LESSON MAKER PRO

Exponential Connections

Use e and ln to solve growth and decay problems.

HIGH SCHOOL · PC.NQ.A.1

PC.NQ.A.1 "Define the constant e in a variety of contexts. a. Explore the behavior of the function $y=e^x$ and its applications. b. Explore the behavior of ln(x), the logarithmic function with base e, and its applications."

NAME _____ DATE _____

THE BIG IDEA

The constant e is the number approached by $(1 + 1/n)^n$ as positive whole numbers n grow without bound. The functions e^x and ln(x) undo each other, so taking ln of both sides can help you isolate an exponent. Models that grow or decay continuously often use e, and ln can help you find when a quantity reaches a given value.

WORKED EXAMPLE

Solve $13e^{11x} = 13e^{77}$.

1. Divide both sides by 13: $e^{11x} = e^{77}$.
2. Take ln of both sides: $11x = 77$.
3. Divide by 11: $x = 7$.

Answer: x = 7

PRACTICE 6 problems

1 Simplify $\ln(e^8)$.

ANSWER _____

2 Simplify $e^{\ln(9)}$.

ANSWER _____

3 Solve $e^{2x} = e^{10}$.

ANSWER _____

4 Solve $\ln(x) = -1$.

ANSWER _____

5 Solve $e^x = 6$. Give an exact answer.

ANSWER _____

6 Which is greater, e^{-1} or $\ln(1)$? Explain briefly.

ANSWER _____

APPLY IT Show your work

1 A school club's post gets views modeled by $V(t) = 20e^{t/9}$, where t is the number of days since posting. When will it reach 100 views? Give an exact answer.

WORK SPACE

ANSWER _____

2 While a student games on a laptop, its battery percentage is modeled by $B(t) = 80e^{-t/6}$, where t is hours. When will the battery reach 40%? Give an exact answer.

WORK SPACE

ANSWER _____

CHALLENGE One step up

An esports team's follower count follows $F(t) = Fe^{kt}$, where t is in days, $F > 0$, and $k > 0$. The count doubles every 8 days. Find k and the time it takes to reach 5F followers. Give exact answers.

WORK SPACE AND ANSWER

ANSWER KEY # Exponential Connections

PART 1 · PRACTICE

#	PROBLEM	ANSWER
1	Simplify $\ln(e^8)$.	**8**
2	Simplify $e^{\ln(9)}$.	**9**
3	Solve $e^{2x} = e^{10}$.	**x = 5**
4	Solve $\ln(x) = -1$.	**x = 1/e**
5	Solve $e^x = 6$. Give an exact answer.	**x = ln(6)**
6	Which is greater, e^{-1} or $\ln(1)$? Explain briefly.	**e^{-1} is greater because $e^{-1} = 1/e > 0$, while $\ln(1) = 0$.**

PART 2 · APPLY IT

1. **9ln(5) days** Set $100 = 20e^{t/9}$, then divide by 20 to get $5 = e^{t/9}$. Take ln of both sides and multiply by 9.
2. **6ln(2) hours** Set $40 = 80e^{-t/6}$, so $1/2 = e^{-t/6}$. Taking ln gives $-\ln(2) = -t/6$, so $t = 6\ln(2)$.

CHALLENGE

k = ln(2)/8; time = 8ln(5)/ln(2) days.

Accept equivalent exact forms, such as e^{-1} for 1/e. Do not require decimal approximations.