Precalculus Worksheet on Exponential Functions

1. Listen to the beginning of "*The King's Chessboard*" by David Birch. Use this worksheet to figure out how much rice the king must give the wise man. Check out www.freerice.com for new vocabulary words.

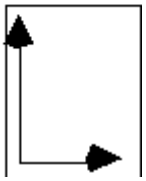
2a. Fill out the top rows of the chessboard with the number of new grains given on that square:

b. Instead of adding all the rice for each square to find the total, let's see if we can find a pattern of how much rice has been given cumulatively for each day.

Days	Total	Total + 1
0		
1		
2		
3		
4		
5		
…		

Since 1 more grain of rice won't make much of a difference, I suggest that the king give the wise man 1 extra grain of rice before he starts the chessboard. (Consider this the rice for the 0th day.) Why will this make your job easier?

3. Sketch a graph of your function on graph paper. Orient your graph paper this way and make sure your axes are as shown:



4. Since we like to work with continuous functions (a curve), connect the points on your graph and assume that you can read the graph at any place on this curve. Use your graph to estimate the following and fill in the *table on the next page*:

a. What is the total number of grains given after 2.5 days? after 3.5 days? after 4.5 days?

b. Is the rate of change the same for one more day? [This type of growth is called exponential. It is similar to the reproduction of rabbits, the growth of bacteria and compound interest growth on bank accounts.]

c. Determine the equation of the curve with x representing the number of days and y representing the total number of grains given.

d. Using your calculator and your equation, complete the table:

number of days	total # of grains estimated from the graph	total # of grains using equation and calculator
2.5		
3.5		
4.5		

How accurate is your graph? Would you prefer to read the answer from the graph or use a calculator?

e. The King's Weigher was getting nervous about how much total rice he would have to give the wise man. How many total grains of rice would the king have to give by the end of the chessboard? Did you get this from your graph????

5. Let's figure out when the wise man will have a specific amount of rice. When we draw graphs, we place the independent variable (the one we know) on the x-axis and the dependent variable (the one we are figuring out) on the y-axis. Draw your graph on a new piece of graph paper switching the variables so the total number of grains is on the x-axis and the number of days is on the y-axis. Orient your graph paper this way:

6. Use your graph to estimate the following:
a. How long did it take for the wise man to have a total of 15 grains? 25? 35?
b. Use your equation from 4c and intersect to fill in the following table:

total # of grains	# of days estimated from the graph	# of days (accurate to the nearest tenth)
15		
25		
35		

c. Can you write an equation of this second graph? Is this equation useful for evaluating the function on your calculator?

Extension: Show your computations, using unit analysis.
How long would it take the United States to grow enough rice to give the wise man?
How much money would all that rice be worth now?

Some facts you might find useful:
1 oz of rice is approximately 2048 grains
1 cwt = 100 lb

	2004
US rice production (cwt)	230,818,000
price of rice (per cwt)	$7.40

Price varies based on supply and demand.
Source: The 2004 World Almanac.

BONUS: How long (in light-years) would your graph paper need to be for you to plot the amount of rice given at the end of the chessboard? (Assume regular ¼ " squares = 1 grain of rice; use 186,282 miles = 1 light-second)

Amazingly enough, the writers of the show "Numb3rs" think this story is pretty common knowledge. Watch episode #324, "Janus List," at time 6:15 – 8:50 to see Charlie asked how much rice for the king!