PHYSICS

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ELECTROMAGNETIC INDUCTION & ALTERNATING CURRENT

SMART ACHIEVERS

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ELECTROMAGNETIC INDUCTION & ALTERNATING CURRENT

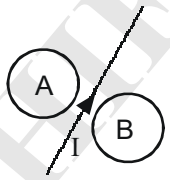
Q.1 The instantaneous flux associated with a closed circuit of 10Ω resistance is indicated by the following reaction $\phi = 6t^2 - 5t + 1$, then the value in amperes of the induced current at t = 0.25 sec will be:

(1) 1.2 (2) 0.8 (3) 6 (4) 0.2

Q.2 When a coil of area 2 cm^2 and having 30 turns, whose plane is normal to the magnetic field, is drawn out of the magnetic field, a charge of 1.5×10^{-4} coulomb flows in the circuit. If its resistance is 40 ohm, then the magnetic flux density in tesla will be –

(1) 10 (2) 0.1 (3) 1 (4) 0.01

Q.3 Consider the situation shown in fig. If the current I in the long straight wire XY is increased at a steady rate then the induced emf's in loops A and B will be-



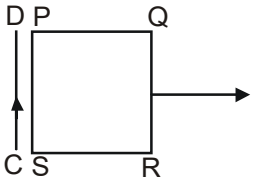
(1) clockwise in A, anticlockwise in B. (2) anticlockwise in A, clockwise in B

(3) clockwise in both A and B (4) anticlockwise in both A and B

Q.4 A copper ring having a cut such as not to form a complete loop is held horizontally and a bar magnet is dropped through the ring with its length along the axis of the ring. Then acceleration of the falling magnet is- (neglect air friction)

(1) g (2) less than g (3) more than g (4) 0

Q.5 A square loop PQRS is carried away from a current carrying long straight conducting wire CD. The direction of induced current in the loop will be



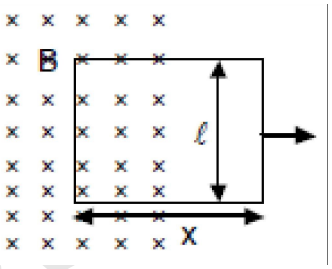
(1) anticlockwise (2) clockwise

(3) sometimes clockwise some times anticlockwise (4) current will not be induced

Q.6 A coil of N turns and area A is rotated at the rate of n rotations per second in a magnetic field of intensity B, the magnitude of the maximum magnetic flux will be :

(1) NAB (2) nAB (3) NnAB (4) 2πnNAB

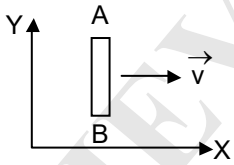
Q.7 A rectangular loop of resistance R, and sides l and x, is pulled out of a uniform magnetic field B with a steady velocity v. The necessary force F required for maintaining uniform velocity of withdrawal is-



(1) $\frac{Bl^2v}{R}$ (2) $\frac{B^2l^2v}{R}$

(3) $\frac{B^2l^2v^2}{R}$ (4) 0

Q.8 A conductor rod AB moves parallel to X-axis in a uniform magnetic field, pointing in the positive Z-direction. The end A of the rod gets-



(m) positively charged (2) negatively charged
(3) neutral (4) first positively charged and then negatively charged.

Q.9 Out of the two coils placed near each other, when a current of 2 amp is passed in one, a flux of 6×10^{-5} weber passes through the other. If the number of turns in the secondary coils is 20, the value of coefficient of mutual induction in the coils will be-

(1) 6H (2) 6mH (3) 0.6H (4) 0.6mH

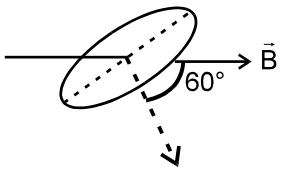
Q.10 Two coils of self inductances L_1 and L_2 are tightly wrapped one over the other. The maximum mutual inductance of the combination will be-

(1) $L_1 + L_2$ (2) $L_1 L_2$ (3) $\sqrt{L_1 L_2}$ (4) $\frac{L_1 L_2}{L_1 + L_2}$

Q.11 The current in an L-R circuit in a time t = 2L/R reduces to-
(1) 36.5% of maximum (2) 13.5% of maximum (3) 0.50% of maximum (4) 63.2% of maximum

