NAME _____ DATE _____ PERIOD ____

9-2 Skills Practice

Logarithms and Logarithmic Functions

Write each equation in logarithmic form.

1. $2^3 = 8$ $\log_2 8 = 3$
2. $3^2 = 9$ $\log_3 9 = 2$
3. $8^{-2} = \frac{1}{64}$ $\log_8 \frac{1}{64} = -2$
4. $\left(\frac{1}{3}\right)^2 = \frac{1}{9}$ $\log_{\frac{1}{3}} \frac{1}{9} = 2$

Write each equation in exponential form.

5. $\log_3 243 = 5$ $3^5 = 243$
6. $\log_4 64 = 3$ $4^3 = 64$
7. $\log_9 3 = \frac{1}{2}$ $9^{\frac{1}{2}} = 3$
8. $\log_5 \frac{1}{25} = -2$ $5^{-2} = \frac{1}{25}$

Evaluate each expression.

9. $\log_5 25$ 2
10. $\log_9 3$ $\frac{1}{2}$
11. $\log_{10} 1000$ 3
12. $\log_{125} 5$ $\frac{1}{3}$
13. $\log_4 \frac{1}{64}$ -3
14. $\log_5 \frac{1}{625}$ -4
15. $\log_8 8^3$ 3
16. $\log_{27} \frac{1}{3}$ $-\frac{1}{3}$

Solve each equation or inequality. Check your solutions.

17. $\log_3 x = 5$ 243
18. $\log_2 x = 3$ 8
19. $\log_4 y < 0$ $0 < y < 1$
20. $\log_{\frac{1}{4}} x = 3$ $\frac{1}{64}$
21. $\log_2 n > -2$ $n > \frac{1}{4}$
22. $\log_b 3 = \frac{1}{2}$ 9
23. $\log_6 (4x + 12) = 2$ 6
24. $\log_2 (4x - 4) > 5$ $x > 9$
25. $\log_3 (x + 2) = \log_3 (3x)$ 1
26. $\log_6 (3y - 5) \geq \log_6 (2y + 3)$ $y \geq 8$

NAME _____ DATE _____ PERIOD ____

9-2 Practice

Logarithms and Logarithmic Functions

Write each equation in logarithmic form.

1. $5^3 = 125$ $\log_5 125 = 3$
2. $7^0 = 1$ $\log_7 1 = 0$
3. $3^4 = 81$ $\log_3 81 = 4$
4. $3^{-4} = \frac{1}{81}$ $\log_3 \frac{1}{81} = -4$
5. $\left(\frac{1}{4}\right)^3 = \frac{1}{64}$ $\log_{\frac{1}{4}} \frac{1}{64} = 3$
6. $7776^{\frac{1}{5}} = 6$ $\log_{7776} 6 = \frac{1}{5}$

Write each equation in exponential form.

7. $\log_6 216 = 3$ $6^3 = 216$
8. $\log_2 64 = 6$ $2^6 = 64$
9. $\log_3 \frac{1}{81} = -4$ $3^{-4} = \frac{1}{81}$
10. $\log_{10} 0.00001 = -5$ $10^{-5} = 0.00001$
11. $\log_{25} 5 = \frac{1}{2}$ $25^{\frac{1}{2}} = 5$
12. $\log_{32} 8 = \frac{3}{5}$ $32^{\frac{3}{5}} = 8$

Evaluate each expression.

13. $\log_3 81$ 4
14. $\log_{10} 0.0001$ -4
15. $\log_2 \frac{1}{16}$ -4
16. $\log_{\frac{1}{3}} 27$ -3
17. $\log_9 1$ 0
18. $\log_8 4$ $\frac{2}{3}$
19. $\log_7 \frac{1}{49}$ -2
20. $\log_6 6^4$ 4
21. $\log_3 \frac{1}{3}$ -1
22. $\log_4 \frac{1}{256}$ -4
23. $\log_9 9^{(n+1)}$ $n + 1$
24. $2^{\log_2 32}$ 32

Solve each equation or inequality. Check your solutions.

