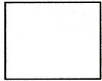
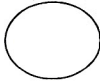



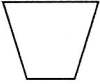






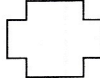

EQUATION CHALLENGE



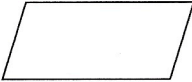
There are some specific rules for this problem. What are some questions you need to ask prior to tackling it?

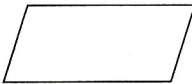
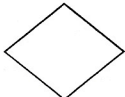
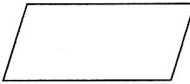
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


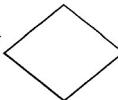
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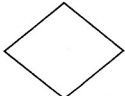
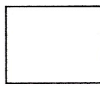


3.  ÷  = 

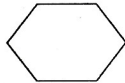


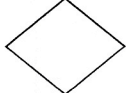
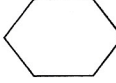
4.  -  = 

5.  +  = 

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7.  •  =  

8.   ÷  = 

9.  +  +  =  

Buttons

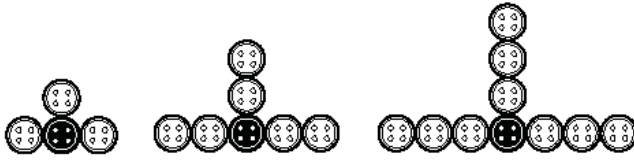
This problem gives you the chance to:

- describe, extend, and make generalizations about a numeric pattern
-

Gita plays with her grandmother’s collection of black and white buttons.

She arranges them in patterns.

Her first 3 patterns are shown below.



Pattern 1

Pattern 2

Pattern 3

Pattern 4

1. Draw Pattern 4 next to Pattern 3.
2. How many **white** buttons does Gita need for Pattern 5 and Pattern 6?

Pattern 5 _____

Pattern 6 _____

Explain how you figured this out.

3. How many buttons in all does Gita need to make Pattern 11?

Explain how you figured this out.

4. Gita thinks she needs 69 buttons in all to make Pattern 24.

How do you know that she is **not** correct?

How many buttons does she need to make Pattern 24? _____

Definitions of Balance

Conceptual Understanding – *“Why” the math works*

- Provides an understanding of the structure and logic of mathematics
- Identifies the necessary constraints on the types of procedures students use to solve mathematical problems
- Enables students to detect when they have committed a procedural error
- Facilitates the representation and translation phase of problem solving

Computational and Procedural Skills – *“How” the math works*

- Practice is required to become proficient
- Develops over time and increases in depth and complexity over several grades
- Distinguishes among different basic procedures by understanding what the procedures do

Problem Solving – *“Where” the math works*

The process of problem solving involves

- Determining mathematical hypothesis, making conjectures, recognizing existing patterns, searching for connections to known mathematical structures, and translating the gist of a problem into mathematical representation
- Putting together different pieces of information that are presented in complex problems, such as multi-step problems
- Developing a range of strategies to use in solving problems and verifying the correctness of the solution
- Applying skills that require and strengthen a student’s conceptual and procedural competencies

Kindergarten: Subtraction $9 - 3$

1st Grade: Subtraction $25 - 8$

2nd Grade: Subtraction $70 - 23$

3rd Grade: Multiplication Facts 4×7

4th Grade: Multiplication 34×57

5th Grade: Subtracting Decimals $4.7 - 1.48$

6th Grade: Multiplying Decimals 1.4×3.7

Assessing Conceptual Understanding

Assessing Procedural Skills

Assessing Mathematical Reasoning / Application

Grade 3 Mathematics Sample ER Item Claim 3

MAT.03.ER.3.000NF.B.229 Claim 3

Sample Item ID:	MAT.03.ER.3.000NF.B.229
Grade:	03
Primary Claim:	Claim 3: Communicating Reasoning Students can clearly and precisely construct viable arguments to support their own reasoning and to critique the reasoning of others.
Secondary Claim(s):	Claim 1: Concepts and Procedures Students can explain and apply mathematical concepts and carry out mathematical procedures with precision and fluency.
Primary Content Domain:	Number and Operations—Fractions
Secondary Content Domain(s):	Geometry
Assessment Target(s):	3 B: Construct, autonomously, chains of reasoning that will justify or refute propositions or conjectures. 1 F: Develop understandings of fractions as numbers. 1 K. Reason with shapes and their attributes.
Standard(s):	3.NF.3, 3.G.2
Mathematical Practice(s):	3, 6
DOK:	3
Item Type:	ER
Score Points:	2
Difficulty:	M
Key:	See Sample Top-Score Response.
Stimulus/Source:	
Target-Specific Attributes (e.g., Accessibility Issues):	
Notes:	Part of a PT set

Rectangle F is divided into 4 equal areas, as shown.



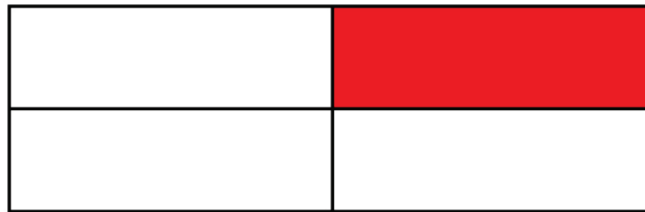
Rectangle F

Part A

What fraction is represented by the shaded area of Rectangle F?



