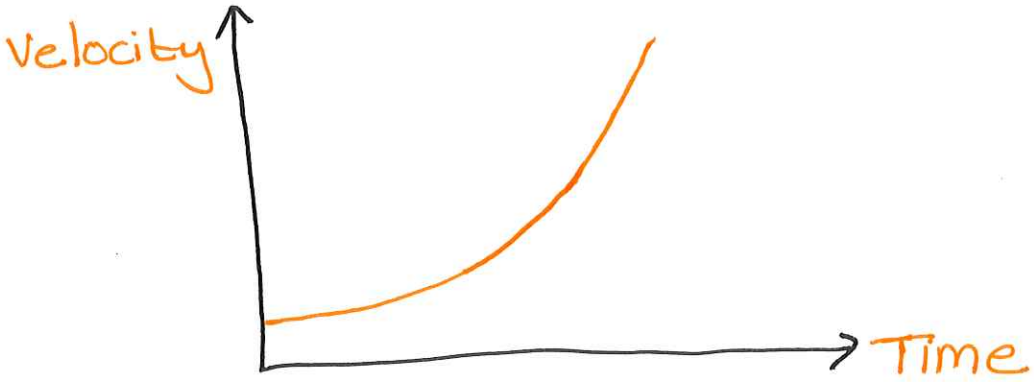
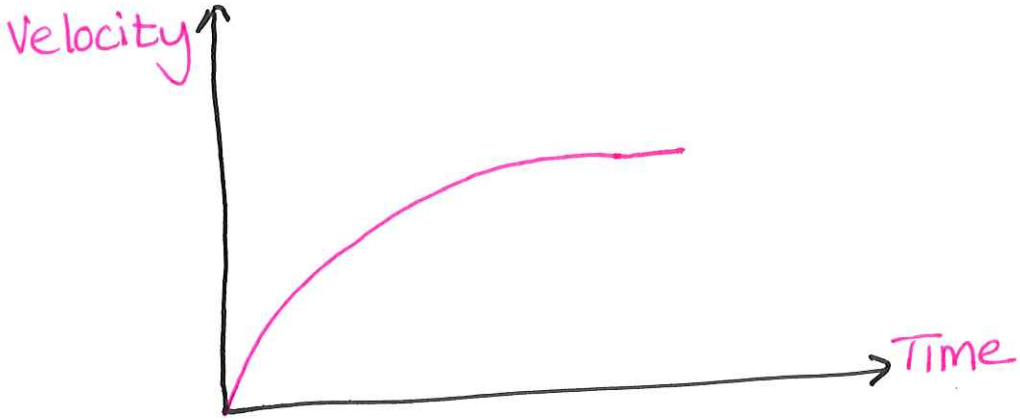
Year 1
Applied

