Rates of Change and Rectilinear Motion

Directions: Show all of your work on your OWN sheet of paper.

I.

1. The length of a rectangle is given by $2t+1$ and its height is $\sqrt{t}$, where *t* is time in seconds and the dimensions are in centimeters. Find the rate of change of the area with respect to time.

2. The radius of a right circular cylinder is given by $\sqrt{t+2}$ and its height is $\frac{1}{2}\sqrt{t}$, where *t* is time in seconds and the dimensions are in inches. Find the rate of change of the volume with respect to time.

3. The ordering and transportation cost *C* for the components used in manufacturing a product is given by $C = 100\left(\frac{200}{x^2} + \frac{x}{x+30}\right), \quad x \geq 1$ where *C* is measured in dollars and *x* is the order size in hundreds. Find the rate of change of *C* when *x*=10, x=15, x=20. What do these rates of change imply about the ordering size?

II.

a) Find the average rate of change of the function over the given interval.
b) Find the instantaneous rate of change at the endpoints of the interval
c) Find the speed at the endpoints of the interval.

4. $s(t) = \frac{-1}{t}$, [1, 2]

5. $s(t) = \sin(t)$, [0, $\frac{\pi}{6}$]

III.

A car is moving along I-75 according to the given position function, where s(t) is measured in meters, and t is measured in hours.

a. Find an expression for the velocity function.
b. Find the value of the velocity at the given time.
c. Find an expression for the acceleration function.
d. Find the value of the acceleration at the given time.

6. $s(t) = 5t^4 - 4t^2 + 3t - 2$, t=0

7. $s(t) = \frac{3}{5t} - 2$, t=2

IV.

A car is moving along I-595 according to the given position function, where s(t) is measured in miles, and t is measured in hours.

a. Determine the values of *t* when the car is moving to the right.
b. Determine the values of *t* when the car is moving to the left.

8. $s(t) = 2t^3 + 9t^2 - 60t - 7$

9. $s(t) = \frac{3t}{1+t^2}$

V.

A car is moving along the Sawgrass Expressway according to the given position function, where s(t) is measured in miles, and t is measured in hours.

a. Find the values of *t* for which the acceleration is zero.
b. Find the position of the car at this time.

10. $s(t) = \frac{t^4}{4} - \frac{t^3}{6} - t^2 + 1$

11. $s(t) = -3\sqrt{t} - \frac{1}{12\sqrt{t}}, \quad t > 0$

VI.

12. An ant moves along the X-axis so that at time *t* its position is given by $x(t) = 2\cos\left(\frac{\pi}{2}t^2\right)$, for values of *t* on the interval [-1,1].
    a. Find an expression for the velocity of the ant at any given time *t.*
    b. Find an expression for the acceleration at any given time *t.*
    c. Determine the average velocity of the ant over the given time interval.
    d. Determine the values of *t* for which the ant is moving to the right. Justify your answer.
    e. Determine the values of *t* for which the ant changes direction. Justify your answer.

13. A particle is moving along the X-axis so that its position for [0, 2] is given by $x(t) = \frac{3}{2}\pi t^2 - \sin\left(\frac{3}{2}\pi t^2\right)$.
    a. Find an expression for the velocity at any given time *t.*
    b. Find an expression for the acceleration at any given time *t.*
    c. Find the values for *t* for which the particle is at rest.
    d. Find the position of the particle at the time(s) found in part (c).

- Finish the AP problems we started in class.