

Pre-Calculus Vector Review

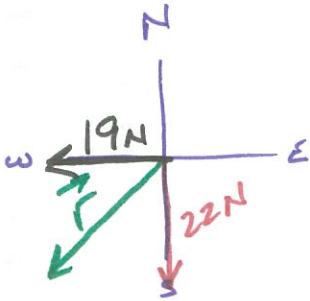
Name _____

Coordinate Systems

Level 1

Solve the problems below. Sketch all vectors, and use proper notation in all answers.

- 1) One child pulls a wagon directly west with a force of 19 newtons, and another child pulls the wagon directly south with a force of 22 newtons. Find the resultant vector of the wagon.

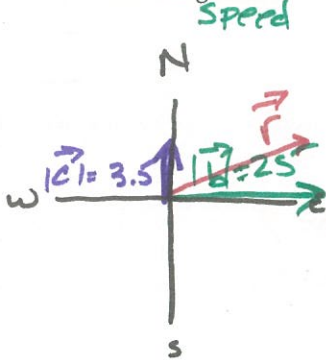


$$\langle 19 \cos 180^\circ, 19 \sin 180^\circ \rangle = \langle -19, 0 \rangle$$

$$\langle 22 \cos 270^\circ, 22 \sin 270^\circ \rangle = \langle 0, -22 \rangle$$

$$\vec{r} = \langle -19, -22 \rangle$$

- 2) A boat is travelling due east at a speed of 25 mph. The current is flowing due north at a speed of 3.5 mph. Find the actual magnitude of the boat.



$$\vec{b} = \langle 25 \cos 0^\circ, 25 \sin 0^\circ \rangle = \langle 25, 0 \rangle$$

$$\vec{c} = \langle 3.5 \cos 90^\circ, 3.5 \sin 90^\circ \rangle = \langle 0, 3.5 \rangle$$

$$\vec{r} = \langle 25, 3.5 \rangle$$

$$\text{SPEED: } |\vec{r}| = \sqrt{25^2 + 3.5^2} \approx 25.24 \text{ mph}$$

- 3) A tow truck is pulling a car with a force of 117 pounds. How much work is done in moving the car 50 feet if the angle of the road 12° with the horizontal?

$$\vec{F} = 117 \text{ lb} \quad \vec{d} = 50 \text{ ft} \quad \theta = 12^\circ$$

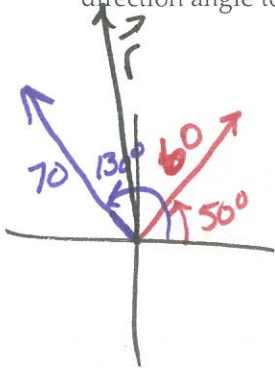
$$W = (117)(\cos 12^\circ)(50)$$

$$\approx 5722.16 \text{ ft} \cdot \text{lb}$$

(Levels 2/3)

Solve the problems below. Sketch all vectors, and use proper notation in all answers.

- 4) Two forces, F_1 and F_2 , of magnitude 60 and 70 pounds, respectively, act on an object. The direction of F_1 is 50° and the direction of F_2 is 130° . Find the magnitude and the direction angle of the resultant force. Express the direction angle to the nearest tenth of a degree.



$$\vec{F}_1 = \langle 60 \cos 50^\circ, 60 \sin 50^\circ \rangle$$

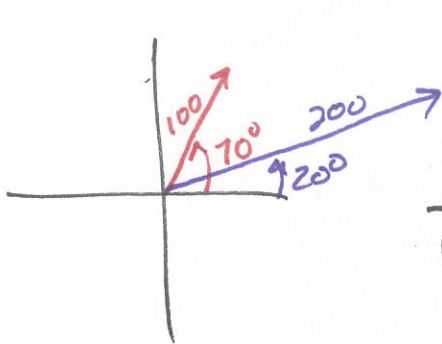
$$\vec{F}_2 = \langle 70 \cos 130^\circ, 70 \sin 130^\circ \rangle$$

$$\vec{R} \approx \langle -6.43, 99.59 \rangle$$

$$|\vec{R}| \approx \sqrt{(-6.43)^2 + 99.59^2} \approx 99.816$$

$$\theta = \tan^{-1}\left(\frac{99.59}{-6.43}\right) \approx -86.31^\circ + 180^\circ \approx 93.7^\circ$$

