Unit 4: Newton's Laws

Newton's 2nd Law

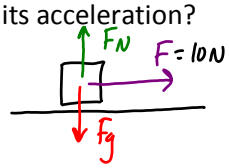
Newton's 2nd Law: An unbalanced force results in an acceleration.

Stated as a formula:

$$F_{net} = ma \quad (F_g = mg)$$

Note that... units $N = kg\,m/s^2$

Ex. A 5.0 kg block is pushed to the right along a frictionless track with a force of 10.0 N. What is its acceleration?



$F_{net} = ma$

$a = \frac{F_{net}}{m} = \frac{10.0\,N}{5.0\,kg}$

$= 2.0\,m/s^2$

Ex. A 650 kg car accelerates at 4.0 m/s^2 south. What is the net force acting on it?

$F_{net} = ma$

$= (650\,kg)(4.0\,m/s^2)$

$= 2600\,N$ South

Ex: A 1500 kg ice cream truck accelerates from rest to a top speed of 45 km/h in 8.0 s. What was the net force acting on the truck?

÷3.6 = 12.5 m/s

$V = 12.5\,m/s$
$V_o = 0$
$a = ?$
$d =$
$t = 8.0\,s$

$V = V_o + at$

$a = \frac{V - V_o}{t} = \frac{12.5 - 0}{8.0}$

$= 1.5625\,m/s^2$

$F_{net} = ma$

$= (1500\,kg)(1.5625\,m/s^2)$

$= 2300\,N$

To find F_{net} when two forces work together …

add them up!

To find F_{net} when many forces act on an object:

F_{net} = Winners − Losers

Ex. Stan and Kyle are pushing a 75 kg sled along a frictionless ice rink. Stan pushes with 55 N and Kyle pushes with 45 N. Find the sled's acceleration.

$F_{net} = F_{stan} + F_{Kyle} = ma$

$a = \frac{F_{stan} + F_{Kyle}}{m}$

$= \frac{55\,N + 45\,N}{75\,kg} = 1.3\,m/s^2$

Ex: The Batmobile exerts a force of 8.50×10^3 N east, while friction pulls back on it with a force of 1500 N. If it has a mass of 1250 kg, what is its acceleration?

$F_{net} = F_{Bat} - F_f = ma$

$a = \frac{F_{Bat} - F_f}{m} = \frac{8500\,N - 1500\,N}{1250\,kg}$

$= 5.6\,m/s^2$ East