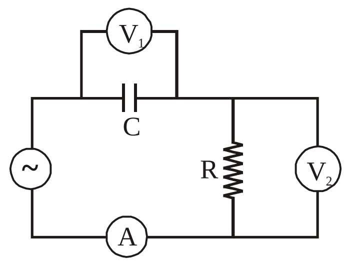
Q.25 The diagram shows a capacitor C and a resistor R connected in series to an AC source, V_1 and V_2 are voltmeters and A is an ammeter. Consider now the following statements :

(i) Readings in A and V_2 are always in phase

(ii) Reading in V_1 is ahead with reading in V_2

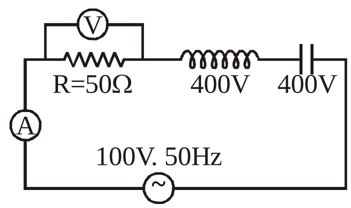
(iii) Readings in A and V_1 are always in phase

Which of these statements are is correct :



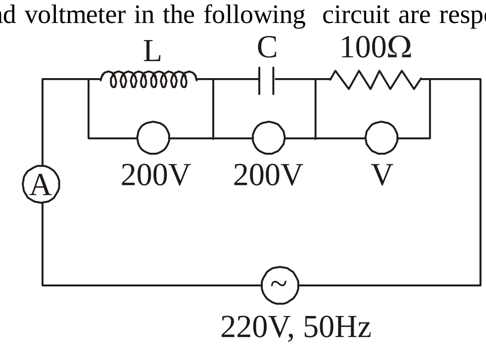
(1*) (i) only (2) (ii) only (3) (i) and (ii) only (4) (ii) and (iii) only

Q.26 In given LCR circuit the voltage across the terminals of a resistance and current will be



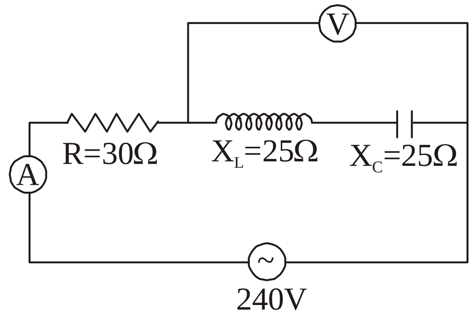
(1) 400 V, 2A (2) 800 V, 2A (3*) 100 V, 2A (4) 100V, 4A

Q.27 The readings of ammeter and voltmeter in the following circuit are respectively



(1) 2A, 200V (2) 1.5 A, 100 V (3) 2.7A, 220 V (4*) 2.2 A, 220 V

Q.28 In the circuit shown in figure neglecting source resistance the voltmeter and ammeter reading will respectively be



(1) 0V, 3A (2) 150 V, 3A (3) 150 V, 6A (4*) 0V, 8A

Power consumed in an ac circuit

Q.29 The current $I = I_0 \sin\left(\omega t - \frac{\pi}{2}\right)$ is flowing in a variable current circuit. The potential $E = E_0 \sin \omega t$ is applied to the circuit. The loss of power will be :

(1) $P = \frac{E_0 I_0}{\sqrt{2}}$ (2) $P = \frac{E_0 I_0}{2}$ (3) $P = \frac{EI}{\sqrt{2}}$ (4*) P = zero

Q.30 If a choke coil of negligible resistance works on 220V source and 5mA current is flowing through it, then the loss of power in choke coil is :

(1*) Zero (2) 11 watt (3) 44×10^3 watt (4) 1.1 watt

Q.31 The value of current at half power point is

(1) $I_m\sqrt{2}$ (2*) $\frac{I_m}{\sqrt{2}}$ (3) $2I_m$ (4) $\frac{I_m}{2}$

Q.32 An alternating e.m.f of frequency $\upsilon\left(=\frac{1}{2\pi\sqrt{LC}}\right)$ is applied to a series LCR circuit. For this frequency of the applied e.m.f.

