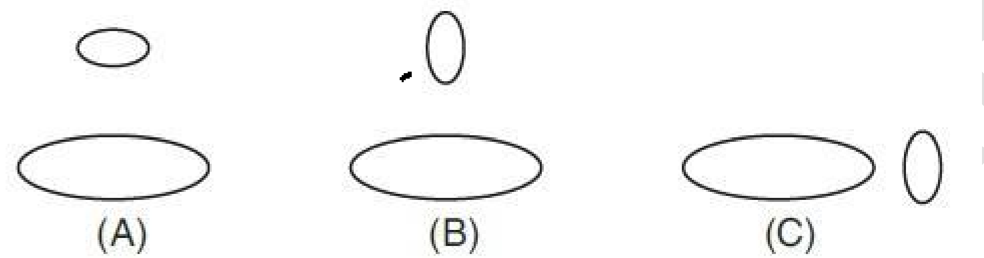
CLASS 12 PHYSICS

TIME:1 HOUR **MAX MARKS:35**

(Q1 - Q10) are multiple choice questions.

Q1. A circular coil of radius R carrying current in the clockwise direction is placed in X_Y plane centred at the origin O. The total magnetic flux through X-Y plane due to its Magnetic field B is
a) Directly Proportional to R^2 b) inversly proportional to R^2 c) zero d) directly proportional to R

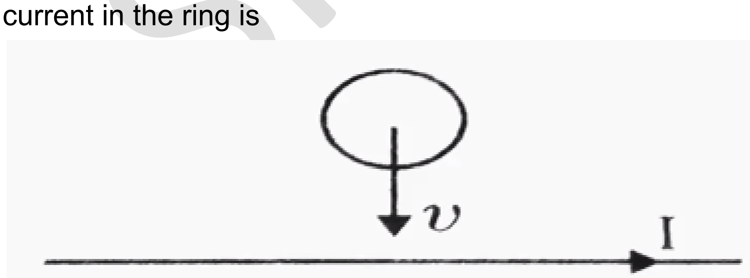
Q2. Two circular coils can be arranged in any of the three situations shown in Fig. Their mutual inductance will be



(a) maximum in situation (A)
(b) maximum in situation (B)
(c) maximum in situation (C)
(d) the same in all situations.

Q3. The average emf 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.

Q4**.** A metal ring moves towards a straight wire carrying current. The direction of induced current in the ring is



(a) Clockwise
(b) Anticlockwise
(c) Can be Clockwise and Anticlockwise

(d) zero

Q5.

A long solenoid of diameter 0.1 m has 2 × 104 turns per meter. At the centre of the solenoid, a coil of 100 turns and radius 0.01 m is placed with its axis coinciding with the solenoid axis. The current in the solenoid reduces at a constant rate to 0 A from 4 A in 0.05 s. If the resistance of the coil is 10π2 Ω, the total charge flowing through the coil during this time is

A. 32 πμC

B. 16 μC

C. 32 μC

D. 16 πμC

Q6. The magnetic field at the centre of a current carrying circular coil of radius 10cm is 5√5 times the magnetic field at a point on its axis. The distance of the point from the centre of the circle is

(a) 5cm (b) 10cm (c) 20cm (d) 2cm

Q7. The maximum current that can be measured by a galvanometer of resistance 40 Ω is 10 mA. It is converted into voltmeter that can read up to 50 V. The resistance to be connected in the series with the galvanometer is

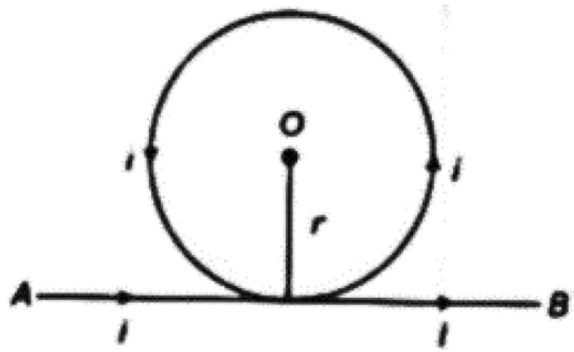
(a) 2010 Ω

(b) 4050 Ω

(c) 5040 Ω

(d) 4960 Ω

Q8. The strength of magnetic field at the centre of circular coil is



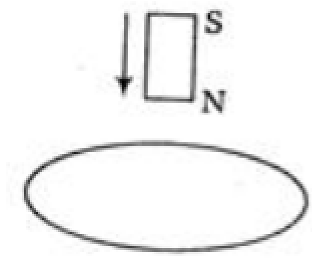
(a) $\frac{\mu_0}{R}(1 - \frac{1}{\pi})$(b) $\mu_0 I / \pi R$(c) $\frac{\mu_0}{2R}(1 - \frac{1}{\pi})$(d) $\frac{\mu_0 I}{2R}(1 + \frac{1}{\pi})$

Q9. A coil having 500 square loops of side 10 cm is placed normal to magnetic flux which increases at a rate of 1 T/s. The induced emf is
(a) 0.1 V
(b) 5 V
(c) 1 V
(d) 0.5 V
Q10. Production of Focault's current in a metal plate by
(a) placing in a constant magnetic field
(b) placing in a time varying magnetic field.
(c) oscillating between the pole pieces of magnet in and out of the magnetic field
(d) both (a) and (b) are correct.

