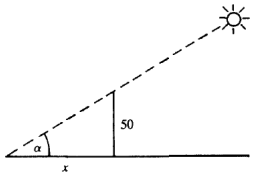
Rutgers University
Math 151

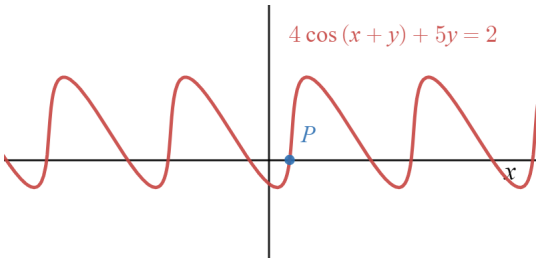
Section 3.10: Related Rates - Worksheet

1. How fast is the shadow cast on level ground by a pole 50 feet tall lengthening when the angle a of elevation of the sun is 45° and is decreasing by $\frac{1}{4}$ radian per hour? (See figure below.)



2. A sphere of radius 5 in fills with water at a rate of 4 in^3/min. When the water level inside the sphere is 6 in, how fast is it increasing? *(Hint: the volume of a spherical cap of height h in a sphere of radius r is $V = \frac{\pi}{3}(3rh^2 - h^3)$.)*

3. A particle travels toward the right on the graph of the implicit function $4\cos(x + y) + 5y = 2$, see the figure below.



When the particle first crosses the positive x-axis (at the point P on the figure), its x-coordinate increases at 6 units/sec. At what rate is the y-coordinate of the particle changing at that time?

4. A 5-foot person is walking toward a 20-foot lamppost at the rate of 6 feet per second. How fast is the length of their shadow (cast by the lamp) changing?

5. The legs of an isosceles triangle of base 6 cm are increasing at a rate of 14 cm/hour, causing the vertex angle to decrease. When the legs are 4 cm, how fast is the vertex angle decreasing?

6. **[Advanced]** An object moves along the graph of a function $y = f(x)$. At a certain point, the slope of the graph is -4 and the y-coordinate of the object is increasing at the rate of 3 units per second. At that point, how fast is the x-coordinate of the object changing?