MULTIPLE CHOICE QUESTIONS

1. Which of the following factors is the induced charge in an electromagnetic induction independent of?
   a. **Time** b. Resistance of the coil c. Change of flux d. None of the above

2. Which of the following states that an emf is induced whenever there is a change in the magnetic field linked with electric circuits?
   a. Lenz's Law b. Ohm's Law
   c. **Faraday's Law of Electromagnetic Induction**
   d. None of the above

3. Which of the following gives the polarity of the induced emf?
   a. Biot-Savart Law **b. Lenz's Law**
   c. Ampere's circuital Law d. Fleming's right-hand Rule

4. Electrical Inertia is the measure of
   a. **Self Inductance** b. Mutual Inductance
   b. c. Impedance d. None of the above

5. Which of the following laws is the consequence of the Law of conservation of energy?
   a. Lenz's Law b. Ohm's Law c. Archimedes Law d. All of the above

Answer: (a) Lenz's Law

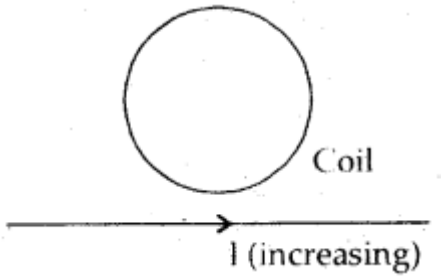
6. Which of the following apparatus construction uses electromagnetic induction?
   a. Voltmeter b. Galvanometer **c. Generator** d. Electric Motor

7. Which of the following factors is the self inductance associated with a coil is independent of?
   a. induced voltage b. current c. time **d. coil resistance**

8. Which of the following rules is used to identify the direction of the current induced in a wire moving in a magnetic field?
   a. Ampere's Rule **b. Fleming's Left-Hand Rule**
   c. Fleming's Right-Hand Rule d. None of the above

9. Which of the following statements is true?
   a. A metal plate can be heated by passing either a direct current or an alternating current through the plate.
   b. A metal plate can be heated by placing it in a time-invariant magnetic field.
   c. A metal plate can be heated by placing it in a time-variant magnetic field
   d. Both (a) and (c)

10. A circular coil is placed near a straight conductor as shown below. When the current in the straight conductor increases, the current in the coil is



(a) clockwise (b) anticlockwise (c) normal to the plane oi coil (d) None of them.

11. Which of the following gives the direction of the induced e.m.f.?
(a) Faraday's law **(b) Lenz's law** (c) Ampere (d) Biot-Savart's law.

12. Which of the following is based on the law of conservation of energy?
(a) Faraday's law **(b) Lenz's law** (c) Ampere (d) Biot-Savart's law.

13. The electric current in a circuit varies from + 2A to – 2A in a time 10^{-2} s. Another coil of resistance 20 Ω and inductance 2H is placed hear it. What will be the induced current in the second coil?
(a) 4A (b) 8A (c) 20A **(d) 40A**

14. Which of the following instrument do not make use of eddy currents?
(a) Electrical brakes (b) Dead beat galvanometer
(c) inductor motor **(d) Transformer.**

15. The motional e.m.f. is the induced e.m.f.
(a) in a circuit due to variation in its own current.
(b) in a circuit due to variation of current in the neighbouring circuit.
(c) in a coil due to the motion of the magnet near it.
(d) across the ends of a wire moving in a magnetic field.

16. Eddy currents produced in a conductor are responsible for:
(a) damping (b) loss of energy (c) heating (d) All of the above

17. A car moves up on a plane road. The induced e.m.f. in the axle connecting the two wheels is maximum, when it moves:
(a) At the poles (b) At equator
(c) remains stationary (d) No e.m.f. is induced at all.

18. When the current through a solenoid increases at a constant rate, the induced current:
(a) is a constant and is in the direction of inducing current.
(b) is a constant and is opposite to the direction of the inducing current.
(c) increases with time and is in the direction of the inducing current.
(d) increases with time and is opposite to the direction of the inducing current.

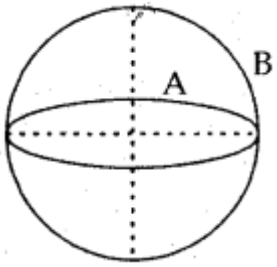
19. Which of the following is/are equal to Henry?
(a) Volt second/ampere. (b Volt(second)^2/coulomb.
(c) Joule (second)^2/(coulomb)^2 **(d) All of these**

17. A copper rod moves parallel to the horizontal direction. The induced e.m.f. developed across its ends due to earth's magnetic field will be maximum at the:
(a) poles (b) equator (c) latitude 30° (d) latitude 60°

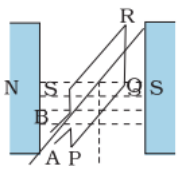
18. When current I is passed through an inductor of coefficient of self-inductance L, energy stored in it is 12 Lt^2. This energy stored is in the form of:
(a) Voltage (b) Current **(c) Magnetic field** (d) Electric field.

