CET 2013

TOPIC

ELECTROMAGNETIC INDUCTION
AND
ALTERNATING CURRENT

1.A cylindrical bar magnet is kept along the axis of circular coil. The magnet is rotated about its axis such that the north pole faces the coil .the induced current in the coil is

a)Anticlockwise from magnet side

b)Clockwise from magnet side.

c)Zero

d) Can be clockwise or anticlockwise

ANSWER :C

On rotating the coil the magneticflux linked with the coil is not changing,there is no induced emf

2.When a current in the coil is changing from 2A to 4A in 0.05s an emf of 8volt is induced in the coil . self inductance of the coil is

a)0.1H

b) 0.2H

c)0.4H

d)0.8H

ANSWER : b

$$e = \left| L\frac{di}{dt} \right|$$

$$L = \frac{edt}{di} = \frac{8X0.05}{4-2} = \frac{0.4}{2} = 0.2$$

3.The mutual inductance between two coils depends on

a) medium between two coils

b) separation between two coils

c) orientation of the two coils

d) all the above

ANSWER : d

Mutual inductance depends on all the above factors

4.Lenz's law is the statement of

a)Law of conservation of energy

b)Law of conservation of charge

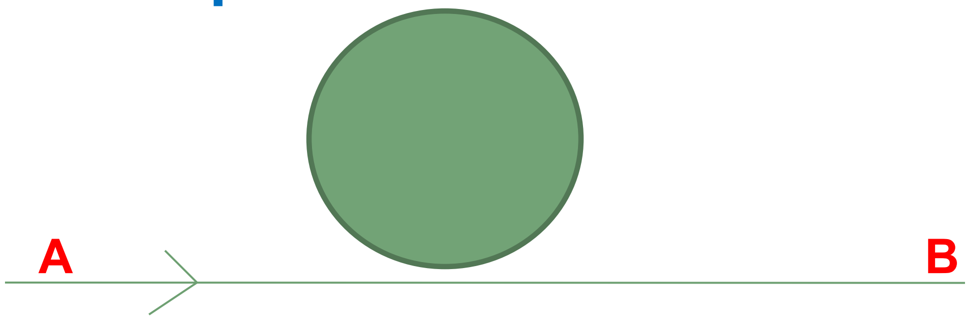
c)Law of conservation of momentum

d)Law of conservation of angular momentum

ANSWER : a

Lenz's law gives the direction of induced current. It is consequence of law of conservation of energy.

5. An electron moves along the line AB which lies in the same plane as a circular loop of conducting wire as shown in the figure. What would be the direction of induced current if any in the loop?



a) no current will be induced
b) the induced is clockwise
c) the induced current is anticlockwise
d) the induced current will change the direction as the electron passes by

ANSWER : d

Here electron is moving from left to right. It is equivalent to a current flowing from right to left. As the electron passes flux increases first and decreases, The induced emf opposes the increase in flux and also opposes the decrease in flux as electron passes. From Lenz's law the induced emf is anticlockwise first and clockwise as electron passes. The direction of induced current changes the direction.

6.A coil is rotated in a uniform magnetic field. The emf induced in the coil would be maximum, when the plane of the coil is

a) parallel to the field
b) perpendicular to the field
c) at 45 degree to the field
d) in none of above positions

ANSWER : a

When the plane of the coil is parallel to the field change in flux is maximum, hence current induced is maximum.

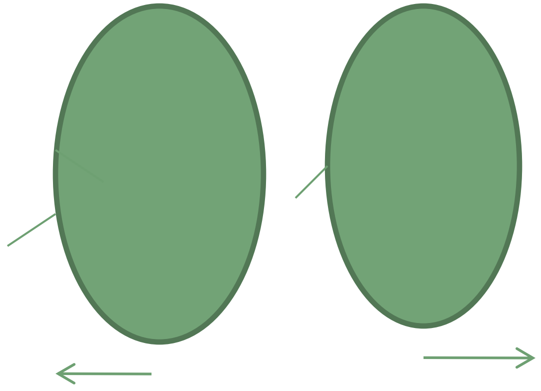
7.Two similar circular loops carry equal currents in the same direction. On moving the coils further apart the electric current will be

a)increase in one and decrease in other

b)remain unaltered

c)decrease in both

d)increase in both.



