# Exercise 3

Paper 2 style · Graphic display calculator

## 3 6 marks AHL 3.18 · 1.16 ●●○ Typical

The planes $\Pi_1$ and $\Pi_2$ have equations $2x + y - z = 4$ and $x - y + 3z = 1$.

**(a)** Find the acute angle between $\Pi_1$ and $\Pi_2$, in degrees. **[2]**

**(b)** Find a vector in the direction of the line of intersection of $\Pi_1$ and $\Pi_2$. **[2]**

**(c)** Find a vector equation of this line. **[2]**

The markscheme is on the next page: try the question first. Written and verified by a practising IB mathematics teacher, produced with AI assistance; solved twice and recomputed by software. Not affiliated with or endorsed by the International Baccalaureate Organization.
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**MARKSCHEME (a)**

$\cos\theta = \dfrac{|2 - 1 - 3|}{\sqrt{6} \times \sqrt{11}} = \dfrac{2}{\sqrt{66}}$ **M1**

$75.7°$ $(75.7482\ldots)$ **A1**

Total 2 marks

**MARKSCHEME (b)**

$\mathbf{n}_1 \times \mathbf{n}_2 = \begin{pmatrix} 2 \\ 1 \\ -1 \end{pmatrix} \times \begin{pmatrix} 1 \\ -1 \\ 3 \end{pmatrix}$ **M1**

$\begin{pmatrix} 2 \\ -7 \\ -3 \end{pmatrix}$ **A1**

Total 2 marks

**MARKSCHEME (c)**

$x = 0$: $y - z = 4$, $-y + 3z = 1$, so $(0,\ 6.5,\ 2.5)$ **M1**

$\mathbf{r} = \begin{pmatrix} 0 \\ 6.5 \\ 2.5 \end{pmatrix} + t \begin{pmatrix} 2 \\ -7 \\ -3 \end{pmatrix}$ **A1**

Total 2 marks

**Note** Any point of both planes.