# ASSIGNMENT-1

# ASNWER KEY

### MCQ TYPE (1MARK EACH)

1.(a) $1.9 \times 10^6 m/s$

2.(c ) $E \neq 0, B \neq 0$

3. (a) $2\pi \times 10^{-3} T$

4. ( b) $10^{-17}\ \mu_0$

5. (a) B ⊥ v

6. (d) Provide electromagnetic damping.

7. (c ) π: 4

8. (a) Zero

9. (b) Parallel current attracts and anti-parallel current repel

10. d) Intensity of magnetic field inside a steel box is zero. No magnetic lines of force pass through the box.

### 1 MARK

11. $\vec{F} = q(\vec{v} x \vec{B})$. The direction of force is perpendicular to both v and B.

12. It is defined as the current which produces a deflection of one scale division in the galvanometer

13. v is parallel or antiparallel to B

14. Using F/l = $\mu 0\ I_1 I_2 / 2\pi r$. One Ampere is the current which when flowing through two infinitely long, straight parallel conductors of negligible cross section held 1m apart in vacuum develop force of 2 x $10^{-7}$ N/m of the conductors

15. F= q ($\vec{v}$ X $\vec{B}$), The force acts in a direction given by the thumb of the right hand with fingers circling from $\vec{v}$ to $\vec{B}$.

16. Low torsional constant is basically required to increase the current sensitivity in an MCG.

17. A current carrying coil, in the presence of magnetic field experiences a torque which produces proportionate deflection. Deflection α Torque

18. Magnetic Moment $\vec{m}$ = I $\vec{A}$

### 2 MARKS

19. Minimum potential energy = – MB when θ = 0 (most stable position)

Maximum potential energy = MB when $\theta = 180°$ (most unstable position)

20. loop will come to equilibrium when torque is zero

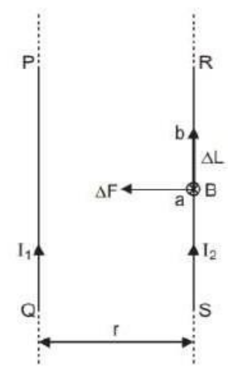
So, $\tau = 0 = M \times B$

$= MB\sin\theta$

$= NiAB\sin\theta$

So, angle between area vector and field is zero than only $\theta$ is 0 so that $\sin\theta = 0$. So, for area vector along field direction plane is perpendicular to the field.

**21.**




Let the given wires PQ and RS separated by a distance 'r'. As the wires carry current, they produce magnetic field around them. The wire Produces magnetic field of intensity B at P on RS, which is equal to $\mu o\ I1 / 2\pi r$ The wire RS carrying current I 2 and placed in a Magnetic field of P Q Experiences a force given by

$F = B\ I_2\ l = (\mu o\ I_1\ I_2 / 2\pi r).\ l$ Similarly, RS also exert an equal and opposite force (attractive for like parallel currents) on the wire PQ, which is equal to

$$F = B\ I_1\ l = (\mu o\ I_1\ I_2 / 2\pi r).\ l \quad N/m$$

22. $Ig = V/G = 1X\ 10^{-3}//100 = 10^{-5}$ A

$V = Ig\ G + Ig\ R,$

$= 10^{-5}(100 + R)$

$R = 100000 - 100 = 99900$ ohms.

23. We know that an ammeter has very low resistance. Thus, in order to convert a galvanometer into an ammeter, a very low shunt resistance must be connected in parallel to galvanometer resistance RG so that the overall resistance of the circuit becomes very small. Thus, a galvanometer can be converted into an ammeter by adding a low shunt resistance in parallel to the galvanometer. It is connected in series so that whole of electric current, which it has to measure, passes through it.

24. A diamagnetic material tends to move from stronger to weaker regions of the magnetic field and hence, decrease the number of lines of magnetic field passing through it. Relative permeability is 1.

25.

