Electromagnetic Induction and Alternating Currents Important Questions With Answers

NEET Physics 2023

1. An e.m.f. of 5 volt is produced by a self inductance, when the current changes at a steady rate from 3A to 2A in 1millisecond. The value of self inductance is:

   a) Zero b) 5 H c) 5000 H **d) 5 mH**

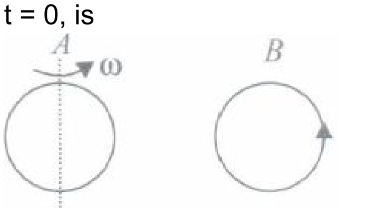
   Solution : -

   E = - L x (dI/dt)

   5 = - L x (2 - 3)/(1 x 10^{-3}) = 1000 L

   or, L = 5 x 10^{-3} H = 5 mH

2. Same as problem 4 except the coil A is made to rotate about a vertical axis. No current flows in B if A is at rest. The current in coil A, when the current in B (at t = 0) is counterclockwise and the coil A is as shown at this instant, t = 0, is

   a) constant current clockwise. b) varying current clockwise. c) varying current counterclockwise.

   d) constant current counterclockwise.

3. Assertion: The back emf in a de motor is maximum when the motor has just been switched on.

   Reason: When motor is switched on it has maximum speed.

   a) If both assertion and reason are true and reason is the correct explanation of assertion.

   b) If both assertion and reason are true but reason is not the correct explanation of assertion.

   c) If assertion is true but reason is false. d) If both assertion and reason are false.

   Solution : -

   Back emf is actually the induced emf produced in motor. When motor is just switched on, the magnitude of back emf is quite small due to the low speed of the motor. But the magnitude of back emf is very large at break (when electric supply fails suddenly, while the motor is running).

4. In a uniform magnetic field B a wire in the form of a semicircle of radius r rotates about the diameter of the circle with angular frequency ω. The axis of rotation is perpendicular to the field. If the total resistance of the circuit is R, the mean power generated per period of rotation is

   a) $\frac{B\pi r^2}{2R}$ **b)** $\frac{(B\pi r^2\omega)^2}{8R}$ c) $\frac{(B\pi r\omega)^2}{2R}$ d) $\frac{(B\pi r\omega^2)^2}{8R}$

5. What is the value of inductance L for which the current is a maximum in a series LCR circuit with C = 10 μF and ω= 1000/s?

   a) 10 mH **b) 100 mH** c) 1 mH d) cannot be calculated unless R is known

   Solution : -

Now the current is maximum at resonance, so

$\omega^2 = 1/LC$ or $L = 1/\omega^2 C$

Now, $= 1/(1000)^2(10 \times 10^{-6}) = 0.1$ H or 100 mH

6. A fully charged capacitor C with initial charge Q_0 is connected to a coil of self inductance L at t = 0. The time at which the energy is stored equally between the electric and the magnetic field is

a) $\frac{\pi}{4}\sqrt{LC}$ b) $2\pi\sqrt{LC}$ c) $\frac{1}{\sqrt{LC}}$ d) $\sqrt{LC}$

Solution : -

As $w^2 = \frac{1}{LC}$ or $w = \frac{1}{\sqrt{LC}}$

Maximum energy stored in capacitor$= \frac{1}{2}\frac{Q_0^2}{C}$

Let at any instant t, the energy be stored equally between electric and magnetic field. Then energy stored in electric field at instant t is

$\frac{1}{2}\frac{Q^2}{C} = \frac{1}{2}\left[\frac{1}{2}\frac{Q_0^2}{C}\right]$

or $Q^2 = \frac{Q_0^2}{2}$ or $Q = \frac{Q_0}{\sqrt{2}} \Rightarrow Q_0 coswt = \frac{Q_0}{\sqrt{2}}$

or $wt = \frac{\pi}{4}$ or $t = \frac{\pi}{4w} = \frac{\pi}{4\times(1/\sqrt{LC})} = \frac{\pi\sqrt{LC}}{4}$

