newton's laws of motion

You will all be familiar with Newton's laws of motion, so we will just summarize them here, using the symbols F for force (which is a vector quantity), v for velocity (also a vector quantity) and m for mass (which is a scalar).

law I *Unless a resultant force acts on a body, its velocity will not change.*

i.e. if $F = 0$, $\Delta v = 0$

This gives us an intuitive meaning of force: a resultant force is that agent which changes the velocity (and momentum) of a body. Law I is a special case of law II.

law II *The rate of change of momentum of a body is proportional to the resultant force that acts on it.*

i.e. $F \propto \mathrm{d}(mv)/\mathrm{d}t$

or $F = k\, \mathrm{d}(mv)/\mathrm{d}t$

Hence $F = km\, \mathrm{d}v/\mathrm{d}t + kv\, \mathrm{d}m/\mathrm{d}t$

$= km\, \mathrm{d}v/\mathrm{d}t$ (since $\mathrm{d}m/\mathrm{d}t = 0$ in most problems in classical mechanics)

$= kma$

We then choose $k=1$, and in so doing we also define our unit for force.

$F[\mathrm{N}] = m[\mathrm{kg}]a[\mathrm{ms}^{-2}]$

1 *newton* (N) is that force which accelerates a mass of 1 kg at 1 ms^{-2}.
$F = ma$ is one form of Newton's second law.

law III *If body A exerts a force F on body B, then body B exerts a force F on* *body A of the same size and along the same line, but in the opposite direction.*

i.e. $F_{AB} = - F_{BA}$

Law III refers to a pair of forces which must always act on two *different* bodies. These two forces have the same size at every instant of time.
