Name:

What's the Rule?

Your Challenge

➤ **Your challenge is to identify the function for each table by examining the inputs and outputs.**

1 Write the rule for each function by examining the values in the table. Look for patterns, and do not calculate the slope or the *y*-intercept. Ask yourself what operation or operations are being performed on the *x*-value to produce the associated *y*-value. The first problem is done for you.

a.

Input (*x*)	1	2	3	4	5	6	20	100
Output (*y*)	2	4	6	8	10	12	40	200

function: $y = 2x$

b.

Input (*x*)	1	2	3	4	5	6	20	100
Output (*y*)	3	5	7	9	11	13	41	201

function: $y = 2x + 1$

c.

Input (*x*)	1	2	3	4	5	6	20	100
Output (*y*)	2	5	8	11	14	17	59	299

function: $y = 3x - 1$

d.

Input (*x*)	1	2	3	4	5	6	20	100
Output (*y*)	3	6	9	12	15	18	60	300

function: $y = 3x$

Name:

What's the Rule?

e.

Input (x)	1	2	3	4	5	6	20	100
Output (y)	2	5	10	17	26	37	401	10,001

function: $y = x^2 + 1$

f.

Input (x)	1	2	3	4	5	6	20	100
Output (y)	11	12	13	14	15	16	30	110

function: $y = x + 10$

g.

Input (x)	1	2	3	4	5	6	20	100
Output (y)	1.5	2	2.5	3	3.5	4	11	51

function: $y = \frac{1}{2}x + 1$

2 Are any of the functions above nonlinear? If so, which one(s)?

The function in problem e is nonlinear.

Springy Springs

Your Challenge

➤ **You will compare two springs and design an object that has a spring.**

From wind-up watches to the landing gear of airplanes, metal springs lurk in many of our everyday objects. The engineers who design these objects must understand and predict how the springs in them will behave under real-world conditions.

One way that engineers understand and predict how their springs will behave is to apply Hooke's Law. This law, discovered by Robert Hooke in 1620, says that the force needed to stretch a metal spring is directly proportional to the extension of that spring. In other words, Hooke's Law describes a linear relationship between the force applied to a spring and the length that spring will reach.

Hooke's Law relates to both mechanical and safety engineering. For example, when designing a pogo stick, engineers must consider the masses of its users and the spring constant. A spring that's too rigid is dull; a spring that's too bouncy can send its user flying.

The next page displays two tables based on data collected by measuring the length of two different springs when a mass is attached to the bottom of the hanging spring. Hooke's Law can be represented as $F = k \cdot x$, where F is the force applied to the spring, k is the spring constant describing how stiff or stretchy it is, and x is distance the spring stretches from its resting state.

➤ **Use Hooke's Law to solve the problems on the next page.**

Name:

Springy Springs

Spring A	
Mass Attached to Spring (kg)	**Length of Stretch (m)**
0	0
1	0.025
2	0.05
5	0.125
10	**0.25**
12	**0.3**

Spring B	
Mass Attached to Spring (kg)	**Length of Stretch (m)**
0	0
1	0.015
2	0.03
5	**0.075**
10	0.15
12	**0.18**

1. Find the slope for the data in each table. Then fill in the missing values in each table.

   slope for Spring A: 0.025; slope for Spring B: 0.015

2. The slope is k in Hooke's function $F = k \cdot x$. Write the equation for each spring.

   Spring A: $F = 0.025x$ **Spring B: $F = 0.015x$**

3. A stronger spring can give extra bounce. Which spring is stronger? How do you know?

   Spring 2; it takes more mass to make it longer.

4. Force, F, is measured in a unit called *newtons*. Imagine you are designing a toy that uses Spring A. The toy is safe only if the spring is not stretched beyond 0.5 meter. What is the maximum force, in newtons, that can be safely applied to the spring? Explain.

   0.0125 newtons; Possible answer: I can substitute the length into Hooke's Law for this spring and calculate F.

   $F = 0.025x$

   $F = 0.025(0.5) = 0.0125$

5. Design and sketch a toy or other object using one of the two springs. Explain why you chose that spring.

   Answers will vary.