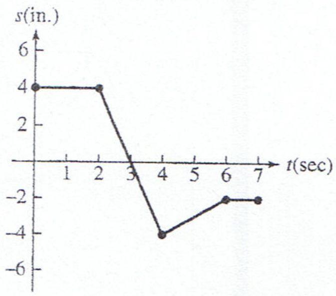
DATE

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.

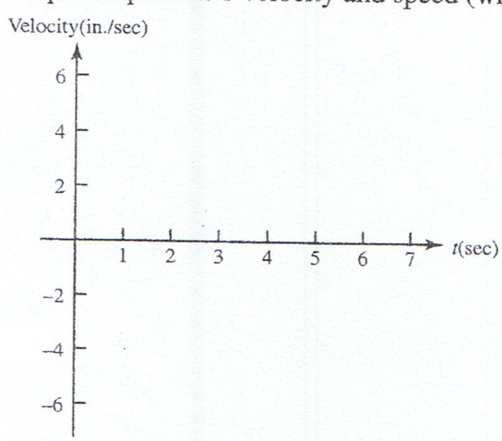


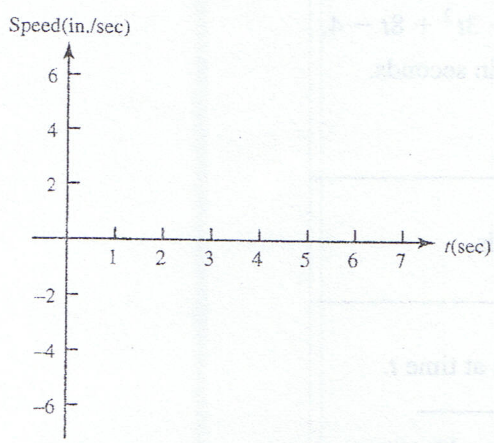
(a) When is the particle moving to the left? ____________

(b) When is the particle moving to the right? ____________

(c) When is the particle standing still? ____________

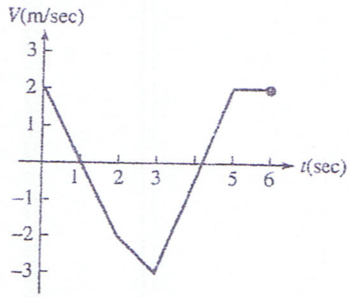
(d) Graph the particle's velocity and speed (where defined).





(e) When is the particle moving fastest? ____________

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

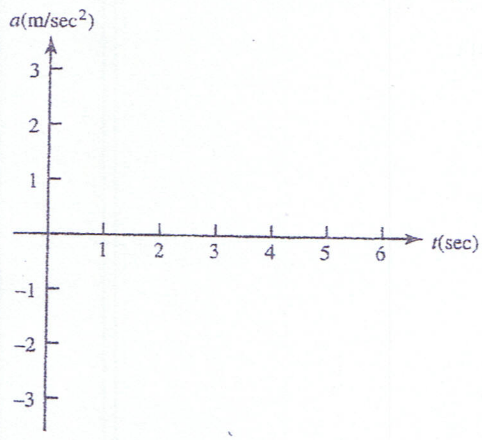


(a) When does the particle reverse direction? ______________

(b) When is the particle moving at a constant speed? ______________

(c) When is the particle moving at its greatest speed? ______________

(d) Graph the acceleration (where defined).



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.

____

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

____

(c) Find expressions for the velocity and acceleration at time t.
$v(t) =$ ______________ $a(t) =$ ______________

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

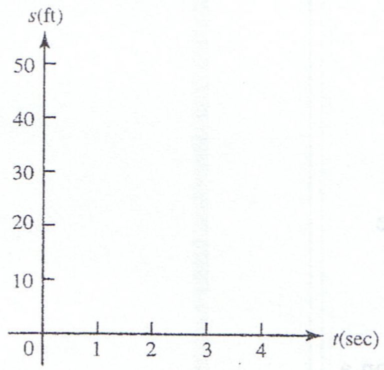
____

Continued

4. The values of the coordinate s of a moving body for various values of t are given below.

t(sec)	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0
s(ft)	40.0	35.0	30.2	36.0	48.2	45.0	38.2	16.0	0.2

(a) Plot s versus t, and sketch a smooth curve through the given points.



(b) Estimate the velocity at each of the following times.
At $t = 0.5$ sec, $v \approx$ ________.
At $t = 2.5$ sec, $v \approx$ ________.
At $t = 3$ sec, $v \approx$ ________.

(c) At what approximate values of t does the particle change direction?

