# QB365 Question Bank Software Study Materials

## Electromagnetic Induction and Alternating Current Important 2 Marks Questions With Answers (Book Back and Creative)

12th Standard

**Physics**

Total Marks : 40

2 Marks

20 x 2 = 40

1) A closed coil of 40 turns and of area 200 $cm^2$, is rotated in a magnetic field of flux density 2 Wb $m^{-2}$. It rotates from a position where its plane makes an angle of 30° with the field to a position perpendicular to the field in a time 0.2 s. Find the magnitude of the emf induced in the coil due to its rotation.

**Answer :** N = 40 turns; B = 2 Wb $m^{-2}$

A = 200 $cm^2$ = 200 x $10^{-4}$ $m^2$;

Initial flux, $\Phi_i$ = BA cos$\theta$

= 2 x 200 x $10^{-4}$ x cos60°

since θ = 90°− 30°= 60°

$\Phi_i$= 2 x $10^{-2}$ Wb

Final flux, $\Phi_f$ = BA cos$\theta$

= 2 x 200 x $10^{-4}$ x cos0° since $\theta$ = 0°

$\Phi_f$ = 4 x $10^{-2}$Wb

Magnitude of the induced emf is

$\varepsilon = N\frac{d\Phi_B}{dt}$

$= \frac{40\times(4\times10^{-2}-2\times10^{-2})}{0.2} = 4V$

2) What is meant by electromagnetic induction?

**Answer :** Whenever the magnetic flux linked with a closed coil changes, an emf is induced and hence an electric current flows in the circuit. This current is called an induced current and the emf giving rise to such current is called an induced emf. This phenomenon is known as electromagnetic induction.

3) How is Eddy current produced? How do they flow in a conductor?

**Answer :** Even for a conductor in the form of a sheet or plate, an emf is induced when magnetic flux linked with it changes. But the difference is that there is no definite loop or path for induced current to flow away. As a result, the induced currents flow in concentric circular paths. As these electric currents resemble eddies of water, these are known as Eddy currents. They are also called Foucault currents.

4) What do you mean by self-induction?

**Answer :** An electric current flowing through a coil will set up a magnetic field around it. Therefore the magnetic flux of the magnetic field is linked with that coil it self. If this flux is changed by changing the current, an emf is induced in that same coil. This phenomenon is known as self-induction.

5) What is meant by mutual induction?

**Answer :** When an electric current passing through a coil changes with time, an emf is induced in the neighboring coil. This phenomenon is known as mutual induction.

6) What are step-up and step-down transformers?

**Answer :** (i) If Ns > Np(K > 1),thenVs > Vp and Is (ii) If NsIp. This is step-down transformer, where voltage is decreased and the current is increased.

7) Define electric resonance.

**Answer :** When the frequency of the applied alternating source ($\omega_r$) is equal to the natural frequency $\left[\frac{1}{\sqrt{LC}}\right]$ of the RLC circuit, the current in the circuit reaches its maximum value. Then, the circuit is said to be in electrical resonance.

8) What is meant by wattles current?

**Answer :** The current in an AC circuit is said to be wattless current if the power consumed by it is zero.

9) Determine the self-inductance of 4000 turn air-core solenoid of length 2m and diameter 0.04 m.

**Answer :** Relative permeability of air-core solenoid is $\mu_r = 1$

Length of the solenoid, I = 2 m, Number of turns, N = 4000

Diameter of the solenoid, d = 4 x $10^{-2}$m

Area of solenoid, A = $\frac{\pi d^2}{4}$

$A = \frac{3.14\times\left(4\times10^{-2}\right)^2}{4}$

$= 12.56 \times 10^{-4}\ \mathrm{m}^2$

Self inductance of a solenoid is, $L = \frac{\mu_0\mu_r N^2 A}{l}$

$\therefore L = \frac{4\pi\times10^{-7}\times1\times(4000)^2\times12.56\times10^{-4}}{2}$

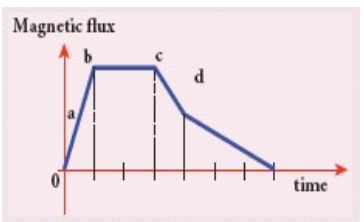
$= 2 \times 3.14 \times 10^{-7} \times 16 \times 10^6 \times 12.56 \times 10^{-4}$

$= 1262 \times 10^{-5}\mathrm{H} = 12.62 \times 10^{-3}\mathrm{H}$

$\therefore L = 12.62\mathrm{mH}$

∴ Self inductance of a solenoid L =12.62 mH

10) A graph between the magnitude of the magnetic flux linked with a closed loop and time is given in the figure. Arrange the regions of the graph in ascending order of the magnitude of induced emf in the loop.




