LESSON MAKER PRO

Inside the Log

Use ln to find exponents and explore change.

HIGH SCHOOL · PC.NQ.A.1.b

PC.NQ.A.1.b "Explore the behavior of ln(x), the logarithmic function with base e, and its applications."

NAME _____ **DATE** _____

THE BIG IDEA

For $x > 0$, $\ln(x)$ tells you the exponent on e that gives x. This means $\ln(e^t) = t$, and $\ln(x)$ increases as x increases. You can also simplify before taking a logarithm: $e^a / e^b = e^{a-b}$.

WORKED EXAMPLE

Simplify $\ln(e^{11}/e^7)$.

1. $e^{11}/e^7 = e^{11-7}$.
2. $e^{11-7} = e^4$.
3. $\ln(e^4) = 4$.

Answer: 4

PRACTICE 6 problems

1 Find $\ln(e^6)$.

ANSWER _____

2 Find $\ln(1/e^3)$.

ANSWER _____

3 Solve $\ln(x) = 2$.

ANSWER _____

4 Simplify $\ln(e^8) - \ln(e^3)$.

ANSWER _____

5 Solve $\ln(e^2 x) = 5$.

ANSWER _____

6 Use the table. Which x-value has $\ln(x) = 0$? Does $\ln(x)$ increase or decrease from left to right?

VALUES OF LN(X)

x	ln(x)
$1/e^2$	-2
1	0
e^2	2
e^6	6

ANSWER _____

APPLY IT Show your work

1 A new song's daily plays are modeled by $P(t) = 300e^{t/2}$, where t is weeks since release. After how many weeks will daily plays reach $300e^{3}$?

WORK SPACE

ANSWER _____

2 A phone's battery percentage is modeled by $B(t) = 80e^{-t/5}$, where t is hours since it was charged. When will the battery reach $80/e^{2}$ percent?

WORK SPACE

ANSWER _____

CHALLENGE One step up

An app's weekly users are modeled by $U(t) = 90e^{t/3}$, where t is weeks since launch. How many weeks pass between reaching $90e^{2}$ users and reaching $90e^{8}$ users? Explain using ln.

WORK SPACE AND ANSWER

ANSWER KEY # Inside the Log

PART 1 · PRACTICE

#	PROBLEM	ANSWER
1	Find $\ln(e^6)$.	**6**
2	Find $\ln(1/e^3)$.	**-3**
3	Solve $\ln(x) = 2$.	**$x = e^2$**
4	Simplify $\ln(e^8) - \ln(e^3)$.	**5**
5	Solve $\ln(e^2x) = 5$.	**$x = e^3$**
6	Use the table. Which x-value has $\ln(x) = 0$? Does $\ln(x)$ increase or decrease from left to right?	**x = 1; ln(x) increases.**

PART 2 · APPLY IT

1. **6 weeks** Divide by 300 and take ln of both sides: $t/2 = \ln(e^3) = 3$. Thus $t = 6$.
2. **10 hours** Divide by 80 and take ln of both sides: $-t/5 = \ln(1/e^2) = -2$. Thus $t = 10$.

CHALLENGE

18 weeks. Taking ln after dividing each user count by 90 gives t/3 = 2 at the first milestone and t/3 = 8 at the second. The milestones occur at t = 6 and t = 24, so 24 - 6 = 18 weeks pass.

Accept equivalent exact expressions involving e. In the challenge, the explanation must find both milestone times before subtracting.