ANSWER : d

Here two coils are identical and carrying the current in same direction. The facing faces of the coils are of opposite poles. If they move apart the flux associated with them decreases, current induces in them try to increase the flux. In order to increase the flux current in them increases

ANSWER : d

Here two coils are identical and carrying the current in same direction. The facing faces of the coils are of opposite poles. If they move apart the flux associated with them decreases, current induces in them try to increase the flux. In order to increase the flux current in them increases

8.A magnet is move towards a coil at rest with a speed v .Due to this there is a induced emf, induced current and induced charge in the coil. If speed is doubled, the incorrect statement is

a) emf increases

b) current increases

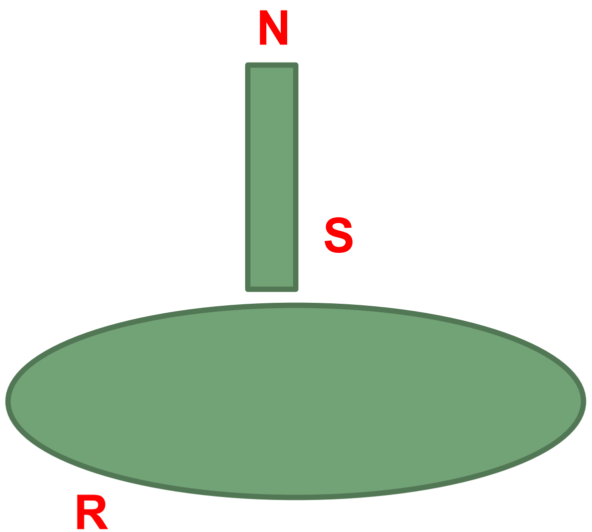
c)charge increases

d) charge remains same

ANSWER : d

When the speed of the magnet doubles induced emf and current increases.But total change in flux remains same, Total charge inducedis not depend on time,so charge remains same.

9.A small bar magnet is allowed to fall through a fixed horizontal conducting ring. Let g be the acceleration due to gravity, then acceleration of the magnet will be



a) >g when it is below R and moving away from R

b) =g when it is below or above R and moving towards or away from R

c) <g when it is above Rand moving towards R

d) >g when it is above Rand moving towards R

ANSWER : c

As the magnet falls the induced emf set up in the ring develops the magnetic field which opposes the field of the magnet. The movement of the magnet towards the ring is opposed, so that acceleration of the magnet is less than g.

10.SI unit of inductance henry , can be written as

a)weber/ampere

b)v.s/ampere

c) $\frac{joule}{ampere^2}$

d)All these

ANSWER : d

$$L = \frac{\phi}{i} = weber / ampere$$

$$L = \left| \frac{-e}{\frac{di}{dt}} \right| = volt.s / amp$$

$$L = \frac{2E}{I^2} = joule / amp^2$$

11. R/L has the dimension of (R is resistance and L is inductance)

a) frequency
b) Length
c) Mass
d) Time

ANSWER : a

$$\frac{R}{L} = \frac{e/I}{e\dfrac{dt}{di}} = \frac{1}{dt} = \left|T^{-1}\right| = frequency$$

12.A galvanometer is connected to a secondary coil. The galvanometer shows an instantaneous deflection of 7 divisions when current is started in the primary coil. Now if the primary coil is suddenly rotated through 180 degree , the new instantaneous deflection in secondary is

b) 14units

a) 7units

c) 21units

d) 0units

ANSWER : b

When current is started , change of current is 0 to I. When rotated by 180 degree, change in current is from I to –I ,net change is 2I. Deflection is doubled.

13. Consider the following statements

A) An emf can be induced by moving a conductor in magnetic field

B) An emf can be induced by changing magnetic field

a)Both A and B are correct

b)Both A and B are incorrect

c)A is false but B is true

d)A is true but B is false

ANSWER : a

Both statements are correct. A is example for motional emf, B is Faraday's experiment.

14. The network shown is a part of a closed circuit in which the current is changing. At an instant, current is 5A. Find potential difference when the current is increasing at 1A per second

a)25v

b) 5v

c)10v

d)20v

ANSWER : a

Whencurrent is increasing the induced emf in inductor is opposite to applied emf.

$$induced emf = L\frac{di}{dt} = 5X1/1 = 5v$$

$$V_A - (5X1) - 15 - 5 = V_B$$

$$V_A - V_B = 25V$$

15.Amagnet is suspended from a spring and while it oscillates ,magnet moves in and out of a coil. The coil is connected to a galvanometer ,as the magnet oscillates

a) Galvanometer shows no deflection

b) Galvanometer shows deflection to the left and right but amplitude steadily decreases

c) Galvanometer shows deflection to the left and right with constant amplitude

d) Galvanometer shows deflection on one side

ANSWER : b

When magnet move towards the coil there is force of repulsion because of increase in flux .When magnet moves away there force of attraction which try

to retain flux. Galvanometer shows deflection left and right ,with decrease in amplitude because of damping.

