

4.2 SECTION EXERCISES

VERBAL

1. What role does the horizontal asymptote of an exponential function play in telling us about the end behavior of the graph?
2. What is the advantage of knowing how to recognize transformations of the graph of a parent function algebraically?

ALGEBRAIC

3. The graph of $f(x) = 3^x$ is reflected about the y -axis and stretched vertically by a factor of 4. What is the equation of the new function, $g(x)$? State its y -intercept, domain, and range.
4. The graph of $f(x) = \left(\frac{1}{2}\right)^{-x}$ is reflected about the y -axis and compressed vertically by a factor of $\frac{1}{5}$. What is the equation of the new function, $g(x)$? State its y -intercept, domain, and range.
5. The graph of $f(x) = 10^x$ is reflected about the x -axis and shifted upward 7 units. What is the equation of the new function, $g(x)$? State its y -intercept, domain, and range.
6. The graph of $f(x) = (1.68)^x$ is shifted right 3 units, stretched vertically by a factor of 2, reflected about the x -axis, and then shifted downward 3 units. What is the equation of the new function, $g(x)$? State its y -intercept (to the nearest thousandth), domain, and range.
7. The graph of $f(x) = -\frac{1}{2}\left(\frac{1}{4}\right)^{x-2} + 4$ is shifted downward 4 units, and then shifted left 2 units, stretched vertically by a factor of 4, and reflected about the x -axis. What is the equation of the new function, $g(x)$? State its y -intercept, domain, and range.

GRAPHICAL

For the following exercises, graph the function and its reflection about the y -axis on the same axes, and give the y -intercept.

8. $f(x) = 3\left(\frac{1}{2}\right)^x$

9. $g(x) = -2(0.25)^x$

10. $h(x) = 6(1.75)^{-x}$

For the following exercises, graph each set of functions on the same axes.

11. $f(x) = 3\left(\frac{1}{4}\right)^x$, $g(x) = 3(2)^x$, and $h(x) = 3(4)^x$

12. $f(x) = \frac{1}{4}(3)^x$, $g(x) = 2(3)^x$, and $h(x) = 4(3)^x$

For the following exercises, match each function with one of the graphs in **Figure 12**.

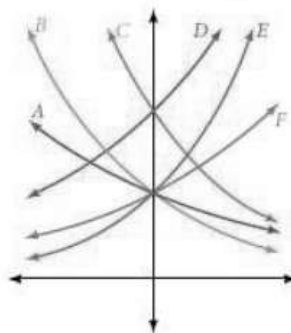


Figure 12

13. $f(x) = 2(0.69)^x$

14. $f(x) = 2(1.28)^x$

15. $f(x) = 2(0.81)^x$

16. $f(x) = 4(1.28)^x$

17. $f(x) = 2(1.59)^x$

18. $f(x) = 4(0.69)^x$

For the following exercises, use the graphs shown in **Figure 13**. All have the form $f(x) = ab^x$.

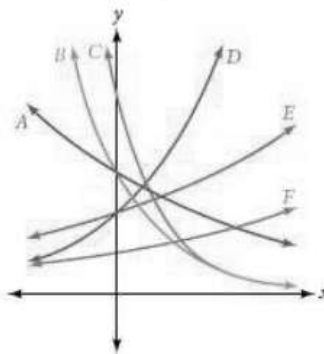


Figure 13

19. Which graph has the largest value for b ?
 20. Which graph has the smallest value for b ?
 21. Which graph has the largest value for a ?
 22. Which graph has the smallest value for a ?

For the following exercises, graph the function and its reflection about the x -axis on the same axes.

23. $f(x) = \frac{1}{2}(4)^x$ 24. $f(x) = 3(0.75)^x - 1$ 25. $f(x) = -4(2)^x + 2$

For the following exercises, graph the transformation of $f(x) = 2^x$. Give the horizontal asymptote, the domain, and the range.

26. $f(x) = 2^{-x}$ 27. $h(x) = 2^x + 3$ 28. $f(x) = 2^{x-2}$

For the following exercises, describe the end behavior of the graphs of the functions.