(1) The circuit is at resonance and its impedance is made up only of a reactive part
(2) The current in the circuit is out of phase with the applied e.m.f. and the voltage across R equals this applied e.m.f.
(3) The sum of the p.d.'s across the inductance and capacitance equals the applied e.m.f. which is 180º ahead of phase of the current in the circuit.

(4*) The quality factor of the circuit is $\frac{\omega L}{R}$ or $\frac{1}{\omega CR}$ and this a measure of the voltage magnification (produced by the circuit at resonance) as well as the sharpness of resonance of the circuit.

Q.33 In an alternating circuit applied voltage and flowing current are $E = E_0 \sin \omega t$ and $I = I_0 \sin\left(\omega t + \frac{\pi}{2}\right)$ respectively. Then the power consumed in the circuit will be :

(1*) Zero (2) $\frac{E_0 I_0}{2}$ (3) $\frac{E_0 I_0}{\sqrt{2}}$ (4) $\frac{E_0 I_0}{4}$

Q.34 In which of the following case power factor will be negligible :

(1) Inductance and resistance both high (2) Inductance and resistance both low
(3*) Low resistance and high inductance (4) High resistance and low inductance

Q.35 Phase difference between V & I at resonance is :

(1*) 0 (2) $\frac{2\pi}{3}$ (3) $\frac{\pi}{3}$ (4) None of these

Q.36 In a purely capacitive circuit average power dissipated in the circuit is :
(1) $V_{rms} I_{rms}$ (2) Depends on capacitance (3) Infinite (4*) Zero

Q.37 Phase of current in LCR circuit :
(1) Is in the phase of potential
(2) Leading from the phase of potential
(3) Lagging from the phase of potential
(4*) Before resonance frequency, leading from the phase of potential and after resonance frequency, lagging from the phase of potential

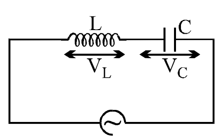
Q.38 In a circuit having a resistance of 100Ω connected is series with a capacitive reactance of 100Ω to an alternating voltage source, the current :
(1) Leads voltage by 90º (2*) Leads voltage by 45º
(3) Lags behind voltage by 90º (4) Lags behind voltage by 45º

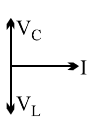
Q.39 The hot wire ammeter measures :
(1) D.C. current (2) A.C. current (3) None of above (4*) both (1) & (2)

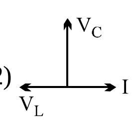
Q.40 Energy loss in pure capacitance in A.C. circuit is
(1) $\frac{1}{2}CV^2$ (2) CV (3) $\frac{1}{4}CV^2$ (4*) Zero

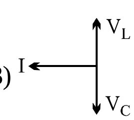
Q.41 A circuit has three elements, a resistance of 11Ω, a coil of inductive reactance 120Ω and a capacitive reactance of 120 Ω in series and connected to an A.C. source of 110 V, 60 Hz. Which of the three elements have minimum potential difference?
(1*) Resistance (2) Capacitance
(3) Inductor (4) All will have equal potential difference

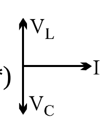
Q.42 The current I, potential difference V_L across the inductor and potential difference V_C across the capacitor in circuit as shown in the figure are best represented vectorially as



(1) 

(2) 

(3) 

(4*) 

EXERCISE-II

Q.1 The peak value of an alternating e.m.f given by $E = E_0 \cos \omega t$, is 10 volt and frequency is 50 Hz. At time t = (1/600) sec, the instantaneous value of e.m.f is :

(1) 10 volt (2*) $5\sqrt{3}$ volt (3) 5 volt (4) 1 volt

Ans. (2)

Sol. $E = 10 \cos\left(2\pi \times 50 \times \frac{1}{600}\right) = 5\sqrt{3}$

Q.2 The voltage of an AC source varies with time according to the equation, $V = 100 \sin 100 \pi t \cos 100 \pi t$. Where t is in second and V is in volt. Then :

