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Quiz 1

You must show all work to receive full credit!!

Problem 1. (3 pts) Give the parametric equations of the line passing through the points $(1, 5, -3)$ and $(-2, 8, -6)$.

direction vector $\vec{v} = \langle 1 - (-2), 5 - 8, -3 - (-6) \rangle = \langle 3, -3, 3 \rangle$ (or $\langle -3, 3, -3 \rangle$)

$\vec{r}(t) = \langle 1, 5, -3 \rangle + t \langle 3, -3, 3 \rangle$ or $\vec{r}(t) = \langle -2, 8, -6 \rangle + t \langle 3, -3, 3 \rangle$

$$\Rightarrow \begin{cases} x = 1 + 3t \\ y = 5 - 3t \\ z = -3 + 3t \end{cases}$$

$$\Rightarrow \begin{cases} x = -2 + 3t \\ y = 8 - 3t \\ z = -6 + 3t \end{cases}$$

Problem 2. (5 pts) Let $\mathbf{u} = \langle 3, -2, 7 \rangle$ and $\mathbf{v} = \langle 2, 1, 2 \rangle$. Find $\mathbf{u}_{\parallel} = \text{proj}_{\mathbf{v}} \mathbf{u}$ and \mathbf{u}_{\perp} .

$$\begin{aligned} \vec{u}_{\parallel} &= \left(\frac{\vec{u} \cdot \vec{v}}{\vec{v} \cdot \vec{v}} \right) \vec{v} = \frac{18}{9} \vec{v} = 2\vec{v} \\ &= \boxed{\langle 4, 2, 4 \rangle} \end{aligned}$$

$$\begin{aligned} \vec{u} \cdot \vec{v} &= \langle 3, -2, 7 \rangle \cdot \langle 2, 1, 2 \rangle \\ &= 3 \cdot 2 - 2 \cdot 1 + 7 \cdot 2 \\ &= 6 - 2 + 14 = 18 \end{aligned}$$

$$\vec{v} \cdot \vec{v} = 2^2 + 1^2 + 2^2 = 4 + 1 + 4 = 9$$

$$\begin{aligned} \vec{u}_{\perp} &= \vec{u} - \vec{u}_{\parallel} = \langle 3, -2, 7 \rangle - \langle 4, 2, 4 \rangle \\ &= \boxed{\langle -1, -4, 3 \rangle} \end{aligned}$$

Problem 3. (2 pts) Suppose that applying a constant force to an object at an angle 60° above the horizontal results in a horizontal displacement of 12 meters. If the total work done is 42 joules, what is the magnitude of the applied force?

$$\begin{aligned} W &= \vec{F} \cdot \vec{d} = \|\vec{F}\| \|\vec{d}\| \cos \theta \Rightarrow 42 = \|\vec{F}\| \cdot 12 \cdot \cos 60^\circ \Rightarrow \\ &42 = \|\vec{F}\| \cdot 6 \\ \Rightarrow \|\vec{F}\| &= \boxed{7 \text{ N}} \end{aligned}$$