Marked example 2

Paper 1 style · No calculator

2 6 marks AHL 3.12 · 3.13 ●●○ Typical

Let $\mathbf{a} = \begin{pmatrix} 2 \\ 1 \\ -2 \end{pmatrix}$, $\mathbf{b} = \begin{pmatrix} 1 \\ k \\ 4 \end{pmatrix}$ and $\mathbf{c} = \begin{pmatrix} 3 \\ 0 \\ 4 \end{pmatrix}$, 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]

MARKSCHEME (a)

$\mathbf{a} \cdot \mathbf{b} = 2 + k - 8 = 0$ M1

$k = 6$ A1

Total 2 marks

Note Set the scalar product to zero.

MARKSCHEME (b)

$\mathbf{a} \cdot \mathbf{c} = 6 + 0 - 8 = -2$ A1

$|\mathbf{a}| = 3,\ |\mathbf{c}| = 5$ A1

$\cos\theta = \dfrac{-2}{3 \times 5} = -\dfrac{2}{15}$ A1

Total 3 marks

MARKSCHEME (c)

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

Total 1 mark

Note The reason must be given.

Written and verified by a practising IB mathematics teacher, produced with AI assistance; solved twice and recomputed by software.
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