

# Speed, Velocity, Acceleration.

Speed (Direction doesn't matter)

$$\bar{s} = \frac{d}{t}$$

$$d = \bar{s}t$$

$$t = \frac{d}{\bar{s}}$$

Velocity

$$\bar{v} = \frac{\Delta x}{\Delta t}$$

$$\bar{v} = \frac{x_2 - x_1}{t_2 - t_1}$$

$$\Delta t = \frac{\Delta x}{\bar{v}}$$

$$\Delta x = \bar{v} \Delta t$$

$$x_2 = x_1 + \bar{v} \Delta t$$

$$x_1 = x_2 - \bar{v} \Delta t$$

## Acceleration

Acceleration occurs when a moving object undergoes a change in velocity. (speeds up or slows down.)  
gravity is an example of acceleration.

$$\text{Acceleration} = \frac{\text{change in velocity (m/s)}}{\text{change in time (s)}} \\ (\text{m/s}^2)$$

$$a = \frac{\Delta v}{\Delta t}$$

$$a = \frac{v_2 - v_1}{t_2 - t_1}$$

$$a = \frac{v_2 - v_1}{\Delta t}$$

$$\Delta v = a \Delta t$$

$$v_2 = v_1 + a \Delta t$$

$$\Delta t = \frac{\Delta v}{a}$$

$$v_1 = v_2 - a \Delta t$$

A ball is rolled at a velocity of 12 m/sec. After 36 seconds, it comes to a stop. What is the acceleration of the ball?

$$v_1 = 12 \text{ m/s}$$

$$v_2 = 0 \text{ m/s}$$

$$t = 36 \text{ s}$$

$$a = \frac{v_2 - v_1}{t}$$

$$a = \frac{0 - 12}{36}$$

$$a = \frac{-12}{36}$$

$$a = -0.33 \text{ m/s}^2$$

A car accelerated from stop to 60 m/s. The car moved in a straight line for 8.0 sec. What was the acceleration of the car?

$$v_1 = 0$$

$$v_2 = 60$$

$$t = 8 \text{ s}$$

$$a = \frac{v_2 - v_1}{t}$$

$$a = \frac{60 - 0}{8}$$

$$a = 7.5 \text{ m/s}^2$$

An object is accelerating at  $-4.5 \text{ m/s}^2$  for 12 seconds. If the final velocity is at rest, find the initial velocity.

$$v_a = \underline{0 \text{ m/s}}$$

$$a = -4.5$$

$$t = 12$$

$$v_i = ?$$

$$v_i = v_a - at$$

$$v_i = 0 - (-4.5)(12)$$

$$\underline{v_i = 54 \text{ m/s}}$$

A car starting from rest accelerates at a rate of  $8.6 \text{ m/s}^2$ . If it has a final velocity of  $64 \text{ m/s}$ , how long was it accelerating for?

$$v_i = 0$$

$$v_a = 64$$

$$a = 8.6$$

$$t = ?$$

$$t = \frac{\Delta V}{a}$$

$$t = \frac{v_a - v_i}{a}$$

$$t = \frac{64 - 0}{8.6}$$

$$t = 7.44 \text{ s.}$$