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Oregon Mathematics Assessment

Art Day! Performance Task
Grade 4 Mathematics Sample Test
Scoring Guide
January 2017

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Art Day!

You are helping your 4th grade class organize an Art Day.

There will be three stations:
- Painting
- Pottery
- Chalk Art

You have two tasks. You will help create the supply list and the schedule for Art Day.

Task 1: Supply List
You need to make sure there are enough supplies at each station for everyone to participate. You will use the following information to create a list of art supplies for your class.

- There are 24 students in your class.
- Each student needs –
  - 2 paint brushes for the Painting Station.
  - 3 pounds of clay for the Pottery Station.
  - 5 pieces of chalk for the Chalk Art Station.

Task 2: Schedule
You also need to help plan the schedule for Art Day using the following information.

- The day starts at 9:00 a.m. and ends at 2:00 p.m.
- Your entire class will rotate through the three stations together.
- The Break has to be at least 10 minutes.
- The Break and Lunch together total 1 hour.
- The three stations (Painting, Pottery, and Chalk Art) do **not** need to be the same amount of time, but each one has to be 30 minutes or longer.

1 According to the supply list, how many paint brushes are needed for 24 students?

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2 According to the supply list, how many pounds of clay are needed for 24 students?

3 You need 120 pieces of chalk for Art Day. Your teacher has 6 boxes of chalk. Each box has 18 pieces of chalk. Is this enough chalk for Art Day?

Explain the steps you used to figure this out.

4 Your next task is to help plan the schedule for Art Day using the information from **Task 2: Schedule.**

Create a schedule for your class to follow on Art Day. You must follow the order given in the table.

Art Day Schedule*

Activity	Start Time	End Time
Painting	9:00 a.m.	
Break		
Pottery		
Lunch		
Chalk Art		2:00 p.m.

*Times must be given using a 12-hour clock.

5 When the class went to the Painting Station at 9:00 a.m., the container of paint was completely full. After 6 of the 24 students got their share of paint, the paint level had dropped to the level shown in the following picture.

Paint Level

Paint Level
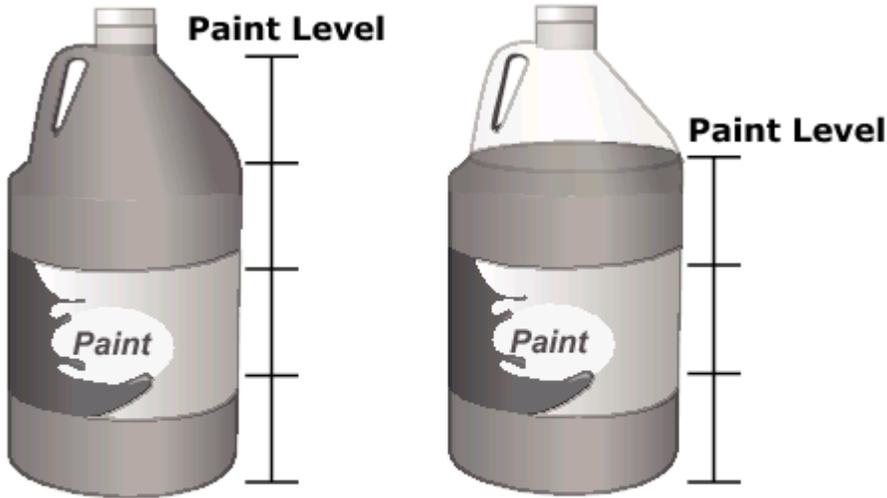
At 9:00 a.m. paint container is full.

After 6 students got their share of paint, the level is here.

Katie thinks there is not enough paint for the rest of the students.

Do you agree with Katie? Explain why or why not. Use the information shown in your explanation.

1 According to the supply list, how many paint brushes are needed for 24 students?

2   According to the supply list, how many pounds of clay are needed for 24 students?

#1 and #2 Equation numeric – 1 point each

Item	Claim	Domain	Target	DOK	Content	MP	Key
#1	2	OA	2A, 2D	2	3.OA.A.3	1	48 (paint brushes)
#2	2	OA	2A, 2D	2	3.OA.A.3	1	72 (pounds of clay)

Rubric:

1 point each: Student writes each value correctly: 48 and 72, respectively

0 points: All other responses

Commentary: The purpose of each question is primarily to assess whether the student (1) understands the context and (2) can identify and infer relevant quantities and perform typical calculations to solve a problem.

