Linear Functions in the Real World

In a story, b is the starting amount or flat fee and m is the rate. Write the model and use it. Test for linear with constant differences. Compare two linear functions given in different ways.

Name _____ Date _____

Words we use

say the math word, then the plain English

WORD	PLAIN ENGLISH	WHAT YOU DO
Rate	The slope m in a story: the per-something amount, per hour, per mile, per ticket.	Read it as the number that repeats each step. Negative if the amount goes down.
Starting value (initial value)	The y-intercept b in a story: what you have when x is 0, the flat fee, the amount at the beginning.	Read it as the one-time amount.
Constant rate of change	The same change every step. What makes a situation linear.	Subtract down a table with equal steps. All the same: linear.
Linear	Changes by the same amount each step, so the graph is a line and the rule is $y = mx + b$.	Write the model as (rate) × x + (start).
Not linear	The rate itself changes: the change grows or shrinks as you go.	Differences down the table are not all the same.
Compare across representations	The same kind of function given as an equation, a graph, a table, or a story.	Get m and b out of each. Bigger b starts higher; bigger m grows faster; set them equal to find when they match.

Part A Start and rate

For each story write b (the start), m (the rate, with its sign), and the equation.

STORY	B	M	EQUATION
A bike rental: $12 plus $4 an hour			
A tank of 900 gallons draining 30 a minute			
A tree 5 feet tall growing 1.5 feet a year			
A gift card with $60, spending $8 a week			

Part B Use the model

1. The bike rental after 5 hours costs:

2. The tank is empty when (find the x-intercept):

Part C Is it linear?

3. The tree is 20 feet tall when:

Subtract down the y column. Write linear (and m) or not linear.

TABLE	DIFFERENCES	LINEAR? M?
x: 0, 1, 2, 3 y: 6, 11, 16, 21		
x: 0, 1, 2, 3 y: 3, 6, 12, 24		
x: 0, 3, 6, 9 y: 50, 44, 38, 32		
x: 0, 1, 2, 3 y: 2, 3, 6, 11		

Part D Compare two

Plan A: cost = 15x + 10. Plan B: a table, months 0, 1, 2 and cost 40, 45, 50. Plan C: a graph crossing the y-axis at (0, 25) and passing through (5, 75).

1. m and b for each plan:

2. Which starts highest? Which grows fastest?

3. When do A and B cost the same? Which is cheaper before that?

Part E In your own words

1. In a story, what is b and what is m? Give an example of each.

2. What makes a situation linear? How does a table show it?

3. Why is doubling not linear?

Part F Exit ticket

1. Car wash: $5 plus $2 per car. b, m, and the equation.

2. x = 0, 1, 2, 3 and y = 9, 13, 17, 21: linear? m?

3. A: 6x + 30. B: starts at 10, grows 10 a month. Starts higher, grows faster, equal when?

Answer key

Part A. Bike: b 12, m 4, y = 4x + 12. Tank: b 900, m –30, y = –30x + 900. Tree: b 5, m 1.5, y = 1.5x + 5. Gift card: b 60, m –8, y = –8x + 60.

Part B. 1. 4(5) + 12 = 32 dollars. 2. 0 = –30x + 900, x = 30 minutes. 3. 20 = 1.5x + 5, x = 10 years.

Part C. +5, +5, +5: linear, m = 5. +3, +6, +12: not linear. –6 per step of 3: linear, m = –2. +1, +3, +5: not linear.

Part D. 1. A: m 15, b 10. B: m 5, b 40. C: m 10, b 25. 2. B starts highest (40); A grows fastest (15). 3. 15x + 10 = 5x + 40, x = 3 months; A is cheaper before 3 months.

Part E. 1. b: start or flat fee (a $12 rental fee). m: rate (per hour, $4). 2. Constant rate of change; equal differences down the table. 3. The change grows each step, so the rate is not constant.

Part F. 1. b 5, m 2, y = 2c + 5. 2. Linear, m = 4. 3. A starts higher, B grows faster, equal at 5 months.