(1) the peak voltage of the source is 100 volt (2) the peak voltage of the source is ($100/\sqrt{2}$) volt

(3*) the peak voltage of the source is 50 volt (4) the frequency of the source is 50 Hz

Ans. (3)

Sol. $V = 100 \sin 100\pi t \cos 100 \pi t$

$V = 50 \sin 200 \pi t$

here $V_O = 50$ & $\omega = 200 \pi$ f = 100 Hz

Q.3 An AC voltage is given by :

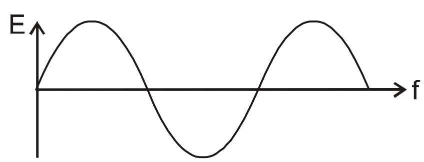
$$E = E_0 \sin \frac{2\pi t}{T}$$

Then the mean value of voltage calculated over time interval of T/2 seconds :

(1) is always zero (2) is never zero (3) is $(2e_0/\pi)$ always (4*) may be zero

Ans. (4)

Sol. If net area of E – t curve is zero for given inteval then average value will be zero.



Q.4 An alternating current changes from a complete cycle in 1μs, then the frequency in Hz will be–

(1) 10^{-6} (2) 50 (3) 100 (4) 10^{6}

Ans. (4)

Sol. Given $T = 1\mu s = 10^{-6}$ s

$$f = \frac{1}{T} = \frac{1}{10^{-0}} = 10^6 Hz$$

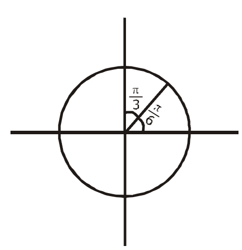
Q.5 An ac circuit, the current is given by $i = 4 \sin (100\pi t + 30^o)$ ampere. The current becomes maximum first time (after t = 0) at t equal to –

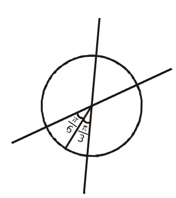
(1) (1/200) sec (2) (1/300) sec (3) (1/50) sec (4) None of the above

Ans. (2)

Sol. Given $i = 4 \sin (100 \pi t + 30°)$

at t = 0; $i = 4 \sin 30° = 2A$





$\frac{\pi}{3} = 100\pi t$

$t = \frac{1}{300}$ sec.

Q.6 If instantaneous value of current is I = 10 sin (314 t) A, then the average current for the half cycle will be –

(1) 10 A (2) 7.07 A (3) 6.37 A (4) 3.53 A

Ans. (3)

Sol. $I_{avg} = \frac{\int_0^{\frac{T}{2}} 10\sin(314\,t)\,dt}{\int_0^{\frac{T}{2}} dt}$

$= \frac{2i_0}{\pi} = 0.637\,i_0 = 0.637 \times 10 = 6.37$ A

Q.7 The value of alternating e.m.f. is e = 500 sin 100πt , then the frequency of this potential in Hz is–

(1) 25 (2) 50 (3) 75 (4) 100

Ans. (2)

Sol. $e = 500\sin 100\pi t$

$\omega = 100\,\pi$

$2\pi f = 100\pi$

$f = 50$

Q.8 The domestic power supply is at 220 volt. The amplitude of emf will be –

(1) 220 V (2) 110 V (3) 311 V (4) None of this

Ans. (3)

Sol. $V_{rms} = \frac{V_0}{\sqrt{2}} = 220$

$V_0 = 220\sqrt{2} = 311$ volt

Q.9 The average value or alternating current for half cycle in terms of I_0 is

(1) $\frac{2i_o}{\pi}$ (2) $\frac{i_o}{\pi}$ (3) $\frac{i_o}{\sqrt{2}}$ (4) 0

Ans. (1)

Sol. $I_{avg} = \frac{\int_0^{\frac{T}{2}} I_0 \sin\omega t\,dt}{\int_0^{\frac{T}{2}} dt} = \frac{2I_0}{T}\left[\frac{-\omega s\,\omega t}{\omega}\right]_0^{\frac{T}{2}} = \frac{2I_0}{\pi}$