<u>Section :B</u>

For questions 11-19 two statements are given-one labelled Assertion (A) and the other labelled Reason (R). Select the correct answer to these questions from the codes (a), (b), (c),(d) and (e) as given below.
(a) Both A and R are true and R is the correct explanation of A
(b) Both A and R are true but R is NOT the correct explanation of A
(c) A is true but R is false
(d) A is false and R is also false
(e) A is false but R is true

Q11.Assertion : The bar magnet falling vertically along the axis of the horizontal coil will be having acceleration less than g.



Reason : No induced current is produced when there is a cut in the ring .

Q12**.Assertion :** Production of eddy current is undesirable in dead beat Galvanometer

Reason : A current induced in a coil rotating in a magnetic field produces a force which tends to oppose the coil's motion .

Q13. Assertion: When the magnetic flux through a loop is maximum, induced emf is maximum.
Reason: Magnetic flux through the coil is maximum when the plane of coil is parallel to the magnetic field B

Q14. **Assertion :** Eddy current effect is used in Electromagnetic breaking .
Reason : As eddy currents always oppose the relative motion.

Q15. **Assertion :** A solenoid tends to expand, when a current passes through it.
Reason : Two straight parallel metallic wires carrying current in the same direction repel each other.

Q16. **Assertion :** An AC generator is based on the phenomenon of self-induction.
Reason – Split rings are used in Ac generator to get AC output.

Q17. **Assertion :** Generally Coil in the resistance boxes are made by doubling the wire.
Reason : No of turns of the coil is doubled , the Self induction effect will also be doubled.

Q18. **Assertion :** The torque acting on square and circular current carrying coils having equal areas, placed in uniform magnetic field, will be same.

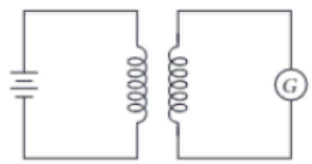
Reason (R): Torque acting on a current carrying coil placed in uniform magnetic field B is same for Square coil and a irregular shaped coil having same area .

Q19. **Assertion :** A phosphor bronze strip is used in a moving coil galvanometer.
Reason : Phosphor bronze strip has the maximum value of torsional constant k.

SECTION C:

Q 20 -23 are case study based questions and are compulsory. Each question carries 4 marks.
Q20

Mutual inductance is the phenomenon of inducing emf in a coil, due to a change of current in the neighbouring coil. The amount of mutual inductance that links one coil to another depends very much on the relative positioning of the two coils, their geometry and relative separation between them. Mutual inductance between the two coils increases μ_r times if the coils are wound over an iron core of relative permeability μ_r.



(i) A short solenoid of radius a, number of turns per unit length n_1, and length L is kept coaxially inside a very long solenoid of radius b, number of turns per unit length n_2. What is the mutual inductance of the system?
(a) $\mu_0 \pi b^2 n_1 n_2 L$ (b) $\mu_0 \pi a^2 n_1 n_2 L^2$ (c) $\mu_0 \pi a^2 n_1 n_2 L$ (d) $\mu_0 \pi b^2 n_1 n_2 L^2$

(ii) If a change in current of 0.01 A in one coil produces a change in magnetic flux of 2×10^{-2} weber in another coil, then the mutual inductance between coils is
(a) 0 (b) 0.5 H (c) 2 H (d) 3 H

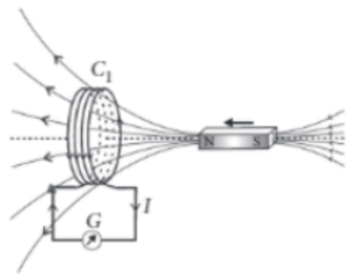
(iii) Mutual inductance of two coils can be increased by
(a) decreasing the number of turns in the coils
(b) increasing the number of turns in the coils
(c) winding the coils on wooden cores
(d) none of these.

(iv) When a sheet of iron is placed in between the two co-axial coils, then the mutual inductance between the coils will
(a) increase (b) decrease
(c) remains same (d) cannot be predicted

Q21.

The Experiments of Faraday and Henry

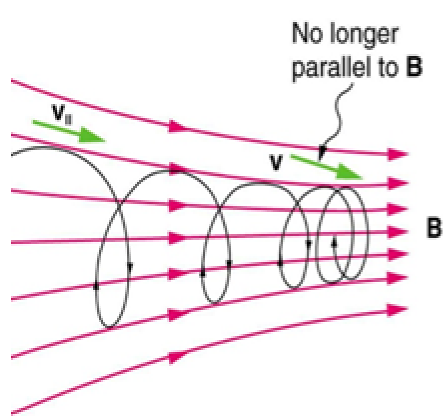
In year 1820 Oersted discovered the magnetic effect of current. Faraday gave the thought that reverse of this phenomenon is also possible *i.e.*, current can also be produced by magnetic field. Faraday showed that when we move a magnet towards the coil which is connected by a sensitive galvanometer. The galvanometer gives instantaneous deflection showing that there is an electric current in the loop.
Whenever relative motion between coil and magnet takes place an emf induced in coil. If coil is in closed circuit then current is also induced in the circuit. This phenomenon is called electromagnetic induction.



