

## Objective 5 Force-Acceleration-Speed

Investigate and describe applications of Newton's laws such as in vehicle restraints, sports activities, geological processes and satellite orbits

### Force Problem Help

A force is a push or a pull on an object (a mass) that causes it to speed up, slow down, or change direction (accelerate).

The force formula is Newton's second law of motion. It describes the effects of unbalanced forces on the motion of objects.

Force = mass x acceleration

Formulas

$$F = ma$$

$$m = F / a$$

$$a = F / m$$

### Units

Force = Newtons (N) or (kg x m/sec<sup>2</sup>)

Mass = kilograms (kg)

Acceleration = meters per second<sup>2</sup> (m/sec<sup>2</sup>) or (m/s/s)

### Examples

1. What force is needed to accelerate a 500 kg object by 10 m/sec<sup>2</sup>?

$$m = 500 \text{ kg}$$

$$a = 10 \text{ m/sec}^2$$

$$F = ma$$

$$F = 500 \text{ kg} \times 10 \text{ m/sec}^2 = 5000 \text{ kg} \times \text{m/sec}^2 \text{ or } 5000 \text{ N}$$

2. If the force on an object is 100 Newtons, and the acceleration is 5 m/sec<sup>2</sup>, what is the mass?

$$F = 100 \text{ N}$$

$$a = 5 \text{ m/sec}^2$$

$$m = F / a$$

$$m = 100 \text{ N} / 5 \text{ m/sec}^2 \text{ or } m = 100 \text{ kg} \times \text{m/sec}^2 / 5 \text{ m/sec}^2 = 20 \text{ kg} \text{ (m/sec}^2 \text{ cancels out)}$$

3. If a force of 20 Newtons is applied to a 10 kg mass what would its acceleration be?

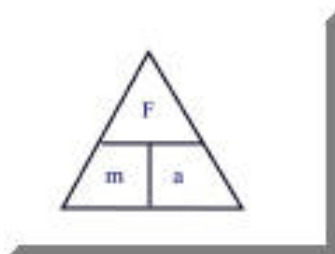
$$F = 20 \text{ N}$$

$$m = 10 \text{ kg}$$

$$a = F / m$$

$$a = 20 \text{ N} / 10 \text{ kg} \text{ or } a = 20 \text{ kg} \times \text{m/sec}^2 / 10 \text{ kg} = 2 \text{ m/sec}^2 \text{ ( kg cancels out)}$$

**The triangle can help you rearrange the formula. Cover up one of the three letters that you want to solve for. If the other two are side by side you multiply them to get the third. If one letter is above the other, divide the letter above by the letter below.**



If the problem asks, *How much force did it take?* use the formula  $\mathbf{F} = \mathbf{ma}$ .

If the problem asks, *What was the mass?* then use the formula  $\mathbf{m} = \mathbf{F} / \mathbf{a}$ .

If the problem asks, *What was the acceleration?* then use the formula  $\mathbf{a} = \mathbf{F} / \mathbf{m}$ .