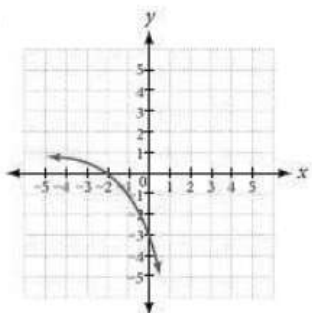
29. $f(x) = -5(4)^x - 1$ 30. $f(x) = 3\left(\frac{1}{2}\right)^x - 2$ 31. $f(x) = 3(4)^{-x} + 2$

For the following exercises, start with the graph of $f(x) = 4^x$. Then write a function that results from the given transformation.

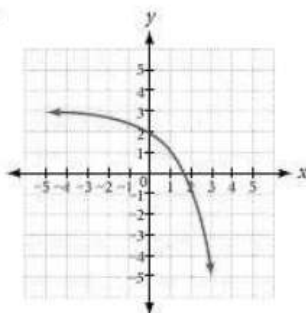
32. Shift $f(x)$ 4 units upward 33. Shift $f(x)$ 3 units downward 34. Shift $f(x)$ 2 units left
 35. Shift $f(x)$ 5 units right 36. Reflect $f(x)$ about the x -axis 37. Reflect $f(x)$ about the y -axis

For the following exercises, each graph is a transformation of $y = 2^x$. Write an equation describing the transformation.

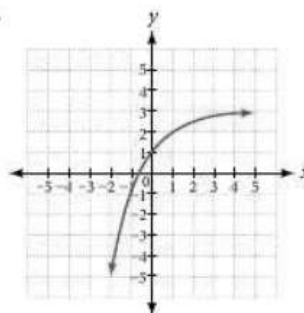
38.



39.

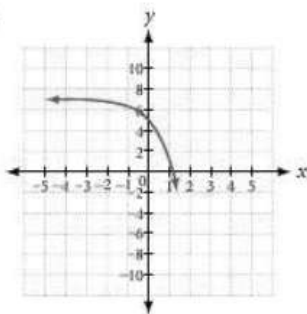


40.

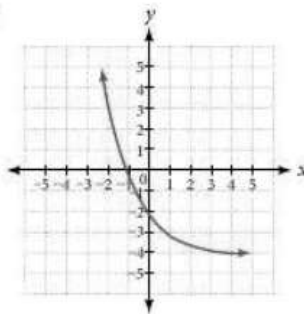


For the following exercises, find an exponential equation for the graph.

41.



42.



NUMERIC

For the following exercises, evaluate the exponential functions for the indicated value of x .

43. $g(x) = \frac{1}{3}(7)^{x-2}$ for $g(6)$.

44. $f(x) = 4(2)^{x-1} - 2$ for $f(5)$.

45. $h(x) = -\frac{1}{2}\left(\frac{1}{2}\right)^x + 6$ for $h(-7)$.

TECHNOLOGY

For the following exercises, use a graphing calculator to approximate the solutions of the equation. Round to the nearest thousandth. $f(x) = ab^x + d$.

46. $-50 = -\left(\frac{1}{2}\right)^{-x}$

47. $116 = \frac{1}{4}\left(\frac{1}{8}\right)^x$

48. $12 = 2(3)^x + 1$

49. $5 = 3\left(\frac{1}{2}\right)^{x-1} - 2$

50. $-30 = -4(2)^{x+2} + 2$

EXTENSIONS

51. Explore and discuss the graphs of $f(x) = (b)^x$ and $g(x) = \left(\frac{1}{b}\right)^x$. Then make a conjecture about the relationship between the graphs of the functions b^x and $\left(\frac{1}{b}\right)^x$ for any real number $b > 0$.

53. Explore and discuss the graphs of $f(x) = 4^x$, $g(x) = 4^{x-2}$, and $h(x) = \left(\frac{1}{16}\right)4^x$. Then make a conjecture about the relationship between the graphs of the functions b^x and $\left(\frac{1}{b^n}\right)b^x$ for any real number n and real number $b > 0$.

52. Prove the conjecture made in the previous exercise.

54. Prove the conjecture made in the previous exercise.

