

## Position, Velocity, Speed

p. 200 - 209 (3.3)

# 25

- 1. Position function:** the function  $s$  that gives the position (relative to the origin) of an object as a function of time  $t$ . Written as  $s(t)$  or  $x(t)$ .
- 2. Instantaneous velocity** tells how fast something is going at that exact instant and in which direction. ie. how the position is changing.

$$\frac{ds}{dt} = s'(t) = v(t) = \lim_{\Delta t \rightarrow 0} \frac{s(t + \Delta t) - s(t)}{\Delta t}$$

- 3. Speed** tells how fast an object is going no matter which direction; measures the rate at which the position changes.

$$\text{speed} = |\text{velocity}|$$

-----  
Do the following Free Response problem by hand and then with a calculator.

**1983 AB2:** A particle moves along the  $x$ -axis so that at time  $t$  its position is  $x(t) = t^3 - 6t^2 + 9t + 11$ .

- a) What is the velocity of the particle at  $t = 0$ ?

$$v(t) = x'(t) = 3t^2 - 12t + 9$$

$$v(0) = 9$$

- b) During what time intervals is the particle moving to the left?

$$3t^2 - 12t + 9 = 0$$

$$t^2 - 4t + 3 = 0$$

$$(t-3)(t-1)$$

$$t = 1$$

$$t = 3$$



The particle is moving left on  $(1, 3)$  since  $v(t) < 0$

- c) What is the total distance traveled by the particle from  $t = 0$

to  $t = 2$ ?  $x(0) = 11$

$$x(1) = 1 - 6 + 9 + 11 = 15$$

$$x(2) = 8 - 24 + 18 + 11 = 13$$

} moved 4

} moved 2

} total distance = 6