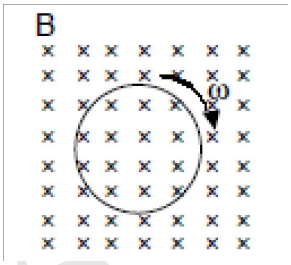
Q.12 A closed coil of copper whose area is 1m × 1m is free to rotate about an axis. The coil is placed perpendicular to a magnetic field of 0.10 Wb/m^2. It is rotated through 180° in 0.01 second. The induced e.m.f. and induced current in the coil will respectively be-
(The resistance of the coil is 2.0 Ω)
(1) 20 V, 10A (2) 10 V, 20 A (3) 10 V, 10 A (4) 20 V, 20 A

Q.13 A coil of area A = 0.5m^2 is situated in a uniform magnetic field B = 4.0 wb/m^2 and makes an angle of 60° with respect to the magnetic field as shown in figure. The value of magnetic flux through the area A would be equal to -



(1) 2 wb (2) 1 wb (3) 3 wb (4) $\frac{3}{2}$ wb

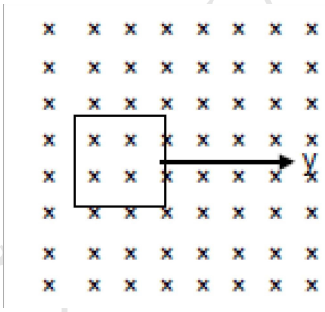
Q.14 A circular coil of radius r is placed in a uniform magnetic field B. The magnetic field is normal to the plane of the coil, as shown in fig. Now if the coil is rotated at an angular speed of ω, about its own axis, then the induced emf in the coil is-



(1) $\frac{BA\omega}{2\pi}$ (2) B (2πr) ω

(3) 0 (4) None of the above

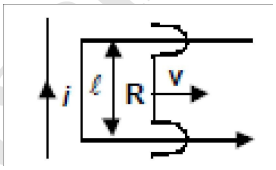
Q.15 A square conducting loop of side L and resistance R is moving with a uniform velocity at right angles to one of the sides in its own plane. On applying a uniform magnetic field at right angles to its plane as shown in the figure the induced current in the loop will be –



(1) Zero (2) $\frac{BLV}{R}$ in anticlockwise direction

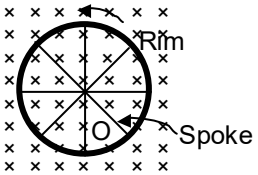
(3) $\frac{BLV}{R}$ in clockwise direction (4) $\frac{2BLV}{R}$ in clockwise direction

Q.16 A straight conductor carrying current i and a loop closed by a sliding connector of resistance R lie in the same plane. The connector slides towards right with a uniform velocity v. The induced current generated in the loop in terms of distance r of the connector from the straight conductor will be –



(1) $\frac{\mu_0 i\lambda v}{2\pi r}$ (2) $\frac{\mu_0 i\lambda}{2\pi r}$ (3) $\frac{\mu_0 i\lambda v}{2\pi rR}$ (4) None of these

Q.17 A bicycle wheel of radius 0.5 m has 32 spokes. It is rotating at the rate of 120 revolutions per minute, perpendicular to the horizontal component of earth's magnetic field $B_H = 4 \times 10^{-5}$ tesla. The emf induced between the rim and the centre of the wheel will be-



(1) 6.28×10^{-5} V (2) 4.8×10^{-5} V (3) 6.0×10^{-5} V (4) 1.6×10^{-5} V

Q.18 The coefficient of mutual induction between two coils is 4H. If the current in the primary reduces from 5A to zero in 10^{-3} second then the induced e.m.f. in the secondary coil will be-

(1) 10^4 V (2) 25×10^3 V (3) 2×10^4 V (4) 15×10^3 V

Q.19 The value of the self inductance of a coil is 5 H. If the current in the coil changes steadily from 1A to 2A in 0.5 seconds, then the magnitude of induced emf is-

(1) 1V (2) 10 V (3) 100 V (4) 0.1 V

Q.20 The coefficients of self induction of two inductance coils are 0.01H and 0.03H respectively. When they are connected in series so as to support each other, then the resultant self inductance becomes 0.06 Henry. The value of coefficient of mutual induction will be-

(1) 0.02 H (2) 0.05 H (3) 0.01 H (4) zero

Q.21 Two coils have mutual inductance 0.005H. The current charges in the first coil according to equation $I = I_0 \sin \omega t$, where $I_o = 10A$ and $\omega = 100\,\pi \frac{rad}{s}$. The maximum value of emf in the second coil (In volts) is