____

(d) At what approximate value of t is the particle moving at the greatest speed?

____

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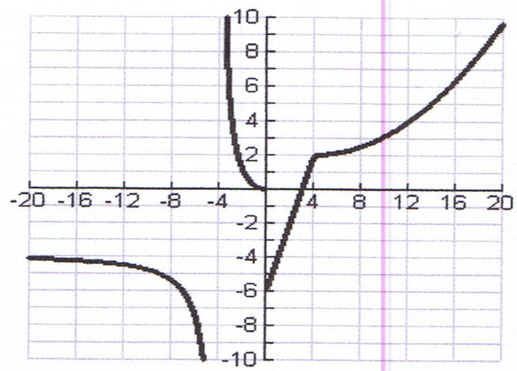
DERIVATIVE'S LAB

NONCALCULATOR PORTION

5. Find the equation of the tangent line to the curve whose equation is **y = 3cos(x)** where **x =** $\frac{\pi}{4}$.

6. Find the points on the function f(x) = $\frac{x+1}{x-1}$ where the tangent line is parallel to the line whose equation is 2x + y = 1.

7. Is f(x) differentiable at the following x values? **Explain** why or why not.



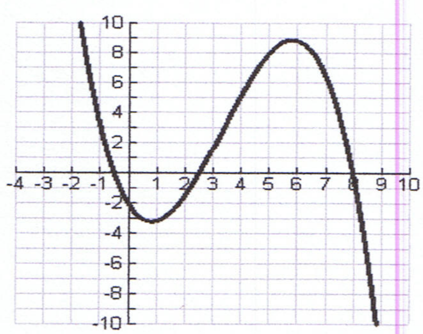
x = 0 ______, ____

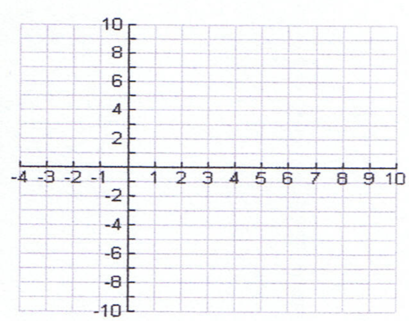
x = 4 ______, ____

x = 12 ______, ____

8. Use the ***Limit definition*** of the derivative to compute $f'(x)$ given $f(x) = \frac{2}{x}$.

9. Sketch the derivative of the function *y = f(x)* to the right.





10. At what point on the curve $y = [\ln(x+4)]^2$ is the tangent line horizontal? Vertical?

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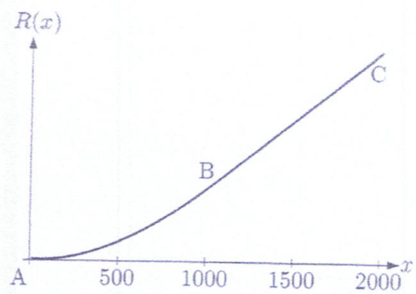
DERIVATIVE'S LAB

11. Find equation of the tangent to the curve $y = e^x$ that is parallel to the line $x - 4y = 1$

12. The height h (feet) at time t (seconds) of a ball dropped off a building is given by $h(t) = -16t^2 + 150$.

   a. Find the average velocity on the interval [1, 3]
   b. Find the instantaneous velocities when t = 1 and t = 3

13.



The figure above shows a road running in the shape of a parabola from the bottom of a hill at A to point B. At B it changes to a line and continues on to C. The equation of the road is

$$R(x) = \begin{cases} ax^2, & \text{from A to B} \\ bx + c, & \text{from B to C} \end{cases}$$

B is 1000 feet horizontally from A and 100 feet higher. Since the road is smooth, $R'(x)$ is continuous. What is the value of b?

(A) 0.2

(B) 0.02

(C) 0.002

(D) 0.0002

(E) 0.00002

14. Find the following derivatives.

a. $\frac{d^2}{dx}(2x^6 - 3x^4 + 10x^2 - 8)$

b. $\frac{d}{dx}\sqrt[3]{2x-2}$

c. $\frac{d^5}{dx}(\cos(2x))$

d. $\frac{d^3}{dx}e^{2x}$

e. $\frac{d}{dx}\left(\frac{\cos x}{1+\tan x}\right)$

f. $\frac{d}{dx}\sqrt{4\sin(x+2)}$

g. $\frac{d}{dx}\left(\frac{2}{e^{(2x^2+3x+1)}}\right)$

h. $\frac{d}{dx}(e^x(-x^3 + 3x))$