Q.10 The phase difference between the alternating current and voltage represented by the following equation $I = I_0 \sin \omega t$, $E = E_0 \cos(\omega t + \pi / 3)$, will be –

(1) $\frac{\pi}{3}$ (2) $\frac{4\pi}{3}$ (3) $\frac{\pi}{2}$ (4) $\frac{5\pi}{6}$

Ans. (2)

Sol. $E = E_0 \cos(\omega t + \frac{\pi}{3})$ can be written as

$$E = E_0 \sin\left(\omega t + \frac{\pi}{2} + \frac{\pi}{3}\right)$$

$$= E_0 \sin\left(\omega t + \frac{5\pi}{6}\right)$$

Phase diff. = $\frac{5\pi}{6}$

Q.11 Alternating current can not be measured by direct current meters, because –
(1) alternating current can not pass through an ammeter
(2) the average value of current for complete cycle is zero
(3) some amount of alternating current is destroyed in the ammeter.
(4) None of these

Ans. (2)

Q.12 A 0.21-H inductor and a 88-Ω resistor are connected in series to a 220-V, 50-Hz AC source. The current in the circuit and the phase angle between the current and the source voltage are respectively.
(Use $\pi = 22/7$)

(1*) 2 A, $\tan^{-1} 3/4$ (2) 14.4 A, $\tan^{-1} 7/8$ (3) 14.4 A, $\tan^{-1} 8/7$ (4) 3.28 A, $\tan^{-1} 2/11$

Ans. (1)

Sol. $I_{rms} = \frac{V_{rms}}{Z} = \frac{V_{rms}}{\sqrt{R^2 + (\omega L)^2}} = 2A$

$\tan\phi = \frac{\omega L}{R} = \frac{66}{88} = \frac{3}{4}$.

Q.13 A 100 volt AC source of angular frequency 500 rad/s is connected to a LCR circuit with L = 0.8 H, C = 5 μF and R = 10 Ω, all connected in series. The potential difference across the resistance is

(1) $\frac{100}{\sqrt{2}}$ volt (2*) 100 volt (3) 50 volt (4) $50\sqrt{3}$

Ans. (2)

Sol. $I_{rms} = \frac{V_{rms}}{Z} = \frac{100}{\sqrt{R^2 + \left(\omega L - \frac{1}{\omega C}\right)^2}}$

P.d. across resistance = $R\, I_{rms}$ = 100 volt.

Q.14 A pure resistive circuit element X when connected to an AC supply of peak voltage 200 V gives a peak current of 5 A which is in phase with the voltage. A second circuit element Y, when connected to the same AC supply also gives the same value of peak current but the current lags behind by 90°. If the series combination of X and Y is connected to the same supply, what will be the rms value of current ?

(1) $\frac{10}{\sqrt{2}}$ amp (2) $\frac{5}{\sqrt{2}}$ amp (3*) $\frac{5}{2}$ amp (4) 5 amp

Ans. (3)

Sol. $R = \frac{V_0}{I_0} = \frac{200}{5} = 40\ \Omega$ (For circuit x)

$X_L = \frac{V_0}{I_0} = 40\ \Omega$ (For circuit y)

If x & y are in series

$I = \frac{200}{40 \times \sqrt{2}} = \frac{5}{\sqrt{2}}$ Amp.

$\Rightarrow I_{rms} = \frac{I_0}{\sqrt{2}} = \frac{5}{2}$ amp.

