

# 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                           |

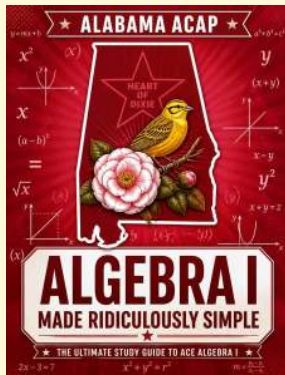
## Step-by-Step Tutor Notes

- 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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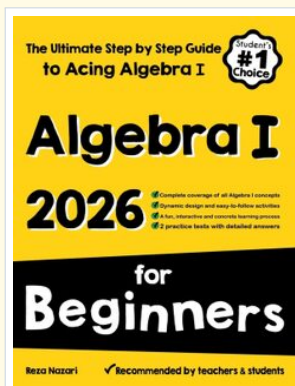
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