Rectangle G is divided into 4 equal areas, as shown.



Rectangle G

Part B

What fraction is represented by the shaded area of Rectangle G?

**Part C**

Is the shaded area of Rectangle F equal to the shaded area of Rectangle G? Explain your thinking. Use what you know about the **area** of Rectangle F and Rectangle G to explain.

Sample Top-Score Response:

Part A: $\frac{1}{4}$

Part B: $\frac{1}{4}$

Part C: The areas are different. Rectangle F and Rectangle G are not the same whole. Also, the area noted by the red-shaded area of Rectangle G is greater than the area of Rectangle F.

Scoring Rubric:

Responses to this item will receive 0–2 points, based on the following:

2 points: The student demonstrates partial understanding of explaining fractions as numbers and reasoning with shapes and their attributes to support their own reasoning by expressing the area of the shaded region of Rectangle F and Rectangle G each as $\frac{1}{4}$ the area of the given rectangle and giving a complete explanation about why the shaded areas of the two rectangles are not equal.

1 point: The student demonstrates limited understanding of explaining fractions as numbers and reasoning with shapes and their attributes to support their own reasoning by expressing the area of the shaded region of Rectangle F and Rectangle G each as $\frac{1}{4}$ the area of the given rectangle and giving a partial or incomplete explanation about why the shaded areas of the two rectangles are not equal.

0 points: The student shows little or no understanding of explaining fractions as numbers and reasoning with shapes and their attributes to support their own reasoning by not expressing the area of the shaded region of Rectangle F and Rectangle G each as $\frac{1}{4}$ the area of the given rectangle and not providing an explanation about why the shaded areas of the two rectangles are not equal. OR The student states that the areas of the two shaded regions are equal.

MAT.04.ER.3.0000A.A.512 Claim 3

Sample Item Id:	MAT.04.ER.3.0000A.A.512
Grade:	04
Primary Claim:	Claim 3: Communicating Reasoning Students can clearly and precisely construct viable arguments to support their own reasoning and to critique the reasoning of others.
Secondary Claim(S):	Claim 1: Concepts and Procedures Students can explain and apply mathematical concepts and carry out mathematical procedures with precision and fluency.
Primary Content Domain:	Operations and Algebraic Thinking
Secondary Content Domain(S):	
Assessment Target(S):	3A: Test propositions or conjectures with specific examples. 1B: Gain familiarity with factors and multiples.
Standard(S):	4.OA.4
Mathematical Practice(S):	1, 2, 3, 8
DOK:	2
Item Type:	ER
Score Points:	2
Difficulty:	H
Key:	See Sample Top-Score Response.
Stimulus/Source:	
Target-Specific Attributes (E.G., Accessibility Issues):	
Notes:	Part of PT set

Peter made the statement shown below.

“The number 32 is a multiple of 8. That means all of the factors of 8 are also factors of 32.”

Is Peter’s statement correct? In the space below, use numbers and words to explain why or why not.

Sample Top-Score Response:

Peter's statement is correct. The factors of 8 are 1, 2, 4, and 8. The factors of 32 are 1, 2, 4, 8, 16, and 32.

Scoring Rubric:

Responses to this item will receive 0–2 points, based on the following:

- 2 points:** The student has a thorough understanding of the relationship between factors and multiples of numbers. The student correctly answers both parts and provides an explanation of reasoning that is thorough and correct for each part.
- 1 point:** The student has a partial understanding of the relationship between factors and multiples of numbers. The student indicates that Peter's statement is correct, but provides an explanation of reasoning that is incomplete or contains a flaw.
- 0 points:** The student has no understanding of the relationship between factors and multiples of numbers. The student does not complete any part correctly. Identifying Peter's statement as correct is not sufficient, by itself, to earn any credit.

MAT.05.ER.3.0000A.A.610 Claim 3

Sample Item ID:	MAT.05.ER.3.0000A.A.610
Grade:	05
Primary Claim:	Claim 3: Communicating Reasoning Students can clearly and precisely construct viable arguments to support their own reasoning and to critique the reasoning of others.
Secondary Claim(s):	Claim 2: Problem Solving Students can solve a range of well-posed problems in pure and applied mathematics, making productive use of knowledge and problem-solving strategies. Claim 1: Concepts and Procedures Students can explain and apply mathematical concepts and carry out mathematical procedures with precision and fluency.
Primary Content Domain:	Operations and Algebraic Thinking
Secondary Content Domain(s):	Numbers and Operations in Base Ten
Assessment Target(s):	3 A: Test propositions or conjectures with specific examples. 2 A: Apply mathematics to solve well-posed problems arising in everyday life, society, and the workplace. 1 C: Understand the place value system.
Standard(s):	5.OA.3, 4.NBT.4, 4.NBT.5
Mathematical Practice(s):	1, 2, 4, 7
DOK:	3
Item Type:	ER
Score Points:	2
Difficulty:	M
Key:	See Sample Top-Score Response.
Stimulus/Source:	
Target-specific attributes (e.g., accessibility issues):	
Notes:	Part of PT set

Branden's teacher said that beginning at age 2, children grow about 6 centimeters per year. Branden is 125 centimeters tall and is 9 years old.

