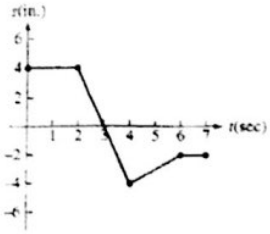
DATE

NAME

3.4 Concepts Worksheet

Velocity, Speed, and Acceleration

1. The graph shows the position $s(t)$ of a particle moving along a horizontal coordinate axis.



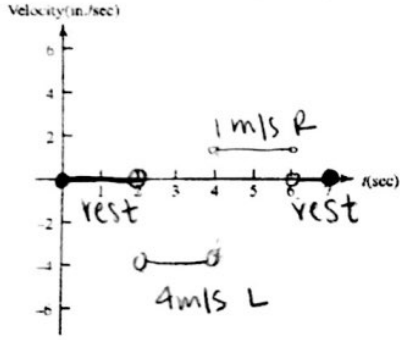
(a) When is the particle moving to the left? (2, 4)

(b) When is the particle moving to the right? (4, 6)

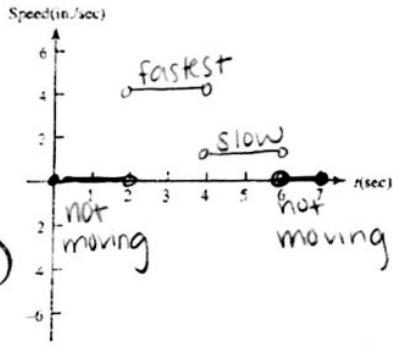
(c) When is the particle standing still? [0, 2] ∪ [6, 7]

(d) Graph the particle's velocity and speed (where defined).

derivative of position... aka slope!



absolute value of velocity (everything +)



(e) When is the particle moving fastest? t (2, 4) seconds

particle changes direction when the slope changes sign!

slope = derivative

derivative of pos = vel

notice we can see where it changes direction by looking at velocity, too.

t = 4 sec

vel. switches signs here

that's our clue!

velocity tells you how fast you're moving

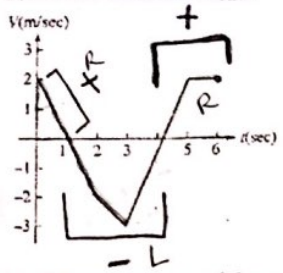
acceleration tells you ~~how quickly~~ your speed increases or decreases... do you go from a walk to a sprint? or a walk to a jog to a sprint?

3.4 Concepts Worksheet

NAME

Continued

2. The graph shows the velocity $v = f(t)$ of a particle moving along a horizontal coordinate axis.

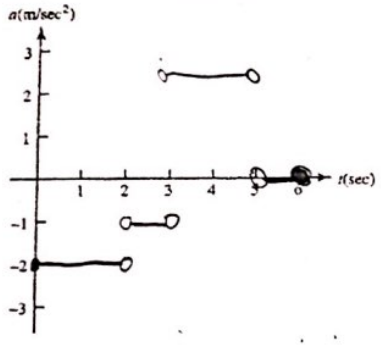


(a) When does the particle reverse direction? t = 1, 4.1 sec. → must be at rest to change directions

(b) When is the particle moving at a constant speed? (5, 6) sec.

(c) When is the particle moving at its greatest speed? t = 3 sec.

(d) Graph the acceleration (where defined).



* constant speed is different than avg speed

* derivative of velocity... aka slope!

3. A particle moves along a vertical coordinate axis so that its position at any time $t \geq 0$ is given by the function $s(t) = \frac{1}{3}t^3 - 3t^2 + 8t - 4$, where s is measured in centimeters and t is measured in seconds.

(a) Find the displacement during the first 6 seconds.

[0, 6] seconds $s(b) - s(a)$

$s(6) - s(0) = 8 - (-4) = 12$

(b) Find the average velocity during the first 6 seconds.

change pos / change time $= \frac{s(b) - s(a)}{b - a} = \frac{12}{6} = 2$

(c) Find expressions for the velocity and acceleration at time t.

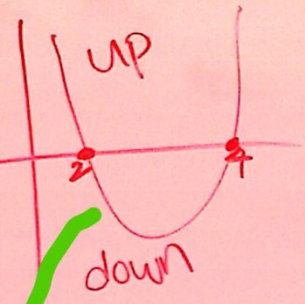
$v(t) = t^2 - 6t + 8$ $a(t) = 2t - 6$

(d) For what values of t is the particle moving downward? Graph!

(2, 4) seconds

* velocity is how pos changes... we just did that in part a! need over time now...

→ either pos. has − slope or vel. is neg. (below x-axis)



avg vel = $\frac{\Delta \text{pos}}{\Delta \text{time}}$

$\frac{s(b)-s(a)}{b-a}$

vel.

3. A particle moves along a vertical coordinate axis so that its position at any time $t \geq 0$ is given by the function $s(t) = \frac{1}{3}t^3 - 3t^2 + 8t - 4$, where s is measured in centimeters and t is measured in seconds.

change in pos.

(0, 6)

(a) Find the displacement during the first 6 seconds.

$s(b) - s(a)$

$s(6) - s(0) = 8 - -4 = 12$ cm

(b) Find the average velocity during the first 6 seconds.

$\frac{12}{6-0} = +2$ cm/s

(c) Find expressions for the velocity and acceleration at time t.

$v(t) = t^2 - 6t + 8$ $a(t) = 2t - 6$

(d) For what values of t is the particle moving downward?

(2, 4) sec

P

V

A

① use pos

analyze slope

m = —

OR

② use vel

look at graph

where it's <u>below</u> x-axis

e) Find total dist. traveled from 0 to 6 sec.

POS

start $s(0) = -4$

$\left|\frac{8}{3} - -4\right| = \frac{20}{3}$

changing directions

$s(2) = \frac{8}{3}$

$\left|\frac{4}{3} - \frac{8}{3}\right| = \frac{4}{3}$

$s(4) = \frac{4}{3}$

$\left|8 - \frac{4}{3}\right| = \frac{20}{3}$

end $s(6) = 8$

$+$

$\frac{44}{3}$ cm