



## Uses of the Dot Product

$$\begin{aligned} \vec{A} \cdot \vec{B} &= |\vec{A}| |\vec{B}| \cos \theta \\ \cos \theta &= \frac{1+16}{\sqrt{65} \sqrt{5}} = \frac{17}{5\sqrt{13}} \\ \theta &= \cos^{-1}\left(\frac{17}{5\sqrt{13}}\right) \end{aligned}$$

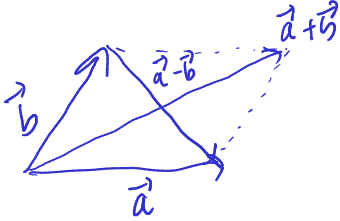
1. Find the angle between the vectors  $\mathbf{A} = \mathbf{i} + 8\mathbf{j}$  and  $\mathbf{B} = \mathbf{i} + 2\mathbf{j}$ .

2. Take points  $P = (a, 1, -1)$ ,  $Q = (0, 1, 1)$ ,  $R = (a, -1, 3)$ . For what value(s) of  $a$  is  $PQR$  a right angle?

$$\vec{PQ} = (-a, 0, 2) \quad \vec{QR} = (a, -2, 2) \quad PQ \perp PR \Rightarrow -a^2 - 2 \times 0 + 4 = 0$$

3. Show that the diagonals of a parallelogram are perpendicular if and only if it is a rhombus, i.e., its four sides have equal lengths.

$$\begin{aligned} &\Rightarrow |a| = 2 \\ &\Rightarrow a = \pm 2 \end{aligned}$$



$$\begin{aligned} \left(\frac{\vec{a} + \vec{b}}{2}\right) \cdot \left(\frac{\vec{a} - \vec{b}}{2}\right) &= 0 \\ |a|^2 - |b|^2 &= 0 \\ \Rightarrow |a| &= |b| \quad \text{proved} \end{aligned}$$

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