

Logarithm Launch

Solve exponential models by rewriting them as logarithms.

HIGH SCHOOL • HSF-LE.A.4

CCSS.Math.Content.HSF-LE.A.4 "For exponential models, express as a logarithm the solution to $ab^ct = d$ where a , c , and d are numbers and the base b is 2, 10, or e ; evaluate the logarithm using technology."

NAME _____

DATE _____

TURN EXPONENTS INTO LOGS

For $a \cdot b^{(c \cdot x)} = d$, divide by a first. Then write $c \cdot x = \log_b(d/a)$ and solve for x . On a calculator, use $\log$ for base 10, $\ln$ for base e , and $\log(d/a)/\log(b)$ for another base.

WORKED EXAMPLE

Solve $11 \cdot e^{(2x)} = 11e^8$.

1. Divide both sides by 11: $e^{(2x)} = e^8$.
2. Rewrite with a logarithm: $2x = \ln(e^8)$.
3. Evaluate and solve: $2x = 8$, so $x = 4$.

Answer: $x = 4$

PRACTICE 6 problems

- 1** Solve $4 \cdot 2^x = 128$. Write a logarithmic equation, then evaluate.

ANSWER _____

- 2** Solve $7 \cdot 10^{(2x)} = 700$. Write a logarithmic equation, then evaluate.

ANSWER _____

- 3** Solve $3 \cdot e^{(x/2)} = 3e^4$. Write a logarithmic equation, then evaluate.

ANSWER _____

- 4** Solve $9 \cdot 2^{(3x)} = 72$. Write a logarithmic equation, then evaluate.

ANSWER _____

- 5** Solve $6 \cdot 10^{(x/4)} = 60000$. Write a logarithmic equation, then evaluate.

ANSWER _____

- 6** Solve $5 \cdot e^{(2x)} = 5e^{(-6)}$. Write a logarithmic equation, then evaluate.

ANSWER _____

APPLY IT Show your work

- 1** A student podcast has $F=125 \cdot 2^{(w/4)}$ followers, where w is the number of weeks after a new episode is released. How many weeks will it take for the podcast to have 1,000 followers? Write a logarithmic equation and evaluate.

WORK SPACE

ANSWER _____

- 2** A gaming club models tournament sign-ups with $S=30 \cdot 10^{(d/3)}$, where d is the number of days since the tournament was announced. How many days will it take to reach 30,000 sign-ups? Write a logarithmic equation and evaluate.

WORK SPACE

ANSWER _____

CHALLENGE One step up

CHALLENGE

Solve $3 \cdot 2^{(2x-1)}=48$. Write a logarithmic equation, then explain in one sentence why you must add 1 before dividing by 2.

PART 1 • PRACTICE

#	PROBLEM	ANSWER
1	Solve $4 \cdot 2^x = 128$. Write a logarithmic equation, then evaluate.	$x = \log_2(32) = 5$
2	Solve $7 \cdot 10^{(2x)} = 700$. Write a logarithmic equation, then evaluate.	$x = \log_{10}(100)/2 = 1$
3	Solve $3 \cdot e^{(x/2)} = 3e^4$. Write a logarithmic equation, then evaluate.	$x = 2\ln(e^4) = 8$
4	Solve $9 \cdot 2^{(3x)} = 72$. Write a logarithmic equation, then evaluate.	$x = \log_2(8)/3 = 1$
5	Solve $6 \cdot 10^{(x/4)} = 60000$. Write a logarithmic equation, then evaluate.	$x = 4\log_{10}(10000) = 16$
6	Solve $5 \cdot e^{(2x)} = 5e^{(-6)}$. Write a logarithmic equation, then evaluate.	$x = \ln(e^{(-6)})/2 = -3$

PART 2 • APPLY IT

- $w = 4\log_2(8) = 12$ weeks** Divide 1,000 by 125 to get $2^{(w/4)} = 8$. Since $w/4 = \log_2(8) = 3$, $w = 12$.
- $d = 3\log_{10}(1000) = 9$ days** Divide 30,000 by 30 to get $10^{(d/3)} = 1,000$. Since $d/3 = \log_{10}(1,000) = 3$, $d = 9$.

CHALLENGE

$2x - 1 = \log_2(16) = 4$, so $x = 5/2$. Explanation: Because -1 is part of $2x - 1$, add 1 before dividing by 2.

Accept equivalent logarithmic forms, including change-of-base forms such as $\log(32)/\log(2)$. Accept correct calculator approximations when students use technology, although all values in this worksheet simplify exactly.