You will have at least 20 minutes to complete the quiz. You may use a calculator for computations, but your process must still be evident in the work you show.

1. [3 pts] Suppose the vector $\vec{v}$ points $20°$ to the *left* of the positive y-axis. Find the components of $\vec{v}$.

$||\vec{v}|| = 7$.

$\vec{v} = (-7 \cdot \sin(20°), 7\cos(20°))$

$= (-2.394, 6.578)$

2. [2 pts] If $||\vec{u}|| = 20$, $||\vec{v}|| = 10$, and the angle between $\vec{u}$ and $\vec{v}$ is $45°$, what is $\vec{u} \cdot \vec{v}$?

$\vec{u} \cdot \vec{v} = ||\vec{u}|| \cdot ||\vec{v}|| \cdot \cos(45°)$

$= (20)(10) \cdot \frac{\sqrt{2}}{2}$

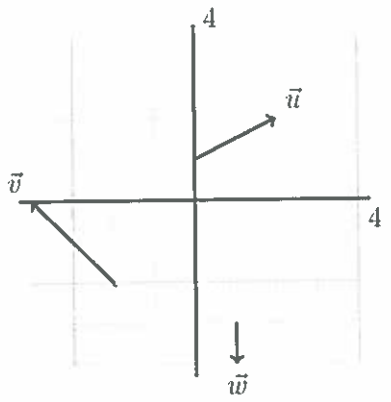
$= 100\sqrt{2} = \boxed{141.42}$

3. [5 pts] Find a vector that is perpendicular to the vector $\vec{v} = 3\vec{i} + 4\vec{j}$, and prove that it is perpendicular.

one example: $\vec{u} = (-4)\vec{i} + 3\vec{j}$.

Pf: $\vec{u} \cdot \vec{v} = (-4)(3) + (3)(4) = -12 + 12 = \boxed{0}$. ✓

4. [10 pts] Suppose the vectors $\vec{u}$, $\vec{v}$, and $\vec{w}$ are shown below.



(a) Write down the components of $\vec{u}$, $\vec{v}$, and $\vec{w}$.

$\vec{u} = (2, 1)$

$\vec{v} = (-2, 2)$

$\vec{w} = (0, -1)$

(b) Find $2\vec{u} + 3\vec{w}$.

$2\vec{u} + 3\vec{w} = (4+0, 2-3) = (4, -1)$

(a) What is $\vec{u} \cdot \vec{w}$?

$\vec{u} \cdot \vec{w} = (2)(0) + (1)(-1) = -1.$

(b) If $\vec{u}$ and $\vec{v}$ are placed tail-to-tail, what is the angle that they make?

$\|\vec{u}\| = \sqrt{4+1} = \sqrt{5}$

$\|\vec{v}\| = \sqrt{4+4} = \sqrt{8} = 2\sqrt{2}$

$\vec{u} \cdot \vec{v} = (2)(-2) + (1)(2) = -4 + 2 = -2$

$2\sqrt{2} \cdot \sqrt{5} \cos\theta = -2$

$\cos\theta = \frac{-2}{2\sqrt{2}\sqrt{5}} = -\frac{1}{\sqrt{10}}$

$\theta = \arccos\left(-\frac{1}{\sqrt{10}}\right) = 1.89 \text{ rad}$

$= 108.4^\circ$

(c) Are any of the vectors $\vec{u}, \vec{v}, \vec{w}$ perpendicular? Explain.

$\vec{u} \cdot \vec{w} = -1$

$\vec{u} \cdot \vec{v} = -2$

$\vec{v} \cdot \vec{w} = (-2)(0) + (2)(-1) = -2$

no, none of them dot to 0, so they can't be perpendicular.