

Problems	1	2	3	4	5	6	Total		Grade
Points								%	
Out of	6	36	21	21	10	6	100		

*Relax. You have done problems like these before. Even if these problems look a bit different, just do what you can. If you're not sure of something, please ask! You may use your calculator. Please show all of your work and write down as many steps as you can. Don't spend too much time on any one problem. Please leave the following grading key blank for me to use. Do well. And remember, ask me if you're not sure about something.*

*A few formulas from our book:*

### Percentage Change Formula

To get the result of increasing an amount by  $r\%$ , multiply by  $1 + \frac{r}{100}$ .

To get the result of decreasing an amount by  $r\%$ , multiply by  $1 - \frac{r}{100}$ .

### The Growth Factor Formula

If an amount is growing exponentially and the amount changes from  $P$  to  $A$  in  $T$  time periods, then the growth factor  $g$  is given by the formula

$$g = \left(\frac{A}{P}\right)^{\left(\frac{1}{T}\right)}$$

### Log Divides Formula

The equation  $b^T = v$  has solution

$$T = \frac{\log(v)}{\log(b)}$$

1. (a) Calculate  $\frac{6.72 \times 10^{27}}{3.70 \times 10^{-64}}$ . Express your answer in scientific notation.

- (b) Using the connection logarithms and scientific notation, what is an approximate value  $\log\left(\frac{6.72 \times 10^{27}}{3.70 \times 10^{-64}}\right)$ ? *Be sure to explain your answer with a sentence.*

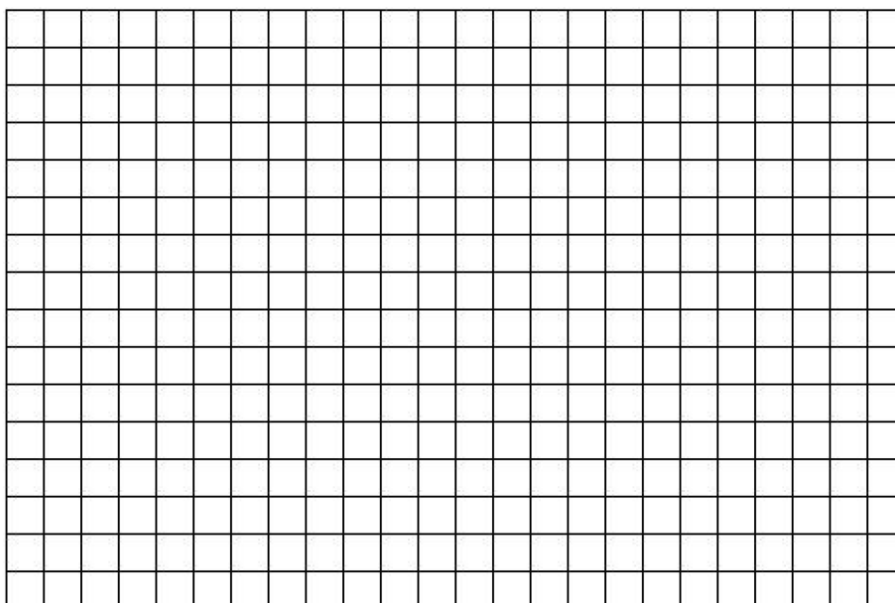
- (c) Now use your calculator to determine  $\log\left(\frac{6.72 \times 10^{27}}{3.70 \times 10^{-64}}\right)$ . Please report your answer to 5 decimal places. Does it agree with your approximation?

2. Biologists in Florida have found a direct link between population increases and decline in local black bear populations. In 1953 the black bear population was 11,000. From that time it had been decreasing at a rate of 6% per year. From the initial estimate of 11,000 the black bear population has decreased to  $B$  bears in  $Y$  years since 1953 where

$$B = 11000(0.94)^Y$$

- (a) Make a table of values showing the bear population 10, 20, 30, 40, and 50 years after 1953.

- (b) Draw a graph illustrating the dependence. *Be sure to include all the information given and space your axes evenly.*



*The problem continues . . . .*

- (c) When will the bear population drop below 1000 bears? Approximate the answer from your graph and then refine your answer by successive approximation to the nearest year.

- (d) Now show how to exactly solve the equation to determine when the bear population will be below 1000 bears.

3. Chlorofluorocarbons (CFCs 11 and 12) are greenhouse gases that result from our use of refrigeration, air conditioning, aerosols, and foams. In 1960, the concentration of CFC-11 in the northern hemisphere was 11.1 parts per trillion (ppt), meaning on average, there are 11 CFC molecules in a trillion ( $=1,000,000,000,000$ ) molecules of air. In 1980 the concentration of CFC-11 in the northern hemisphere was 177 ppt.

Let  $C$  denote the concentration of CFC-11 in the northern hemisphere (in ppt or parts per trillion) and  $Y$  the year, measured in years since 1960. Suppose that this concentration has been increasing at a *constant rate each year*.

(a) By how many parts per trillion per year have CFC-11 concentrations increased?

(b) Write an equation illustrating this model.

(c) According to this equation, how much will the concentration of CFC-11 be by the year 2009?

(d) What type of equation is being used here?

4. Remember from the previous problem that in 1960, the concentration of CFC-11 in the northern hemisphere was 11.1 parts per trillion (ppt), meaning on average, there are 11 CFC molecules in a trillion ( $=1,000,000,000,000$ ) molecules of air. In 1980 the concentration of CFC-11 in the northern hemisphere was 177 ppt. Let  $C$  denote the concentration of CFC-11 in the northern hemisphere (in ppt or parts per trillion) and  $Y$  the year, measured in years since 1960. For this problem assume instead that the concentration of CFC-11 has been increasing *a fixed percentage each year*.

(a) What is the annual growth factor that CFC-11 concentrations increased?

(b) Write an equation illustrating this model.

(c) According to this new equation, how much will the concentration of CFC-11 be by the year 2009?

(d) What type of equation is being used here?

5. Seth would like to determine how many cells his body contains. From a biology book he discovered that a single cell has a mass of 0.000000000001 kilograms.

(a) Write the mass of a cell in scientific notation.

(b) Express the mass of the cell as a conversion factor. In other words, complete the following:

1 cell = \_\_\_\_\_ kilograms

(c) Seth weighs 180 pounds. Using your above conversion factor, how many cells are in Seth's body? *Use the fact that 1 kilogram  $\approx$  2.2 pounds.*

6. In 2009 the population of Ethiopia is 85,237,338 people. At that time it is expected that the population would increase 3.2% annually. Assuming this increase is exponential, what would the population of Ethiopia be in 2019? *Test-taking tip: Be sure to name variables and identify all formulas used.*