Instruction

Guided Practice 2.1.4

Example 1

Solve $4^x = 1024$.

1. Rewrite the base as powers of a common base.

   You may not recognize right away if it is possible to write 1,024 as an exponential expression with a base of 4. Begin by finding values of powers of 4 to see if it is possible.

   $4^1 = 4$

   $4^2 = 16$

   $4^3 = 64$

   $4^4 = 256$

   $4^5 = 1024$

   We now know that it is possible to write 1,024 as a power of 4.

2. Rewrite the equation so that both sides have a base of 4.

   $4^x = 4^5$

3. Now solve for x by setting the exponents equal to each other.

   $x = 5$

   The solution to the equation $4^x = 1024$ is $x = 5$.

4. Check your answer.

   Substitute 5 for the variable x in the original equation.

   $4^x = 1024$

   $4^5 = 1024$

   $1024 = 1024$ This is a true statement. ✓

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Example 2

Solve the equation $\left(\frac{1}{2}\right)^x = 16$.

1. Rewrite the base as powers of a common base.
   Both $\frac{1}{2}$ and 16 are powers of base 2.
   Referring back to the Laws of Exponents table, we know that $\frac{1}{2}$ is equal to 2 to the power of –1.
   16 is equal to 2 to the power of 4.

2. Rewrite the equation so both sides have a base of 2.

   $\left(\frac{1}{2}\right)^x = 16$

   $(2^{-1})^x = 2^4$

   Following the laws of exponents, we know that we can rewrite $(2^{-1})^x$ as 2^{-x}.

   $(2^{-1})^x = 2^4$

   $2^{-x} = 2^4$

3. Now solve for x by setting the exponents equal to each other.

   $-x = 4$

   Divide by –1 to isolate the variable.

   $x = -4$

   The solution to the equation $\left(\frac{1}{2}\right)^x = 16$ is $x = -4$.

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4. Check your answer.

   Substitute –4 for the variable x in the original equation.

   $\left(\frac{1}{2}\right)^{x} = 16$

   $\left(\frac{1}{2}\right)^{-4} = 16$

   $2^4 = 16$

   $16 = 16$ This is a true statement.

Example 3

Solve the equation $\frac{1}{49} = 7^{x}$.

1. Rewrite the base as powers of a common base.

   $\frac{1}{49}$ can be rewritten as $\frac{1}{7^2}$.

   Referring back to the Laws of Exponents table, we know that $\frac{1}{7^2}$ is equal to 7 to the power of –2.

2. Rewrite the equation so both sides have a base of 7.

   $\frac{1}{49} = 7^{x}$

   $\frac{1}{7^2} = 7^{x}$

   $7^{-2} = 7^{x}$

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3. Now solve for x by setting the exponents equal to each other.

   $x = -2$

   The solution to the equation $\frac{1}{49} = 7^x$ is $x = -2$.

4. Check your answer.

   Substitute –2 for the variable x in the original equation.

   $\frac{1}{49} = 7^x$

   $\frac{1}{49} = 7^{-2}$

   $\frac{1}{49} = \frac{1}{7^2}$

   $\frac{1}{49} = \frac{1}{49}$ This is a true statement. ✓

Example 4

Solve the equation $117 = 5^x - 8$.

1. Begin by eliminating the subtraction of 8 from the right side of the equal sign. Do so by adding 8 to both sides of the equation.

   $117 = 5^x - 8$

   $+8 \quad +8$

   $125 = 5^x$

2. Rewrite the base as powers of a common base.

   125 can be rewritten as 5 to the power of 3.

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3. Rewrite the equation so both sides have a base of 5.

   $125 = 5^x$

   $5^3 = 5^x$

4. Now solve for x by setting the exponents equal to each other.

   $x = 3$

   The solution to the equation $117 = 5^x - 8$ is $x = 3$.

5. Check your answer.

   Substitute 3 for the variable x in the original equation.

   $117 = 5^x - 8$

   $117 = 5^3 - 8$

   $117 = 125 - 8$

   $117 = 117$ This is a true statement.