Solutions

Each answer shows the steps, then the **result**.

2.1

- $|\mathbf{v}| = \sqrt{9 + 16 + 144} = \sqrt{169} = 13$

2.2

- $\mathbf{a} \cdot \mathbf{b} = 2 - 3 + 1 = 0$

3.1 B

- Perpendicular vectors have scalar product 0

3.2

(a)

- $\begin{pmatrix} 4 \\ -1 \\ 3 \end{pmatrix} - 3\begin{pmatrix} 1 \\ 2 \\ -2 \end{pmatrix} = \begin{pmatrix} 1 \\ -7 \\ 9 \end{pmatrix}$

(b)

- direction of l is $\mathbf{b} = (1, 2, -2)$; $\mathbf{b} \cdot \mathbf{d} = (1)(2) + (2)(-1) + (-2)(2) = 2 - 2 - 4 = -4$; $|\mathbf{b}| = \sqrt{1 + 4 + 4} = 3$ and $|\mathbf{d}| = \sqrt{4 + 1 + 4} = 3$; $\cos\theta = \dfrac{-4}{9}$, so $\theta = 116.4°$ — obtuse. The **acute** angle between the two directions is therefore $180° - 116.4° = 63.6°$; equivalently, take the modulus first: $\cos\theta = \frac{4}{9}$

3.3

(a)

- $\overrightarrow{AB} = (2, 1, 3)$, $\overrightarrow{AC} = (1, -2, 2)$

(b)

- $\overrightarrow{AB} \cdot \overrightarrow{AC} = 2 - 2 + 6 = 6$; $|\overrightarrow{AB}| = \sqrt{14}$, $|\overrightarrow{AC}| = 3$; $\cos(BAC) = \dfrac{6}{3\sqrt{14}} = 0.5345 \Rightarrow BAC = 57.7°$