## 3.3 <br> Solving Equations Using Addition or Subtraction

## Essential Question How can you use algebra ties to solve

 addition or subtraction equations?
## 1 ACIIVITY: Solving Equations

## Work with a partner. Use algebra tiles to model and solve the equation.

a. $x-3=-4$

Model the equation $x-3=-4$.

To get the variable tile by itself, remove
the tiles on the left side by adding tiles to each side.

How many zero pairs can you remove
from each side?


Circle them.
The remaining tile shows the value of $x$.

$\therefore \quad$ So, $x=\square$.
b. $z-6=2$
c. $p-7=-3$
d. $-15=t-5$

## 2 ACTIMIJY: Solving Equations

## Work with a partner. Use algebra tiles to model and solve the equation.

a. $-5=n+2$

Model the equation $-5=n+2$.

Common
Core
Solving Equations
In this lesson, you will

- write simple equations.
- solve equations using addition or subtraction.
- solve real-life problems.

Learning Standard 7.EE.4a

$\therefore$ So, $n=$ $\square$
b. $y+10=-5$
c. $7+b=-1$
d. $8=12+z$

## Math

## 3 ACTJVJJY: Writing and Solving Equations

Interpret Results
How can you add tiles to make zero pairs? Explain how this helps you solve the equation.

Work with a partner. Write an equation shown by the algebra tiles. Then solve.
a.

b.

c.

d. ${\underset{ \pm \pm}{ \pm+ \pm}+\square+\square}_{-}^{+}$

## 4 ACIIVIJY: Using a Different Method to Find a Solution



Work with a partner. The melting point of a solid is the temperature at which the solid melts to become a liquid. The melting point of the element bromine is about $19^{\circ} \mathrm{F}$. This is about $57^{\circ} \mathrm{F}$ more than the melting point of mercury.
a. Which of the following equations can you use to find the melting point of mercury? What is the melting point of mercury?

$$
\begin{array}{l|l|l|l}
x+57=19 & x-57=19 & x+19=57 & x+19=-57
\end{array}
$$

b. CHOOSE TOOLS How can you solve this problem without using an equation? Explain. How are these two methods related?

## What Is Your Answer?

5. IN YOUR OWN WORDS How can you use algebra tiles to solve addition or subtraction equations? Give an example of each.
6. STRUCTURE Explain how you could use inverse operations to solve addition or subtraction equations without using algebra tiles.
7. What makes the cartoon funny?
8. The word variable comes from the word vary. For example, the temperature in Maine varies

"Dear Sir: Yesterday you said $\boldsymbol{x}=\mathbf{2}$. Today you are saying $x=3$. Please make up your mind." a lot from winter to summer.

Write two other English sentences that use the word vary.

## Practice

Use what you learned about solving addition or subtraction equations to complete Exercises 5-8 on page 100.

## Key Vocabulary

 equivalent equations, p. 98Two equations are equivalent equations if they have the same solutions. The Addition and Subtraction Properties of Equality can be used to write equivalent equations.

## Key Ideas

## Addition Property of Equality

Words Adding the same number to each side of an equation produces an equivalent equation.
Algebra If $a=b$, then $a+c=b+c$.

## Subtraction Property of Equality

Words Subtracting the same number from each side of an equation produces an equivalent equation.
Algebra If $a=b$, then $a-c=b-c$.

EXAMPLE

## (1) Solving Equations

a. Solve $x-5=-1$.
$x-5=-1 \quad$ Write the equation.

$x=4 \quad$ Simplify.
$\therefore \quad$ The solution is $x=4$.

Check

$$
\begin{array}{r}
x-5=-1 \\
4-5 \stackrel{?}{=}-1 \\
-1=-1
\end{array}
$$

b. Solve $z+\frac{3}{2}=\frac{1}{2}$.


## Check

$$
\begin{aligned}
z+\frac{3}{2} & =\frac{1}{2} \\
-1+\frac{3}{2} & \stackrel{?}{=} \frac{1}{2} \\
\frac{1}{2} & =\frac{1}{2}
\end{aligned}
$$

## On Your Own

Solve the equation. Check your solution.

1. $p-5=-2$
2. $w+13.2=10.4$
3. $x-\frac{5}{6}=-\frac{1}{6}$

A company has a profit of $\$ 750$ this week. This profit is $\$ 900$ more than the profit $P$ last week. Which equation can be used to find $P$ ?
(A) $750=900-P$
(B) $750=P+900$
(C) $900=P-750$
(D) $900=P+750$

Words The profit this week is $\$ 900$ more than the profit last week.
Equation $750 \quad=P \quad 900$
$\therefore \quad$ The equation is $750=P+900$. The correct answer is (B).

## On Your Own

4. A company has a profit of $\$ 120.50$ today. This profit is $\$ 145.25$ less than the profit $P$ yesterday. Write an equation that can be used to find $P$.

## EXAMPLE

## 3 Real-Life Application

The line graph shows the scoring while you and your friend played a video game. Write and solve an equation to find your score after Level 4.

