RLP-ALG2B · RLP Algebra 2B — Logarithms, Transformations, Trigonometry and Statistical Inference

Unit 1: Exponential Functions and Logarithms

Practice Workbook. The same problems, in the same order, as the Practice sections of the online lessons.

Name _____ Period _____

Lesson 1.1 — Exponential Growth and Decay, Rewritten

FLUENCY

1. A quantity starts at 2,500 and grows by 12% each year. Write a model and find its value after 5 years, to the nearest whole number.

2. A quantity starts at 500 and grows by 12% each year. Write a model and find its value after 12 years, to the nearest whole number.

3. A quantity starts at 500 and grows by 12% each year. Write a model and find its value after 15 years, to the nearest whole number.

4. A quantity starts at 1,200 and decreases by 2% each year. Write a model and find its value after 10 years, to the nearest whole number.

5. A quantity starts at 500 and decreases by 6% each year. Write a model and find its value after 14 years, to the nearest whole number.

6. A quantity starts at 8,000 and decreases by 4% each year. Write a model and find its value after 11 years, to the nearest whole number.

7. $V(t) = 500(1.06)^t$, t in years. Rewrite to show the monthly growth factor and the per-decade growth factor.

8. A medication (illustrative) has a half-life of 6 hours. What fraction remains after 24 hours, and what is the hourly decay factor?

9. Rewrite $200 \cdot 3^{t/4}$ to show the growth factor per unit of time.

APPLICATION

10. Missouri grew about 0.27% a year in the 2010s. What growth factor per decade is that?

11. Carbon-14 has a half-life of about 5,730 years. What fraction of the original carbon-14 remains in a 3,000-year-old sample?

12. Which is better for a saver: 5% a year compounded yearly, or 0.4% a month compounded monthly? Compare annual factors.

CHALLENGE

13. Which grows faster: a quantity that doubles every 7 years or one that grows 10% a year? Compare annual factors.

REVIEW

14. Simplify: $(-7 - 6i)(7 + 2i)$

15. Evaluate exactly: $25^{-3/2}$

Lesson 1.2 — Logarithms and Change of Base Lab

FLUENCY

1. Evaluate: $\log_4 4$
2. Evaluate: $\log_3 (1/3)$
3. Evaluate: $\log_3 81$
4. Evaluate: $\log_3 9$
5. Evaluate: $\log_3 27$

6. Evaluate: $\log_{10} 10000$

7. Evaluate: $\log_{10} 1$

8. Evaluate: $\log_5 1$

9. Use change of base to evaluate $\log_3 50$, $\log_6 200$ and $\log_2 0.1$ to four decimal places.

10. Between which two integers is log 0.02? Then evaluate it.

APPLICATION

11. pH = $-\log[H^+]$. A sample of Missouri River water (illustrative) has $[H^+] = 3.2 \times 10^{-8}$. Find its pH.

12. Sound level in decibels is $10 \log(I/I_0)$. What is the level of a sound 10^8 times the reference intensity? How many times as intense is a 90 dB sound?

13. On the earthquake magnitude scale, each whole step multiplies the measured wave amplitude by 10. The February 7, 1812 New Madrid earthquake is estimated at magnitude 7.5. How many times the amplitude of a magnitude 6.5 quake was it, and of a magnitude 5.5?

CHALLENGE

14. Without a calculator, find the two integers $\log_2 1{,}000$ lies between, then use change of base to evaluate it.

REVIEW

15. Evaluate exactly: $25^{-3/2}$

16. Solve: $2x^2 - 9x - 8 = 0$

Lesson 1.3 — Proving the Laws of Logarithms

FLUENCY

1. Write as a single logarithm: $2 \log x + \log y - 4 \log z$

2. Write as a single logarithm: $3 \log x + \log y - 3 \log z$

3. Expand: $\log(x^5 y / z^4)$

4. Expand: $\log(x^5 y / z^2)$

5. Expand: $\log(x^4 y / z^4)$

6. Expand: $\log(x^3y / z^4)$

7. Expand: $\log(x^4y / z^3)$

8. Expand: $\log(x^2y / z^4)$

9. Given $\log 2 \approx 0.3010$ and $\log 3 \approx 0.4771$, find $\log 18$, $\log 0.75$ and $\log 45$.

APPLICATION

10. Doubling the intensity of a sound adds how many decibels? (Level = $10 \log(I/I_0)$.)

11. A solution is 1,000 times as acidic ($[H^+]$ 1,000 times as large) as another. How do their pH values compare? Use a log law.