7. The rms value of current in an ac circuit is 25 A, then peak current is

a) 35.36 mA **b) 35.36 A** c) 3.536 A d) 49.38 A

Solution : -

Here, $I_{rms} = 25$ A

$\therefore I_m = \sqrt{2}\, I_{rms} = \sqrt{2} \times 25 = 35.36$ A

8. A rectangular loop of sides 6 cm and 2 ern with a small cut is moving out of a region of uniform magnetic field of magnitude 0.4 T directed normal to the loop. The voltage developed across the cut if velocity of loop is 2 cm s^{-1} in a direction normal to the longer side is

a) 3.8×10^{-4} V **b) 4.8×10^{-4} V** c) 2.2×10^{-2} V d) 3.2×10^{-2} V

Solution : -

Here, $l = 6$ cm $= 6 \times 10^{-2}$m

B = 0.4 T,

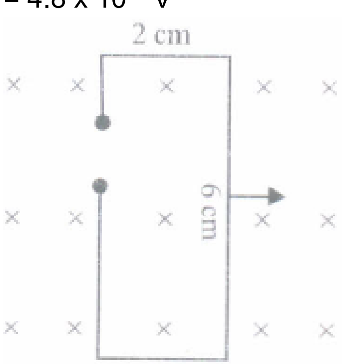
$v = 2$ cm s^{-1}

$= 2\times10^{-2}$m s^{-1}

Voltage developed is

$\varepsilon = Blv = 0.4 \times 6 \times 10^{-2} \times 2 \times 10^{-2}$

$= 4.8 \times 10^{-4}$ V



9. Faraday's laws are consequence of conservation of:

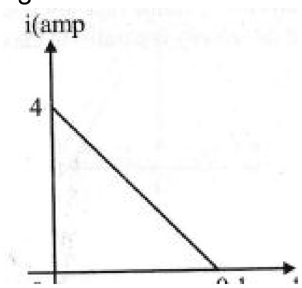
a) Energy b) Energy and magnetic field c) Charge d) Magnetic field

Solution : -
As per Faraday's laws, mechanical energy gets transformed into electric energy which is done in accordance with law of conservation of energy, hence Faraday's laws are consequence of conservation of energy.

10. If V= 100sin(100t) V and I = 100 sin $\left(100t + \frac{\pi}{3}\right)$ mA are the instantaneous values of voltage and current, then the rms values of voltage and current are respectively
a) 70.7 V, 70.7 mA b) 70.7 V, 70.7 A c) 141.4 V, 141.4 mA d) 100 V, 100 mA

Solution : -
The instantaneous value of voltage is
V = 100sin(100 t) V Compare it with, $V = V_0\sin(\omega t)$ V
we get, V_0= 100 V, ω= 100 rad S^{-1}
The rms value of voltage is
$V_{rms} = \frac{V_0}{\sqrt{2}} = \frac{100}{\sqrt{2}}$ V = 70.7 V
The instantaneous value of current is
I = 100 sin $\left(100t + \frac{\pi}{3}\right)$ mA
Compare it with, $I = I_o \sin(\omega t + \phi)$
we get, I_o = 100 mA, ω = 100 rad S^{-1}
The rms value of current is
$I_{rms} = \frac{I_o}{\sqrt{2}} = \frac{100}{\sqrt{2}}$ mA = 70.7 mA

11. In a coil of resistance 10 W, the induced current developed by changing magnetic flux through it, is shown in figure as a function of time. The magnitude of change in flux through the coil in Weber is



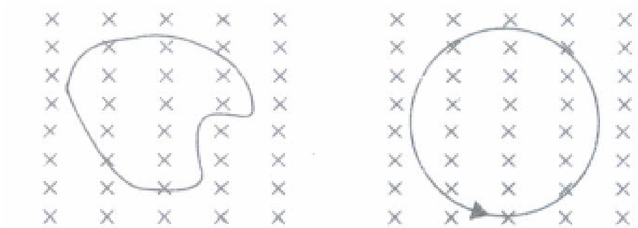
a) 8 **b) 2** c) 6 d) 4

Solution : -
The charge through the coil = area of current-time (i - t) graph
$q = \frac{1}{2} \times 0.1 \times 4 = 0.2C$
$q = \frac{\Delta\phi}{R}$ ∵ Change of flux $(\Delta\phi) = q \times R$
$q = 0.2 = \frac{\Delta\phi}{10}$
$\Delta\phi = 2$ Weber

12. An inductor 20 mH, a capacitor 100 μF and a resistor 50 Ω are connected in series across a source of emf, V = 10 sin 314 t. The power loss in the circuit is :
a) 0.79 W b) 0.43 W c) 2.74 W d) 1.13 W

