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1-1 Puzzle: What's Missing?

Patterns and Expressions

Each row and column in the grid follows a pattern. Fill in the missing numbers to complete the pattern, and write the pattern beneath the grid. The first "Down" pattern has been done for you. The fraction $\frac{1}{9}$ completes the pattern $\frac{1}{6}, \frac{1}{7}, \frac{1}{8}, \frac{1}{9}$.

A. $\frac{1}{6}$			B. 130	C. 128	126	124	D. 122	120	E. 118
$\frac{1}{7}$		F. 1		64			95		78
G. $\frac{1}{8}$	$\frac{1}{2}$	2	8	32		H. 78	68	58	48
$\frac{1}{9}$		4		16			41		28
		8		I. 8	10	12	14	16	18
J. 2048		16		4					
K. 512	128	32	8	2		L. 27	M. 9	3	N. 1
64				1			22		4
16							35		9
4		P. 128	112	96	80	64	48	32	16

ACROSS

B. $130 - 2n$; $n = 0, 1, \ldots, 6$

G. $\frac{1}{8} \cdot 4^n$; $n = 0, 1, \ldots, 4$

H. $78 - 10n$; $n = 0, 1, 2, 3$

I. $8 - 2n$; $n = 0, 1, \ldots, 5$

K. $\frac{512}{4^n}$; $n = 0, 1, \ldots, 4$

L. 3^n; $n = 3, 2, 1, 0$

P. $128 - 16n$; $n = 0, 1, 2, \ldots, 7$

DOWN

A. $\frac{1}{n}$; $n = 6, 7, 8, 9$

C. 2^n; $n = 7, 6, \ldots, 0$

D. $122 - 27n$; $n = 0, 1, \ldots, 4$

E. $118 - 5n(n + 1)$; $n = 0, 1, \ldots, 4$

F. 2^n; $n = 0, 1, \ldots, 5$

J. $\frac{2048}{4^n}$; $n = 0, 1, \ldots, 4$

M. $9 + 13n$; $n = 0, 1, 2, 3$

N. n^2; $n = 1, 2, 3, 4$

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1-2 Activity: Property Patterns

Properties of Real Numbers

Examples of the properties of real numbers with addition and multiplication follow patterns. These patterns can be identifiable even if numbers and symbols are not used. For example, consider the following phrase. It does not make any sense, but it illustrates a property of real numbers.

peanuts bake apples inside apples

This word structure follows the pattern for the Identity Property of Addition.

peanuts bake apples inside apples
↓ ↓ ↓ ↓ ↓
0 + *a* = *a*

Likewise, you can designate a word to indicate grouping.

twisted apples bake bananas bake coconuts inside apples bake twisted bananas bake coconuts
↓ ↓ ↓ ↓ ↓ ↓ ↓ ↓ ↓ ↓ ↓ ↓ ↓
(*a* + *b*) + *c* = *a* + (*b* + *c*)

The equation above illustrates the Associative Property of Addition. The word "twisted" is used for grouping. In translating the two phrases above, "bake" represents addition, "inside" represents equal to, "twisted" represents grouping, and "peanuts" represents the additive identity. A word can also be used to designate an additive inverse. For example, "sour" can be used to make "sour apples," the additive inverse of "apples."

Determine which properties are illustrated using the phrases below, and which words represent *addition, multiplication, equal to, grouping, the additive identity, the additive inverse, the multiplicative identity,* and *the multiplicative inverse.* Record these at the bottom of the page.

1. *lizards slap frogs over frogs slap lizards* — Commutative Property of Addition
2. *lizards jump crickets over lizards* — Identity Property of Multiplication
3. *frogs slap green frogs over toads* — Additive Inverse Property
4. *crickets over yellow snakes jump snakes* — Multiplicative Inverse Property
5. *snakes jump slimy frogs jump lizards over slimy snakes jump frogs jump lizards* — Associative Property of Multiplication
6. *lizards jump slimy frogs slap snakes over lizards jump frogs slap lizards jump snakes* — Distributive Property

additive identity: toads
additive inverse: green
addition: slap
grouping: slimy
multiplicative identity: crickets
multiplicative inverse: yellow
multiplication: jump
equal to: over

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1-3 Game: Number-Cube Substitution

Algebraic Expressions

Material

- 1 six-sided number cube

Game Play

Play this game in pairs. Each player takes a turn and rolls the number cube. Whoever rolls the lowest number goes first.

