Exponential Growth

Name: _____ Date: _____ Score: _____ / 24

Quick Review

Exponential growth multiplies by a factor greater than 1 each equal time period. The model is $y = a(1 + r)^t$, where a is the initial value and r is the growth rate as a decimal. A 6% growth rate uses multiplier 1.06. Growth can also be given with a doubling time: if a quantity doubles every d units, use $y = a \cdot 2^{t/d}$.

PRACTICE

Model or evaluate each exponential growth situation.

1. A savings account has $\$100$ and grows by 10% over one year. What is the new balance? _____

2. A club has 500 members and grows by 8% during a membership drive. How many members are expected after one period? _____

3. A nursery models plant starts with $N(t) = 1000(1.05)^t$. Estimate $N(3)$ to the nearest whole plant. _____

4. A town reports a 15% yearly growth rate. What multiplier should be used in an exponential model? _____

5. A growth model uses multiplier 1.07. What percent growth rate does that represent? _____

6. A bacteria sample starts at 50 and doubles 3 times. How many bacteria are in the sample? _____

7. A game score bonus starts at 200 points and triples for 2 rounds. What is the final bonus? _____

8. A population model is $P(t) = 300(1.04)^t$. Estimate the population when $t = 5$. _____

9. An investment model is $A(t) = 1000(1.06)^t$. What is the value after 2 years? _____

10. A lab culture starts with 80 cells and grows by 25% each hour. Write an exponential model. _____

11. A small city has 1200 residents and grows by 3% each year. Write a model for the population after t years. _____

12. An account has $\$2000$ and earns 4% interest each year. Estimate the balance after 5 years. _____

13. A culture starts with 40 cells and doubles every 6 hours. Write a model using t hours. _____

14. The model $y = 75 \cdot 2^{t/3}$ describes growth over time t. What is the doubling time? _____

15. A bank account has annual multiplier 1.0281. What is the approximate annual growth rate? _____

16. A reward triples at each step. What percent growth rate is represented by a multiplier of 3? _____

17. A video channel has 600 subscribers and its audience is multiplied by 1.5 each month. How many subscribers are expected after 4 months? _____

18. What formula is used for continuous exponential growth with principal P, rate r, and time t? _____

19. In the continuous growth model $A = Pe^{0.05t}$, what growth rate is represented? _____

20. Is $y = 90(1.12)^t$ an exponential growth model or an exponential decay model? _____

♦ Word Problems

21. A bacteria culture starts with 200 bacteria and triples every hour. How many bacteria will there be after 5 hours?

_____

22. A neighborhood has $1{,}600$ residents and grows by 3% each year. Estimate the population after 6 years.

_____

23. A membership site has 240 members and grows by 7% each month. Write a model and estimate the membership after 8 months.

_____

24. A lab culture starts with 75 cells and doubles every 30 minutes. How many cells are expected after 2 hours?

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Answer Keys

1. $\$110$
2. 540
3. ≈ 1158
4. 1.15
5. 7%
6. 400
7. 1800
8. ≈ 365
9. $\$1123.60$
10. $y = 80(1.25)^t$
11. $P(t) = 1200(1.03)^t$
12. $\approx \$2433.31$
13. $y = 40 \cdot 2^{t/6}$
14. 3
15. 2.81%
16. 200%
17. 3037.5
18. $A = Pe^{rt}$
19. 5%
20. growth
21. $48{,}600$
22. $\approx 1{,}910$
23. $M(t) = 240(1.07)^t;\ \approx 412$
24. 1200

