

MAT.04.PT.4.ROBMK.A.043 Claim 4

Sample Item Id:	MAT.04.PT.4.ROBMK.A.043
Title:	Robot Maker (ROBMK)
Grade:	04
Primary Claim:	Claim 4: Modeling and Data Analysis Students can analyze complex, real-world scenarios and can construct and use mathematical models to interpret and solve problems.
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.
Primary Content Domain	Measurement and Data
Secondary Content Domain(S):	Operations and Algebraic Thinking Numbers and Operations—Fractions Geometry
Assessment Target(S):	A: Apply mathematics to solve problems arising in everyday life, society, and the workplace. D: Interpret results in the context of a situation.
Standard(S):	4.MD.1, 4.MD.3, 4.OA.5, 4.G.2, 3.MD.1, 3.MD.5, 3.MD.6, 3.MD.7, 3.MD.8, 3.G.1, 3.NF.1, 2.G.1, 2.G.3, 2.MD.1
Mathematical Practice(S):	1, 2, 3, 4, 5, 6, 7
DOK:	3
Item Type:	PT
Score Points:	15
Difficulty:	M
How This Task Addresses The "Sufficient Evidence" For This Claim:	The student uses concepts of measurement, geometry, and fractions to design various features of a robot. The work is supported by calculations supporting determinations of area, perimeter, conversions, and generation of a pattern.
Target-Specific Attributes (E.G., Accessibility Issues):	Accommodations may be necessary for students who have fine-motor-skill and language-processing challenges.
Stimulus/Source:	
Notes:	Multi-part task
Task Overview:	Students are asked to develop various features of a robot given specific guidelines that must be followed.
Teacher Preparation/ Resource Requirements:	Sheets of 1-centimeter grid paper (at least 3 per student), pencil, AAA batteries (2 per student), centimeter ruler, student answer sheet.
Teacher Responsibilities During Administration:	Monitor individual student work; provide resources as necessary. Start by giving each student 2 sheets of grid paper, 2 AAA batteries (or paper cutouts that represent the true size of an AAA battery), a centimeter ruler, and a student answer sheet.
Time Requirements:	Two sessions totaling no more than 120 minutes. Tasks should be done in sequential order. Tasks 1 and 2 should be completed in the first day or session. Tasks 3 and 4 should be completed in the second day or session.

Robot Maker—Task 1

You work for a company that makes robots. Your boss has asked you to design a new robot. The robot will contain a head, a body, 2 arms, and 2 legs.

The first step is to draw what the front of your robot will look like. Use the practice grid paper provided to draw the front of your robot. Make sure to follow **all** of the guidelines below.

Guidelines:

1. The front of the body must be a rectangle with an area that is greater than 64 square centimeters but less than 140 square centimeters.
2. The front of the head must be a rectangle with a perimeter of 18 centimeters.
3. The front of each leg must be a quadrilateral that is **not** a rectangle.
4. The front of each arm must be a rectangle divided into equal parts with $\frac{3}{4}$ of the parts shaded.
5. Each eye must be shaped like a hexagon divided into equal parts with $\frac{1}{3}$ of the parts shaded.

The drawing must contain labels with any numbers and words that help your boss understand how you met each of the five guidelines.

When you are sure your drawing is complete, copy your drawing to the answer sheet provided.

Robot Maker—Task 2

Your boss wants you to continue with your robot drawing. He has given you guidelines for creating a drawing of the back of the robot's head and body. Use the practice grid paper provided to draw the back of your robot's head and body. Make sure to follow **all** of the guidelines below.

Guidelines:

1. The back of the body must be the same size and shape as the front of the body.
2. The back of the body must contain a rectangular opening that is big enough to fit 2 AAA batteries placed side by side. The perimeter of this opening must be less than 16 centimeters. Use the batteries and a centimeter ruler to help you.
3. The back of the body must contain an on/off switch shaped like a rhombus. The rhombus must have a perimeter of 8 centimeters. Use a centimeter ruler to help you.
4. The back of the head must be the same size and shape as the front of the head.
5. A code is needed to lock and unlock the robot. Make this code by creating a skip-counting number pattern that starts with the number 7. The number pattern must have 5 terms. Write this code beneath the drawing of your robot.

The drawing must contain labels with any numbers and words that help your boss understand how you met the five guidelines.

When you are sure your drawing is complete, copy your drawing to the answer sheet provided.

Robot Maker—Task 3

Your boss has asked you to add a feature to your robot. He wants you to program 3 measurement conversions for the robot to speak when a button is pushed. In order for the measurement conversions to be spoken, the robot must be programmed with the correct information. Use the guidelines below to complete this part of the design.

Guidelines:

1. Add 3 square buttons to the **front** of the body. Each button, when pushed, will control a different measurement conversion.
2. Pushing the first button will cause the robot to say one of two sentences about converting measurements from kilometers to meters. In the space below, finish the sentences the robot will say when the first button is pushed.

