Assignment-1

Answer Key

1 (a) Since ϕ = NBA cosθ ; For ϕ to be maximum; cosθ = max = 1 so ϕ_{max} = NBA.

2. (c) Because induced e.m.f. is given by $E = -N\frac{d\phi}{dt}$.

3. (d) The energy of the field increases with the magnitude of the field. Lenz's law infers that there is an opposite field created due to increase or decrease of magnetic flux around a conductor so as to hold the law of conservation of energy.

4. (c) As it is seen from the magnet side induced current will be anticlockwise.

5. (b)

6. (d)

7. (c) $e = -L\frac{di}{dt} \Rightarrow e = 5 \times \frac{1}{5} = 1\ volt$

8. (a)

9. The magnitude of induced e.m.f. is directly proportional to the rate of change of magnetic flux. Induced charge doesn't depend upon time.

10. (b)

11. (b)

12. (a) As maximum linkage of magnetic flux is possible in A situation .

13. (d) E.M.F. induces, when there is change in magnetic flux. Faraday did experiment in which, there is relative motion between the coil and magnet, the flux linked with the coil changes and e.m.f. induces.

14. (a) as there is relative motion between solenoid and magnet gives change in flux

15. (a) Transformer works on ac only, ac changes in magnitude as well as in direction.

16. (a)

17. (c)

18 (c)

19. The SI unit of magnetic flux is weber or tesla – metre

20. Whenever the magnetic flux linked with an electric circuit changes an e.m.f. is induced in the circuit. The phenomenon is called electromagnetic induction.

21. The direction of induced current due to the change in magnetic flux through a closed-loop is always such that it opposes the change or cause which produces it.

when Lenz law is applied to it, it will be

E a $-d\Phi/dt$ where a negative sign shows the opposing nature of induced emf. It is based on the principle of conservation of energy.

22. $L = (\mu_0 N^2 A) / l$

- It depends on number of turns N
- It depends on area of cross section A
- Permeability of core material $\mu 0$

23. From self-induction, we know that if I is the strength of the current flowing through a coil at any time ϕ is amount of magnetic flux linked with the coil at that time.
It is found that

$$\phi \text{ a } I, \quad \phi \alpha LI \qquad \ldots(i)$$

L is a constant of proportionality and is called coefficient of self induction or self inductance of the coil.

S.I Unit $\frac{\text{volt sec}}{\text{Amp}}$ or Henry

The value of L depends upon the number of turn of the coil, area of cross-section and nature of material of the core on which coil is wound.

24. (i) The magnetic flux through the rectangular loop abcd increases, due to the motion of the loop into the region of magnetic field, The induced current must flow along the path bcdab so that it opposes the increasing flux.

(ii) Due to the outward motion, magnetic flux through the triangular loop abc decreases due to which the induced current flows along bacb, so as to oppose the change in flux.

(iii) As the magnetic flux decreases due to motion of the irregular shaped loop abcd out of the region of magnetic field, the induced current flows along cdabc, so as to oppose change in flux.

Note that there are no induced current as long as the loops are completely inside or outside the region of the magnetic field.

25. Consider current I flowing through a long solenoid of area A,

Let N be the total number of turns in the solenoid,

Total flux, ϕ=NBA

Here, $B=\mu_0 nI$

Where, n is no. of turns per unit length of the solenoid, $N=nl$

$$\phi=nl\times\mu_0 nIA$$

$$\Rightarrow\phi=\mu_0 n^2 AlI \ldots\ldots\ldots (1)$$

Also, $\phi=LI \ldots\ldots\ldots\ldots\ldots (2)$

From equation (1) & (2)

$$I\mu_0 n_2 Al=LI$$

$$L=\mu_0 n^2 Al$$

$$L=\mu_0 N^2 A \quad \text{where } (n=N/l)$$

One henry(1H) can be defined as: If current is changing at a rate of 1A/s in a coil inducing an emfof 1volt in it, then the inductance of the coil is one henry.