(1) 2π (2) 5π (3) π (4) 4π

Q.22 The r.m.s. value of current for a variable current $i = i_1 \cos \omega t + I_2 \sin \omega t$:

(1) $\frac{1}{\sqrt{2}}(i_1 + i_2)$ (2) $\frac{1}{\sqrt{2}}(i_1 + i_2)^2$ (3) $\frac{1}{\sqrt{2}}\left(i_1^2 + i_2^2\right)^{1/2}$ (4) $\frac{1}{2}\left(i_1^2 + i_2^2\right)^{1/2}$

Q.23 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

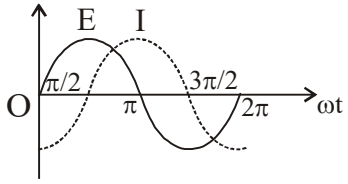
Q.24 A coil has reactance of 100Ω. When frequency is 50Hz. If the frequency becomes 150 Hz., then the reactance will be :

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

Q.25 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.26 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.27 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.28 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.29 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.30 Which one of the following has not the same unit

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

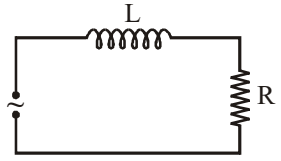
Q.31 The current $I = I_0 \sin\left(\omega t - \frac{\pi}{2}\right)$ is flowing in a variable current circuit. The potential $E = E_0 \sin \omega t$ is applied to the circuit. The loss of power will be :

(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.32 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.33 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.34 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 :

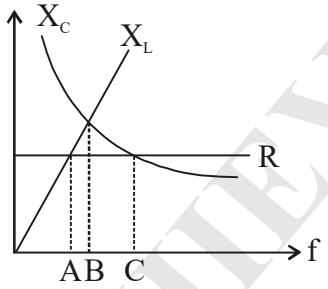
(1) $I_0 \omega L \sin\left(\omega t - \frac{\pi}{2}\right)$ (2) $I_0 \omega L \sin\left(\omega t + \frac{\pi}{2}\right)$
(3) $I_0 \omega L \sin(\omega t - \pi)$ (4) None of these

Q.35 The average power dissipation in a pure capacitance in ac circuit is

(1) $\frac{1}{2}CV^2$ (2) CV^2

(3) $\frac{1}{4}CV^2$ (4) zero

Q.36 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.37 If a resistance of 30 Ω, a capacitor of capacitive reactance 20 Ω and an inductor of inductive reactance 60 Ω are connected in series to a 100 V, 50 Hz power source, then

(1) a current of 2.0 A flows

(2) a current of 3.33 A flows

(3) power factor of the circuit is zero.

(4) power factor of the circuit is 4/5

Q.38 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?

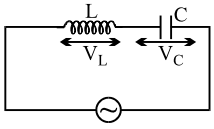
(1) Resistance (2) Capacitance

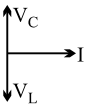
(3) Inductor (4) All will have equal potential difference

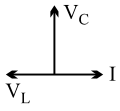
Q.39 The power in ac circuit is given by $P = E_{rms} I_{rms} \cos\phi$. The vale of cos ϕ in series LCR circuit at resonance is:

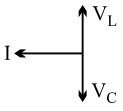
(1) zero (2) 1 (3) $\frac{1}{2}$ (4) $\frac{1}{\sqrt{2}}$

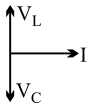
Q.40 The current I, potential difference V_L across the inductor and potential difference V_C across the capacitor in circuit as shown in the figure are best represented vectorially as



(1A) 

(2) 

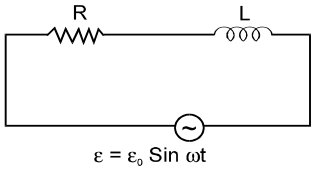
(3) 

(4) 

Q.41 The self inductance of the motor of an electric fan is 10 H. In order to impart maximum power at 50 Hz, it should be connected to a capacitance of –

(1) 4μF (2) 8μF (3) 1μF (4) 2μF

Q.42 Power factor of the circuit is –

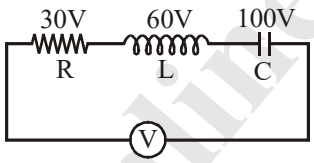


(1) $\frac{R}{\omega L}$ (2) $\frac{R}{\sqrt{R^2+\omega^2L^2}}$ (3) $\frac{R}{R^2+\omega^2L^2}$ (4) None of these

