## *Newton's Second Law of Motion* Pg 160

Newton's second law can be formally stated as:

The acceleration of an object produced by a net force is:

- directly proportional to the magnitude of the net force

$$a \propto F_{net}$$

∝ = proportional to

- inversely proportional to the mass of the object

$$a \propto \frac{1}{m}$$

---

$$\vec{a} = \frac{\vec{F}_{net}}{m}$$

$$\boxed{\vec{F}_{net} = m\vec{a}}$$ ← Starting point for force problems involving acceleration.

$\vec{F}_{net}$ -> net force (N)
m -> mass (kg)
$\vec{a}$ -> acceleration ($m/s^2$)

---

Remember: The acceleration of an object has the same direction as the net force acting on the object.

**Sample Problems**

An object is accelerating at 2.0 $m/s^2$ east.

1. If the net force is tripled, what is the object's new acceleration?

2. If the net force is halved, what is the object's new acceleration?

3. If the net force is tripled and the mass is quadrupled, what is the object's new acceleration?

What is the acceleration of a 12 kg cart under a constant force of 88 N?

$F_g = mg$

$a = ?$

$F = ma$

$m = 12\,kg$

$88 = 12a$

$F = 88\,N$

$\frac{88}{12} = a$

$7.3\,m/s^2 = a$

A force of 1200 N accelerates an object at 21 $m/s^2$. What is the mass of the object?

$F = 1200\,N$

$F = ma$

$57\,kg = m$

$a = 21\,m/s^2$

$1200 = m(21)$

$m = ?$

$\frac{1200}{21} = m$

What average force is required to accelerate a 33 kg mass at 4.6 $m/s^2$?

$F = ma$

$F = (33)(4.6)$

$m = 33\,kg$

$F_{avg} = 151.8\,N$

$a = 4.6\,m/s^2$

A 2.5 kg object falls on an air mattress. Just as it hit it was traveling 19 m/s. The air mattress depressed 0.75 m before coming to a stop. What was the average force stopping the object?

$F = ma$

$m = 2.5\,kg$

$d = 0.75m$

$v_0 = 19\,m/s$

$v_f = 0\,m/s$

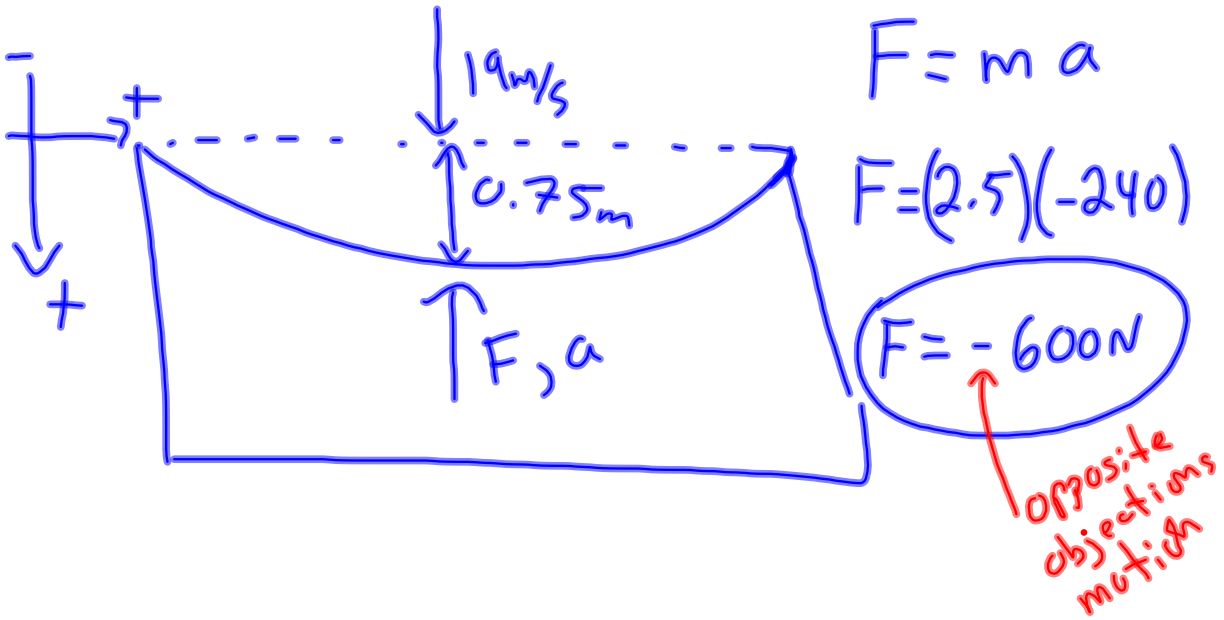
→ calculate acceleration

$v_f^2 = v_0^2 + 2ad$

$0^2 = (19)^2 + 2a(0.75)$

$-361 = 1.5a$

$\frac{-361}{1.5} = a$ $\quad -240\,m/s^2 = a$




$F = ma$

$F = (2.5)(-240)$

$F = -600N$

opposite objections motion