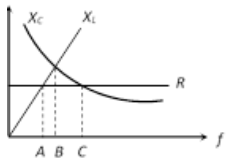
EMI & Alternating Current

Single Correct Answer Type:

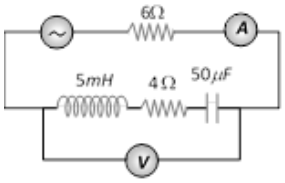
1. The figure shows variation of R, X_L and X_C with frequency f in a series L, C, R circuit. Then for what frequency point, the circuit is inductive



(A) A (B) B
(C) C (D) All points

2. For a series RLC circuit $R = X_L = 2X_C$. The impedance of the circuit and phase difference between V and I will be
(A) $\sqrt{5}R/2, \tan^{-1}(2)$ (B) $\sqrt{5}R/2, \tan^{-1}(1/2)$ (C) $\sqrt{5}X_c, \tan^{-1}(2)$ (D) $\sqrt{5}R, \tan^{-1}(1/2)$

3. In the circuit shown in the figure, the ac source gives a voltage $V=20\cos(2000t)$. Neglecting source resistance, the voltmeter and ammeter reading will be



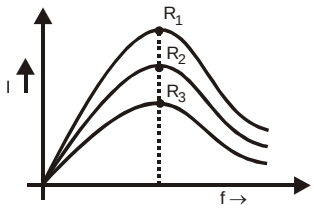
(A) 0V, 0.47A (B) 1.68V, 0.47A (C) 0V, 1.4 A (D) 5.6V, 1.4 A

4. 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
(A) Bulb will give more intense light (B) Bulb will give less intense light
(C) Bulb will give light of same intensity as before (D) Bulb will stop radiating light

5. In a certain circuit current changes with time according to $i=2\sqrt{t}$. Then r.m.s. value of current between t=2 to t=4s will be
(A) 3A (B) $3\sqrt{3}$ A (C) $2\sqrt{3}$ A (D) $(2-\sqrt{2})$A

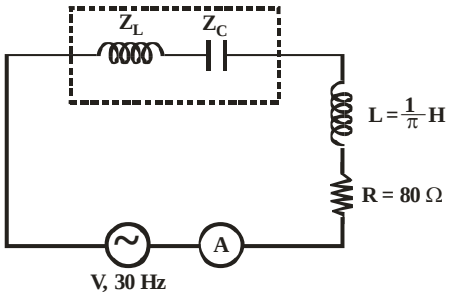
6. An LCR series circuit with a resistance of 100 ohm is connected to an ac source of 200 V (r.m.s.) and angular frequency 300 rad/s. When only the capacitor is removed, the current lags behind the voltage by 60^0. When only the inductor is removed the current leads the voltage by 60^0. The average power dissipated is
(A) 50 W (B) 100 W (C) 200 W (D) 400 W

7. In series L, C, R circuit at resonance current versus frequency graph is shown below for different resistances choose correct alternative



(A) $R_1 > R_2 > R_3$
(B) $R_1 < R_2 < R_3$
(C) $R_1 = R_2 = R_3$
(D) impedance of circuit will be same for any value of R

8. In figure below if $Z_L = Z_c$ and reading of ammeter is 1 A. Find value of source voltage V.



(A) 80 Volt (B) 60 Volt
(C) 100 Volt (D) None of these

9. In an LR-circuit, the inductive reactance is equal to the resistance R of the circuit. An emf $E=E_0\cos(\omega t)$ applied to the circuit. The power consumed in the circuit is
(A) E_0^2/R (B) $E_0^2/2R$ (C) $E_0^2/4R$ (D) $E_0^2/8R$

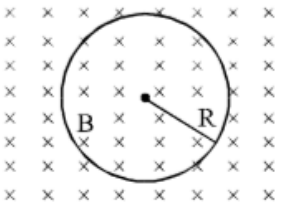
10. An alternating e.m.f. of angular frequency ωis applied across an inductance. The instantaneous power developed in the circuit has an angular frequency
(A) ω/4 (B) ω/2 (C) ω (D) 2ω

11. An electron is moving in a circular orbit of radius R with an angular acceleration α. At the centre of the orbit is kept a conducting loop of radius r, $(r << R)$. The e.m.f. induced in the smaller loop due to the motion of the electron is

(A) zero, since charge on electron in constant (B) $\frac{\mu_0 e r^2}{4R}\alpha$