The context is reasonably authentic. Many schools plan for activities that require materials for each student. Keeping track of how many supplies are needed for an entire class is a good experience for students to record and represent quantities. This task is about deciding how to organize an art activity, including supplies needed and a potential schedule to follow for the day.

Rationale for Content:
The numbers and operations involved are solidly in Grade 3.
> 3.OA.A.3 Use multiplication and division within 100 to solve word problems in situations involving equal groups, arrays, and measurement quantities.

Rationale for Claim:
The fact that the student must extract the quantities, choose the procedure, and calculate the answer to solve this problem is what makes this a Target 2A (primary target) and Target 2D (secondary target).

> Claim 2, Target A: Apply mathematics to solve well-posed problems in pure mathematics and arising in everyday life, society, and the workplace.

> Claim 2, Target D: Identify important quantities in a practical situation and map their relationships (e.g., using diagrams, two-way tables, graphs, flowcharts, or formulas).

Rationale for DOK:
Since the student needs to retrieve information from the context and select a procedure (in this case, multiplication), it meets the requirement for DOK 2. From the *Depth of Thinking* chart:

> APPLY (DOK 2):
> -Select a procedure and perform it
> -Solve a routine problem applying multiple concepts or decision points
> -Retrieve information to solve a problem

Note that the descriptors for APPLY DOK 1 are follow simple procedures, calculate, measure, apply a rule (e.g., rounding), apply algorithm or formula. The key idea is that the procedure or rule or algorithm *is given or specified*. This question, although intended to be straightforward, *does not tell* the student to multiply. This separates DOK 1 from DOK 2.

3 You need 120 pieces of chalk for Art Day. Your teacher has 6 boxes of chalk. Each box has 18 pieces of chalk. Is this enough chalk for Art Day?

Explain the steps you used to figure this out.

#3 Short answer – 2 points

Item	Claim	Domain	Target	DOK	Content	MP	Key
#3	3	OA	3B	2	3.OA.A.3	3,6	See sample responses

Rubric:
2 points: Student develops an approach (compares the amount of chalk needed to the amount available) to determine whether more chalk is needed AND gives a justification for the result.

1 point: Student correctly calculates the amount of chalk available and determines that more chalk is needed, but does not provide a logical explanation why.

0 points: All other responses

Commentary: This question is designed to provide 4th-grade students an opportunity to develop and justify a result. It is reasonably authentic and addresses the overarching question of whether or not there are enough materials (in this case, chalk) for Art Day.

The key elements are that the students are not told what quantities to use, how they are operated on, nor what to conclude from them. This increases the depth of knowledge. This question is not meant to be overly difficult in terms of numeric computational complexity, which would distract students from the communicating reasoning aspect of the question.

Rationale for Content:
The numbers and operations involved are solidly in Grade 3:
> 3.OA.A.3 Use multiplication and division within 100 to solve word problems in situations involving equal groups, arrays, and measurement quantities.

This qualifies as securely held content knowledge.

Rationale for Claim:
The work required of this problem has a few necessary steps: (1) Students must develop a chain of reasoning, i.e. interpret the context (Is there enough chalk?). This requires determining the total chalk in the boxes (by whatever method, additive or multiplicative) AND comparing to the required amount. Note that by design, this problem does *not* tell the students to add up the totals and compare. This takes away the scaffolding and requires students to select the quantities and appropriate operation on them based on the context. (2) Students must provide an explanation to justify a claim. Correctly calculating the amount of chalk does not provide a logical argument. The student must connect the computation to the reasoning, essentially, that there are 108 pieces of chalk and this total is less than the required amount of 120.

Claim 3, Target B: Tasks used to assess this target should ask students to develop a chain of reasoning to justify or refute a conjecture. Tasks for Target B might include the types of examples called for in Target A as part of this reasoning, but should do so with a lesser degree of scaffolding than tasks that assess Target A alone.

