Explanation of Different Acceleration Units

Some students get confused about the different units used to express acceleration when using different methods of calculation. We will try to clear that up in this short section of notes.

When we calculate acceleration using the change in velocity we tend to use the units meters per second squared (m/s^2). This comes from the following equation:

$a = \frac{\triangle v}{\triangle t}$ gives the units $\frac{m/s}{s} \Rightarrow \frac{m}{s \cdot s} \Rightarrow \frac{m}{s^2}$

In the above expressions: a is acceleration, $\triangle v$ is change in velocity, $\triangle t$ is change in time, m is the unit "meters" and s is the unit "seconds".

When we use Newton's second law to calculate acceleration we divide a force (generally in Newtons) by a mass (generally in kilograms).

$a = \frac{F}{m}$ gives the units $\frac{N}{kg}$.

In the above expressions: a is acceleration, F is force, m is mass, N is the unit "Newtons", and kg is the unit "kilograms".

1 Newton is defined as the following:

$1\ N = 1\ kg \cdot m/s^2$

Therefore, $\frac{N}{kg} \Rightarrow \frac{1\ \cancel{kg} \cdot m/s^2}{\cancel{kg}} \Rightarrow \frac{m}{s^2}$.

This means that $\frac{m}{s^2} = \frac{N}{kg}$ so both $a = \frac{\triangle v}{\triangle t}$ and $a = \frac{F}{m}$ are equivalent and valid methods for calculating acceleration!