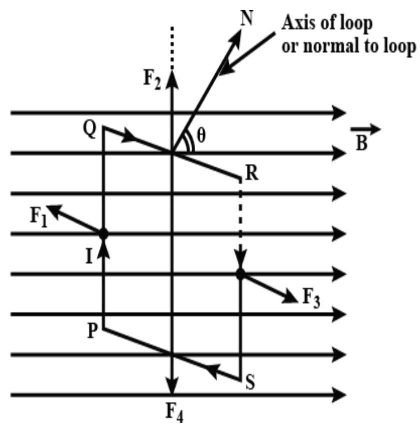
## 3 MARKS

26. Current, I=50A, Distance, r = 2.5 m, Magnetic field, B = 2πrμoI, B = $4.0\times10^{-6}$ T

According to Maxwell's right hand, the direction of field is upward.

27. Lorentz magnetic force F = q (V x B). As the magnetic force F acts in the direction perpendicular to the direction of velocity V or the direction of motion of the charge particle, so the work done is zero. So, W = F.ds = Fds cosɵ = f ds cos90 = 0

28. Torque on a rectangular current loop in a uniform magnetic field




Let I= current through the coil

a, b = sides of the rectangular loop ,PQ = b & QR= a

A=ab = area of the loop

n= number of turns in the loop

B= magnetic field

Θ= angle between magnetic field B and area vector A

Force exerted on the arm PQ inward

$F_1$ = I b B [F = ILB]

Force exerted on the arm RS outward

$F_3$= I b B F1 = F3

Therefore, two equal and opposite forces form a couple which exerts a torque.

Therefore, Magnitude of the torque on the loop is,

τ = F1 x (a/2) sin θ + F3 (a/2) sin θ

= (F1 + F3). (a/2) sin θ

= (IbB + IbB). (a/2) sin θ

⇨ τ = 2IbB (a/2) sin θ

⇨ = IabB sin

= IAB sinθ

magnetic moment of the current loop is

M= IA

τ = MB sinθ = τ = M x B

If loop has n turns then M= nIA

$\tau$ = nIAB sin$\theta$

when $\theta$ = 90 $^0$ then $\tau$max = nIAB

when $\theta$=$0^0$ then $\tau$ = 0.

29. (i) It keeps the magnetic field line normal to the area vector of the coil

(ii) The cylindrical soft iron core, when placed inside the coil of a galvanometer, makes the magnetic field stronger and radial in the space between it and pole pieces, such that whatever the position of the rotation of the coil maybe, the magnetic field is always parallel to its plane.

Current sensitivity is defined as the deflection produced by the galvanometer when unit current is passed through its coil.

Is = $\varphi$/I = NBA/k radian/ampere or division $A^{-1}$.

No, the galvanometer cannot be used to measure current. it can only detect current but cannot measure as it is not calibrated. The galvanometer coil is likely to be damaged by currents in the (mA/A) range.

**5-MARKS**

30. (i)A galvanometer is an electromechanical instrument used for the detection of electric currents flowing through electrical circuits. It is a very sensitive instrument which cannot be used for the measurement of large currents. It works on the principle of conversion of electrical energy into mechanical energy while a current is flowing in a magnetic field as it experiences a magnetic torque and hence rotates through an angle proportional to the current flowing through it.

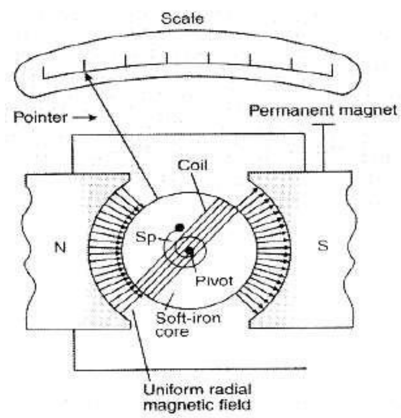
Let I = the current flowing through coil,

B = magnetic field parallel to the coil, and

A = area of the coil.

