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2-4 Study Guide and Intervention

Solving Multi-Step Equations

Work Backward **Working backward** is one of many problem-solving strategies that you can use to solve problems. To work backward, start with the result given at the end of a problem and undo each step to arrive at the beginning number.

Example 1 **A number is divided by 2, and then 8 is subtracted from the quotient. The result is 16. What is the number?**

Solve the problem by working backward.

The final number is 16. Undo subtracting 8 by adding 8 to get 24. To undo dividing 24 by 2, multiply 24 by 2 to get 48.

The original number is 48.

Example 2 **A bacteria culture doubles each half hour. After 3 hours, there are 6400 bacteria. How many bacteria were there to begin with?**

Solve the problem by working backward.

The bacteria have grown for 3 hours. Since there are 2 one-half hour periods in one hour, in 3 hours there are 6 one-half hour periods. Since the bacteria culture has grown for 6 time periods, it has doubled 6 times. Undo the doubling by halving the number of bacteria 6 times.

$$6{,}400 \times \frac{1}{2} \times \frac{1}{2} \times \frac{1}{2} \times \frac{1}{2} \times \frac{1}{2} \times \frac{1}{2} = 6{,}400 \times \frac{1}{64}$$
$$= 100$$

There were 100 bacteria to begin with.

Exercises

Solve each problem by working backward.

1. A number is divided by 3, and then 4 is added to the quotient. The result is 8. Find the number.

2. A number is multiplied by 5, and then 3 is subtracted from the product. The result is 12. Find the number.

3. Eight is subtracted from a number, and then the difference is multiplied by 2. The result is 24. Find the number.

4. Three times a number plus 3 is 24. Find the number.

5. **CAR RENTAL** Angela rented a car for $29.99 a day plus a one-time insurance cost of $5.00. Her bill was $124.96. For how many days did she rent the car?

6. **MONEY** Mike withdrew an amount of money from his bank account. He spent one fourth for gasoline and had $90 left. How much money did he withdraw?

7. **TELEVISIONS** In 2003, 68% of households with TVs subscribed to cable TV. If 8,000 more subscribers were added to the number of households with cable, the total number of households with cable TV would be 73,448,000. How many households were there with TV in 2003? **Source:** *World Almanac*

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2-4 Study Guide and Intervention *(continued)*

Solving Multi-Step Equations

Solve Multi-Step Equations To solve equations with more than one operation, often called **multi-step equations**, undo operations by working backward. Reverse the usual order of operations as you work.

Example **Solve $5x + 3 = 23$.**

$5x + 3 = 23$	Original equation.
$5x + 3 - 3 = 23 - 3$	Subtract 3 from each side.
$5x = 20$	Simplify.
$\frac{5x}{5} = \frac{20}{5}$	Divide each side by 5.
$x = 4$	Simplify.

Exercises

Solve each equation. Then check your solution.

1. $5x + 2 = 27$

2. $6x + 9 = 27$

3. $5x + 16 = 51$

4. $14n - 8 = 34$

5. $0.6x - 1.5 = 1.8$

6. $\frac{7}{8}p - 4 = 10$

7. $16 = \frac{d - 12}{14}$

8. $8 + \frac{3n}{12} = 13$

9. $\frac{g}{-5} + 3 = -13$

10. $\frac{4b + 8}{-2} = 10$

11. $0.2x - 8 = -2$

12. $3.2y - 1.8 = 3$

13. $-4 = \frac{7x - (-1)}{-8}$

14. $8 = -12 + \frac{k}{-4}$

15. $0 = 10y - 40$

Write an equation and solve each problem.

16. Find three consecutive integers whose sum is 96.

17. Find two consecutive odd integers whose sum is 176.

18. Find three consecutive integers whose sum is -93.

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2-5 Study Guide and Intervention

Solving Equations with the Variable on Each Side

Variables on Each Side To solve an equation with the same variable on each side, first use the Addition or the Subtraction Property of Equality to write an equivalent equation that has the variable on just one side of the equation. Then solve the equation.

