

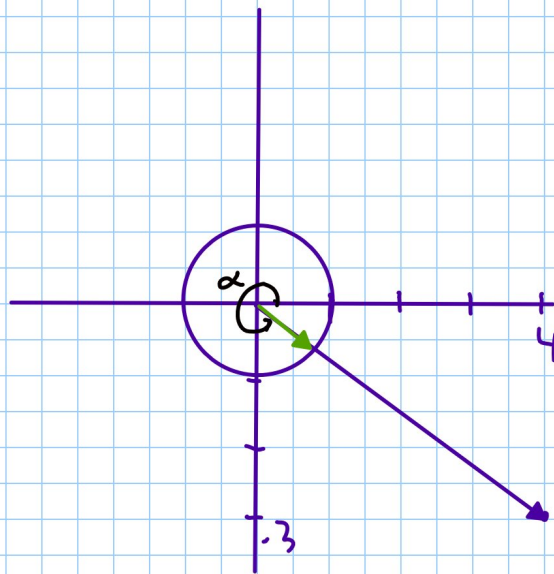
Section 8.4 (continued and concluded)

For any nonzero vector \mathbf{v} , the vector $\mathbf{u} = \frac{\mathbf{v}}{\|\mathbf{v}\|}$ is a unit vector that has the same direction as \mathbf{v} and a magnitude of 1.

ex: Find the unit vector in the same direction as $\mathbf{v} = 4\mathbf{i} - 3\mathbf{j}$

$$\begin{aligned}\|\mathbf{v}\| &= \sqrt{4^2 + (-3)^2} \\ &= \sqrt{16 + 9} \\ &= \sqrt{25} = 5\end{aligned}$$

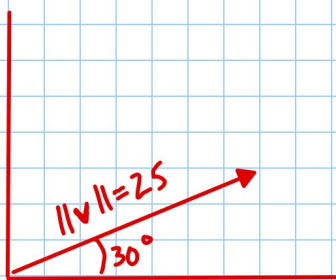
$$\mathbf{u} = \frac{4\mathbf{i} - 3\mathbf{j}}{5} = \frac{4}{5}\mathbf{i} - \frac{3}{5}\mathbf{j}$$



Often the direction of the vector \mathbf{v} is given by the angle \mathbf{v} makes with the positive x -axis. If this angle is α , then the vector \mathbf{v} can be expressed by

$$\mathbf{v} = \|\mathbf{v}\| (\cos \alpha \mathbf{i} + \sin \alpha \mathbf{j})$$

ex: You throw a ball at 25 mph so the angle is 30° with the positive x -axis.



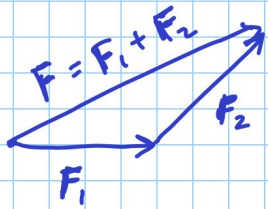
$$\mathbf{v} = \|\mathbf{v}\| (\cos \alpha \mathbf{i} + \sin \alpha \mathbf{j})$$

$$\mathbf{v} = 25 (\cos 30^\circ \mathbf{i} + \sin 30^\circ \mathbf{j})$$

$$\mathbf{v} = 25 (0.866 \mathbf{i} + 0.5 \mathbf{j})$$

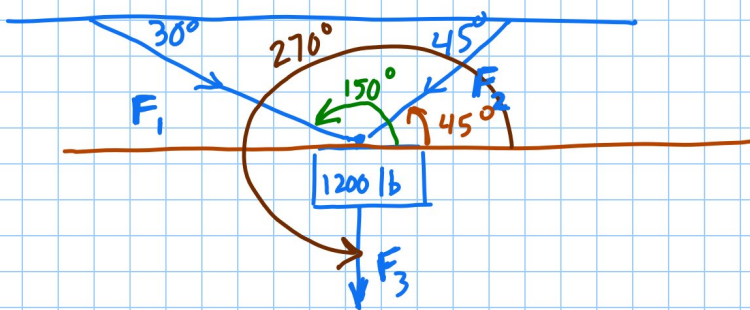
$$\mathbf{v} = 21.65 \mathbf{i} + 12.5 \mathbf{j}$$

In Physics, force F is a vector. If 2 different forces F_1 and F_2 act on an object, the resultant force is $F = F_1 + F_2$



An object is in equilibrium if
 1) the sum of all the forces is 0
 2) the object is at rest

ex



$$F_1 = \|F_1\| (\cos 150^\circ \hat{i} + \sin 150^\circ \hat{j}) = -0.866 \|F_1\| \hat{i} + 0.5 \|F_1\| \hat{j}$$

$$F_2 = \|F_2\| (\cos 45^\circ \hat{i} + \sin 45^\circ \hat{j}) = 0.707 \|F_2\| \hat{i} + 0.707 \|F_2\| \hat{j}$$

$$F_3 = 1200 (\cos 270^\circ \hat{i} + \sin 270^\circ \hat{j}) = -1200 \hat{j}$$

$$F_1 + F_2 + F_3 = 0 = 0\hat{i} + 0\hat{j}$$

$$\text{Let } x = \|F_1\|$$

$$y = \|F_2\|$$

$$-0.866x + 0.707y = 0$$

$$0.5x + 0.707y - 1200 = 0$$

$$-0.866x + 0.707y = 0$$

$$-(0.5x + 0.707y = 1200)$$

$$-1.366x = -1200$$

$$x = 878.5$$

$$-0.866(878.5) + 0.707y = 0$$

$$-760.78 + 0.707y = 0$$

$$0.707y = 760.78$$

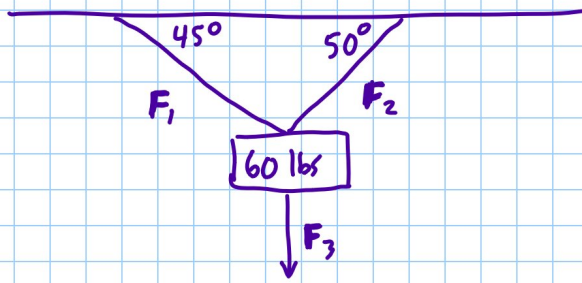
$$\text{so } \|F_1\| = 878.5 \text{ lbs}$$

$$\|F_2\| = 1076.1 \text{ lbs}$$

$$y = 1076.1$$

Classwork

1)



Find $\|F_1\|$ and $\|F_2\|$
so this is in equilibrium

2) Find unit vector for $v = -5i + 12j$

3) Write vector v in $ai + bj$ form given $\|v\| = 25$ and $\alpha = 330^\circ$.