Algebra 2/Pre-Calculus   **Name**_____
Exponential Word Problems (Day 2, Exponentials)

In this handout, we will continue our study of exponential word problems.

1. Tanya currently has $4000 in her bank account. The amount of money in her bank account grows at 2.3% per year. ***Note:*** Answers are given at the end of this problem.

   a. Write a function giving the amount of money in the bank account as a function of time.

   b. How much money will Tanya have in her bank account after 4 years?

   c. When will the amount of money in her bank account reach $4500?

   d. When will the amount of money in her bank account reach $7000? ***Hint:*** You may have to change the viewing window to get find the intersection.

   e. How many years ago did Tanya have $3500 in her bank account?

   Answers

   a. $f(x) = 4000(1.023)^x$ b. $4380.89   c. 5.18 years   d. 24.6 years   e. 5.87 years ago

2. There are currently 10,000 bacteria in a Petri dish. The number of bacteria doubles every hour.

   a. How many bacteria are there in the Petri dish after one hour? After 5 hours?

   b. Write a function formula giving the number of bacteria in the Petri dish after x hours.

   c. How many hours until there are 1,000,000 bacteria in the Petri dish?

   d. How many bacteria will there be in the Petri dish after 50 minutes? ***Hint:*** How many hours is 50 minutes?

   e. **(Optional Challenge)** Write a function formula giving the number of bacteria in the Petri dish after x *minutes*.

Answers

a. 20,000 bacteria, 32,000 bacteria   b. $f(x) = 10000(2)^x$ c. 6.64 hours

d. 17,818 bacteria   e. $g(x) = 10000(2)^{x/60}$

3. Albert owns a computer that is currently valued at $1200. Every year the computer loses half its value.

   a. How much is the computer worth after one year? After two years? After three years?

   b. Write a function formula giving the value of the computer after x years.

   c. When will the value of the computer be $500?

   d. How realistic do you think this model is? Explain in words.

Some answers a. $600, $300, $150 b. $f(x) = 1200(\frac{1}{2})^x$ c. 1.26 years

4. Mehk buys a nice bike for $600. Every year her bike loses 22.5% of its value.

   a. Write a function formula for the value of the bike after x years.

   b. When will the value of the bike be $200?

   c. **(Optional Challenge)** Suppose Mehk bought her bike (for $600) at the same time that Albert from problem **3** bought his computer (for $1200). When will the computer and the bike be worth the same amount? *Hint:* Solve graphically.

Answers a. $f(x) = 600(0.775)^x$ b. 4.31 years c. 1.58 years

5. An ambitious start up company claims their stock price will increase by one quarter every month. (In other words, each month the stock price increases by one quarter of what it was the previous month.) The company's stock price is currently $30.

   a. What is the stock price after one month?

   b. Write a function formula giving the stock price after x months.

   c. How many months will it take for the stock price to double in value?

   d. How many months will it take for the stock price to quadruple in value?

   e. According to this model, what will the stock price be in 5 years? Is this realistic? Explain.

   f. **(Optional Challenge)** Write a formula giving the stock price after x years?

   g. **(Optional Challenge)** Look at your answers to parts **c** and **d**. Are these answers related in some way? Explain.

Some answers

a. $37.50   b. $f(x) = 30(1.25)^x$ c. 3.11 months   d. 6.21 months

e. $19,575,913.40 (completely unrealistic!)   f. $f(x) = 30(1.25)^{12x}$

6. Here's a legendary (probably untrue) story: When the game of chess was invented, the king said to the inventor, "I will give you anything. What would you like?" His subject replied, "Put one grain of rice on the first square of the board, put two grains of rice on the next square, then four, then eight, doubling each time." Supposedly, the king responded, "That's all you want?"

a. Fill in the following table.

Square: x	# of grains of rice on that square: f(x)
1	1
2	2
3	4
4	
5	
6	

b. Write a function formula giving the number of grains of rice on each square. *Be careful:* This one is tricky! Make sure your formula works. *Hint:* According to this pattern, what would be the value of $f(0)$?

c. A modern chess board has 64 squares. According to this model, how many grains of rice were on the last square? *Note:* You may want to use wolframalpha to do this calculation…

d. (**Optional challenge**) According to this model, how many grains of rice were there on the entire chess board? *Note:* Again, use wolframalpha.

e. Which is more likely: That the king honored this request or simply had his subject executed in order to avoid paying?

Some answers

b. $f(x) = 0.5(2)^x$ or $f(x) = 2^{x-1}$ (both work)   c. 9,223,372,036,854,775,808 grains of rice d. 18,446,744,073,709,551,615 grain of rice   e. execution

7. Here's a table of values for an exponential function.

x	f(x)
0	4000
1	4600
2	5290
3	6083.5

a. If $f(x) = ab^x$, what is the value of a? Why?

b. Since $f(0) = 4000$, $a = 4000$. Now find the value of b.

c. Here's one way of finding the value of b: $f(1) = 4600$ so $4600 = 4000b^1$. Thus $b = \frac{4600}{4000} = 1.15$. What formula does this give you? Does your formula give you the right values for $f(2)$ and $f(3)$?

d. Find the value of $f(10)$.

8. Here's another table of values for an exponential function.

x	f(x)
0	600
1	516
2	443.76

a. Find a function formula for $f(x)$.

b. Find the value of $f(-3)$.

9. Another table. This one is a bit different.

x	$f(x)$
0	500
2	980
4	1920.8

a. Find a function formula for $f(x)$. *Note:* If you need a hint, look ahead to part **b**. But try it on your own first.

b. Here's a hint for part a: $980 = 500b^2$.

c. Find the value of $f(1)$.

10. These problems are similar to the ones with the tables.

a. Suppose $f(x)$ is an exponential function. $f(0) = 250$ and $f(2) = 1322.5$ Find a formula for $f(x)$.

b. Suppose $g(x)$ is an exponential function. $g(0) = 600$ and $g(3) = 2695.275$ Find a formula for $g(x)$.

Answers a. $f(x) = 250(2.3)^x$ b. $g(x) = 600(1.64)^x$ (Suggestion: When solving, raise to the $\frac{1}{3}$ power.)

11. (Optional Challenge) Suppose $h(x)$ is an exponential function. $h(2) = 512$ and $h(5) = 262.144$. Find the value of $h(4)$.

Answer $h(4) = 327.68$