

Combining Functions

Name: _____ Date: _____ Score: _____ / 26

Quick Review

Functions can be combined just like numbers: **add** $(f + g)(x) = f(x) + g(x)$; **subtract** $(f - g)(x) = f(x) - g(x)$; **multiply** $(f \cdot g)(x) = f(x) \cdot g(x)$; **divide** $\left(\frac{f}{g}\right)(x) = \frac{f(x)}{g(x)}$ (as long as $g(x) \neq 0$). After combining the expressions, simplify — combine like terms, factor when possible. For division, the domain excludes any x that makes the denominator zero. To evaluate a combination at a number, you can either combine first and then substitute, or substitute into each function first and then combine. Either way works.

PRACTICE

Let $f(x)=2x+5$ and $g(x)=x^2-1$ unless stated otherwise.

- | | |
|--|---|
| 1. $(f + g)(x)$ _____ | 11. $p(x) = 6x, q(x) = 3; \left(\frac{p}{q}\right)(x)$ _____ |
| 2. $(f - g)(x)$ _____ | 12. $p(x) = x^2 + x, q(x) = x; \left(\frac{p}{q}\right)(x)$ _____ |
| 3. $(f \cdot g)(1)$ _____ | 13. $f(x) = 3, g(x) = x; (f + g)(5)$ _____ |
| 4. $\left(\frac{g}{f}\right)(x)$ _____ | 14. $f(x) = x^2, g(x) = x; (f - g)(4)$ _____ |
| 5. $(f + g)(0)$ _____ | 15. $(f \cdot g)(0)$ _____ |
| 6. $(f - g)(3)$ _____ | 16. $(2f)(x)$ _____ |
| 7. $(g \cdot f)(-1)$ _____ | 17. $(f + g)(-2)$ _____ |
| 8. Domain of $\frac{f}{g}$ _____ | 18. $\left(\frac{f}{f}\right)(x) (x \neq -\frac{5}{2})$ _____ |
| 9. $h(x) = x, k(x) = 4x - 3; (h + k)(2)$ _____ | 19. $h(x) = 2x, k(x) = 3x; (h + k)(x)$ _____ |
| 10. $h(x) = x + 1, k(x) = x - 1; (h \cdot k)(x)$ _____ | 20. $f(x) = x + 2, g(x) = x - 2; (f \cdot g)(x)$ _____ |

VISUAL PRACTICE

Use the graph, table, chart, or diagram to answer the question.

21. Use the tables to find $f(g(2))$.

x	1	2	3
$g(x)$	3	1	2
$f(x)$	4	7	9

Answer: _____

22. Use the tables to find $(f + g)(2)$.

x	1	2	3
$f(x)$	4	6	8
$g(x)$	3	5	7

Answer: _____

Word Problems

23. A store's revenue is $R(x) = 12x$ and cost is $C(x) = 5x + 200$. Write profit $P = R - C$ and find break-even ($P = 0$). _____
24. A rectangular poster has area $A(x) = x(x + 4)$. A border adds 2 inches to every side, so the new area is $B(x) = (x + 4)(x + 8)$. Find $(B - A)(3)$ and interpret it. _____
25. A truck's fuel is $F(t) = 20 - 2t$ gallons after t hours. Cost per gallon is $C = 4$. Write total spent so far $S(t) = 4 \cdot (20 - F(t))$. Find $S(5)$. _____
26. Person A walks at 3 mph, B at 4 mph. Write distance functions $D_A(t) = 3t$ and $D_B(t) = 4t$, then find the gap $(D_B - D_A)(2)$ hours. _____



Answer Keys

- | | |
|-------------------------|---------------------------------------|
| 1. $x^2 + 2x + 4$ | 14. 12 |
| 2. $-x^2 + 2x + 6$ | 15. -5 |
| 3. 0 | 16. $4x + 10$ |
| 4. $\frac{x^2-1}{2x+5}$ | 17. 4 |
| 5. 4 | 18. 1 |
| 6. 3 | 19. $5x$ |
| 7. 0 | 20. $x^2 - 4$ |
| 8. $x \neq \pm 1$ | 21. 4 |
| 9. 7 | 22. 11 |
| 10. $x^2 - 1$ | 23. $P(x) = 7x - 200; x \approx 28.6$ |
| 11. $2x$ | 24. 56 |
| 12. $x + 1 (x \neq 0)$ | 25. \$40 |
| 13. 8 | 26. 2 miles |