25. $\log_{10} n = -3$ $\frac{1}{1000}$
26. $\log_4 x > 3$ $x > 64$
27. $\log_4 x = \frac{3}{2}$ 8
28. $\log_{\frac{1}{5}} x = -3$ 125
29. $\log_7 q < 0$ $0 < q < 1$
30. $\log_6 (2y + 8) \geq 2$ $y \geq 14$
31. $\log_y 16 = -4$ $\frac{1}{2}$
32. $\log_n \frac{1}{8} = -3$ 2
33. $\log_b 1024 = 5$ 4
34. $\log_8 (3x + 7) < \log_8 (7x + 4)$ $x > \frac{3}{4}$
35. $\log_7 (8x + 20) = \log_7 (x + 6)$ -2
36. $\log_3 (x^2 - 2) = \log_3 x$ 2

37. **SOUND** An equation for loudness, in decibels, is $L = 10 \log_{10} R$, where R is the relative intensity of the sound. Sounds that reach levels of 120 decibels or more are painful to humans. What is the relative intensity of 120 decibels? 10^{12}

38. **INVESTING** Maria invests $1000 in a savings account that pays 4% interest compounded annually. The value of the account A at the end of five years can be determined from the equation $\log A = \log[1000(1 + 0.04)^5]$. Find the value of A to the nearest dollar. $1217

Answers

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9-3 Practice

Properties of Logarithms

Use $\log_{10} 5 \approx 0.6990$ and $\log_{10} 7 \approx 0.8451$ to approximate the value of each expression.

1. $\log_{10} 35$ **1.5441**
2. $\log_{10} 25$ **1.3980**
3. $\log_{10} \frac{7}{5}$ **0.1461**
4. $\log_{10} \frac{5}{7}$ **−0.1461**
5. $\log_{10} 245$ **2.3892**
6. $\log_{10} 175$ **2.2431**
7. $\log_{10} 0.2$ **−0.6990**
8. $\log_{10} \frac{25}{7}$ **0.5529**

Solve each equation. Check your solutions.

9. $\log_7 n = \frac{2}{3} \log_7 8$ **4**
10. $\log_{10} u = \frac{3}{2} \log_{10} 4$ **8**
11. $\log_6 x + \log_6 9 = \log_6 54$ **6**
12. $\log_8 48 - \log_8 w = \log_8 4$ **12**
13. $\log_9 (3u + 14) - \log_9 5 = \log_9 2u$ **2**
14. $4 \log_2 x + \log_2 5 = \log_2 405$ **3**
15. $\log_3 y = -\log_3 16 + \frac{1}{3} \log_3 64$ **$\frac{1}{4}$**
16. $\log_2 d = 5 \log_2 2 - \log_2 8$ **4**
17. $\log_{10} (3m - 5) + \log_{10} m = \log_{10} 2$ **2**
18. $\log_{10} (b + 3) + \log_{10} b = \log_{10} 4$ **1**
19. $\log_8 (t + 10) - \log_8 (t - 1) = \log_8 12$ **2**
20. $\log_3 (a + 3) + \log_3 (a + 2) = \log_3 6$ **0**
21. $\log_{10} (r + 4) - \log_{10} r = \log_{10} (r + 1)$ **2**
22. $\log_4 (x^2 - 4) - \log_4 (x + 2) = \log_4 1$ **3**
23. $\log_{10} 4 + \log_{10} w = 2$ **25**
24. $\log_8 (n - 3) + \log_8 (n + 4) = 1$ **4**
25. $3 \log_5 (x^2 + 9) - 6 = 0$ **±4**
26. $\log_{16} (9x + 5) - \log_{16} (x^2 - 1) = \frac{1}{2}$ **3**
27. $\log_6 (2x - 5) + 1 = \log_6 (7x + 10)$ **8**
28. $\log_2 (5y + 2) - 1 = \log_2 (1 - 2y)$ **0**
29. $\log_{10} (c^2 - 1) - 2 = \log_{10} (c + 1)$ **101**
30. $\log_7 x + 2 \log_7 x - \log_7 3 = \log_7 72$ **6**

31. **SOUND** Recall that the loudness L of a sound in decibels is given by $L = 10 \log_{10} R$, where R is the sound's relative intensity. If the intensity of a certain sound is tripled, by how many decibels does the sound increase? **about 4.8 db**

32. **EARTHQUAKES** An earthquake rated at 3.5 on the Richter scale is felt by many people, and an earthquake rated at 4.5 may cause local damage. The Richter scale magnitude reading m is given by $m = \log_{10} x$, where x represents the amplitude of the seismic wave causing ground motion. How many times greater is the amplitude of an earthquake that measures 4.5 on the Richter scale than one that measures 3.5? **10 times**

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9-3 Word Problem Practice

Properties of Logarithms

1. **MENTAL COMPUTATION** Jessica has memorized $\log_5 2 \approx 0.4307$ and $\log_5 3 \approx 0.6826$. Using this information, to the nearest thousandth, what power of 5 is equal to 6?
1.113

2. **POWERS** A chemist is formulating an acid. The pH of a solution is given by

$$-\log_{10} C,$$

where C is the concentration of hydrogen ions. If the concentration of hydrogen ions is increased by a factor of 100, what happens to the pH of the solution?
The pH decreases by 2.

