1. Suppose that the interest rate on a mortgage is $8 \%$, compounded monthly. Suppose you can afford to make a monthly payment of $\$ 450$.
(a) How much can you afford to borrow if you want to pay off the loan after 20 years? Answer: $\$ 53799.43$
(b) How much can you afford to borrow if you want to pay off the loan eventually?
i. Graph the solution to the difference equation when $y_{0}=\$ 60,000$.
ii. Graph the solution to the difference equation when $y_{0}=\$ 67,500$.
iii. Graph the solution to the difference equation when $y_{0}=\$ 70,000$.

Answer: You can afford to borrow at most $\$ 67499$
2. Suppose that a car drives in a straight line, beginning at a fixed starting point. Let the function $s(t)$ be the position of the car (relative to the fixed starting point), with respect to time. Assume that position direction is to the right of the starting point. In each item below, sketch the graph of $s(t)$ that fits the description listed. You should have three graph-sketches, one for each item.
(a) The car has constant, negative velocity.
(b) The car achieves a maximum distance from the starting point at $t=3$, and then reverses back to the starting point.
(c) The car's distance from the starting point is increasing, and its velocity is increasing (decreasing?).
3. Suppose that $f(x)$ is with derivative equal to $f^{\prime}(x)=e^{-2 x}(x-3)(x+1)^{2}$.
(a) Find the intervals of increasing and decreasing for $f(x)$. Answer: Decreasing: $(-\infty, 3)$ Increasing: $(3, \infty)$.
(b) Find any relative minima or maxima for $f(x)$. Write only the $x$-value. Answer: Relative Minimum at $x=3$
4. A closed rectangular box with a square base and a volume of 12 cubic is to be constructed with two different types of materials. The top is made of metal costing $\$ 2$ per square foot and the remainder of the wood costing $\$ 1$ per square foot. What are the dimensions of the box for which the cost of materials is minimized.
(a) Write the objection function.
(b) Write the constraint equation.
(c) Find the intervals of increasing and decreasing for the objective function.
(d) Find any relative maxima/minima for the objective function.
(e) Find the intervals of concavity for the objective function.
(f) Sketch the graph of the objective. Label any relative maxima/minima.
(g) What are the optimal dimensions for the box. Answer: $x=2$ and $h=3$.
5. Suppose the population of a certain bacteria satisfies the following differential equation: $y^{\prime}=\frac{1}{3} y$. In this differential equation $y$ stands for the number of bacteria (in millions) and $x$ stands for time (in hours). Exactly many hours must pass before the population has doubled? Answer: $3 \ln (2) \approx 2.08$.

