**Dot Product of** $\vec{u}=\left〈u\_{1}, u\_{2}\right〉$ **and** $\vec{v}=\left〈v\_{1}, v\_{2}\right〉$

 $\vec{u} ∙ \vec{v}= u\_{1}v\_{1}+u\_{2}v\_{2}$

Ex: Find each dot product

 $\left〈3, 4\right〉 ∙ \left〈2, -3\right〉$

 $\left〈2, 2\right〉 ∙ \left〈1, -1\right〉$

 $\left〈0, 4\right〉 ∙ \left〈-3, -2\right〉$

**Properties of Dot Products**

 $\vec{u} ∙ \vec{v}= \vec{v} ∙ \vec{u}$

 $\vec{0} ∙ \vec{v}=0$

 $\vec{u} ∙ \left(\vec{v}+ \vec{w}\right)= \vec{u} ∙ \vec{v}+ \vec{u} ∙ \vec{w}$

 $\vec{v} ∙ \vec{v}= \left‖\vec{v}\right‖^{2}$ \* \* magnitude of $\vec{v}= \sqrt{\vec{v} ∙ \vec{v}}$

 $c\left(\vec{u} ∙ \vec{v}\right)= c\vec{u} ∙ \vec{v}= \vec{u} ∙ c\vec{v}$

Ex: Use $\vec{u}= \left〈3, 4\right〉$ to find each of the following:

 $\vec{v}= \left〈-2, 6\right〉$

 $\vec{w}= \left〈1, -1\right〉$

 $\left(\vec{u}∙ \vec{v}\right) ∙ \vec{w}$ $\vec{v}∙2\vec{w}$

 $\vec{u} ∙ \vec{u}$ $\left‖\vec{v}\right‖+5$

 $6\left(\vec{v} ∙ \vec{w}\right)$ $6\vec{v} ∙ 6\vec{w}$

**Using dot product to find the magnitude of a vector**

 $\vec{v} ∙ \vec{v}= \left‖\vec{v}\right‖^{2}$ so $\left‖\vec{v}\right‖= \sqrt{\vec{v} ∙ \vec{v}}$

Ex: $\vec{w}= \left〈4, -2\right〉$ find the magnitude of $\vec{w}$

 $\left‖\vec{w}\right‖ $ =

 =

 =

**The angle between two vectors**

 $\cos(θ)= \frac{\vec{u} ∙ \vec{v}}{\left‖\vec{u}\right‖\left‖\vec{v}\right‖}$

Ex: find the angle between the vectors: $\vec{u}= \left〈3, 0\right〉$

 $\vec{v}= \left〈1, 6\right〉$

**Orthogonal Vectors (perpendicular)**

**Definition of orthogonal vectors**

 Vectors $u$and$u$are orthogonal iff$u∙v=0$

Ex: Are the vectors $u= \left〈-12, 30\right〉$and $v= \left〈\frac{5}{4}, \frac{1}{2}\right〉$ orthogonal?

Ex: Determine whether the vectors: $\vec{u}= \vec{i}$

 $\vec{v}= -2\vec{i}+2\vec{j}$

 are orthogonal?

 parallel?

 neither?