Comparing Linear Quadratic and Exponential Models

Name: _____	Date: _____	Score: _____ / 24

Quick Review

Three growth types, distinguished by how they change: **Linear** ($y = mx + b$) grows by *constant amount* per step. **Quadratic** ($y = ax^2 + \ldots$) grows by an *increasing amount* per step. **Exponential** ($y = ab^x$) grows by a *constant ratio* per step. **For large x, exponential eventually dominates polynomial** (any quadratic). For instance, 2^x eventually surpasses x^2 no matter how slowly. **From a table**, check: constant first differences → linear; constant second differences → quadratic; constant ratios → exponential. **From a context**, simple interest is linear; compound is exponential; area growth is often quadratic.

PRACTICE

Identify the type or compare growth.

1. A school club sells $3, 6, 9, 12$ tickets over four equal time intervals. Which model type fits the totals? _____

2. A square patio has side lengths $1, 2, 3, 4$ yards, giving areas $1, 4, 9, 16$. Which model type fits area vs. side length? _____

3. A bacteria culture has counts $2, 4, 8, 16$ after equal time intervals. Which model type fits the data? _____

4. A savings plan adds the same deposit each week, producing balances $5, 8, 11, 14$. Which model type fits? _____

5. A plant population triples each month: $3, 9, 27, 81$. Which model type fits? _____

6. For very large x, which grows fastest: a square-area model x^2, a doubling model 2^x, or a linear model $3x$? _____

7. A dropped object has distances $0, 1, 4, 9, 16$ at equal time marks. Which model type is most reasonable? _____

8. A rumor reaches $1, 2, 4, 8, 16$ people after equal rounds. Which model type fits? _____

9. A runner covers $0, 3, 6, 9$ miles after equal time intervals. Which model type fits? _____

10. A bank account earns simple interest, adding the same dollar amount each year. Which model type is this? _____

11. A bank account earns compound interest, growing by the same percent each year. Which model type is this? _____

12. The area of a square is modeled as the side length changes. Which model type is this? _____

13. A town's population grows by 4% each year. Which model type should be used? _____

14. A car travels at a constant speed. Which model type describes distance vs. time? _____

15. A physics class models free-fall distance over time. Which model type is expected? _____

16. A table has constant first differences. Which model type does that indicate? _____

17. A table has a constant ratio from one output to the next. Which model type does that indicate? _____

18. A website's traffic doubles every day. Which model type best describes the traffic? _____

19. A cube's volume changes as its side length changes. Is that linear, quadratic, or something else? _____

20. A bouncing ball reaches heights $80, 60, 45, 33.75$ cm. Which model type fits the rebound heights? _____

Word Problems

21. Job A pays \$30K + \$1K raise each year. Job B pays \$25K + 5% raise each year. Which is higher at year 15?

_____

22. A wildlife count is recorded each month as $100, 150, 225, 337.5$. Identify the model type and write a formula using t for months after the first count.

_____

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23. During a free-fall experiment, the distances after $t = 0, 1, 2, 3$ seconds are $0, 16, 64, 144$ feet. What kind of function best models the data?

_____

24. A school play sells $100, 105, 110, 115$ tickets during four equal time intervals. Is the pattern linear or expone

_____

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Answer Keys

1. linear
2. quadratic
3. exponential
4. linear
5. exponential
6. 2^x
7. quadratic
8. exponential
9. linear
10. linear
11. exponential
12. quadratic
13. exponential
14. linear
15. quadratic
16. linear
17. exponential
18. exponential
19. cubic, not quadratic
20. exponential
21. Job B
22. exponential, $P = 100 \cdot 1.5^t$
23. quadratic
24. linear

