

Mathematics Toolkit: Grade 8 Objective 2.D.1.a

Standard 2.0 Knowledge of Geometry

Topic D. Congruence and Similarity

Indicator 1. Apply the properties of similar polygons

Objective a. Determine similar parts of polygons

Assessment Limits:

Use the length of corresponding sides or the measure of corresponding angles and rational numbers with no more than 2 decimal places (0 – 1000)

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Objective 2.D.1.a Tools

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Scoring Rubric

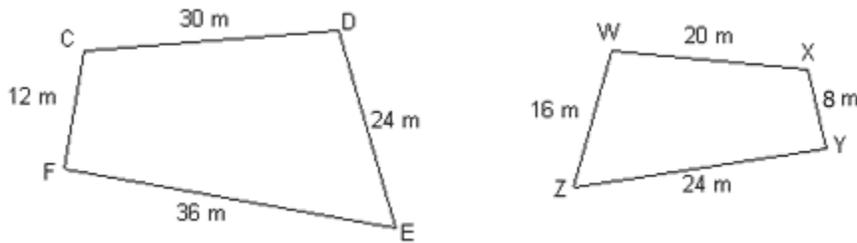
- Rubric - Extended Constructed Response

Higher Order Thinking Skills

Mathematics Grade 8 Objective 2.D.1.a Assessment Limit 1

Level 1: Knowledge/Comprehension

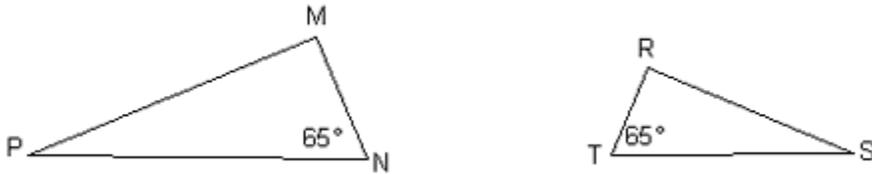
The two quadrilaterals shown below are similar.



Which side of quadrilateral WXYZ corresponds to \overline{DE} ?

Answer: \overline{WZ}

The triangles below are similar.

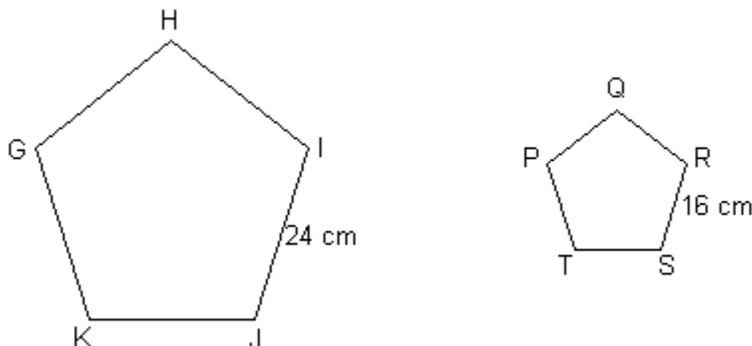


Which angle in $\triangle RST$ corresponds to $\angle MNP$?

Answer: $\angle RTS$

Level 2: Application/Analysis

Figure GHIJK is similar to PQRST.



If $HG = 15$ cm, what is the length of \overline{QP} ?

Answer: 10cm

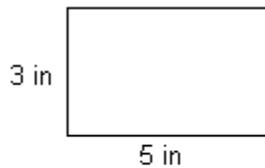
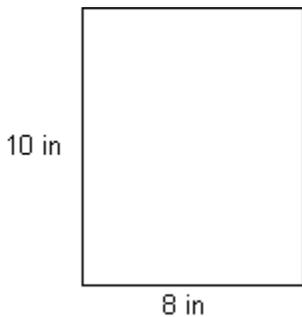
$$\frac{24}{16} = \frac{15}{x}$$

so that $24x = 15 \cdot 16$

$$\frac{24x}{24} = \frac{240}{24}$$

$x = 10$

Look at the rectangles below.