Solution : -
Average power in impedance
Z=$\sqrt{R^2 + (\omega L - 1/\omega C)^2}$
$\omega L = X_L = (314) \times (20 \times 10^{-3}) = 6.280$
$X_C = 1/C\omega = 10^6/(100 \times 314) = 31.84$
Solving for impedance Z = 56.15 Ω

$I_{rms} = V_{rms}/Z = V_m/(\sqrt{2} \times Z) = 0.1259$ A
Hence power loss in the circuit
$= I^2 \times R = 0.0159 \times 50 = 0.79$ W

13. There is a uniform magnetic field directed perpendicular and into the plane of the paper. An irregular shaped conducting loop is slowly changing into a circular loop in the plane of the paper. Then
a) current is induced in the loop in the anti-clockwise direction
b) current is induced in the loop in the clockwise direction.   c) ac is induced in the loop.
d) no current is induced in the loop.
Solution : -
Due to change in the shape of the loop, the magnetic flux linked with the loop increases. Hence, current is induced in the loop in such a direction that it opposes the increases in flux.Therefore, induced current flows in the anticlockwise direction.


14. An LCR series ac circuit is at resonance with 10 V each across L, C and R. If the resistance is halved, the respective voltages across L, C and R are
a) 10 V,10 V and 5 V   b) 10 V,10 V and 10 V   c) 20 V, 20 V and 5 V   **d) 20 V, 20 V and 10 V**

15. A 2 m long metallic rod rotates with an angular frequency of 200 rad s^{-1} about an axis normal to the rod passing through its one end. The other end of the rod is in contact with a circular metallic ring. A constant magnetic field of 0.5 T parallel to the axis exists everywhere. The emf developed between the centre and the ring is
a) 100 V   **b) 200 V**   c) 300 V   d) 400 V
Solution : -
The emf developed between the centre and the ring is
$\varepsilon = \frac{1}{2}Bl^2\omega = \frac{0.5\times2^2\times200}{2}200 \quad V$

16. If the number of turns per unit length of a coil of solenoid is doubled, the self-inductance of the solenoid will ______.
a) remain unchanged   b) be halved   c) be doubled   **d) become four times**
Solution : -
A long solenoid is that whose length is very large as compared to its radius of cross-section. If N is total number of turns in the solenoid. A is area of each turn of the solenoid and l is length of solenoid, then self-inductance of solenoid is given by
$L = \frac{\mu_0 N^2 A}{l} \Rightarrow L = \mu_0 n^2 Al$
(n : number of turns per unit length)
So, $L\mu n^2$
When n^2 is doubled, L becomes 4 times.

17. A conductor is moving with the velocity v in the magnetic field and induced current is 1. If the velocity of conductor becomes double, the induced current will be
a) 0.5 I   b) 1.5 I   **c) 2 I**   d) 2.5 I
Solution : -
When the velocity of conductor becomes double, area intercepted becomes twice. Therefore induced current becomes twice.

18. In a LCR circuit having L = 8.0 henry, C = 0.5 μF and R = 100 ohm in series. The resonance frequency in per second is :

a) 600 radian b) 600 Hz **c) 500 radian** d) 500 Hz

Solution : -

It is seen that the resonance frequency in radian/second is given as:

$\omega_0 = 1/\sqrt{LC}$

$= \frac{1}{\sqrt{8 \times 0.5 \times 10^{-6}}}$ = 500 rad/sec.

19. The mutual inductance M_{12} of a coil 1 with respect to coil 2

a) increases when they are brought nearer. b) depends on the current passing through the coils.

c) increases when one of them is rotated about an axis. d) both (a) and (b) are correct.

Solution : -

The mutual inductance M_{12} of coil 1 with respect to coil 2 increases when they are brought nearer.