3. **LUCKY MATH** Frank is solving a problem involving logarithms. He does everything correctly except for one thing. He mistakenly writes

$$\log_2 a + \log_2 b = \log_2 (a + b).$$

However, after substituting the values for a and b in his problem, he amazingly still gets the right answer! The value of a was 11. What must the value of b have been?
1.1

4. **LENGTHS** Charles has two poles. One pole has length equal to $\log_7 21$ and the other has length equal to $\log_7 25$. Express the length of both poles joined end to end as the logarithm of a single number.
$\log_7 525$

SIZE For Exercises 5-7, use the following information.

Alicia wanted to try to quantify the terms *puny, tiny, small, medium, large, big, huge,* and *humongous.* She picked a number of objects and classified them with these adjectives of size. She noticed that the scale seemed exponential. Therefore, she came up with the following definition. Define S to be $\frac{1}{3} \log_3 V$, where V is volume in cubic feet.

Then use the following table to find the appropriate adjective.

S satisfies	Adjective
$-2 \le S < -1$	tiny
$-1 \le S < 0$	small
$0 \le S < 1$	medium
$1 \le S < 2$	large
$2 \le S < 3$	big
$3 \le S < 4$	huge
$4 \le S < 5$	humongous

5. Derive an expression for S applied to a cube in terms of ℓ where ℓ is the side length of a cube.
$\log_3 \ell$

6. How many cubes, each one foot on a side, would have to be put together to get an object that Alicia would call "big"?
729

7. How likely is it that a large object attached to a big object would result in a huge object, according to Alicia's scale?
Not very likely; most likely the result will be big, not huge.

Answers

NAME _____ DATE _____ PERIOD ____

9-4 Skills Practice

Common Logarithms

Use a calculator to evaluate each expression to four decimal places.

1. log 6 **0.7782**
2. log 15 **1.1761**
3. log 1.1 **0.0414**
4. log 0.3 **−0.5229**

Use the formula pH = −log[$H+$] to find the pH of each substance given its concentration of hydrogen ions.

5. gastric juices: $[H+] = 1.0 \times 10^{-1}$ mole per liter **1.0**
6. tomato juice: $[H+] = 7.94 \times 10^{-5}$ mole per liter **4.1**
7. blood: $[H+] = 3.98 \times 10^{-8}$ mole per liter **7.4**
8. toothpaste: $[H+] = 1.26 \times 10^{-10}$ mole per liter **9.9**

Solve each equation or inequality. Round to four decimal places.

9. $3^x > 243$ **$\{x|x > 5\}$**
10. $16^v \leq \frac{1}{4}$ **$\left\{v\middle|v \leq -\frac{1}{2}\right\}$**
11. $8^p = 50$ **1.8813**
12. $7^y = 15$ **1.3917**
13. $5^{3b} = 106$ **0.9659**
14. $4^{5k} = 37$ **0.5209**
15. $12^{7p} = 120$ **0.2752**
16. $9^{2m} = 27$ **0.75**
17. $3^{r-5} = 4.1$ **6.2843**
18. $8^{y+4} > 15$ **$\{y|y > -2.6977\}$**
19. $7.6^{d+3} = 57.2$ **−1.0048**
20. $0.5^{t-8} = 16.3$ **3.9732**
21. $42^{x^2} = 84$ **±1.0888**
22. $5^{x^2+1} = 10$ **±0.6563**

Express each logarithm in terms of common logarithms. Then approximate its value to four decimal places.

23. $\log_3 7$ **$\frac{\log_{10} 7}{\log_{10} 3}$; 1.7712**
24. $\log_5 66$ **$\frac{\log_{10} 66}{\log_{10} 5}$; 2.6032**
25. $\log_2 35$ **$\frac{\log_{10} 35}{\log_{10} 2}$; 5.1293**
26. $\log_6 10$ **$\frac{\log_{10} 10}{\log_{10} 6}$; 1.2851**

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9-4 Practice

Common Logarithms

Use a calculator to evaluate each expression to four decimal places.