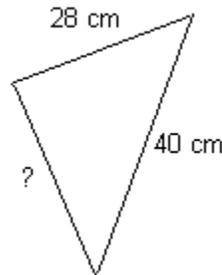
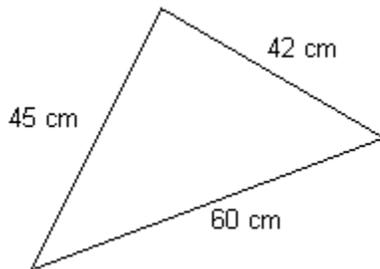
Note: The figures are not drawn to scale.

Is the 8 in by 10 in rectangle similar to the 3 in by 5 in rectangle?

Justify your answer. Use words, numbers, and/or symbols in your justification.

Sample correct response: No, the rectangles are not similar. The smaller sides of the rectangles are in the ratio of 3:8 but the larger sides are in the ratio of 5:10, or 1:2. Since the ratios of the sides are different, the rectangles are not similar.

Look at the similar triangles below.



What is the length, in centimeters, of the missing side?

Answer: 30 cm

Explain how you determined the length of the missing side. Use words, numbers, and/or symbols in your explanation.

Sample correct response:

$$\frac{42}{28} = \frac{45}{x}$$

$$42x = 28 \cdot 45$$

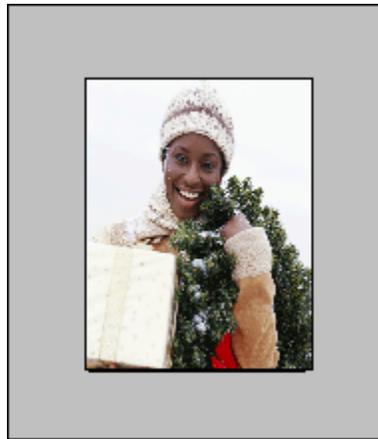
$$\frac{42x}{42} = \frac{1260}{42}$$

$$x = 30$$

Sample correct response: The length is 30 cm because the ratio 28:45, 30:45, and 40:60 all reduce to 2:3, which means all of the sides are in the same ratio. Since the figures are similar, the sides must all be in the same ratio.

Level 3: Synthesis/Evaluation

An 8" by 10" photograph will be surrounded by a 2" border as shown below.



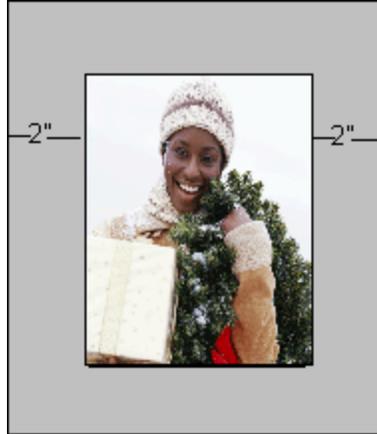
Will the framed photograph be similar to the 8" by 10" photograph? Justify your answer. Use words, numbers, and/or symbols in your justification.

Sample correct response: No. The framed photograph will have dimensions 12" by 14". I found the new dimensions by adding the 2" border to the top and bottom and both sides. I checked to see if the sides were proportional.

$$\frac{8}{12} \neq \frac{10}{14}$$

because $8 \cdot 14 = 112$ and $12 \cdot 10 = 120$.

An 8" by 10" photograph will be surrounded by a border as shown below. The border on the width is 2".



How wide should the border on the length be so that the framed photograph and the photograph are similar?

Sample correct answer:

$$\frac{8}{10} = \frac{12}{x}$$

$$8x = 120$$

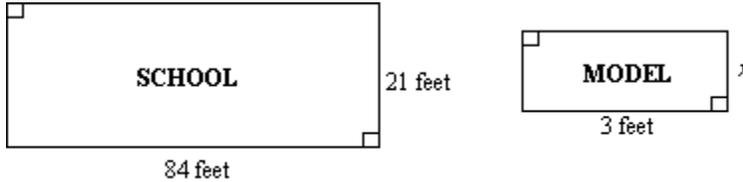
$$x = 15$$

The original length of the photograph is 10. To place a border on the length take the difference of 15 and 10 and split it in two. The border along the length should be 2.5".

