

UNIT 2 • REASONING WITH EQUATIONS AND INEQUALITIES

Lesson 1: Solving Equations and Inequalities

Instruction

Guided Practice 2.1.1

Example 1

Which property of equality is missing in the steps to solve the equation $-7x + 22 = 50$?

| Equation | Steps |
|-----------------|-------------------------------|
| $-7x + 22 = 50$ | Original equation |
| $-7x = 28$ | |
| $x = -4$ | Division property of equality |

1. Observe the differences between the original equation and the next equation in the sequence. What has changed?

Notice that 22 has been taken away from both expressions, $-7x + 22$ and 50.



2. Refer to the table of Properties of Equality.

The subtraction property of equality tells us that when we subtract a number from both sides of the equation, the expressions remain equal.

The missing step is "Subtraction property of equality."



Example 2

Which property of equality is missing in the steps to solve the equation $-3 - \frac{x}{6} = 4$?

| Equation | Steps |
|------------------------|-------------------------------|
| $-3 - \frac{x}{6} = 4$ | Original equation |
| $-\frac{x}{6} = 7$ | Addition property of equality |
| $-x = 42$ | |
| $x = -42$ | Division property of equality |

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1. Observe the differences between the original equation and the next equation in the sequence. What has changed?

Notice that 3 has been added to both expressions, $-3 - \frac{x}{6}$ and 4.

The result of this step is $-\frac{x}{6} = 7$.

In order to move to the next step, the division of 6 has been undone.

The inverse operation of the division of 6 is the multiplication of 6.

The result of multiplying $-\frac{x}{6}$ by 6 is $-x$ and the result of multiplying 7 by 6 is 42. This matches the next step in the sequence.



2. Refer to the table of Properties of Equality.

The multiplication property of equality tells us that when we multiply both sides of the equation by a number, the expressions remain equal.

The missing step is “Multiplication property of equality.”



Example 3

Which property of equality is missing in the steps to solve the equation $76 = 5x - 15 + 2x$?

| Equation | Steps |
|---------------------|---|
| $76 = 5x - 15 + 2x$ | Original equation |
| $76 = 5x + 2x - 15$ | Commutative property of addition |
| $76 = 7x - 15$ | Distributive property to combine like terms |
| $91 = 7x$ | Addition property of equality |
| $13 = x$ | Division property of equality |
| $x = 13$ | |

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1. Observe the differences between the original equation and the next equation in the sequence. What has changed?

Notice that the expression $5x - 15 + 2x$ was rearranged using the commutative property of addition. The new expression, $5x + 2x - 15$, although in a different order, has the same meaning.

The distributive property allows us to combine like terms by thinking of $5x + 2x$ as $x(5 + 2)$. Simplifying this expression to $7x - 15$ has the same meaning as the prior step.

The addition property of equality allows us to add 15 to both sides of the equation, bringing us one step closer to finding out the value of x .

To isolate x in the equation $91 = 7x$, we use the division property of equality to divide both sides of the equation by the coefficient 7.



2. Notice that the equation now reads $13 = x$. Compare this to the final line, $x = 13$. The symmetric property of equality allows us to write $x = 13$. This more standard way of writing the solution means the same as the previous step.

The missing step is “Symmetric property of equality.”



Example 4

What equation is missing in the steps to solve the equation $5x + 3(x + 4) = 28$?

| Equation | Steps |
|----------------------|---|
| $5x + 3(x + 4) = 28$ | Original equation |
| $5x + 3x + 12 = 28$ | Distributive property |
| $8x + 12 = 28$ | Distributive property to combine like terms |
| | Subtraction property of equality |
| $x = 2$ | Division property of equality |

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1. Look at the differences between the original equation and the next equation in the sequence. What has changed?

Notice that the expression $5x + 3(x + 4)$ was rewritten using the distributive property. The new expression, $5x + 3x + 12$, looks different but has the same meaning.

The distributive property also allows us to combine like terms by thinking of $5x + 3x$ as $x(5 + 3)$. Simplifying this expression to $8x + 12$ has the same meaning as the prior step.



2. We are told that the subtraction property of equality justifies the next step. This property states that we can subtract the same number from both sides of the equation and not change the equality of the equation. In order to solve for x , we have learned to isolate the variable. We do this by subtracting the constant from both sides. The constant is 12, so subtract 12 from both sides.

$$\begin{array}{r} 8x + 12 = 28 \\ -12 \quad -12 \\ \hline 8x = 16 \end{array}$$

Now we have an equation, $8x = 16$, which may be our missing equation. Let's look at what happens to get to the final statement in the table to see if this equation makes sense.



3. The table lists the division property of equality as the property that leads to $x = 2$. Look at the equation we found: $8x = 16$. In this equation, the coefficient of x is 8. If we divide both sides of the equation by 8, we get the final statement, $x = 2$.

$$\begin{array}{r} 8x = 16 \\ \div 8 \quad \div 8 \\ \hline x = 2 \end{array}$$

The division property of equality justifies the division of the equation $8x = 16$ by the coefficient, 8.

The missing equation is $8x = 16$.