On your turn, roll the number cube. This number is the value of x for the first expression shown, $x + 32$. Substitute the value of x in the expression to calculate your score for the first roll. Record your roll and score on the scorecard.

Players take turns evaluating each expression. Then each player totals up his or her score, and the player with the higher total wins.

Scorecard

Check students' work.

	Player 1		Player 2	
	Number rolled, x	Score	Number rolled, x	Score
$x + 32$				
$x^2 - 3x$				
$\frac{120}{x}$				
$6x - 10$				
$-x^2$				
$-2 - x$				
$(x - 3)(x + 2)$				
$x^2 - 5x - 3$				
$(x + 3)^2 - 7$				
$-3x + 5$				
$\frac{60}{x - 7}$				
	Total		Total	

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TEACHER INSTRUCTIONS

1-4 Game: Solve That Equation

Solving Equations

Provide the host with the following questions and answers. The host keeps score in the columns on the right.

		Player 1	Player 2
		100	100
	Properties of Equality		
1.	Name this property: $a = a$ **Answer: Reflexive Property**		
2.	Name this property: If $a = b$, then $a - c = b - c$. **Answer: Subtraction Property of Equality**		
3.	Name this property: If $a = b$ and $b = c$, then $a = c$. **Answer: Transitive Property of Equality**		
4.	Name this property: If $a = b$, then you can replace a with b and vice versa. **Answer: Substitution Property**		
	Solve a Multi-Step Equation		
5.	Solve $3x - 2 = 2(4 - x)$. **Answer: $x = 2$**		
6.	Solve $3x - 1 = (8 - 2x)$. **Answer: $x = 3$**		
7.	Solve $-9(4 - y) = 2(2y + 2)$. **Answer: $y = 8$**		
8.	Solve $4(5 - 2y) = 5(-y + 2) - 20$. **Answer: $y = 10$**		
	Sometimes, Always,* or *Never		
9.	Is $12(x + 5) - 4x = 2(4x - 30)$ *sometimes, always,* or *never* true? **Answer: never**		
10.	Is $5(-2x + 2) + 7x = (3x - 10)$ *sometimes, always,* or *never* true? **Answer: always**		
11.	Is $12x + 10 - 4x = 6x - 30 + 3x$ *sometimes, always,* or *never* true? **Answer: sometimes**		
12.	Is $5x + 8 - 2x = 2(4x - 5) - 5x$ *sometimes, always,* or *never* true? **Answer: never**		
	Literal Equations		
13.	Solve $ac - 2b = 3a + bc$ for b. **Answer: $b = \frac{ac - 3a}{c + 2}$**		
14.	Solve $ac - 3b = 2a + bc$ for c. **Answer: $c = \frac{2a + 3b}{a - b}$**		
15.	Solve $a + b = ab + 2ac$ for a. **Answer: $a = \frac{b}{b + 2c - 1}$**		
16.	Solve $3ab + b = a + bc$ for b. **Answer: $b = \frac{a}{3a - c + 1}$**		

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1-4 Game: Solve That Equation

Solving Equations

This is a game for three students. Decide which student will be the host and which students will be the players. Your teacher will provide the host with the questions, answers, and scorecard.

Rules

Each player begins with 100 points. The host asks the players questions from the following categories.

- **Properties of Equality:** Players are asked to name the property of equality illustrated in the question.
- **Solve a Multi-Step Equation:** Players are given an equation requiring multiple steps to solve for x.
- ***Sometimes, Always,* or *Never:*** Players are given an equation and must determine whether the equation is *sometimes, always,* or *never* true.
- **Literal Equations:** Players are asked to solve a literal equation for a given variable.

Before a player receives a question, the host tells the player the category and the player must choose a "risk value" from 1 to 10. If the answer is correct, then the player earns the number of points risked. If the answer is incorrect, then the player loses the number of points risked.

Students take turns answering questions. Each question is asked only once. The host asks each player two questions from each category. The host keeps score on a scorecard.

The player with the most points after all questions have been answered wins!

See Teacher Instructions Page.

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1-5 Puzzle: What's the Inequality?

Solving Inequalities

To solve this puzzle, each box must be filled in with a math symbol (x, $+$, $-$, $<$, $>$) or a digit from 0 to 9 to complete an inequality. The clues below give the solution to the inequality you complete. 1-Across has been done for you. The boldfaced "**4**" and "$>$" complete the inequality $4x > 4, x > 1$ (See clue below).