- 5) The magnitude and direction of two forces acting on an object are 100 pounds, 75° and 200 pounds, 20° , respectively. Find the magnitude, to the nearest hundredth of a pound, and the direction angle, to the nearest tenth of a degree, of the resultant force.



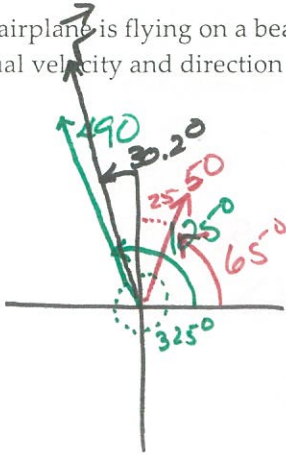
$$\begin{aligned} &\langle 100 \cos 75^\circ, 100 \sin 75^\circ \rangle \\ &+ \\ &\langle 200 \cos 20^\circ, 200 \sin 20^\circ \rangle \end{aligned}$$

$$\vec{R} \approx \langle 222.14, 162.37 \rangle$$

$$|\vec{R}| \approx \sqrt{222.14^2 + 162.37^2} \approx 275.16 \text{ lb}$$

$$\theta = \tan^{-1}\left(\frac{162.37}{222.14}\right) \approx 36.16^\circ$$

- 6) An airplane is flying on a bearing of 325° at 490 mph. It encounters a 50 mph wind at a bearing of 25° . Find the actual velocity and direction of the airplane.



$$\vec{p} = \langle 490 \cos 125^\circ, 490 \sin 125^\circ \rangle$$

$$\vec{w} = \langle 50 \cos 65^\circ, 50 \sin 65^\circ \rangle$$

$$\vec{r} \approx \langle -259.92, 446.7 \rangle$$

$$|\vec{r}| \approx \sqrt{(-259.92)^2 + 446.7^2} \approx 516.8 \text{ mph}$$

$$\theta \approx \tan^{-1} \left(\frac{446.7}{-259.92} \right) \approx -59.81^\circ + 180^\circ = 120.2^\circ$$

$$\text{BEARING} = 360^\circ - 30.2^\circ \approx 329.8^\circ$$

- 7) Find the angle between the given vectors to the nearest tenth of a degree and determine whether they are parallel, orthogonal or neither.

a) $u = \langle 6, 3 \rangle, v = \langle -5, -3 \rangle$

$$\cos^{-1} \left(\frac{(6)(-5) + (3)(-3)}{\sqrt{45} \sqrt{34}} \right)$$

$$\approx \cos^{-1} \left(\frac{-39}{\sqrt{1530}} \right) \approx 175.6^\circ \text{ NEITHER}$$

b) $u = \langle 4, -2 \rangle, v = \langle 6, 12 \rangle$

$$\cos^{-1} \left(\frac{(4)(6) + (-2)(12)}{\sqrt{20} \sqrt{180}} \right)$$

$$\cos^{-1} \left(\frac{0}{\sqrt{3600}} \right) = 90^\circ$$

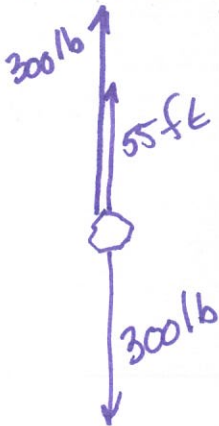
ORTHOGONAL

c) $u = \langle 4, -6 \rangle, v = \langle -8, 12 \rangle$

$$\cos^{-1} \left(\frac{(4)(-8) + (-6)(12)}{\sqrt{52} \sqrt{208}} \right)$$

$$\cos^{-1} \left(\frac{-104}{\sqrt{10816}} \right) \approx 90.55^\circ \text{ NEITHER}$$

- 8) Find the work done lifting a 300 pound boulder 55 feet into the air.