Rationale for DOK:
Since the student needs to retrieve information from the context and select a procedure (in this case, multiplication), it meets the requirement for DOK 2. From the *Depth of Thinking* chart:

     APPLY (DOK 2):
     -Select a procedure and perform it
     -Solve a routine problem applying multiple concepts or decision points
     -Retrieve information to solve a problem

Note that the descriptors for APPLY DOK 1 are follow simple procedures, calculate, measure, apply a rule (e.g., rounding), apply algorithm or formula. The key idea is that the procedure or rule or algorithm *is given or specified*. This question, although intended to be straightforward, *does not tell* the student what the solution method is. This question is also an example of routine, but there are multiple approaches. This separates DOK 1 from DOK 2.

What follows are sample responses and scoring annotations for Item 3.

Sample Response 3a
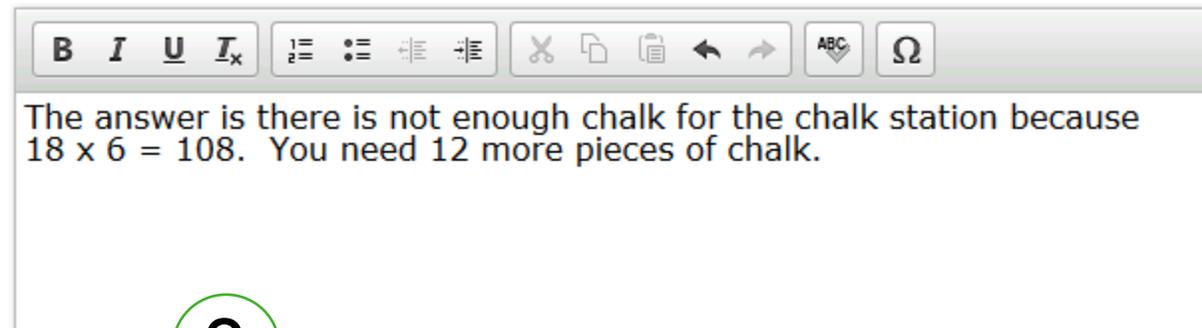
The answer is there is not enough chalk for the chalk station because 18 x 6 = 108. You need 12 more pieces of chalk.

SCORE POINT 2

The student correctly calculated the amount of chalk available (108) and determined that it was not enough for Art Day. He/she also explained that 12 more piece of chalk would be needed. The response contains evidence of the student's competence in reasoning to the full extent that these processes apply to this item.

120 / 6 = 20

If you divide 6 into 120 you will get 20, so 18 pieces of chalk in each box is not enough.

SCORE POINT **2**

The student used division to determine how many pieces of chalk must be in each box in order to equal 120. He/she determined that 20 are needed and that 18 pieces in each box are not enough. The response contains evidence of the student's competence in reasoning to the full extent that these processes apply to this item.

18 x 6 = 108 chalk

The teacher needs one more box of chalk for the class.

SCORE POINT **1**

The student correctly calculated the amount of chalk that was available for Art Day (108) and determined the one more box was needed. However, the student did not justify nor explain why one more box would have been sufficient for the amount needed for the class. The student has demonstrated only a **partial** understanding of the mathematical content and practices essential to this item.

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Sample Response 3d

| **B** | *I* | U | I_x | | | | | | | | | | | ABC | Ω |

First, add 18 +18 + 18 + 18+ 18 + 18 = 108

Then you look at what you need and it is not enough.

SCORE POINT **1**

The student correctly calculated the amount of chalk that was available for Art Day (18+18+18+18+18+18=108). However, the student did not provide a logical explanation as to why it was not enough (i.e., comparing 108 to 120) and therefore demonstrated only a **partial** understanding of the mathematical content and practices essential to this item.

Sample Response 3e

| **B** | *I* | U | I_x | | | | | | | | | | | ABC | Ω |

No, there are not enough. First, I mulitplied 18 x 6. After I got the answer, 108.

So that is how I got my answer.

SCORE POINT **1**

The student correctly calculated the amount of chalk that was available for Art Day (108). However, the student was unable to make the logical connection and has demonstrated only a **partial** understanding of the mathematical content and practices essential to this item.

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B *I* <u>U</u> I_x

$18 \times 6 = 102$

SCORE POINT 0

The student showed initial understanding of the required multiplication, but did not execute the operation correctly nor use his/her answer to build an argument as to whether or not there was enough chalk for Art Day. No evidence is present that demonstrates the student's competence in reasoning or communicating essential to this item.

