



## Chapter 3B: Vectors II - Equations of Straight Lines

### SYLLABUS INCLUDE

- Vector and cartesian equations of lines
- Finding the distance from a point to a line
- Finding the angle between two lines
- Relationships between two lines (coplanar or skew)

### CONTENT

#### 1 Equations of Straight Lines

- 1.1 Vector Equation of a Straight Line
- 1.2 Parametric Form of Equation of a Straight Line
- 1.3 Cartesian Equation of a Straight Line

#### 2 Calculations Involving a Point and a Line

- 2.1 Determining whether a Point lies on a Line or a Line passes through a Point
- 2.2 Finding the Foot of Perpendicular from a Point to a Line and the Corresponding Perpendicular Distance

#### 3 Calculations Involving a Pair of Lines

- 3.1 Parallel Lines, Intersecting Lines and Skew Lines
- 3.2 Acute Angle between Two Lines

### INTRODUCTION

In this Chapter, we shall see how the equation of a straight line can be expressed in three forms, namely vector, parametric and cartesian. We will then use the equation to solve problems involving distances, intersections and angles.

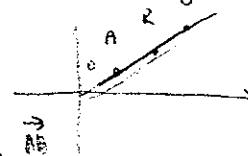
#### 1 EQUATIONS OF STRAIGHT LINES

##### 1.1 Vector Equation of a Straight Line

Recall that to find the equation of a straight line in the  $x-y$  plane, we need a point which lies on the line and the gradient of the line.

Similarly, to obtain a vector equation of a line, we need

- (i) the position vector of a point on the line and
- (ii) a vector parallel to the line (known as the direction vector).



$$\vec{r} = \vec{OA} + \vec{AR}$$

since  $\vec{AR} \parallel \vec{AB}$

$$\vec{AR} = \lambda \vec{AB} \text{ for some } \lambda \in \mathbb{R}$$

A straight line  $l$  which passes through a fixed point  $A$  with position vector  $\mathbf{a}$  and is parallel to a vector  $\mathbf{b}$  has vector equation given by

$$\mathbf{r} = \mathbf{a} + \lambda \mathbf{b}, \lambda \in \mathbb{R},$$

where  $\mathbf{r}$  represents the position vector of any point on the line  $l$ .

Each real value of  $\lambda$  gives the position vector of a point on the line  $l$ .