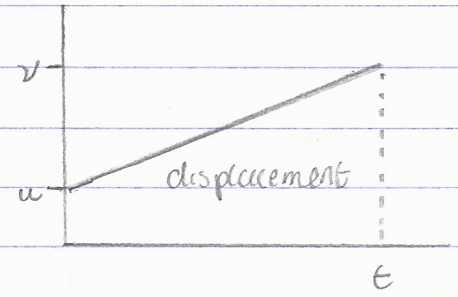
Kinematics

Position - Defined as relative to a fixed point.

Averages - Avg. speed = total distance / time & same for velocity.

Acceleration - Acceleration is rate in change of velocity.
- Accelerating ⇒ velocity increases & decelerating ⇒ velocity decreases.

Derivation of SUVAT equations



$$a = \frac{v-u}{t} \Rightarrow at = v-u \Rightarrow \boxed{v = u+at}$$

(like $y = mx + c$)

using trapezium:

$$s = \left(\frac{u+v}{2}\right)t \Rightarrow \boxed{s = \frac{u+v}{2}t}$$

THEN sub $v = u + at$ into $s = \frac{u+v}{2}t$

$$\Rightarrow s = \frac{u+u+at}{2}t = \frac{2ut+at^2}{2} = ut + \frac{at^2}{2}$$

$$\Rightarrow \boxed{s = ut + \frac{at^2}{2}}$$

∵ of $t = \frac{v-u}{a}$ (from $v = u+at$) & $s = \left(\frac{u+v}{2}\right)t$

$$\Rightarrow s = \frac{u+v}{2}t \Rightarrow t = \frac{2s}{u+v}$$

$$\frac{2s}{u+v} = \frac{v-u}{a} \Rightarrow 2as = (u+v)(v-u) = \cancel{uv} - u^2 + v^2 - \cancel{uv}$$

$$= -u^2 + v^2$$

$$\Rightarrow \boxed{v^2 = u^2 + 2as}$$

Variable Acceleration

$v = \frac{ds}{dt} = \dot{s}$ (the derivative of displacement is velocity)

$a = \frac{dv}{dt} = \frac{d^2s}{dt^2}$ (the derivative of velocity is acceleration)

$= \dot{v} = \ddot{s}$

$\Rightarrow v = \frac{ds}{dt} \Rightarrow s = \int v\,dt$, $a = \frac{dv}{dt} \Rightarrow v = \int a\,dt$