(i) The north pole of a long bar magnet was pushed slowly into a short solenoid connected to a galvanometer. The magnet was held stationary for a few seconds with the north pole in the middle of the solenoid and then withdrawn rapidly. The maximum deflection of the galvanometer was observed when the magnet was

(a) moving towards the solenoid
(b) moving into the solenoid
(c) at rest inside the solenoid
(d) moving out of the solenoid.

Q22. Bubble Chamber: Trails of bubbles are produced by high-energy charged particles moving through the superheated liquid hydrogen in this artist's rendition of a bubble chamber. There is a strong magnetic field perpendicular to the page that causes the curved paths of the particles. The radius of the path can be used to find the mass, charge, and energy of the particle.



Magnetic forces can cause charged particles to move in circular or spiral paths. Particle accelerators keep protons following circular paths with magnetic force. Cosmic rays will follow spiral paths when encountering the magnetic field of astrophysical objects or planets (one example being Earth's magnetic field). The bubble chamber photograph in the figure below shows charged particles moving in such curved paths. The curved paths of charged particles in magnetic fields are the basis of a number of phenomena and can even be used analytically, such as in a mass spectrometer. shows the path traced by particles in a bubble chamber.

1. When a charged particle moves perpendicular to a uniform electric field, it follows-

(a) circular path (b) parabolic path

(c) translational path (d) helical path

2. A charged particle moving with velocity v in X direction is subjected to a magnetic field B in negative X direction. As a result, the charge will

(a) retard along X-axis

(b) start moving in a circular path in YZ plane

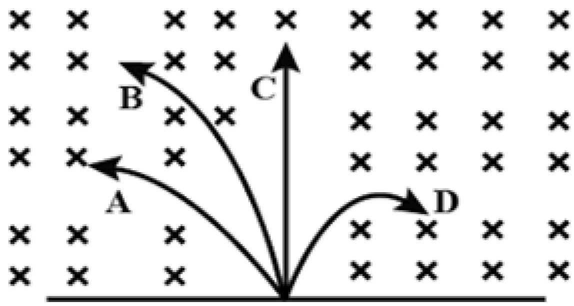
(c) remains unaffected

(d) move in a helical path around X-axis

3. An α- particle and proton having same momentum enter into a region of uniform magnetic field and move in a circular path. The ratio of the radii of curvature of their paths

(a) 1 (b) ¼ (c) ½ (d) 4

4. A neutron, a proton, an electron and an α- particle enter in a region of uniform magnetic field with equal velocities. The magnetic field is perpendicular and directed into the paper. The tracks



of the particles are shown in figure. The electron will follow the track-

(a) A (b) B (c) C (d) D

Q23.

A magnetic field can be produced by moving, charges or electric currents. The basic equation governing the magnetic field due to a current distribution is the Biot-Savart law.
Finding the magnetic field resulting from a current distribution involves the vector product, and is inherently a calculus problem when the distance from the current to the field point is continuously changing.
According to this law, the magnetic field at a point due to a current element of length $d\vec{l}$ carrying current I, at a distance r from the element is $dB = \frac{\mu_0}{4\pi}\frac{I(d\vec{l} \times \vec{r})}{r^3}$.
Biot-Savart law has certain similarities as well as difference with Coloumb's law for electrostatic field *e.g.*, there is an angle dependence in Biot-Savart law which is not present in electrostatic case.

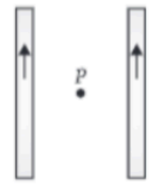
(i) The direction of magnetic field $d\vec{B}$ due to a current element $Id\vec{l}$ at a point of distance $\vec{r}$ from it, when a current I passes through a long conductor is in the direction

(a) of position vector $\vec{r}$ of the point
(b) of current element $d\vec{l}$
(c) perpendicular to both $d\vec{l}$ and $\vec{r}$
(d) perpendicular to $d\vec{l}$ only

(ii) The magnetic field due to a current in a straight wire segment of length L at a point on its perpendicular bisector at a distance r ($r >> L$)

(a) decreases as $\frac{1}{r}$.
(b) decreases as $\frac{1}{r^2}$.
(c) decreases as $\frac{1}{r^3}$.
(d) approaches a finite limit as $r \to \infty$

(iii) Two long straight wires are set parallel to each other. Each carries a current *i* in the same direction and the separation between them is $2r$. The intensity of the magnetic field midway between them is



(a) $\mu_0 i/r$ (b) $4\mu_0 i/r$

(c) zero (d) $\mu_0 i/4r$

(iv) A long straight wire carries a current along the z-axis for any two points in the $x - y$ plane. Which of the following is always false?

(a) The magnetic fields are equal

(b) The directions of the magnetic fields are the same

(c) The magnitudes of the magnetic fields are equal

(d) The field at one point is opposite to that at the other point