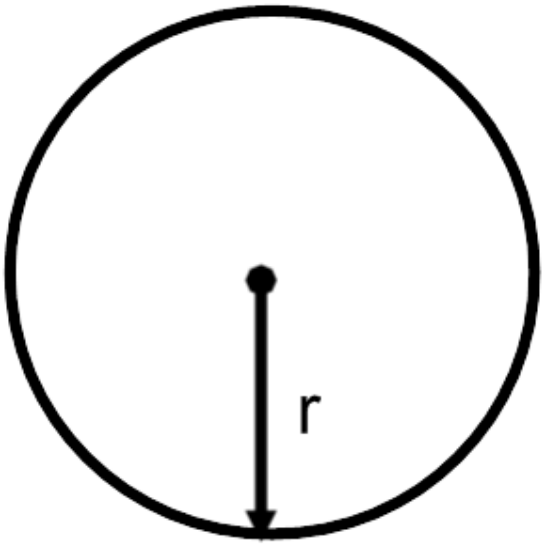
More Than One Rate

General steps for solving Related Rates problems.

- Introduce variables, identify the given rate and unknown rate.
- Draw a picture.
- Find equations.
- Differentiate with respect to t.
- Evaluate and solve.

Recitation Questions

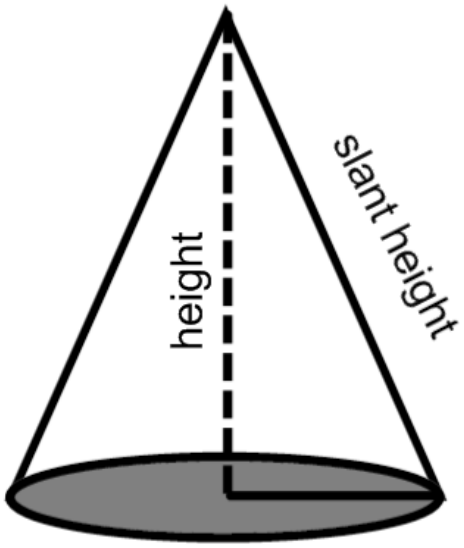
Problem 1 *The radius of a circle is increasing at a rate of 2 inches per minute.*



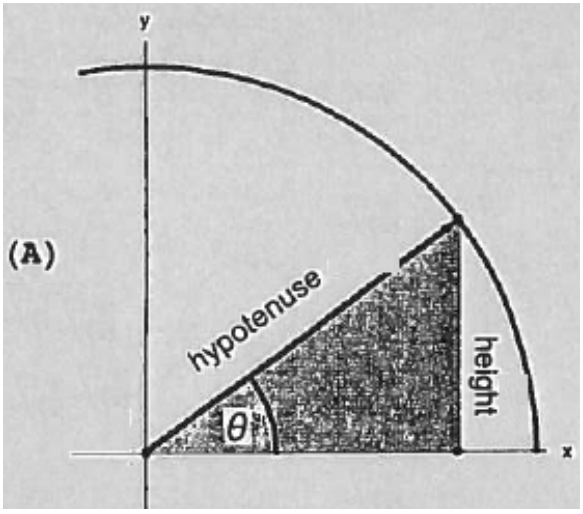
(a) *At what rate is the circumference of the circle changing when the radius is 10 inches?*

(b) *At what rate is the area of the circle changing when the radius is 12 inches?*

Problem 2 *A right cone has a fixed slant height (see figure below) of 9 ft. The cone's height is shrinking at a rate of 0.5 ft/sec. At what rate is the* ***volume*** *of the cone changing when the height is 6 ft? Be sure to label the picture.*

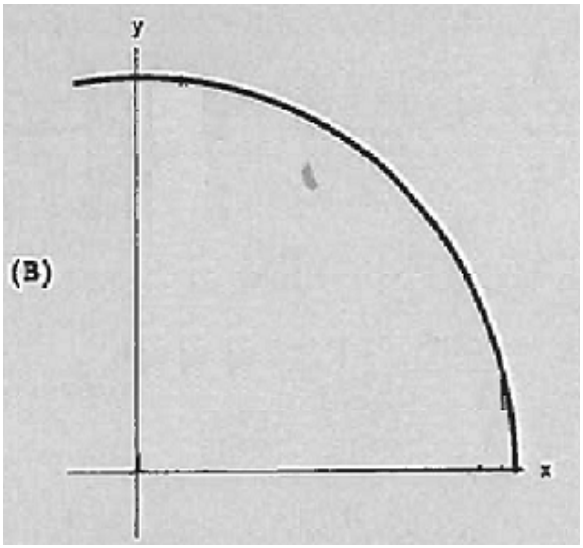


Problem 3 *A part of a circle centered at the origin with radius $r = 7$ cm is given in the figure (A) below. A right triangle is formed in the first quadrant (see Figure (A)). One of its sides lies on the x-axis. Its hypotenuse runs from the origin to a point on the circle. The hypotenuse makes an angle θ with the x-axis. Assume that the angle θ changes at the rate $\dfrac{d\theta}{dt} = 0.2$ radians per second.*



(a) *Label Figure A.*

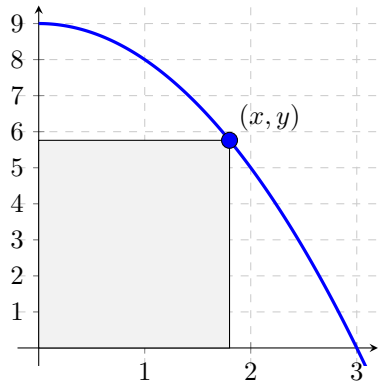
(b) *In Figure B, draw the the triangle twice; once when θ is small and once more, when θ is close to $\dfrac{\pi}{2}$.*



(c) *Find the rate of change of the height of the triangle when* $\theta = \dfrac{\pi}{3}$

(d) *Find the rate of change of the area of the triangle when* $\theta = \dfrac{\pi}{3}$

Problem 4 *A **rectangle in the first quadrant** is constructed by taking a point (x, y) on the graph of the function $f(x) = 9 - x^2$, drawing a line segment vertically downward to the x-axis and a line segment horizontally leftward to the y-axis, as in the picture below. Denote the **length of the base** (along the x-axis) of the rectangle by x, the **height of the rectangle** (along the y-axis) by y (in meters), and the **PERIMETER** of the rectangle by P. When $x = 2$ m (and only at that moment), the height y is shrinking at a rate of $\frac{1}{5}$ m/s. Find the value of $\left[\frac{dP}{dt}\right]_{x=2m}$ **by performing the steps below**.*



(a) ***Find a formula*** *for the height, y, of the rectangle as a function of x. (This is denoted as $y(x)$.)*

(b) ***Find the value*** *of $\left[\frac{dx}{dt}\right]_{x=2m}$.*

(c) ***Find a formula*** *for the perimeter, P, of the rectangle as a function of x. (This is denoted as $P(x)$.)*

(d) ***Find the value*** *of $\left[\frac{dP}{dt}\right]_{x=2m}$.*

(e) ***Write a sentence to explain*** *what the value found in (d) means about the rectangle. (Don't forget UNITS.)*