Sample Item #1 Extended Constructed Response (ECR) Item with Annotated Student Responses

Question

Cedric is making a scale model of his school. The dimensions of his school and of his model are shown below.



Note: The figures are not drawn to scale.

Step A

What is the length, in feet, of side x of the model?

Step B

- Use what you know about similar polygons to justify why your value of side x is correct. Use words, numbers, and/or symbols in your justification.
- If Cedric changes the length of his model from 3 feet to 6 feet, explain how this change will affect the value of side x . Use words, numbers, and/or symbols in your explanation.

Step A is scored 0 (Incorrect) or 1 (Correct) and assesses 2.D.1.a.

Step B is scored with a 4 point (0, 1, 2, 3) rubric and assesses Processes of Mathematics.

Note: Twenty "Sample Student Responses" follow below. Each response appears on its own separate page and includes scoring information. The "Sample Student Responses" represent a range of score points.

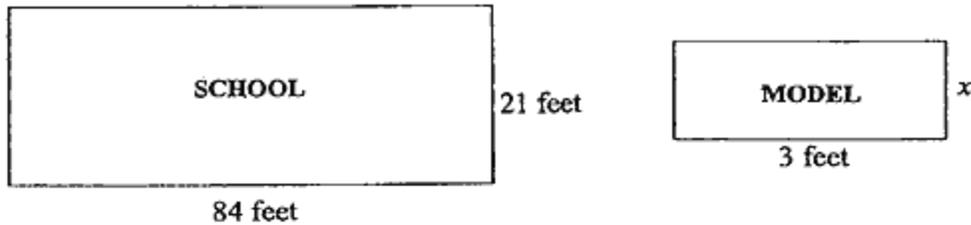
Correct Answer

Step A
0.75 or $\frac{3}{4}$

Annotated Student Responses

Sample Student Response #1

Cedric is making a scale model of his school. The dimensions of his school and of his model are shown below.



Note: The figures are not drawn to scale.

Step A

What is the length, in feet, of side x of the model?

1 ft. feet

Step B

- Use what you know about similar polygons to justify why your value of side x is correct. Use words, numbers, and/or symbols in your justification.
- If Cedric changes the length of his model from 3 feet to 6 feet, explain how this change will affect the value of side x . Use words, numbers, and/or symbols in your explanation.

If Cedric changes the length of his
model from 3 to 6 feet it would lower the
value of side x . For instance, right now it is
one foot, which means that it would be
very long like a rectangle and wouldn't be
able to fit much on that one side. In
conclusion, if Cedric changes the length of his
model on side x , it's value would go down.

Score for Sample Student Response #1:

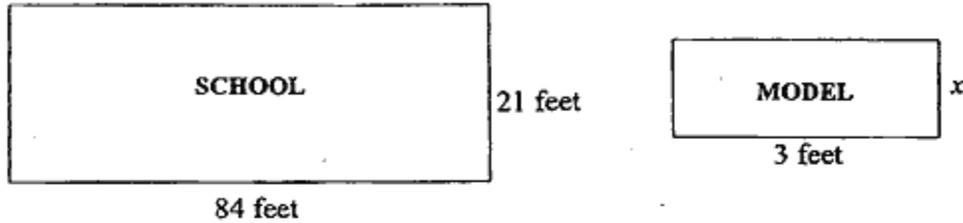
Step A - Content (Knowledge of Geometry): 0

Step B - Processes of Mathematics: 0

Annotation for Step B, Using the Rubric: This response is completely incorrect.

Sample Student Response #2

Cedric is making a scale model of his school. The dimensions of his school and of his model are shown below.



