Adding and Subtracting Functions

Name: ________________	Date: ____________	Score: ______ / 37

Quick Review

You can **add** or **subtract** two functions by working on their outputs at each input. The definitions: $(f+g)(x) = f(x)+g(x)$ and $(f-g)(x) = f(x) - g(x)$. The new function gets a new name (often $f+g$ or $f-g$), but the rule is just "combine the outputs."

Watch the minus. When subtracting $(f-g)(x)$, distribute the negative across *every term* of g. So if $f(x) = 2x^2 - 3x + 5$ and $g(x) = x^2 + 4x - 1$, then $(f-g)(x) = (2x^2 - 3x + 5) - (x^2 + 4x - 1) = 2x^2 - 3x + 5 - x^2 - 4x + 1 = x^2 - 7x + 6$. The $+1$ at the end is the sign-flip many students miss.

Domains. The domain of $f+g$ (or $f-g$) is the *intersection* of the domains of f and g. If $f(x) = \sqrt{x-1}$ (needs $x \geq 1$) and $g(x) = \sqrt{4-x}$ (needs $x \leq 4$), then $(f+g)(x)$ is defined only on $[1, 4]$.

Properties. Addition is commutative: $f + g = g + f$. Subtraction isn't — $f - g$ and $g - f$ are negatives of each other. To evaluate at a number, you can build the combined formula first or just compute $f(c)$ and $g(c)$ separately and combine. The second route is usually faster.

PRACTICE

Combine the functions as indicated. Simplify and state any domain restrictions when asked.

1. $f(x) = 2x + 3,\ g(x) = x - 1;\ (f+g)(x)$ ________
2. $f(x) = 4x + 5,\ g(x) = x + 2;\ (f-g)(x)$ ________
3. $f(x) = x^2 + 3x - 1,\ g(x) = 2x + 4;\ (f+g)(x)$ ________
4. $f(x) = 2x^2 - 3x + 5,\ g(x) = x^2 + 4x - 1;\ (f-g)(x)$ ________
5. The tables give f and g. Find $(f+g)(2)$. ________

x	0	1	2	3
$f(x)$	1	2	5	10

x	0	1	2	3
$g(x)$	-2	1	4	7

6. $f(x) = 3x - 5,\ g(x) = x^2 + 2x;\ (f+g)(x)$ ________
7. $f(x) = 3x - 5,\ g(x) = x^2 + 2x;\ (f-g)(x)$ ________
8. $f(x) = 5x^2 - 2x + 7,\ g(x) = 3x^2 + x - 4;\ (f-g)(x)$ ________
9. $f(x) = \sqrt{x-1},\ g(x) = \sqrt{4-x};$ domain of $(f+g)(x)$ ________
10. $f(x) = \sqrt{x+2},\ g(x) = \sqrt{6-x};$ domain of $(f+g)(x)$ ________
11. $f(x) = x^3 + 2x,\ g(x) = x^3 - x;\ (f-g)(x)$ ________
12. $f(x) = 4x^2 + x,\ g(x) = 4x^2 - x;\ (f+g)(x)$ ________
13. $f(x) = 2x + 1,\ g(x) = 3x - 4;\ (f-g)(5)$ ________
14. $f(x) = x^2,\ g(x) = 2x + 3;$ find $(f-g)(-1)$ ________

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15. The tables give f and g. Find $(f+g)(0)$. ________

x	-1	0	1	2
$f(x)$	-1	2	5	8

x	-1	0	1	2
$g(x)$	0	-1	0	3

16. $R(x) = 45x + 200$ revenue, $C(x) = 18x + 125$ cost. Profit $P = R - C$. ________

17. $f(x) = 2x - 7,\ g(x) = 5 - x$; find x with $(f+g)(x) = 0$ ________

18. $A + B = 5x^2 + 3x - 2,\ A = 2x^2 - x + 4$. Find B. ________

19. The tables give f and g. Find $(f-g)(3)$. ________

x	1	2	3	4
$f(x)$	-3	0	5	12

x	1	2	3	4
$g(x)$	3	4	5	6

20. $f(x) = |x|,\ g(x) = x$. For $x < 0$, simplify $(f-g)(x)$. ________

♦ Word Problems

21. A store's revenue is modeled by $R(x) = 45x + 200$ dollars and its cost is $C(x) = 18x + 125$ dollars, where x is the number of items sold. Write the profit function $P(x) = R(x) - C(x)$ and find $P(10)$. ____

22. Two divisions of a company contribute to quarterly profit. Division X contributes $X(t) = 2t^2 - 3t + 5$ thousand dollars and division Y contributes $Y(t) = -t^2 + 4t + 3$ thousand dollars, where t is months since the quarter started. Write the total profit function $T(t)$ in simplified form. ____