Q.43 In a LCR circuit capacitance is changed from C to 2C. For the resonant frequency to remain unchanged, the inductance should be changed from L to –

(1) 4 L (2) 2 L (3) L/2 (4) L/4

Q.44 In the given figure, the potential difference is shown on R. L and C. The e.m.f. of source in volt is :



(1) 190 (2) 70
(3) 50 (4) 40

Q.45 In an LCR circuit C = 25 μF, L = 0.1 H, R = 25Ω, if E = 310 sin 314 t volts is the generator voltage which is connected in the circuit then, how much inductance should be connected so that impedance is minimum:

(1) 0.31 H (2) 0.41 H (3) 1.25 H (4) 1.75 H

Q.46 In an A.C. circuit V and I are given by

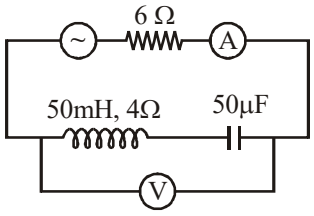
V = 100 sin (100 t) volts

$$I = 100 \sin\left(100t + \frac{\pi}{3}\right) mA$$

The power dissipated in the circuit is

(1) 10^4 watt (2) 10 watt (3) 2.5 watt (4) 5.0 watt

Q.47 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 :

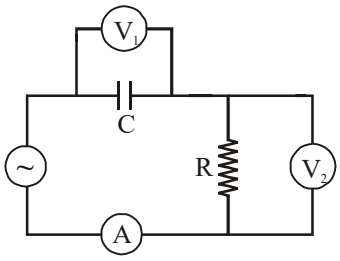


(1) 0V, 1.4 A (2) 5.6 V, 1.4 A
(3) 0 V, 0.47 A (4) 1.68 V, 0.47 A

Q.48 In a circuit 20 Ω resistance and 0.4 H inductance are connected with a source of 220 volt of frequency 50 Hz, then the value of ϕ will be :

(1) $\tan^{-1}(4\pi)$ (2) $\tan^{-1}(2\pi)$ (3) $\tan^{-1}(1\pi)$ (4) $\tan^{-1}(3\pi)$

Q.49 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

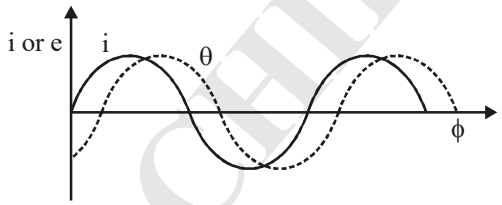
Q.50 In a series LCR circuit voltage across resister, inductor and capacitor are 1V, 3V and 2V respectively. At the instant t when the source voltage is given by :

$V = V_0 \cos \omega t$. the current in the circuit will be :

(1) $I = I_0 \cos\left(\omega t + \frac{\pi}{4}\right)$ (2) $I = I_0 \cos\left(\omega t - \frac{\pi}{4}\right)$

(3) $I = I_0 \cos\left(\omega t + \frac{\pi}{3}\right)$ (4) $I = I_0 \cos\left(\omega t - \frac{\pi}{3}\right)$

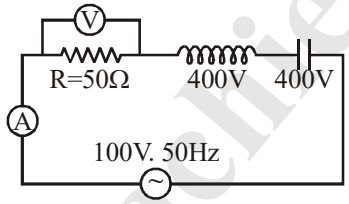
Q.51 When an AC source of e.m.f. $e = E_0 \sin(100\ t)$ is connected across a circuit, the phase difference between the e.m.f. e and the current i in the circuit is observed to be $\frac{\pi}{4}$, as shown in the diagram. If the circuit consists possibly only of R–C or R–L or L–C in series, find the relationship between the two elements



(1) $R = 1\ k\Omega,\ C = 10\mu F$ (2) $R = 1\ k\Omega,\ C = 1\ \mu F$

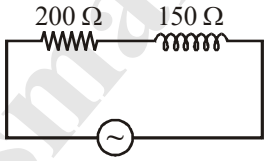
(3) $R = 1\ k\Omega,\ L = 10\ H$ (4) $R = 1\ k\Omega,\ L = 1\ H$

Q.52 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.53 Impedance of the following circuit will be :



