Rewriting Expressions to Solve Problems

Name: _____	Date: _____	Score: _____ / 17

Here is a powerful idea: two expressions can look completely different and still represent the *exact same* quantity! Sometimes one form is easier to understand, while another is easier to calculate with—that is why you learn to distribute, factor, regroup, or change forms to match the situation. This flexibility is what turns algebra from a set of rigid rules into a creative problem-solving tool. The more comfortable you get at rewriting expressions, the more problems you will be able to crack!

Key Concepts & Quick Review

Rearranging formulas: isolate the desired variable using inverse operations. Example: from $A = lw$, find l: divide both sides by $w \Rightarrow l = \frac{A}{w}$.

Equivalent expressions: $2(x+3)$, $2x+6$, and $\frac{4x+12}{2}$ all represent the same quantity. Choose the form that's most useful for your goal.

Examples

① The formula for the perimeter of a rectangle is $P = 2l + 2w$. Solve for l in terms of P and w. Then find l when $P = 48\ cm$ and $w = 9\ cm$.

Think It Through: Treat the other letters like numbers and isolate l. First subtract $2w$ from both sides: $P - 2w = 2l$. Then divide both sides by 2 to get $l = \frac{P-2w}{2}$. Substituting $P = 48$ and $w = 9$ gives $l = \frac{48-18}{2} = \frac{30}{2} = 15\ cm$.

Answer: $l = \frac{P-2w}{2}$; $l = 15\ cm$

② A runner's pace formula is $T = d \cdot p$, where T is time in minutes, d is distance in miles, and p is pace in minutes per mile. Rewrite the formula to find pace p. If a runner finishes $6.2\ mi$ in $55.8\ min$, what is their pace?

Think It Through: To solve for p, divide both sides of $T = dp$ by d, which gives $p = \frac{T}{d}$. Now substitute the numbers: $p = \frac{55.8}{6.2} = 9$. So the runner's pace is $9\ min$ per mile. Solving a formula is just like solving an equation, except the other letters stay as symbols until you need them.

Answer: $p = \frac{T}{d}$; *pace* $= 9\ min/mile$

Practice Problems

Rearrange the formula to isolate the indicated variable, or rewrite the expression in an equivalent form.

1. Rearrange the formula $A = lw$ to solve for w. _____
2. Rearrange the formula $d = rt$ to solve for r. _____
3. Rearrange the formula $P = 2l + 2w$ to solve for w. _____
4. Rearrange the formula $I = Prt$ to solve for P. _____

5. Rearrange the formula $y = mx + b$ to solve for x. _____
6. Rearrange the formula $A = \frac{1}{2}bh$ to solve for h. _____
7. Rearrange the formula $V = lwh$ to solve for h. _____
8. Rearrange the formula $C = \frac{5}{9}(F - 32)$ to solve for F. _____
9. Rearrange the formula $S = P(1 + rt)$ to solve for t. _____
10. Rearrange the formula $y = kx$ to solve for k. _____
11. Expand the expression $5(x + 3)$. _____
12. Factor the expression $6x + 18$. _____
13. Factor the expression $3x - 12$. _____
14. Expand the expression $2(a - 7)$. _____
15. Simplify the expression $\frac{4x+8}{2}$. _____

Study Tips

- When solving a formula for a variable, treat **all other letters as numbers**. The same inverse-operation rules apply.
- Ask yourself: "Which form of this expression is **most useful** for what I need?" Factored form is best for finding dimensions; expanded form is best for combining with other terms.
- Verify any rearranged formula by **substituting numbers** into both versions and confirming they give the same result.

Word Problems

16. A scientist uses the formula $F = \frac{9}{5}C + 32$ to convert Celsius to Fahrenheit. Rearrange the formula to solve for C in terms of F. The temperature inside a spacecraft is maintained at $68°$F. What is that in Celsius? At what Fahrenheit temperature does water freeze ($0°$C) and boil ($100°$C)? _____

17. A cyclist's average speed formula is $s = \frac{d}{t}$, where s is speed in km/h, d is distance in km, and t is time in hours. Rearrange to find t in terms of s and d. If the cyclist averages $24\ km$/h, how long (in hours and minutes) will it take to ride $60\ km$? To ride $90\ km$? _____

Answer Keys

1) $w = \frac{A}{l}$
2) $r = \frac{d}{t}$
3) $w = \frac{P-2l}{2}$
4) $P = \frac{I}{rt}$
5) $x = \frac{y-b}{m}$
6) $h = \frac{2A}{b}$
7) $h = \frac{V}{lw}$
8) $F = \frac{9}{5}C + 32$
9) $t = \frac{S-P}{Pr}$
10) $k = \frac{y}{x}$
11) $5x + 15$
12) $6(x + 3)$
13) $3(x - 4)$
14) $2a - 14$
15) $2x + 4$
16) $C = \frac{5}{9}(F - 32)$; $20°$C; freeze $32°$F; boil $212°$F
17) $t = \frac{d}{s}$; $60\,km$: 2 hr 30 min; $90\,km$: 3 hr 45 min

Step-by-Step Explanations

Strategy: For Introduction to Personal Financial Literacy, keep income, expenses, savings, and percent rates clearly labeled so the money story stays organized. The useful habit is to keep every dollar amount tied to income, spending, saving, or interest.

Practice 1: A worker earns \$10 per hour and works 25 hours. Find the gross pay. **Answer:** \$250.00
In the opening example, read the budget item as a share of the total monthly income.

Practice 15: A business has revenue \$540 and cost \$600. State whether this is a profit or loss and give the amount. **Answer:** \$60.00 loss
For the end-of-set item, compare income and expenses first; the sign tells whether the budget has a gain or loss.

Word-problem notes:

16. Answer: \$55
Gross $= 11 \times 20 = \$220$. Savings $= 220 \times 0.25 = \$55$.

17. Answer: Save \$875; that is 25% of their income.
Total expenses $= 1{,}050 + 700 + 350 + 525 = \$2{,}625$. Savings $= 3{,}500 - 2{,}625 = \$875$. Percent $= \frac{875}{3{,}500} \times 100 = 25\%$.

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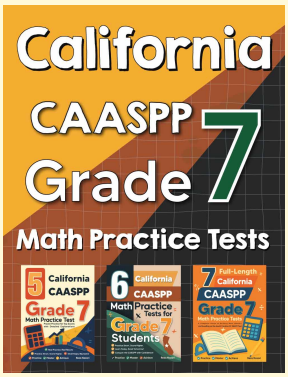

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