16. When current i flows through an inductor of self inductance L, energy stored is

$$\frac{1}{2}Li^2$$

this is stored in the form of

a) magnetic field

b) electric field

c) both electric and magnetic field

d) voltage

ANSWER : a

Energy stored in the inductor is in the form of magnetic field

17.The armature of a dc motor has 20Ω resistance. It draws a current of 1.5A when run by a 220volt dc supply. The value of back emf (in volt) is

a)150

b)170

c)180

d)190

ANSWER : d

current is given by

$$I = \frac{E-e}{R};1.5 = \frac{E-e}{R}$$

$$I = \frac{220-e}{20}$$

$$e = 190V$$

18.Aconducting rod of length ‘L’ is moved with a constant velocity ‘v’ in a magnetic field ‘B’. No emf will appear across the two ends of the rod is

a) v is parallel to L
b) v is parallel to B
c) B is parallel to L
d) In all above situations

ANSWER : d

Emf induced when conducting rod is moved in a magnetic field such that, all three vectors length, magnetic field and velocity are perpendicular to each other. Here in all situations two vectors are parallel ,no emf is induced

19.Atrain moving towards north with a speed of 180 km/h. If vertical component of earth's magnetic field is

$$2X10^{-4}T$$

The emf, induced in the axle 1.5m long is (in mv)

a) 5.4
b) 54
c) 15
d) 1.5

ANSWER : d

Trainis moving with constant velocity. The axle is a conductor moving in a constant magnetic field. It moves in horizontal plane and cuts earth's vertical field. Hence emf inducede=Blv

$$v = 180 X \frac{5}{18} = 50 ms^{-1}$$

$$e = Blv = 0.2 X 10^{-4} X 1.5 X 50$$

$$e = 1.5 mv$$

20.Aconducting circular loop is placed in a uniform magnetic field B =0.025T,with its plane perpendicular to the loop. The radius of the loop is made to shrink at a constant rate of 1mm per second. The induced emf when radius is 2cm is

a)2πμv

b) πμv

c) (π/2)μv

d)2μv

ANSWER : b

Flux φ=Bacosθ

$$\varphi = B\Pi r^2$$

$$e = \frac{d\phi}{dt} = \frac{d}{dt}\left(B\Pi r^2\right) = B\Pi 2r\frac{dr}{dt}$$

$$e = 0.025X\Pi X2X2X10^{-2}X1X10^{-3}$$

$$e = \Pi\mu v$$

21.If is V_{rms} rms voltage and be V_m the mean value(over half cycle) of an alternating voltage then $\frac{V_{rms}}{V_m}$ is

a) $\frac{\pi}{2}$

b) $\frac{\pi}{\sqrt{2}}$

c) $\frac{2\sqrt{2}}{\pi}$

d) $\frac{\pi}{2\sqrt{2}}$

ANSWER : d

Averagevalueover half cycle= $V_m = \frac{2V_o}{\pi}$

RMS value= $\frac{V_o}{\sqrt{2}}$

$$\frac{V_{rms}}{V_m} = \frac{\pi}{2\sqrt{2}}$$

22. An alternating emf is represented as V=10sin(314t). The instantaneous emf at t=(1/600) s is

a)10v

b)4v

c)5v

d)6v

ANSWER : c

$$V = V_o \sin \omega t = 10\sin(314t) = 10\sin\left(\frac{314}{600}\right)$$

$$V = 10\sin\left(\frac{100\pi}{600}\right) = 10\sin\left(\frac{\pi}{6}\right)$$

$$V = 10\sin 30^0$$

$$V = 10X0.5 = 5v$$

23. In an AC circuit the reactance of the coil is $\sqrt{3}$ times its resistance, the phase difference between the voltage across the coil to current in it is

