

Books, watches, notes or cell phones are not allowed. The only calculators allowed are the Sharp EL-531**. You must show all your work, the correct answer is worth 1 mark the remaining marks are given for the work.

Question 1. (3 marks) Find a vector of length 3 which is oppositely directed to \vec{AB} where $A(1, 5, -3)$ and $B(3, 0, -2)$.

$$\vec{AB} = \vec{B} - \vec{A} = (3, 0, -2) - (1, 5, -3) = (2, -5, 1)$$

$$\frac{-3}{\|\vec{AB}\|} (2, -5, 1) = \frac{-3}{\sqrt{2^2 + (-5)^2 + 1^2}} (2, -5, 1) = \frac{-3}{\sqrt{30}} (2, -5, 1)$$

Questions 2. Given $\vec{u} = (1, 2, 0)$ and $\vec{v} = (2, 1, -1)$.a. (3 marks) Find $\|\vec{a}\|$ where $\vec{a} = (\vec{u} \cdot \vec{v})\vec{u} - 2\vec{v}$.b. (3 marks) Find the angle in degrees between \vec{u} and \vec{v} .

$$\begin{aligned} \vec{a} &= ((1, 2, 0) \cdot (2, 1, -1))(1, 2, 0) - 2(2, 1, -1) \\ &= (1 \cdot 2 + 2 \cdot 1 + 0 \cdot (-1))(1, 2, 0) - 2(2, 1, -1) \\ &= (4)(1, 2, 0) - 2(2, 1, -1) \\ &= (4, 8, 0) - (4, 2, -2) \\ &= (0, 6, 2) \end{aligned}$$

$$\|\vec{a}\| = \|(0, 6, 2)\| = \sqrt{0^2 + 6^2 + 2^2} = \sqrt{36 + 4} = \sqrt{40}$$

$$\vec{u} \cdot \vec{v} = \|\vec{u}\| \|\vec{v}\| \cos \theta$$

$$(1, 2, 0) \cdot (2, 1, -1) = \|(1, 2, 0)\| \|(2, 1, -1)\| \cos \theta$$

$$(1 \cdot 2) + 2 \cdot 1 + 0 \cdot (-1) = \sqrt{1^2 + 2^2 + 0^2} \sqrt{2^2 + 1^2 + (-1)^2} \cos \theta$$

$$4 = \sqrt{5} \sqrt{6} \cos \theta$$

$$\frac{4}{\sqrt{5} \sqrt{6}} = \cos \theta$$

$$\theta \approx 43^\circ$$