**Answer :** Magnitude of induced emf $|\mathrm{e}| = \left|-\frac{d\phi}{dt}\right|$

$\therefore c = \frac{d\phi}{dt}$

(i) In the region ab,

$c_1 = \frac{d\phi_1}{dt} = \frac{4-0}{1-0} = \frac{4}{1} = 4\ \mathrm{V}$

(ii) In the region bc,

$c_2 = \frac{d\phi_2}{dt} = \frac{4-4}{3-1} = \frac{0}{2} = 0\ \mathrm{V}$

(iii) In the region cd,

$e_3 = \frac{d\phi_2}{dt} = \frac{4-2}{4-3} = \frac{2}{1} = 2\ \mathrm{V}$

(iv) In the region de,

Hence,

$e_4 = \frac{d\phi_4}{dt} = \frac{2-0}{7-4} = \frac{2}{3} = 0.66V$

$\mathrm{e}_2 < \mathrm{e}_4 < \mathrm{e}_3 < \mathrm{e}_1$

In the ascending order of the magnitude of induced emf

Region bc < Region de < Region cd < Region ab.

11) Define Magnetic Flux.

**Answer :** The magnetic flux through an area A in a magnetic field is defined as the number of magnetic field lines passing through that area normally and is given by the equation.

$\Phi_B = \int_A \vec{B}.d\vec{A} = BAcos\theta$

where the integral is taken over the area A and θ is the angle between the direction of the magnetic field and the outward normal to the area.

12) What is meant by power transmission?

**Answer :** Most of the power stations are located in remote places. Hence the electric power generated is transmitted over long distances through transmission lines to reach towns or cities where it is actually consumed. This process is called power transmission.

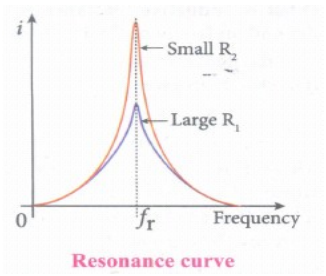
13) What is resonant frequency?

**Answer :** When the frequency of the applied alternating source ($\omega_r$) is equal to the natural frequency $\left[\frac{1}{\sqrt{LC}}\right]$ of the RLC circuit, the current in the circuit reaches its maximum value. Then the circuit is said to be in electrical resonance. The frequency at which resonance takes place is called resonant frequency.

Resonant angular frequency, $\omega_r = \frac{1}{\sqrt{LC}}$

14) Draw a graph showing variation of current with changing frequency of applied voltage in a series LCR circuit for two different values of resistance R1 & R2 ($I_1 > I_2$) fr - resonant frequency.

**Answer :** The maximum current at series resonance is limited by the resistance of the circuit. For smaller resistance, a larger current with a sharper curve is obtained and vice versa.

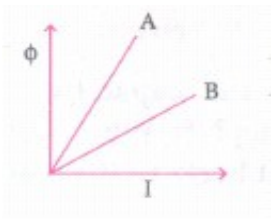


Resonance curve

15) Show the directions of induced currents in metal rings 1 and 2 lying in the same place where current I in the wire is increasing steadily


**Answer :** 1 clockwise, 2 anti clockwise

16) A graph of magnetic flux (Φ) versus current CI is shown for two inductors A & B, which has a larger value of self-inductance?




**Answer :** $\Phi = LI$

For same current $\Phi_A > \Phi_B$

So $L_A > L_B$

i.e conductor a has a larger value of self-induction

For a series LCR circuit power factor is

$$\frac{R}{z} = \frac{R}{\sqrt{R^2+\left(\omega L-\frac{1}{\omega c}\right)}}$$

The maximum value of power factor = 1

The minimum value of power factor = 0

17) What is phasor?

**Answer :** A quantity which varies sinusoidally with time and represented as the projection of a rotating vector is called phasor.

18) Can one coil have inductance without a resistance?

**Answer :** No. If on coil has inductance, definitely it will have a resistance.

19) When an inductor is connected to a 230 V d.c. source, a current of 2 A passes through it. When the same inductor is connected to a 230 V, 50 Hz, a.c.source, the amount of current decreases (i.e. 1 A). Why?

**Answer :** (i) When Ac flows through L Produces time varying magnetic field which produce self induced emf (back emf).
(ii) This back emf according to Lenz's law opposes any change in the current. So the amount of current decreases.

20) Define RMS current. Give its expression.

**Answer :** **Definition:**

The root mean square value of an alternating current is defined as the square root of the mean of the squares of all currents over one cycle.

**Expression**

$$I_{RMS} = \sqrt{\frac{\text{Area one cycle of squared wave}}{\text{Baselength of onecycle}}}$$