

## 8.6 Vectors in Space

In space, each point is associated with an ordered triple  $(x,y,z)$  of real numbers. Through a fixed point, the origin  $(0)$ , draw three mutually perpendicular lines, the x-axis, the y-axis and the z-axis.

**\*\*Right hand rule:** index finger of the right hand points in the direction of the positive x-axis; the middle finger points in the direction of the positive y-axis and the thumb will point in the direction of the positive z-axis. **See figure 72 on page 638 (this is helpful if drawings or axis rotation.**

**\*\*points are ordered triples:**  $P_1 = (x,y,z)$ . Look at fig. 73 & 74 on pg. 639

## Distance Formula in Space

$$d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2 + (z_2 - z_1)^2}$$

Ex. 1 Find the distance from  $P_1 = (-1, 3, 2)$  to  $P_2 = (4, -2, 5)$

**\*\*position vector (initial point at origin) is  $\mathbf{v} = a\mathbf{i} + b\mathbf{j} + c\mathbf{k}$**

Remember: we can find the position vector if initial point given is not the origin

$$\mathbf{v} = (x_2 - x_1)\mathbf{i} + (y_2 - y_1)\mathbf{j} + (z_2 - z_1)\mathbf{k}$$

Ex. 2 Find the position vector of the vector  $\mathbf{v} = P_1P_2$  if  $P_1 = (-1, 2, 3)$  &  $P_2 = (4, 6, 2)$

Ex. 3 Add & Subtract Vectors

$$\mathbf{v} = 2\mathbf{i} + 3\mathbf{j} - 2\mathbf{k} \quad \& \quad \mathbf{w} = 3\mathbf{i} - 4\mathbf{j} + 5\mathbf{k}$$

a)  $\mathbf{v} + \mathbf{w}$

b)  $\mathbf{v} - \mathbf{w}$

Ex. 4 Find scalar products & magnitudes

$$\mathbf{v} = 2\mathbf{i} + 3\mathbf{j} - 2\mathbf{k} \quad \& \quad \mathbf{w} = 3\mathbf{i} - 4\mathbf{j} + 5\mathbf{k}$$

a)  $3\mathbf{v}$

b)  $2\mathbf{v} - 3\mathbf{w}$

c)  $\|\mathbf{v}\|$

Ex. 5 Find unit vector in the same direction as  $\mathbf{v} = 2\mathbf{i} - 3\mathbf{j} - 6\mathbf{k}$

Ex. 6 Find dot product and magnitude:  $\mathbf{v} = 2\mathbf{i} - 3\mathbf{j} + 6\mathbf{k}$  &  $\mathbf{w} = 5\mathbf{i} + 3\mathbf{j} - \mathbf{k}$

a)  $\mathbf{w} \cdot \mathbf{v}$

b)  $\|\mathbf{w}\|$

Ex. 7 Find angle  $\theta$  between  $\mathbf{u} = 2\mathbf{i} - 3\mathbf{j} + 6\mathbf{k}$  &  $\mathbf{v} = 2\mathbf{i} + 5\mathbf{j} - \mathbf{k}$