Newton's Second Law of Motion

Newton's First Law (N1) states that an object will remain in a state of rest or continue to move with constant velocity unless acted upon by an unbalanced force.

Now if the force does become unbalanced the acceleration of the object will depend on what?

Demo: Cart, increase force

As the force goes ~~goes~~ up the acceleration goes up. F↑, a↑

Cart, increase mass

As the mass goes up the acceleration goes down. m↑ a↓

Newton's Second Law states that the acceleration of an object depends inversely on its mass and directly on the unbalanced force applied to it. As well the object will accelerate in the same direction as the net force on the object.

$$\bar{a} = \frac{\bar{F}}{m} \longrightarrow \bar{F}_{net} = m\bar{a}$$

a = acceleration m/s^2
m = mass kg

Unit 1 kg* m/s^2 = 1 Newton = 1N

Example: What is the acceleration of a 10 kg object sitting on a frictionless surface if it is pushed with a force of 60 N [E]?

$$\bar{a} = \frac{F_{net}}{m} = \frac{60}{10} = 6\ m/s^2\ [E]$$

Example: A sports car initially at travelling at 10 m/s [S] comes to a full stop after 3.9 s. The mass of the car is 2000 kg. Calculate the car's deceleration and the net force needed to stop the car.

$V_1 = 10\,m/s\,[S]$

$V_2 = 0$

$t = 3.9\,s$

$a = ?$

$m = 2000\,kg$

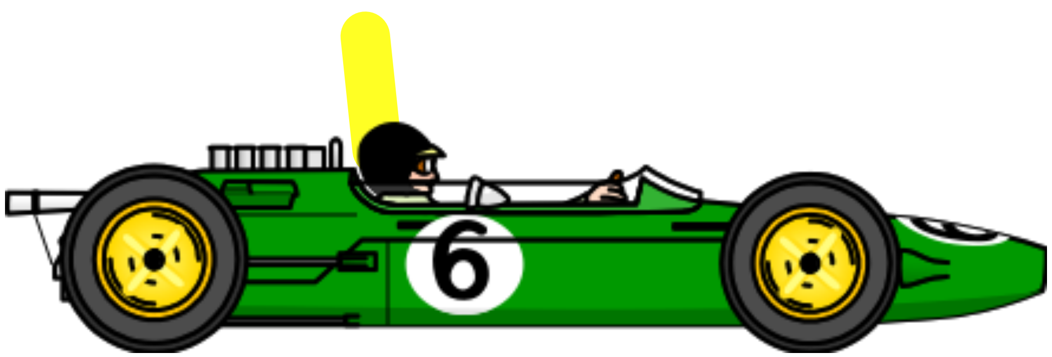
$F_{net} = ?$

$$\bar{a} = \frac{\bar{v}_2 - \bar{v}_1}{t}$$

$$\bar{a} = \frac{0 - 10}{3.9}$$

$$\bar{a} = -2.6\,m/s^2\,[S]$$

$$= 2.6\,m/s^2\,[N]$$



$$\bar{F}_{net} = m\bar{a}$$

$$= 2000 \times 2.6$$

$$= 5200\,N\,[N]$$