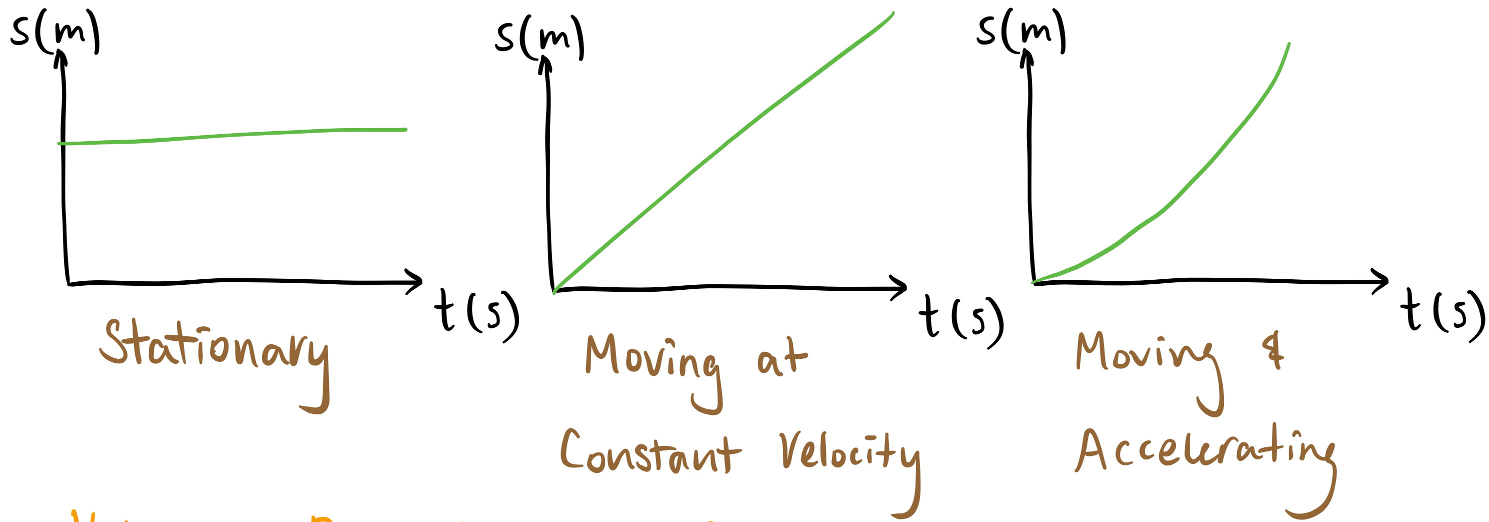
Constant Acceleration

SUVAT <3

(Refer to physics notes if needed!)