4 Your next task is to help plan the schedule for Art Day using the information from **Task 2: Schedule.**

Create a schedule for your class to follow on Art Day. You must follow the order given in the table.

Art Day Schedule*

Activity	Start Time	End Time
Painting	9:00 a.m.	
Break		
Pottery		
Lunch		
Chalk Art		2:00 p.m.

*Times must be given using a 12-hour clock.

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#4 Table item – 1 point

Item	Claim	Domain	Target	DOK	Content	MP	Key
#4	4	MD	A	4	2.MD.C.7	4	See exemplar

Rubric:
1 point: Student enters times that satisfy the restrictions listed in Task 2: Schedule (at least 10 minutes for Break, Break and Lunch take exactly one hour, and each station is at least 30 minutes in length).

0 points: All other responses

Scoring Note: Although students can enter a.m. and p.m. in the schedule, it is **not** required, nor should it count against the students if they use the wrong indication (a.m. or p.m.).

One example of a correct response:

Art Day Schedule*		
Activity	**Start Time**	**End Time**
Painting	9:00 a.m.	10:30 a.m.
Break	10:30 a.m.	10:45 a.m.
Pottery	10:45 a.m.	12:15 p.m.
Lunch	12:15 p.m.	1:00 p.m.
Chalk Art	1:00 p.m.	2:00 p.m.
*Times must be given using a 12-hour clock		

Commentary: The purpose of this question is to increase the level of abstraction for a 4th-grade student to solve a reasonably authentic scheduling situation that would satisfy a list of requirements. Because students are given the flexibility to create their own schedule with a limited list of restrictions, there is not one correct answer. The nature of this question is for students to design under constraints. Students are not asked to explain why they chose the times that they did, but rather can determine for themselves if the times are appropriate based on the list of requirements from Task 2: Schedule.

Rationale for Content:

The content at the heart of this problem is working with time, but in the context of designing a schedule. Hence although "working" with time is a Grade 2 content standard, the addition and possible subtraction of times would put this into more grade level content.

2.MD.C Work with time and money.

> 7. Tell and write time from analog and digital clocks to the nearest five minutes, using a.m. and p.m. Know relationships of time (e.g., minutes in an hour, days in a month, weeks in a year).

Rationale for Claim:

Students are given the flexibility to create their own schedule with a limited list of restrictions. The nature of this question is for students to *design under constraints*. This is what makes this a Claim 4 item: Apply mathematics to solve problems arising in everyday life, society, and the workplace.

> Claim 4, Target A: Problems used to assess this target for Claim #4 should not be completely formulated (as they are for the same target in Claim #2), and require students to extract relevant information from within the problem and find missing information through research or the use of reasoned estimates.

Rationale for DOK:

Since the student needs to retrieve information from the context and design a model (in this case a schedule) that satisfies certain given constraints, it meets the requirement of DOK 4. From the *Depth of Thinking* chart:

> CREATE: DOK 4
> -Synthesize information across multiple sources or data sets
> -Design a model to inform and solve a practical or abstract situation

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5 When the class went to the Painting Station at 9:00 a.m., the container of paint was completely full. After 6 of the 24 students got their share of paint, the paint level had dropped to the level shown in the following picture.

Paint Level

Paint

At 9:00 a.m. paint container is full.