Chapter 11 - VARIABLE ACCELERATION

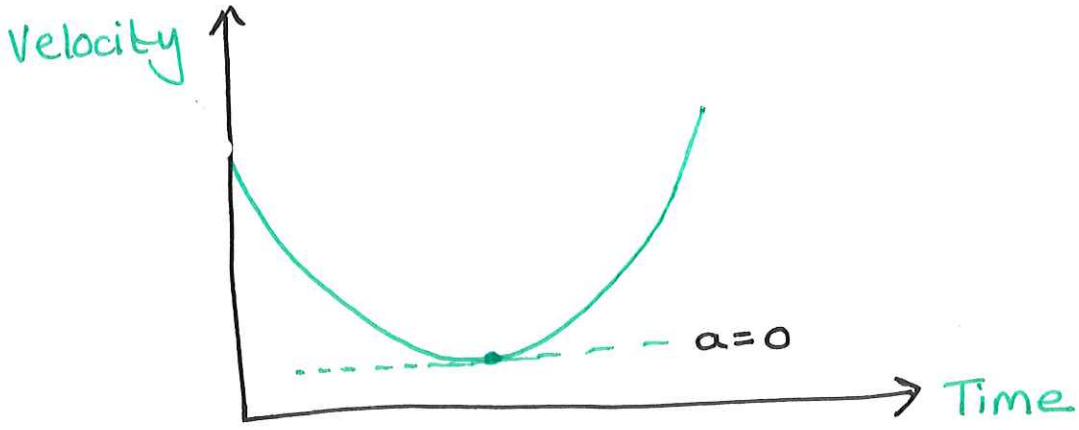
INCREASING ACCELERATION



DECREASING ACCELERATION



AT A TURNING POINT ACCELERATION IS ZERO



A particle moves in a straight line and its velocity is given by

$$V = 2t^2 - 16t + 24 \quad \text{for } t \geq 0$$

initial velocity is when $t = 0$

$$V = 2(0)^2 - 16(0) + 24$$

$$V = 24$$

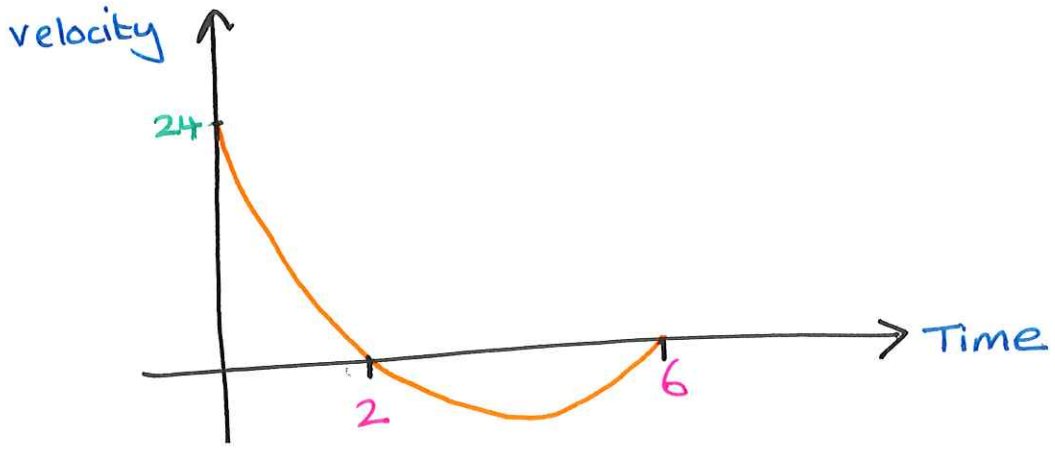
find t when the particle is a rest ($v = 0$)

