

## 8. Three Dimensional Geometry

- **Direction cosines (d.c.'s) of a line:**

- d.c.'s of a line are the cosines of angles made by the line with the positive direction of the coordinate axes.
- If  $l$ ,  $m$ , and  $n$  are the d.c.'s of a line, then  $l^2 + m^2 + n^2 = 1$
- d.c.'s of a line joining two points P ( $x_1, y_1, z_1$ ) and Q ( $x_2, y_2, z_2$ ) are  $\frac{x_2 - x_1}{PQ}, \frac{y_2 - y_1}{PQ}, \frac{z_2 - z_1}{PQ}$ , where
$$PQ = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2 + (z_2 - z_1)^2}$$

- **Direction ratios (d.r.'s) of a line:**

- d.r.'s of a line are the numbers which are proportional to the d.c.'s of the line.
- d.r.'s of a line joining two points P ( $x_1, y_1, z_1$ ) and Q ( $x_2, y_2, z_2$ ) are given by  $x_1 - x_2, y_1 - y_2, z_1 - z_2$  or  $x_2 - x_1, y_2 - y_1, z_2 - z_1$ .

- If  $a, b$ , and  $c$  are the d.r.'s of a line and  $l, m$ , and  $n$  are its d.c.'s, then  $\frac{l}{a} = \frac{m}{b} = \frac{n}{c}$

$$l = \pm \frac{a}{\sqrt{a^2 + b^2 + c^2}}, m = \pm \frac{b}{\sqrt{a^2 + b^2 + c^2}}, \text{ and } n = \pm \frac{c}{\sqrt{a^2 + b^2 + c^2}}$$