ANSWER KEY

Assignment-3

MCQ

1.(d) 8 N in $-z$ direction

2. (d) $3/2$

3. (a) $\sqrt{\frac{4\pi M}{l}}$

4. (a) $\frac{\sqrt{5}\mu_0 I}{2R}$

5. (d) The electron will continue to move with uniform velocity along the axis of the solenoid.

6. (a) E /B (hint: qE = qvB)

7. (c) Move towards the wire or towards left

8. (c) 4B

9. (c) 2MB

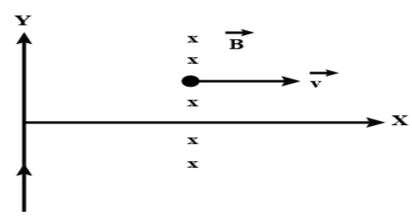
10. (d) decrease by 4%

1-MARK

11. No, if an electron enters parallel to a magnetic field, no force acts and the electron remains undeflected.

12. Zero, because the upper and lower current carrying conductors are identical and so the magnetic fields caused by them at the centre O will be equal and opposite.

13. From Fleming's left-hand rule, thumb points along + y direction, so the direction of magnetic force will be along + y axis (or in the direction of flow of current).



14. Weight per unit length of the wire must be supported by magnetic force per unit length.

$(m/l)\, g = \mu_0 I_1 I_2 / 2\pi r$

$(m/l) = (\mu_0 I_1 I_2 / 2\pi r)\, g$

$= 4\pi \times 10^{-7} \times 6 \times 4 / 2\pi (10^{-3}) (10)$

$= 2 \times 10^{-7} \times 6 \times 4 / 10^{-3} \times 10$

$= 48 \times 10^{-5}$ kg/m

= 0.48 mg/m.

15. Given: resistance of galvanometer = G Ω

Range of voltmeter (RL)= (0-V) volts

Resistance to be connected in parallel= R

R'=? where range is (0-V/2) volts

In the first case ig= V/ (R+G) ….(i)

In the second case ig= V/2/ (R'+G) …. (ii)

[ig is the maximum current which can flow through galvanometer]

From equation (i) and (ii) on solving we get

R'= (R-G) / 2

16. (a) -mB (b) Zero

3 MARKS

17.(a) Net force experienced by wire (1) can be zero only when the current in wire (3) flows along -J i.e. downwards it means that force acting on the wire (1) due to wire (3) and wire (2) are equal and opposite

$\mu_0 I_1 I/2\pi(2a) = \mu_0 I_1 I_2/2\pi(a)$

Therefore, $I = 2I_2$

(b) when direction of current in wire (3) is reversed then current should be along +j i.e., upwards. For this case net force on wire (2) becomes zero, which means that the force due to wire (1) and wire (3) are equal and opposite

$\mu_0 I_1 I_2/2\pi a = \mu_0 I_2 I/2\pi(a)$

therefore $I = I_1$

$I=I_1=2 I_2$

18. Magnetic field due to the straight wire AB at a perpendicular, distance r from it.

$$B = \mu_0 I/(2\pi r)$$

Therefore, force on proton moving with velocity 'v' perpendicular to B, is

$$F = qvB = \mu_0 Iqv/(2\pi r)$$

The direction of force on proton acts in plane of paper towards right.

5 MARKS

19. (a) Galvanometer works on the principle of torque on a coil carrying current in a magnetic field. The torque acting on the coil is proportional to the magnitude of electric current. The coil is connected to a pointer and the pointer of the galvanometer is calibrated to show correct deflection on a scale.

(b) Let the resistance of the galvanometer be R_G.

Let the max. current carrying capacity be I.

From the given data,

$V = I (R_G + R_1)$

$V/2 = I (R_G + R_2)$

From the equations,

$2 = (R_G + R_1)/ (R_G + R_2)$

$R_G = R_1 - R_2$

Let the resistance required to read 2V be R_3

$2V = I (R_G + R_3)$

$2 (R_G + R_1) = R_G + R_3$

$R_3 = R_G + 2R_1$

$R_3 = 3R_1 – 2R_2$

(c) Due to deflecting torque, the coil rotates and suspension wire gets twisted. A restoring torque is set in the suspension wire.

$NIBA = k\theta$ (In equilibrium)

$I = k/(NBA) . \theta$

$I = G\theta$

Where, $G = k / (NBA)$

It is known as galvanometer constant.

$\theta/I = NBA / k$

Therefore, current sensitivity of the galvanometer is the deflection per unit current.

$\theta/V = (NBA/k). (I/V) = (NBA/k). 1/R$

Therefore, voltage sensitivity is the deflection per unit voltage. It depends on the resistance also.

Assertion-Reason

20.(d) moving charge, electron, current carrying wire, naturally occurring magnet all these can create magnetic field.

21.(a) Stationary charge doesn't get affected by magnetic field, moving charge creates magnetic field.

22.(a) If F⊥V, at all instants then motion will be circular.

23.(b) For velocity selector the electrons can pass undeflected, when velocity and magnetic field are parallel , in that case force can be zero, both are correct but reason is not correct explanation of assertion.

24.(a) F = q E+ q(v × B) this is called Lorentz force.

Due to electric field, acceleration a $=\frac{qE}{m}$, hence velocity will not remain constant.

25.(c) current sensitivity $I_s = \frac{\phi}{I} = \frac{NAB}{k}$

voltage sensitivity $V_S = \frac{NAB}{kR}$

$V_s = \frac{I_S}{R}$

26. (d) In a non-uniform magnetic field both the torque and force will act.

27.(d) Galvanometer is used to detect the direction of current in a circuit, it gives full scale deflection to the current of microampere range.

28.(c) Diamagnetic materials get repelled in magnetic fields so they exhibit magnetism but they don't have unpaired electrons so we can say that they don't have dipole moment.

29.(a) Paramagnetic materials have unpaired electrons so they exhibit magnetism.

Case study based

30. 1.(d) **B** $=\mu_0 nI$

where n= 400 and I = 1.5A

putting values B= 0.007 T

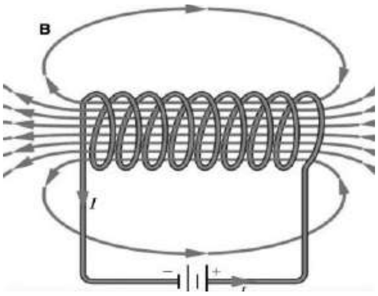
2. (b) Derivation of magnetic field inside a solenoid.

3. (d) **B** $=\mu_0 nI$

where n is number of turns per unit length.

4. (b) The magnetic field outside the solenoid is so weak that it is taken to

be zero.5. (a)



The magnetic field lines in a solenoid form closed loop.

SOURCE BASED QUESTION

31. Due to deflecting torque, the coil rotates and suspension wire gets twisted. A restoringtorque is set in the suspension wire.

τ = MB sin90

= NiAB

Also, $\tau = K\,\theta$

$K = \tau/\theta = NIAB/\theta = (250 \times 100 \times 10^{-6} \times 2.1 \times 1.2 \times 10^{-4})/28$

$= 5.2 \times 10^{-8}$ Nm/degree

(b) 5.2×10^{-8} Nm/degree

2. (b) 56^o using $\tau = K\,\theta$

3. (b) $=28^o$ using $\theta = \tau/K$