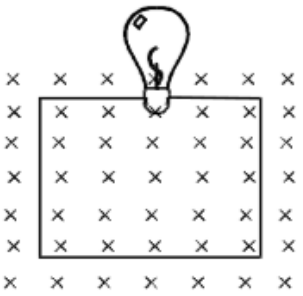
(C) $\frac{\mu_0 e r^2}{4\pi R}\alpha$ (D) none of these

12. A conducting loop of radius R is present in a uniform magnetic field B perpendicular the plane of the ring. If radius R varies as a function of time 't', as $R = R_0 + t$. The e.m.f. induced in the loop is



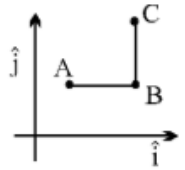
(A) $2\pi(R_0 + t)B$
(B) $\pi(R_0 + t)B$
(C) $2\pi(R_0 + t)B$ anticlockwise
(D) zero

13. A square wire loop of 10.0 cm side lies at right angles to a uniform magnetic field of 20 T. A 10 V light bulb is in a series with the loop as shown in the figure. The magnetic field is decreasing steadily to zero over a time interval Δt. The bulb shine with full brightness if Δt is equal to



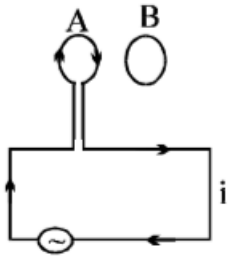
(A) 20 ms (B) 0.02 ms
(C) 2 ms (D) 0.2 ms

14. There is a uniform magnetic field B normal to the xy plane. A conductor ABC has length $AB = l_1$, parallel to the x-axis, and length $BC = l_2$, parallel to the y-axis. ABC moves in the xy plane with velocity $v_x\hat{i} + v_y\hat{j}$. The potential difference between A and C is proportional to

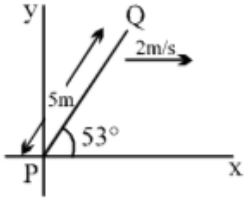


(A) $v_x l_1 + v_y l_2$ (B) $v_x l_2 + v_y l_1$ (C) $v_x l_2 - v_y l_1$ (D) $v_x l_1 - v_y l_2$

15. Two circular coils A and B are facing each other as shown in figure. The current i through A can be altered
(A) there will be repulsion between A and B if i is increased
(B) there will be attraction between A and B if i is increased
(C) there will be neither attraction nor repulsion when i is changed
(D) attraction or repulsion between A and B depends on the direction of current. It does not depend whether the current is increased or decreased

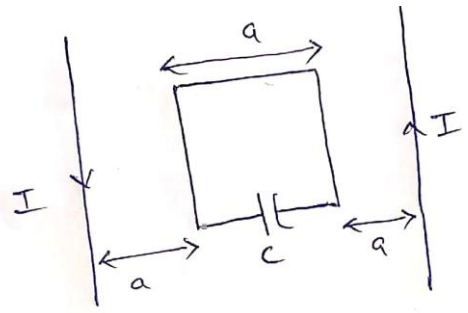


16. A conducting rod PQ of length 5 m oriented as shown in figure is moving with velocity $(2m/s)\hat{i}$ without any rotation in a uniform magnetic field $(3\hat{j} + 4\hat{k})$ Tesla. Emf induced in the rod is



(A) 32 Volts (B) 40 Volt
(C) 50 Volt (D) none

17. Figure shows a square loop of edge (a) with a capacitor (c), placed between two long parallel wire $I = I_0 \sin\omega t$. Find the amplitude of current induced in the capacitive loop



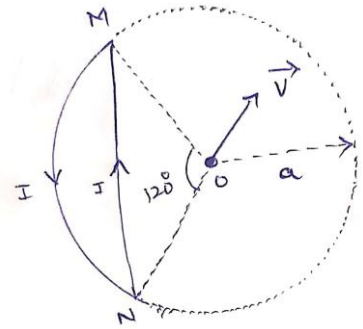
(A) $\frac{c\mu_0 I_0 a\omega^2}{4\pi}$ (B) $\frac{c\mu_0 I_0 a\omega^2}{2\pi}$

