Section 4.7
Logistic Growth

1. If t is in years since 1990, one model for the population of the world, P, in billions, is
   $P = \frac{40}{1+11e^{-0.08t}}$.

    a. What does this model predict for the maximum sustainable population of the world?

    b. Sketch the graph of P against t.

    c. According to this model, when will the earth's population reach 20 billion? 39.9 billion?

2.   a. Draw a logistic curve. Label the carrying capacity L and the point of diminishing returns t_0.

    b. Draw the derivative of the logistic curve. Mark the point t_0 on the horizontal axis.

    c. Suppose a company keeps track of the rate of sales (for example, sales per week) rather than total sales. Explain how the company can tell on a graph of rate of sales when the point of diminishing returns is reached.

3. The Metro Department Store found that t wk after the end of a sales promotion the volume of sales was given by a function of the form $S(t) = B + Ae^{-kt}$ where $0 \leq t \leq 4$ where $B = 50,000$ and is equal to the average weekly volume of sales before the promotion. The sales volumes at the end of the first and third weeks were \$83,515 and \$65,055, respectively. Assume that the sales volume is decreasing exponentially.

   a. Find the decay constant k.

   b. Find the sales volume at the end of the fourth week.

   c. How fast is the sales volume dropping at the end of the fourth week?