Q.15 In an L-R series circuit ($L = \frac{175}{11}$ mH and R = 12Ω), a variable emf source ($V = V_0 \sin \omega t$) of $V_{rms} = 130\sqrt{2}$ V and frequency 50 Hz is applied. The current amplitude in the circuit and phase of current with respect to voltage are respectively.
(Use π = 22/7)

(1) 14.14A, 30° (2) $10\sqrt{2}$ A, $\tan^{-1}\frac{5}{12}$ (3) 10 A, $\tan^{-1}\frac{5}{12}$ (4*) 20 A, $\tan^{-1}\frac{5}{12}$

Ans. (4)

Sol. $I_0 = \sqrt{2}\ I_{rms} = \sqrt{2}\frac{V_{rms}}{Z}$

$I_0 = \frac{\sqrt{2} \times 130\sqrt{2}}{\sqrt{R^2 + (\omega L)^2}}$

$\tan\phi = \frac{\omega L}{R}$

$\phi = \tan^{-1}\left(\frac{\omega L}{R}\right)$.

Q.16 In an AC circuit the potential differences across an inductance and resistance joined in series are respectively 16 V and 20 V. The total potential difference across the circuit is

(1) 20 V (2*) 25.6 V (3) 31.9 V (4) 53.5 V

Ans. (2)

Sol. $V_{net} = \sqrt{V_R^2 + V_L^2} = \sqrt{(20)^2 + (16)^2} = 25.6$.

Q.17 An AC voltage source $V = 200\sqrt{2}\ \sin 100\,t$ is connected across a circuit containing an AC ammeter(it reads rms value) and capacitor of capacity 1 μF. The reading of ammeter is :

(1) 10 mA (2*) 20 mA (3) 40 mA (4) 80 mA

Ans. (2)

Sol. $I = \dfrac{200\sqrt{2}}{(X_C)\times\sqrt{2}} = 200 \times \omega C = 20\ \text{mA}.$

Q.18 If in a series LCR AC circuit, the rms voltage across L, C and R are V_1, V_2 and V_3 respectively, then the voltage of the source is always :

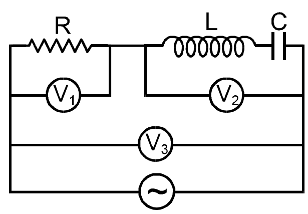
(1) equal to $V_1 + V_2 + V_3$ (2) equal to $V_1 - V_2 + V_3$

(3) more than $V_1 + V_2 + V_3$ (4*) none of these is true

Ans. (4)

Sol. Voltage of source is always less than $(V_1 + V_2 + V_3)$,

Q.19 A resistor R, an inductor L, a capacitor C and voltmeters V_1, V_2 and V_3 are connected to an oscillator in the circuit as shown in the adjoining diagram. When the frequency of the oscillator is increased, upto resonance frequency, the voltmeter reading (at resonance frequency) is zero in the case of :



(1) voltmeter V_1 (2*) voltmeter V_2 (3) voltmeter V_3 (4) all the three voltmeters

Ans. (2)

Sol. At resonance voltages across C and L are in opposite phase so net voltage will be zero.

So, $V_2 = 0$.

Q.20 The inductive reactance of a coil is 1000Ω. If its self inductance and frequency both are increased two times then inductive reactance will be –

(1) 1000Ω (2) 2000Ω (3) 4000Ω (4) 16000Ω

Ans. (3)

Sol. $X_L = \omega t = 1000\ \Omega$

$(X_L)_{new} = (2\omega)(2t) = 4 \times 1000 = 4000\ \Omega$

Q.21 A coil of inductance 0.1 H is connected to an alternating voltage generator of voltage E = 100 sin (100t) volt. The current flowing through the coil will be –

(1) $I = 10\sqrt{2}\ \sin(100t)$ A (2) $I = 10\sqrt{2}\ \cos(100t)$ A

(3) $I = -10\ \sin(100t)$ A (4) $I = -10\ \cos(100t)$ A

Ans. (4)

Sol. $X_L = \omega L = 100 \times 0.1 = 10\ \Omega$

$i = \dfrac{100}{10}\sin\left(100t - \dfrac{\pi}{2}\right) = -10\cos(100t)\ A$

Q.22 Alternating current lead the applied e.m.f. by $\pi/2$ when the circuit consists of –

(1) only resistance (2) only capacitor

(3) only an inductance coil (4) capacitor and resistance both

Ans. (2)