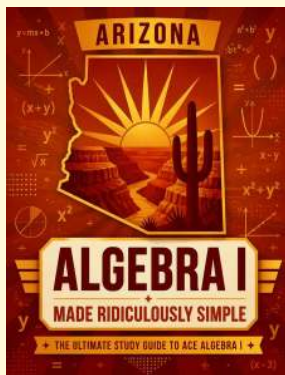
Step-by-Step Tutor Notes

- Focus on the main idea of the problem, then simplify carefully. $(2x + 5) + (x^2 - 1) = x^2 + 2x + 4$. So the answer is $x^2 + 2x + 4$.
- $(2x + 5) - (x^2 - 1) = 2x + 5 - x^2 + 1 = -x^2 + 2x + 6$. (The minus flips the signs inside $(x^2 - 1)$.)
- First identify the feature of the graph or equation that matches the wording of the question. $f(1) = 7, g(1) = 0$. Product: 0. (Anything times zero is zero.) That leads to 0.
- Start with the definition the problem is testing, then apply it directly. Just write the ratio: $\frac{x^2-1}{2x+5}$. Domain excludes $x = -\frac{5}{2}$. So the answer is $\frac{x^2-1}{2x+5}$.
- This is a good place to slow down, check the notation, and simplify cleanly. $f(0) = 5, g(0) = -1$. Sum: $5 + (-1) = 4$. So the answer is 4.
- Focus on the main idea of the problem, then simplify carefully. $f(3) = 11, g(3) = 8$. Difference: $11 - 8 = 3$. So the answer is 3.
- $g(-1) = 0, f(-1) = 3$. Product: $0 \cdot 3 = 0$. (Same as $f \cdot g$ — multiplication is commutative.)
- Focus on the main idea of the problem, then simplify carefully. $g(x) = x^2 - 1 = 0$ when $x = \pm 1$. Exclude those. So the answer is $x \neq \pm 1$.
- This is a good place to slow down, check the notation, and simplify cleanly. $h(2) = 2, k(2) = 5$. Sum: 7. So the answer is 7.
- Focus on the main idea of the problem, then simplify carefully. $(x + 1)(x - 1) = x^2 - 1$ (difference of squares). So the answer is $x^2 - 1$.
- Start with the definition the problem is testing, then apply it directly. $\frac{6x}{3} = 2x$. So the answer is $2x$.
- Use the clue in the question first, then let the arithmetic finish the job. $\frac{x^2+x}{x} = \frac{x(x+1)}{x} = x + 1$ for $x \neq 0$. So the answer is $x + 1 (x \neq 0)$.
- This is a good place to slow down, check the notation, and simplify cleanly. $3 + 5 = 8$. So the answer is 8.
- This is a good place to slow down, check the notation, and simplify cleanly. $f(4) = 16, g(4) = 4$. $16 - 4 = 12$. So the answer is 12.
- This is a good place to slow down, check the notation, and simplify cleanly. $f(0) = 5, g(0) = -1$. Product: $5 \cdot (-1) = -5$. So the answer is -5.
- Keep the order of operations in view, then simplify without skipping the sign check. Multiply f by 2: $2(2x + 5) = 4x + 10$. After simplifying, the answer is $4x + 10$.
- This is a good place to slow down, check the notation, and simplify cleanly. $f(-2) = 1, g(-2) = 3$. Sum: 4. So the answer is 4.
- Move carefully through the arithmetic; one clean operation usually unlocks the next one. Any nonzero quantity divided by itself is 1. After simplifying, the answer is 1.
- Use the clue in the question first, then let the arithmetic finish the job. $2x + 3x = 5x$ (combining like terms). So the answer is $5x$.
- This is a good place to slow down, check the notation, and simplify cleanly. Difference of squares again: $(x + 2)(x - 2) = x^2 - 4$. So the answer is $x^2 - 4$.
- This is a good place to slow down, check the notation, and simplify cleanly. First, $g(2) = 1$. Then use the table again: $f(1) = 4$. So the answer is 4.
- Use the clue in the question first, then let the arithmetic finish the job. At $x = 2, f(2) = 6$ and $g(2) = 5$, so $(f + g)(2) = 11$. So the answer is 11.
- $P(x) = 12x - (5x + 200) = 7x - 200$. Break-even: $7x - 200 = 0$, so $x = \frac{200}{7} \approx 28.6$ items. Round up to 29 to actually profit.
- $(B - A)(x) = (x + 4)(x + 8) - x(x + 4)$. Factor out $(x + 4)$: $(x + 4)[(x + 8) - x] = (x + 4)(8) = 8(x + 4)$. At $x = 3$: $8(7) = 56$ square units.
- Gallons used: $20 - F(t) = 20 - (20 - 2t) = 2t$. So $S(t) = 4(2t) = 8t$. At $t = 5$: $S(5) = 40$ dollars.
- $D_B - D_A = 4t - 3t = t$. At $t = 2$: gap is 2 miles. (B walks 1 mph faster, so after 2 hours B is 2 miles ahead.)



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