Section 5.5: Applications

Exercises

Solve the following compound interest problems.

1. If $500 is deposited into an account paying 8% compounded quarterly, then how long will it take before the account contains $700?

2. How long will it take to double an investment which is compounded continuously at an interest rate of 5% per year?

3. Charlotte invests a certain amount of money at 12% per year, compounded semi-annually. How long will it take to double her initial investment?

4. Doug invests a certain amount of money at 12% per year, compounded monthly. After five years, his investment is worth $2500. How much did he invest initially?

5. Steve invests $500 in an account that compounds continuously. If the account is worth $727.50 after five years, what was the interest rate on Steve's account?

6. As part of a science experiment, Pat is cryogenically frozen for many years. Once she wakes up, she finds that her bank account, which had a balance of $1600 when she was frozen, has grown to 5.8 million dollars. The interest rate on her account has remained at 6% the entire time. How long has she been asleep if her account was compounded

   a) monthly?
   b) continuously?

Solve the following exponential growth problems.

7. The Saanich News reported on page A3 of the edition printed Wednesday, November 14, 2007 that UVic has a rabbit problem. The article states that "If 95 percent of the University of Victoria's bunnies were blown off the face of the planet, they would repopulate to their current population within two years". What is the doubling time for fluffy bunnies at UVic?

8. Could there have been vampires in Transylvania? Assume that each vampire creates another vampire by biting a human during the full moon. Starting then with one vampire, how long would it take before every person in Transylvania (estimated population of 2.4 million people) was turned into a vampire? (Assume no population grown in Transylvania during this time.)

9. Barry Hendy of Kodak Australia has found that the number of pixels you can get per dollar for a digital camera grows exponentially. His graph on the Wikipedia commons (http://en.wikipedia.org/wiki/Image:Hendys_Law.jpg) shows that in 1999

you could get about 1000 pixels per dollar, and in 2004 you could get 10,000 pixels per dollar. If this relationship is true, when could you get roughly 5000 pixels per dollar?

10. According to Wikipedia, the United Nations estimated the world's population to be about 6.070 billion people in the year 2000, growing at a rate of 1.14% per year.

   a) If that estimate is accurate, how many people are added to the Earth's population in a single year? In a single day?
   b) What's the doubling time for the world's population if the rate of growth remains constant?
   c) How many people will there be in 2050?

Solve the following exponential decay problems.

11. The fictional radioactive isotope Adamantium-354 has a half-life of 3.5 seconds. If you have exactly 1 gram of the substance to begin with, how much will be left after exactly one second?

12. After five days, the amount of Unobtainium-157 has decayed to 35% of the original amount. What is the half-life of this radioactive isotope?

13. If 80% of a radioactive element remains radioactive after 250 million years, then what percent remains radioactive after 600 million years? What is the half-life of this element?

14. The half-life of U-235 (uranium-235) is 7.0×10^8 years. After one billion years, how much of the original uranium-235 will remain? How much will have decayed away?

15. Dr. Evil, in his underground volcano lair, has manufactured a certain amount of the radioactive isotope Explodium-337, which has a half-life of 36 minutes. To save the day, after the isotope was made Austin Powers managed to create chaos and distract everyone for exactly two and a half hours. After that time, what fraction of the original Explodium is left?

16. In Smallville, Lex Luthor is threatening to destroy Superman's superpowers using Red Kryptonite. However, Lex's plans have misfired – Red Kryponite is radioactive and after 11.5 days, 88% has decayed away, leaving only 12% of the original material. What is the half-life of Red Kryptonite?