Derivatives as Rates of Change

In #1-6, the position s at time $t(t \geq 0)$ of a particle P is given, s being measured in meters and t in seconds.

a. Find the velocity v.

b. Find the acceleration a of P at time t.

c. When is P moving to the right and when to the left?

d. Find the positions and accelerations of P at the times when it is instantaneously at rest.

e. Indicate the motion of P in a diagram.

1. $s = 2 + 4t - t^2$

2. $s = t^2 - 6t + 5$

3. $s = 2t^3 - 9t^2 + 12t$

4. $s = 2 - 9t + 6t^2 - t^3$

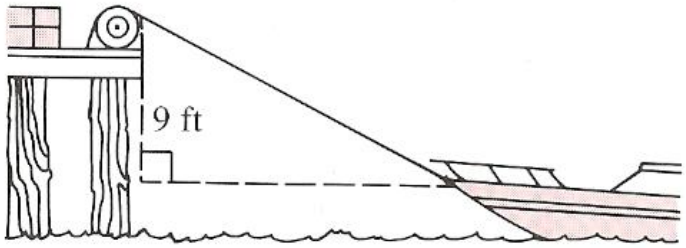
5. $s = (t-2)^2(t^2 - 4t + 2)$

6. $s = t^4 - 8t^3 + 18t^2 - 16t$

7. A rock dropped into still water sends out concentric ripples. If the radius of the out ripple increases at the rate of 2 ft/s, how fast is the area of the disturbed surface increasing when it is 6 ft in diameter?

8. Helium is being pumped into a spherical rubber balloon at the rate of 200 cubic inches per second. At what rate is the radius increasing when the balloon is 40 inches in diameter?

9. A boat is being pulled toward a dock by means of a cable attached to a windlass 9 feet above the deck of the boat. The cable is being wound in at the rate of 6 feet per second. How fast is the boat approaching the dock when its horizontal distance to the dock is 12 feet?



10. The foot of a 13-foot ladder leaning against a high wall is pulled away from the wall at the rate of 4 feet per minute. How fast is the top of the ladder moving when it is (a) 12 feet above the ground? (b) 5 feet above the ground?

11. Let A be the area of a variable circle having radius r at time t and circumference C. Show that $\frac{dA}{dt} = C\frac{dr}{dt}$