1. log 101 **2.0043**
2. log 2.2 **0.3424**
3. log 0.05 **−1.3010**

Use the formula pH = −log[$H+$] to find the pH of each substance given its concentration of hydrogen ions.

4. milk: $[H+] = 2.51 \times 10^{-7}$ mole per liter **6.6**
5. acid rain: $[H+] = 2.51 \times 10^{-6}$ mole per liter **5.6**
6. black coffee: $[H+] = 1.0 \times 10^{-5}$ mole per liter **5.0**
7. milk of magnesia: $[H+] = 3.16 \times 10^{-11}$ mole per liter **10.5**

Solve each equation or inequality. Round to four decimal places.

8. $2^x < 25$ **$\{x|x < 4.6439\}$**
9. $5^a = 120$ **2.9746**
10. $6^z = 45.6$ **2.1319**
11. $9^m \geq 100$ **$\{m|m \geq 2.0959\}$**
12. $3.5^x = 47.9$ **3.0885**
13. $8.2^y = 64.5$ **1.9802**
14. $2^{b+1} \leq 7.31$ **$\{b|b \leq 1.8699\}$**
15. $4^{2x} = 27$ **1.1887**
16. $2^{a-4} = 82.1$ **10.3593**
17. $9^{z-2} > 38$ **$\{z|z > 3.6555\}$**
18. $5^{w+3} = 17$ **−1.2396**
19. $30^{x^2} = 50$ **±1.0725**
20. $5^{x^2-3} = 72$ **±2.3785**
21. $4^{2x} = 9^{x+1}$ **3.8188**
22. $2^{n+1} = 5^{2n-1}$ **0.9117**

Express each logarithm in terms of common logarithms. Then approximate its value to four decimal places.

23. $\log_5 12$ **$\frac{\log_{10} 12}{\log_{10} 5}$; 1.5440**
24. $\log_8 32$ **$\frac{\log_{10} 32}{\log_{10} 8}$; 1.6667**
25. $\log_{11} 9$ **$\frac{\log_{10} 9}{\log_{10} 11}$; 0.9163**
26. $\log_2 18$ **$\frac{\log_{10} 18}{\log_{10} 2}$; 4.1699**
27. $\log_9 6$ **$\frac{\log_{10} 6}{\log_{10} 9}$; 0.8155**
28. $\log_7 \sqrt{8}$ **$\frac{\log_{10} 8}{2 \log_{10} 7}$; 0.5343**

29. **HORTICULTURE** Siberian irises flourish when the concentration of hydrogen ions [$H+$] in the soil is not less than 1.58×10^{-8} mole per liter. What is the pH of the soil in which these irises will flourish? **7.8 or less**
30. **ACIDITY** The pH of vinegar is 2.9 and the pH of milk is 6.6. How many times greater is the hydrogen ion concentration of vinegar than of milk? **about 5000**
31. **BIOLOGY** There are initially 1000 bacteria in a culture. The number of bacteria doubles each hour. The number of bacteria N present after t hours is $N = 1000(2)^t$. How long will it take the culture to increase to 50,000 bacteria? **about 5.6 h**
32. **SOUND** An equation for loudness L in decibels is given by $L = 10 \log R$, where R is the sound's relative intensity. An air-raid siren can reach 150 decibels and jet engine noise can reach 120 decibels. How many times greater is the relative intensity of the air-raid siren than that of the jet engine noise? **1000**

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9-5 Practice

Base e and Natural Logarithms

Use a calculator to evaluate each expression to four decimal places.

1. $e^{1.5}$ 4.4817
2. $\ln 8$ 2.0794
3. $\ln 3.2$ 1.1632
4. $e^{-0.6}$ 0.5488
5. $e^{4.2}$ 66.6863
6. $\ln 1$ 0
7. $e^{-2.5}$ 0.0821
8. $\ln 0.037$ −3.2968

Write an equivalent exponential or logarithmic equation.

9. $\ln 50 = x$ — $e^x = 50$
10. $\ln 36 = 2x$ — $e^{2x} = 36$
11. $\ln 6 \approx 1.7918$ — $e^{1.7918} \approx 6$
12. $\ln 9.3 \approx 2.2300$ — $e^{2.2300} \approx 9.3$
13. $e^x = 8$ — $x = \ln 8$
14. $e^5 = 10x$ — $5 = \ln 10x$
15. $e^{-x} = 4$ — $x = -\ln 4$
16. $e^2 = x + 1$ — $2 = \ln (x + 1)$

Evaluate each expression.

