Exercise 2

Paper 1 style · No calculator

2 6 marks AHL 3.12 · 3.13 ●●○ Typical

Let $\mathbf{a} = \begin{pmatrix} 1 \\ -2 \\ 2 \end{pmatrix}$, $\mathbf{b} = \begin{pmatrix} 4 \\ k \\ 1 \end{pmatrix}$ and $\mathbf{c} = \begin{pmatrix} 2 \\ 6 \\ -3 \end{pmatrix}$, where $k \in \mathbb{R}$.

(a) Find the value of k for which $\mathbf{a}$ and $\mathbf{b}$ are perpendicular. **[2]**

(b) Find the cosine of the angle between $\mathbf{a}$ and $\mathbf{c}$. **[3]**

(c) Hence state whether this angle is acute or obtuse. **[1]**

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)

$\mathbf{a} \cdot \mathbf{b} = 4 - 2k + 2 = 0$ **M1**

$k = 3$ **A1**

Total 2 marks

MARKSCHEME (b)

$\mathbf{a} \cdot \mathbf{c} = 2 - 12 - 6 = -16$ **A1**

$|\mathbf{a}| = 3,\ |\mathbf{c}| = 7$ **A1**

$\cos\theta = -\frac{16}{21}$ **A1**

Total 3 marks

MARKSCHEME (c)

obtuse, because $\cos\theta < 0$ **R1**

Total 1 mark