In the table below, Branden used his current age and height to calculate his possible height for each of the previous 3 years.

Branden's Age and Height

Branden's Age (years)	Branden's Height (centimeters)
9	125
8	119
7	113
6	107

Branden used the equation $7 \times 6 + \square = 125$ to estimate how tall he was at age 2. Will the equation give him a reasonable estimate of his height at age 2? Explain your answer by relating the information in the table to the given equation.

What is a reasonable height for Branden at age 2?

centimeters

Sample Top-Score Response:

Yes, because Branden was 2 years old 7 years ago. 7×6 will be the number of centimeters he's grown. If you subtract that from 125, you should get how tall he was at age 2. Also, if you follow the pattern in the table (-6) and go all the way down to 2, you get the same answer; 83 centimeters.

Scoring Rubric:

Responses to this item will receive 0-2 points, based on the following:

2 points: The student demonstrates an ability to construct viable arguments in support of his or her reasoning by providing a complete explanation about the equation that represents the information in the table, and by providing 83 centimeters as a reasonable height.

1 point: The student demonstrates a partial ability to construct viable arguments in support of his or her reasoning by providing 83 as a reasonable height, but does not adequately relate the information in the table to the equation.

0 points: The student demonstrates inconsistent or no ability to construct viable arguments in support of his or her reasoning.

Grade 6 Mathematics Sample ER Item Claim 3



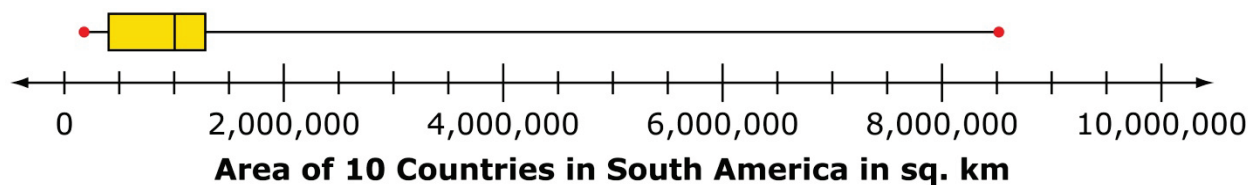
MAT.06.ER.3.000SP.F.195 Claim 3

Sample Item ID:	MAT.06.ER.3.000SP.F.195
Grade:	06
Primary Claim:	Claim 3: Communicating Reasoning Students can clearly and precisely construct viable arguments to support their own reasoning and to critique the reasoning of others.
Secondary Claim(s):	Claim 1: Concepts and Procedures Students can explain and apply mathematical concepts and interpret and carry out mathematical procedures with precision and fluency. Claim 2: Problem Solving Students can solve a range of complex well-posed problems in pure and applied mathematics, making productive use of knowledge and problem solving strategies.
Primary Content Domain:	Statistics and Probability
Secondary Content Domain(s):	
Assessment Target(s):	3 F: Base arguments on concrete referents such as objects, drawings, diagrams, and actions. 3 B: Construct, autonomously, chains of reasoning that will justify or refute propositions or conjectures. 1 J: Summarize and describe distributions. 2 C: Interpret results in the context of a situation.
Standard(s):	6.SP.5
Mathematical Practice(s):	1, 3, 6, 7
DOK:	3
Item Type:	ER
Score Points:	2
Difficulty:	M
Key:	See Sample Top-Score Response.
Stimulus/Source:	
Target-Specific Attributes (e.g., accessibility issues):	
Notes:	

The areas, in square kilometers, of 10 countries in South America are shown in the table.

Country	Area, in Square Kilometers
Uruguay	176,215
Ecuador	256,369
Paraguay	406,752
Chile	756,102
Venezuela	912,050
Bolivia	1,098,581
Colombia	1,141,748
Peru	1,285,216
Argentina	2,780,400
Brazil	8,514,877

The data is also summarized in the box plot.



Which measure of center, the mean or the median, is best to use when describing this data? Thoroughly explain your reasoning for choosing one measure over the other measure.

Sample Top-Score Response:

The mean is not the best measure of center to use because the area of Brazil is much larger than the other areas. Only two areas are larger than the mean area. The best measure of center to use is the median because most of the areas are clustered together, as can be seen in the box plot, so the median reflects what the typical area is.

Scoring Rubric:

Responses to this item will receive 0-2 points, based on the following:

2 points: The student demonstrates thorough understanding of the best measure of center to use to describe a given set of data. The student provides a good explanation of why the mean is not the best AND why the median is the best.

1 point: The student demonstrates partial understanding of the best measure of center to use to describe a given set of data. The student provides either a good explanation of why the mean is not the best OR a good explanation of why the median is the best.

0 points: The student shows inconsistent or no understanding of the best measure of center to use to describe a given set of data. The student provides neither a good explanation of why the mean is not the best nor a good explanation of why the median is the best.