17. $e^{\ln 12}$ 12
18. $e^{\ln 3x}$ $3x$
19. $\ln e^{-1}$ −1
20. $\ln e^{-2y}$ $-2y$

Solve each equation or inequality.

21. $e^x < 9$ — $\{x|x < 2.1972\}$
22. $e^{-x} = 31$ — −3.4340
23. $e^x = 1.1$ — 0.0953
24. $e^x = 5.8$ — 1.7579
25. $2e^x - 3 = 1$ — 0.6931
26. $5e^x + 1 \geq 7$ — $\{x|x \geq 0.1823\}$
27. $4 + e^x = 19$ — 2.7081
28. $-3e^x + 10 < 8$ — $\{x|x > -0.4055\}$
29. $e^{3x} = 8$ — 0.6931
30. $e^{-4x} = 5$ — −0.4024
31. $e^{0.5x} = 6$ — 3.5835
32. $2e^{5x} = 24$ — 0.4970
33. $e^{2x} + 1 = 55$ — 1.9945
34. $e^{3x} - 5 = 32$ — 1.2036
35. $9 + e^{2x} = 10$ — 0
36. $e^{-3x} + 7 \geq 15$ — $\{x|x \leq -0.6931\}$
37. $\ln 4x = 3$ — 5.0214
38. $\ln (-2x) = 7$ — −548.3166
39. $\ln 2.5x = 10$ — 8810.5863
40. $\ln (x - 6) = 1$ — 8.7183
41. $\ln (x + 2) = 3$ — 18.0855
42. $\ln (x + 3) = 5$ — 145.4132
43. $\ln 3x + \ln 2x = 9$ — 36.7493
44. $\ln 5x + \ln x = 7$ — 14.8097

INVESTING For Exercises 45 and 46, use the formula for continuously compounded interest, $A = Pe^{rt}$, where P is the principal, r is the annual interest rate, and t is the time in years.

45. If Sarita deposits $1000 in an account paying 3.4% annual interest compounded continuously, what is the balance in the account after 5 years? $1185.30

46. How long will it take the balance in Sarita's account to reach $2000? about 20.4 yr

47. **RADIOACTIVE DECAY** The amount of a radioactive substance y that remains after t years is given by the equation $y = ae^{kt}$, where a is the initial amount present and k is the decay constant for the radioactive substance. If $a = 100$, $y = 50$, and $k = -0.035$, find t. about 19.8 yr

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9-5 Word Problem Practice

Base e and Natural Logarithms

1. **INTEREST** Horatio opens a bank account that pays 2.3% annual interest compounded continuously. He makes an initial deposit of 10,000. What will be the balance of the account in 10 years? Assume that he makes no additional deposits and no withdrawals.
$12,586

2. **INTEREST** Janie's bank pays 2.8% annual interest compounded continuously on savings accounts. She placed $2000 in the account. How long will it take for her initial deposit to double in value? Assume that she makes no additional deposits and no withdrawals. Round your answer to the nearest quarter year.
24.75 yr

3. **BACTERIA** A bacterial population grows exponentially, doubling every 72 hours. Let P be the initial population size and let t be time in hours. Write a formula using the natural base exponential function that gives the size of the population as a function of P and t.
$P = e^{\frac{\ln 2}{72}t}$

4. **POPULATION** The equation $A = A_0e^{rt}$ describes the growth of the world's population where A is the population at time t, A_0 is the population at $t = 0$, and r is the annual growth rate. How long will take a population of 6.5 billion to increase to 9 billion if the annual growth rate is 2%?
16.3 yr

MONEY MANAGEMENT For Exercises 5–7, use the following information.

Linda wants to invest $20,000. She is looking at two possible accounts. Account A is a standard savings account that pays 3.4% annual interest compounded continuously. Account B would pay her a fixed amount of $200 every quarter.

