Name _____KEY_____

Instructions: Show all work. Use exact answers unless otherwise asked to round.

1. Use $\vec{u} = \langle -4, -1 \rangle$, $\vec{v} = \langle 3, 10 \rangle$ to find the following.

   a. $\vec{u} + \vec{v}$

   $$= \langle -1, 9 \rangle$$

   b. $\|\vec{u}\|$

   $$\sqrt{(-4)^2 + (-1)^2} = \sqrt{16+1} = \sqrt{17}$$

   c. Write $\vec{v}$ in polar form.

   $\tan^{-1}\left(\frac{10}{3}\right) \approx 1.279$ radians $\approx 73.3°$

   $\|\vec{v}\| = \sqrt{3^2 + 10^2} = \sqrt{109}$

   $\vec{v} = \sqrt{109} \langle \cos(1.279), \sin(1.279) \rangle$

   d. Write a unit vector in the direction of $\vec{u}$

   $$\left\langle \frac{-4}{\sqrt{17}}, \frac{-1}{\sqrt{17}} \right\rangle$$

   e. Find $\vec{u} \cdot \vec{v}$

   $$-12 - 10 = -22$$

   f. Find the angle between $\vec{u}$ and $\vec{v}$

   $$\cos\theta = \frac{-22}{\sqrt{17}\sqrt{109}} \Rightarrow \theta \approx 2.1072 \text{ radians}$$
   $$120.7°$$

2. Find the resulting for and direction of adding $\|F_1\| = 200\ lbs., \theta_1 = -45°, and\ \|F_2\| = 500\ lbs., \theta_2 = 30°$. Round answers to one decimal place.

$$f_1 = \left\langle 200\ \tfrac{1}{\sqrt{2}},\ 200\left(-\tfrac{1}{\sqrt{2}}\right) \right\rangle = \left\langle 100\sqrt{2}, -100\sqrt{2} \right\rangle$$

$$f_2 = \left\langle 500\ \tfrac{\sqrt{3}}{2},\ 500\left(\tfrac{1}{2}\right) \right\rangle = \left\langle 250\sqrt{3},\ 250 \right\rangle$$

$$f_{TOTAL} \approx \left\langle 574.434,\ 108.579 \right\rangle$$

$$\|f_{TOTAL}\| = \sqrt{574.434^2 + 108.579^2} = 584.606 \approx 584.6\ lbs$$

$$\tan^{-1}\left(\frac{108.579}{574.434}\right) \approx 10.7°\ or\ .1868\ radians$$

3. Find the work done by pulling a wagon with a force of 25 lbs. at an able of 20° (with respect to the horizontal) if the wagon is pulled 50 feet. Round answer to one decimal place.

$$F = \left\langle 25\cos 20°,\ 25\sin 20° \right\rangle$$

$$d = \left\langle 50, 0 \right\rangle$$

$$\vec{F} \cdot \vec{d} = 1174.62\ ft\ lbs.$$