Q.23 A coil has reactance of 100Ω when frequency is 50Hz. If the frequency becomes 150Hz, then the reactance will be –

(1) 100Ω (2) 300Ω (3) 450Ω (4) 600Ω

Ans. (2)

Sol. $X_L = \omega L = 2\pi f \times L$

$100 = 2\pi \times 50 \times L$ ....(Eqn. 1)

$(X_L)_{new} = 2\pi \times 150 \times L$ ....(Eqn. 2)

from eqn. (i) & (ii)

$(X_L)_{new} = 300\ \Omega$

Q.24 A resistance of 50Ω, an inductance of $20/\pi$ henry and a capacitor of $5/\pi$ μF are connected in series with an A.C. source of 230 volt and 50Hz. The impedance of circuit is –

(1) 5Ω (2) 50Ω (3) 5KΩ (4) 500Ω

Ans. (2)

Sol. Given $R = 50\ \Omega$, $L = \frac{20}{\pi} H, C = \frac{5}{\pi} \mu F$

$$X_L = \omega L = 2\pi \times 50 \times \frac{20}{\pi} = 2000\ \Omega$$

$$X_C = \frac{1}{\omega C} = \frac{1}{2\pi \times 50 \times \frac{5}{x} \times 10^{-6}} = 2000\ \Omega$$

$X_L = X_C$ then $Z = R$

Q.25 In an LCR circuit, the capacitance is made one-fourth, when in resonance. Then what should be the change in inductance, so that the circuit remains in resonance ?

(1*) 4 times (2) 1/4 times (3) 8 times (4) 2 times

Ans. (1)

Sol. At resonance $\omega L = \frac{1}{\omega C}$

$L \propto \frac{1}{C}$.

Q.26 The potential difference between the ends of a resistance R is V_R between the ends of capacitor is $V_C = 2V_R$ and between the ends of inductance is $V_L = 3V_R$, then the alternating potential of the source in terms of V_R will be –

(1) $\sqrt{2}\ V_R$ (2) V_R (3) $V_R/\sqrt{2}$ (4) $5V_R$

Ans. (1)

Sol. Given potential difference between the ends of the resistance wire = V_R

across capacitor $V_C = 2V_R$

and across the inductor $V_L = 3V_R$

then

$$V = \sqrt{V_R^2 + (V_L - V_C)^2}$$

$$= \sqrt{V_R^2 + (3V_R - 2V_R)^2} = \sqrt{2}\ V_R$$

Q.27 In a series resonant L–C–R circuit, if L is increased by 25% and C is decreased by 20%, then the resonant frequency will –

(1) Increase by 10%
(2) Decrease by 10%
(3) Remain unchanged
(4) Increase by 2.5%

Ans. (3)

Sol. In resonance condition

$$\omega = \frac{1}{\sqrt{LC}}$$

when L $\uparrow$ 25% and C $\downarrow$ 20% then

$$\omega_{new} = \frac{1}{\sqrt{\frac{125}{100}L \times \frac{80}{100}C}} = \frac{1}{\sqrt{\frac{5}{4}L \times \frac{4}{5}C}}$$

$$\omega_{new} = \frac{1}{\sqrt{LC}} \Rightarrow \omega_{new} = \omega$$

Q.28 A capacitor is a perfect insulator for :

(1*) direct current
(2) alternating current
(3) direct as well as alternating current
(4) None of the above

Ans. (1)

Q.29 With increase in frequency of an AC supply, the capacitive reactance :

(1*) varies inversely with frequency
(2) varies directly with frequency
(3) varies directly as square of frequency
(4) remains constant

Ans. (1)

Q.30 In an a.c. circuit consisting of resistance R and inductance L, the voltage across R is 60 volt and that across L is 80 volt. The total voltage across the combination is

(1) 140 V
(2) 20 V
(3*) 100 V
(4) 70 V

Ans. (3)

