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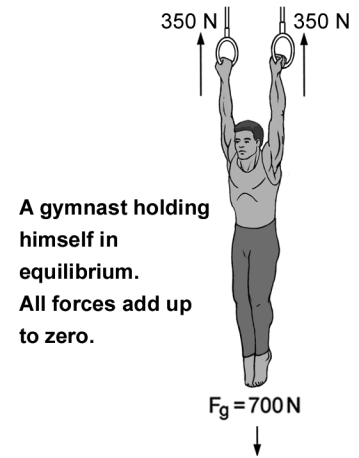
## Skill Sheet 7.3A

## Equilibrium in 2-D

Here you will solve problems that require you to determine the unknown forces needed for an object to be in equilibrium.

### 1. Forces and equilibrium

Forces are represented by vectors. They have magnitude (the strength of the force) and direction. When forces are applied to an object, it will move unless all forces acting on the object add up to zero. In this case the object is in equilibrium.



### 2. Equilibrium problems

Do the following equilibrium problems. The first one is done for you.

- A force  $\vec{F} = (10, 30^\circ)\text{N}$  is applied on an object. Find the  $x$  and  $y$  components of the force required for the object to be in equilibrium.  
 $x$  component =  $10\cos(30^\circ + 180^\circ) = -10\cos 30^\circ \text{ N} = -8.66 \text{ N}$   
 $y$  component =  $10\sin(30^\circ + 180^\circ) = -10\sin 30^\circ \text{ N} = -5.0 \text{ N}$
- Find the force required to counteract the force  $\vec{F} = (-5, 10) \text{ kN}$ .
- A box weighing 10 kilograms is pulled along the floor with a force of 100 N. The coefficient of friction  $\mu$  between the floor and the box is 0.5. Calculate the force required for the box to be in equilibrium.
- The force  $\vec{F} = (100, -45^\circ)\text{N}$  is applied to an object. Find the  $x$  and  $y$  components of the force required for equilibrium.
- Find the  $x$  and  $y$  components of a force needed to counteract the forces  $\vec{F}_1 = (100, 315^\circ)\text{N}$ ,  $\vec{F}_2 = (100, 225^\circ)\text{N}$ ,  $\vec{F}_3 = (60, 150^\circ)\text{N}$ .