Conversion #1 Sentences

Two (2) kilometers equals _____ meters.

Eight (8) kilometers equals _____ meters.

3. Pushing the second button will cause the robot to say one of two sentences about converting from hours to minutes. In the space below, write two sentences that the robot will say when the second button is pushed.

Conversion #2 Sentences

_____ equals _____.
_____ equals _____.

4. Pushing the third button will cause the robot to say one of two sentences about converting from pounds to ounces. In the space below, write two sentences that the robot will say when the third button is pushed.

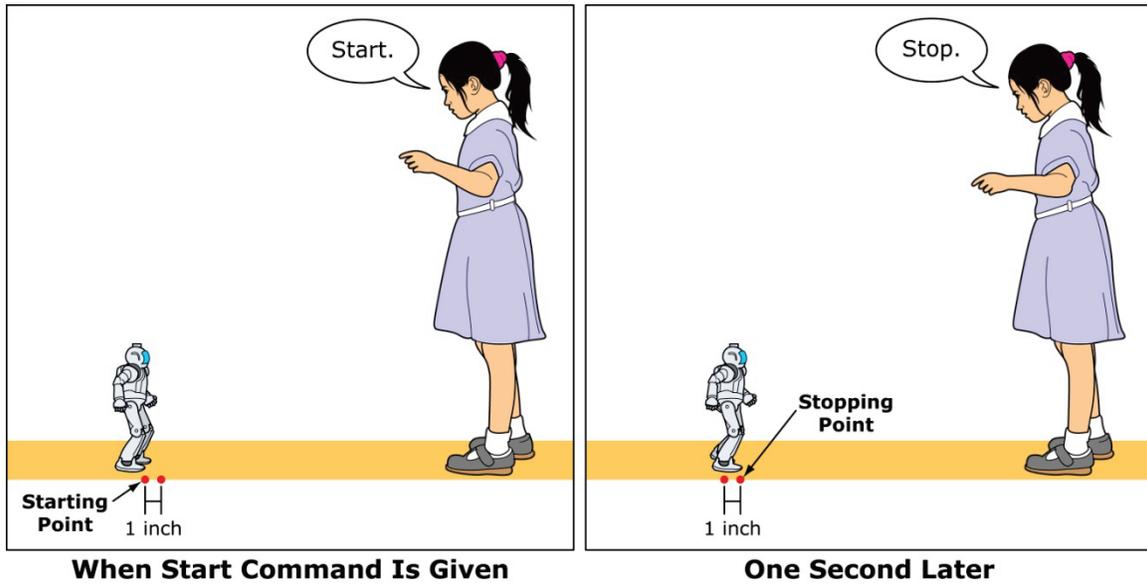
Conversion #3 Sentences

_____ equals _____.
_____ equals _____.

Robot Maker—Task 4

Your boss wants you to test a movement of the robot that is not working correctly. The movement should work as described below.

- When the robot's feet are placed at a starting point and the voice command "Start" is given, the robot moves in a straight line.
- When the voice command "Stop" is given, the robot stops.
- The robot travels 1 inch for every 1 second it moves.



The table below shows the amounts of time and the distances the robot is currently traveling. For each amount of time, decide whether or not the robot is working correctly. If the distance is not correct, state the correct distance the robot should have traveled. Show your reasoning with numbers and words.

12 seconds: 1 foot

24 seconds: 1 yard

26 seconds: 2 feet 6 inches

Choose a name for your robot. Write the name of the robot below your drawing on the answer sheet.

Sample Top-Score Response:**Task 1:**

The student will produce a drawing of a robot that meets the following guidelines:

1. The front of the body must be a rectangle with an area that is greater than 64 square centimeters but less than 140 square centimeters.
2. The front of the head must be a rectangle with a perimeter of 18 centimeters.
3. The front of each leg must be a quadrilateral that is **not** a rectangle.
4. The front of each arm must be a rectangle divided into equal parts with $\frac{3}{4}$ of the parts shaded.
5. The eyes must be shaped like hexagons with $\frac{1}{3}$ of each hexagon shaded.

Task 2:

The student will produce a drawing of a robot that meets the following guidelines:

1. The back of the body must be the same size and shape as the front of the body.
2. The back of the body must contain a rectangular opening that is big enough to fit 2 AAA batteries placed side by side. The perimeter of this opening must be less than 16 centimeters.
3. The back of the body must contain an on/off switch shaped like a rhombus with a perimeter of 8 centimeters. An error of ± 0.5 is allowable in the drawing, as long as the labels indicate 2-centimeter side lengths.
4. The back of the head must be the same size and shape as the front of the head.
5. The student should have created a skip-number pattern starting with the number 7. The number pattern must have 5 terms and appear beneath the student's drawing of the robot.

Task 3:

The student's addition of three squares to represent the conversion buttons is not scored.

Conversion #1 Sentences

Two (2) kilometers equals 2000 meters.
Eight (8) kilometers equals 8000 meters.

