

Scalar Product (Dot Product)

$$\vec{P} \cdot \vec{Q} = PQ \cos \theta$$

Determine θ

$$\vec{P} \cdot \vec{Q} = \vec{Q} \cdot \vec{P}$$

from two vectors

Distributive

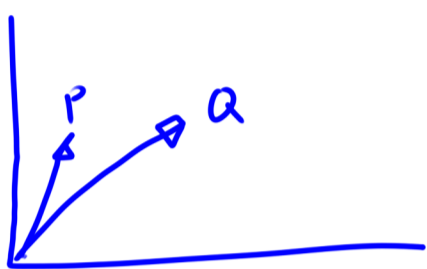
$$\vec{P} \cdot (\vec{Q}_1 + \vec{Q}_2) = \vec{P} \cdot \vec{Q}_1 + \vec{P} \cdot \vec{Q}_2$$

$$\vec{P} \cdot \vec{Q} = (P_x i + P_y j + P_z k) \cdot (Q_x i + Q_y j + Q_z k)$$

$$= P_x i \cdot Q_x i + P_x i \cdot Q_y j + \dots$$

$$= P_x Q_x + P_y Q_y + P_z Q_z$$

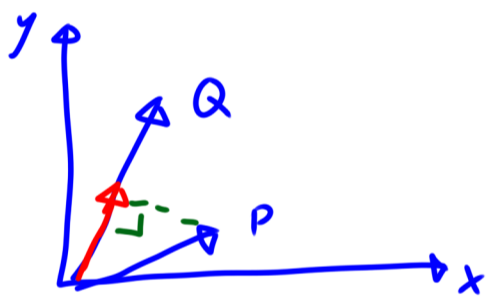
Vector Projection



Project P onto Q

Find the component of P in the direction of Q

$$\vec{Q} \frac{\vec{P} \cdot \vec{Q}}{\vec{Q} \cdot \vec{Q}} = \vec{Q} \frac{\vec{P} \cdot \vec{Q}}{Q^2}$$



$$\vec{Q} = 3i + 5j$$

$$\vec{P} = 4i + 2j$$

Project P onto Q

$$= 3 \cdot 4 + 5 \cdot 2 + 0 \cdot 0$$

$$\vec{P} \cdot \vec{Q} = 12 + 10 = 22$$

$$Q = \sqrt{3^2 + 5^2} = \sqrt{9 + 25} = \sqrt{34} = 5.83$$

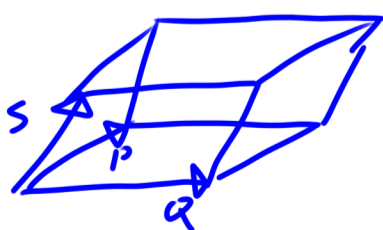
$$\vec{Q} \frac{\vec{P} \cdot \vec{Q}}{Q} = \frac{22}{5.83^2} (3i + 5j)$$

$$= \frac{22}{34} (3i + 5j)$$

$$= 1.94i + 3.24j$$

Triple Product

$$\vec{S} \cdot (\vec{P} \times \vec{Q}) = \text{Volume}$$



$$\vec{S} \cdot (\vec{P} \times \vec{Q}) = \begin{vmatrix} S_x & S_y & S_z \\ P_x & P_y & P_z \\ Q_x & Q_y & Q_z \end{vmatrix}$$