(1) 150 Ω (2) 200 Ω (3) 250 Ω (4) 340 Ω

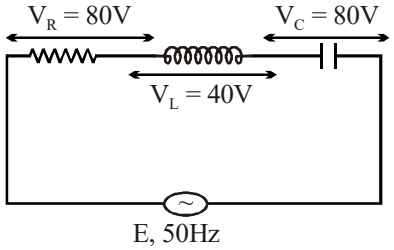
Q.54 In an a.c. circuit the emf (e) and the current (i) at any instant are given respectively by

$e = E_0 \sin \omega t$ $i = I_0 \sin(\omega t - \phi)$

The average power in the circuit over one cycle of a.c. is

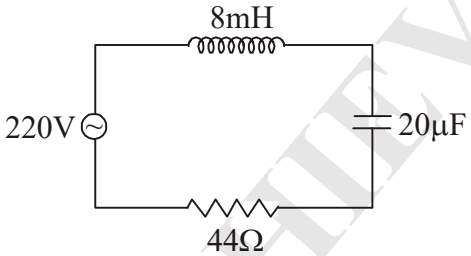
(1) $\frac{E_0 I_0}{2} \cos \phi$ (2) $E_0 I_0$ (3) $\frac{E_0 I_0}{2}$ (4) $\frac{E_0 I_0}{2} \sin \phi$

Q.55 The value of alternating emf E in the given circuit will be



(1) 100V (2) 20V (3) 220 V (4) None of these

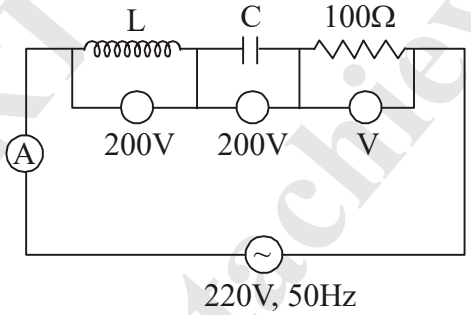
Q.56 For the series LCR circuit shown in the figure, what is the presences frequency and the amplitude of the current at the resonating frequency



(1) 2500 rad – s^{-1} and $5\sqrt{2}$A (2) 2500 rad – s^{-1} and 5A

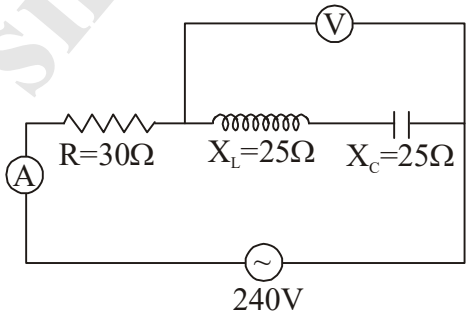
(3) 2500 rad – s^{-1} and $\frac{5}{\sqrt{2}}$A (4) 25 rad – s^{-1} and $5\sqrt{2}$A

Q.57 The readings of ammeter and voltmeter in the following circuit are respectively



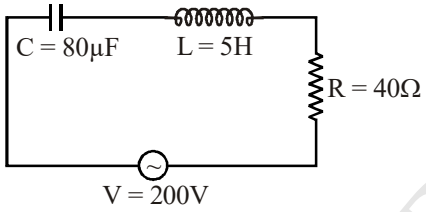
(1) 2A, 200V (2) 1.5 A, 100 V (3) 2.7A, 220 V (4) 2.2 A, 220 V

Q.58 In the circuit shown in figure neglecting source resistance the voltmeter and ammeter reading will respectively be



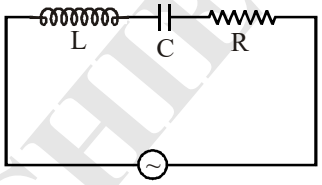
(1) 0V, 3A (2) 150 V, 3A (3) 150 V, 6A (4) 0V, 8A

Q.59 In the adjoining figure a series L-C-R circuit is connected to a variable frequency 200V source. L = 5H ; C = 80μF and R = 40Ω. Then, the source frequency which drive the circuit at resonance is :



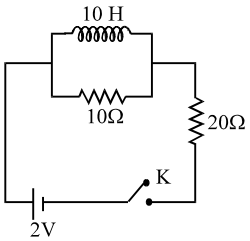
(1) 25 Hz (2) $\frac{25}{\pi}$ Hz (3) 50 Hz (4) $\frac{50}{\pi}$ Hz

Q.60 A 100V, AC source of frequency 500 Hz is connected to an L-C-R circuit with L = 8.1 mH, C = 12.5 μF, R = 10Ω, all connected in series as shown in figure. What is the quality factor of circuit ?



