LESSON MAKER PRO

Two Ways to Grow

Rewrite exponential models and connect them to logarithms.

HIGH SCHOOL · MT.PLUS.ALG.EXP.3

MT.PLUS.ALG.EXP.3 "Understand that exponential and logarithmic functions can be represented using multiple forms by: Expressing exponential functions in the form f(x) = a · b^x and f(x) = Pe^(r·t), and Expressing logarithmic functions in base 10 and base e."

NAME _____ DATE _____

THE BIG IDEA

To rewrite $a \cdot b^x$ in the form Pe^{rx}, use $P = a$ and $r = \ln(b)$. A logarithm names an exponent: log(N) uses base 10, while ln(N) uses base e.

WORKED EXAMPLE

Rewrite $f(x) = 7 \cdot 9^x$ in the form Pe^{rx}.

1. Use $9 = e^{\ln(9)}$.
2. Then $9^x = e^{(\ln 9)x}$.
3. Substitute into f(x): $f(x) = 7e^{(\ln 9)x}$.

Answer: $f(x) = 7e^{(\ln 9)x}$, so $P = 7$ and $r = \ln(9)$.

PRACTICE 6 problems

1 Rewrite $f(x) = 3 \cdot 4^x$ in the form Pe^{rx}. Give P and r.

ANSWER _____

2 Rewrite $f(x) = 6e^{(\ln 2)x}$ in the form $a \cdot b^x$. Give a and b.

ANSWER _____

3 An exponential function has f(0) = 5 and f(1) = 15. Write it in the form $f(x) = a \cdot b^x$.

ANSWER _____

4 Write log(1000) = 3 as a base-10 exponential equation.

ANSWER _____

5 Write $e^2 = x$ as a logarithmic equation using ln.

ANSWER _____

6 Evaluate both $\ln(e^4)$ and log(100).

ANSWER _____

APPLY IT Show your work

1 A student posts a short video. It has 20 views at the start, and the total number of views doubles each day. Let t be the number of days since posting. Write V(t) in the form Pe^{rt}, then find V(3).

WORK SPACE

ANSWER _____

2 A concert's sound level is 80 decibels. The sound level D and intensity ratio R satisfy D = 10 log(R). Write the base-10 logarithmic equation for R, then find R.

WORK SPACE

ANSWER _____

CHALLENGE One step up

An app's follower count is modeled by $F(t) = 16e^{(\ln 2)t}$, where t is measured in weeks. Write F(t) in the form $a \cdot b^t$. Then find when F(t) = 128, showing a logarithmic equation using ln.

WORK SPACE AND ANSWER

Two Ways to Grow

PART 1 · PRACTICE

#	PROBLEM	ANSWER
1	Rewrite $f(x) = 3 \cdot 4^x$ in the form Pe^{rx}. Give P and r.	**$f(x) = 3e^{(\ln 4)x}$; P = 3, r = ln(4).**
2	Rewrite $f(x) = 6e^{(\ln 2)x}$ in the form $a \cdot b^x$. Give a and b.	**$f(x) = 6 \cdot 2^x$; a = 6, b = 2.**
3	An exponential function has f(0) = 5 and f(1) = 15. Write it in the form $f(x) = a \cdot b^x$.	**$f(x) = 5 \cdot 3^x$**
4	Write log(1000) = 3 as a base-10 exponential equation.	**$10^3 = 1000$**
5	Write $e^2 = x$ as a logarithmic equation using ln.	**ln(x) = 2**
6	Evaluate both $\ln(e^4)$ and log(100).	**$\ln(e^4) = 4$; log(100) = 2.**

PART 2 · APPLY IT

1. **$V(t) = 20e^{(\ln 2)t}$; V(3) = 160 views.** Doubling each day gives $V(t) = 20 \cdot 2^t$, so r = ln(2). After 3 days, $V(3) = 20 \cdot 2^3 = 160$.
2. **log(R) = 8; $R = 10^8 = 100{,}000{,}000$.** Substitute 80 for D and divide by 10 to get log(R) = 8. Rewrite this as $10^8 = R$.

CHALLENGE

$F(t) = 16 \cdot 2^t$. Since $2^t = 128/16 = 8$, $\ln(8) = t \ln(2)$, so $t = \ln(8)/\ln(2) = 3$ weeks.

Accept equivalent exact forms, such as $\ln(4) = 2\ln(2)$. Do not require decimal approximations of logarithms.