a) $\frac{\pi}{2}$

b) $\frac{\pi}{6}$

c) $\frac{\pi}{4}$

d) $\frac{\pi}{3}$

ANSWER : d

$$\tan\varphi = \frac{X_L}{R} = \frac{R\sqrt{3}}{R} = \sqrt{3}$$

$$\varphi = \frac{\pi}{3}$$

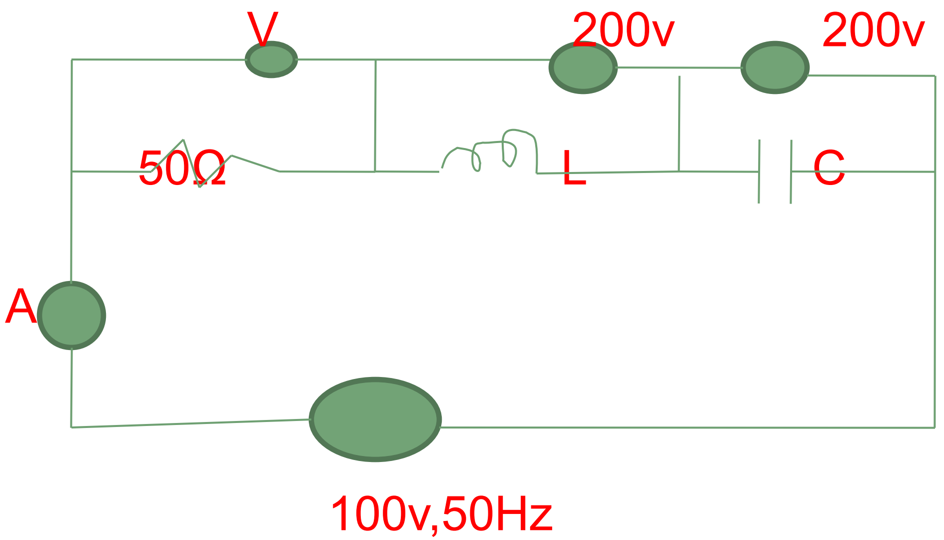
24.InLCRcircuit,the voltmeter and ammeter readings are respectively

a)250v,4A

b)200v,2A

c)150v,2A

d)100v,2A



ANSWER : d

Circuit is in resonance

$$V^2 = \left(V_R^2 + V_L - V_c\right)^2 ; V_L = V_c$$

$$V = V_R = 100v$$

$$z = R = 50\Omega$$

$$I = \frac{V}{z} = 2A$$

25. If L,C,R and V respectively represent inductance, capacitance, resistance and potential difference. Then the dimensions of

$$\frac{L}{RCV}$$ **is same as that of**

a)Current

b)1/current

c)Charge

d)1/charge

ANSWER : b

RC has the dimension of timeV has dimension of emf which has the dimension of

$$L\left(\frac{di}{dt}\right); \frac{L}{RCV} = \frac{L}{TL\left(\frac{di}{dt}\right)}$$

$$= \frac{1}{di} = \frac{1}{current}$$

26.A choke coil is preferred to a rheostat in AC circuits, because

a)It consumes almost zero power

b)It increases the current

c)It increases the power

d)It is cheap

ANSWER : a

for pure inductor phase difference between current and voltage is 90degree,there is no loss of power.

27.The frequency at which one henry inductor will have a reactance of 2500Ωis

a)418Hz

b)378Hz

c)398Hz

d)406Hz

ANSWER : c

$$X_L = \omega L = 2\pi f L$$

$$2500 = 2X\frac{22}{7}fX1$$

$$f = 398Hz$$

28.A resistor and a capacitor are connected in series with an AC source. If the p.d. across the capacitor is 5v and across resistor is 12v,the applied voltage is

a)13v

b)17v

c)5v

d)12v

ANSWER : a

$$V^2 = \left(V_R^2 + V_c^2\right)$$

$$V^2 = 12^2 + 5^2 = 169$$

$$V = \sqrt{169} = 13v$$

29.A resistor R capacitor c and inductor L are connected in series across AC source of angular frequency ω.If resonant frequency is ω_o The current will

lag behind the voltage if

a) ω< ω_o

b) ω> ω_0

c) ω= ω_o

d) ω=0

ANSWER : b

$$X_L > X_c ; \omega_L > \frac{1}{\omega_c}$$

$$2\pi f L > \frac{1}{2\pi f C}$$

$$\omega^2 > \frac{1}{LC}$$

$$\omega^2 > \omega_o^2$$

$$\omega > \omega_o$$

30.The circuit consists 3Ω resistance and reactance of 4Ω.The power factor of the circuit is

