

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

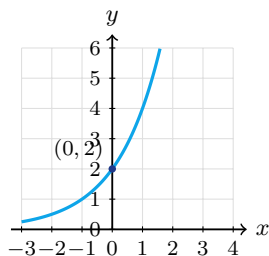
Identify features of each exponential.

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

VISUAL PRACTICE

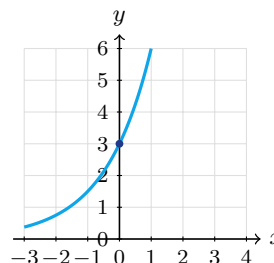
Use the graph, table, chart, or diagram to answer the question.

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



Answer: _____

22. Use the graph of $y = 3 \cdot 2^x$. What is the y -intercept?



Answer: _____



◆ 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

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

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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