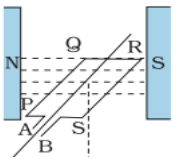
19. If a core of soft iron is introduced into a coil its coefficient of self induction gets .....(increased)

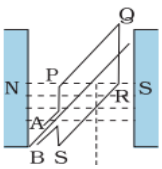
20. Two circular conductors A and B are placed perpendicular to each other as shown in the figure. If the current in one of the coils is changed, then current induced in the other coil is equal to **.....(Zero)**

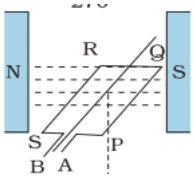


21. An alternating emf is generated by a loop of wire rotating in a magnetic field given in following fig., arrange them in stage – 1(0^0), stage – 2(90^0), stage – 3(180^0), stage – 4 (270^0) respectively,

(i) 

(ii) 

(iii) 

(iv) 

(a) (i) is stage -1, (ii) is stage – 2, (iii) is stage – 3, (iv) is stage – 4
(b) (ii) is stage -1, (iii) is stage – 2, (i) is stage – 3, (iv) is stage – 4
(c) (i) is stage -1, (iii) is stage – 2, (iv) is stage – 3, (ii) is stage – 4
(d) (iv) is stage -1, (iii) is stage – 2, (i) is stage – 3, (ii) is stage – 4

22. Magnetic flux through a plane of area A placed in a uniform magnetic field B is
(a) BA$\cos\theta$ (b) BA$\sin\theta$ (c) BA$\tan\theta$ (d) BA$\sec\theta$

23. SI unit of magnetic flux is
(a) weber (b) Wbm^{-1} (c) Tm^{-2} (d) Wbm^{-2}

24. which method/s can be used to induce emf in respective
(a) by changing magnetic field and by rotating a coil in a magnetic field such that the angle between B and A changes
(b) by changing area of the coil
(c) by changing the shape of a coil
(d) all the above

25. In ciol and coil experiment to obtain a large deflection, which of the following steps can be taken:

(a) Use a rod made of soft iron inside the coil C_2

(b) Connect the coil to a powerful battery

(c) Move the arrangement rapidly towards the test coil C_1

(d) all the above

27. A straight conductor of length 'l' is moving with velocity 'v' in the direction of uniform magnetic field of strength 'B'. the magnitude of emf induced between the ends of the conductor is

(a) $\boldsymbol{Blv}$ (b) $\frac{Blv}{2}$ (c) 0 (d) $2Blv$

28. flux linkage is equal to

(a) $\mathbf{N\phi_B}$ (b) $2N\phi_B$ (c) $3N\phi_B$ (d) $N^2\phi_B$

29. Inductance depends only on

(a) the geometry of the coil and intrinsic material properties.

(b) current through the coil

(c) voltage across the coil

(d) none of these.

30. An ac generator converts

(a) mechanical energy into electrical energy.

(b) electrical energy into mechanical energy.

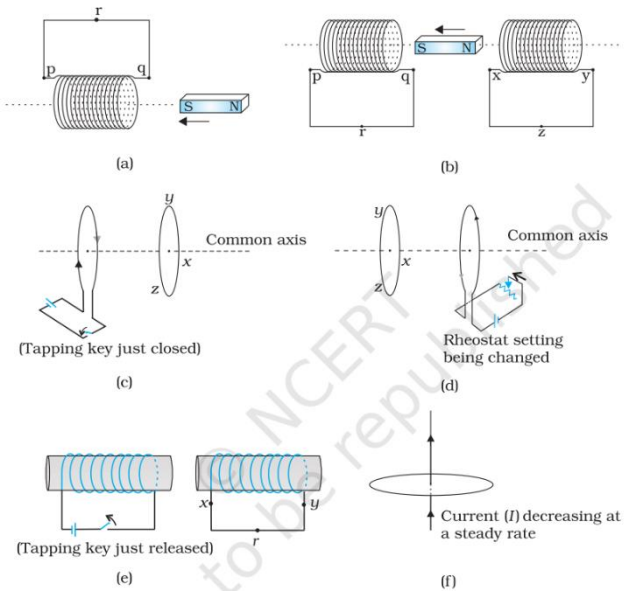
(c) heat energy into electrical energy.

(d) light energy into electrical energy.

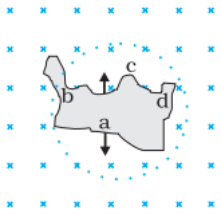
FILL IN THE BLANKS

1. Predict the direction of induced current in the situations described by the following Figs.

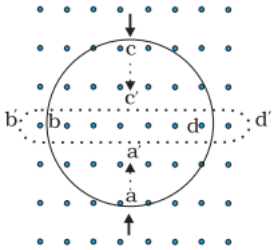
Answers: (a) Along qrpq (b) Along prq, along yzx (c) Along yzx (d) Along zyx (e) Along xry (f) No induced current since field lines lie in the plane of the loop



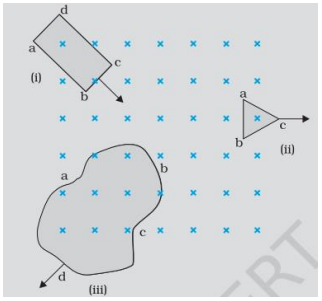
2. The direction of induced current in the situations described by a wire of irregular shape turning into a circular shape is…… (**Along adcd**) (flux through the surface increases during shape change, so induced current produces opposing flux).