Deflection acting on the coil is

$\tau$ = NIBA sin 90° = NIBA [$\because$ sin 90°=1]




**(a)** By making a uniform radial magnetic field through a coil, the magnetic field lines become perpendicular to the magnetic moment of a galvanometer.

$\tau$ = k$\Phi$

NIBA = kΦ

Φ = (NBAI/k)

∴ Φ α I

**(b)** Soft Iron core can make the electromechanical field radial which in turn would increase the magnetic field.

(ii) Definition for the terms :

**(a)** Current Sensitivity- It is deflection produced per unit current flowing across the galvanometer

. $I_s = \theta/I = NBA/K$

**(b)** Voltage Sensitivity- It is the minimum change in voltage which produces change in the output of the galvanometer.

$V_s = \theta/V = \theta/IR = NBA/KR$

(iii) Since Voltage sensitivity decreases with the increase in resistance of the coil and the effect of an increase in the number of turns is hence nullified in case of voltage sensitivity so there is no change of voltage sensitivity, whenever there is a change in current sensitivity.

## Assertion-Reason

30.(a) Since no electric lines of forces exist inside a charged body, the electric lines of force only travel from positive to negative charge and are discontinuous. Secondly, magnetic lines of force travel from north to south pole and inside the magnet they are from south pole to north pole hence continuous.

31.(a) A solenoid is a type of electromagnet formed by a helical coil of wire whose length is substantially greater than its diameter, its two ends can be visualised as two coils.

32.(c) Permanent magnets retain their ferromagnetic property for a long period of time and steel is a paramagnetic material.

33.(b) It is the property of a magnet to rest in a geographical north and south pole and another property of magnetic field is that magnetic field lines do not intersect.

34.(a) In the case of diamagnetic substances, the magnetic moments of atoms and the orbital magnetic moments have been oriented in such a manner that the vector sum of an atom's magnetic moment becomes zero. An external magnetic field can repel them weakly.

35.(d) Neil Bohr proposed a model, which is familiar as a planetary model of atoms. In Bohr's model, the neutrons and protons occupy a dense central region called the nucleus, and electrons orbit the nucleus much like planets orbiting the sun. Electrons are negatively charged and the nucleus is positively charged. Force in the former case is electrostatic force but in later case it is gravitational force.

36.(a) By using the right hand thumb rule, the direction of the magnetic field can be determined then by using Fleming's right hand rule the direction of force comes towards each other.

37.(d) As the galvanometer is used to check the current flow direction and the magnitude of the direct current. That's why the resistance of the galvanometer is nearly zero. This is somewhere similar to ammeter but both are different devices. Ammeter can only show us the current magnitude not the direction. A Galvanometer's needle can fluctuate in two directions whereas an ammeter's needle can only show one side deflection.

38.(b) Electric lines of forces do not exist inside a charged body, the magnetic lines of force travel from north to south pole and inside the magnet they are from south pole to north pole hence continuous.

39.(a) If the particle is moving along the direction of magnetic field, then ɵ = 0° hence force becomes zero.

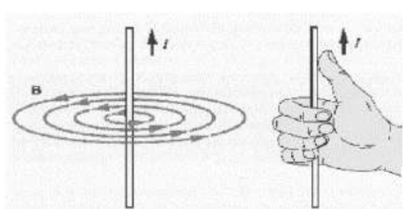
40. c) Assertion is true reason is false. Iron is a ferromagnetic material.

## Case study based question

41.

1.(c) stationary charge creates electric field but moving charge creates both electric and magnetic field.

2.(a)



The direction of thumb is from south to north, using right hand thumb rule, if we curl our fingers on the left side, it shows the outward direction.

3.(d) Magnetic field is created around moving charge, a stationary charge cannot create magnetic field.

4.(b) $F = ilB \sin\theta = 6 \times 10 \times 2 \times \sin 90° = 120N$

5.(a) $mg = ilB \sin\theta$

$100 \times 10^{2} \times 9.8 = 5 \times 1 \times B \times \sin 90°$ $B = 0.196T$