1. The position of a particle moving along the x-axis at time t seconds is given by the function $x = 3+4t-t^2$, $t \geq 0$, where x is measured in meters. Find all times when the pariticle is speeding up.

2. A rock dropped near the surface of the earth falls $s = 16t^2$ feet in the first t seconds after it is released. Determine the rate of change in the speed v of the rock with respect to s. Evaluate this derivative at $s = 16$ and $s = 64$. Interpret the meanings of these derivatives. Take v to be measured in ft/sec. Approximate the relative change in the speed of the rock if s is increased by 3%.

3. Determine the rate of change of the area of a circle with respect to its radius. Explain.
b. If the radius of a circle increases at a rate of 4 in/sec, determine the rate at which the area is increasing when the radius is 10 inches.
c. Determine the rate of change of the area of a circle with respect to its circumference.
d. If the radius of a circle increases by 1%, estimate the relative change in the area of the circle.
e. If the circumference of a circle increases by 1%, estimate the relative change in the area of the circle.

4. Boyle's law states that when a sample of gas is compressed at a constant temperature, the product of the pressure and volume remains constant: $PV = C$. Suppose that for a sample of hydrogen, the pressure is one atmosphere when the volume is 2 liters.
a. Find the rate of change of pressure with respect to volume at $V = 2$. Interpret your answer.
b. Find the rate of change of pressure with respect to volume at $V = 20$. Compare your answer with part a. Why are they so different?
c. Find dV/dP when $V = 2$ and interpret your result. Compare with part a.
d. If the volume of a gas increases by 2%, estimate the relative change in the pressure.

5. The period T (in seconds) of a simple pendulum of length L meters swinging with a small angular amplitude is given by the function

$$T = 2\pi\sqrt{\frac{L}{g}},$$

where g is the acceleration due to gravity. Take $g = 10\ m/sec^2$.

a. Find $\frac{dT}{dL}\,|_{L=1}$ and interpret your result.
b. Find $\frac{dT}{dL}\,|_{L=10}$ and interpret your result.
c. If the length of a pendulum is increased by 3%, approximate the relative change in the period.

6. The graph below is called a hypsometric curve. It shows the percentage of the earth's surface above a certain altitude. For example, about 42% of the earth's surface is above sea-level and about 10% of the earth's surface is above 2500 feet. Draw a tangent line to estimate the derivative of this function at 10%. Interpret the meaning of the derivative as simply as possible. If we assume that the graph tells us that 10% of the earth's surface is above 2500 feet, approximately what percent of the earth's surface is above 2400 feet?

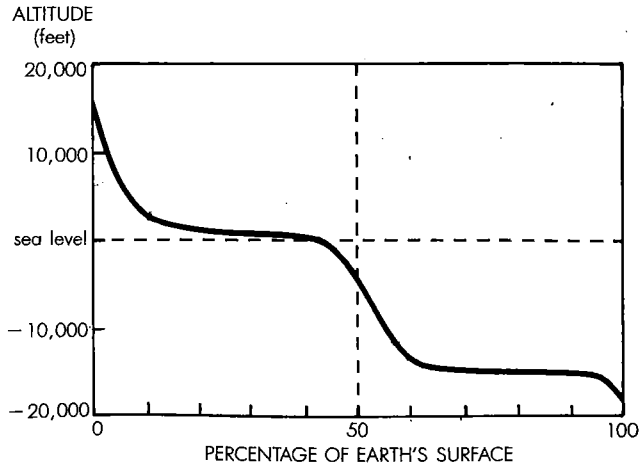

FIGURE 1.1