23. Let $f(x) = \sqrt{x+3}$ and $g(x) = \sqrt{5-x}$. Find the domain of $(f-g)(x)$, and evaluate it at $x = 1$. ____

24. A garden's total perimeter is $T(x) = 8x + 14$ meters, made up of two pieces: the front fence $F(x) = 3x + 4$ meters and the side fences combined. Write a function $S(x)$ for the total side-fence length, then find $S(5)$. ____

Additional Practice

25. If $f(x) = 2x - 5$, find $f(4)$. ________

26. If $g(x) = x^2 + 1$, find $g(-3)$. ________

27. For $f(x) = 3x + 2$, solve $f(x) = 14$. ________

28. Find $(f+g)(x)$ if $f = x + 1$, $g = 2x - 5$. ________

29. Find $(fg)(x)$ if $f = x - 2$, $g = x + 3$. ________

30. Find $f(g(x))$ if $f(x) = 2x$, $g(x) = x + 7$. ________

31. Find the inverse of $f(x) = x - 9$. ________

32. Find the inverse of $f(x) = 3x + 1$. ________

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33. Domain of $f(x) = \sqrt{x - 4}$. ________

34. Domain of $f(x) = \dfrac{1}{x + 6}$. ________

35. Parent function for $y = |x| + 3$. ________

36. Shift $y = x^2$ left 4. ________

37. Average rate from $(1, 5)$ to $(4, 17)$. ________

Answer Keys

1. $\boxed{3x+2}$
2. $\boxed{3x+3}$
3. $\boxed{x^2+5x+3}$
4. $\boxed{x^2-7x+6}$
5. $\boxed{9}$
6. $\boxed{x^2+5x-5}$
7. $\boxed{-x^2+x-5}$
8. $\boxed{2x^2-3x+11}$
9. $\boxed{[1,4]}$
10. $\boxed{[-2,6]}$
11. $\boxed{3x}$
12. $\boxed{8x^2}$
13. $\boxed{0}$
14. $\boxed{0}$
15. $\boxed{1}$
16. $\boxed{P(x)=27x+75}$
17. $\boxed{x=2}$
18. $\boxed{B=3x^2+4x-6}$
19. $\boxed{0}$
20. $\boxed{-2x}$
21. $\boxed{P(x)=27x+75,\ P(10)=\$345}$
22. $\boxed{T(t)=t^2+t+8 \text{ thousand dollars}}$
23. $\boxed{\text{domain } [-3,5];\ (f-g)(1)=0}$
24. $\boxed{S(x)=5x+10,\ S(5)=35 \text{ meters}}$

Additional Practice Answers

25. $\boxed{3}$
26. $\boxed{10}$
27. $\boxed{x=4}$
28. $\boxed{3x-4}$
29. $\boxed{x^2+x-6}$
30. $\boxed{2x+14}$
31. $\boxed{f^{-1}(x)=x+9}$
32. $\boxed{f^{-1}(x)=\frac{x-1}{3}}$
33. $\boxed{x\geq 4}$
34. $\boxed{x\neq -6}$
35. $\boxed{y=|x|}$
36. $\boxed{y=(x+4)^2}$
37. $\boxed{4}$

Additional Practice: Answers for all numbered items, including the added practice, are shown in the grid above.