Conversion #2 Sentences

One (1) hour equals 60 minutes.
Two (2) hours equals 120 minutes.

Sample Top-Score Response:

Conversion #3 Sentences

One (1) pound equals 16 ounces.
Two pounds equals 32 ounces.

Task 4:

1. Correct; accompanying reasoning showing that 1 foot is equivalent to 12 inches and $\frac{12 \text{ seconds}}{12 \text{ inches}} = \frac{1 \text{ second}}{1 \text{ inch}}$.
2. Incorrect; accompanying reasoning showing that 1 yard is equivalent to 36 inches and $\frac{36 \text{ seconds}}{36 \text{ inches}} = \frac{1 \text{ second}}{1 \text{ inch}}$.
3. Incorrect: accompanying reasoning showing that 1 foot 6 inches is equivalent to 30 inches and $\frac{30 \text{ seconds}}{30 \text{ inches}} = \frac{1 \text{ second}}{1 \text{ inch}}$.

Scoring Notes:

Each task is evaluated individually. The total number of points is determined by adding the points assigned for each task.

Scoring Rubric for Task 1:

5 points: Thorough understanding of attributes of two-dimensional shapes, area, perimeter, elapsed time, and partitioning shapes into parts with equal areas. All guidelines are fulfilled, and student work contains labels showing correct reasoning.

4 points: Good understanding of attributes of two-dimensional shapes, area, perimeter, elapsed time, and partitioning shapes into parts with equal areas. All guidelines are fulfilled, but the student is missing labels showing correct reasoning for 1 or 2 guidelines.

OR Only 4 of the 5 guidelines are fulfilled, and student work includes labels showing correct reasoning for these 4 guidelines.

3 points: Partial understanding of attributes of two-dimensional shapes, area, perimeter, elapsed time, and partitioning shapes into parts with equal areas. All guidelines are fulfilled, but the student is missing labels showing correct reasoning for 3 or 4 guidelines.

OR Only 3 of the 5 guidelines are fulfilled, and student work includes labels showing correct reasoning for these 3 guidelines.

2 points: Some understanding of attributes of two-dimensional shapes,

area, perimeter, elapsed time, and partitioning shapes into parts with equal areas. Only 2 of the 5 guidelines are fulfilled, and student work includes labels showing correct reasoning for these 2 guidelines.

1 point: Limited understanding of attributes of two-dimensional shapes, area, perimeter, elapsed time, and partitioning shapes into parts with equal areas. Only 1 of the 5 guidelines is fulfilled, and student work includes labels showing correct reasoning for this 1 guideline.

0 points: No understanding of attributes of two-dimensional shapes, area, perimeter, elapsed time, and partitioning shapes into parts with equal areas. No guidelines are fulfilled.

Scoring Rubric for Task 2:

3 points: Thorough understanding of attributes of two-dimensional shapes, measurement, and number patterns. Guidelines 2, 3, and 5 are fulfilled, and student work contains labels showing correct reasoning.

2 points: Partial understanding of attributes of two-dimensional shapes, measurement, and number patterns. Guidelines 2, 3, and 5 are fulfilled, but student work does not contain labels showing correct reasoning. **OR** Only 2 of Guidelines 2, 3, and 5 are fulfilled, and student work contains labels showing correct reasoning for these 2 guidelines.

1 point: Limited understanding of attributes of two-dimensional shapes, measurement, and number patterns. Only 1 of Guidelines 2, 3, and 5 is fulfilled, and student work contains labels showing correct reasoning for this 1 guideline.

0 points: No understanding of attributes of two-dimensional shapes, area, perimeter, elapsed time, and partitioning shapes into parts with equal areas. No guidelines are fulfilled.

Scoring Rubric for Task 3:

3 points: Thorough understanding of converting from a larger unit to a smaller unit. All six conversion sentences are correct.

2 points: Partial understanding of converting from a larger unit to a smaller unit. The sentences for two of the three types of conversions are correct.

1 point: Limited understanding of converting from a larger unit to a smaller unit. The sentences for one of the three types of conversions are

correct.

0 points: No understanding of converting from a larger unit to a smaller unit. There is no type of conversion for which both of the sentences are correct.

Scoring Rubric for Task 4:

3 points: Thorough understanding of number patterns and conversions. The student chooses Correct, Incorrect, and Incorrect, fills in correct distance in incorrect movements, and shows work that indicates sound reasoning.

2 points: Partial understanding of number patterns and conversions. The student makes mistakes on 1 of the 3 Correct/Incorrect decisions and shows flaws in reasoning.

1 point: Limited understanding of number patterns and conversions. The student makes mistakes on 2 of the 3 Correct/Incorrect decisions, and shows flaws in reasoning.

OR The student chooses Correct, Incorrect, and Incorrect but does not fill in correct distances in incorrect movements.

0 points: No understanding of number patterns and conversions. The student makes mistakes on 3 of the 3 Correct/Incorrect decisions and shows flaws in reasoning.