$$0 = 2t^2 - 16t + 24$$

$$0 = (t - 6)(t - 2)$$

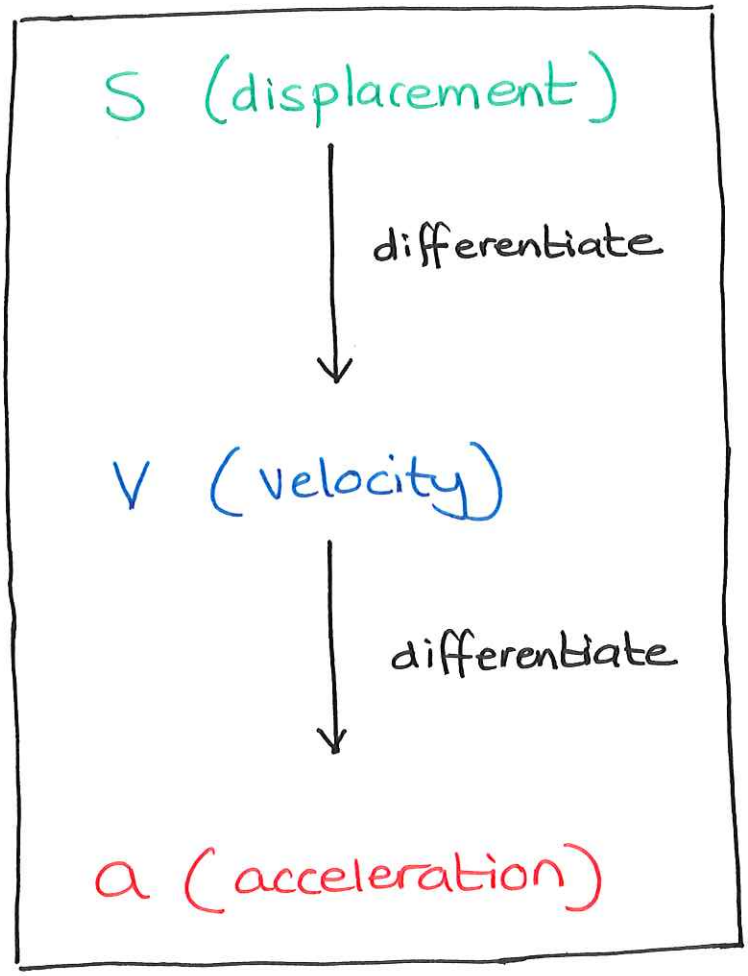
$$t = 2 \text{ and } t = 6$$

what is the greatest speed between $0 \leq t \leq 6$



greatest speed is $24 ms^{-1}$

If VARIABLE ACCELERATION (DONT USE SUVAT!!!)



$$s = t^4 - 32t + 12$$

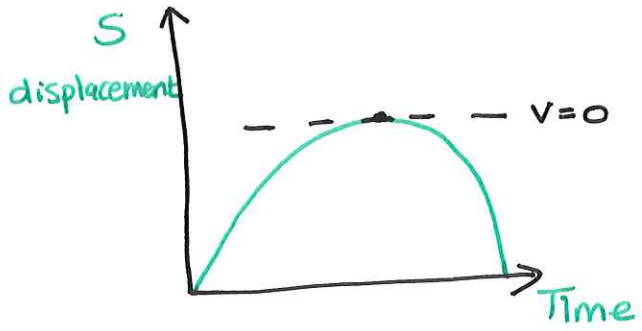
$$\downarrow$$

$$v = 4t^3 - 32$$

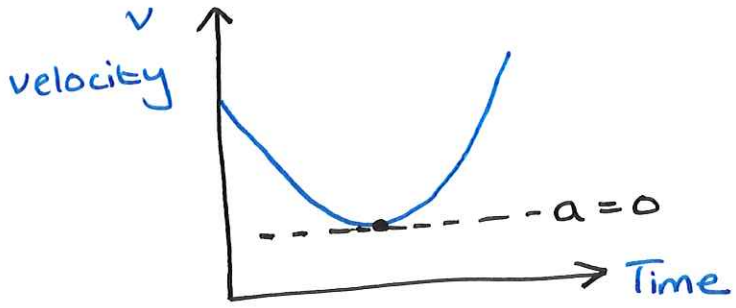
$$\downarrow$$

$$a = 12t^2$$

- MAXIMUM AND MINIMUM



S
↓ differentiate
$\frac{ds}{dt} = v = 0$



V
↓ differentiate
$\frac{dv}{dt} = a = 0$

Example

$$s = 0.6t + 0.4t^2 - 0.2t^3 \quad \text{for } 0 \leq t \leq 3$$

Find the maximum distance

$$\frac{ds}{dt} = 0.6 + 0.8t - 0.6t^2$$

for max distance $\frac{ds}{dt} = 0$

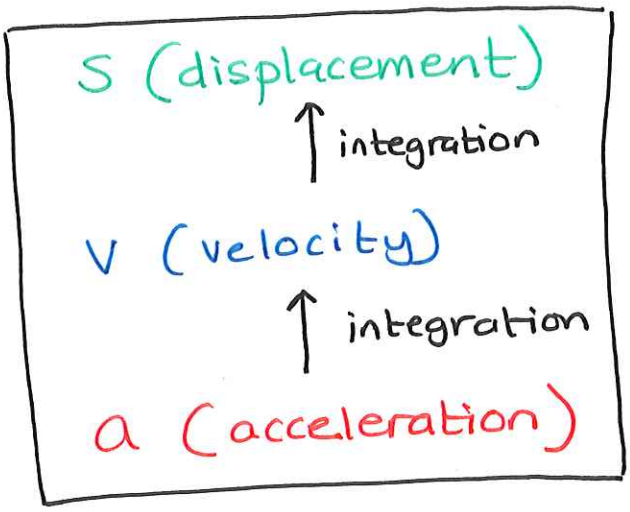
$$0 = 0.6 + 0.8t - 0.2t^2$$

using quadratic formula → $t = 1.8685$ or -0.5351

$$s = 0.6(1.8685) + 0.4(1.8685) - 0.2(1.8685)^3$$

$$s = 1.21 \quad (3.sf)$$

If VARIABLE ACCELERATION (DONT USE SUVAT!!!)



