Graphing Exponential Functions

Name: _____	Date: _____	Score: _____ / 26

Quick Review

An **exponential function** has form $y = a \cdot b^x$, where a is the **initial value** (y-intercept) and b is the **base** ($b > 0$, $b \neq 1$). The graph: passes through $(0, a)$. If $b > 1$, exponential **growth** (rises to the right, approaches 0 to the left). If $0 < b < 1$, exponential **decay** (falls to the right and approaches 0 to the right). The **horizontal asymptote** is $y = 0$ — the graph gets arbitrarily close but never touches. Domain: all real numbers. Range: $y > 0$ (the graph stays above the x-axis when $a > 0$). **Big idea**: exponentials grow (or decay) by *constant ratios*, unlike linear functions which change by constant amounts.

PRACTICE

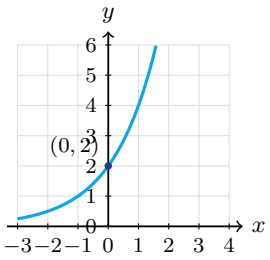
Identify features of each exponential.

1. $y = 2^x$; y-int _____
2. $y = 3^x$; growth or decay? _____
3. $y = (\frac{1}{2})^x$; growth or decay? _____
4. $y = 5 \cdot 2^x$; y-int _____
5. $y = 2^x$; y at $x = 3$ _____
6. $y = (\frac{1}{3})^x$; y at $x = 2$ _____
7. $y = 4 \cdot 3^x$; y at $x = 0$ _____
8. $y = 10 \cdot (0.5)^x$; y at $x = 1$ _____
9. Horizontal asymptote of $y = 2^x$ _____
10. Domain of $y = 3^x$ _____
11. Range of $y = 2^x$ _____
12. $y = 2^{x+1}$; y-int _____
13. $y = 2^x - 3$; asymptote _____
14. $y = 2^{-x}$; growth or decay? _____
15. $y = 3 \cdot 2^x$; y at $x = 2$ _____
16. $y = (1.5)^x$; growth or decay? _____
17. $y = 100 \cdot (0.9)^x$; y at $x = 1$ _____
18. $y = 2^x$; y at $x = -2$ _____
19. $y = 5^x$; y at $x = 3$ _____
20. $y = a \cdot b^x$; decay if _____

VISUAL PRACTICE

Use the graph, table, chart, or diagram to answer the question.

21. Use the graph of $y = 2 \cdot 2^x$. What is the y-intercept?



Answer: _____

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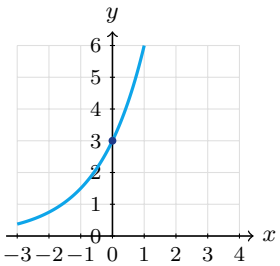

Answer: _____

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Word Problems

23. A small town has $1{,}000$ residents and its population grows by 5% each year. Write an exponential model for the population after t years.

Model: _____ **Answer:** _____

24. A car worth $20,000 loses 12%/year. Write the model and find value after 5 years.

Model: _____ **Answer:** _____

25. A lab culture starts with 500 bacteria and doubles every 2 hours. Find the population after 6 hours.

Model: _____ **Answer:** _____

26. A drug's level in the body halves every 4 hours, starting at 200 mg. Find amount after 12 hours.

Model: _____ **Answer:** _____

Answer Keys

1. $(0, 1)$
2. growth
3. decay
4. $(0, 5)$
5. 8
6. $\frac{1}{9}$
7. 4
8. 5
9. $y = 0$
10. $\mathbb{R}$
11. $y > 0$
12. $(0, 2)$
13. $y = -3$
14. decay
15. 12
16. growth
17. 90
18. $\frac{1}{4}$
19. 125
20. $0 < b < 1$
21. 2
22. 3
23. $P(t) = 1000 \cdot 1.05^t$
24. $V = 20000 \cdot 0.88^t$; \$10,555
25. 4000
26. 25 mg

