Name: _____ Date: _____

AP CALCULUS BC
Worksheet 3.6
Position, velocity, acceleration

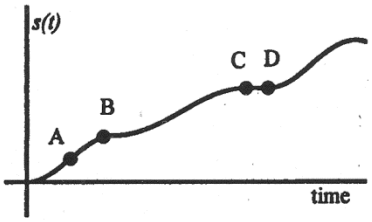
You may use a calculator for these questions. Show all of your work; use a separate piece of paper, if necessary.

1. The position, in meters, of a particle moving in a straight line is given by $x(t) = 4t^3 + 6t + 2.5$ (where t is measured in seconds).
   a. Find the velocity function.
   b. Find the velocity at time $t = 2$ seconds.
   c. Find the acceleration function.
   d. Find the acceleration at time 3 seconds.
   e. When is the velocity of the particle 18 meters per second?
   f. Find the velocity when the position of the particle is 25 meters.
   g. Find the initial position.
   h. Find the particle's displacement from 0 to 1.5 seconds.

2. A helium balloon rises so that its height (position) is given by $s(t) = t^2 + 3t + 5$ (where height is measured in feet and time is measured in seconds). Assume $t \geq 0$.
   a. When is the balloon 45 feet high?
   b. How fast is the balloon rising at time 1 second?
   c. How fast is the balloon rising at time 4 seconds?
   d. What is the balloon's velocity when it is 45 feet high?

3. A ball rolls on an inclined plane with position function $s(t) = 2t^3 + 3t^2 + 5$ (where position is measured in centimeters and time is measured in seconds).
   a. Find the ball's velocity at time 2 seconds.
   b. When is the velocity of the ball 30 centimeters per second?

4. The graph at the right shows the position function of a car. Answer these questions and explain each answer.
   a. What was the car's initial position?
   b. Was the car going faster at A or at B?
   c. Was the car speeding up or slowing down at B?
   d. What happened between C and D?

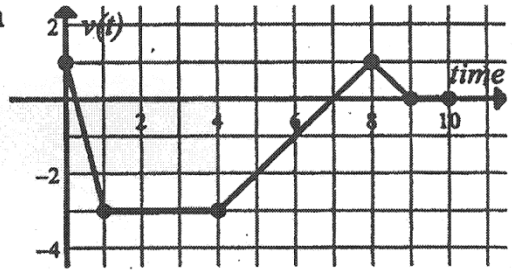


5. A particle moves along a horizontal line with position function $x(t) = t^3 - 3t^2$ (where position is measured in centimeters and time is measured in minutes).
   a. Find the particle's displacement between $t = 0$ minutes and $t = 5$ minutes.
   b. Find the particle's velocity when $t = 4$ minutes.
   c. Find the particle's acceleration when $t = 4$ minutes.
   d. At what time does the particle change direction?
   e. What is the total distance traveled by the particle between 0 and 5 minutes?

Average Velocity $= \dfrac{\text{displacement}}{\text{elapsed time}}$	**Average Speed** $= \dfrac{\text{total distance}}{\text{elapsed time}}$

   f. Find the particle's average velocity (average rate of change of position) between $t = 0$ and $t = 5$ minutes.
   g. Find the particle's average speed between $t = 0$ and $t = 5$ minutes.

6. The graph at the right shows the velocity function of a particle moving horizontally.
   a. When does the particle move left?
   b. When is the particle's acceleration positive?
   c. When is the speed greatest?
   d. When does the particle stop for more than an instant?



7. The position at time t seconds of a pebble dropped from an initial height of 600 feet is given by $s(t) = -16t^2 + 600$.
   a. At what time will the pebble hit the ground?
   b. What is the pebble's velocity when it hits the ground?
   c. What is the pebble's speed when it hits the ground?