EXAMPLE 1: A particle moves according to the equation of motion $s(t) = 4t^3 - 9t^2 + 6t + 2$, where $s(t)$ is measured in meters and t in seconds.

(a) Find the velocity at time t.

$$v(t) = 12t^2 - 18t + 6$$

(b) When is the particle at rest?

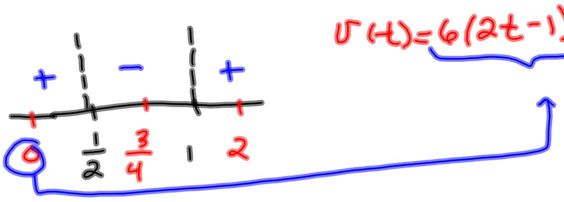
at rest when $v(t) = 0$

$$12t^2 - 18t + 6 = 0$$
$$6(2t^2 - 3t + 1) = 0$$
$$6(2t-1)(t-1) = 0$$
$$\boxed{t = \tfrac{1}{2},\ t = 1 \text{ seconds}}$$

(c) When is the particle moving in the positive direction?

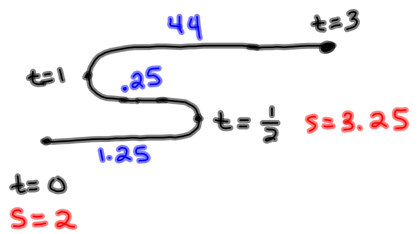
solve $v(t) > 0$

$$v(t) = 6\underbrace{(2t-1)(t-1)}$$



$$\boxed{\begin{array}{l} [0, \tfrac{1}{2}) \cup (1, \infty) \\ 0 \le t < \tfrac{1}{2},\ t > 1 \end{array}}$$

(d) Draw a diagram that represents the motion of the particle.



$s(t) = 4t^3 - 9t^2 + 6t + 2$

$s(0) = 2$

$s(\frac{1}{2}) = 3.25$

$s(1) = 3$

$s(3) = 47$

(e) Find the distance traveled in the first 3 seconds.

$$1.25 + .25 + 44$$

$$\boxed{45.5 \text{ m}}$$

EXAMPLE 2: A ball is thrown vertically upward with a velocity of 80 feet per second. The height after t seconds is given by $h(t) = 80t - 16t^2$. What is the maximum height of the ball?

max height: $v(t) = 0$

$80 - 32t = 0$

$32t = 80$

$t = 2.5$ seconds

$h(2.5) = 80(2.5) - 16(2.5)^2$

$= \boxed{100 \text{ feet}}$