

Name:
Algebra 2

Date:

Word Problems: Exponential Growth and Decay

- The population of the US is about 300 million and has been increasing by about 1% per year.
 - If this continues, what will the population in 20 years be?
 - What was the population 15 years ago?
 - What annual rate of increase is required for the population to reach 450 million in 25 years?
- The population of Afghanistan is currently about 30 million. It has been increasing at 4.8% per year.
 - If this continues, what will its population be in the year 2020?
 - What was the population 20 years ago?
 - In the extremely unlikely event that US and Afghan annual population growth rates remain at 1% and 4.8% forever, which country will have a larger population in the year 2100?
- The value of a new sports car decreased from \$40,000 to \$20,000 in 7 years.
 - What was the annual rate of decline in the car's value?
 - Write an exponential function showing its value when it is t years old. (Assume the annual rate of decline stays constant).
 - What will its value be when it is 10 years old?
 - Graph the function in your calculator. Choose your window settings carefully (you may decide to have your function be the price *in thousands of dollars*). Use calc-intersect to determine when its value is exactly \$8000.
- Two banks offer different interest rates on deposits. Bank A offers 20% per year, and Bank B offers 10% every six months.
 - If you put \$5000 in Bank A, how much would you have after 10 years?
 - If you put \$5000 in Bank B, how much would you have after 10 years? [Think # of periods]
 - What would Bank C need to pay to turn \$5000 into \$20,000 in ten years (annual interest)?
- The population of Uganda is now about 25 million and has been increasing by about 4% per year.
 - If this continues what will the population be in 2020?
 - About what was the population 18 *months* ago?
- An investment lost a total of half of its value in 8 years.
 - If the initial value is \$1000, then what annual rate of decrease did it have?
 - If the initial value is \$5000, then what annual rate of decrease did it have?
- The value of an investment triples in 15 years. What is the annual rate of increase in value?
- In 1950 the average Algebra II book had 412 pages. The current Algebra II book has 850 pages.
 - What was the annual percentage growth in the number of pages?
 - Write an equation describing the number of pages the average book had $P(t)$ as a function of the number of years since 1950 (t). Assume that the annual growth rate has been constant.
 - Graph this on your calculator and determine about when the average was 600 pages.
- In Germany in the early 1920's there was a period of hyperinflation where prices were increasing by about 2.3% **per day**.
 - If something cost 50 Marks one day, how much would it be expected to cost 2 months later?

- b. How much would that 50-Mark item cost one week earlier?
10. Germany's hyperinflation in 1923 amounted to about a 100% rise in prices per month.
- If something cost 15 marks at one time, how much would it cost 8 months later?
 - If the price of some object grew at this rate, how many months would it take to increase in price from 10 to 320?
11. Sally took a job at IBM in 1990 and got an initial annual salary of \$45,000. Her salary grew at a rate of 5% per year.
- What is her current salary (2007)?
 - Ann started in 1995 and has earned raises of 4% per year. If her current salary is \$95,000 per year then what was her starting salary?
 - Joanne started in 1997 with a salary of \$60,000 per year and now makes \$110,000 per year. What annual percentage raise did she get over this period?
12. The population of bluebirds in one particular park is now 275 and is expected to grow at 4% per year. The population of crows in the same park is now 80 and is expected to grow at 12% per year.
- Write a growth model for each, showing population as a function of time.
 - Graph both of these on your calculator. Determine when the population of crows will first exceed the population of bluebirds. Use calc-intersect or a table.
13. Your body metabolizes the caffeine you drink. Each hour about 16% of the caffeine gets metabolized. If you drink a double-latte that has 100 milligrams of caffeine at noon, then how much caffeine will be in your body 3 hours later? 8 hours later? n hours later?
14. When we were kids, our math-genius neighbor named Victor offered my mom the following deal. He would wash our dinner dishes each day for 3 full weeks. The first day we would pay him one cent. His daily pay would double each day. Knowing Victor, we declined. If we accepted, how much would his pay have been on the 7th day? The 14th day? The last day?
15. A regular piece of notebook paper is about 0.005 inches thick. Every time you fold it in half, its thickness doubles.
- How thick is it after 1, 2, and 3 folds?
 - Write an expression showing its thickness after x folds.
 - How thick is it after 20 folds?
 - How many miles thick is it after 30 folds? [One mile is 5280 feet].
 - The moon is about 384,000 miles away. Use your calculator to estimate how many folds would be theoretically required for it to reach the moon.

ANSWERS

- 1a. 366.1 mill b. 258.4 mill c. 1.64% 2a. 55.18 mill b. 11.75 million c. Afghan (more than 3x!)
- 3a. 9.4% b. $V = 40000 \cdot 0.906^t$ c. \$14,860 d. 16.25 years 4a. \$30,959 b. \$33,637 c. 14.9%
- 5a. 41.6 mill b. 23.57 mil 6a&b 8.3% 7. 7.60%
- 8a. 1.3% b. $P(t) = 412 \cdot 1.013^t$ c. about 29 yrs (1979)
- 9a. about 200 9b. 42.64 10a. 3840 b. 5 months 11a. \$98,229 b. \$61,710 c. 6.97%
- 12a. $C(t) = 275 \cdot 1.04^t$ $B(t) = 80 \cdot 1.12^t$ b. ~17 yrs 13. 59.3 mg, 24.79mg, $100 \cdot 0.84^n$

13. Solve the following equations:

a. $2^x = 8$

b. $3^x = 9$

c. $3^x = \frac{1}{9}$

d. $2^x = \frac{1}{4}$

e. $3 \cdot 2^x = 48$

f. $4^x + 7 = 71$

g. $2^{x+2} = 8$

h. $2^x \cdot 2^{x-2} = 16$