20. A metal conductor of length 1 m rotates vertically about one of its ends with an angular velocity 5 rad S^{-1}. If the horizontal component of earth's magnetic field is 0.2 x 10^{-4} T, then the emf developed between the ends of the conductor is

a) 5 μV b) 5 mV **c) 50 μV** d) 50 mV

Solution : -

The emf developed between the ends of the conductor is

$\omega = 2\pi\left(\frac{1800}{60}\right) rad_s^{-1} = 60\pi rad_s^{-1},$

$\varepsilon = \frac{1}{2}\omega Bl^2 = \frac{1}{2} \times 5 \times 0.2 \times 10^{-4} \times (1)^2$

= 5 x 10^{-5} V = 50 x 10^{-6} V = 50 μV

21. In an ac circuit an alternating voltage $\varepsilon = 200\sqrt{2}\sin 100$ t volts is connected to a capacitor of capacity $1\mu\mathrm{F}$. The r.m.s. value of the current in the circuit is___

a) $10\mu\mathrm{A}$ b) $100\mu\mathrm{A}$ **c)** $200\mu\mathrm{A}$ d) $20\mu\mathrm{A}$

Solution : -

$V_{rms} = \frac{200\sqrt{2}}{\sqrt{2}} = 200\ \mathrm{V}$

$I_{rms} = \frac{V_{rms}}{X_C} = \frac{\frac{200}{1}}{100 \times 10^{-6}}$

$= 2 \times 10^{-2} = 200\mu\mathrm{A}$

22. In an AC circuit, the rms value of current, i_{rms} is related to the peak current, i_0 by the relation_____

a) $i_{\mathrm{rms}} = \sqrt{2} i_0$ b) $i_{\mathrm{rms}} = \pi i_0$ c) $i_{\mathrm{rms}} = \frac{i_0}{\pi}$ **d)** $i_{\mathrm{rms}} = \frac{1}{\sqrt{2}} i_0$

Solution : -

Root mean square value of an alternating current is defined as the square root of the average of i^2, during a complete cycle, it may be taken by

$j^2 = \frac{b^{2\pi/\omega} i^2 dt}{\frac{2\pi}{\omega}}$

$= \frac{\int_0^{2\pi/\omega} i_0^2 \sin^2 \omega t dt}{\frac{2\pi}{\omega}}$

$= \frac{i_0^2 \omega}{2\pi} \int_0^{2\pi/\omega \frac{1}{2}(1-\cos 2\omega t) dt}$

$= \frac{i_0^2 \omega}{4\pi}\left[t - \frac{\sin 2\omega t}{2\omega}\right]_0^{2\times/\omega}$

$= \frac{i_0^2 \omega}{4\pi}\left(\frac{2\pi}{\omega}\right) = \frac{i_0^2}{2}$

$= \sqrt{i^2} = \frac{i_0}{\sqrt{2}}$

$\therefore i_{\mathrm{mss}} = \sqrt{i^2} = \frac{i_0}{\sqrt{2}}$

23. The coefficient of mutual inductance of two coils depends on
a) medium between the coils b) distance between the two coils c) orientation of the two coils

d) all of these

24. A 5μF capacitor is connected to a 200 V, 100 Hz ac source. The capacitive reactance is
a) 212 Ω b) 312 Ω **c) 318** Ω d) 412 Ω

25. A 30 μlF capacitor is connected to a 150 V, 60 Hz ac supply. The rms value of current in the circuit is
a) 17 A **b) 1.7 A** c) 1.7 mA d) 2.7 A

Solution : -
Here, C = 30 X 10^{-6} F, V_{rms}= 150 V, U = 60 Hz Capacitive reactance
$X_C = \frac{1}{\omega C} = \frac{1}{2\pi\upsilon C} = 88.46\Omega$
$I_{rms} = \frac{V_{rms}}{X_C} = \frac{150}{88.46} = 1.7$ A

26. Assertion: Sensitive electrical instruments should not be placed in the vicinity of an electromagnet.
Reason: Electromagnet can damage the instruments.

a) If both assertion and reason are true and reason is the correct explanation of assertion.

b) If both assertion and reason are true but reason is not the correct explanation of assertion.

c) If assertion is true but reason is false. d) If both assertion and reason are false.

Solution : -
Sensitive electrical instruments in the vicinity of electromagnet can be damaged due to the induced emfs and the resulting currents when the electromagnet is turned on or off.

27. Quantity that remains unchanged in a transformer is
a) voltage b) current **c) frequency** d) none of these

Solution : -
A transformer does not change the frequency of ac.

28. In electromagnetic induction, the induced e.m.f. in a coil is independent of
a) Change in the flux b) Time **c) Resistance of the circuit** d) None of the above

Solution : -
The induced e.m.f for a coil of wire depends on, magnetic strength of core in coil of wire, number of turns of wire in coil, cross-sectional area of coil, speed of magnet movement of the coil.

