

## QUIZ 01 SOLNS

1. Find the scalar projection of  $(1, 3, 2)$  onto  $(1, 0, 1)$ .

soln: Let  $\vec{a} = (1, 3, 2)$  &  $\vec{b} = (1, 0, 1)$ .

$$\text{comp}_{\vec{b}}(\vec{a}) = \vec{a} \cdot \frac{\vec{b}}{|\vec{b}|} = \frac{\vec{a} \cdot \vec{b}}{|\vec{b}|} = \frac{3}{\sqrt{2}} //$$

2. Find the vector projection of  $(54, 276, 1000e)$  onto  $(0, 1, 0)$ .

soln: Let  $\vec{a} = (54, 276, 1000e)$  &  $\vec{b} = (0, 1, 0)$ .

$$\begin{aligned} \text{proj}_{\vec{b}}(\vec{a}) &= \text{comp}_{\vec{b}}(\vec{a}) \frac{\vec{b}}{|\vec{b}|} = 276(0, 1, 0) \\ &= (0, 276, 0) // \end{aligned}$$

3. Let  $\vec{v}$  &  $\vec{w}$  be vectors. Show that  $\vec{v} - \text{proj}_{\vec{w}}(\vec{v})$  &  $\vec{w}$  are perpendicular.

soln. Two vectors are perpendicular if and only if their dot product is zero.

$$\begin{aligned} \vec{v} - \text{proj}_{\vec{w}}(\vec{v}) \cdot \vec{w} &= \left( \vec{v} - \left( \vec{v} \cdot \frac{\vec{w}}{|\vec{w}|} \right) \frac{\vec{w}}{|\vec{w}|} \right) \cdot \vec{w} \\ &= \vec{v} \cdot \vec{w} - \left[ \left( \vec{v} \cdot \frac{\vec{w}}{|\vec{w}|} \right) \frac{\vec{w}}{|\vec{w}|} \right] \cdot \vec{w} \\ &= \vec{v} \cdot \vec{w} - \frac{\vec{v} \cdot \vec{w}}{|\vec{w}|^2} \vec{w} \cdot \vec{w} \\ &= \vec{v} \cdot \vec{w} - \vec{v} \cdot \vec{w} = 0 // \end{aligned}$$