Name: _____ Date: _____ Period: _____

Unit 3 Growing, Growing, Growing #3 Classwork

The patterns of change in the ballot problem and the king's Rubas from day 2 show exponential growth. These relationships are called exponential relationships. In each case, you can find the value for any square or cut by multiplying the value for the previous square or cut by a fixed number. This fixed number is called the growth factor.

The king told the queen about the reward he had promised the peasant. The queen said, "You have promised her more money than we have in the entire royal treasury! You must convince her to accept a different reward."

After much thought, the king came up with Plan 2. He would make a new board with only 16 squares. He would place 1 Ruba on the first square and 3 Rubas on the second. He drew a graph to show the number of Rubas on the first five squares. He would continue this pattern until all 16 squares were filled.
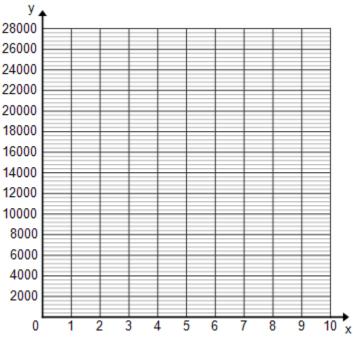
The queen wasn't convinced about the king's new plan, so she devised a third plan. Under Plan 3, the king would make a board with 12 squares. He would place 1 Ruba on the first square. He would use the equation $R = 4^{n-1}$ to figure out how many Rubas to put on each of the other squares. In the equation, R is the number of Rubas on square n.

In this table, Plan 1 is the reward requested by the peasant. Plan 2 is the king's new plan. Plan 3 is the queen's plan. Complete the table to show the number of Rubas on squares 1 to 10 for each plan.

Square	Plan 1 Rubas	Plan 2 Rubas	Plan 3 Rubas	Plan 4 Rubas
1	1	1	1	
2	2	3	4	
3	4	9	16	
4	8	27	64	
5	16	81		
6	32			
7				
8				
9				
10				
Final Square:				
Equation:				

1. How are the patterns of change in Plans 2 and 3 different and similar to Plan 1?

2. Are the growth patterns for Plans 2 and 3 exponential relationships?
   If so, what is the growth factor for each?

3. Use three different colors to graph Plans 1 - 3 for *n* = 1 to 10.
Do not connect the dots. Why not?

4. How do the graphs compare?

y

28000
26000
24000
22000
20000
18000
16000
14000
12000
10000
8000
6000
4000
2000

0   1   2   3   4   5   6   7   8   9   10   x

5. The queen's assistant wrote the equation $R = \frac{1}{4}(4)^n$ for Plan 3. This equation is different than the one the queen wrote. Did the assistant make a mistake? Explain.

Before presenting Plans 2 and 3 to the peasant, the king consulted with his financial advisors. They told him that either plan would devastate the royal treasury. The advisors proposed a fourth plan. Under Plan 4, the king would put 20 Rubas on the first square of a chessboard, 25 on the second, 30 on the third, and so on. He would increase the number of Rubas by 5 for each square, until all 64 squares were covered.

6. Finish the table on the front page showing the number of Rubas for the first 10 days of this new plan.

7. Is the growth plan in Plan 4 an exponential relationship? Explain.

8. Write an explicit equation for the relationship between the number of the square n and the number of rubas R for Plan 4.

9. How many Rubas would be on square 20 for Plan 1?
   How many Rubas would be on square 20 for Plan 4?

10. Which plan would you recommend as the best compromise for the king and the peasant, and why?