Building and Using Exponential Models

Build a model: a is the start, b is the factor. Forward: evaluate, power first. Backward: table, or target line and the crossing. Say what a and b mean.

Name _____ Date _____

Words we use

say the math word, then the plain English

WORD	PLAIN ENGLISH	WHAT YOU DO
Model	An equation that stands in for a real situation.	Find a and b from the story, table, or points; say what they mean.
Forward question	Given x, find y. Put x in and evaluate, power first.	After 3 years, what is it worth?
Backward question	Given y, find x. Use a table or the graph.	When is it worth $200?
Target line	The horizontal line y = the given value. The answer is where the curve crosses it.	Same crossing idea as a system in Unit 6.
Discrete	Only whole steps make sense (yearly, each day). The honest picture is dots.	Answer with a whole step.
Continuous	Any x makes sense (all the time). The curve is the honest picture.	Answer with any number.

Part A Build the model

SITUATION	A	B	MODEL	WHAT A AND B MEAN
A phone costs $800 and loses 20% a year				
300 bacteria, tripling every hour				
Table: x 0, 1, 2, 3; y 50, 150, 450, 1350				
Through (0, 12) and (1, 18)				
A town of 2,000 growing 5% a year				

Part B Forward

1. $y = 800 \cdot 0.8^x$: value after 3 years, and after 5 years. Power first.

2. $y = 300 \cdot 3^x$: bacteria after 4 hours.

Part C Backward, by table

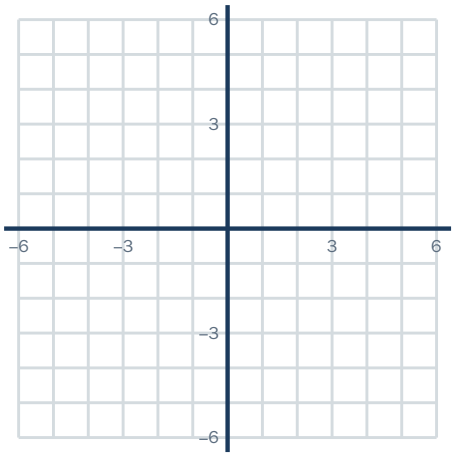
$y = 800 \cdot 0.8^x$. Fill the table (round to the nearest dollar) and answer.

X	0	1	2	3	4	5	6	7
y	800							

1. In which year does the phone first drop under $300? Under $200?

Part D Backward, by graph

Plot the table on the grid (x from 0 to 8, each square is 1; y from 0 to 800, each square is 100). Draw the target line $y = 200$ dashed and mark the crossing.



1. About what x is the crossing? What whole year is the honest answer, and why (discrete or continuous)?

Part E What would change?

1. If the phone lost 15% a year instead of 20%, what changes in the model? In the graph? Does it cross $200 sooner or later?

2. If it cost $1,000 new, what changes?

Part F Exit ticket

1. A car costs $20,000 and loses 25% a year. Model, and what a and b mean.

2. Value after 2 years?

3. How would you find on the graph when it is worth $5,000?

Answer key

Part A. 800, 0.80, $y = 800 \cdot 0.8^x$ (price new; keeps 80% a year). 300, 3, $y = 300 \cdot 3^x$ (start; triples). 50, 3, $y = 50 \cdot 3^x$. 12, 1.5, $y = 12 \cdot 1.5^x$. 2000, 1.05, $y = 2000 \cdot 1.05^x$ (start; 105% each year).

Part B. 1. $409.60; $262.14. 2. $300 \cdot 81 = 24{,}300$.

Part C. 640, 512, 410, 328, 262, 210, 168. Under $300 in year 5; under $200 in year 7.

Part D. Crossing a little after $x = 6$. Year 7: the phone loses value yearly, so the situation is discrete.

Part E. 1. $b = 0.85$; falls more slowly and stays above; crosses later (year 9). 2. $a = 1000$; same shape, starts higher, every value is a quarter bigger; crosses later (year 8).

Part F. 1. $y = 20000 \cdot 0.75^x$; $a = \$20{,}000$ new; $b = 0.75$ keeps 75% a year. 2. $11,250. 3. Draw $y = 5000$, read the crossing (about 4.8, so year 5).