Note: The figures are not drawn to scale.

Step A

What is the length, in feet, of side x of the model?

1 feet

Step B

- Use what you know about similar polygons to justify why your value of side x is correct. Use words, numbers, and/or symbols in your justification.
- If Cedric changes the length of his model from 3 feet to 6 feet, explain how this change will affect the value of side x . Use words, numbers, and/or symbols in your explanation.

You find this by dividing 84 by 3 and
get 28. This means means 1 foot on the
model is 28 feet on the real school.

Score for Sample Student Response #2:

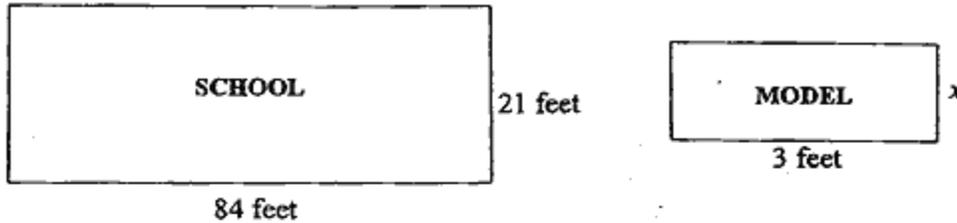
Step A - Content (Knowledge of Geometry): 0

Step B - Processes of Mathematics: 1

Annotation for Step B, Using the Rubric: This response demonstrates a minimal understanding and analysis of the problem. A partial application of a strategy in the context of the problem is indicated. The justification for why the length of side x is correct is logically flawed as the scale is not correctly applied to the given dimensions: "[Divide] 84 by 3 and get 28... 1 foot on the model is 28 feet on the real school." The explanation for how the change in the length of the model will change with value of side x is missing.

Sample Student Response #3

Cedric is making a scale model of his school. The dimensions of his school and of his model are shown below.



Note: The figures are not drawn to scale.

Step A

What is the length, in feet, of side x of the model?

$\frac{1}{12}$ feet

Step B

- Use what you know about similar polygons to justify why your value of side x is correct. Use words, numbers, and/or symbols in your justification.
- If Cedric changes the length of his model from 3 feet to 6 feet, explain how this change will affect the value of side x . Use words, numbers, and/or symbols in your explanation.

The value of side x is $\frac{1}{12}$ ft. I know this because $\frac{21}{84} = \frac{x}{3}$ is the scale. $\frac{21}{84} = \frac{x}{3}$ simplifies to $\frac{1}{4} = \frac{x}{3}$. $\frac{1}{4}$ simplifies to $\frac{1}{12}$. $\frac{x}{3} = \frac{1}{12}$ and if $\frac{1}{12} = \frac{x}{3}$, $x = \frac{1}{12}$. This will effect the value of side x by increasing it. This is because the scale would then have to bring both measurements up, not just one of them. So, if 6 went up, x would have to go up as well.

Score for Sample Student Response #3:

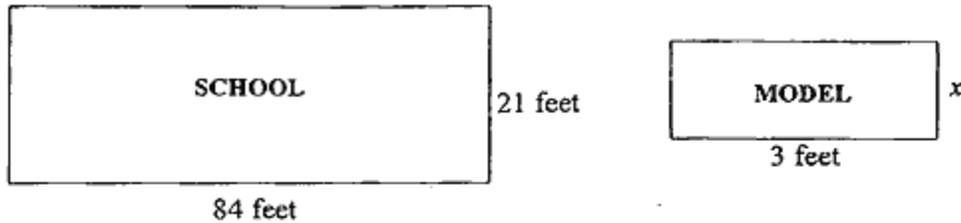
Step A - Content (Knowledge of Geometry): 0

Step B - Processes of Mathematics: 1

Annotation for Step B, Using the Rubric: This response demonstrates a minimal understanding and analysis of the problem. An application of a strategy of using proportions is indicated. However, the justification for the value of side x is logically flawed as the proportion is simplified incorrectly. The explanation of how the value of side x will change is minimal: "The scale would then have to bring both measurements up, not just one of them." Supportive information and/or numbers are not provided. Connections to the concept of similarity are missing.

