How Functions Connect

Sort two ways to combine functions

8A.AF.F.19 "Combine different types of standard functions to write, evaluate, and interpret functions in context. Limit to linear, quadratic, exponential, and absolute value functions. a..."

NAME _____ DATE _____

ARITHMETIC

Use +, −, ×, or ÷ to combine the outputs of two functions at the same input.

Cycling distances: $a(t)=4t$ miles and $b(t)=t^2$ miles. At $t=3$, $(a+b)(3)=12+9=21$ miles.

COMPOSITION

Use the output of one function as the input of another. In $E(l(r))$, find $l(r)$ first, then use that result in E.

A light display uses $l(r)=2^r$ lamps and $E(l)=l^2$ joules of energy. $E(l(2))=E(4)=16$ joules.

1 SORT

8 items

For Part 1, evaluate each expression and circle its category; for Part 2, choose one item from each category and explain how you knew.

1. Sticker piles: $f(n)=2n+3$ and $g(n)=n^2$ stickers. $(f+g)(2)=?$ — ARITHMETIC / COMPOSE

2. Game points: $f(r)=3\cdot2^r$ and $g(r)=5r$. $(f-g)(2)=?$ — ARITHMETIC / COMPOSE

3. Screen size: $w(t)=t+4$ cm and $A(w)=w^2$ cm^2. $A(w(2))=?$ — ARITHMETIC / COMPOSE

4. Delivery charge: $b(k)=2^k$ dollars and $c(b)=b+6$ dollars. $c(b(3))=?$ — ARITHMETIC / COMPOSE

5. Plant counts: $f(d)=d^2$ and $g(d)=2^d$. $(f+g)(3)=?$ — ARITHMETIC / COMPOSE

6. Time gap: $d(h)=|h-4|$ hours and $p(d)=3d+2$ dollars. $p(d(1))=?$ — ARITHMETIC / COMPOSE

7. Scores: $f(x)=|x-5|$ points and $g(x)=2x$ points. $(f+g)(3)=?$ — ARITHMETIC / COMPOSE

8. Ticket sales: $p(n)=n+3$ dollars per ticket and $q(n)=n^2$ tickets. $(p\cdot q)(2)=?$ — ARITHMETIC / COMPOSE

2 PROVE IT

Explain your thinking

Choose one item from each category and explain how you knew.

ITEM # _____ **HOW I KNEW** _____

ITEM # _____ **HOW I KNEW** _____

3 MAKE YOUR OWN

One of each

Write one new example of each category in a real-world situation. Define two different types of functions and evaluate each expression at an input you choose.

ARITHMETIC

COMPOSE

CHALLENGE

Create three functions for one situation, including a linear and a quadratic function. Use both composition and arithmetic in one expression, evaluate it at 2, and state what the result means.

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PART 1 · SORT

#	ITEM	CATEGORY	WHY
1	Sticker piles: $f(n)=2n+3$ and $g(n)=n^2$ stickers. $(f+g)(2)$=?	**ARITHMETIC**	Adds two outputs at n=2: 7+4=11 stickers.
2	Game points: $f(r)=3\cdot 2^r$ and $g(r)=5r$. $(f-g)(2)$=?	**ARITHMETIC**	Subtracts two outputs at r=2: 12−10=2 points.
3	Screen size: $w(t)=t+4$ cm and $A(w)=w^2$ cm². $A(w(2))$=?	**COMPOSE**	Uses w(2)=6 as the input to A: A(6)=36 cm².
4	Delivery charge: $b(k)=2^k$ dollars and $c(b)=b+6$ dollars. $c(b(3))$=?	**COMPOSE**	Uses b(3)=8 as the input to c: c(8)=14 dollars.
5	Plant counts: $f(d)=d^2$ and $g(d)=2^d$. $(f+g)(3)$=?	**ARITHMETIC**	Adds two outputs at d=3: 9+8=17 plants.
6	Time gap: $d(h)=\lvert h-4\rvert$ hours and $p(d)=3d+2$ dollars. $p(d(1))$=?	**COMPOSE**	Uses d(1)=3 as the input to p: p(3)=11 dollars.
7	Scores: $f(x)=\lvert x-5\rvert$ points and $g(x)=2x$ points. $(f+g)(3)$=?	**ARITHMETIC**	Adds two outputs at x=3: 2+6=8 points.
8	Ticket sales: $p(n)=n+3$ dollars per ticket and $q(n)=n^2$ tickets. $(p\cdot q)(2)$=?	**ARITHMETIC**	Multiplies two outputs at n=2: 5 dollars per ticket times 4 tickets equals 20 dollars.

PART 2 · PROVE IT

Task: Choose one item from each category and explain how you knew.
Accept any explanation that names the deciding feature from the rule box for the chosen item.

PART 3 · MAKE YOUR OWN (SAMPLE ANSWERS)

- **ARITHMETIC**: A mural has $f(n)=n^2$ blue tiles and $g(n)=3n$ red tiles. $(f+g)(2)=4+6=10$ tiles.
- **COMPOSE**: A square patio has side $s(t)=t+3$ feet and area $A(s)=s^2$ square feet. $A(s(2))=A(5)=25$ square feet.

Challenge: A square has side $U(x)=x+2$ cm and area $V(s)=s^2$ cm². A strip has area $W(x)=3x$ cm². $T(x)=V(U(x))+W(x)$, so $T(2)=V(4)+6=22$ cm² of total area.

Items 1, 2, 5, 7, and 8 use arithmetic. Items 3, 4, and 6 use composition. In Part 2, look for an explanation of whether the functions use the same input or one function's output becomes the other's input.