$$s = \frac{4t^3}{3} - \frac{t^4}{6} + 3$$

when $t = 0$ $s = 3$ $\therefore c = 3$

$$s = \frac{4t^3}{3} - \frac{2t^4}{12} + c$$

} displacement

$$v = 4t^2 - \frac{2t^3}{3}$$

when $= 0$ $= 0$ $\therefore c = 0$

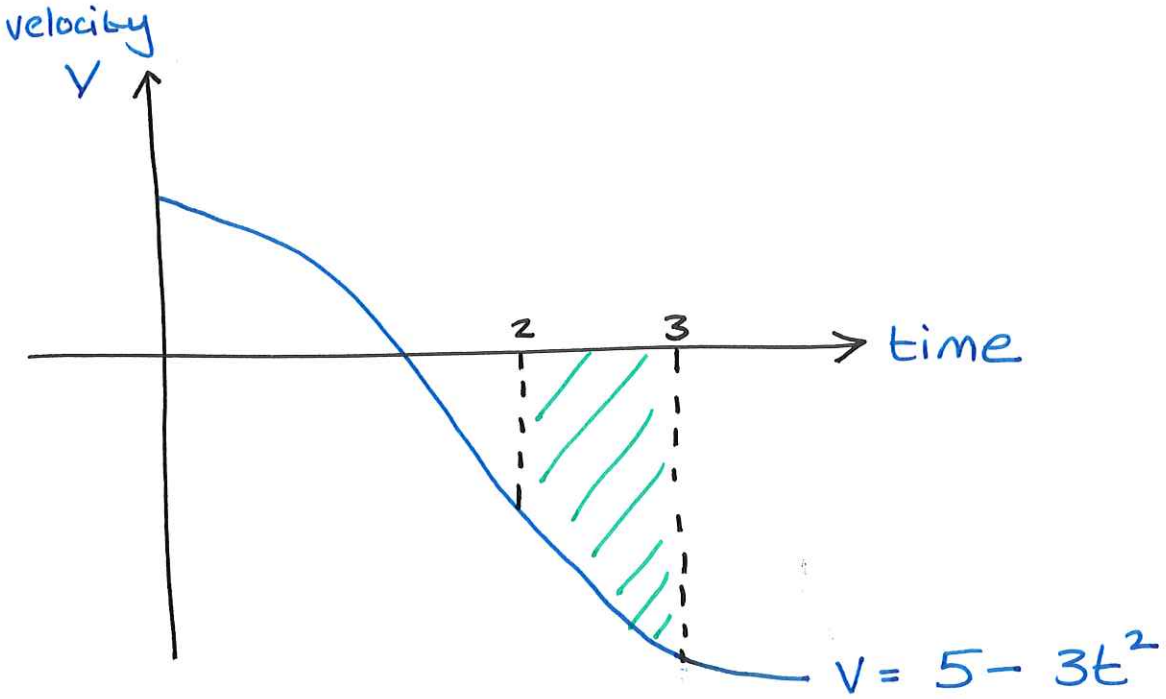
$$v = 4t^2 - \frac{2t^3}{3} + c$$

} velocity

$$a = 8t - 2t^2$$

} acceleration

AREA UNDER A VELOCITY GRAPH = DISTANCE TRAVELLED



$$S = \int_2^3 5 - 3t^2$$

$$S = \left[5t - t^3\right]_2^3$$

$$= [-12] - [2]$$

$$= -14$$

∴ Distance travelled is 14 metres

CONSTANT ACCELERATION FORMULAE

A particle is moving with constant acceleration $5ms^{-2}$.

When $t=0$ $V=12$ and $S=7$

Find a formula for displacement

$$a = 5$$

$\downarrow$ integrate

$$V = 5t + C$$

when $t=0$ $V=12$ $\therefore C=12$

$$V = 5t + 12$$

$\downarrow$ integrate

$$S = \frac{5t^2}{2} + 12t + C$$

when $t=0$ $s=7$ $\therefore C=7$

$$S = \frac{5t^2}{2} + 12t + 7$$