Pre-Calculus Name: **SOLUTIONS** Date: Period:

# Assignment 10B.1-Dot Products

Let $\mathbf{u} = \langle 3,6\rangle$, $\mathbf{v} = \langle -4,3\rangle$, and $\mathbf{w} = \langle 3,4\rangle$

1. Find the following dot products
   *a.* $\mathbf{u} \cdot \mathbf{v}$

   $$\langle 3,6\rangle \cdot \langle -4,3\rangle = -12 + 18 = 6$$

   *b.* $\mathbf{u} \cdot \mathbf{w}$

   $$\langle 3,6\rangle \cdot \langle 3,4\rangle = 9 + 24 = 33$$

   *c.* $\mathbf{v} \cdot \mathbf{w}$

   $$\langle -4,3\rangle \cdot \langle 3,4\rangle = -12 + 12 = 0$$

2. Find the angle between each pair of vectors:

   $$|\mathbf{u}| = \sqrt{3^2 + 6^2} = \sqrt{45}, \qquad |\mathbf{v}| = \sqrt{(-4)^2 + 3^2} = 5, \qquad |\mathbf{w}| = \sqrt{3^2 + 4^2} = 5$$

   *a.* $\mathbf{u}$, *and* $\mathbf{v}$

   $$\cos^{-1}\left(\frac{6}{\sqrt{45} \cdot 5}\right) = 79.7°$$

   *b.* $\mathbf{u}$, *and* $\mathbf{w}$

   $$\cos^{-1}\left(\frac{33}{\sqrt{45} \cdot 5}\right) = \mathbf{10.3°}$$

   *c.* $\mathbf{v}$, *and* $\mathbf{w}$

   $$\cos^{-1}\left(\frac{0}{5 \cdot 4}\right) = 90°$$

3. Which vectors pairs above are orthogonal? Explain.
   **v** *and* **w** *are orthoganal because their dot product is zero which makes the angle between them* 90°

4. Let $\mathbf{r} = \langle x, -2\rangle$. Find the value of $x$ that will make $\mathbf{u}$ and $\mathbf{r}$ orthogonal.

   $$\mathbf{u} \cdot \mathbf{r} = \langle 3,6\rangle \cdot \langle x, -2\rangle = 3x - 12 = 0$$

   $$x = \frac{12}{3} = 4$$

5. Let $\mathbf{s} = \langle -5, y\rangle$. Find the value of $x$ that will make $\mathbf{v}$ and $\mathbf{s}$ orthogonal.

   $$\mathbf{v} \cdot \mathbf{s} = \langle -4,3\rangle \cdot \langle -5, y\rangle = 20 + 3y = 0$$

   $$y = -\frac{20}{3}$$

6. Find $\mathbf{u} \cdot \mathbf{v}$ satisfying the given conditions where $\theta$ is the angle between $\mathbf{u}$ and $\mathbf{v}$.

   $$\theta = 100°, |\mathbf{u}| = 6, |\mathbf{v}| = 9$$

   $$\cos 100 = \frac{(\mathbf{u} \cdot \mathbf{v})}{6 \cdot 9}$$

   $$\mathbf{u} \cdot \mathbf{v} = 54 \cos 100 \approx -9.38$$