Step-by-Step Tutor Notes

1. Take it one clear step at a time and keep the original question in mind. $2^0 = 1$. So the answer is $(0, 1)$.
2. Start with the definition the problem is testing, then apply it directly. $b = 3 > 1$. So the answer is growth.
3. Start with the definition the problem is testing, then apply it directly. $0 < b < 1$. So the answer is decay.
4. Take it one clear step at a time and keep the original question in mind. $a = 5$. So the answer is $(0, 5)$.
5. Start with the definition the problem is testing, then apply it directly. $2^3 = 8$. So the answer is 8.
6. Take it one clear step at a time and keep the original question in mind. $(\frac{1}{3})^2 = \frac{1}{9}$. So the answer is $\frac{1}{9}$.
7. Take it one clear step at a time and keep the original question in mind. Initial value. So the answer is 4.
8. Start with the definition the problem is testing, then apply it directly. $10 \cdot 0.5 = 5$. So the answer is 5.
9. Take it one clear step at a time and keep the original question in mind. Basic exponential functions approach $y = 0$. So the answer is $y = 0$.
10. Use the clue in the question first, then let the arithmetic finish the job. All real x. So the answer is $\mathbb{R}$.
11. Use the clue in the question first, then let the arithmetic finish the job. Always positive. So the answer is $y > 0$.
12. Start with the definition the problem is testing, then apply it directly. $2^{0+1} = 2$. So the answer is $(0, 2)$.
13. Use the clue in the question first, then let the arithmetic finish the job. Vertical shift down 3 moves asymptote. So the answer is $y = -3$.
14. Focus on the main idea of the problem, then simplify carefully. $2^{-x} = (\frac{1}{2})^x$, decay form. So the answer is decay.
15. Take it one clear step at a time and keep the original question in mind. $3 \cdot 4 = 12$. So the answer is 12.
16. Focus on the main idea of the problem, then simplify carefully. $b = 1.5 > 1$. So the answer is growth.
17. Start with the definition the problem is testing, then apply it directly. $100 \cdot 0.9$. So the answer is 90.
18. Start with the definition the problem is testing, then apply it directly. $2^{-2} = \frac{1}{4}$. So the answer is $\frac{1}{4}$.
19. Focus on the main idea of the problem, then simplify carefully. 5^3. So the answer is 125.
20. Use the clue in the question first, then let the arithmetic finish the job. Base between 0 and 1. So the answer is $0 < b < 1$.
21. Use the clue in the question first, then let the arithmetic finish the job. The graph crosses the y-axis when $x = 0$. That point is $(0, 2)$. So the answer is 2.
22. Take it one clear step at a time and keep the original question in mind. The y-intercept occurs when $x = 0$. The graph crosses at $(0, 3)$. So the answer is 3.
23. Name the quantities first so the model is easy to read. Multiplier per year: $1 + 0.05 = 1.05$. Initial: 1000.
24. Loses 12%, keeps 88%. $V(5) = 20000 \cdot 0.88^5 \approx 10554.64$, so the value is about \$10,555 to the nearest dollar.
25. Set up the model from the story, then calculate carefully. After 6 hours = 3 doublings: $500 \cdot 2^3 = 4000$.
26. Name the quantities first so the model is easy to read. 3 half-lives: $200 \cdot (\frac{1}{2})^3 = 25$ mg.

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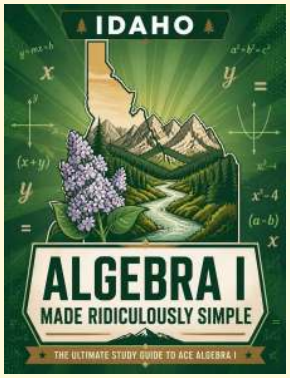

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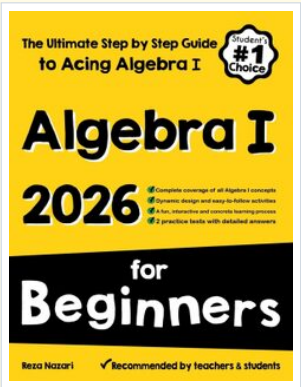

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