

Vector notation:

$$\vec{r} = (x, y, z) = x\hat{i} + y\hat{j} + z\hat{k}$$

vector addition

e.g. -2.7m

$$\vec{v} = \frac{d\vec{r}}{dt} = v_x\hat{i} + v_y\hat{j} + v_z\hat{k}$$

"velocity along x"

e.g. $+1.7\text{m/s}$

"x-component of velocity"

If we're working in 1D, let's agree to drop the subscript: e.g.

instead of $F_x = m \frac{dv_x}{dt}$, write

$$F = m \frac{dv}{dt}$$

v is the x-component of $\vec{v}$, but $|v|$ is the speed.

$$N2 : \vec{F} = m\vec{a} = m \frac{d^2\vec{r}}{dt^2}$$

is a differential equation.

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Algebraic equations: e.g.  $x - 3 = 0$   
answer is a number.

But a DE is different!

$$\frac{dx}{dt} - 3 = 0$$

answer is a function  $x(t)$

$$x(t) = 3t + A$$

If I also know  $x(t=0) = 5 \Rightarrow A=5$

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is an initial
condition

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N2 is an ODE, of 2nd order  
↑ Ordinary

$$F = m \frac{d^2 x}{dt^2} = m \ddot{x} \leftarrow \text{fluxions}$$