Q.31 In an A.C. circuit, a resistance of 3Ω, an inductance coil of 4Ω and a condenser of 8Ω are connected in series with an A.C. source of 50 volt (R.M.S.). The average power loss in the circuit will be

(1) 600 watt
(2) 500 watt
(3) 400 watt
(4) 300 watt

Ans. (4)

Sol. Given R = 3Ω, X_L = 4Ω, X_C = 8Ω

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

$$Z = \sqrt{3^2 + (8-4)^2} = 5\Omega$$

then

$$P = VI\cos\phi = VI\frac{R}{Z} \qquad (\cos\phi = \frac{R}{Z})$$

$$= V\frac{V}{Z}\frac{R}{Z} = \frac{V^2}{Z}\frac{R}{Z}$$

$$= \frac{50 \times 50 \times 3}{5 \times 5} = 300 \text{ watt}$$

Q.32 In LR circuit the a.c. source has voltage 220 V. If the potential difference across the inductance is 176 volts, the p.d. across the resistance will be :

(1) 44 V (2) 396 V (3) 132 V (4) $\sqrt{(250 \times 176)}$ V

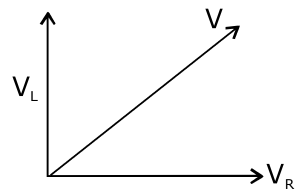
Ans. (3)

Sol. Given $V_L = 176$

$V_R = \sqrt{V^2 - V_L^2}$

$= \sqrt{(220)^2 - (176)^2}$

$V_R = 132$ V



Q.33 Energy dissipates in LCR circuit in :

(1) L only (2) C only (3*) R only (4) all of these

Ans. (3)

Q.34 The potential difference V across and the current I flowing through an instrument in an AC circuit are given by :

$V = 5\cos\omega t$ volt

I = 2 sin ωt volt

The power dissipated in the instrument is :

(1*) zero (2) 5 watt (3) 10 watt (4) 2.5 watt

Ans. (1)

Sol. $P_{av} = v_{rms} I_{rms} \cos\phi$

Here $\phi = 90^o$ so $P_{av} = 0$

Q.35 A coil has an inductance of $\frac{2.2}{\pi}$ H and is joined in series with a resistance of 220 Ω. When an alternating e.m.f. of 220 V at 50 c.p.s. is applied to it, then the wattless component of the rms current in the circuit is

(1) 5 ampere (2*) 0.5 ampere (3) 0.7 ampere (4) 7 ampere

Ans. (2)

Sol. Wattless current = $I_{rms} \sin\phi$

Where $\tan\phi = \frac{\omega L}{R} = \frac{2\pi f L}{R} = 1$

and $I_{rms} = \frac{v_{rms}}{z} = \frac{v_{rms}}{\sqrt{R^2 + (\omega L)^2}} = \frac{1}{\sqrt{2}}$

Q.36 A direct current of 2 A and an alternating current having a maximum value of 2 A flow through two identical resistances. The ratio of heat produced in the two resistances in the same time interval will be:

(1) 1 : 1 (2) 1 : 2 (3*) 2 : 1 (4) 4 : 1

Ans. (3)

Sol. $\frac{H_{D.C.}}{H_{A.C.}} = \frac{I^2 R}{I_{rms}^2 R} = 2$

Q.37 A sinusoidal AC current flows through a resistor of resistance R. If the peak current is I_p, then average power dissipated is :

(1) $I_p^2 R\cos\theta$ (2*) $\frac{1}{2} I_p^2 R$ (3) $\frac{4}{\pi} I_p^2 R$ (4) $\frac{1}{\pi^2} I_p^2 R$

Ans. (2)

Sol. $\langle P \rangle = I^2_{rms} R = \left(\frac{I_P}{\sqrt{2}}\right)^2 R = \frac{I_P^2 R}{2}$

Q.38 A resistor and a capacitor are connected to an AC supply of 200 volt, 50 Hz in series. The current in the circuit is 2 ampere. If the power consumed in the circuit is 100 watt, then the resistance in the circuit is:

