Exercise 2

Paper 1 style · No calculator

2 7 marks AHL 3.14 · 3.15 ●●○ Typical

The lines L_1 and L_2 have equations $\mathbf{r} = \begin{pmatrix} 2 \\ 1 \\ 0 \end{pmatrix} + \lambda \begin{pmatrix} 1 \\ 2 \\ -1 \end{pmatrix}$ and $\mathbf{r} = \begin{pmatrix} -1 \\ 1 \\ 5 \end{pmatrix} + \mu \begin{pmatrix} 2 \\ 1 \\ -3 \end{pmatrix}$.

(a) Show that L_1 and L_2 intersect, and find the coordinates of their point of intersection. **[5]**

(b) Find the cosine of the acute angle between L_1 and L_2. **[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.
© 2026 Hence

Exercise 2 — markscheme

Paper 1 style · No calculator

2 7 marks AHL 3.14 · 3.15 ●●○ Typical

The lines L_1 and L_2 have equations $\mathbf{r} = \begin{pmatrix} 2 \\ 1 \\ 0 \end{pmatrix} + \lambda \begin{pmatrix} 1 \\ 2 \\ -1 \end{pmatrix}$ and $\mathbf{r} = \begin{pmatrix} -1 \\ 1 \\ 5 \end{pmatrix} + \mu \begin{pmatrix} 2 \\ 1 \\ -3 \end{pmatrix}$.

(a) Show that L_1 and L_2 intersect, and find the coordinates of their point of intersection. **[5]**

(b) Find the cosine of the acute angle between L_1 and L_2. **[2]**

MARKSCHEME (a)

$2 + \lambda = -1 + 2\mu,\ 1 + 2\lambda = 1 + \mu,\ -\lambda = 5 - 3\mu$ **M1**

$\lambda = 1$ **A1**

$\mu = 2$ **A1**

z: -1 and $5 - 6 = -1$: the third equation holds, so the lines meet **R1**

$(3,\ 3,\ -1)$ **A1**

Total 5 marks

MARKSCHEME (b)

$\dfrac{|2 + 2 + 3|}{\sqrt{6} \times \sqrt{14}}$ **M1**

$\cos\theta = \dfrac{7}{\sqrt{84}} = \dfrac{\sqrt{21}}{6}$ **A1**

Total 2 marks