12. Before calculators, 347×29 was computed as $10^{\log 347 + \log 29}$. Carry this out with logs to four places and compare with the exact product.

CHALLENGE

13. Solve $\log x + \log(x - 3) = 1$.

REVIEW

14. Simplify: i^{36}

15. Divide $-2x^3 + 3x^2 + 2$ by $x + 4$. State the quotient and remainder, and use the remainder to evaluate $p(-4)$.

Lesson 1.4 — Solving Exponential Equations with Logarithms

FLUENCY

1. Solve for x: $1.08^x = 3.5$. Give an exact answer using logarithms and a decimal to the nearest thousandth.

2. Solve for x: $10^x = 250$. Give an exact answer using logarithms and a decimal to the nearest thousandth.

3. Solve for x: $1.05^x = 7$. Give an exact answer using logarithms and a decimal to the nearest thousandth.

4. Solve for x: $2^x = 3.5$. Give an exact answer using logarithms and a decimal to the nearest thousandth.

5. Solve for x: $5^x = 50$. Give an exact answer using logarithms and a decimal to the nearest thousandth.

6. Solve for x: $1.08^x = 50$. Give an exact answer using logarithms and a decimal to the nearest thousandth.

7. Find the inverse of $f(x) = 4x$.

8. Find the inverse of $f(x) = -6x - 2$.

9. Solve $1{,}000e^{0.05t} = 2{,}500$.

10. Find the inverse of $f(x) = 2 \cdot 3^x - 4$ and state its domain.

APPLICATION

11. At 5.5% annual growth, how long does an investment take to double?

12. A medication level is $400(0.8)^t$ mg after t hours. When does it reach 50 mg?

13. With $P(t) = 3{,}954{,}653(1.00634)^t$ (Missouri, t years after 1950), in what year does the model reach 7 million?

CHALLENGE

14. Solve $2^x = 3^{x-1}$ exactly and to three decimals.

REVIEW

15. Solve: $9 / (x - 3) = 4 / (x + 4)$

16. Solve: $3x^2 - x - 6 = 0$

Unit 1 checkpoint

1. Which shows the monthly factor for 1.05^t (t in years)?
   A. (1.05/12)^{12t}
   B. (1.05^{1/12})^{12t}
   C. (1.05¹²)^{t/12}
   D. 1.0042^t

2. log₂ 32 = _____ and log 0.001 = _____.

3. log₇ 50 = ?
   A. log 7/log 50
   B. log 50/log 7
   C. log 50 − log 7
   D. log(50/7)

4. True or false: log(M + N) = log M + log N.

5. With log 2 ≈ 0.3010, log 8 ≈ _____.

6. In proving log_b(MN) = log_b M + log_b N, which exponent law is used?
   A. b^mbⁿ = b^{m+n}
   B. (b^m)ⁿ = b^{mn}
   C. b⁰ = 1
   D. b^{−n} = 1/bⁿ

7. The solution of 5 · 2^t = 80 is t = _____.

8. Solve 3 · 10^{0.2t} = 600.
   A. t = 5 log 200
   B. t = 0.2 log 200
   C. t = log 600/0.6
   D. t = 200/0.2

9. True or false: The graph of y = log₂ x has a vertical asymptote at x = 0.

10. The inverse of f(x) = 10^x is f^{−1}(x) = _____.

11. Doubling time at 7% a year is closest to
    A. 7 years
    B. 10.2 years
    C. 14 years
    D. 70 years

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