

Study Guide and Review - Chapter 7

Choose a word or term from the list above that best completes each statement or phrase.

1. A function of the form $f(x) = b^x$ where $b > 1$ is a(n) _____ function.

ANSWER:

exponential growth

2. In $x = b^y$, the variable y is called the _____ of x .

ANSWER:

logarithm

3. Base 10 logarithms are called _____.

ANSWER:

common logarithms

4. A(n) _____ is an equation in which variables occur as exponents.

ANSWER:

exponential equation

5. The _____ allows you to write equivalent logarithmic expressions that have different bases.

ANSWER:

change of base formula

6. The base of the exponential function, $A(t) = a(1 - r)^t$, $1 - r$ is called the _____.

ANSWER:

decay factor

7. The function $y = \log_b x$, where $b > 0$ and $b \neq 1$, is called a(n) _____.

ANSWER:

logarithmic function

8. An exponential function with base e is called the _____.

ANSWER:

natural base exponential function

9. The logarithm with base e is called the _____.

ANSWER:

natural logarithm

10. The number e is referred to as the _____.

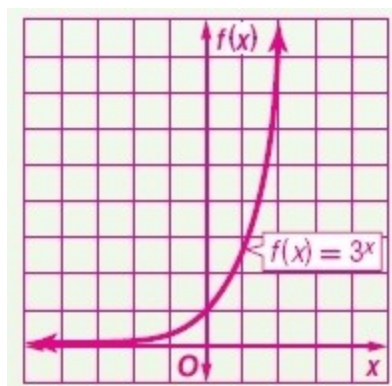
ANSWER:

natural base

Graph each function. State the domain and range.

11. $f(x) = 3^x$

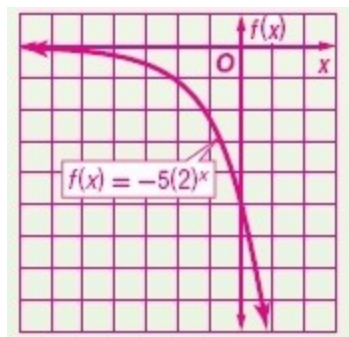
ANSWER:



$$D = \{\text{all real numbers}\} \quad R = \{f(x) \mid f(x) > 0\}$$

12. $f(x) = -5(2)^x$

ANSWER:

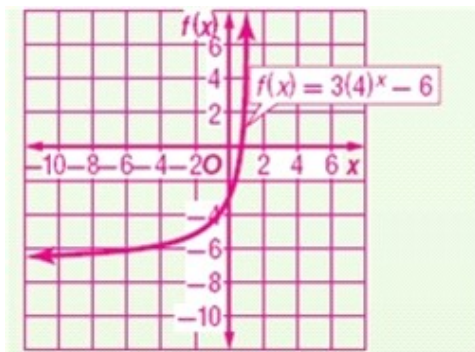


$$D = \{\text{all real numbers}\} \quad R = \{f(x) \mid f(x) < 0\}$$

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13. $f(x) = 3(4)^x - 6$

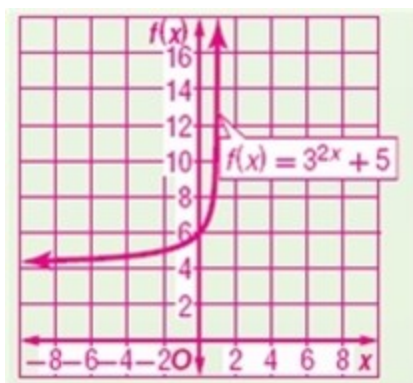
ANSWER:



$D = \{\text{all real numbers}\}$ $R = \{f(x) \mid f(x) > -6\}$

14. $f(x) = 3^{2x} + 5$

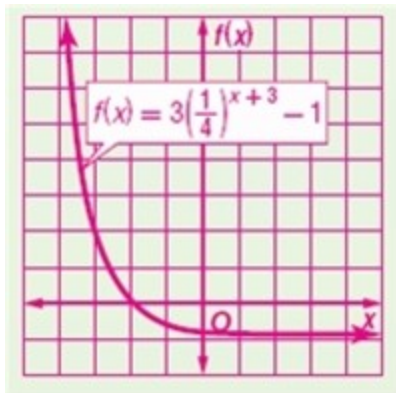
ANSWER:



$D = \{\text{all real numbers}\}$ $R = \{f(x) \mid f(x) > 5\}$

15. $f(x) = 3\left(\frac{1}{4}\right)^{x+3} - 1$

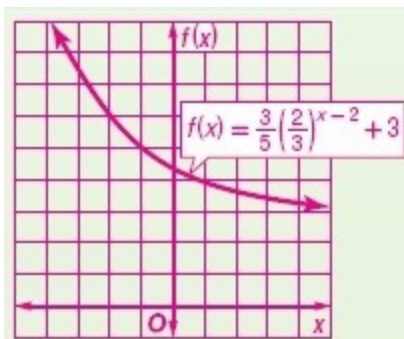
ANSWER:



$D = \{\text{all real numbers}\}$ $R = \{f(x) \mid f(x) > -1\}$

16. $f(x) = \frac{3}{5}\left(\frac{2}{3}\right)^{x-2} + 3$

ANSWER:



$D = \{\text{all real numbers}\}$ $R = \{f(x) \mid f(x) > 3\}$

17. **POPULATION** A city with a population of 120,000 decreases at a rate of 3% annually.

- Write the function that represents this situation.
- What will the population be in 10 years?

ANSWER:

- $f(x) = 120,000(0.97)^x$
- about 88,491

Solve each equation or inequality.

18. $16^x = \frac{1}{64}$

ANSWER:

$-\frac{3}{2}$

19. $3^{4x} = 9^{3x+7}$

ANSWER:

-7

20. $64^{3n} = 8^{2n-3}$

ANSWER:

$-\frac{3}{4}$

21. $8^{3-3y} = 256^{4y}$

ANSWER:

$\frac{9}{41}$

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22. $9^{x-2} > \left(\frac{1}{81}\right)^{x+2}$

ANSWER:

$$x > -\frac{2}{3}$$

23. $27^{3x} \leq 9^{2x-1}$

ANSWER:

$$x \leq -\frac{2}{5}$$

24. **BACTERIA** A bacteria population started with 5000 bacteria. After 8 hours there were 28,000 in the sample.

a. Write an exponential function that could be used to model the number of bacteria after x hours if the number of bacteria changes at the same rate.

b. How many bacteria can be expected in the sample after 32 hours?

ANSWER:

a. $y = 5000(1.240)^x$

b. about 4,880,496

25. Write $\log_2 \frac{1}{16} = -4$ in exponential form.

ANSWER:

$$2^{-4} = \frac{1}{16}$$

26. Write $10^2 = 100$ in logarithmic form.

ANSWER:

$$\log_{10} 100 = 2$$

Evaluate each expression.

27. $\log_4 256$

ANSWER:

$$4$$

28. $\log_2 \frac{1}{8}$

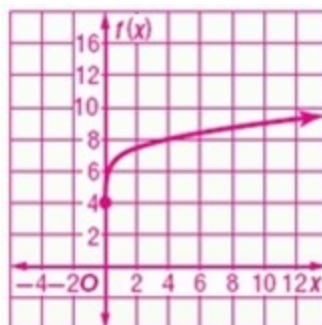
ANSWER:

$$-3$$

Graph each function.

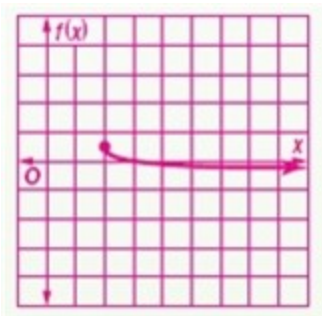
29. $f(x) = 2 \log_{10} x + 4$

ANSWER:



30. $f(x) = \frac{1}{6} \log_{\frac{1}{3}} (x-2)$

ANSWER:



Solve each equation or inequality.

