Exercise 1

Paper 1 style · No calculator

1 **6 marks** AHL 3.16 ●○○ Routine

Let $\mathbf{a} = \begin{pmatrix} 2 \\ -1 \\ 3 \end{pmatrix}$ and $\mathbf{b} = \begin{pmatrix} 1 \\ 4 \\ 0 \end{pmatrix}$.

(a) Find $\mathbf{a} \times \mathbf{b}$. **[2]**

(b) Find a unit vector perpendicular to both $\mathbf{a}$ and $\mathbf{b}$. **[2]**

(c) Find a vector equation of the line through $(1, 0, -1)$ perpendicular to both $\mathbf{a}$ and $\mathbf{b}$. **[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)

$\begin{pmatrix} -1 \times 0 - 3 \times 4 \\ 3 \times 1 - 2 \times 0 \\ 2 \times 4 - (-1) \times 1 \end{pmatrix}$ M1

$\begin{pmatrix} -12 \\ 3 \\ 9 \end{pmatrix}$ A1

Total 2 marks

Note Correct method for at least two components.

MARKSCHEME (b)

$|\mathbf{a} \times \mathbf{b}| = \sqrt{144 + 9 + 81} = \sqrt{234} = 3\sqrt{26}$ M1

$\frac{1}{\sqrt{26}} \begin{pmatrix} -4 \\ 1 \\ 3 \end{pmatrix}$ A1

Total 2 marks

Note Or its opposite.

MARKSCHEME (c)

direction $\mathbf{a} \times \mathbf{b}$ M1

$\mathbf{r} = \begin{pmatrix} 1 \\ 0 \\ -1 \end{pmatrix} + t \begin{pmatrix} -4 \\ 1 \\ 3 \end{pmatrix}$ A1

Total 2 marks