Calculus AP/Dual Worksheet Rev 2017 **Name: _____**

§3.6A: Particle Motion Day 2 **Date: _____ Period _____**

Show all work on a separate sheet of paper. Unless stated, no calculators allowed.

1) A particle moves along a horizontal line so that its position at any time $t \geq 0$ is given by $s(t) = -t^3 + 7t^2 - 14t + 8$, where s is measured in meters and t in seconds.
   (a) Find the instantaneous velocity at any time t and when $t = 2$.
   (b) Find the acceleration of the particle at any time t and when $t = 2$.
   (c) When is the particle at rest? When is moving to the right? To the left? Justify your answer. (use calculator for this question)

2) The position of a particle at time t seconds, $t \geq 0$, is given by $s(t) = t^2 - \sin(t)$, $0 \leq t \leq 3$, where t is measured in seconds and s is measured in meters. Find the particle's acceleration each time the velocity is zero. (calc)

3) A particle's velocity at time t seconds, $t \geq 0$, is given by $v(t) = \cos(t^2) + t$, $0 \leq t \leq 2$, where t is measured in seconds and v is measured in meters/second. Find the velocity of the particle each time the acceleration is zero. (calc)

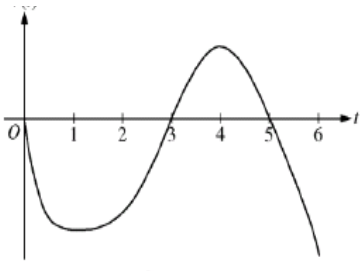
Calculator allowed.

4) A particle moves along the x–axis so that its velocity at time t, for $0 \leq t \leq 5$, is given by $v(t) = \ln(t^2 - 3t + 3)$.
   (a) Find the acceleration of the particle at time $t = 4$.
   (b) Find all times t in the open interval $0 < t < 5$ at which the particle changes direction. During which time intervals, for $0 \leq t \leq 5$, does the particle travel to the left? Justify your answer.
   (c) Find the average rate of change of $v(t)$ on $1.5 \leq t \leq 3.2$.

Calculator allowed.

5) A particle moves along the y–axis so that its velocity at time $t \geq 0$ is given by $v(t) = 1 - \tan^{-1}(e^t)$.
   (a) Find the acceleration of the particle at time $t = 2$.
   (b) Is the speed of the particle increasing or decreasing at time $t = 2$? Give a reason for your answer.
   (c) Find the time $t \geq 0$ at which the particle reaches its highest point. Justify your answer.

6) A particle moves along the x–axis so that its velocity at time t, for $0 \leq t \leq 6$, is given by a differentiable function v whose graph is shown above. The velocity is 0 at $t = 0$, $t = 3$, and $t = 5$, and the graph has horizontal tangents at $t = 1$ and $t = 4$.



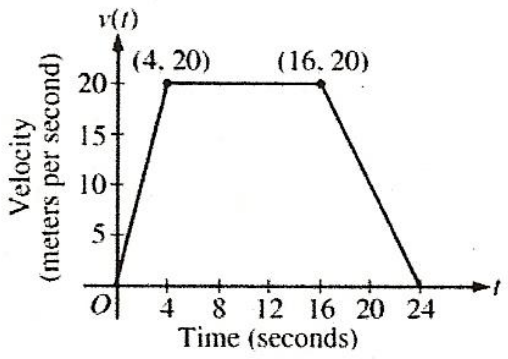
Graph of v

(a) On the interval $3 < t < 4$, is the speed of the particle increasing or decreasing? Give a reason for your answer.

(b) On the interval $2 < t < 3$, is the speed of the particle increasing or decreasing? Give a reason for your answer.

(c) During what intervals, if any, is the acceleration of the particle negative? Justify.

7) A car is traveling on a straight road. For $0 \le t \le 24$ seconds, the car's velocity $v(t)$, in meters per second, is modeled by the piecewise linear function defined by the graph on the right.



(a) For each of $v'(4)$ and $v'(20)$ find the value or explain why it does not exist. Indicate units of measure.

(b) Let $a(t)$ be the car's acceleration at time t, in meters per second per second. For $0 < t < 24$, write a piecewise–defined function for $a(t)$.

(c) Find the average rate of change of v over the interval $8 \le t \le 20$. Does the Mean Value Theorem guarantee a value of c, for $8 < c < 20$, such that $v'(c)$ is equal to this average rate of change? Why or why not?

8) The velocity of a particle moving along the x–axis is modeled by a differentiable function v, where the position x is measured in meters, and time t is measured in seconds. Selected values of $v(t)$ are given in the table below.

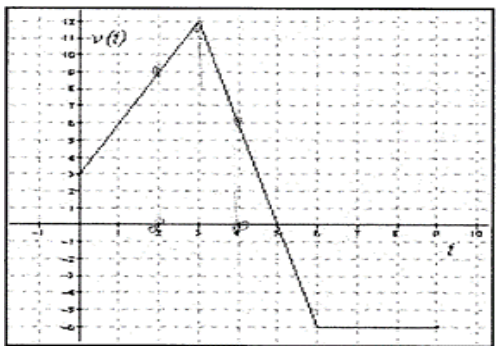
t (seconds)	0	8	20	25	32	40
$v(t)$ (meters/sec)	3	5	–10	–8	–4	7

(a) Use data from the table to estimate the acceleration of the particle at $t = 36$ seconds. Show the computations that lead to your answer. Indicate units of measure.

(b) For $0 \le t \le 40$, must the particle change direction in any of the subintervals indicated by the data in table? If so, identify the subintervals and explain your reasoning. If not, explain why not.

(c) Based on the values in the table, what is the smallest number of instances at which the velocity $v(t)$ could equal $-9\ \frac{m}{sec}$ on the interval $0 < t < 40$? Justify your answer.

9) The graph below represents the velocity v, in feet per second, of a particle moving along the x-axis over the time interval from $t = 0$ to $t = 9$ seconds.



(a) If $t = 4$, is the particle moving to the right or left? Explain.
(b) Over what time interval is the particle moving to the left? Explain.
(c) At $t = 4$ seconds, is the acceleration of the particle positive or negative? Explain.
(d) Is there guaranteed to be a time t in the interval, [2,4] such that $v'(t) = -\frac{3}{2}\frac{\text{ft}}{sec^2}$? Justify answer.