🔁 Use What You Know

You have seen that an equation is a statement that states two expressions are equivalent. In Lesson 18 you learned what it means to solve an equation. Take a look at this problem.

The picture below shows a pan balance holding 10 blocks and a bag with an unknown number of blocks. The pans hang evenly. How many blocks are in the bag?

Use the math you know to answer the question.

a. What does the letter x represent? _____

b. How many blocks are in the right-side pan? _____

c. Write an expression for the number of blocks in the left-side pan. _____

d. What will you need to do to get the bag by itself on the left side?

_____

e. Then, what must you also do to keep the pans hanging evenly?

_____

f. Explain how you could find the number of blocks in the bag. _____

_____

_____

_____

▶▶ Find Out More

To find the number of blocks in the bag, you had to do two things.

First: Get the bag with the unknown number of blocks by itself on one side of the balance. You did this by taking away 2 blocks from the pan with the bag.

Second: Keep the pans hanging evenly. You did this by also taking away 2 blocks from the other pan.

The pan balance, blocks, and bag represent the equation $x + 2 = 8$.

To solve the equation $x + 2 = 8$, you have to do two things.

First: Get the variable x by itself on one side of the equal sign. Another way to say this is you need to *isolate the variable*.

Second: Keep the two expressions equivalent to each other. Another way to say this is you need to keep the equation *balanced*.

How do you isolate the variable x in the equation $x + 2 = 8$? Use *inverse operations*. Inverse operations are operations that "undo" each other. Addition and subtraction are inverse operations. Since the expression $x + 2$ has 2 being added to x, you can isolate x by subtracting 2 from $x + 2$.

How do you keep the equation balanced after isolating x? Subtract 2 from the other side of the equation.

> isolate the variable

> balance the equation

$$x + 2 = 8$$
$$x + 2 - 2 = 8 - 2$$
$$x + (2 - 2) = 8 - 2$$
$$x + 0 = 6$$
$$x = 6$$

▶ Reflect

1 Write an equation for which subtracting 5 from an expression would isolate the variable.

_____

Learn About ▷ **Solving Addition and Subtraction Equations**

Read the problem below. Then explore how to solve a subtraction equation.

> Suppose you have a bag with an unknown number of blocks and you take 3 blocks out of the bag. Then you put the bag in one pan of a pan balance. It takes 7 blocks in the other pan to make the pans hang evenly. How many blocks were in the bag before you took 3 out?

▶ **Picture It** **Draw the balance, bag, and blocks.**

The label on the bag means "the bag has 3 less than some number of blocks in it."

▶ **Solve It** **Write an expression for the number of blocks in each pan.**

number of blocks in left-side pan: $x - 3$
number of blocks in right-side pan: 7

Since the pans are hanging evenly, you know there is the same number of blocks in each pan. Write an equation to show the expressions are equivalent.

number of blocks in left-side pan = number of blocks in right-side pan

$$x - 3 = 7$$

Connect It Now use inverse operations to solve the problem.

2 Look at *Solve It* on the previous page. If you solve the equation $x - 3 = 7$, what information will you have? _____

3 What is the operation in the expression $x - 3$? _____

4 What is the inverse of this operation? _____

5 How can you isolate the variable in $x - 3 = 7$? _____

6 When you isolate the variable, what must you do to keep the equation balanced?

_____

7 Solve $x - 3 = 7$.

$$x - 3 = 7$$

isolate the variable $x - 3 \underline{\quad} = 7 \underline{\quad}$ balance the equation

$$x \underline{\quad} = \underline{\quad}$$

$$x = \underline{\quad}$$

8 How many blocks were in the bag before you took 3 out? _____

Try It Use what you just learned to solve these problems. Show your work on a separate sheet of paper.
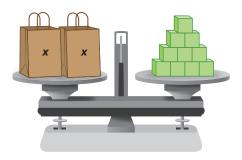
9 Solve $x + 5 = 15$.