Step-by-Step Tutor Notes

1. Start with the definition the problem is testing, then apply it directly. The total increases by the same amount, $+3$, each interval. Constant first differences mean linear. So the answer is linear.
2. Area is side squared, $A = s^2$. The outputs follow perfect squares, so the relationship is quadratic.
3. Use the labels on the display first; they tell you which count or total belongs in the answer. Each count is multiplied by 2. A constant ratio means exponential growth. This gives exponential.
4. Start with the definition the problem is testing, then apply it directly. The balance increases by 3 each week, so the first differences are constant. So the answer is linear.
5. Read the table by matching the correct row and column first, then use the count or total that fits the question. The common ratio is 3, so this is exponential growth. This gives exponential.
6. Read the table by matching the correct row and column first, then use the count or total that fits the question. Exponential growth eventually passes both linear and quadratic growth for large enough inputs. This gives 2^x.
7. Take it one clear step at a time and keep the original question in mind. Those outputs match t^2, and falling-distance models are quadratic. So the answer is quadratic.
8. Use the clue in the question first, then let the arithmetic finish the job. The number doubles each round, so the ratio is constant. So the answer is exponential.
9. Compare the change in output to the change in input, because slope is a rate of change. The distance increases by 3 miles each interval, a constant rate of change. So the requested value is linear.
10. Move carefully through the arithmetic; one clean operation usually unlocks the next one. Simple interest adds a fixed amount each year, so the balance changes by constant differences. After simplifying, the answer is linear.
11. Take it one clear step at a time and keep the original question in mind. A constant percent is a constant multiplier, which creates an exponential model. So the answer is exponential.
12. Use the clue in the question first, then let the arithmetic finish the job. Square area is $A = s^2$, so the side length is squared. So the answer is quadratic.
13. Use the structure of the expression to find the important point, then check that it fits the context. A constant percent increase means the population is multiplied by the same factor each year. That leads to exponential.
14. Think of slope as the amount the output changes for each 1-unit change in the input. Distance follows $d = rt$ when the rate is constant, so the graph is a line. So the requested value is linear.
15. This is a good place to slow down, check the notation, and simplify cleanly. Free-fall distance is proportional to t^2, so the relationship is quadratic. So the answer is quadratic.
16. Constant first differences mean the output changes by the same amount each step, which is linear.
17. Take it one clear step at a time and keep the original question in mind. A constant multiplier from step to step is the signature of an exponential model. So the answer is exponential.
18. Use the clue in the question first, then let the arithmetic finish the job. Doubling is repeated multiplication by 2, so the model is exponential. So the answer is exponential.
19. Cube volume is $V = s^3$, so it is a cubic relationship rather than linear or quadratic.
20. Start with the definition the problem is testing, then apply it directly. Each height is 0.75 times the previous height. A constant ratio means exponential decay. So the answer is exponential.
21. A at year 15: $30 + 14 = 44$ K. B: $25(1.05)^{14} \approx 49.50$ K. Job B is higher.
22. Name the quantities first so the model is easy to read. Ratios: $1.5, 1.5, 1.5$ — constant. Exponential with base 1.5.
23. Set up the model from the story, then calculate carefully. $y = 16t^2$: free-fall pattern.
24. Read the table by matching the correct row and column first, then use the count or total that fits the question. Adds 5 each time — linear growth. This gives linear.

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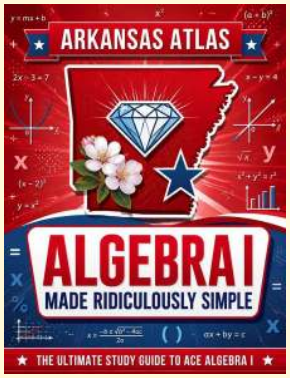

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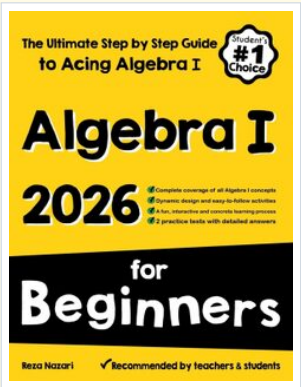

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