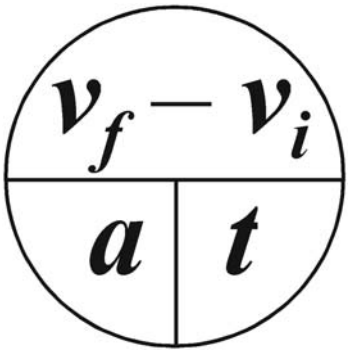
Acceleration

Whether you are speeding up, slowing down, or just changing direction, any change in velocity is acceleration. When an object falls from a window, it is accelerating. When a plane lands and comes to a stop, it is accelerating. As the earth zips around the sun it is accelerating. A car that goes from zero to 50 km/h in 5 seconds is accelerating. A car that goes from zero to 100 km/h in 5 seconds is also accelerating. The accelerations are not equal, however. A car that goes from zero to 100 km/h in 5 seconds has a greater acceleration than one that goes from zero to 50 km/h in 5 seconds. Acceleration is the change in velocity over time. Acceleration, time, and the final velocity can be calculated as shown below.

Inertia Man: Resists acceleration unless he's rushing to bed.

$$a = \frac{\Delta v}{t} = \frac{v_f - v_i}{t}\ ;\ t = \frac{v_f - v_i}{a}\ ;$$
$$\text{and} \quad v_f = v_i + at$$

- a = *acceleration*
- Δv = *change in velocity*
  - v_f = *final velocity*
  - v_i = *initial velocity*



Sample Problem 1

What is the acceleration of a car that speeds up from 85 km/h to 100 km/h in 3 seconds?

$$a = \frac{v_f - v_i}{t}$$
$$a = \frac{100\,km/h - 85\,km/h}{3s}$$
$$= 5\,km/h \cdot s$$

Sample Problem 2

A falling brick passes a window at a speed of 29.4 m/s. How fast will it be going 2 seconds later if the acceleration of gravity is 9.8 m/s^2?

$$v_f = v_i + at$$
$$v_f = 29.4\,m/s + \left(9.8\,m/s^2\right)(2s)$$
$$= 49.0\,m/s$$

Sample Problem 3

How long does it take to stop a car going 88 km/h if it accelerates at a rate of –5 km/h/s?

$$t = \frac{v_f - v_i}{a}$$
$$t = \frac{0\,km/h - 88\,km/h}{-5\,km/h \cdot s}$$
$$= 17.6s$$

Answer the questions below using the equations above.

1. How fast will a runner be going if she speeds up from 2.7 m/s by accelerating at a rate of 0.5 m/s^2 for 6 s?
2. How long does it take for a car going 40 km/h to speed up to 75 km/h with an acceleration of 10 km/h/s?
3. What is the acceleration of a car that goes from a stop to 88 km/h in 4.0 s?