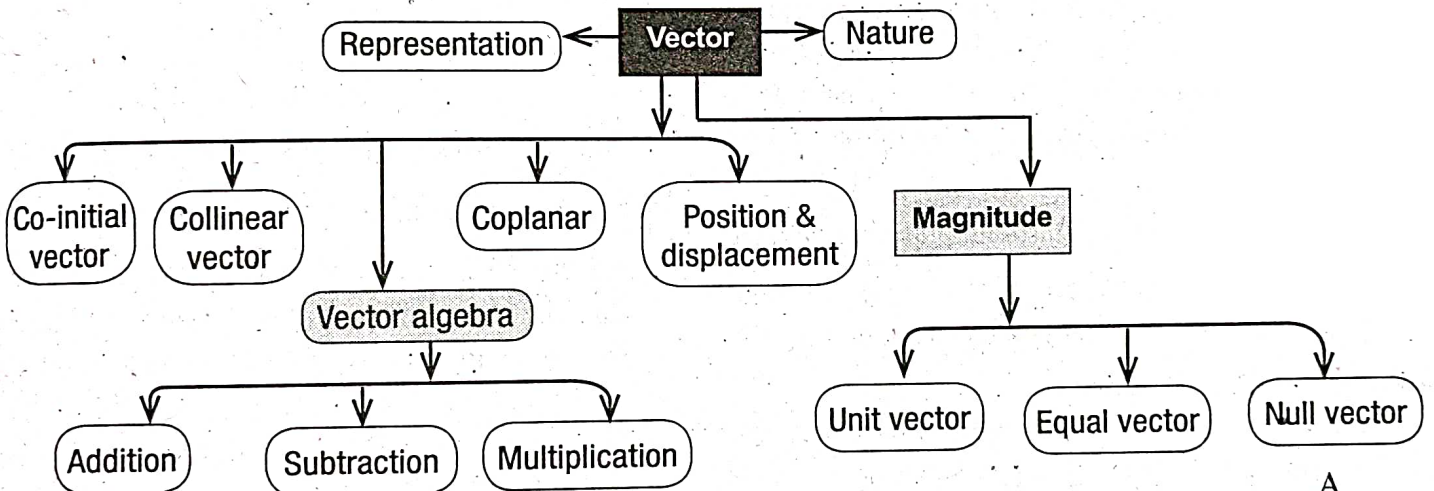# 4 Motion in a Plane

4.1. Introduction

When two or three coordinates specifying the position of the object change with time, it is the motion in a plane. The motion of a planet around the sun is an example.

4.2. Scalars and vectors

♦ **Scalar:** Quantities having magnitude only.
e.g. Mass, time, work, power, energy, temperature, speed, pressure, charge, potential etc.

♦ **Vector:** Quantities having both magnitude and direction.
e.g. Displacement, velocity, momentum, acceleration, electric field etc.

♦ **Nature of vector:** Addition and subtraction are possible. Electric current is a scalar, since vector addition and subtraction are not possible.

♦ **Representation of a vector**

```
                    Vector
    Representation ←  ▼  → Nature

Co-initial  Collinear      Coplanar   Position &      Magnitude
vector      vector                    displacement

        Vector algebra                        Unit vector  Equal vector  Null vector

Addition  Subtraction  Multiplication
```

Usually vector physical quantities are represented by $\bar{A}$, it is pronounced as 'vector A'. That is a vector is represented as $\bar{A}$ or $\vec{a}$.

♦ **Magnitude of a vector**

The magnitude of a vector is often called its absolute value and indicated by $|\bar{A}|$ or $|A|$. It is pronounced as 'modulus of vector A'.
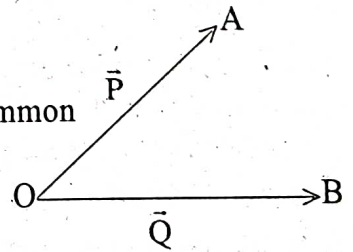
♦ **Unit Vector**

Unit vector is a vector having unit magnitude and specified direction or drawn in the direction of a given vector. Unit vector is represented by $\hat{A}$, pronounced as 'A cap' or 'A hat'.

$$\text{Unit vector} = \frac{\text{vector}}{\text{Modulus of the vector}} \quad \text{or} \quad \hat{A} = \frac{\bar{A}}{|\bar{A}|}$$

The unit vectors along x, y and z axes are written as $\hat{i}$, $\hat{j}$, and $\hat{k}$ respectively.
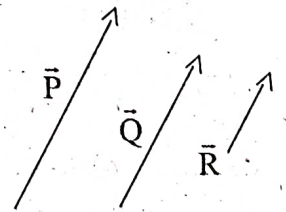
♦ **Co-initial vectors**
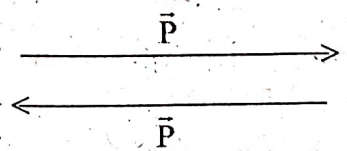These vectors have common initial point.

♦ **Collinear vectors**
Vectors are said to be collinear if they act along the same (or parallel) lines. Magnitude of collinear vectors may or may not be equal.

The negative of a vector is defined as another vector having the same length but drawn in opposite direction.

Co-planar vectors: Vectors in the same plane are called co-planar vectors.