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Summary of chapter 29

I. Objective:

1. Calculate the magnetic force **F** (magnitude and direction) on a **moving charge** in a **magnetic field**.

2. Calculate the magnetic force **F** (magnitude and direction) on a **current-carrying conductor** when placed in **magnetic field**.

3. Calculate the torque **t** (magnitude and direction) exerted on a closed current loop in a magnetic field.

4. Study the motion of charged particles in a magnetic field.

II. Summary of major points:

1. The magnetic force that acts on a charge q moving with a velocity **v** in an external magnetic field **B** is given by;

$$\vec{F}_M = q\vec{v}\times\vec{B}$$

where F_M is in Newton(N), q is in coulomb(C), v is in m/s and B is in Tesla(T).

Important:
The force is **perpendicular** to **v** and **B**. The magnitude of the force is given by;

$$F_M = qvB\sin\theta$$

where q is the angle between the velocity **v** and the magnetic field **B**.

To find the direction of the magnetic force, use the **RIGHT HAND RULE**.

2. If a **straight** conductor of **length** l carries a **current I**, the force on that conductor in the external magnetic field **B** is given by;

$$\vec{F}_M = I\left(\vec{L}\times\vec{B}\right)$$

where F_M is in Newton(N), I is in Ampere(A), L is in meters(m) and B is in Tesla(T).

3. The magnetic moment **m** of a **current loop** carrying a current **I** is:

$$\vec{\mu} = I\vec{A}$$

where m is magnetic moment ($A.m^2$), I is current (A) and A is vector area (m^2) perpendicular to the plane of the loop.

The torque **t** on a current loop placed in a uniform magnetic field **B** is:

$$\vec{\tau} = \vec{\mu} \times \vec{B}$$

where τ is magnetic torque (N.m), μ is magnetic moment ($A.m^2$) and B is magnetic field (T).

- Magnitude of the torque is:

$$\tau = \mu B \sin\alpha$$

where α is the angle between **v** and **B** .

- Direction: **Use the right hand rule**.

4. If a charged particle moves in a uniform magnetic field **B** such that **B** is perpendicular to **v**, then the particle will move in a **circle** whose plane is **perpendicular** to **B**.

- The radius r of the circle is:

$$r = \frac{mv}{qB}$$

where m is mass, v is velocity, q is charge of the particle and B is magnetic field.

- The angular frequency ω of he particle is:

$$\omega = \frac{qB}{m}$$