(1) 2.02 (2) 2.5434 (3) 20.54 (4) 200.54

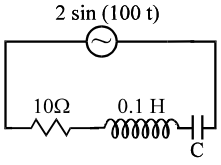
Q.61 Two resistors of 10 Ω and 20 Ω and an ideal inductor of 10 H are connected to a 2 V battery as shown. The key K is inserted at time t = 0. The initial (t = 0) and final ($t \to \infty$) currents through battery are



(1) $\frac{1}{15}$ A, $\frac{1}{10}$ A (2) $\frac{1}{10}$ A, $\frac{1}{15}$ A

(3) $\frac{2}{15}$ A, $\frac{1}{10}$ A (4) $\frac{1}{15}$ A, $\frac{2}{25}$ A

Q.62 The power factor of the circuit is $1/\sqrt{2}$. The capacitance of the circuit is equal to



(1) 400 μF (2) 300 μF
(3) 500 μF (4) 200 μF

Direction for following questions.

A. Both Assertion and Reason are true, and Reason is the correct explanation of Assertion.
B. Both Assertion and Reason are true but Reason is not the correct explanation of Assertion.
C. Assertion is true but Reason is false.
D. Assertion and Reason both are false.

Q.63 **Assertion :** A copper ring and a wooden ring of same dimensions are placed so that there is same magnetic flux through each. Induced current is same in each.
Reason : Induced emf is same in each of them.
(1) A (2) B (3) C (4) D

Q.64 **Assertion :** An airliner is cruising in level flight over Alaska, where Earth's magnetic field has a large downward component. Its left wingtip will contain more electrons.

Reason : According to Hall's effect, conduction electrons in a moving conductor can be deflected by magnetic field.

(1) A (2) B (3) C (4) D

Q.65 **Assertion :** The magnetic flux through a loop of conducting wire of a fixed resistance changes by $\Delta\phi_B$ in a time Δt. Then $\Delta\phi_B$ is proportional to the current through the loop.

Reason : $I = -\frac{\Delta\phi_B}{R}$

(1) A (2) B (3) C (4) D

Q.66 **Assertion :** A system cannot have mutual inductance without having self inductance.
Reason : If mutual inductance of system is zero, its self inductances must be zero.
(1) A (2) B (3) C (4) D

Q.67 **Assertion :** An electric lamp is connected in series with a long solenoid of copper with air core and then connected to AC source. If an iron rod is inserted in solenoid the lamp will become dim.
Reason : If an iron rod is inserted in solenoid, the inductance of solenoid increases.
(1) A (2) B (3) C (4) D

Q.68 **Assertion :** The work done by a charge in a closed (induced) current carrying loop is non-zero.
Reason : Induced electric field is non-conservative in nature.
(1) A (2) B (3) C (4) D

Q.69 **Assertion :**Magnetic flux linked to closed surface is zero.
Reason : Direction of induced current due to change of magnetic flux is given by Faraday's Law.
(1) A (2) B (3) C (4) D

Q.70 **Assertion :** The magnetic field at the ends of a very long current carrying solenoid is half of that at the center.
Reason : If the solenoid is sufficiently long, the field with in it is uniform.
(1) A (2) B (3) C (4) D

ANSWER KEY

Q.1	4	Q.2	3	Q.3	1	Q.4	1	Q.5	2
Q.6	1	Q.7	2	Q.8	2	Q.9	4	Q.10	3
Q.11	2	Q.12	1	Q.13	2	Q.14	3	Q.15	1
Q.16	3	Q.17	1	Q.18	3	Q.19	2	Q.20	3
Q.21	2	Q.22	3	Q.23	1	Q.24	2	Q.25	2
Q.26	2	Q.27	2	Q.28	3	Q.29	3	Q.30	2
Q.31	4	Q.32	1	Q.33	4	Q.34	2	Q.35	4
Q.36	3	Q.37	1	Q.38	1	Q.39	2	Q.40	4
Q.41	3	Q.42	2	Q.43	3	Q.44	3	Q.45	1
Q.46	3	Q.47	2	Q.48	2	Q.49	1	Q.50	2
Q.51	1	Q.52	3	Q.53	3	Q.54	1	Q.55	4
Q.56	2	Q.57	4	Q.58	4	Q.59	2		
Q.60	2	Q.61	1	Q.62	3	Q.63	4	Q.64	1
Q.65	1	Q.66	3	Q.67	1	Q.68	1	Q.69	3
Q.70	2								