ALTERNATING CURRENT, ELECTROMAGNETIC WAVES

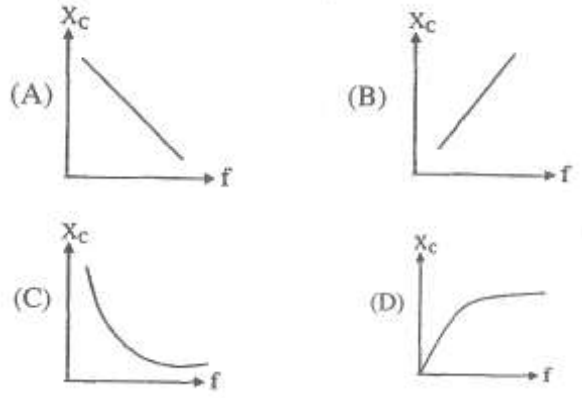
1. The ratio of the mean value over half cycle to the rms value of an AC is
   a) $2:\pi$ b) $2\sqrt{2}:\pi$
   c) $\sqrt{2}:\pi$ d) $\sqrt{2}:1$

2. When an AC voltage of 220 V is applied to the capacitor C
   a) the maximum voltage between plates is 220 V
   b) the current is in phase with the applied voltage
   c) the charge on the plates is not in phase with the applied voltage
   d) average power delivered over one cycle to the capacitor is zero

3. In a series L – R circuit, if the inductive reactance is equal to $\sqrt{3}$ times the resistance, then
   a) the voltage leads the current by 30°
   b) the voltage lags the current by 30°
   c) the voltage leads the current by 60°
   d) the voltage lags the current by 60°

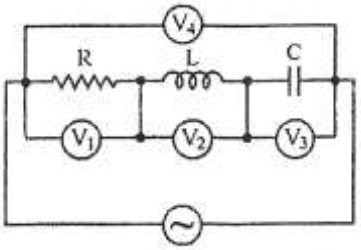
4. A coil, a capacitor and an AC source of voltage 24 V(rms) are connected in series. By varying the frequency of the source, a maximum rms current of 6 A is observed. If this coil is connected to a DC battery of emf 12 V and internal resistance $4\,\Omega$, the current through it will be
   a) 2.0 A b) 1.5 A
   c) 3.0 A d) 2.5 A

5. Of the following graphs, the one that represents the variation



6. In an LCR series circuit, at resonance
   a) the current and voltage are in phase
   b) the impedance is maximum
   c) the current in minimum
   d) the current leads the voltage by $\frac{\pi}{2}$

7. An ideal resistor R, ideal inductor L, ideal capacitor C and AC voltmeters V_1, V_2, V_3, V_4 are connected to an AC source as shown. At resonance



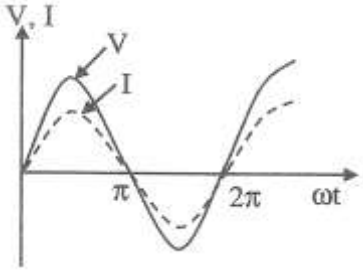
   a) reading in V_2 = reading in V_3
   b) reading in V_3 = reading in V_1
   c) reading in V_1 = reading in V_2
   d) reading in V_2 = reading in V_4

8. In a circuit inductor of inductance L, capacitor of capacitance C and resistor of resistance R are connected in series with an alternating voltage source of frequency f. The current lags the voltage by 45°
   a) $\frac{1}{\pi f\left(2\pi fL - R\right)}$ b) $\frac{1}{2\pi f\left(2\pi fL - R\right)}$
   c) $\frac{1}{\pi f\left(2\pi fL + R\right)}$ d) $\frac{1}{2\pi f\left(2\pi fL + R\right)}$

9. In an LCR series resonant circuit, the capacitance is changed from C to 4C. For the same resonant frequency, the inductance should be changed from L to
   a) 2 L b) $\frac{L}{2}$
   c) 4 L d) $\frac{L}{4}$

10. The frequency of an alternating current is 50 Hz. The minimum time taken by current to reach its peak value from rms value is
    a) 5×10^{-3} s b) 2.5×10^{-3} s
    c) 0.02 s d) 10×10^{-3} s

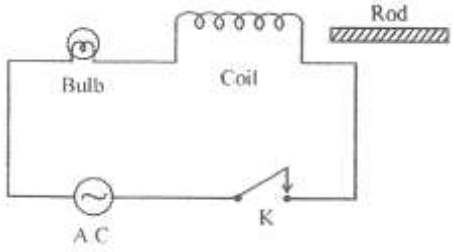
11. Figure shows the variation of AC voltage and current in an AC circuit. The circuit contains



a) only a capacitor
b) only an inductor
c) only a resistor
d) resistor and an inductor in series

