

Name: _____

Date: _____

Classwork $\frac{2}{8-4}$

Growing, Growing, Growing – Investigation 1 Problem 1.2, Requesting a Reward

When you found the number of ballots after 10, 20, and 30 cuts, you may have multiplied long strings of 2s. Instead of writing long product strings of the same factor, you can use **exponential form**. For example, you can write $2 \times 2 \times 2 \times 2 \times 2$ as 2^5 , which is read "2 to the fifth power." In the expression 2^5 , 5 is the **exponent** and 2 is the **base**. When you evaluate 2^5 , you get $2^5 = 2 \times 2 \times 2 \times 2 \times 2 = 32$. We say that 32 is the **standard form** for 2^5 .

Getting Ready for Problem 1.2

• Write each expression in exponential form.

a. $2 \times 2 \times 2 = 2^3$

b. $5 \times 5 \times 5 \times 5 = 625 = 5^4$

c. $1.5 \times 1.5 \times 1.5 \times 1.5 \times 1.5 \times 1.5 \times 1.5 = 1.5^7$

• Write each expression in standard form.

a. $2^7 = 128$

b. $3^3 = 27$

c. $4 \cdot 2^3 = 74,088$

• Most calculators have a key for evaluating exponents. Use your calculator to find the standard form for each expression.

a. $2^{15} = 32,768$

b. $3^{10} = 59,049$

c. $1.5^{20} = 3325.25673$

• Explain how the meanings of 5^2 , 2^5 , and 5×2 differ. (Hint: Evaluate all three expressions.)

$5^2 = 5 * 5 = 25$

$2^5 = 2 * 2 * 2 * 2 * 2 = 32$

$5 \times 2 = 10$

One day in the ancient kingdom of Montarek, a peasant saved the life of the king's daughter. The king was so grateful he told the peasant she could have any reward she desired. The peasant—who was also the kingdom's chess champion—made an unusual request:

Plan 1 – The Peasant's Plan

"I would like you to place 1 ruba on the first square of my chessboard, 2 rubas on the second square, 4 on the third square, 8 on the fourth square, and so on, until you have covered all 64 squares. Each square should have twice as many rubas as the previous square."

The king replied, "Rubas are the least valuable coin in the kingdom. Surely you can think of a better reward." But the peasant insisted, so the king agreed to her request. Did the peasant make a wise choice?

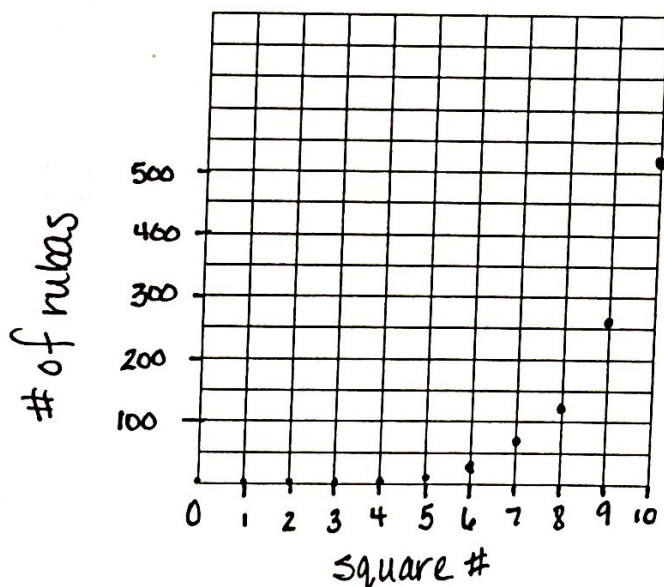
A. 1. Make a table showing the number of rubas the king will place on squares 1 through 10 of the chessboard.

0 $0.5 = \frac{1}{2}$

Square Number	Number of Rubas	write expanded and exponential forms
1	1	1
2	2	$1 * 2$
3	4	$1 * 2 * 2$
4	8	$1 * 2 * 2 * 2$
5	16	$1 * 2 * 2 * 2 * 2 = 2^4$ or $1 * 2^4$
6	32	2^5
7	64	2^6
8	128	2^7
9	256	2^8
10	512	2^9

$1x+2$

2. Graph the points (number of the square, number of rubas) data for squares 1 to 10.



3. Write an equation for the relationship between the number of the square n and the number of rubas r .

equation: $r = 2^{n-1}$

B. 1. How does the number of rubas change from one square to the next?

The number of rubas double from one square to the next.

2. How does the pattern of change you observed in the table show up in the graph?

The graph is curving upwards since the points get further and further apart.

How does it show up in the equation?

The base of 2 indicates doubling at each square.

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c. 1. Which square will have 2^{30} rubas? 31 Explain.

2. What is the first square on which the king will place at least one million rubas? 21
How many rubas will be on this square? 1048576

3. Larissa uses a calculator to compute the number of rubas on a square. When is the first time the answer is displayed in scientific notation?

Square 21

D. Compare this growth pattern to the growth pattern in Problem 1.1

① Similarity: • They both start off with a small change between each step, until you get to 7 when the change is increasingly larger.
• Increasing curve
• Doubling

② Difference: The number of rubas at step 1 is 1 but in 1.1, the number of ~~rubas~~ pieces ballots

2.2 E 10
2.2 x 10¹⁰

1.4 E 9 at step 1 is 2.
1.4 x 10⁹