Properties of Operations and Simplifying Expressions

Name: _____	Date: _____	Score: _____ / 17

The properties of operations are like a toolbox that lets you rearrange and simplify expressions without changing their value. You can move terms around, regroup them, and use the distributive property to break apart or combine pieces. Combining **like terms**—terms that share the same variable part—is a big part of this, and once you see the pattern, algebra starts to feel organized instead of random. Think of these properties as the "grammar rules" of math: learn them now and everything you write in algebra will make sense!

Key Concepts & Quick Review

Commutative: $a + b = b + a$; $ab = ba$. **Associative:** $(a + b) + c = a + (b + c)$. **Distributive:** $a(b + c) = ab + ac$.

Like terms share the same variable(s) and exponent(s). Combine by adding/subtracting **coefficients** only. Example: $5x + 3 - 2x + 7 = 3x + 10$.

Examples

① Simplify: $7x - 3 + 2x + 5y - x + 9$.

Think It Through: Look for like terms, which means terms with the same variable part. The x-terms are $7x$, $2x$, and $-x$, so they combine to $8x$. The $5y$ term stays by itself because it is a different variable. The constants -3 and 9 combine to 6. Putting everything together gives $8x + 5y + 6$.

Answer: $8x + 5y + 6$

② Apply the distributive property and simplify: $3(2x - 4) + 5(x + 1)$.

Think It Through: Start by distributing to both terms inside each set of parentheses. The first part becomes $3(2x) - 3(4) = 6x - 12$, and the second becomes $5(x) + 5(1) = 5x + 5$. Now combine like terms: $6x + 5x = 11x$ and $-12 + 5 = -7$. So the simplified expression is $11x - 7$. Distribute first, then combine.

Answer: $11x - 7$

Practice Problems

Simplify each expression by combining like terms or applying properties.

1. $5x + 3x$ _____
2. $9y - 4y + 2$ _____
3. $6a + 3b - 2a$ _____
4. $4m + 7 - m + 2$ _____
5. $3(x + 5)$ _____
6. $2(3y - 4)$ _____
7. $5x + 2 - 3x + 8$ _____
8. $4(2a + 3) - 5$ _____
9. $7n - 2 + 3n - 6$ _____
10. $2(x + 4) + 3(x - 1)$ _____

11. $6k - 3k + 5k$ _____

12. $4(3 - 2y) + y$ _____

13. $8p + 2q - 3p + q$ _____

14. $5(2x - 3) - 4x$ _____

15. $9 - 2(m + 3) + 4m$ _____

Study Tips

- Only **like terms** can be combined — $3x$ and $3x^2$ are different terms because the exponents differ.
- When distributing a **negative**: $-2(x - 5) = -2x + 10$. The negative must multiply both terms inside the parentheses.
- **Underline** or **circle** like-term groups in different colors before combining — it prevents you from missing a term.

Word Problems

16. A school play sells student tickets for $\$s$ each and adult tickets for $\$a$ each. On opening night, 3 groups of 5 students attended, and 2 groups of 4 adults attended. Write an unsimplified expression for total ticket revenue, then simplify it using the distributive property. If $s = \$4$ and $a = \$7$, evaluate your expression. _____

17. A landscaper charges $\$12$ per hour for mowing and $\$9$ per hour for weeding. This week she mowed for $(2x + 1)$ hours and weeded for $(x + 3)$ hours. Write and simplify an expression for her total earnings. If $x = 4$, how much did she earn? How many more mowing hours would give her at least $\$200$ if x stays at 4?

_____

Answer Keys

1) $8x$
2) $5y + 2$
3) $4a + 3b$
4) $3m + 9$
5) $3x + 15$
6) $6y - 8$
7) $2x + 10$
8) $8a + 7$
9) $10n - 8$
10) $5x + 5$
11) $8k$
12) $12 - 7y$
13) $5p + 3q$
14) $6x - 15$
15) $2m + 3$
16) Unsimplified: $3(5s) + 2(4a)$; simplified: $15s + 8a$; evaluated: $\$60 + \$56 = \$116$.
17) Simplified $33x + 39$; at $x = 4$: \$171; needs 3 more mowing hours

Step-by-Step Explanations

Strategy: For Finding the Percent of a Number, rewrite the percent as a decimal and multiply by the whole amount to find the part. A percent-of-number estimate should be close to the computed part.

Practice 1: 20% of 50 **Answer:** 10
In the first example, translate 25% as one fourth of the number, which keeps the arithmetic friendly.

Practice 15: 85% of 60 **Answer:** 51
Toward the end, treat 34% as 0.34 of the whole and multiply by the full amount.

Word-problem notes:

16. Answer: \$1,560 raised; \$840 remaining; 35% remains.
Find the amount raised by taking 65% of $2{,}400$: $0.65 \times 2{,}400 = 1{,}560$. To find how much is still needed, subtract from the goal: $2{,}400 - 1{,}560 = 840$. Since 65% has already been raised, the percent that remains is $100\% - 65\% = 35\%$. Using the whole goal as the reference amount keeps the problem organized.

17. Answer: 175%: $560\,g$; 40%: $128\,g$; difference: $432\,g$.
Convert each percent to a decimal and multiply by the original amount. For the large batch, $175\% = 1.75$, so $1.75 \times 320 = 560\,g$. For the small batch, $40\% = 0.40$, so $0.40 \times 320 = 128\,g$. To compare them, subtract: $560 - 128 = 432\,g$. Notice that a percent greater than 100% means more than the original recipe.

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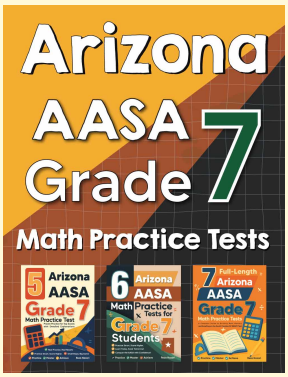

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