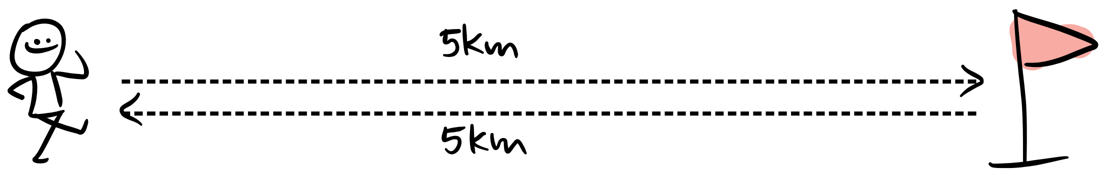
① Displacement - Time Graph



Velocity = Rate of change of displacement

Therefore if $s = f(t)$ (displacement is a function of time),

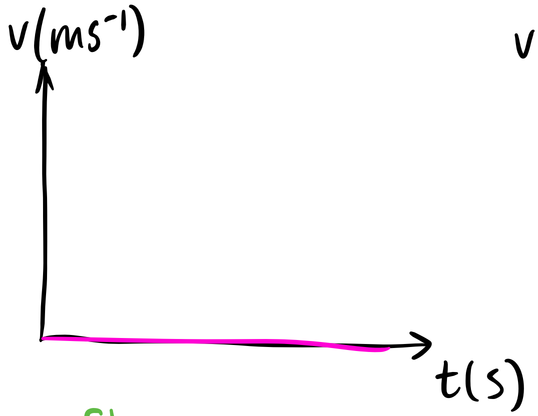
$v = f'(t)$ and $a = f''(t)$



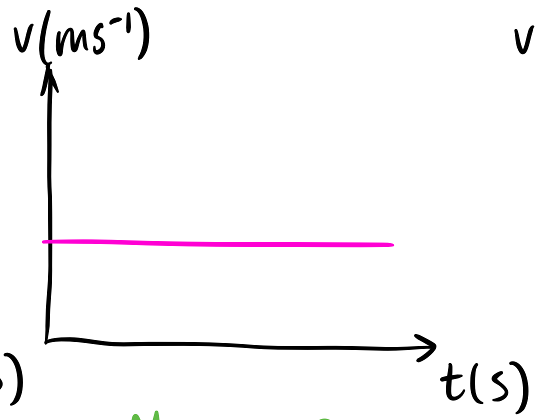
Displacement : $5km + (-5km) = 0km$

Distance : $5km + 5km = 10km$

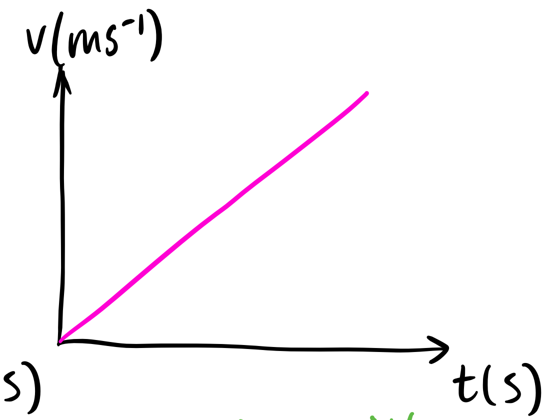
② Velocity-Time Graph



Stationary

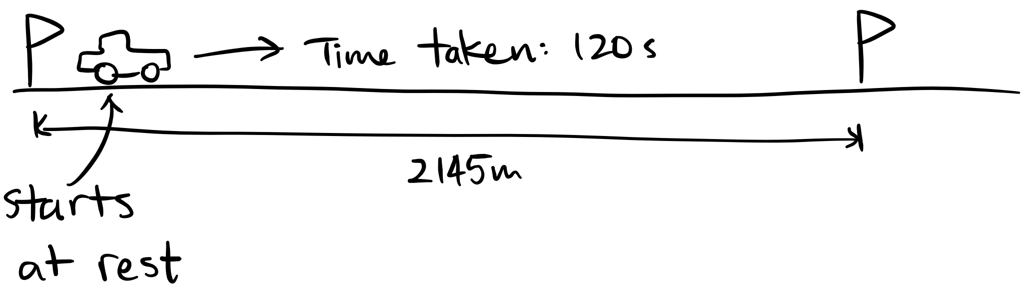


Moving @ constant velocity



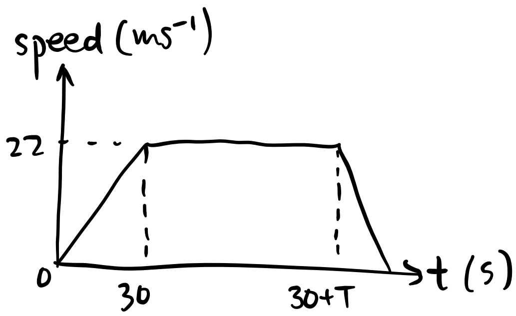
Moving with constant acceleration

Question!



- Const acc for 30 s until $22ms^{-1}$
- Const $22ms^{-1}$ for T s
- Const decc & comes to rest at endpoint.

(a)



(b)

EX9A

1 (a) A: $\frac{40}{0.5} = 80 \text{ kmh}^{-1}$ B: $\frac{20}{0.5} = 40 \text{ kmh}^{-1}$

C: 0 kmh^{-1} D: $\frac{40}{1} = 40 \text{ kmh}^{-1}$ E: $\frac{-100}{1.5} = -\frac{200}{3} = -66.7 \text{ kmh}^{-1}$

(b) $\text{Average velocity} = \frac{\text{total displacement}}{\text{total time}} = \frac{0}{4}$

$= 0 \text{ kmh}^{-1}$

(c) $\text{Average speed} = \frac{\text{total distance}}{\text{total time}} = \frac{100+100}{4}$

$= 50 \text{ kmh}^{-1}$

2 (a) $s = vt = 60 \times 2.5 = 150$ km at 2.5 hours

$s = vt = 60 \times 0.75 = 45$ km from 3 to $3\frac{3}{4}$ hours

total $= 195$ km

(b) $\bar{v} = \frac{195}{3.75} = 52 \text{ kmh}^{-1}$

3 (a) $v = \frac{s}{t} = \frac{12}{11-10} = 12 \text{ kmh}^{-1}$

(b) 12:45

(c) 3rd Stage: $\frac{-15}{1.5} = -10 \text{ kmh}^{-1}$

4th Stage: $\frac{3}{1} = 3 \text{ kmh}^{-1}$

(d) $\text{Avg. speed} = \frac{12+15+3}{4} = \frac{30}{4} = 7.5 \text{ kmh}^{-1}$

