

Combining Functions Review

Answer key Final answers only. Try first, then check.

CORE SKILLS

- K1** a) $(f - g)(x) = 2x^2 + 2x - 2$
 b) $[-2, 4]$
 c) $(f + g)(4) = 3; x = -2$
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- K2** a) $(fg)(x) = 2x^2 + 5x - 12$
 b) $\left(\frac{f}{g}\right)(x) = \frac{x-3}{x-2}; D = \{x \in \mathbb{R} \mid x \neq -3, x \neq 2\}$
 c) $\frac{u}{v}: [1, 4) \cup (4, \infty); \frac{v}{u}: (1, \infty)$
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- K3** a) $f(g(0)) = 0; g(f(0)) = 3$
 b) $(g \circ g)(1) = 2; (f \circ g)(2) = -1$
 c) $x = 0$ and $x = 3$
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- K4** a) $f(g(x)) = x^2 - 3x + 2$
 b) $g(f(x)) = x^2 + x - 2$
 c) $p(q(x)) = x - 2; D = [-3, \infty)$
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- K5** a) $(-1, 3)$ and $(4, 8)$
 b) $x = 3$ (the value $x = -2$ is extraneous)
 c) $(3, \infty)$

REAL WORLD

- A1** a) $R(x) = 15x - 0.025x^2; P(x) = -0.025x^2 + 11x - 400$
 b) Break even at 40 or 400 meals; profit for $40 < x < 400$ (41 to 399 meals).
 c) 150 meals at \$11.25 each, for a profit of \$687.50. The vertex ($x = 220$, \$810) is out of reach, and P is still increasing at $x = 150$.
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- A2** a) $d(0.5) \approx -8.5$: 8.5 cm below rest; $d(1) = 6.0$: 6 cm above rest.
 b) After about 4.6 s ($t > \log_2 24 \approx 4.58$).
 c) About 0.012 cm (0.1 mm). The model never reaches 0, since $(0.5)^t > 0$, so it never stops. A real board stops because of friction, and a 0.1 mm swing can't be seen: past about 5 s the model describes no visible motion.
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- A3** a) $T(h(t)) = 15 - 1.95t$; input: minutes since launch; output: the air temperature ($^{\circ}\text{C}$) at the balloon.
 b) After 20 minutes, at 6 km.
 c) $T(h(50)) = -82.5^{\circ}\text{C}$, but $h(50) = 15$ km is above 11 km, where T no longer applies (real air there stays near -56°C). Domain: $0 \leq t \leq \frac{110}{3}$, about $[0, 36.7]$ minutes.

THINK IT THROUGH

- T1** a) $x = -1$: $-1 \geq -4$ is true, but the student left it out. $x = -3$: $-27 \geq -12$ is false, but the student included it.
 b) Dividing by x : the sign of x is unknown, so for $x < 0$ the inequality should flip, and $x = 0$ (a solution) is lost.
 c) $[-2, 0] \cup [2, \infty)$
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- T2** a) e.g. $g(x) = 3x - 1, f(x) = x^5 + 2$
 b) e.g. $g(x) = x^2 + 1, f(x) = \sqrt{x}$; or $g(x) = x^2, f(x) = \sqrt{x+1}$
 c) e.g. $f(x) = x + 2, g(x) = x - 5$: both composites equal $x - 3$. Or $f(x) = 2x, g(x) = 3x$: both equal $6x$.

BOSS LEVEL

- Boss**
- a) $f_2(x) = \frac{x-1}{x} \ (x \neq 0, 1)$
 - b) $f_3(x) = x \ (x \neq 0, 1)$
 - c) -1 (since $2026 = 3 \cdot 675 + 1$, $f_{2026}(2) = f(2)$)
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