1. Suppose you want to accumulate $120,000 for your retirement in 30 years. You have three choices: Plan A is a single deposit into an account with annual compounding and an APR of 5%. Plan B is single deposit into an account with continuous compounding and an APR of 4.8%. Plan C is a regular monthly payment at an APR of 3%. How much do you need to deposit in your account for Plan A and Plan B, and how much is it per month for Plan C?

2. Suppose you are planning to buy a new car which costs $30,000. You have opened an savings account and started saving $500 every month to buy the car. Assume that your bank gives 5% interest on your savings account. Assuming that the price of the care is never changed, how long will it take for you to be able to buy the car?

3. Suppose you are 25 years old and would like to retire at an age 65. Furthermore, you would like to have a retirement fund from which you can draw an income of $200,000 per year — forever!

   (a) What should be your regular monthly payment at a constant APR of 6%?
   
   (b) Find the to the total amount of money you have deposited in Part (a). Now, if you cloud gather the same amount of money as the total deposit in Part (a) when you were 25 years old and would put all of it in a savings account which offers 4% APR compounded continuously, then how much money would you earn as interest when you would retire at the age of 65?

4. Some “car-title lenders” offer quick cash loans in exchange for being allowed to hold the title to your car as collateral (you lose your car if you fail to pay off the loan). In many states, these lenders operate under pawnbroker laws that allow them to charge fees as a percentage of the unpaid balance. Suppose you need $2000 in cash, and a car-title company offers you a loan at an interest rate of 2% per month plus a monthly fee of 20% of the unpaid balance.

   (a) How much will you owe in interest and fees on your $2000 loan at the end of the first month?
   
   (b) Suppose that you pay only the interest and fees each month. How much will you pay over the course of a full year?
   
   (c) Suppose instead that you obtain a loan from a bank with a term of 3 years and an APR of 10%. What are your monthly payment in that case? Compare these to the payments to the car-title lender.

5. A community of mice has doubling time of 3 months.

   (a) How long will it take for this mice population to triple in size?
   
   (b) If there are initially 500 mice, find the population after 2 years.

6. You take 300 mg of a certain medication at 2 pm. A lab test done at 6 pm shows that you still have 120 mg of that medication left in your bloodstream.
(a) Assuming the medication decays exponentially, what is the rate of decrease of the medication in your bloodstream?

(b) What is the exact half-life of that medication in your bloodstream?

7. One morning, there were 3 inches of snow on the ground. Then the winter storm started and snow started accumulating at a constant rate of 5 inches every 2 hours.

(a) Identify the independent and dependent variables.
(b) Write a linear equation that describes this situation.
(c) How long did it take for the height of the snow to reach 21 inches?

8. A $1200 washing machine in a laundromat is depreciated for tax purpose at a rate of $75 per year. Find a function for the depreciated value of the washing machine as it varies with the time. When does the depreciated reach $0?

9. The maximum speed of a semitrailer truck up a steep hill varies with the weight of its cargo. With no cargo, it can maintain a maximum speed of 50 miles per hour. With 20 tons of cargo, its maximum speed drops to 40 miles per hour. At what load does a linear model predict a maximum speed of 0 miles per hour?

10. Suppose that poaching reduces the population of an endangered animal by 8% per year. Further suppose that when the population of this animal falls below 30, its extinction is inevitable (owing to the lack of reproductive options without severe in-breeding). If the current population of the animals is 1500, when will it face extinction? Comment on the validity of the exponential model.

11. Uranium-238 has a half-life of 4.5 billion years.

(a) You find a rock containing a mixture of Uranium-238 and lead. You determine that 65% of the original Uranium-238 remains; the other 35% decayed into lead. How old is the rock?

(b) Analysis of the another rock shows that it contains 45% of its original Uranium-238; the other 55% decayed into lead. How old is the rock?