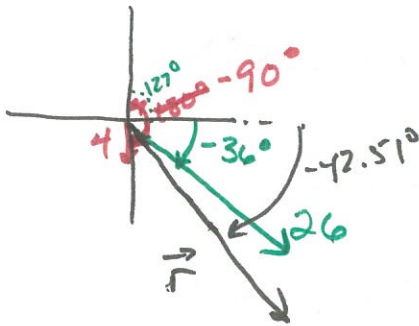


$$\vec{F} = 300 \text{ lb} \quad \theta = 180^\circ \quad \theta = 0^\circ \quad \vec{d} = 55 \text{ ft}$$

$$W = (300 \text{ lb}) (\cos 0^\circ) (55 \text{ ft})$$

$$W = 16,500 \text{ ft} \cdot \text{lb}$$

- 9) A cruise ship going from Miami to Nassau on a bearing of 127° is travelling at a speed of 26 miles per hour. The current is moving south at a speed of 4 miles per hour. Find the actual speed and direction of the ship. If the total distance between Miami and Nassau is about 187 miles, how long will the cruise take?



$$\vec{S} = \langle 26 \cos(-36^\circ), 26 \sin(-36^\circ) \rangle$$

$$\vec{C} = \langle 4 \cos(-90^\circ), 4 \sin(-90^\circ) \rangle = \langle 0, -4 \rangle$$

$$\vec{r} \approx \langle 21.03, -19.28 \rangle$$

$$|\vec{r}| \approx \sqrt{21.03^2 + (-19.28)^2} \approx 28.54 \text{ mph}$$

$$\theta = \tan^{-1}\left(\frac{-19.28}{21.03}\right) \approx -42.51^\circ$$

$$\text{BEARING: } 90^\circ + 42.51^\circ \approx 132.5^\circ$$

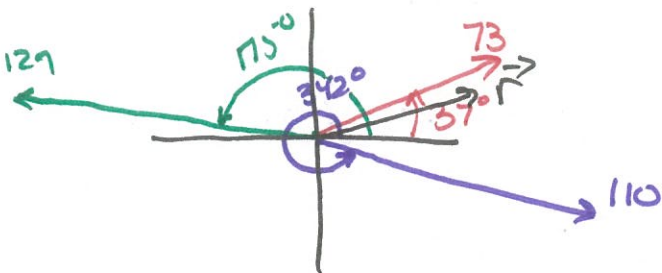
$$d = r \cdot t$$

$$\frac{187 \text{ mi}}{t} = 28.54$$

$$187 \text{ mi} = 28.54 \text{ mph} \cdot t$$

$$t = \frac{187 \text{ mi}}{28.54 \text{ mph}} \approx 6.55 \text{ hours}$$

- 10) Maria and Tina are walking their dog, Thor. Thor does not like to be on the leash and is pulling the girls the opposite direction. Maria is pulling with a force of 73 lb at a 37° angle, Tina is pulling with a force of 110 lb at 342° , and Thor is using a force of 127 lb at 175° . Who is really being taken for a walk? How do you know?



$$\vec{M} = \langle 73 \cos 37^\circ, 73 \sin 37^\circ \rangle$$

$$\vec{T}_i = \langle 110 \cos 342^\circ, 110 \sin 342^\circ \rangle$$

$$\vec{T}_h = \langle 127 \cos 175^\circ, 127 \sin 175^\circ \rangle$$

$$\vec{r} = \langle 36.4, 21 \rangle$$

$$|\vec{r}| = 42.03 \text{ lb}$$

$$\theta = \tan^{-1}\left(\frac{21}{36.4}\right) \approx 30^\circ$$

Thor is being walked but much slower
 than the girls want
 to go :)