Linear or Exponential?

Equal x steps first. Subtract for a constant difference (linear); divide for a constant ratio (exponential); neither constant means neither. Fixed amounts add, doubles and percents multiply.

Name _____ Date _____

Words we use

say the math word, then the plain English

WORD	PLAIN ENGLISH	WHAT YOU DO
Equal steps	The x values go up by the same amount each row.	Check this before subtracting or dividing.
Constant difference	Subtracting gives the same number every step: linear.	The difference is the slope, rise over the run.
Constant ratio	Dividing gives the same number every step: exponential.	The ratio is b.
Neither	Differences and ratios both change.	Another family, or no simple rule.
Clue words	per, each, every with a fixed amount: linear. Doubles, halves, a percent: exponential.	Grows by 10 adds; grows by 10% multiplies.
Eventually exceeds	An exponential growth curve is eventually bigger than any line.	The line's step is fixed; the exponential's step keeps growing.

Part A Test the tables

Write the differences, the ratios if needed, and the family with its constant.

TABLE (X = 0, 1, 2, 3)	DIFFERENCES	RATIOS	FAMILY AND CONSTANT
y: 4, 7, 10, 13			
y: 4, 12, 36, 108			
y: 64, 32, 16, 8			
y: 2, 5, 10, 17			
y: 200, 220, 242, 266.2			
y: 100, 90, 80, 70			

Part B Unequal steps

1. x: 0, 1, 3, 4 and y: 5, 10, 40, 80. Why can you not run the test as is? Fill in the missing row and decide.

Part C Sort the stories

STORY	LINEAR OR EXPONENTIAL	CLUE WORD
A jar gains $10 every week		
Bacteria double every hour		
A town grows by 10 people a year		
A town grows by 10% a year		
A car loses $1,500 a year		
A car loses 15% a year		

Part D The race

Town A: 145 people, gains 10 a year. Town B: 145 people, grows 10% a year.

1. Write both equations.

2. Fill in the table (round B to the nearest person).

YEAR	0	1	2	3	5	8
Town A	145					
Town B	145					

3. Why must Town B eventually pass Town A?

Part E The doubling penny

A dollar a day for 30 days, or a penny that doubles every day for 30 days?

1. Which is worth more on day 10? (Day 0 is the first day, with $1 and one penny.)

2. Which is worth more on day 30? Explain what eventually exceeds means.

Part F Exit ticket

1. y: 9, 12, 15, 18 (x = 0 to 3): family and constant?

2. y: 9, 18, 36, 72: family and constant?

3. Grows by 50 each year versus grows by 50% each year: which is which?

Answer key

Part A. Linear, difference 3. Exponential, ratio 3. Exponential, ratio 1/2. Neither (differences 3, 5, 7; ratios change). Exponential, ratio 1.1. Linear, difference negative 10.

Part B. The x steps are 1, 2, 1, not equal. With x = 2, y = 20: ratio 2 each step, exponential.

Part C. Linear (every, $10). Exponential (double). Linear (by 10). Exponential (by 10%). Linear ($1,500). Exponential (15%).

Part D. 1. A: $y = 145 + 10x$. B: $y = 145 \cdot 1.10^x$. 2. A: 155, 165, 175, 195, 225. B: 160, 175, 193, 234, 311. 3. A adds 10 forever; B's yearly gain keeps growing.

Part E. 1. The dollars: $11 versus $10.24. 2. The penny: over $5 million versus $31. The exponential's step keeps growing until it passes the line and pulls away.

Part F. 1. Linear, difference 3. 2. Exponential, ratio 2. 3. By 50 is linear; by 50% is exponential.