Flipping Physics Lecture Notes:
Introduction to Newton's Second Law of Motion with Example Problem

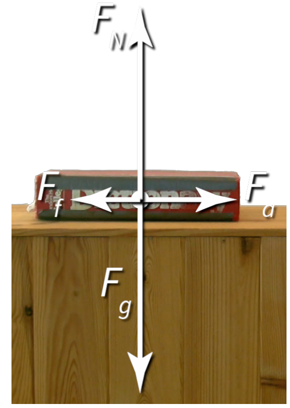
Newton's Second Law of Motion: $\boxed{\sum \vec{F} = m\vec{a}}$
The Net force equals mass times acceleration where force and acceleration are both vectors.

Example problem: You apply a force of 5.0 N horizontally to a 1627 g book that is at rest on a horizontal table. If the force of friction between the book and table is 3.6 N:

a) What are the magnitudes of all the forces acting on the book?
b) What is the acceleration of the book?

Givens: $\boxed{F_a = 5.0\text{ N}, F_f = 3.6\text{ N},}$ $m = 1627\text{ g}$, $v_i = 0$

Draw the Free Body Diagram.



We have an equation for the Force of Gravity or Weight of the book. However, we need to convert the mass of the book before we use it to kg because Newtons is in $\frac{kg \cdot m}{s^2}$.

$$m = 1627g \times \frac{1kg}{1000g} = 1.627kg \;\&$$

$$F_g = mg = (1.627)(9.81) = 15.961 \approx \boxed{16N}$$

Sum the forces in the y-direction:

$$\sum F_y = F_n - F_g = ma_y = m(0) = 0 \Rightarrow F_n - F_g = 0 \Rightarrow F_n = F_g = 15.961 \approx \boxed{16N}$$

Force Normal and Force of Gravity have the same magnitude and are in opposite directions.
That completes part (a) because we already knew the magnitudes of the Force Applied and Force of Friction.

Sum the forces in the x-direction:

$$\sum F_x = F_a - F_f = ma_x \Rightarrow a_x = \frac{F_a - F_f}{m} = \frac{5 - 3.6}{1.627} = 0.86048 \approx \boxed{0.86\frac{m}{s^2}}$$

This is how you show the dimensions work out to be meters per second squared:

$$a_x = \frac{F_a - F_f}{m} \Rightarrow \frac{N}{kg} = \frac{\frac{kg \cdot m}{s^2}}{kg} = \frac{\frac{kg \cdot m}{s^2}}{\frac{kg}{1}} = \frac{kg \cdot m}{s^2} \times \frac{1}{kg} = \frac{m}{s^2}$$

You can see that we can use Newton's Second Law of Motion to determine the acceleration of a mass caused by a net external force. Because those forces are constant, the acceleration is also constant and we could use the Uniformly Accelerated Motion (UAM) equations to find out more information about the book.

The 4 UAM Equations: $\Delta x = v_i \Delta t + \frac{1}{2} a \Delta t^2;\ v_f = v_i + a\Delta t;\ v_f^2 = v_i^2 + 2a\Delta x;\ \Delta x = \frac{1}{2}(v_f + v_i)\Delta t$