Sample Student Response #4

Cedric is making a scale model of his school. The dimensions of his school and of his model are shown below.



Note: The figures are not drawn to scale.

Step A

What is the length, in feet, of side x of the model?

1.7 feet

Step B

- Use what you know about similar polygons to justify why your value of side x is correct. Use words, numbers, and/or symbols in your justification.
- If Cedric changes the length of his model from 3 feet to 6 feet, explain how this change will affect the value of side x . Use words, numbers, and/or symbols in your explanation.

① If you look at the school the sides are 21 ft and 84 ft. You'd divide 3 ft into $84 = 28$. Divide $28/21 = 1.7 = x$

② If 3ft would change to 6ft then you would multiply the other side by two 6ft and 3.4.

Score for Sample Student Response #4:

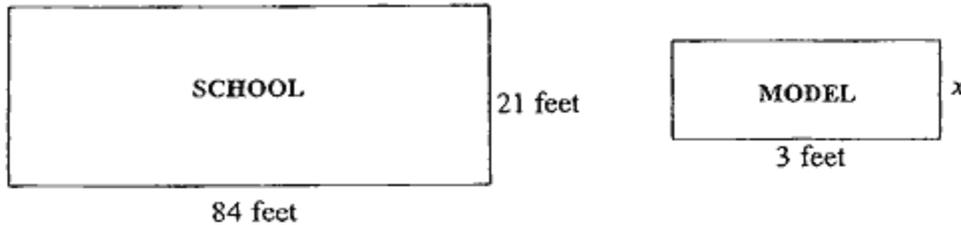
Step A - Content (Knowledge of Geometry): 0

Step B - Processes of Mathematics: 1

Annotation for Step B, Using the Rubric: This response demonstrates a minimal understanding and analysis of the problem. An application of a strategy of using proportions is indicated. The justification for the value of side x is logically flawed: "You divide 3 ft into $84=28$. Divide $28/21 = 1.7$." The explanation for how the change will affect the value of side x is minimal: "You would multiply the other side by two." Connections to the concept of similarity are missing.

Sample Student Response #5

Cedric is making a scale model of his school. The dimensions of his school and of his model are shown below.



Note: The figures are not drawn to scale.

Step A

What is the length, in feet, of side x of the model?

75 feet

Step B

- Use what you know about similar polygons to justify why your value of side x is correct. Use words, numbers, and/or symbols in your justification.
- If Cedric changes the length of his model from 3 feet to 6 feet, explain how this change will affect the value of side x . Use words, numbers, and/or symbols in your explanation.

If Cedric changes the length from three feet to six feet he will have to change the other side or it will make the school look longer than it really is. And it will mean that the other sides are shorter than they really are.

Score for Sample Student Response #5:

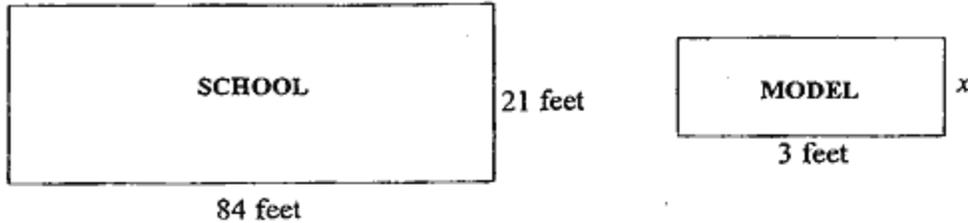
Step A - Content (Knowledge of Geometry): 1

Step B - Processes of Mathematics: 1

Annotation for Step B, Using the Rubric: This response demonstrates a minimal understanding and analysis of the problem. The justification for why the value of side x is correct is missing. The connection to similar polygons having the same shape and proportional sized is implied: "He will have to change the other side or it will make the school look bigger than it really is." Supportive information and/or numbers are not provided.

