1. A particle moves according to a law of motion $s(t) = t^3 - 9t^2 + 15t + 10$, $t \geq 0$, where t is measured in seconds and s in feet.

   (a) Find the velocity at time t.

   (b) Find the velocity after 3 seconds.

   (c) When is the particle at rest?

   (d) When is the particle moving in a positive direction?

   (e) Find the total distance traveled during the first 8 seconds.

2. If a ball is thrown vertically upward with a velocity of 80 ft/s, then its height after t seconds is $s(t) = 80t - 16t^2$.

   (a) What is the maximum height reached by the ball?

   (b) What is the velocity of the ball when it is 96 ft above the ground on its way up? On its way down?

3. A stone is dropped into a lake, creating a circular ripple that travels outward at a speed of 60 cm/s. Find the rate at which the area within the circle is increasing after (a) 1 sec, (b) 3 sec, and (c) 5 sec. What can you conclude?

4. Newton's Law of Gravitation says that the magnitude F of the force exerted by a body of mass m on a body of mass M is

$$F = \frac{GmM}{r^2}$$

   where G is the gravitational constant and r is the distance between the bodies.

   (a) If the bodies are moving, find $\frac{dF}{dr}$ and explain its meaning.

   (b) Suppose it is known that Earth attracts an object with a force that decreases at the rate of 2 N/km when r = 20,000 km. How fast does this force change when r = 10,000 km?

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