Paint Level
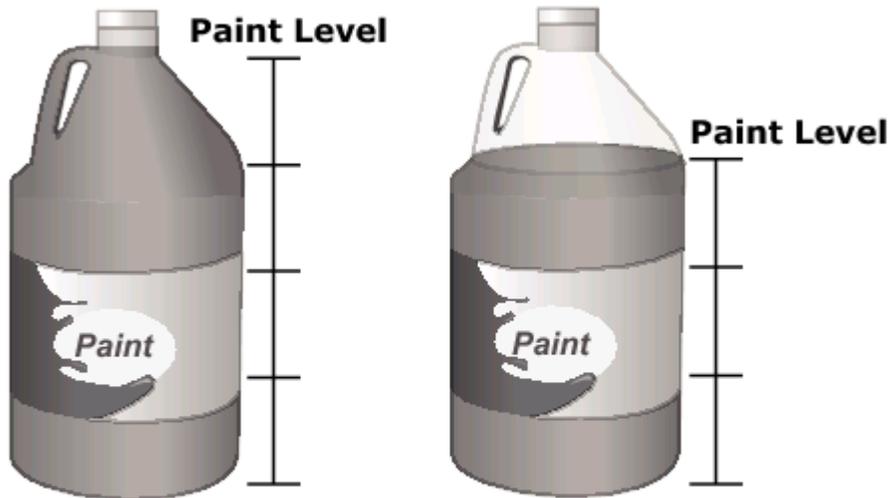
Paint

After 6 students got their share of paint, the level is here.

Katie thinks there is not enough paint for the rest of the students.

Do you agree with Katie? Explain why or why not. Use the information shown in your explanation.

#5 Short answer – 1 point

Item	Claim	Domain	Target	DOK	Content	MP	Key
#5	2	MD	2A, 3F	3	3.MD.A.2	1	See sample responses

Rubric:
1 point: Student states whether he/she agrees or disagrees with Katie and provides a mathematically logical explanation as to why or why not.

0 points: The student may agree or disagree, but does not supply any logical explanation for his/her response.

Commentary: This question is designed to provide students an opportunity to interpret a diagram (a picture of a paint container), as well as interpret and apply the information given in the prompt to determine whether there is enough paint to last the entire activity. Because 6 students have used their share of paint, 1/4 of the class has used the paint from the container. Based on the height of the container, it would appear that 1/4 of the paint has been used by 1/4 of the class; however, because the bottle is not cylindrical, there has been *less than* 1/4 of the paint used. Therefore, there should be sufficient paint left for the remaining 18 students (3/4 of the class).

Rationale for Content:
This is an application of 3rd Grade Measurement.

> 3.MD.A Solve problems involving measurement and estimation of intervals of time, liquid volumes, and masses of objects.

> 2. Measure and estimate liquid volumes and masses of objects using standard units of grams (g), kilograms (kg), and English units (oz, lb.), and liters (l).

Note that the content may also entail some fraction work, but students can avoid this and work more additively. Also note, that this question does NOT require students know how to compute the volume of a cylinder or other 3-D object. The problem is designed to promote problem solving.

Rationale for Claim:
This is intended to be *primarily* about solving a problem arising "in everyday life." There are a variety of approaches available to students. The problem is asking students to determine whether there is enough paint left for the rest of the class.

Therefore, the primary alignment is Claim 2, Target A.

> "Apply mathematics to solve well-posed problems in pure mathematics and those arising in everyday life, society, and the workplace. Under Claim 2, the problems should be completely formulated, and students should be asked to find a solution path from among their readily available tools."

However, because students are to take a position and argue in order to support or refute Katie's claim, a secondary alignment to Claim 3, Target F exists.

> "Base arguments on concrete referents such as objects, drawings, diagrams, and actions. In earlier grades, the desired student response might be in the form of concrete referents. In later grades, concrete referents will often support generalizations as part of the justification rather than constituting the entire expected response."

Rationale for DOK:

The key point is that students need to understand and use the concept of liquid volumes, namely by breaking the paint container into fourths. Since the top fourth of the container (the level at which the paint is after 1/4 of the class has used it) is tapered, it must contain less liquid volume than the other 3/4 of the bottle. Hence comparing additively or multiplicatively, there will clearly be enough paint for the rest of the class.

As mentioned under the rationale for the content, this problem is not about finding volumes of cylinders. So for 4th-grade students this is designed to be non-routine. This increases the DOK to level 3. Furthermore, there is added complexity of comparing amounts of paint and numbers of students. This would be routine proportional thinking for students in middle school, but it is not routine for 4th-grade students. This requires students to have to connect different units with a DOK 3 level of understanding.

> UNDERSTAND (DOK 3):
> -Use concepts to solve non-routine problems
> -Use supporting evidence to justify conjectures, generalize, or connect ideas

What follows are sample responses and scoring annotations for Item 5.

Sample Response 5a

| B *I* U *I*ₓ | ₁₌ :≡ ≡ ≡ | ✂ ⎘ ⎘ ↰ → | ABC | Ω |

There will be enough because 6 + 6 + 6 + 6 is 24. The first 6 used about 1/4 of the bottle. If each 6 students use 1/4, there will be just enough paint. Also, the top of the bottle is narrow, so it really is less paint than 1/4 of the total bottle.

