Unit 2: Dynamics

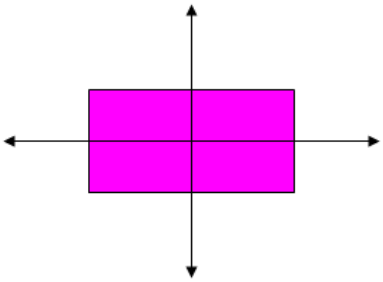
Lesson 1
Vectors and Forces

Dynamics: the study of the causes of motion. Why do objects move the way they do?

Force:

- A push or a pull (not necessarily resulting from physical contact).
- Measured in units of Newtons (N).
- 1 Newton = 1 $kg \cdot m/s^2$.
- Vector quantity.

Free Body Diagrams: a diagram drawn to represent all the forces acting on an object at a particular time.



Forces can be balanced or unbalanced.

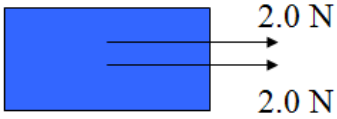
Consider:

$$F_{net} = 0N$$
$$F_{net} = 6.0 - 3.0$$
$$F_{net} = 3.0N(E)$$

Equilibrant Force:
The force needed to balance the net force.

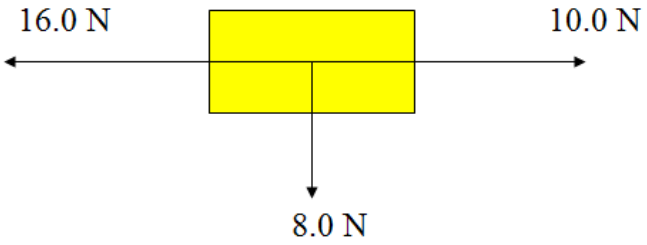
Example 1:
Find the net force acting on the objects shown.

a)



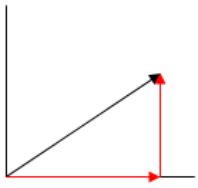
b)

Example 2:
Find the net force acting on the object shown.



Force Components

Recall that any vector (including force) has both an x and a y-component.

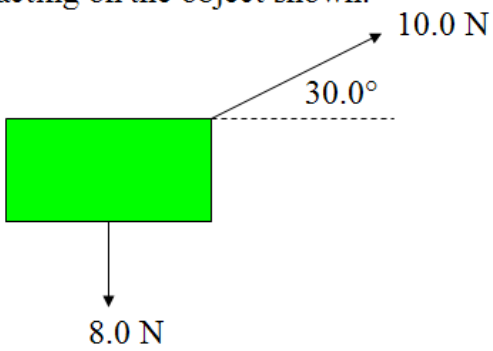


$$\sin\theta = \frac{F_y}{F} \qquad \cos\theta = \frac{F_x}{F}$$

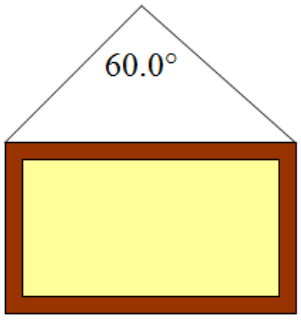
$$F_y = F\sin\theta \qquad F_x = F\cos\theta$$

Example 1:
A force of magnitude 125 N makes an angle of 30.0° with the horizontal. Determine its vertical and horizontal force components.

Example 2:
Find the net force acting on the object shown.



Example 3:
The picture shown below weighs 60.0 N. The angle made by the supporting string at the nail is 60.0°. Determine the force in each string (the tension).



Example 4:
Find the net force for the following forces:

$$F_1 = 60.0N(50.0^\circ S\,of\,W)$$
$$F_2 = 80.0N(10.0^\circ S\,of\,E)$$
$$F_3 = 40.0N(70.0^\circ N\,of\,W)$$