Example 1 **Solve $5y - 8 = 3y + 12$.**

$$\begin{aligned} 5y - 8 &= 3y + 12 \\ 5y - 8 - 3y &= 3y + 12 - 3y \\ 2y - 8 &= 12 \\ 2y - 8 + 8 &= 12 + 8 \\ 2y &= 20 \\ \frac{2y}{2} &= \frac{20}{2} \\ y &= 10 \end{aligned}$$

The solution is 10.

Example 2 **Solve $-11 - 3y = 8y + 1$.**

$$\begin{aligned} -11 - 3y &= 8y + 1 \\ -11 - 3y + 3y &= 8y + 1 + 3y \\ -11 &= 11y + 1 \\ -11 - 1 &= 11y + 1 - 1 \\ -12 &= 11y \\ \frac{-12}{11} &= \frac{11y}{11} \\ -1\frac{1}{11} &= y \end{aligned}$$

The solution is $-1\frac{1}{11}$.

Exercises

Solve each equation. Then check your solution.

1. $6 - b = 5b + 30$

2. $5y - 2y = 3y + 2$

3. $5x + 2 = 2x - 10$

4. $4n - 8 = 3n + 2$

5. $1.2x + 4.3 = 2.1 - x$

6. $4.4s + 6.2 = 8.8s - 1.8$

7. $\frac{1}{2}b + 4 = \frac{1}{8}b + 88$

8. $\frac{3}{4}k - 5 = \frac{1}{4}k - 1$

9. $8 - 5p = 4p - 1$

10. $4b - 8 = 10 - 2b$

11. $0.2x - 8 = -2 - x$

12. $3y - 1.8 = 3y - 1.8$

13. $-4 - 3x = 7x - 6$

14. $8 + 4k = -10 + k$

15. $20 - a = 10a - 2$

16. $\frac{2}{3}n + 8 = \frac{1}{2}n + 2$

17. $\frac{2}{5}y - 8 = 9 - \frac{3}{5}y$

18. $-4r + 5 = 5 - 4r$

19. $-4 - 3x = 6x - 6$

20. $18 - 4k = -10 - 4k$

21. $12 + 2y = 10y - 12$

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2-5 Study Guide and Intervention *(continued)*

Solving Equations with the Variable on Each Side

Grouping Symbols When solving equations that contain grouping symbols, first use the Distributive Property to eliminate grouping symbols. Then solve.

Example **Solve $4(2a - 1) = -10(a - 5)$.**

$4(2a - 1) = -10(a - 5)$	Original equation
$8a - 4 = -10a + 50$	Distributive Property
$8a - 4 + 10a = -10a + 50 + 10a$	Add $10a$ to each side.
$18a - 4 = 50$	Simplify.
$18a - 4 + 4 = 50 + 4$	Add 4 to each side.
$18a = 54$	Simplify.
$\frac{18a}{18} = \frac{54}{18}$	Divide each side by 18.
$a = 3$	Simplify.

The solution is 3.

Exercises

Solve each equation. Then check your solution.

1. $-3(x + 5) = 3(x - 1)$

2. $2(7 + 3t) = -t$

3. $3(a + 1) - 5 = 3a - 2$

4. $75 - 9g = 5(-4 + 2g)$

5. $5(f + 2) = 2(3 - f)$

6. $4(p + 3) = 36$

7. $18 = 3(2c + 2)$

8. $3(d - 8) = 3d$

9. $5(p + 3) + 9 = 3(p - 2) + 6$

10. $4(b - 2) = 2(5 - b)$

11. $1.2(x - 2) = 2 - x$

12. $\frac{3 + y}{4} = \frac{-y}{8}$

13. $\frac{a - 8}{12} = \frac{2a + 5}{3}$

14. $2(4 + 2k) + 10 = k$

15. $2(w - 1) + 4 = 4(w + 1)$

16. $6(n - 1) = 2(2n + 4)$

17. $2[2 + 3(y - 1)] = 22$

18. $-4(r + 2) = 4(2 - 4r)$

19. $-3(x - 8) = 24$

20. $4(4 - 4k) = -10 - 16k$

21. $6(2 - 2y) = 5(2y - 2)$