Bellwork: Find all relative
extrema and points of inflection:

$$s(t) = t^2 - 2t - 3$$

$s'(t) = 2t - 2 \longrightarrow v(t)$ velocity

$2t - 2 = 0$

$t = 1$

$\xleftarrow{\qquad \underset{\qquad}{-} \quad \Big|_{1} \quad \overset{+}{\qquad}}\rightarrow$

$s(t)$ has a relative minimum
@ $t = 1$ because $s'(t)$ goes from negative
to positive @ $t = 1$.
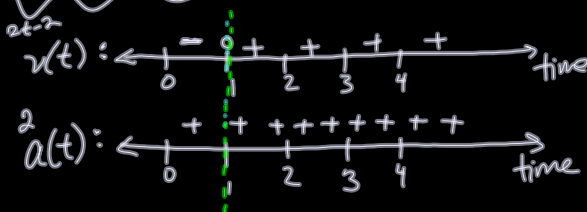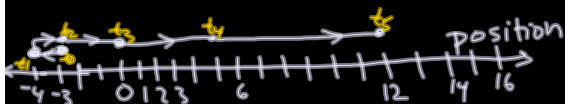
$s''(t) = 2 \longrightarrow a(t) \rightarrow$ acceleration

$s''(t)$ is a positive constant ∴ $s(t)$ is

always concave up.

$$s(t) = t^2 - 2t - 3$$

Position function.

Determine location of particle for
given times:

t	0	1	2	3	4	5
s(t)	-3	-4	-3	0	5	12

position

-4 -3 0 1 2 3 6 12 14 16

$2t-2$

$v(t): \xleftarrow{\quad \Big|_0 \; \overset{-}{} \; \overset{+}{\Big|_2} \; \overset{+}{\Big|_3} \; \overset{+}{\Big|_4} \; \overset{+}{}}\rightarrow$ time

2

$a(t): \xleftarrow{\quad \overset{+}{\Big|_0} \; \overset{+}{} \; \overset{+\,+\,+\,+\,+\,+\,+}{\Big|_2 \; \Big|_3 \; \Big|_4}}\rightarrow$ time

$0 < t < 1$, $v(t) < 0$ ¿ $a(t) > 0$
The particle is slowing down.

$t > 1$, $v(t) > 0$ ¿ $a(t) > 0$

The particle is speeding up bc
velocity ¿ acceleration are the same

sign.

Example 3) A particle is moving along a horizontal line with position function $s(t) = t^3 - 9t^2 + 24t + 4$. Do an analysis of the particle's direction, acceleration, motion (speeding up or slowing down), and position.

$$s'(t) = v(t) = 3t^2 - 18t + 24$$

$$v(t) = 0$$
$$3t^2 - 18t + 24 = 0$$
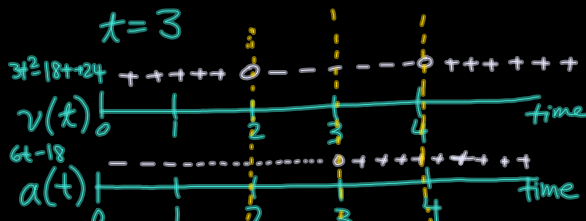$$t^2 - 6t + 8 = 0$$
$$(t-4)(t-2) = 0$$
$$t = 2, \quad t = 4$$

$$s''(t) = v'(t) = a(t)$$
$$a(t) = 6t - 18$$

$$6t - 18 = 0$$
$$t = 3$$

$3t^2 - 18t + 24$ $+ + + + +$ 0 $- - -$ $- - -$ 0 $+ + + + + +$

$v(t)$ | time

$6t - 18$ $- - - - - - - - - \cdots \cdots$ 0 $+ + + + + + + + +$

$a(t)$ | time

$v(t) > 0$
$(0,2) \cup (4, \infty)$ } particle moving to right

$v(t) < 0$ } particle moving to left
$(2,4)$

From $t = 0$ to $t = 2$, the particle is moving to right $(v(t) > 0)$ and slowing down (velocity & acceleration have different signs.)

From $t = 2$ to $t = 3$, the particle is moving left $(v(t) < 0)$ & speeding up (v & a have same signs)

From $t = 3$ to $t = 4$, the particle is moving left $(v < 0)$ & slowing down (v & a diff. signs.)

From $t = 4$ to ∞, particle is moving Right $(v > 0)$ & speeding up (v & a have same sign.)

position graph
$$s(t) = t^3 - 9t^2 + 24t + 4$$

t	0	1	2	3	4	5	6
$s(t)$	4	20	24	22	20	24	

$s(t)$

0 4 8 12 16 20 24 28