

Unit 4: Newton's Laws

Newton's 2nd Law

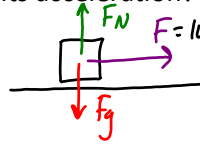
Newton's 2nd Law: *An unbalanced force results in an acceleration.*

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/s² south. What is the net force acting on it?

$$\begin{aligned} F_{net} &= ma \\ &= (650\ kg)(4.0\ m/s^2) \\ &= 2600\ N\ South \end{aligned}$$

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?

$$F_{net} = ma$$

$$= (1500\ kg)(1.5625\ m/s^2) = 2300\ N$$

$$\begin{aligned} v &= 12.5\ m/s \\ v_0 &= 0 \\ a &= ? \end{aligned}$$

$$d = 8.0\ s$$

$$v = v_0 + at$$

$$a = \frac{v - v_0}{t} = \frac{12.5 - 0}{8.0} = 1.5625\ m/s^2$$

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

add them up!

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

$F_{net} = \text{Winners} - \text{Losers}$

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 $8.50 \times 10^3\ N$ 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?

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

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

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