

motion in a line

displacement (distance vs time) s in m
 t in sec

Ex) $s(t) = -4.9t^2 + 4.9t + 10$

* initial position occurs at $t = 0$ sec

velocity $v(t) = s'(t) = \lim_{h \rightarrow 0} \frac{s(t+h) - s(t)}{h}$
speed vs time

* velocity is the rate of change or instantaneous speed on a distance vs time graph.

Ex) A particle moves in a straight line, $s(t) = 2t^3 - 21t^2 + 60t + 3$, $t \geq 0$

(a) Find velocity at any time t

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

(b) Find initial position and initial velocity

↓

$$\begin{aligned} \text{position} &= s(0) = 2(0)^3 - 21(0)^2 + 60(0) + 3 = 3 \text{ m} \\ \text{velocity} &= v(0) = s'(0) = 60 \text{ ms}^{-1} \end{aligned}$$

(c) Find when the particle is at rest

$$6t^2 - 42t + 60 = 0$$

$$6(t^2 - 7t + 10) = 0$$

$$6(t - 5)(t - 2) = 0$$

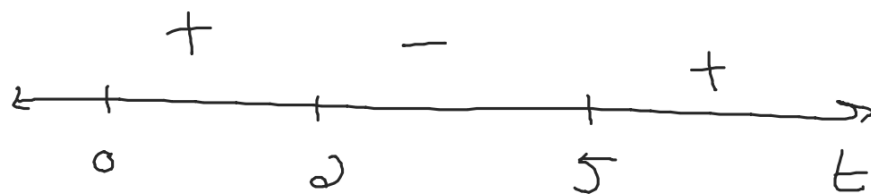
$$t - 5 = 0$$

$$t = 5 \text{ sec}$$

$$t - 2 = 0$$

$$t = 2 \text{ sec.}$$

(d) Find when the particle is moving right or left and draw a sign diagram
 ↓
 velocity is positive velocity is negative



$$(0, 2)$$

$$v(1) = 6(1-2)(1-5) = (6)(-1)(-4) = 24$$

$$= (+)(-)(-) = (+) \rightarrow$$

$$(2, 5)$$

$$v(3) = 6(3-2)(3-5) = 6(1)(-2) = -12$$

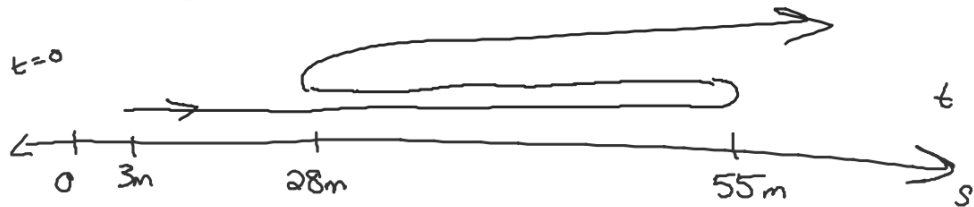
$$= (+)(+)(-) = -$$

$$(5, \infty)$$

$$v(6) = 6(6-2)(6-5) = (+)(+)(+) = +$$

c) Draw a motion diagram

find the displacement when the particle changes direction



$$s(2) = 2(2)^3 - 21(2)^2 + 60(2) + 3 = 55 \text{ m}$$

$$s(5) = 2(5)^3 - 21(5)^2 + 60(5) + 3 = 28 \text{ m}$$

HW 70
p. 225 #1-3