a)0.4

b)0.6

c)0.8

d)1.0

ANSWER : b

Power factor is cosφ

$$z^2 = X_L^2 + R^2 ; 3^2 + 4^2$$

$$z = \sqrt{25} = 5$$

$$\cos\varphi = \frac{R}{z} = \frac{3}{5}$$

$$\cos\varphi = 0.6$$

31. A pure inductance offers a resistance to dc which is

a)Infinite

b)Zero

c)Between zero and infinity

d)None of above

ANSWER : b

For dc frequency is zero

$$X_L = 2\pi f L$$

$$f = 0$$

$$x_L = 0$$

32. A pure resistance and a pure inductance are in series wit 100 v AC line. An ac voltmeter gives the same reading when connected either across resistance or inductance. The reading of voltmeter is

a)50v

b)100v

c)75v

d)70.7v

ANSWER : d

Here current is same because of series connection

$$IR = IX_L ; R = X_L$$

$$z^2 = R^2 + X_L^2$$

$$z = \sqrt{2}R ; I = \frac{100}{\sqrt{2}R}$$

$$V = IR = \left(\frac{100}{\sqrt{2}R}\right)R$$

$$V = \frac{100}{\sqrt{2}} = 70.7V$$

33. When 100volt dc is applied across a solenoid, a current of 1A flows in it. When 100v AC is applied across it current drops to 0.5A. If the frequency is50Hz,the impedance and inductance is

a)200Ω;1H

b)100Ω;0.86H

c)200Ω;0.55H

d)100Ω;0.9H

ANSWER : c

$$R = \frac{100}{1} = 100\Omega; z = \frac{100}{05} = 200\Omega$$

$$X_L^2 = 200^2 - 100^2$$

$$X_L = 100\sqrt{3}\Omega$$

$$L = \frac{100\sqrt{3}}{100\pi} = 0.55H$$

34. In an LCR series circuit the value of capacitance is doubled. To keep same resonant frequency the inductance should be changed from L to

a)4L

b)2L

c)L/4

d)L/2

ANSWER : d

Resonant frequency is given by

$$f = \frac{1}{2\pi\sqrt{LC}}$$

$$C \rightarrow 2C$$

$$L \rightarrow \frac{L}{2}$$

35. In an LCR series circuit the the phase difference voltage and current is

a)π/4

b) π/2

c) π

d)zero

ANSWER : d

At resonance voltage across inductance and capacitance is same but out of phase. applied voltage is equal to voltage across resistance and current and voltage are phase.

36.If the power factor changes from0.5 to 0.25,increase in impedence of ac circuit is

a)20%

b)50%

c)25%

d)100%

ANSWER : d

power factor is cosφ

$$\cos\varphi = \frac{R}{z}$$

$$\frac{\cos\varphi_1}{\cos\varphi_2} = \frac{z_2}{z_1} = \frac{0.5}{0.25}$$

$$z_2 = 2z_1$$

$$\%change = \frac{2z_1 - z_1}{z_1} X100 = 100\%$$

37.Aseries LCR circuit having L=04H,C=01μF and R=500Ω is connected to an ac source of variable frequency. The quality factor is

a)8

b)16

c)4

d)10

ANSWER : c

Quality factor is ratio of voltage across inductance or capacitance to voltage across resistance at resonance is given by

$$Q = \frac{\omega_o L}{R} = \frac{2\pi f L}{R} = \frac{2\pi L}{R} X \frac{1}{2\pi\sqrt{LC}}$$

$$Q = \frac{2\pi X 0.4}{500} X \frac{1}{2\pi\sqrt{0.4 X 10^{-7}}}$$

$$Q = \frac{2\pi X 0.4}{500} X \frac{1}{2\pi X 2} X 10^{4}$$

$$Q = 4$$

38.The equation of ac voltage is $V=220\sin(\omega t+\pi/6)$and equation for current is $I=10\sin(\omega t-\pi/6)$. The average power dissipated in the circuit is

a)55watt

b)5.5watt

c)550watt

d)1100watt

ANSWER : c

phase difference between current and voltage is

$$\varphi = \frac{\pi}{6} - \left(- \frac{\pi}{6} \right) = \frac{\pi}{3}$$

$$P_{avg} = \frac{E_o}{\sqrt{2}} X \frac{I_o}{\sqrt{2}} \cos \varphi$$

$$P_{avg} = \frac{220 X 10}{2} X \cos \frac{\pi}{3}$$

$$P_{avg} = 220 X 5 X 0.5 = 550 watt$$

39.For LCR series circuit at resonance, the statement which is not true is

a)Power factor is zero

b)Wattless current is zero

c)Average power=apparent power

d)Peak energy stored in capacitor is equal to peak energy stored in inductor

ANSWER : a

at resonance in series LCR circuit voltage across capacitor and inductor is equal and out of phase. Resistance=impedence(R=z)

$\cos\varphi = R/z = 1$

Statement (a) is not true.

