Ch 17A.2

Velocity – Has magnitude and direction (vector)

Speed- measures how fast you are moving (no direction) (scalar)

Given a point P with displacement $s(t)$, then:

- If $v(t) > 0$ and $a(t) > 0$ then the speed is increasing
- If $v(t) < 0$ and $a(t) < 0$ then the speed is increasing
- If $v(t) > 0$ and $a(t) < 0$ then the speed is decreasing
- If $v(t) < 0$ and $a(t) > 0$ then the speed is decreasing

→ Signs are the same - speed is increasing
→ Signs are different - speed is decreasing

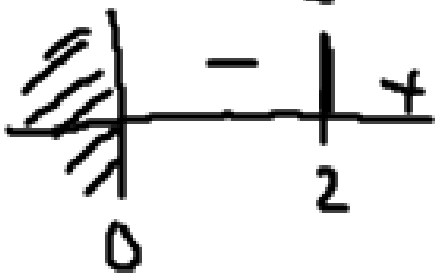
1 An object moves in a straight line with position given by $s(t) = t^2 - 4t + 3$ cm from O, where t is in seconds, $t \geqslant 0$.

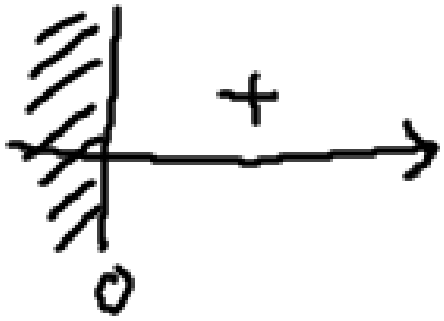
- a Find expressions for the object's velocity and acceleration, and draw sign diagrams for each function.
- b Find the initial conditions and explain what is happening to the object at that instant.
- c Describe the motion of the object at time $t = 2$ seconds.
- d At what time does the object reverse direction? Find the position of the object at this instant.
- e Draw a motion diagram for the object.
- f For what time intervals is the speed of the object decreasing?

A) $v(t) = s'(t) = 2t - 4$ $\quad a(t) = v'(t) = 2$

$0 = 2t - 4$

$t = 2$ sec





B) $t = 0$

$s(0) = 3$ cm

$v(0) = -4$ cm/sec

$a(0) = 2$ cm/s^2

The object is 3cm to the right of the origin moving to the left and slowing down.

c Describe the motion of the object at time $t = 2$ seconds.

d At what time does the object reverse direction? Find the position of the object at this instant.

e Draw a motion diagram for the object.

f For what time intervals is the speed of the object decreasing?

c)

$s(2) = -1\,cm$

$v(2) = 0\,cm/s$

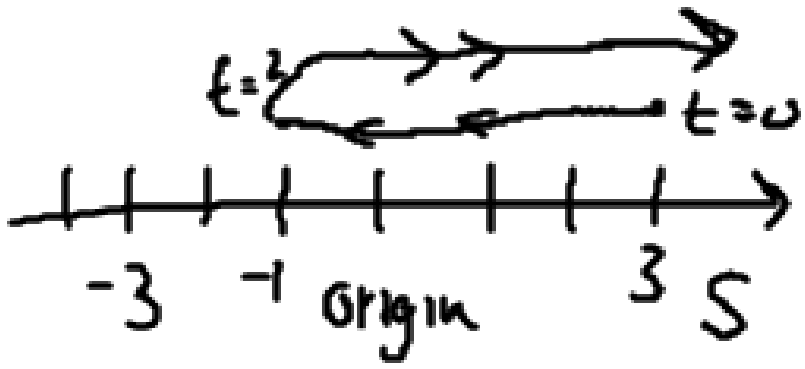
$a(2) = 2\,cm/s^2$

The object is to the left of the origin, instantaneously stationary (turning around), accelerating to the right

d) the object reverses direction when $v(t) = 0$, at $t = 2$

the object is 1cm to the left of the origin

e)



f) decreasing when $v(t) < 0$

$t \in (0, 2)$

Ch 17 B – Rates of Change

There are many examples in the real world where quantities vary with respect to time or other quantities.

- Displacement
- Temperature
- Height
- Prices

All means the slope of the tangent line for some function $f(x)$

Example: pg 424

1 The estimated future profits of a small business are given by $P(t) = 2t^2 - 12t + 118$ thousand dollars, where t is the time in years from now.

a What is the current annual profit? **b** Find $\frac{dP}{dt}$ and state its units.

c Explain the significance of $\frac{dP}{dt}$.

d For what values of t will the profit:

i decrease **ii** increase on the previous year?

e What is the minimum profit and when does it occur?

f Find $\frac{dP}{dt}$ when $t = 4$, 10 and 25. What do these figures represent?

A) Profit when $t=0$

$P(0) = 118$ thousand

$= \$118000$

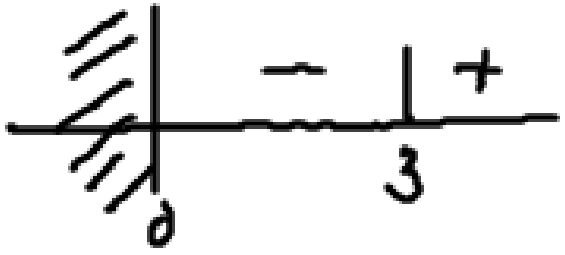
B) $\frac{dP}{dt} = 4t - 12$

units $\$/y$

c) $\frac{dP}{dt}$ is the rate of change of the profit with respect to time

d) $\frac{dP}{dt} = 0$ $\quad 0 = 4t - 12$

$t = 3$



dec in profit

$t \leq 3$

inc. in profit

$t \geq 3$

e What is the minimum profit and when does it occur?

f Find $\frac{dP}{dt}$ when $t = 4$, 10 and 25. What do these figures represent?

e) the min. profit occurs at $t = 3$

$P(3) = 2(3)^2 - 12(3) + 118$

$= 18 - 36 + 118$

$= 100$

min profit is \$100,000

f) $\frac{dP}{dt} = 4t - 12$

$t = 4$

$\frac{dP}{dt} = 4$ → increasing \$4000/yr after 4 yrs

$t = 10$

$\frac{dP}{dt} = 28$

→ increasing \$28000/yr after 10 yrs

$t = 25$

$\frac{dP}{dt} = 88$

→ increasing \$88000/yr after 25 yrs.

Hw: ch 17A.2

#6, 7, 8

ch 17B

#2, 3, 4, 5