Step-by-Step Tutor Notes

1. Read the table by matching the correct row and column first, then use the count or total that fits the question. Growth by 10% uses multiplier 1.10. The balance is $100(1.10) = 110$. This gives $\$110$.
2. Start with the definition the problem is testing, then apply it directly. Use multiplier 1.08: $500(1.08) = 540$ members. So the answer is 540.
3. Use the clue in the question first, then let the arithmetic finish the job. Evaluate the model at $t = 3$: $1000(1.05)^3 \approx 1158$. So the answer is ≈ 1158.
4. Use the labels on the display first; they tell you which count or total belongs in the answer. Add the growth rate to 1: $1 + 0.15 = 1.15$. This gives 1.15.
5. Keep the order of operations in view, then simplify without skipping the sign check. Subtract 1 from the multiplier: $1.07 - 1 = 0.07$, which is 7%. After simplifying, the answer is 7%.
6. Start with the definition the problem is testing, then apply it directly. Each doubling multiplies by 2, so $50 \cdot 2^3 = 400$. So the answer is 400.
7. Keep the order of operations in view, then simplify without skipping the sign check. Tripling twice means multiply by 3^2: $200 \cdot 3^2 = 1800$. After simplifying, the answer is 1800.
8. The safest move is to replace the variable, keep the arithmetic organized, and simplify one step at a time. Substitute $t = 5$: $300(1.04)^5 \approx 365$. That confirms the final answer is ≈ 365.
9. This is a good place to slow down, check the notation, and simplify cleanly. Evaluate $A(2) = 1000(1.06)^2 = 1123.60$. So the answer is $\$1123.60$.
10. The starting value is 80 and the multiplier is 1.25, so $y = 80(1.25)^t$.
11. Focus on the main idea of the problem, then simplify carefully. Use the starting value 1200 and yearly multiplier 1.03. So the answer is $P(t) = 1200(1.03)^t$.
12. Start with the definition the problem is testing, then apply it directly. The yearly multiplier is 1.04, so $2000(1.04)^5 \approx 2433.31$. So the answer is $\approx \$2433.31$.
13. Use the clue in the question first, then let the arithmetic finish the job. The exponent counts how many 6-hour doubling periods have passed, so use $t/6$. So the answer is $y = 40 \cdot 2^{t/6}$.
14. When t increases by 3, the exponent increases by 1, so the quantity doubles every 3 time units.
15. Keep the order of operations in view, then simplify without skipping the sign check. Subtract 1 to get 0.0281, then convert to a percent: 2.81%. After simplifying, the answer is 2.81%.
16. A multiplier of 3 means $1+2$, so the increase is 200% of the previous amount.
17. The model is $600(1.5)^t$. At $t = 4$, $600(1.5)^4 = 3037.5$.
18. Use the clue in the question first, then let the arithmetic finish the job. Continuous compounding uses the number e, so the formula is $A = Pe^{rt}$. So the answer is $A = Pe^{rt}$.
19. Compare the change in output to the change in input, because slope is a rate of change. In $A = Pe^{rt}$, the rate is $r = 0.05$, which is 5%. So the requested value is 5%.
20. Use the labels on the display first; they tell you which count or total belongs in the answer. The multiplier 1.12 is greater than 1, so the model shows growth. This gives growth.
21. Name the quantities first so the model is easy to read. Use $B(t) = 200 \cdot 3^t$. At $t = 5$, $B = 200 \cdot 243 = 48{,}600$.
22. Set up the model from the story, then calculate carefully. Use $P(t) = 1600(1.03)^t$. Then $P(6) \approx 1600(1.1941) \approx 1910$.
23. Use the given numbers to build the model, then finish the calculation. The multiplier is 1.07. After 8 months, $240(1.07)^8 \approx 412$.
24. Use the given numbers to build the model, then finish the calculation. Two hours is 4 half-hour periods. Use $75 \cdot 2^4 = 1200$.

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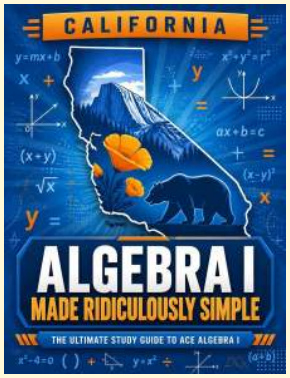

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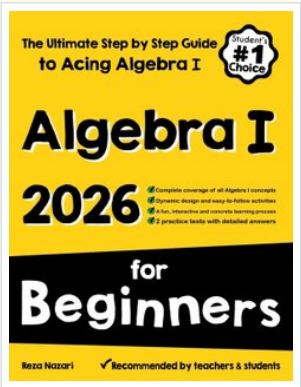

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