1. In a fish farm, a population of fish is introduced into a pond and harvested regularly. A model for the rate of change of the fish population is given by

$$\frac{dP}{dt} = \beta\left(1 - \frac{P(t)}{P_c}\right)P(t) - hP(t)$$

where β is the birth rate of the fish, P_c is the maximum population the pond can sustain (called the *carrying capacity*), and h is the percentage of the population that is harvested.

a) What value of $\frac{dP}{dt}$ corresponds to stable population? Explain your answer.

b) If the pond can sustain 10,000 fish, the birthrate is 5% and the harvesting rate is 4%, find the stable population.

c) What is the stable population if the harvesting rate is raised to 5%?

2. Consider the curve $xy^2 - x^3y = 6$.

   a. Show that $\frac{dy}{dx} = \frac{3x^2y - y^2}{2xy - x^3}$.

   b. Find all points on the curve whose x-coordinate is 1, and write an equation for the tangent line at each of these points.

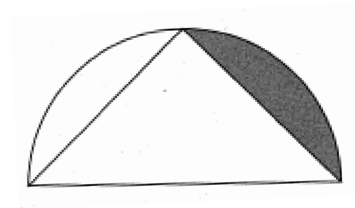
3. If two resistors with resistances R_1 and R_2 are connected in a particular way then the total resistance R, measured in ohms (Ω) is given by

$$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2}$$

If R_1 and R_2 are increasing at rates of $0.3\ \Omega/\text{sec}$ and $0.2\ \Omega/\text{sec}$, respectively, how fast is R changing when $R_1 = 80\ \Omega$ and $R_2 = 100\ \Omega$?

4. An isosceles triangle is inscribed in a semicircle, as shown in the diagram, and it continues to be inscribed as the semicircle changes size. The area of the semicircle is increasing at the rate of 1 cm^2/sec when the radius of the semicircle is 3 cm.

   Show your work and circle your answers.



a. How fast is the radius of the semicircle increasing when the radius is 3cm? Include units in your answer.

b. How fast is the perimeter of the semicircle increasing when the radius is 3cm? Include units in your answer.

c. How fast is the area of the isosceles triangle increasing when the radius is 3cm? Include units in your answer.

d. How fast is the area of the shaded region increasing when the radius is 3cm? Include units in your answer.