5. If Linda can invest the money for 5 years only, which account would give her the higher return on her investment? How much more money would she make by choosing the higher paying account?
Account B; she'll make $24000 − $23706.10 = $293.90 more

6. If Linda can invest the money for 10 years only, which account would give her the higher return on her investment? How much more money would she make by choosing the higher paying account?
Account A; she'll make $28098.95 − $28000 = $98.95 more

7. If Linda can invest the money for 20 years only, which account would give her the higher return on her investment? How much more money would she make by choosing the higher paying account?
Account A; she'll make $39477.55 − $36000 = $3477.55 more

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9-6 Skills Practice

Exponential Growth and Decay

1. **FISHING** In an over-fished area, the catch of a certain fish is decreasing at an average rate of 8% per year. If this decline persists, how long will it take for the catch to reach half of the amount before the decline? **about 8.3 yr**

2. **INVESTING** Alex invests $2000 in an account that has a 6% annual rate of growth. To the nearest year, when will the investment be worth $3600? **10 yr**

3. **POPULATION** A current census shows that the population of a city is 3.5 million. Using the formula $P = ae^{rt}$, find the expected population of the city in 30 years if the growth rate r of the population is 1.5% per year, a represents the current population in millions, and t represents the time in years. **about 5.5 million**

4. **POPULATION** The population P in thousands of a city can be modeled by the equation $P = 80e^{0.015t}$, where t is the time in years. In how many years will the population of the city be 120,000? **about 27 yr**

5. **BACTERIA** How many days will it take a culture of bacteria to increase from 2000 to 50,000 if the growth rate per day is 93.2%? **about 4.9 days**

6. **NUCLEAR POWER** The element plutonium-239 is highly radioactive. Nuclear reactors can produce and also use this element. The heat that plutonium-239 emits has helped to power equipment on the moon. If the half-life of plutonium-239 is 24,360 years, what is the value of k for this element? **about 0.00002845**

7. **DEPRECIATION** A Global Positioning Satellite (GPS) system uses satellite information to locate ground position. Abu's surveying firm bought a GPS system for $12,500. The GPS depreciated by a fixed rate of 6% and is now worth $8600. How long ago did Abu buy the GPS system? **about 6.0 yr**

8. **BIOLOGY** In a laboratory, an organism grows from 100 to 250 in 8 hours. What is the hourly growth rate in the growth formula $y = a(1 + r)^t$? **about 12.13%**

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9-6 Practice

Exponential Growth and Decay

1. **INVESTING** The formula $A = P\left(1 + \frac{r}{2}\right)^{2t}$ gives the value of an investment after t years in an account that earns an annual interest rate r compounded twice a year. Suppose $500 is invested at 6% annual interest compounded twice a year. In how many years will the investment be worth $1000? **about 11.7 yr**

2. **BACTERIA** How many hours will it take a culture of bacteria to increase from 20 to 2000 if the growth rate per hour is 85%? **about 7.5 h**

3. **RADIOACTIVE DECAY** A radioactive substance has a half-life of 32 years. Find the constant k in the decay formula for the substance. **about 0.02166**

4. **DEPRECIATION** A piece of machinery valued at $250,000 depreciates at a fixed rate of 12% per year. After how many years will the value have depreciated to $100,000? **about 7.2 yr**

5. **INFLATION** For Dave to buy a new car comparably equipped to the one he bought 8 years ago would cost $12,500. Since Dave bought the car, the inflation rate for cars like his has been at an average annual rate of 5.1%. If Dave originally paid $8400 for the car, how long ago did he buy it? **about 8 yr**

6. **RADIOACTIVE DECAY** Cobalt, an element used to make alloys, has several isotopes. One of these, cobalt-60, is radioactive and has a half-life of 5.7 years. Cobalt-60 is used to trace the path of nonradioactive substances in a system. What is the value of k for Cobalt-60? **about 0.1216**

7. **WHALES** Modern whales appeared 5–10 million years ago. The vertebrae of a whale discovered by paleontologists contain roughly 0.25% as much carbon-14 as they would have contained when the whale was alive. How long ago did the whale die? Use $k = 0.00012$. **about 50,000 yr**

8. **POPULATION** The population of rabbits in an area is modeled by the growth equation $P(t) = 8e^{0.26t}$, where P is in thousands and t is in years. How long will it take for the population to reach 25,000? **about 4.4 yr**

9. **DEPRECIATION** A computer system depreciates at an average rate of 4% per month. If the value of the computer system was originally $12,000, in how many months is it worth $7350? **about 12 mo**

10. **BIOLOGY** In a laboratory, a culture increases from 30 to 195 organisms in 5 hours. What is the hourly growth rate in the growth formula $y = a(1 + r)^t$? **about 45.4%**

Answers