10 Solve $x - 9 = 8$.

Learn About ▶ Solving Multiplication Equations

Read the problem below. Then explore how to solve a multiplication equation.

Delia puts two bags of blocks in the left-side pan of a balance. Each bag has the same number of blocks. After she adds 10 blocks to the right-side pan, the pans hang evenly. How many blocks are in 1 bag?

▶ **Picture It** **Draw the balance, bags, and blocks.**

The 2 bags together have a total of 10 blocks.

▶ **Solve It** **Write an expression for the number of blocks in each pan.**

number of blocks in left-side pan: $2x$
number of blocks in right-side pan: 10

Since the pans are hanging evenly, you know there is the same number of blocks in each pan. Write an equation showing the expressions are equivalent.

number of blocks in left-side pan = number of blocks in right-side pan

$$2x = 10$$

Connect It Now use inverse operations to solve the problem.

11 Look at *Solve It* on the previous page. What do you need to do to find the number of blocks in 1 bag? _____

12 The expression $2x$ is a multiplication expression. It tells you to combine 2 equal groups of x blocks each. What is the "opposite" of combining two equal groups of blocks?

_____

13 What operation is the inverse of multiplication? _____

14 How can you isolate the variable in $2x = 10$? _____

15 When you isolate the variable, what must you do to balance the equation?

_____

16 Write numbers inside the boxes to solve $2x = 10$.

$$2x = 10$$

isolate the variable $\qquad \dfrac{2x}{\Box} = \dfrac{10}{\Box} \qquad$ balance the equation

$$x = 5$$

17 How many blocks are in 1 bag? _____

18 How could you check your solution? _____

_____

_____

_____

Try It Use what you just learned to solve this problem. Show your work on a separate sheet of paper.

19 Solve $7x = 21$.

Learn About > **Solving Equations for Real-World Situations**

Read the problem below. Then explore how to write and solve an equation based on a real-world situation.

> Rita sells 6 tickets for a school fundraiser. The total price of the 6 tickets is $84. What is the price of 1 ticket?

▶ **Model It** **Create a bar model to represent the 6 tickets and the total price. Let t be the price of 1 ticket.**

t	t	t	t	t	t

$$\leftarrow\!\!\!\text{—— } \$84 \text{ ——}\!\!\!\rightarrow$$
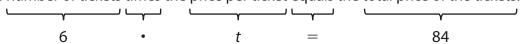
The top bar represents $84, the total price of the 6 tickets.

The bottom bar represents the expression $6t$, the total price of the 6 tickets Rita sells.

The bars are the same length, so $6t = 84$.

▶ **Solve It** **Let the price of each ticket be t dollars. Write a sentence describing two amounts in the problem that are equivalent. Then, translate your sentence into math symbols.**

The number of tickets times the price per ticket equals the total price of the tickets.

$$6 \quad \cdot \quad t \quad = \quad 84$$

Write an equation.

$6t = 84$.

Solve this equation to find t, the price of 1 ticket.

> **Connect It** **Now use inverse operations to solve the problem.**

20 Look at *Solve It* on the previous page. What is the operation in the equation $6t = 84$?

_____

21 What is the inverse of this operation?

_____

22 What is the first step to solve the equation?

_____

23 What must you do to keep the equation balanced?

_____

24 Write numbers inside the boxes to solve $6t = 84$.

$$6t = 84$$

isolate the variable $\quad \dfrac{6t}{\Box} = \dfrac{84}{\Box} \quad$ balance the equation

$$t = 14$$

25 What is the price of 1 ticket?_____

26 Explain how you know what step to take to solve an equation.

_____

_____

_____

_____

> **Try It** **Use what you just learned to solve this problem. Show your work on a separate sheet of paper.**

27 Marie drives 35 miles per hour and travels a total of 105 miles. For how many hours does Marie drive?

_____

Practice ▸ **Solving Equations**

Study the example below. Then solve problems 28–30.