(C) $\frac{c\mu_0 I_0 a\omega^2}{6\pi}$ (D) $\frac{c\mu_0 I_0 a\omega^2}{8\pi}$

18. A particle of mass (m) and charge (q) starts form origin at $\vec{v} = v_0\hat{i}$ in a magnetic field $\vec{B} = B_0 x\hat{k}$. Find the maximum (X) coordinate of particle in the subsequence motion of particle

(A) $\sqrt{\frac{6n_1 v_0}{qB_0}}$ (B) $\sqrt{\frac{10mv_0}{qB_0}}$ (C) $\sqrt{\frac{2mv_0}{qB_0}}$ (D) $\sqrt{\frac{11mv_0}{qB_0}}$

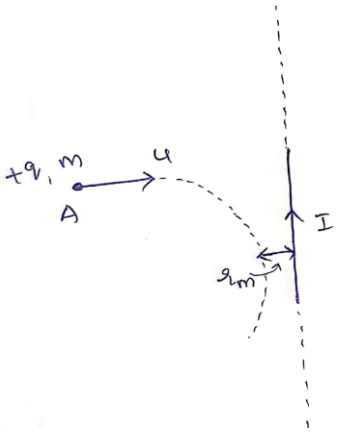
19. Figure shows a wire loop MN which carries a current I. A particle of charge (q) and mass (m) is placed at centre (o) of circle. If particle is given a velocity (v) along NO, find acceleration of particle at this instant.



(A) $\frac{\mu_0 qvl}{2am}\left(\frac{\sqrt{6}}{\pi} - \frac{1}{2}\right) m/s^2$ (B) $\frac{\mu_0 qv}{2aml}\left(\frac{\sqrt{3}}{\pi} - \frac{1}{3}\right) m/s^2$

(C) $\frac{\mu_0 qvl}{4am}\left(\frac{\sqrt{3}}{\pi} - \frac{1}{3}\right) m/s^2$ (D) $\frac{\mu_0 qvl}{2am}\left(\frac{\sqrt{3}}{\pi} - \frac{1}{3}\right) m/s^2$

20. Figure shows a charge particle (+q) and mass (m) projected from point (A) toward a long wire carrying a current (I). Find the closet separation of particle from wire during, its motion ($r_m \rightarrow$ closest separation of particle)



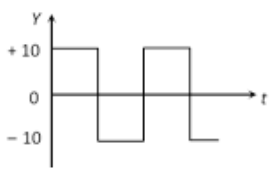
(A) $r_m = ae^{\frac{-2\pi mu}{q\mu_0 I}}$ (B) $r_m = ae^{\frac{-4\pi mu}{q\mu_0 I}}$

(C) $r_m = ae^{\frac{-6\pi mu}{q\mu_0 I}}$ (D) $r_m = ae^{-\frac{8\pi mu}{q\mu_0 I}}$

Numerical Based:

21. In a series circuit C=2μF,L=1mH and R=10Ω,when the current in the circuit is maximum, at that time the ratio of the energies stored in Inductor capacitor will be

22. The r.m.s. voltage of the wave form shown is (In V)



23. A long metal bar of 30 cm length is aligned along a north south line and moves eastward at a speed of $10ms^{-1}$. A uniform magnetic field of 4.0 T points vertically downwards. If the south end of the bar has a potential of 0 V, the induced potential at the north end of the bar is (in V)

24. A square coil of edge length 2 mts and mass (40 kg) is placed on a horizontal table which carries a current (20 A). A uniform horizontal magnetic field is applied in a direction which is parallel to two edges of the coil. Find the minimum magnetic field for which the coil will start tipping over about on edge. (Take $g = 10m/s^2$)

25. Two co-axial coils A (12500 terms) and B (16000 terms) are placed such that 60% of flex produced in (A) passes through coil B. It is found that current of 5A in (A). Produces a flux of (0.6 millli wb) through its cross section and same current in (B) produces a flux of (0.8 milli wb) through its cross section. The coefficient of coupling is ____

KEY

1.	**C**	**2.**	**B**	**3.**	**D**	**4.**	**A**	**5.**	**C**
6.	**D**	**7.**	**B**	**8.**	**C**	**9.**	**C**	**10.**	**D**
11.	**B**	**12.**	**C**	**13.**	**A**	**14.**	**C**	**15.**	**A**
16.	**A**	**17.**	**B**	**18.**	**C**	**19.**	**D**	**20.**	**A**
21.	**5**	**22.**	**10**	**23.**	**12**	**24.**	**5**	**25.**	**0.587**