1 4	x	$>$	2 4		3 2	x	$<$	1	4 4
			x		x				x
	5 3	x	$+$	1	$<$	1	6 2		$>$
	9		3		8		$>$		2
	$<$		$<$				x		
7 1	1	x	$-$	2	8 x	$\geq$	$-$	1	
	3		3		$+$		1		
9 9	x	$>$	x	$+$	2		0		
					$\leq$				
		10 5	x	$-$	5	$>$	7	$+$	x

ACROSS

1. $x > 1$
3. $x < 7$ $2x < 14$
5. $x < \frac{11}{3}$ $3x + 1 < 12$
7. $x \geq -\frac{1}{9}$ $11x - 2x \geq -1$
9. $x > \frac{1}{4}$ $9x > x + 2$
10. $x > 3$ $5x - 5 > 7 + x$

DOWN

2. $x < -\frac{3}{7}$ $4x + 3 < -3x$
3. $x < 4$ $2x < 8$
4. $x > \frac{1}{2}$ $4x > 2$
5. $x > 3$ $39 < 13x$
6. $x < 12$ $2 > x - 10$
8. $x \leq 3$ $x + 2 \leq 5$

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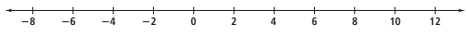
1-6 Activity: Rolling Out Inequalities

Absolute Value Equations and Inequalities

1. Roll a number cube. Plot the value of the roll on a number line.



2. Roll the number cube again. Using the same number line, plot two different points whose distances from the point in Step 1 are equal to the value of the roll.

3. Describe the points you plotted in Step 2 verbally.
"I plotted two points on the number line that are [circle one] (*exactly, greater than, less than*) a distance of ☐ units from ☐."

4. Describe the two points you plotted in Step 2 mathematically.
$|x - (\text{1st roll})| = (\text{2nd roll})$
$x - (\text{1st roll}) = (\text{2nd roll})$ or $x - (\text{1st roll}) = -(\text{2nd roll})$
$x - \square = \square$ or $x - \square = \square$
$x = \square$ or $x = \square$

5. Roll the number cube a third time. If it is an even number, draw a line segment connecting the points you plotted in Step 2. If it is an odd number, draw two rays on the number line that do not intersect, with endpoints at the points you plotted in Step 2.

6. Describe the points you graphed in Step 5 verbally.
"I plotted all points on the number line that are [circle one] (*exactly, greater than or equal to, less than or equal to*) a distance of ☐ units from ☐."

7. Describe the points you graphed in Step 5 mathematically. Refer to the setup in Step 4 for help.
Check students' work.

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2-1 Activity: Real-Life Relations and Functions

Relations and Functions

This activity should be done in groups of 3 to 5 students, with each group completing the entire sheet.

Relations That Are Not Functions

Here is an ad for a roofing company from a telephone book. Discuss why this is not a function if:

- domain: roofing companies;
- range: telephone numbers.

Check students' work.

Acme Roofing Co.
(555) 314-1592
(555) 271-8281

Use the spaces below to explain why the following are not functions:

- **Domain:** teachers; **range:** students assigned to each teacher
  Answers may vary. Sample: Any teacher will have more than one student in class.
- **Domain:** all students; **range:** each student's biological parents
  Answers may vary. Sample: Any student has more than one biological parent.

Find two more relations that are not functions, including one that you encountered today. Think about sports, music, science, art, employment, and so on. Discuss how you can express these relations using ordered pairs, a mapping diagram, a table of values, and a graph.

1. Check students' work.
2. Check students' work.

Relations That Are Functions

Here is the cost for mailing a first-class letter at the post office. Discuss why this is a function if:

- domain: letter weight;
- range: mailing cost.

Check students' work.

First–Class Mail Letter Prices

Weight Up To	Price	Weight Up To	Price
1 oz	$0.42	3 oz	$0.76
2 oz	$0.59	3.5 oz	$0.93

Use the spaces below to explain why the following are functions:

- **Domain:** students; **range:** algebra teacher assigned to each student
  Answers may vary. Sample: Each student will have exactly one algebra teacher.
- **Domain:** all students; **range:** each student's biological mother
  Answers may vary. Sample: Each student will have exactly one biological mother.

Find two more relations that are functions, including one that you encountered today. Think about sports, music, science, art, employment, and so on. Discuss how you could express these functions using ordered pairs, a mapping diagram, a table of values, and a graph.

3. Check students' work.
4. Check students' work.