Difference or Factor?

Sort functions by how their outputs change.

A1.F.2.1 "Distinguish between linear and nonlinear (including exponential) functions. Understand that linear functions grow by equal intervals (arithmetic) and that exponential functions grow by equal factors over equal intervals (geometric)."

NAME _____ DATE _____

LINEAR

When the input increases by the same amount each time, the output changes by a constant amount. That amount can be positive or negative.

A lantern holds 30, 26, 22, then 18 mL of oil at successive checks.

EXPONENTIAL

When the input increases by the same amount each time, the output is multiplied by a constant factor. The factor can be greater or less than 1.

A yeast culture contains 5, 15, 45, then 135 cells at successive checks.

1 SORT

8 items

For Part 1, circle ARITHMETIC or GEOMETRIC for each item; for Part 2, choose one item from each category and explain how the outputs change.

1. $y = 7x - 4$ — ARITHMETIC / GEOMETRIC

2. $y = 2(5)^x$ — ARITHMETIC / GEOMETRIC

3. For x = 0, 1, 2, 3, the outputs are 3, 12, 48, 192. — ARITHMETIC / GEOMETRIC

4. A taxi fare starts at $6 and rises $2 per mile. — ARITHMETIC / GEOMETRIC

5. For x = 0, 1, 2, 3, the outputs are 11, 14, 17, 20. — ARITHMETIC / GEOMETRIC

6. $y = 9 - 2x$ — ARITHMETIC / GEOMETRIC

7. A savings balance starts at $40 and doubles each year. — ARITHMETIC / GEOMETRIC

8. For x = 0, 1, 2, 3, the outputs are 25, 20, 15, 10. — ARITHMETIC / GEOMETRIC

2 PROVE IT

Explain your thinking

Choose one item from each category and explain how the outputs change.

ITEM # _____ **HOW I KNEW** _____

ITEM # _____ **HOW I KNEW** _____

3 MAKE YOUR OWN

One of each

For Part 3, write one new linear example and one new exponential example, using four outputs for x = 0, 1, 2, 3 in each example.

ARITHMETIC

GEOMETRIC

CHALLENGE

Write a linear function and an exponential function that both output 6 when x = 0 and 12 when x = 1, then find each output when x = 2.

ANSWER KEY # Difference or Factor?

PART 1 · SORT

#	ITEM	CATEGORY	WHY
1	$y = 7x - 4$	**ARITHMETIC**	For each increase of 1 in x, y increases by 7.
2	$y = 2(5)^x$	**GEOMETRIC**	For each increase of 1 in x, y is multiplied by 5.
3	For x = 0, 1, 2, 3, the outputs are 3, 12, 48, 192.	**GEOMETRIC**	Each output is 4 times the previous output.
4	A taxi fare starts at $6 and rises $2 per mile.	**ARITHMETIC**	The fare increases by $2 for each mile.
5	For x = 0, 1, 2, 3, the outputs are 11, 14, 17, 20.	**ARITHMETIC**	Each output is 3 more than the previous output.
6	$y = 9 - 2x$	**ARITHMETIC**	For each increase of 1 in x, y decreases by 2.
7	A savings balance starts at $40 and doubles each year.	**GEOMETRIC**	The balance is multiplied by 2 each year.
8	For x = 0, 1, 2, 3, the outputs are 25, 20, 15, 10.	**ARITHMETIC**	Each output is 5 less than the previous output.

PART 2 · PROVE IT

Task: Choose one item from each category and explain how the outputs change.
Accept any explanation that names the deciding feature from the rule box for the chosen item.

PART 3 · MAKE YOUR OWN (SAMPLE ANSWERS)

- **ARITHMETIC**: Linear: For x = 0, 1, 2, 3, the outputs are 8, 13, 18, 23.
- **GEOMETRIC**: Exponential: For x = 0, 1, 2, 3, the outputs are 7, 21, 63, 189.

Challenge: Linear: $y = 6x + 6$, so $y = 18$ when $x = 2$. Exponential: $y = 6(2)^x$, so $y = 24$ when $x = 2$.

For Part 2, a student might explain that item 5 increases by 3 each step, while item 3 is multiplied by 4 each step. Accept other pairs with a correct constant difference and constant factor.