40.A 10v,60W bulb to be connected to 100v line.The required self induction of induction coil will be(f=50Hz)

a)0.052H

b)2.50H

c)5.2H

d)1.6H

ANSWER : a

$$I = \frac{P}{V} = \frac{60}{10} = 6A$$

$$V_L^2 = V^2 - V_R^2 = 100^2 - 10^2$$

$$V_L = \sqrt{9900} = 99.5$$

$$V_L = IX_L$$

$$99.5 = 6X2X3.14X50XL$$

$$L = .052H$$

41.With increase in frequency of an ac supply, capacitive reactance

a)Varies directly with frequency

b)Varies inversely with frequency

c)Varies directly as square of frequency

d)Remains constant

ANSWER : b

Capacitive reactance

$$X_c = \frac{1}{\omega c} = \frac{1}{2\pi f c}$$

$$X_c \, \alpha \, \frac{1}{f}$$

42.A transformer changes

a)power

b)frequency

c)ac voltage

d)none of these

ANSWER : c

transformer changes the ac voltage

43. A step up transformer the turns ratio is 1:2 A dc source of 10v is connected across primary. Output voltage is

a)20v

b)10v

c)5v

d)zero

ANSWER : d

Transformer can’t work with dc.so ouput voltage is zero.

44. A transformer is used to light 100W,110vlamp from 220v mains. If the current is 0.5A,efficiency of the transformer is

a)11%

b)50%

c)80%

d)91%

ANSWER : d

Input power = 220X0.5=110W

Output power = 100W

$$\eta = \frac{P_o}{P_i} = \frac{100}{110} = .9009 \approx 91\%$$

45. One kw power is supplied to a 200turns primary of a transformer of 0.5A. The secondary gives 200v. The number of turns in the secondary is

a)20

b)200

c)2

d)2000

ANSWER : a

Here output power = input power (no loss)

$$I_s = \frac{P_i}{V_s} = \frac{1000}{200} = 5A$$

$$\frac{N_s}{N_p} = \frac{I_p}{I_s}$$

$$N_s = 200 X \frac{0.5}{5} = 20$$

46.The power loss in a transformer working on 220vac supply is 30%.The ratio of primary to secondary current when output voltage is 110v is

a)1:2

b)2:1

c)1:1

d)5:7

ANSWER : d

Here loss is 30%,efficiency is 70%.

$$\eta = \frac{E_s I_s}{E_p I_p}$$

$$\frac{I_p}{I_s} = \frac{E_s}{E_p \eta} = \frac{110}{220 X\left(\frac{70}{100}\right)}$$

$$I_p : I_s = 5 : 7$$

47.Ferromagnetic material used in transformer must have

a) Low permeability and low hysteresis loss

b) Low permeability and high hysteresis loss

c) High permeability and l ow hysteresis loss

d) High permeability and high hysteresis loss

ANSWER : c

in transformer flux linkage should be maximum and loss to be minimum

48.The materials suitable for making electromagnets should have

a)High retentivity and high coercive force

b)low retentivity and low coercive force

c)High retentivity and low coercive force.

d)Low retentivity and high coerceive force.

ANSWER : b

electromagnets are not permanent magnets, they should be demagnetised eaisly.

49.The hysteresis loss per unit volume per cycle of magnetismis

a) μ_o X area of I-H loop

b)Equal to area of B-H loop

c)Both (a) and (b)

d)Only (b)

ANSWER : c

50.The rms value of an ac of 50Hz is 10A.The time taken by an alternating current in reaching from zero to maximum valueis

a)0.002s

b)0.001s

c)0.005s

d)0.5s

ANSWER : c

time taken to reach from zero to maximum is T/4,where T is time period. T=1/f

=(1/4)(1/50)=1/200=0.005s