29. A metal plate can be heated by
a) passing either a direct or alternating current through the plate. b) placing in a time varying magnetic field.

c) placing in a space varying magnetic field, but does not vary with time. **d) both (a) and (b) are correct.**

Solution : -
When a metal plate is getting heated, it may be due to the passage of direct current, alternating current or even induced current through the plate. As time varying magnetic field produces induced current in the plate, so both (a) and (b) are correct.

30. The primary winding of transformer has 500 turns whereas its secondary has 5000 turns. The primary is connected to an A C supply of 20 V-50 Hz. The secondary will have an output of_____
a) $2 \mathrm{~V}, 5 \mathrm{~Hz}$ b) $200 \mathrm{~V}, 500 \mathrm{~Hz}$ c) $2 \mathrm{~V}, 50 \mathrm{~Hz}$ **d)** $200 \mathrm{~V}, 50 \mathrm{~Hz}$

Solution : -
The transformer converts AC high voltage into AC low voltage, but it does not cause any change in frequency.
The ratio of voltage across input with output voltage is given by
$\frac{V_s}{V_p} = \frac{N_s}{N_p}$
$N_s =$ No. of turns in secondary coil

$N_p =$ No. of turns in primary coil

Making substitution, we obtain

$V_s = \frac{N_3}{N_p} V_p$

$= \frac{5000}{500} \times 20 = 200 \text{ V}$

Thus, output has voltage 200 V and frequency 50 Hz.

31. Assertion: Mutual inductance of a pair of coils depend on their separation as well as their relative orientation.
Reason: Mutual inductance depend upon the length of the coil only.
a) If both assertion and reason are true and reason is the correct explanation of assertion.
b) If both assertion and reason are true but reason is not the correct explanation of assertion.
c) If assertion is true but reason is false. d) If both assertion and reason are false.

Solution : -

The mutual inductance in case of a medium of relative permeability Ilr present is

M=$\mu_r \mu_0 n_1 n_2 \pi r_1^2 l$

32. In an A.C. circuit containing only capacitance, the current:
a) leads the voltage by 180° b) lags the voltage by 90° **c) leads the voltage by 90°**
d) remains in phase with the voltage

Solution : -

In an a.c. circuit containing only capacitance, the current remains ahead of voltage by a phase difference of 90°.

33. When the number of turns and the length of the solenoid are doubled keeping the area of crosssection same, the inductance:
a) Remains the same b) Is halved **c) Is doubled** d) Becomes four times

Solution : -

As $L \propto N^2/l$ so $L_2/L_1 = (N_2/N_1)^2(l_1/l_2)$

As $N_2 = 2N_1$ and $l_2 = 2l_1$

$L_2/L_l = 4(1/2) = 2$

$L_2 = 2L_1$

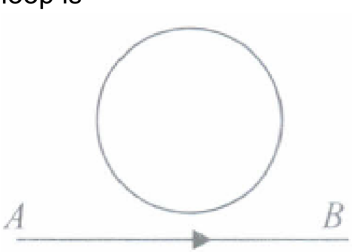
34. If number of turns in primary and secondary coils is increased to two times each, the mutual inductance
a) becomes 4 times b) becomes 2 times c) becomes $\frac{1}{4}$ times d) remains unchanged

Solution : -

M=$\frac{\mu_0 N_1 N_2 A}{l}$

$\therefore$ M becomes 4 times.

35. In the given figure current from A to B in the straight wire is decreasing. The direction of induced current in the loop is



a) clockwise **b) anticlockwise** c) changing d) nothing can be said

Solution : -

When the current in the wire AB decreases, the magnetic flux linked with the loop (which is out of the page) will decrease. Hence, the current induced in the loop must be anticlockwise to oppose the decrease in magnetic flux.

36. A series LCR-circuit with R = 20 Ω, L = 1.5 Hand C = 35 μF is connected to a variable frequency 200 V ac supply. When the frequency of the supply equals the natural frequency of the circuit, the average power transferred to the circuit in one complete cycle is

a) 200W **b) 2000W** c) 100W d) 4000W

Solution : -

If the frequency of the ac source equals the natural frequency of the circuit, the impedance

Z= R = 20Ω

The average power dissipated per cycle,

$P_{av} = \frac{V_{rms}^2}{Z} = \frac{V_{rms}^2}{R} = \frac{(200)^2}{20} = 2000W$

37. **Assertion:** A step-up transformer changes a lowvoltage into a high voltage.