Example

> Amanda's age is William's age divided by 2. If Amanda is
> 12 years old, how old is William?
>
> **Look at how you could solve this problem.**
>
> Write a sentence describing two amounts in the problem that are
> equal. Then, translate your sentence into math symbols and write
> an equation.
>
> Amanda's age is William's age divided by 2.
>
> $$12 = \frac{w}{2}$$
>
> The equation is $12 = \frac{w}{2}$.
>
> $$12 = \frac{w}{2}$$
> $$2 \cdot 12 = 2 \cdot \frac{w}{2}$$
> $$24 = w$$
>
> *Solution* ___William is 24 years old.___

The student wrote an equation, then used an inverse operation to solve the problem.

Pair/Share
How do you know your solution is correct?

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28 Ray and Hunter sell newspapers after school. Ray earns $11 more than Hunter. If Ray earns $25, how much money does Hunter earn?

Show your work.

Before you begin writing, ask yourself, "Should the solution be less than or greater than $25?"

Pair/Share
How could you use a bar model to help solve this problem?

Solution _____

29 Nina has 2 cups of flour. However, this is only $\frac{1}{4}$ of the amount of flour that she needs for a bread recipe. How many cups of flour does the recipe call for?

Show your work.

Solution _____

---

30 Tara and Julia run a race. Julia takes 42 seconds to run the race. She is 7 seconds faster than Tara. How many seconds does Tara take?

A 6 seconds

B 35 seconds

C 49 seconds

D 294 seconds

Nolan chose **B** as the correct answer. How did he get that answer?

_____

Practice ▶ **Solving Equations**

Solve the problems.

1 Solve the following equation for *a*.

$$a - 32 = 47$$

A $a = 15$

B $a = 47$

C $a = 64$

D $a = 79$

2 Ali reads a story and a play. The play has 165 pages, which is 5 times as many pages as the story. Which equation could you use to find *s*, the number of pages in the story?

A $\frac{1}{5}s = 165$

B $165 = s + 5$

C $5s = 165$

D $165s = 5$

3 Caroline charges $15 per hour babysitting. Let *h* represent the number of hours she babysits and *E* represent how much she earns. Choose *True* or *False* for each statement.

a. $h + 15 = E$ is the equation that represents how much Caroline earns after *h* hours. ☐ True ☐ False

b. If Caroline babysits for 5 hours, she earns $20. ☐ True ☐ False

c. $15h = E$ is the equation that represents how much Caroline earns after *h* hours. ☐ True ☐ False

d. If Caroline earned $52.50, then she babysat for $3\frac{1}{2}$ hours. ☐ True ☐ False

e. $75f$ represents how much Caroline makes after *f* days babysitting 5 hours a day. ☐ True ☐ False

4 Which scenario could be represented by the following expression? Circle all that apply.

$48 + 2x$

A Sara's phone contract costs her $48 per month, but she pays an additional $2 for every minute she goes over her allotted minutes.

B A fast food restaurant expects to use 48 eggs per day plus an additional 2 eggs for every customer coming in for breakfast.

C A florist began the day with 48 roses and sold approximately 2 roses per hour.

D The entrance fee to the amusement park is $48 plus $2 for each ticket purchased for the rides.

5 A builder has built $\frac{1}{6}$ of the floors of a new skyscraper. If the builder has built 13 floors, how many floors will the skyscraper have when it is finished? Write and solve an equation to find the answer.

6 Big-Box brand computers have $\frac{1}{4}$ of the gigabytes of RAM that Zap brand computers have. A Big-Box computer has 20 gigabytes of RAM. Maia and Jada each write an equation to find how many gigabytes of RAM a Zap computer has. Is one, both, or neither girl correct? Solve each correct equation.

Maia: $20 = \frac{1}{4}z$ Jada: $20 = \frac{z}{4}$

✔ **Self Check** **Go back and see what you can check off on the Self Check on page 143.**