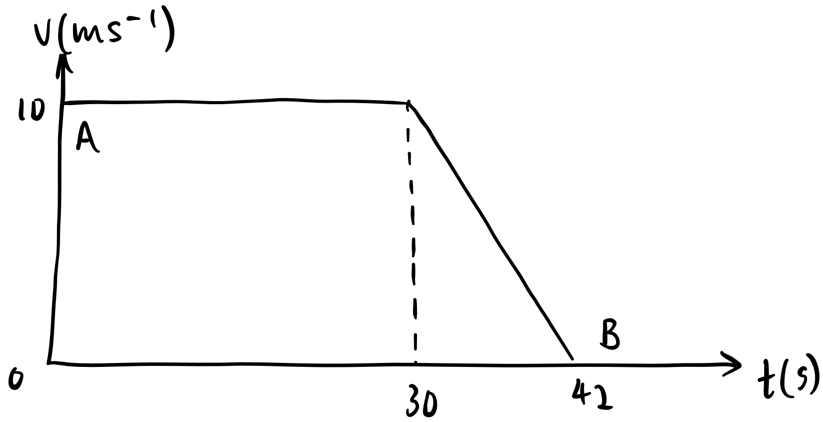
Ex 9B

1 (a) $a = \frac{v-u}{t} = \frac{9-0}{4} = 2.25\ ms^{-2}$

(b) $s =$ area under curve $= \frac{9 \times 4}{2} + 9 \times 8$

$= 18 + 72 = 90m$

2 (a)



(b) Distance from A to B = area under curve

$= 30 \times 10 + \frac{12 \times 10}{2} = 300 + 60 = 360m$

3 (a) $a = \frac{v-u}{t} = \frac{8-0}{20} = 0.4\ ms^{-2}$

(b) $a = \frac{v-u}{t} = \frac{0-8}{15} = -\frac{8}{15} = -0.533\ ms^{-2}$

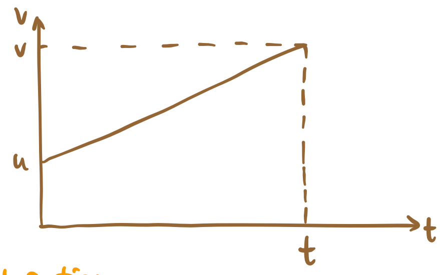
(c) distance = area under curve $= \frac{8 \times 20}{2} + 40 \times 8 + \frac{15 \times 8}{2}$

$= 80 + 320 + 30 = 430m$

Suvat

s - displacement
u - initial velocity
v - final velocity
a - acceleration
t - time

From v-t-graph



① gradient = acceleration

$\frac{v-u}{t} = a$

$v = u + at$

② area under curve = displacement

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

$s = \frac{1}{2}(u+v)t$

③ From ①: $t = \frac{v-u}{a}$

Sub into ②: $s = \frac{1}{2}(u+v)\left(\frac{v-u}{a}\right)$

$s = \frac{1}{2a}(v^2 - u^2)$

$v^2 = u^2 + 2as$

④ From ①: $v = u + at$

Sub into ②: $s = \frac{1}{2}(u + at + u)t$

$s = \frac{1}{2}(2u + at)t$

$s = ut + \frac{1}{2}at^2$

- OR -

$u = v - at \rightarrow s = vt - \frac{1}{2}at^2$

Conclusion!

$v = u + at$

$s = \frac{1}{2}(u+v)t$

$v^2 = u^2 + 2as$

$s = ut + \frac{1}{2}at^2$

$s = vt - \frac{1}{2}at^2$

Each ones only have 4 variables
∴ 1 variable can be ignored!

Ex 9D

1. $v^2 = u^2 + 2as$

$v^2 = 3^2 + 2(2.5)(8)$

$v = \sqrt{3^2 + 2(2.5)(8)}$

$= 7 \text{ ms}^{-}$

2. $s = ut + \frac{1}{2}at^2$

$60 = 8 \times 6 + \frac{1}{2} \times 6^2 \times a$

$18a = 12$

$a = \frac{2}{3} = 0.667 \text{ ms}^{-2}$

3. $v^2 = u^2 + 2as$

$0 = 12^2 + 2 \times 36 \times a$

$a = \frac{-144}{2 \times 36} = -2 \text{ ms}^{-2}$

Gravitational Acceleration

Things fall & accelerate at $9.8\ ms^{-2}$

When calculating dropping things: $s = ut + \frac{1}{2}at^2$