ANSWER KEY

Assignment-2

MCQ

1. (c) Attraction and $\frac{\mu 0 i^2}{2\pi r}$
2. (b) 2 : 1
3. (b) 27
4. (d) $\frac{2\sqrt{2}\mu_0 l}{a\pi}$
5. (c) Can be in equilibrium in two orientations, one stable while the other is unstable
6. (c) BILsinΘ
7. (d) None of these
8. (c) 4N/m   hint: BILsinΘ
9. (c) introducing resistance of large value in series

1 MARK

10. Net force on electron moving in the combined electric field E and magnetic field B is

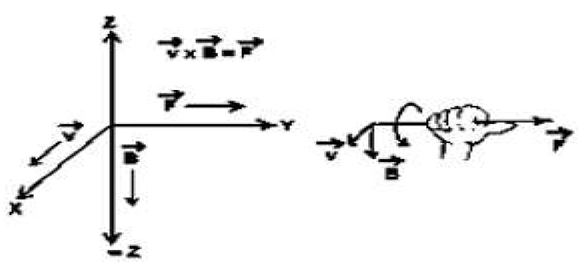
    F = e (E + V X B)

    Since electron moves undeflected then F = 0

    e (E + V X B) = 0

    V = l E l/l B l

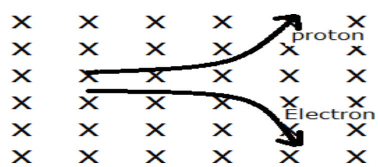
11. 1:1, The angular frequency does not depend on the speed of the particle or radius of its orbit.
12. 1:2 (r = mv/qB = p/qB, for equal p, r α 1/q)
13. The direction of Magnetic field is towards positive direction of z axis.



2-MARKS

14. An ammeter is basically a permanent magnet moving coil (PMMC) instrument which deflects for very small amount of current (in mA range). Its only possible to increase the range of an ammeter but we cannot decrease the range of an ammeter. The range of an ammeter can be easily increased by adding a shunt resistance of very low value to bypass the major part of the current through the resistance path instead of ammeter. This increases the range of an ammeter by reducing the actual current flow through the ammeter. There is a way to decrease the range of an ammeter but it is not practically feasible. If we decrease the restoring torque by reducing spring stiffness inside the ammeter it will decrease the range of the ammeter. We are basically increasing the sensitivity of the ammeter. But reducing spring stiffness causes large stray errors in the readings and is therefore not practically feasible.

15. A magnetic field does not exert any force on a charge moving parallel or antiparallel to the field direction. Since they are travelling in the direction of the magnetic field, there will be no force acting on them. Hence their paths will remain the same after entering the magnetic field.



16. (i) Shunt resistance, S=IgG/I –Ig

1x 0.6 /(5-1)

0.15 ohm

(ii) Total resistance,

1/R= 1/.6 +1/.15

= (50+ 200) /30

= 250/30

Therefore, R = 30/250 = 0.12 0hms

17. We are given:

I_1 = 2A, I_2 = 1A

r_1 = 10 cm, r_2 = 30 cm

$\mu_o = 4 \pi$ x 10-7 TmA^{-1}

We have

Now net force on the side will be;

$F = \mu_o I_1 I_2 l (1/r_1 - 1/r_2)$

$F = 2x\ 10^{-7}\ x\ 1x2x\ (20x10^{-2})\ [\ 1/10x10^{-2} - 1/30x10^{-2}]$

$F = 5.33\ x\ 10^{-7}\ N$

The direction of force is towards the infinitely long straight wire.

3-MARKS

18. Lorentz force = magnetic force + electric force

$F = [\ Qvb \sin\theta + Qe]$

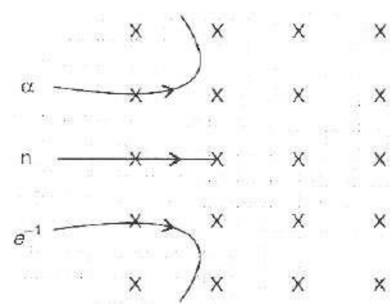
We know that a charged particle will experience a force when it enters a magnetic field. The magnetic field will move the charged particle in a circular path, as the force is perpendicular to the velocity of particle. The radius of the circular path will be given by

$mv^2 / r = Bqv$

$r = mv / Bq$

As B and v are constant, we can write

r a m/q



The neutron will move along the straight line as it has no charge.