Reason : This violate the law of conservation of energy.

a) If both assertion and reason are true and reason is the correct explanation of assertion.

b) If both assertionand reason are true but reason is not the correct explanation of assertion.

c) If assertion is true but reason is false. d) If both assertion and reason are false

Solution : -

A step up transformer changes a low voltage into a high voltage. This does not violate the law of conservation of energy, because the current is reduced by the same proportion.

38. A varying current in a coil changes from 10 A to zero in 0.5s. If the average emf induced in the coil is 220 V, the self-inductance of the coil is _______.

a) 5 H b) 6 H **c) 11 H** d) 12 H

Solution : -

Emf induced in the coil of self-inductance (L) is given by

$e = -\frac{d\phi}{dt} = -\frac{d}{dt}(Li) \text{ or } e = -L\frac{di}{dt}$

($\frac{di}{dt} =$ rate of flow of current in coil)

As di = i_2 = d-i_1 = 0-10 = -l0A

dt = 0.5a

e = 220V

$\therefore \quad 220 = -L\frac{(-10)}{0.5}$

or $L = \frac{220}{20} = 11H$

39. A pair of adjacent coils has a mutual inductance of 2.5 H. If the current in one coil changes from 0 to 40 A in 0.8 s, then the change in flux linked with the other coil is

a) 100 Wb b) 120 Wb c) 200 Wb d) 250 Wb

Solution : -

Given, M =2.5 H,$\frac{dI}{dt} = \frac{40-0}{0.8} = 50 \quad As^{-1}$

Also,$\varepsilon = M\frac{dI}{dt} = \frac{d\phi}{dt}$

or $\quad d\phi = MdI = 2.5(40-0) = 100Wb$

40. The self inductance L of a solenoid of length l and area of cross-section A, with a fixed number of turns N increases as

a) l and A increase. **b) l decreases and A increases.** c) l increases and A decreases.

d) both l and A decrease.

Solution : -

The self inductance L of a solenoid of length l and area of cross section A with fixed number of turns N is

$$L = \frac{\mu_0 N^2 A}{l}$$

So, L increases when l decreases and A increases.

41. A transformer is used to light 140 W, 24 V lamp from a 240 V ac mains. If the main current is 0.7 A, the efficiency of the transformer is

a) 63.8% b) 74% **c) 83.3%** d) 48%

Solution : -

Output power = 140 W

Input power = 240 x 0.7 = 168 W

Efficiency= $\frac{output\ power}{input\ power} \times 100 = \frac{140}{168} \times 100$=83.3%

42. The average e.m.f. induced in a coil in which the current changes from 2 ampere to 4 ampere in 0.05 second is 8 volt. What is the self-inductance of the coil?

a) 0.1 H **b) 0.2 H** c) 0.4 H d) 0.8 H

Solution : -

Induced emf, e = - L (di/dt)

As average e.m.f. induced in a coil is 8 V, so

8 = L x (4 - 2)/0.05 or L = 0.2 H

43. In an alternating current circuit consisting of elements in series, the current increases on increasing the frequency of supply. Which of the following elements are likely to constitute the circuit?

a) Only resistor b) Resistor and inductor **c) Resistor and capacitor** d) Only inductor

Solution : -

Reactance of a capacitor, $X_C = \frac{1}{\omega C} = \frac{1}{2\pi v C}$

As frequency increases, Xc decreases and therefore current increases. As R does not vary with frequency, therefore, likely elements constituting the circuit may be capacitor and resistor.

44. A voltage of peak value 283 V and varying frequency is applied to series LCR combination in which R = 3Ω , L = 25 mH and C = 400 μ F. Then the frequency (in Hz) of the source at which maximum power is dissipated in the above is

a) 51.5 b) 50.7 c) 51.1 **d) 50.3**

Solution : -

Here, V_0 = 283 V,R = 3Ω, L = 25 x 10^{-3} H

C = 400 μF = 4 x 10^{-4} F

Maximum power is dissipated at resonance, for which

$$v = \frac{1}{2\pi\sqrt{LC}} = \frac{1\times7}{2\times22\sqrt{25\times10^{-3}\times4\times10^{-4}}}$$

$$= \frac{7\times10^3}{44\sqrt{10}} = 50.3Hz$$

45. If N is the number of turns in a coil, the value of self-inductance varies a _______.

a) N^0 b) N **c) N^2** d) N^{-2}

Solution : -

Magnetic flux,f = BA

and magnetic field due to circular coil is $B = \frac{\mu_0 N i}{2R}$

As self-inductance,

$L=\frac{N\phi}{i}$

$\therefore L=\frac{N}{i}(BA)=\frac{N}{i}\left(\frac{\mu_0 Ni}{2R}\right)A=\frac{\mu_0 N^2 A}{2R}$

