| | |
|---|---|
| | $x$-intercepts: none; $y$-intercept: 1<br>Horizontal asymptote: $x$-axis ($y = 0$) as $x \to -\infty$<br>Increasing; one-to-one; smooth; continuous<br>See Figure 21 for a typical graph. |
| $f(x) = a^x, \quad 0 < a < 1$ | Domain: the interval $(-\infty, \infty)$; range: the interval $(0, \infty)$<br>$x$-intercepts: none; $y$-intercept: 1<br>Horizontal asymptote: $x$-axis ($y = 0$) as $x \to \infty$<br>Decreasing; one-to-one; smooth; continuous<br>See Figure 25 for a typical graph. |

If $a^u = a^v$, then $u = v$.

## 5.3 Assess Your Understanding

**'Are You Prepared?'** *Answers are given at the end of these exercises. If you get a wrong answer, read the pages listed in red.*

1. $4^3 =$ ____; $8^{2/3} =$ ____; $3^{-2} =$ ____. (pp. A7–A9 and pp. A81–A87)
2. Solve: $x^2 + 3x = 4$ (pp. A44–A51)
3. ***True or False*** To graph $y = (x - 2)^3$, shift the graph of $y = x^3$ to the left 2 units. (pp. 90–99)
4. Find the average rate of change of $f(x) = 3x - 5$ from $x = 0$ to $x = 4$. (pp. 74–76; 118–121)
5. ***True or False*** The function $f(x) = \dfrac{2x}{x - 3}$ has $y = 2$ as a horizontal asymptote. (pp. 191–192)

### Concepts and Vocabulary

6. A(n) _____ _____ is a function of the form $f(x) = Ca^x$, where $a > 0, a \neq 1$, and $C \neq 0$ are real numbers. The base $a$ is the _____ _____ and $C$ is the _____ _____.
7. For an exponential function $f(x) = Ca^x$, $\dfrac{f(x + 1)}{f(x)} =$ ____.
8. ***True or False*** The domain of the exponential function $f(x) = a^x$, where $a > 0$ and $a \neq 1$, is the set of all real numbers.
9. ***True or False*** The range of the exponential function $f(x) = a^x$, where $a > 0$ and $a \neq 1$, is the set of all real numbers.
10. ***True or False*** The graph of the exponential function $f(x) = a^x$, where $a > 0$ and $a \neq 1$, has no $x$-intercept.
11. The graph of every exponential function $f(x) = a^x$, where $a > 0$ and $a \neq 1$, passes through three points: ____, ____, and ____.
12. If the graph of the exponential function $f(x) = a^x$, where $a > 0$ and $a \neq 1$, is decreasing, then $a$ must be less than ____.
13. If $3^x = 3^4$, then $x =$ ____.
14. ***True or False*** The graphs of $y = 3^x$ and $y = \left(\dfrac{1}{3}\right)^x$ are identical.

### Skill Building

*In Problems 15–24, approximate each number using a calculator. Express your answer rounded to three decimal places.*

15. (a) $3^{2.2}$ (b) $3^{2.23}$ (c) $3^{2.236}$ (d) $3^{\sqrt{5}}$
16. (a) $5^{1.7}$ (b) $5^{1.73}$ (c) $5^{1.732}$ (d) $5^{\sqrt{3}}$
17. (a) $2^{3.14}$ (b) $2^{3.141}$ (c) $2^{3.1415}$ (d) $2^{\pi}$
18. (a) $2^{2.7}$ (b) $2^{2.71}$ (c) $2^{2.718}$ (d) $2^{e}$
19. (a) $3.1^{2.7}$ (b) $3.14^{2.71}$ (c) $3.141^{2.718}$ (d) $\pi^{e}$
20. (a) $2.7^{3.1}$ (b) $2.71^{3.14}$ (c) $2.718^{3.141}$ (d) $e^{\pi}$
21. $e^{1.2}$
22. $e^{-1.3}$
23. $e^{-0.85}$
24. $e^{2.1}$



*In Problems 25–32, determine whether the given function is linear, exponential, or neither. For those that are linear functions, find a linear function that models the data; for those that are exponential, find an exponential function that models the data.*

25.

| x | f(x) |
|---|---|

26.

| x | g(x) |
|---|---|

27.

| x | H(x) |
|---|---|
| | 1 |

28.

| x | F(x) |
|---|---|
| | 2 |