Miscellaneous Vector Concepts

Concept 1: Vectors in the Plane Applications

1. A commercial jet is flying from Miami to Seattle. The jet's velocity with respect to the air is 580 mph, and its bearing is 332°. The wind, at the altitude of the plane, is blowing from the southwest w/ a velocity of 40 mph.
   a. Draw a visual representation, using vectors, of the problem.
   b. Write a vector in component form that represents the wind.
   c. Write a vector in component form that represents the airspeed of the jet.
   d. What is the speed of the jet w/ respect to the ground?
   e. What is the true direction of the jet?

Concept 2: The dot Product

Notes: The dot product of $\mathbf{u}=\langle u_1, u_2\rangle$ and $\mathbf{v}=\langle v_1, v_2\rangle$ is given by

$$\mathbf{u}\cdot\mathbf{v} = u_1v_1 + u_2v_2$$

★ your final answer is a constant, not a vector!

Example: Let $\mathbf{u}=\langle -1,3\rangle$ and $\mathbf{v}=\langle 2,-4\rangle$. Determine $\mathbf{u}\cdot\mathbf{v}$

$(-1)(2) + (3)(-4)$

$-2 + -12 = \boxed{-14}$

→

1. Let $u=\langle -1, 3\rangle$, $v=\langle 2, -4\rangle$, and $w=\langle 1, -2\rangle$. Determine the following:

a. $(u \bullet v)w$ ← dot product

b. $u \bullet 2v$

c. $\|u\|$

Concept 3: Angle Between Vectors

1. Use any method you can think of to determine the angle between $u=\langle 4, 3\rangle$ and $v=\langle 3, 5\rangle$. Perhaps you should draw a picture to get started :)

2. Are vectors $u=\langle 2, -3\rangle$ and $v=\langle 6, 4\rangle$ orthogonal? (Orthogonal means perpendicular in vector language)

3. Use the formula, below, to try the first to problems again. This should be a lot easier.

If θ is the angle between two nonzero vectors u and v, then

$$\cos\theta = \frac{u \bullet v}{\|u\| \, \|v\|}$$ → dot product!