AP Calculus AB Name _____

Intro to Rectilinear Motion

1. The position of a skateboarder at any time t (in seconds) is given by the function $s(t) = 2t^3 - 9t^2 + 12t + 1$ measured in feet for $t \geq 0$.

a) What are the velocity and acceleration functions in terms of t?
b) When is the skateboarder at rest?
c) On what time interval(s) is the skateboarder moving to the right? Justify your answer.
d) What is the position of the skateboarder the first time she is at rest?
e) What is the velocity and speed at t = 1.5 sec?
f) Find the displacement in the first 3 seconds.
g) What is the average rate of change of the skateboarder on the interval [1, 2]

2. The table shows the position s(t) of a particle that moves along a straight line at several times t, where t is measured in seconds and s is measured in meters.

t	2.0	2.7	3.2	3.8
$s(t)$	5.2	7.8	10.6	12.2

a) Estimate the velocity of the particle at t = 3. Include units of measure.
b) What is the average velocity on the interval [2, 3.2]? Include units of measure.

3. The number of gallons of water in a swimming pool t minutes after it has started to drain is $f(t) = 20(40 - t)^2$

a) What is the instantaneous rate of change of the water in the pool at t = 0 and t = 10 minutes?
b) What is the average rate of change of water in the pool during the first 10 minutes?

4. Use the position function $s(t) = -16t^2 + v_o t + s_o$, where v_o is the initial velocity and s_o is the initial height.

A person is standing on top of a building that is 80 feet high. This person throws a rock vertically upward with an initial velocity of 64 feet per second.

a) What are the functions for position, velocity, and acceleration of the rock?
b) When does the rock hit the ground?
c) What is its velocity at impact?
d) When is the velocity zero?

5. For $0 \leq t \leq 8$, a particle moves along the x-axis. The velocity of the particle at time t is given by $v(t) = -(t-3)^2(t-6)$.

a) At what time(s) does the particle change direction? Justify your answer.
b) On what interval(s) is the particle moving to the right? Justify your answer.
c) Find $v(2)$ and $a(2)$.

Answers

1a $s'(t) = v(t) = 6t^2 - 18t + 12$; $s''(t) = a(t) = 12t - 18$
1b $t = 1, 2$ sec
1c $(0,1) \cup (2,\infty)$ because $v(t) > 0$ on these intervals
1d $s(1) = 6$ feet
1e velocity: -1.5 ft/sec; speed: 1.5 ft/sec
1f displacement: 9 feet
1g -1 ft/sec

2a 5.6 m/sec
2b 4.5 m/sec

3a -1600 gal/min ; -1200 gal/min
3b -1400 gal/min

4a $s(t) = -16t^2 + 64t + 80$; $v(t) = -32t + 64$; $a(t) = -32$
4b 5 sec
4c -96 ft/sec
4d $t = 3$ sec

5a $t = 6$; since $v(6) = 0$ and $v(t)$ changes signs at $t = 6$
5b Particle is moving to the right (0, 6) since $v(t) \geq 0$ on this interval
5c $v(2) = 4$; $a(2) = -9$