You can determine the following from the graph.
Words Your friend's score is 33 points less than your score.
Variable Let $s$ be your score after Level 4.


$$
\begin{aligned}
&-8=s-33 \text { Write equation. } \\
&+\underline{+33}+\underline{33} \\
& \text { Addition Property of Equality } \\
& 25=s \\
& \text { Simplify. }
\end{aligned}
$$

$\therefore$ ©- Your score after Level 4 is 25 points.
Reasonable? From the graph, your score after Level 4 is between 20 points and 30 points. So, 25 points is a reasonable answer.

## On Your Own

5. WHAT IF? You have -12 points after Level 1 . Your score is 27 points less than your friend's score. What is your friend's score?

## Vocabulary and Concept Check

1. VOCABULARY What property would you use to solve $m+6=-4$ ?
2. VOCABULARY Name two inverse operations.
3. WRITING Are the equations $m+3=-5$ and $m=-2$ equivalent? Explain.
4. WHICH ONE DOESN'T BELONG? Which equation does not belong with the other three? Explain your reasoning.
$x+3=-1$
$x+1=-5$
$x-2=-6$

$$
x-9=-13
$$

## Practice and Problem Solving

Solve the equation. Check your solution.
5. $a-6=13$
6. $-3=z-8$
7. $-14=k+6$
8. $x+4=-14$
9. $c-7.6=-4$
10. $-10.1=w+5.3$
11. $\frac{1}{2}=q+\frac{2}{3}$
12. $p-3 \frac{1}{6}=-2 \frac{1}{2}$
13. $g-9=-19$
14. $-9.3=d-3.4$
15. $4.58+y=2.5$
16. $x-5.2=-18.73$
17. $q+\frac{5}{9}=\frac{1}{6}$
18. $-2 \frac{1}{4}=r-\frac{4}{5}$
19. $w+3 \frac{3}{8}=1 \frac{5}{6}$
20. $4 \frac{2}{5}+k=-3 \frac{2}{11}$
21. ERROR ANALYSIS Describe and correct the error in finding the solution.

$$
\text { N } \begin{aligned}
x+8 & =10 \\
+\frac{8}{x} & =\frac{+8}{18}
\end{aligned}
$$

## Write the word sentence as an equation. Then solve.

22. 4 less than a number $n$ is -15 .
23. 10 more than a number $c$ is 3 .
24. The sum of a number $y$ and -3 is -8 .
25. The difference between a number $p$ and 6 is -14 .

In Exercises 26-28, write an equation. Then solve.
26. DRY ICE The temperature of dry ice is $-109.3^{\circ} \mathrm{F}$. This is $184.9^{\circ} \mathrm{F}$ less than the outside temperature. What is the outside temperature?
27. PROFIT A company makes a profit of $\$ 1.38$ million. This is $\$ 2.54$ million more than last year. What was the profit last year?
28. HELICOPTER The difference in elevation of a helicopter and a submarine is $18 \frac{1}{2}$ meters. The elevation of the submarine is $-7 \frac{3}{4}$ meters. What is the elevation of the helicopter?

GEOMETRY Write and solve an equation to find the unknown side length.
29. Perimeter $=12 \mathrm{~cm}$

30. Perimeter $=24.2$ in.

31. Perimeter $=34.6 \mathrm{ft}$


In Exercises 32-36, write an equation. Then solve.

32. STATUE OF LIBERTY The total height of the Statue of Liberty and its pedestal is 153 feet more than the height of the statue. What is the height of the statue?
33. BUNGEE JUMPING Your first jump is $50 \frac{1}{6}$ feet higher than your second jump. Your first jump reaches $-200 \frac{2}{5}$ feet. What is the height of your second jump?
34. TRAVEL Boatesville is $65 \frac{3}{5}$ kilometers from Stanton. A bus traveling from Stanton is $24 \frac{1}{3}$ kilometers from Boatesville. How far has the bus traveled?
35. GEOMETRY The sum of the measures of the angles of a triangle equals $180^{\circ}$. What is the measure of the missing angle?

36. SKATEBOARDING The table shows your scores in a skateboarding competition. The leader has 311.62 points. What score

| Round | 1 | 2 | 3 | 4 |
| :--- | :---: | :---: | :---: | :---: |
| Points | 63.43 | 87.15 | 81.96 | $?$ | do you need in the fourth round to win?

37. CRITICAL THINKING Find the value of $2 x-1$ when $x+6=2$.


Find the values of $x$.
38. $|x|=2$
39. $|x|-2=4$
40. $|x|+5=18$

## Fair Game Review what you learned in previous grades \& lessons

Multiply or divide. (Section 1.4 and Section 1.5)
41. $-7 \times 8$
42. $6 \times(-12)$
43. $18 \div(-2)$
44. $-26 \div 4$
45. MULTIPLE CHOICE A class of 144 students voted for a class president. Three-fourths of the students voted for you. Of the students who voted for you, $\frac{5}{9}$ are female. How many female students voted for you? (Section 2.4)
(A) 50
(B) 60
(C) 80
(D) 108