$\therefore L\mu N^2$

46. A power transmission line feeds input power at 2400 V to a step down transformer with its primary windings having 4000 turns. What should be the number of turns in the secondary windings in order to get output power at 240 V?

    a) 400 b) 420 c) 424 d) 436

47. By a change of current from 5 A to 10A in 0.1 s, the self induced emf is 10V. The change in the energy of the magnetic field of a coil will be

    a) 5 J b) 6 J **c) 7.5 J** d) 9 J

    Solution : -

    $|\varepsilon|=L\frac{\Delta I}{\Delta t}$

    $L=\frac{|\varepsilon|\Delta t}{\Delta I}=\frac{10\times0.1}{(10-5)}=0.2H$

    The magnetic field energies for currents I_1 and I_2 are

    $U_1=\frac{1}{2}LI_1^2$ and $U_1=\frac{1}{2}LI_2^2$

    Change in energy = $U_2 - U_1$

    $=\frac{1}{2}LI_2^2-\frac{1}{2}LI_1^2=\frac{L}{2}(I_2^2-I_1^2)$

    $=\frac{0.2}{2}(10^2-5^2)$

48. In an AC circuit with voltage V and current i the power dissipated is______

    a) Depends on the phase between V and i b) $\frac{1}{\sqrt{2}}Vi$ c) $\frac{1}{2}Vi$ d) Vi

    Solution : -

    In an A C circuit with voltage V and current i, the power dissipated is given by

    $P=Vi\cos\phi$

    where, f is the phase and cos f is the power factor. Thus, the power dissipated, depends upon the phase between voltage V and current i.

49. For an LCR circuit, the power transferred from the driving source to the driven oscillator is P =I^2 Z cos ϕ . Then

    a) the power factor cos $\phi\leq 0$, P ≥ 0.

    b) the driving force can give no energy to the oscillator (P = 0) in some cases.

    c) the driving force cannot syphon out (P < 0) the energy out of oscillator. **d) all of these.**

    Solution : -

    Here, P = I^2Z cos ϕ

    (a) If power factor cos $\phi \geq 0 \Rightarrow$ P $\geq$ O.

    (b) For wattless component the driving force shall give no energy to the oscillator. so, at ϕ = 90°, P = O.

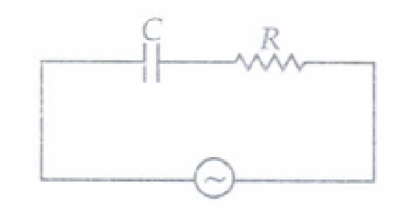
    (c) The driving force cannot syphon out the energy out of oscillator. i.e. P cannot be negative.

    Hence all options are correct.

50. A series R-C combination is connected to an AC voltage of angular frequency ω = 500 radian/s. If the impedance of the R-C circuit is $R\sqrt{1.25}$, the time constant (in millisecond) of the circuit is

    a) 2 b) 3 **c) 4** d) 5

    Solution : -



Here, ω= 500 radian/s

The capacitive reactance is

$X_C = \frac{1}{wC}$

The impedance of the circuit is

$Z = \sqrt{R^2 + (X_C)^2} = \sqrt{R^2 + \left(\frac{1}{wC}\right)^2}$

$R\sqrt{\frac{5}{4}} = \sqrt{R^2 + \left(\frac{1}{wC}\right)^2}$ or $\frac{5}{4}R^2 = R^2 + \left(\frac{1}{wC}\right)^2$

$\frac{1}{4}R^2 = \left(\frac{1}{wC}\right)^2$ or $R^2C^2 = 4\left(\frac{1}{w}\right)^2$

or RC = $\frac{2}{w} = \frac{2}{500}s$ = 0.4 $\times$ 10^{-2} s = 4 millisecond

$\therefore$The time constant of RC circuit, τ = RC = 4 ms