(1) 100 Ω (2*) 25 Ω (3) $\sqrt{125\times75}$ Ω (4) 400 Ω

Ans. (2)

Sol. $I^2R = 100$

$$R = \frac{100}{I^2} = \frac{100}{(2)^2} = 25.$$

Q.39 The impedance of a series circuit consists of 3 ohm resistance and 4 ohm reactance. The power factor of the circuit is :

(1) 0.4 (2*) 0.6 (3) 0.8 (4) 1.0

Ans. (2)

Sol. $\tan\phi = \frac{x}{R} = \frac{4}{3}$

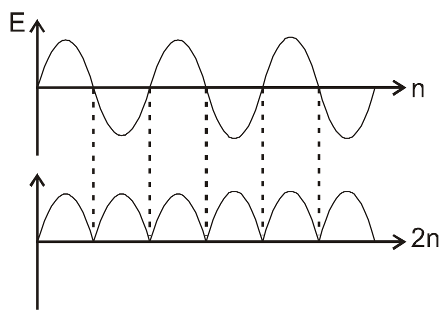
$\cos\phi = \frac{3}{5} = 0.6$

Q.40 If the frequency of the source e.m.f. in an AC circuit is n, the power varies with a frequency :

(1) n (2*) 2n (3) n/2 (4) zero

Ans. (2)

Sol.



Q.41 An LCR series circuit with 100 Ω resistance is connected to an AC source of 200 V and angular frequency 300 radians per second. When only the capacitance is removed, the current lags the voltage by 60°. When only the inductance is removed, the current leads the voltage by 60º. Then the current and power dissipated in LCR circuit are respectively

(1) 1A, 200 watt. (2) 1A, 400 watt. (3) 2A, 200 watt. (4*) 2A, 400 watt.

Ans. (4)

Sol. When all (L,C,R) are connected then net phase difference = 60 – 60 = 0. So, there will be resoance.

$I = \frac{V}{R} = 2A$ & $P = I^2 R = 400$ watt.

Q.42 Power factor may be equal to 1 for :

(1) pure inductor (2) pure capacitor (3*) pure resistor (4*) An LCR circuit

Ans. (4)

Sol. $\cos\phi = \frac{R}{z} = \frac{R}{\sqrt{R^2+(x_L-x_C)^2}} = 1$

Because $x_L = x_C$

Q.43 In an ac circuit emf and current are $E = 5 \cos \omega t$ volt and $I = 2 \sin \omega t$ ampere respectively. The average power dissipated in this circuit will be –

(1) 10 W (2) 2.5 W (3) 5 W (4) Zero

Ans. (4)

Sol. Given $E = 5 \cos\omega t$, $I = 2 \sin\omega t$, $\phi = \frac{\pi}{2}$

then

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

$= \frac{5}{\sqrt{2}} \times \frac{2}{\sqrt{2}} \cos \frac{\pi}{2} = 0$

Q.44 If the power factor changes from $\frac{1}{2}$ to $\frac{1}{4}$ then what is the increase in impedance in AC ?

(1) 20% (2) 50% (3) 25% (4) 100%

Ans. (4)

Sol. $\because \cos\phi = \frac{R}{z}$

$\cos\phi_1 = \frac{1}{2} = z_1 = 2R$

$\cos\phi_2 = \frac{1}{4} = z_2 = 4R$

% increase $= \frac{4R - 2R}{2R} \times 100$

$= 100\ \%$

Q.45 A power transformer (step up) with an 1 : 8 turn ratio has 60 Hz, 120 V across the primary; the load in the secondary is $10^4\ \Omega$. The current in the secondary is

(1) 96 A (2) 0.96 A (3) 9.6 A (4*) 96 mA

Ans. (4)

Sol. $\frac{V_2}{V_1} = \frac{N_2}{N_1} = \frac{8}{1}$

$V_2 = 8 \times 120 = 960$ volt

$I = \frac{960}{10^4} = 96$ mA.