12. The core of a transformer is laminated to reduce
a) hysteresis loss
b) copper loss
c) eddy current loss
d) magnetic loss

13. In the AC circuit shown, keeping 'k' pressed, if an iron rod is inserted into the coil, the bulb in the circuit,



a) glows with same brightness (as before the rod is inserted)
b) glows more brightly
c) gets damaged
d) glows less brightly

14. A parallel plate capacitor consists of two circular plates with radius 10 cm, separated by a distance of 0.5 mm. If the electric field between the plates is changing at a rate of $\frac{7}{22}\times10^{14}\,Vm^{-1}s^{-1}$, then displacement current in the capacitor is
a) 0.885 A
b) 8.85 A
c) 8.85 mA
d) 8.85 μA

15. The amplitudes E_0 of electric field and the magnetic (B_0 of field) components of an electromagnetic wave respectively are related to the velocity of light c in vacuum as
a) $E_0B_0=\frac{1}{c}$
b) $E_0=\frac{c}{B_0}$
c) $B_0=cE_0$
d) $E_0=cB_0$

16. If the magnetic field of an electromagnetic wave is given by $B_y=2\times10^{-7}\sin\left(10^3x+1.5\times10^{12}t\right)$ testa, the wavelength of the electromagnetic wave is
a) 0.314 mm
b) 0.628 mm
c) 6.28 mm
d) 1.26 mm

17. Dimensions of $\frac{1}{\mu_0\varepsilon_0}$ is (where μ_0 is the absolute permeability of free space and ε_0 is absolute permittivity of free space)
a) $\left[L^{-1}\right]$
b) $\left[L^2T^2\right]$
c) $\left[L^2T^{-2}\right]$
d) $\left[LT^{-1}\right]$

18. The ratio of contributions made by the electric field and magnetic field components to the intensity of an electromagnetic wave is
a) $c:1$
b) $c^2:1$
c) $1:1$
d) $\sqrt{c}:1$

19. If $\vec{E}$ and $\vec{B}$ represent and magnetic field vectors of electromagnetic wave, the direction of propagation of electromagnetic wave is along
a) $\vec{E}$
b) $\vec{B}$ ^
c) $\vec{B}\times\vec{E}$ ^
d) $\vec{E}\times\vec{B}$

20. One of the following pairs of $\vec{E}$ and $\vec{B}$, the pair that is suitable for a plane electromagnetic wave propagating along positive X direction is
a) E_X, B_y
b) E_y, B_z
c) B_X, E_y
d) E_z, B_x

21. At resonance frequency in an a.c. circuit containing L, C and R, in series
a) The voltage and current will be in the same phase
b) The voltage and will lead the current
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d) None of these

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23. The following series L – C – R circuit, when driven by an e.m.f. source of angular frequency 70 – kilo radians per second, the circuit effectively behaves like
a) Purely resistive circuit
b) Series R – L circuit
c) Series R – C circuit
d) Series L – C circuit with R = 0

24. An electromagnetic wave in free space is described by $E = E_0 \sin(kx - \omega t)$. The parameter which is independent of the wavelength is
a) k
b) ω
c) $\frac{k}{\omega}$
d) $k\omega$

25. Suppose that the electric field amplitude of electromagnetic wave is $E_0 = 120\ NC^{-1}$ and its frequency is f = 50 MHz. Then which of the following value is incorrectly computed?
a) Magnetic field amplitude is 400 nT
b) Angular frequency of EM wave is $\pi \times 10^8$ rad/s
c) Propagation constant (angular wave number) is 2.1 rad/m
d) Wavelength of the EM wave is 6 m.

26. The peak value of an alternating emf V given by $V = V_0 \cos(\omega t)$ is 10 V and its frequency is 50 Hz. At time $t = \left(\frac{1}{600}\right)$ s, the instantaneous emf is
a) 1 V
b) 5 V
c) 10 V
d) $5\sqrt{3}$ V

27. The impedance of an ac circuit is $200\ \Omega$ and the phase angle between current and voltage is 60°. The resistance of the circuit is
a) $50\ \Omega$
b) $100\ \Omega$
c) $100\sqrt{3}\ \Omega$
d) $300\ \Omega$

28. The capacitor required to make the power factor unity in an AC circuit with an inductor of 0.5 H and a resistor of $15\ \Omega$ is (frequency of AC = 50 Hz)
a) 20 μF
b) 20 mF
c) 20 F
d) 200 μF

29. The source of electromagnetic waves can be
a) moving with a constant velocity
b) an oscillating charge
c) at rest
d) in an electric field

30. The output of a step down transformer is measured to be 24 V when connected to a 12 W light bulb. The value of the peak current is
a) $\frac{1}{\sqrt{2}}$ A
b) $\sqrt{2}$ A
c) 2 A
d) $2\sqrt{2}$ A