Step-by-Step Explanations

1. Add the outputs: $(f+g)(x)=(2x+3)+(x-1)$. Group like terms — the x-terms give $2x+x=3x$, the constants give $3-1=2$. So $(f+g)(x)=3x+2$.
2. Keep the rule visible: Distribute the minus: $(4x+5)-(x+2)=4x+5-x-2=3x+3$. This is the part to check before moving on, because it keeps the answer tied to the original question.
3. Add the outputs and group like terms: $(x^2+3x-1)+(2x+4)$. The x^2 has no partner, the x-terms give $3x+2x=5x$, and the constants give $-1+4=3$. So $(f+g)(x)=x^2+5x+3$.
4. Flip every sign in g: $-(x^2+4x-1)=-x^2-4x+1$. Combine: $(2-1)x^2+(-3-4)x+(5+1)=x^2-7x+6$. The $+1$ at the end is the easy slip.
5. Read each table at $x=2$: $f(2)=5$ and $g(2)=4$. Add the outputs: $(f+g)(2)=5+4=9$. Reading values straight off a table beats rebuilding the combined formula.
6. Add the outputs: $(3x-5)+(x^2+2x)$. The x^2 stands alone, the x-terms give $3x+2x=5x$, and the only constant is -5. So $(f+g)(x)=x^2+5x-5$.
7. One steady path is: Flip g's signs: $-(x^2+2x)=-x^2-2x$. Combine: $-x^2+(3-2)x-5=-x^2+x-5$. That gives a quick check on the answer.
8. Subtract by flipping every sign in g: $-(3x^2+x-4)=-3x^2-x+4$. Now combine with f: $(5-3)x^2+(-2-1)x+(7+4)=2x^2-3x+11$. The trap is the last term — $-(-4)$ becomes $+4$, so $7+4=11$, not 3.
9. For the sum to exist, both square roots must be defined at once. From $\sqrt{x-1}$ we need $x-1\geq 0$, so $x\geq 1$; from $\sqrt{4-x}$ we need $4-x\geq 0$, so $x\leq 4$. The domain is where both hold — the intersection $[1,4]$.
10. Both radicals must be nonnegative simultaneously. From $\sqrt{x+2}$: $x+2\geq 0$, so $x\geq -2$. From $\sqrt{6-x}$: $6-x\geq 0$, so $x\leq 6$. The domain is the overlap of these, the interval $[-2,6]$.
11. Subtract by flipping g's signs: $-(x^3-x)=-x^3+x$. Combine with f: the cubes give $x^3-x^3=0$, and the linear terms give $2x+x=3x$. So $(f-g)(x)=3x$ — the cubes cancel cleanly.
12. Add the outputs: $(4x^2+x)+(4x^2-x)$. The squared terms give $4x^2+4x^2=8x^2$, and the linear terms cancel: $x+(-x)=0$. So $(f+g)(x)=8x^2$.
13. A careful way to see it: $f(5)=11$, $g(5)=11$. Difference: 0. The two functions meet at $x=5$, so the subtraction gives zero there. That gives a quick check on the answer.
14. Keep the rule visible: $f(-1)=1$, $g(-1)=1$. Difference: $1-1=0$. (The parabola and the line cross at $x=-1$.) That gives a quick check on the answer.
15. Look down the $x=0$ column in each table: $f(0)=2$ and $g(0)=-1$. Sum the outputs: $(f+g)(0)=2+(-1)=1$.
16. Distribute the minus: $(45x+200)-(18x+125)=45x+200-18x-125=27x+75$. A student who adds instead of subtracts gets $63x+325$ — wrong direction.
17. A careful way to see it: $(f+g)(x)=(2x-7)+(5-x)=x-2$. Set $x-2=0$: $x=2$. This is the part to check before moving on, because it keeps the answer tied to the original question.
18. Keep the rule visible: $B=(A+B)-A=(5x^2+3x-2)-(2x^2-x+4)$. Flip A's signs: $-2x^2+x-4$. Combine: $3x^2+4x-6$. That gives a quick check on the answer.
19. Read at $x=3$: $f(3)=5$ and $g(3)=5$. Subtract: $(f-g)(3)=5-5=0$. (The two functions meet at $x=3$, so their difference is zero there.)
20. For $x<0$, $|x|=-x$. So $(f-g)(x)=-x-x=-2x$, which is positive when $x<0$. (At $x=-3$, $(f-g)(-3)=3-(-3)=6=-2(-3)$. Sanity-check passes.)
21. Subtract carefully: $P(x)=(45x+200)-(18x+125)=27x+75$. Each item sold adds \$27 to profit (the \$45 revenue minus the \$18 cost per item), starting from a \$75 baseline. At $x=10$: $P(10)=270+75=345$. So selling 10 items yields \$345 profit.
22. Add term by term: $X(t)+Y(t)=(2-1)t^2+(-3+4)t+(5+3)=t^2+t+8$. At the start of the quarter ($t=0$), total profit is \$8,000 — a sensible baseline. The t^2 term means profit grows faster as the months tick by.
23. Both radicands must be nonnegative. From f: $x+3\geq 0$ so $x\geq -3$. From g: $5-x\geq 0$ so $x\leq 5$. The intersection is $[-3,5]$. At $x=1$: $f(1)=\sqrt{4}=2$ and $g(1)=\sqrt{4}=2$, so $(f-g)(1)=0$. (The two functions cross at $x=1$ — their graphs meet there.)
24. Side fences total $S=T-F=(8x+14)-(3x+4)$. Flip the signs in F: $-3x-4$. Combine: $5x+10$. At $x=5$: $S(5)=25+10=35$ meters. Sanity-check: $F(5)+S(5)=19+35=54=T(5)$. Numbers add up.

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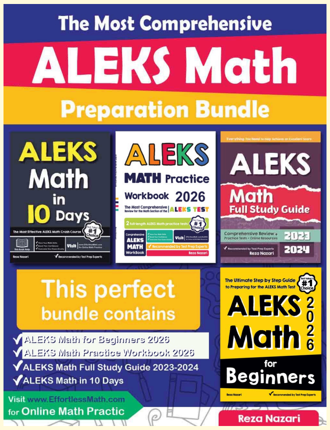

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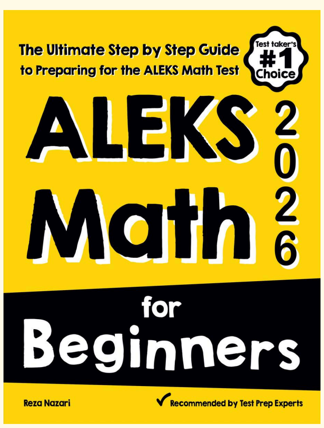

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