Name____ Date__________

6.6 Solving Exponential and Logarithmic Equations
For use with Exploration 6.6

Essential Question How can you solve exponential and logarithmic equations?

1 EXPLORATION: Solving Exponential and Logarithmic Equations

Work with a partner. Match each equation with the graph of its related system of equations. Explain your reasoning. Then use the graph to solve the equation.

a. $e^x = 2$

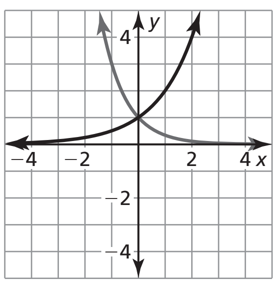
b. $\ln x = -1$

c. $2^x = 3^{-x}$

d. $\log_4 x = 1$

e. $\log_5 x = \frac{1}{2}$

f. $4^x = 2$

A.


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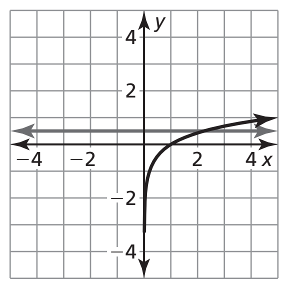

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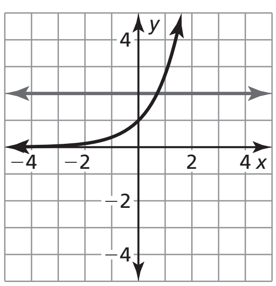

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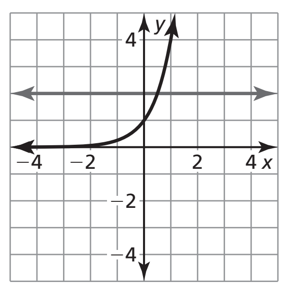

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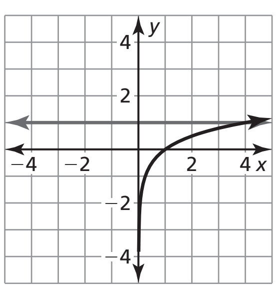

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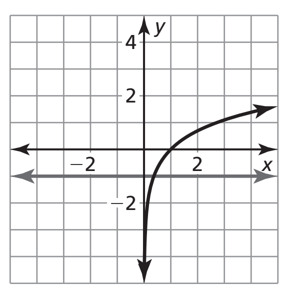

2 EXPLORATION: Solving Exponential and Logarithmic Equations

Go to *BigIdeasMath.com* for an interactive tool to investigate this exploration.

Work with a partner. Look back at the equations in Explorations 1(a) and 1(b). Suppose you want a more accurate way to solve the equations than using a graphical approach.

a. Show how you could use a *numerical approach* by creating a table. For instance, you might use a spreadsheet to solve the equations.

b. Show how you could use an *analytical approach*. For instance, you might try solving the equations by using the inverse properties of exponents and logarithms.

Communicate Your Answer

3. How can you solve exponential and logarithmic equations?

4. Solve each equation using any method. Explain your choice of method.

a. $16^x = 2$

b. $2^x = 4^{2x+1}$

c. $2^x = 3^{x+1}$

d. $\log x = \frac{1}{2}$

e. $\ln x = 2$

f. $\log_3 x = \frac{3}{2}$

Name____ Date__________

6.6 Notetaking with Vocabulary

For use after Lesson 6.6

In your own words, write the meaning of each vocabulary term.

exponential equations

logarithmic equations

Core Concepts

Property of Equality for Exponential Equations

Algebra If b is a positive real number other than 1, then $b^x = b^y$ if and only if $x = y$.

Example If $3^x = 3^5$, then $x = 5$. If $x = 5$, then $3^x = 3^5$.

Notes:

Property of Equality for Logarithmic Equations

Algebra If b, x, and y are positive real numbers with $b \neq 1$, then $\log_b x = \log_b y$ if and only if $x = y$.

Example If $\log_2 x = \log_2 7$, then $x = 7$. If $x = 7$, then $\log_2 x = \log_2 7$.

Notes:

Extra Practice

In Exercises 1–6, solve the equation.

1. $5^{2x+4} = 5^{5x-8}$

2. $4^{2x-1} = 8^{x+2}$

3. $3^{x+3} = 5$

4. $\left(\frac{1}{5}\right)^{3x-2} = \sqrt{25^x}$

5. $12e^{1-x} = 500$

6. $-14 + 3e^x = 11$

In Exercises 7–11, solve the equation. Check for extraneous solutions.

7. $2 = \log_3(4x)$

8. $\ln(x^2 + 3) = \ln(4)$

9. $\log_8(x^2 - 5) = \frac{2}{3}$

10. $\ln x + \ln(x + 2) = \ln(x + 6)$

11. $\log_2(x + 5) - \log_2(x - 2) = 3$

Name____ Date __________

6.6 Notetaking with Vocabulary (continued)

12. Solve the inequality $\log x \le \frac{1}{2}$.

13. Your parents buy juice for your graduation party and leave it in their hot car. When they take the cans out of the car and move them to the basement, the temperature of the juice is 80°F. The room temperature of the basement is 60°F, and the cooling rate of the juice is $r = 0.0147$. Using Newton's Law of Cooling, how long will it take to cool the juice to 63°F?

14. Earthquake intensity is measured by the formula $R = \log\left(\frac{I}{I_0}\right)$ where R is the Richter scale rating of an earthquake, I is the intensity of the earthquake, and I_0 is the intensity of the smallest detectable wave. In 1906, an earthquake in San Francisco had an estimated measure of 7.8 on the Richter scale. In the same year, another earthquake had an intensity level four times stronger than the San Francisco earthquake giving it a Richter scale rating of $R_2 = \log\left(\frac{4I}{I_0}\right)$. What was the Richter scale rating on a scale of 1–10 of the other earthquake?