31. $\log_{16} x = \frac{3}{2}$

ANSWER:

$$64$$

32. $\log_2 \frac{1}{64} = x$

ANSWER:

$$-6$$

33. $\log_4 x < 3$

ANSWER:

$$\{x | 0 < x < 64\}$$

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34. $\log_5 x < -3$

ANSWER:

$$\left\{ x \mid 0 < x < \frac{1}{125} \right\}$$

35. $\log_9 (3x - 1) = \log_9 (4x)$

ANSWER:

no solution

36. $\log_2 (x^2 - 18) = \log_2 (-3x)$

ANSWER:

-6

37. $\log_3 (3x + 4) \leq \log_3 (x - 2)$

ANSWER:

no solution

38. **EARTHQUAKE** The magnitude of an earthquake is measured on a logarithmic scale called the Richter scale. The magnitude M is given by $M = \log_{10} x$, where x represents the amplitude of the seismic wave causing ground motion. How many times as great is the amplitude caused by an earthquake with a Richter scale rating of 10 as an aftershock with a Richter scale rating of 7?

ANSWER:

1000

Use $\log_5 16 \approx 1.7227$ and $\log_5 2 \approx 0.4307$ to approximate the value of each expression.

39. $\log_5 8$

ANSWER:

1.2920

40. $\log_5 64$

ANSWER:

2.5841

41. $\log_5 4$

ANSWER:

0.8614

42. $\log_5 \frac{1}{8}$

ANSWER:

-1.2921

43. $\log_5 \frac{1}{2}$

ANSWER:

-0.4307

Solve each equation. Check your solution.

44. $\log_5 x - \log_5 2 = \log_5 15$

ANSWER:

30

45. $3 \log_4 a = \log_4 27$

ANSWER:

3

46. $2 \log_3 x + \log_3 3 = \log_3 36$

ANSWER:

$2\sqrt{3}$

47. $\log_4 n + \log_4 (n - 4) = \log_4 5$

ANSWER:

5

48. **SOUND** Use the formula $L = 10 \log_{10} R$, where L is the loudness of a sound and R is the sound's relative intensity, to find out how much louder 20 people talking would be than one person talking. Suppose the sound of one person talking has a relative intensity of 80 decibels.

ANSWER:

361.6

Solve each equation or inequality. Round to the nearest ten-thousandth.

49. $3^x = 15$

ANSWER:

$x \approx 2.4650$

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50. $6^{x^2} = 28$

ANSWER:

$$x \approx \pm 1.3637$$

51. $8^{m+1} = 30$

ANSWER:

$$m \approx 0.6356$$

52. $12^{r-1} = 7^r$

ANSWER:

$$r \approx 4.6102$$

53. $3^{5n} > 24$

ANSWER:

$$\{n | n > 0.5786\}$$

54. $5^{x+2} \leq 3^x$

ANSWER:

$$\{x | x \leq -6.3013\}$$

55. **SAVINGS** You deposited \$1000 into an account that pays an annual interest rate r of 5% compounded

quarterly. Use $A = P\left(1 + \frac{r}{n}\right)^{nt}$.

a. How long will it take until you have \$1500 in your account?

b. How long will it take for your money to double?

ANSWER:

a. about 8.2 years

b. about 13.9 years

Solve each equation or inequality. Round to the nearest ten-thousandth.

56. $4e^x - 11 = 17$

ANSWER:

$$x \approx 1.9459$$

57. $2e^{-x} + 1 = 15$

ANSWER:

$$x \approx -1.9459$$

58. $\ln 2x = 6$

ANSWER:

$$x \approx 201.7144$$

59. $2 + e^x > 9$

ANSWER:

$$\{x | x > 1.9459\}$$

60. $\ln(x+3)^5 < 5$

ANSWER:

$$\{x | -3 < x < -0.2817\}$$

61. $e^{-x} > 18$

ANSWER:

$$\{x | x < -2.8904\}$$

62. **SAVINGS** If you deposit \$2000 in an account paying 6.4% interest compounded continuously, how long will it take for your money to triple? Use $A = Pe^{rt}$.

ANSWER:

about 17.2 years

63. **CARS** Abe bought a used car for \$2500. It is expected to depreciate at a rate of 25% per year. What will be the value of the car in 3 years?

ANSWER:

Sample answer: \$1054.69

64. **BIOLOGY** For a certain strain of bacteria, k is 0.728 when t is measured in days. Using the formula $y = ae^{kt}$, how long will it take 10 bacteria to increase to 675 bacteria?

ANSWER:

≈ 5.8 days

65. **POPULATION** The population of a city 20 years ago was 24,330. Since then, the population has increased at a steady rate each year. If the population is currently 55,250, find the annual rate of growth for this city.

ANSWER:

about 4.1%