3.11 Vector equation of a line

Checklist

What you should know

By the end of this subtopic you should be able to:

- write the vector equation of a straight line as $\boldsymbol{r} = \boldsymbol{a} + \lambda \boldsymbol{b}$, where $\boldsymbol{a}$ is the position vector of a point on the line, $\boldsymbol{b}$ is a vector describing the direction of the line and the parameter λ is a scalar
- write the position of a point on a straight line with coordinates (x, y, z) in terms of a vector equation: $\boldsymbol{r} = \begin{pmatrix} x \\ y \\ z \end{pmatrix} = \begin{pmatrix} a_1 \\ a_2 \\ a_3 \end{pmatrix} + \lambda \begin{pmatrix} b_1 \\ b_2 \\ b_3 \end{pmatrix}$
- write the equation of a straight line in vector form, parametric form and Cartesian form: given a point (x_0, y_0, z_0) and a direction vector $\begin{pmatrix} l \\ m \\ n \end{pmatrix}$, the equation of a straight line can be written:
  - in vector form as $\boldsymbol{r} = \begin{pmatrix} x_0 \\ y_0 \\ z_0 \end{pmatrix} + \lambda \begin{pmatrix} l \\ m \\ n \end{pmatrix}$
  - in parametric form as $x = x_0 + \lambda l, y = y_0 + \lambda m, z_0 + \lambda n$
  - in Cartesian form as $\frac{x - x_0}{l} = \frac{y - y_0}{m} = \frac{z - z_0}{n}$