3. he direction of induced current in the situations described by a wire of irregular shape turning into a circular shape is…… (**Along a'd'c'b'**)(flux decreases during the process)



4. shows planar loops of different shapes moving out of or into a region of a magnetic field which is directed normal to the plane of the loop away from the reader. Determine the direction of induced current in each loop using Lenz's law.



Answer: (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.

5. When the rate of change of current through a closed circuit is unity, then the induced e.m.f. produced in it is equal to ……(Coefficient of self induction or self inductance L.)

6. If a coil is removed from a magnetic field: (a) slowly, (b) rapidly, then work done will be more when the coil is removed from the magnetic field ……(rapidly.)

7. A coil of copper wire is being pulled with a constant velocity $\vec{v}$ in a magnetic field $\vec{B}$. If its ohmic resistance is increased, it will be …… to pull it.(easier)

8. When the number of turns in a coil is doubled without any change in the length of the coil, its self inductance becomes ……(four times)

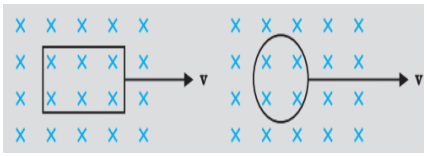
9. Magnetic flux is a …… Quantity (scalar)

10. The SI unit of inductance is …… (henry)

11. The self-induced emf is also called the ……(back emf)

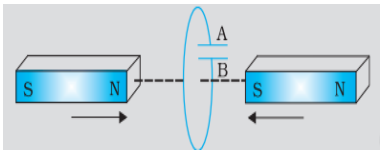
12.A device used to convert mechanical energy into electrical energy is .....(generator)

13. A rectangular loop and a circular loop are moving out of a uniform magnetic field region (Fig. 6.8) to a field-free region with a constant velocity v. In which loop do you expect the induced emf to be constant during the passage out of the field region? The field is normal to the loops.



Ans: The induced emf is expected to be constant only in the case of the rectangular loop. In the case of circular loop, the rate of change of area of the loop during its passage out of the field region is not constant, hence induced emf will vary accordingly

14. Predict the polarity of the capacitor in the situation described by



Ans: The polarity of plate 'A' will be positive with respect to plate 'B' in the capacitor

2 MARKS QUESTIONS

1. State and explain Faraday's law of electromagnetic induction.

2. State and explain Lenz's law in electromagnetic induction.

3. The magnetic flux linked with a coil changes from 12 x 10^{-3} Wb (Tm^2) to 6x10^{-3}Wb in 0.01 second. Calculate the induced emf in the coil.

4. Write the expression for energy stored in inductor and explain the terms.

5. Write the expression for mutual inductance of coil. Explain its terms.

6. Write the expression for self inductance of coil. Explain its terms.

7. Name the factors on which mutual induction between two coils depends.

8. A square loop of side 10 cm and resistance 0.5Ω is placed vertically in the east-west plane. A uniform magnetic field of 0.10 T is set up across the plane in the north-east direction. The magnetic field is decreased to zero in 0.70 s at a steady rate. Determine the magnitudes of induced emf and current during this time-interval.

9. A circular coil of radius 10 cm, 500 turns and resistance 2Ω is placed with its plane perpendicular to the horizontal component of the earth's magnetic field. It is rotated about its vertical diameter through 180° in 0.25 s. Estimate the magnitudes of the emf and current induced in the coil. Horizontal component of the earth's magnetic field at the place is 3.0 × 10^{-5} T.

10. A metallic rod of 1 m length is rotated with a frequency of 50 rev/s, with one end hinged at the centre and the other end at the circumference of a circular metallic ring of radius 1 m, about an axis passing through the centre and perpendicular to the

plane of the ring. A constant and uniform magnetic field of 1 T parallel to the axis is present everywhere. What is the emf between the centre and the metallic ring?

11. A wheel with 10 metallic spokes each 0.5 m long is rotated with a speed of 120 rev/min in a plane normal to the horizontal component of earth's magnetic field HE at a place. If HE = 0.4 G at the place, what is the induced emf between the axle and the rim of the wheel? Note that 1 G = 10^{-4} T.

3 MARKS QUESTIONS

1. Derive the expression for motional emf in a conducting rod moving in uniform magnetic field.

2. Explain briefly the coil and magnet experiment to demonstrate electromagnetic induction.

3. Explain briefly the coil and coil experiment to demonstrate electromagnetic induction.

4. Explain briefly the Faraday experiment to demonstrate electromagnetic induction