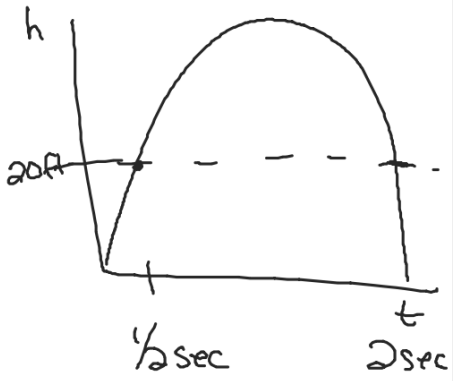
2. $s(t) = -16t^2 + 40t + 4 \quad , t \geq 0$



c) $20 = -16t^2 + 40t + 4$

$5 = -4t^2 + 10t + 1$

$0 = -4t^2 + 10t - 4$

$0 = (2t - 1)(2t - 4)(-4)$

$2t = 1 \qquad 2t = 4$

$t = \frac{1}{2}s \qquad t = 2\,sec$

3) $s(t) = \frac{t}{e^t}$ Sin m an tins

(a) $v(t) = \frac{1-t}{e^t}$

$s(t) = t \cdot e^{-t}$

$s'(t) = t \cdot e^{-t}(-1) + e^{-t}(1)$

$= -te^{-t} + e^{-t}$

$= e^{-t}(-t+1)$

$= \frac{-t+1}{e^t}$

$= \frac{1-t}{et}$

$$s'(t) = \frac{e^t(1) - t(e^t)}{(e^t)^2} = \frac{e^t(1-t)}{e^{2t}} = \frac{1-t}{e^t}$$

(b) $v(t) = s'(t)$

$$e^t \cdot 0 = \frac{1-t}{e^t} \cdot e^t$$

$$0 = 1 - t$$

$$t = 1 \text{ sec}$$

acceleration function: the gradient of velocity

$$a(t) = \lim_{h \to 0} \frac{v(t+h) - v(t)}{h} = v'(t) = s''(t)$$

Note:
- gas: $a(t) > 0$ velocity is increasing
- breaks: $a(t) < 0$ velocity is decreasing
- cruise: $a(t) = 0$ velocity is constant

Ex) for $s(t) = 2t^3 - 21t^2 + 60t + 3$, $t \geq 0$

$$v(t) = s'(t) = 6t^2 - 42t + 60, \quad t \geq 0$$

a) Find the average acceleration from $t=1$ to $t=4$

slope of secant line going thru 2 points

code for - AROC

(1, 24) and (4, -12) points

$$\frac{\Delta v}{\Delta t} = \frac{v_2 - v_1}{t_2 - t_1} = \frac{24 - (-12)}{1 - 4} = -12 \text{ m s}^{-2}$$

$v(t) = 6t^2 - 42t + 60$

b) Find the 'instantaneous acceleration at $t = 3$ sec and Explain what it means

code for - slope of tangent line at $t = 3$

$$a(t) = v'(t) = s''(t) = 12t - 42, \quad t \geq 0$$

$$a(3) = 12(3) - 42$$

$$= 36 - 42 = -6 \text{ m s}^{-2}$$

This means that the velocity is decreasing 6 meters per second each second at time $t = 3$ seconds.

* <u>speed</u> is the absolute value of velocity

why it's true:

$v(t) > 0$ particle $\longrightarrow$

$v(t) < 0$ particle $\longleftarrow$

* <u>velocity</u> - tells us both the speed <u>and</u> the direction of particle

* when velocity and acceleration have the same sign, the object is speeding up

* when velocity and acceleration have different signs, the particle is slowing down.

Ex $s(t) = 2t^3 - 21t^2 + 60t + 3$

$v(t) = 6t^2 - 42t + 60$

$a(t) = 12t - 42$

(a) Find the speed of the particle at $t = 3$ sec and determine whether the particle is speeding up or slowing down.

$v(3) = 6(3)^2 - 42(3) + 60$

$= 6(9) - 42(3) + 60 = -12 \text{ ms}^{-1}$

speed $|-12| = 12 \text{ ms}^{-1}$

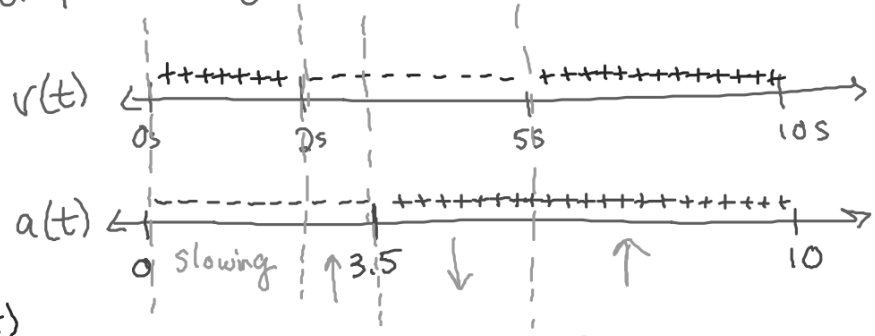
$a(3) = 12(3) - 42 = 36 - 42 = -6 \text{ ms}^{-2}$

Since $a(3) < 0$ and $v(3) < 0$

Speeding up

(b) During $0 \le t \le 10$s, find the intervals where the particle is speeding up and when it's slowing down.

Compare sign charts of velocity + acceleration



1st find where $v(t) = 0$

find where $a(t) = 0$

$0 = 12t - 42$

$42 = 12t$

$3.5 = t$

$v(t)$

$v(1) = 6(1) - 42(1) + 60 = 24$ (+)

$v(3) = (-)$

$v(6) = (+)$

HW 7P

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Speeding up

$(2, 3.5]$ and $(5, 10)$

Since $v(t)$ and $a(t)$ have same sign