The electron will inscribe a circle of radius smaller than that of the alpha particle as the mass to charge ratio of the alpha particle is more than that of the electron. So, the alpha particle will move in the clockwise direction and the electron will move in anticlockwise direction according to the right-hand rule.

5 MARKS

19. (a) $\tau = MB \sin\theta = \tau = M\ x\ B$

(a) $\tau\ =\ M \times B =\ Mb\sin\theta$

here M and B are in the same direction so

$\theta = 0, \therefore \tau = 0$

© we know, FB = © l × B

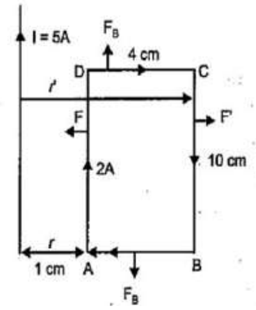
Force between two current carrying wires is given by

$F = (\mu_0/2\pi).\ (I_1 I_2/r) \times l = (\mu_0/2\pi) \times (5 \times 2/\ 1 \times 10^{-2}) \times 0.10$

$F = (\mu_0/2\pi).\ 100$

And $F' = (\mu_0/2\pi) \times (5 \times 2/\ 1 \times 10^{-2}) \times 0.10$

$F' = (\mu_0/2\pi) \times 20$



Now, resultant force on the loop,

$F_{net} = F - F' = (\mu_0/2\pi)\ (100 - 20)$

$= 2 \times 10^{-7} \times 80 = 16 \times 10^{-6}$ N

The direction of net force is towards the straight wire i.e., attractive.

Assertion-Reason

20.(b) The magnetic dipole moment will be reduced to half when broken into two equal pieces and every atom behaves like a dipole so the dipole of a magnet cannot be separated.

21.(a) When a bar magnet is placed in a uniform magnetic field. Then the bar magnet will experience only torque and no force, and this torque on the bar magnet will be acting on both ends, and will be equal but opposite in direction.

22.(d) Parallel currents attract and antiparallel currents repel.

23.(a) Gauss's law of magnetism is different from that for electrostatics because electric charges do not necessarily exist in pairs but magnetic monopoles do not exist.

24.(b) **B** $=\mu_0 N i$, from this formula we see the dependence of B in current and inside a solenoid it is uniform.

25.(c) Force =q(V x B) it is independent of mass and if v and B are perpendicular to each other, the particle describes a circle.

26.(a) A charged particle moves in a circle when its velocity is perpendicular to the magnetic field. When it forms an acute angle with the magnetic field, it can be resolved in two components, parallel and perpendicular. The perpendicular components tend to move it in a circle, the parallel components tend to move along the magnetic field to form a helical motion of uniform radius and pitch.

27.(c) Torque, τ = mBsinθ

Here ɵ = 90°, Sin 90° = 1 so torque will be maximum.

28.(b) A galvanometer is a device that is used to detect small electric current or measure itsmagnitude. The current sensitivity of a galvanometer is the deflection of current per unit current passing through the coil $I_s = \frac{NAB}{k}$

29.(b) Assertion is the property of a magnet while reason is one of the sources of magnetic field.

Case study based question

30. 1.(a) The forces of magnitude Mb act opposite to each other on two poles, hence net forceacting on the dipole due to external magnetic field is zero.

2.(b) Forces acting on the poles are along different lines of action constituting a couple hencenon zero torque.

3.(a) The magnetic dipole moment of a current loop is the product of the current passing throughthe loop and the area inside the loop.

4.(c)Materials with no unpaired, or isolated electrons are considered diamagnetic. Diamagneticsubstances do not have magnetic dipole moments.

5.(d)Every magnet has two poles,no monopole exists.

31.1. (b) Magnetic field

2.(c) If v is parallel to B

3.(d) + Y axis

4.(d) All of these

5.(d) A helix with non-uniform pitch