SCORE POINT **1**

The student displays good problem-solving skills in dividing up the number of students into 4 equal sets of 6 students. Furthermore, the student argues that there would be enough paint if the remaining students used the same amount of paint the first 6 students used. The student even realizes that because the top of the container is tapered (narrow), less than ¼ of the paint was actually used by the first 6 students. The response contains evidence of the student's competence in problem solving to the full extent that these processes apply to this item.

Sample Response 5b

I agree with Katie because the first 6 kids didn't use much paint. It looks like 1/4 of the paint is gone because of the marks, but very little is realy gone. Unless the other 18 kids use a lot more paint than the first 6 kids, there is enough for the whole class.

SCORE POINT 1

The student displays good problem-solving skills in recognizing that less than ¼ of the paint was actually used by the first 6 students. The student even includes the caveat "unless the other 18 kids use a lot more paint . . ." to show his/her understanding that the amount used is based on the first 6 students and could actually vary and not be the same. The response contains evidence of the student's competence in problem solving to the full extent that these processes apply to this item.

Sample Response 5c

I think that katie is correct because when they went in the paint container was full and after 6 students used it was half left.

SCORE POINT 0

The student did link the amount of paint to the number of students who used the paint so far, but stating that only ½ of the paint is left is too far off the actual amount to provide any evidence of the student's ability to solve problems using measurement and estimation. No evidence is present that demonstrates the student's competence in problem solving essential to this item.

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I agree with Katie because 6 x 4 = 24

SCORE POINT **0**

Although the student correctly stated a multiplication fact (6 x 4 = 24), there is no clear indication that the student made a connection between the number of students who need to use the paint and the amount of paint remaining in the container. No evidence is present that demonstrates the student's competence in problem solving essential to this item.

The handscored items in this guide are either 1-point or 2-point short-text items. The general rubrics that are used as a basis for scoring all 1-point and 2-point short-text items are shown below. Although item-specific rubrics are also provided to scorers to facilitate the handscoring of short-text items, every response should be able to map back to these general rubrics in a consistent and reliable manner.

General Rubric for 2-Point Items

Score	Description
2	The student has demonstrated a **full and complete** understanding of all mathematical content and practices essential to this task. The student has addressed the task in a mathematically sound manner. The response contains evidence of the student's competence in problem solving, reasoning, and/or modeling to the full extent that these processes apply to the specified task. The response may, however, contain minor flaws that do not detract from a demonstration of full understanding.
1	The student has demonstrated a **partial** understanding of the mathematical content and practices essential to this task. The student's response contains some of the attributes of an appropriate response but lacks convincing evidence that the student fully comprehends the essential mathematical ideas addressed by this task. Such deficits include evidence of insufficient mathematical knowledge; errors in fundamental mathematical procedures; and other omissions or irregularities that bring into question the student's competence in problem solving, reasoning, and/or modeling related to the specified task.
0	The student has demonstrated **merely an acquaintance** with the topic, or provided a completely incorrect or uninterpretable response. The student's response may be associated with the task, but contains few attributes of an appropriate response. There are significant omissions or irregularities that indicate a lack of comprehension in regard to the mathematical content and practices essential to this task. No evidence is present that demonstrates the student's competence in problem solving, reasoning, and/or modeling related to the specified task.

General Rubric for 1-Point Items

Score	Description
1	The student has demonstrated a **full and complete** understanding of all mathematical content and practices essential to this task. The student has addressed the task in a mathematically sound manner. The response contains evidence of the student's competence in problem solving, reasoning, and/or modeling to the full extent that these processes apply to the specified task. The response may, however, contain minor flaws that do not detract from a demonstration of full understanding.
0	The student has demonstrated **merely an acquaintance** with the topic, or provided a completely incorrect or uninterpretable response. The student's response may be associated with the task, but contains few attributes of an appropriate response. There are significant omissions or irregularities that indicate a lack of comprehension in regard to the mathematical content and practices essential to this task. No evidence is present that demonstrates the student's competence in problem solving, reasoning, and/or modeling related to the specified task.