2-8 Simplifying Algebraic Expressions Containing Parentheses

INTRODUCTION

Working with **parentheses** can sometimes be confusing. It is important to know how to work with expressions contained in parentheses. In many problems, it is necessary to remove parentheses to find solutions.

When removing parentheses many students often have difficulties with positive and negative signs especially when working with subtraction. Remember the following important facts. They can prevent a lot of mistakes.

Helpful Hints

- When removing parentheses with a **plus sign (+)** in front, get rid of the plus sign and the parentheses and **do not change** the signs of any of the terms. Remember to collect like terms.
- When removing parentheses with a **minus sign (–)** in front, get rid of the minus sign and the parentheses and **change** the sign of each of the terms. Remember to collect like terms.

EXAMPLES

1) (3x – 2xy + 3) + (7x + 5xy – 7)

= 3x – 2xy + 3 + 7x + 5xy – 7 — *Remove parentheses and get rid of plus sign (+). Do not change any signs.*

= 3x + 7x – 2xy + 5xy + 3 – 7 — *Collect like terms and simplify.*

= 10x + 3xy – 4

2) (5y + 2xy + 3) + (-6y + 3xy + 4)

= 5y + 2xy + 3 – 6y + 3xy + 4 — *Remove parentheses and get rid of plus sign (+). Do not change any signs.*

= 5y – 6y + 2xy + 3xy + 3 + 4 — *Collect like terms and simplify.*

= -y + 5xy + 7

3) (4x – 2xy + 5) – (3x + 8xy + 7)

= 4x – 2xy + 5 – 3x – 8xy – 7 — *Remove parentheses and get rid of minus sign (–). Change the sign of each term.*

= 4x – 3x – 2xy – 8xy + 5 – 7 — *Collect like terms and simplify.*

= x – 10xy – 2

4) (3x + 2xy – 3) – (-5x + 3xy – 8)

= 3x + 2xy – 3 + 5x – 3xy + 8) — *Remove parentheses and get rid of minus sign (–). Change the sign of each term.*

= 3x + 5x + 2xy – 3xy – 3 + 8 — *Collect like terms and simplify.*

= 8x – xy + 5

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EXERCISES

Simplify each of the following.

1) $(5x + 7y) + (-2x - 2y)$

2) $(8x + 4y) - (2x + 7y)$

3) $(6m - 3x) - (-4m - 6x)$

4) $(-7x + 8y) + (7x - 11y)$

5) $(2y + 3x - 7) + (3y - 4x - 4)$

6) $(3m - 4n + 8) - (6m + 8n + 3)$

7) $(-5x + 3y - 7) - (-8x - 3y - 4)$

8) $(3x - 4xy + 7) + (-11x + 3y + 7)$

9) $(3x - 9y) - (-7x - 8y)$

10) $(7x + 9y) + (-12x - 15y)$

11) $(5x - 7y) - (12x + 2y)$

12) $(7x - 2xy + y) + (-9x + 7y)$

13) $(3x - y + 2z) - (-2x - 8y - 3z)$

14) $(-3x^2 + 2y - 3x^2y) + (2x^2 - 3y + 2x^2y)$

15) $(6x - y + 3) - (2x + 7y - 9)$

16) $(7x^2 - 5x) - (6x - 3x^2 + xy)$

REVIEW

Simiplify each of the following.

1) $\frac{7^3}{7^2}$

2) $n^7 \bullet n^8$

3) $(n^2)^3$

4) $\sqrt[4]{121}$

2-9 Solving Multi-Step Equations

INTRODUCTION

Some equations take several steps. Often there is more than one effective strategy to use. Remember to use all the algebra tools that you have learned. Also remember that if you add, subtract, multiply, or divide on one side of the equal sign, you must do the same on the other side of the equal sign. It is also important to work neatly, carefully, and avoid making careless errors. Remember the following tips as you work through multi-step equations.

Helpful Hints

- It is good to isolate the variable on the left if possible.
- Remember to treat each side of the equal sign the same.
- Be careful with negative signs.
- Use the distributive law to get rid of parentheses when possible.
- Combine like terms.
- If there is division by a number, eliminate it by multiplying both sides of the equal sign by that number.
- Check your answers by substituting them back into the original equation.

EXAMPLES

Solve each of the following equations. Check your answers by substituting them back into the original equation.

1) $\mathbf{7(x-2)-6=2x+8+x}$

First use distributive property and collect like terms.

$$7x - 14 - 6 = 2x + 8 + x$$
$$7x - 20 = 3x + 8$$
$$7x - 3x - 20 = 3x - 3x + 8 \quad \textit{Subtract 3x from both sides.}$$
$$4x - 20 = 8$$
$$4x - 20 + 20 = 8 + 20 \quad \textit{Add 20 to both sides.}$$
$$4x = 28$$
$$\frac{4x}{4} = \frac{28}{4} \quad \textit{Divide both sides by 4.}$$
$$x = 7$$

2) $\mathbf{\frac{x+4}{5} = x}$

$$5 \bullet \frac{x+4}{5} = 5 \bullet x \quad \textit{Multiply both sides by 5.}$$
$$x + 4 = 5x$$
$$x - 5x + 4 = 5x - 5x \quad \textit{Subtract 5x from both sides.}$$
$$-4x + 4 = 0$$
$$-4x + 4 - 4 = 0 - 4 \quad \textit{Subtract 4 from both sides.}$$
$$-4x = -4$$
$$\frac{-4x}{-4} = \frac{-4}{-4} \quad \textit{Divide both sides by -4.}$$
$$x = 1$$

2-9 Solving Multi-Step Equations

3) $\frac{x-2}{2} = 5$

$2 \bullet \frac{(x-2)}{2} = 2 \bullet 5$ *Multiply both sides by 2.*

$x - 2 = 10$

$x - 2 + 2 = 10 + 2$ *Add 2 to both sides.*

$x = 12$

4) $x = \frac{x}{2} + 5$

$2 \bullet x = 2\left(\frac{x}{2} + 5\right)$ *Multiply both sides by 2. Use distributive property.*

$2x = x + 10$

$2x - x = x - x + 10$ *Subtract x from both sides.*

$x = 10$

EXERCISES

Solve each of the following equations. Check your answers by substituting them back into the original equation.

1) $7(x + 1) = 5(x - 3)$

2) $3(x - 3) - 4x = 5$

3) $4(x - 3) - x = x - 6$

4) $\frac{2x + 4}{2} = 2$

5) $\frac{6x - 1}{2} = 4$

6) $\frac{7x + 3}{3} = 2x - 1$

7) $\frac{x}{2} - 3 = 7$

8) $\frac{5x - 4}{2} = 18$

9) $\frac{x - 8}{3} = -10$

10) $7(m + 2) - 4m = 2(m + 10)$

11) $\frac{x + 40}{15} = -4$

12) $\frac{15 + 9x}{6} = 7$

13) $-9 - 3(2x - 1) = -18$

14) $\frac{2}{3}n + 6 = 16$

REVIEW

Solve each equation.

1) $-m + 4m = 15$

2) $7x - 2 - 5x = 0$

3) $3(x - 2) = 2x$

4) $4(x + 3) = 6x + 8$