\[ \frac{\sin 144^\circ}{6000} = \frac{\sin 18^\circ}{x} \]

\[ x \cdot \sin 144^\circ = 6000 \cdot \sin 18^\circ \]

\[ x \]
\[ \vec{V} = 875 \cos 58^\circ \hat{i} + 875 \sin 58^\circ \hat{j} \]
\[ \vec{V} = 600 \cos 50^\circ \hat{i} + 600 \sin 50^\circ \hat{j} \]
\[ \vec{W} = 50.55 \hat{i} + 129.21 \hat{j} \]
\[ ||\vec{W}|| = \sqrt{50.55^2 + 129.21^2} = 138.7 \]
\[ \tan \Theta = \frac{129.21}{50.55} \quad \Theta = 68.6^\circ \]
\[ 90 - 68.6^\circ = 21.4^\circ \]
6.4 Vectors and Dot Products

\[ \mathbf{\hat{u}} = \langle u_1, u_2 \rangle \]
\[ \mathbf{\hat{v}} = \langle v_1, v_2 \rangle \]
\[ \mathbf{\hat{u}} \cdot \mathbf{\hat{v}} = u_1v_1 + u_2v_2 \]

Find the angle between \( \langle 5, -4 \rangle \) and \( \langle 9, -2 \rangle \)

\[ \langle 5, -4 \rangle \cdot \langle 9, -2 \rangle = \sqrt{5^2 + (-4)^2} \sqrt{9^2 + (-2)^2} \cos \theta \]

\[ 45 + 8 = \sqrt{41} \sqrt{85} \cos \theta \]

\[ 53 = \sqrt{3485} \cos \theta \]

\[ 0.8978 = \cos \theta \]

\[ 26.13^\circ = \theta \]
If \( \vec{u} \cdot \vec{v} = 0 \), then \( \vec{u} \) and \( \vec{v} \) are orthogonal (perpendicular).

Are \( \langle 1, -4 \rangle \) and \( \langle 6, 2 \rangle \) orthogonal?

\[
\langle 1, -4 \rangle \cdot \langle 6, 2 \rangle = 1(6) + (-4)(2) = 6 - 8 = -2
\]

\(-2 \neq 0 \) \( \implies \) No
Finding Vector Components

Let \( \vec{u} \) and \( \vec{v} \) be vectors such that
\[ \vec{u} = \vec{w}_1 + \vec{w}_2 \]
where \( \vec{w}_1 \) and \( \vec{w}_2 \) are orthogonal and \( \vec{w}_1 \) is parallel to \( \vec{v} \). \( \vec{w}_1 \) and \( \vec{w}_2 \) are components of \( \vec{u} \).

\( \vec{w}_1 \) is the projection of \( \vec{u} \) onto \( \vec{v} \):
\[
\vec{w}_1 = \text{proj}_{\vec{v}} \vec{u} = \frac{\vec{u} \cdot \vec{v}}{\|\vec{v}\|^2} \vec{v}
\]

Work = \( F \cdot \vec{d} \)
Find the projection of \( \vec{u} = \langle 3, 4 \rangle \) onto \( \vec{v} = \langle 8, 2 \rangle \). Then write \( \vec{u} \) as the sum of 2 orthogonal vectors.

\[
\vec{u} = \vec{w}_1 + \vec{w}_2
\]

\[
\vec{w}_1 = \text{proj}_v \vec{u} = \frac{\vec{u} \cdot \vec{v}}{\| \vec{v} \|^2} \vec{v}
\]

\[
\vec{w}_2 = \vec{u} - \vec{w}_1 = \langle 3, 4 \rangle - \langle \frac{64}{17}, \frac{16}{17} \rangle
\]

\[
= \langle \frac{51}{17}, \frac{68}{17} \rangle - \langle \frac{64}{17}, \frac{16}{17} \rangle
\]

\[
= \langle \frac{51}{17} - \frac{64}{17}, \frac{68}{17} - \frac{16}{17} \rangle
\]

\[
= \langle \frac{-13}{17}, \frac{52}{17} \rangle
\]

\[
\vec{u} = \langle \frac{64}{17}, \frac{16}{17} \rangle + \langle -\frac{13}{17}, \frac{52}{17} \rangle
\]