Key

Math 4

5-5 **Learn Check**

Name_____

Date_____

In this learning check you will be assessed on the following learning goals:
I can use derivatives to find the velocity and acceleration of a moving object and solve problems involving particle motion

1. A particle moves on the x-axis (in units) such that its position at time t (in seconds) is given by the function

$$s(t) = t^3 - 9t^2 + 15t, \quad 0 \le t \le 6$$

Domain

a. Determine the velocity & acceleration of the particle at time t.

$s'(t) = v(t) = 3t^2 - 18t + 15$

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

b. For what values of t is the particle at rest?

$v(t) = 0$

$0 = 3t^2 - 18t + 15$

$0 = 3(t^2 - 6t + 5)$

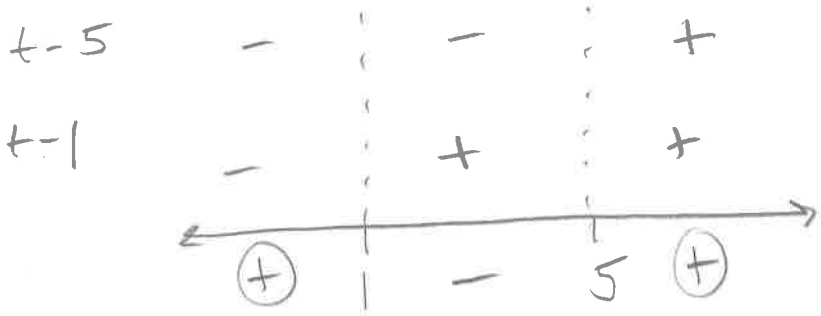
$= 3(t-5)(t-1)$

$t = 1$ second

$t = 5$ seconds

c. For what values of t is the particle moving to the right?

$v(t)$ is positive.



$0 \le t < 1$ + $5 < t \le 6$ or $[0,1) \cup (5,6]$

d. For what values of t is the particle moving to the left?

$v(t)$ is negative.

$1 < t < 5$ or $(1,5)$

OVER →

Plug in each "boundary" point from Parts c-d for t.

e. What is the total distance it has traveled after 6 seconds?

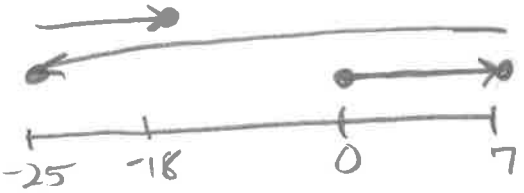
$s(0) = 0$ → started at 0

$s(1) = 1 - 9 + 15 = 7$ → moved right to 7

$s(5) = -25$ → moved left to -25

$s(6) = -18$ → moved right to -18

$7 + 32 + 7 =$ **46 units**



f. What is the velocity when the acceleration is zero? Explain what your answer means in context.

$0 = 6t - 18$

$t = 3$

$v(3) = -12$ units/s

The particle is moving backward at a constant velocity of -12 units/s at a time of 3 seconds.

(constant ↓ since $a = 0$)

g. What is the maximum distance from the starting point reached by the particle? Use calculus to explain.

Max distance is when $v(t) = 0$

$v(t) = 0$ when $t = 1$ & $t = 5$

$v(1) = 7$ & $v(5) = -25$

-25 is further from 0 (starting point) than 7.

25 units

2. The distance of an object from its starting point is measured (in feet) by the equation $f(t) = -\frac{1}{6}t^3 + 3t^2 - 4t$ for any time t seconds the interval $0 \le t \le 17$

2a. At $t = 13$, is the projectile moving up or down? Use calculus to explain how you know.

$f'(t) = v(t) = -\frac{1}{2}t^2 + 6t - 4$

$v(13) = -10.5$ ft/s

The projectile is moving down at $t = 13$ since its velocity is negative.

2b. At $t = 13$, is the projectile speeding up or slowing down? Use calculus to explain how you know.

$f''(t) = a(t) = -t + 6$

$a(13) = -7$ ft/s^2

The projectile is speeding up since it has a negative velocity & a negative acceleration.