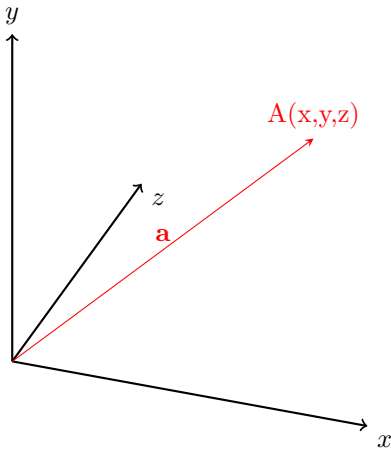# Differentiation

1 3D Vectors

$$\overrightarrow{OA} = xi + yj + zk$$

$$\overrightarrow{OA} = \begin{pmatrix} x \\ y \\ z \end{pmatrix}$$

Magnitude of $\overrightarrow{OA}$

$$|\overrightarrow{OA}| = \sqrt{x^2 + y^2 + z^2}$$

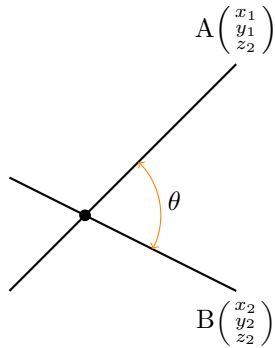**The vector between two vectors**

$$\overrightarrow{OA} = \begin{pmatrix} x_1 \\ y_1 \\ z_1 \end{pmatrix} \quad \overrightarrow{OB} = \begin{pmatrix} x_2 \\ y_2 \\ z_2 \end{pmatrix}$$

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

2   Vector dot product

$$\mathbf{a} = \begin{pmatrix} x_1 \\ y_1 \\ z_1 \end{pmatrix} \quad \mathbf{b} = \begin{pmatrix} x_2 \\ y_2 \\ z_2 \end{pmatrix}$$

$\mathbf{a{\cdot}b} = x_1 x_2 + y_1 y_2 + z_1 z_2$

$\cos\theta = \dfrac{\mathbf{a}\cdot\mathbf{b}}{|\mathbf{a}||\mathbf{b}|}$

2.1   Perpendicular vectors

$\cos 90 = 0$

$\cos\theta = \dfrac{\mathbf{a}\cdot\mathbf{b}}{|\mathbf{a}||\mathbf{b}|}$

$\mathbf{a}\cdot\mathbf{b} = 0$

2.2   Parallel vectors

$\theta = 1 \quad \cos\theta = 1$

$\mathbf{a}\cdot\mathbf{b} = |\mathbf{a}||\mathbf{b}|$

3   Vector equation of a straight line

Types of situation:

1. Through one point parallel to a given vector

*Find the equation of the line through **a** which is parallel to **b***

r=a+tb

2. A line through two points

Find the equation of a line through a and b

r = a + t(b − a)