Sample Student Response #6

Cedric is making a scale model of his school. The dimensions of his school and of his model are shown below.



Note: The figures are not drawn to scale.

Step A

What is the length, in feet, of side x of the model?

74 feet

Step B

- Use what you know about similar polygons to justify why your value of side x is correct. Use words, numbers, and/or symbols in your justification.
- If Cedric changes the length of his model from 3 feet to 6 feet, explain how this change will affect the value of side x . Use words, numbers, and/or symbols in your explanation.

Side x of the model would measure out to be 74 feet long. This is my justification.

$$\begin{array}{r} 28 \\ 3 \overline{)84} \end{array}$$
 then $28 \times 21 = 00$ so that's how to find side x 's length.

If cedric changes the length from 3ft. to 6ft then the length of side x will change to 1.5.

Here is my justification.
$$\begin{array}{r} 14 \\ 6 \overline{)84} \end{array}$$
 so then I divided $14 \overline{)21.0}$ so therefore that is my answer.

Score for Sample Student Response #6:

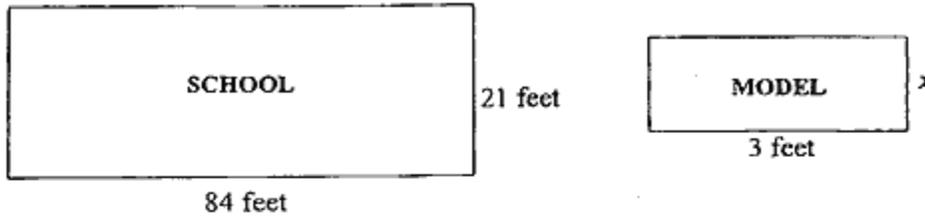
Step A - Content (Knowledge of Geometry): 0

Step B - Processes of Mathematics: 2

Annotation for Step B, Using the Rubric: This response demonstrates a general understanding and analysis of the problem. A reasonable strategy of using proportional reasoning to find the value for side x is indicated. The justification, presented as an explanation, for the value of side x is partially developed: " $84/3 = 28$ then $21/28 = .74$." The minor calculation error does not detract from the overall understanding of the process used to determine the value of side x . The explanation for how the change will affect the value of side x is clear: "The length of side x will change to $1.5 \dots 84/6 = 14 \dots 21/14 = 1.5$." Connections to the concept of similarity are missing.

Sample Student Response #7

Cedric is making a scale model of his school. The dimensions of his school and of his model are shown below.



Note: The figures are not drawn to scale.

Step A

What is the length, in feet, of side x of the model?

$\frac{3}{4}$ feet

Step B

- Use what you know about similar polygons to justify why your value of side x is correct. Use words, numbers, and/or symbols in your justification.
- If Cedric changes the length of his model from 3 feet to 6 feet, explain how this change will affect the value of side x . Use words, numbers, and/or symbols in your explanation.

I divided 3 by 84 to get the scale, then divided
21 by 28. If Cedric changes the side of his
model to 6 feet then the scale would end
up being 14. You would then have to divide
21 by 14 to get the value of x .

Score for Sample Student Response #7:

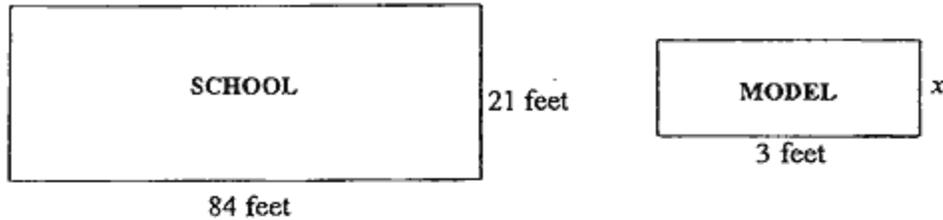
Step A - Content (Knowledge of Geometry): 1

Step B - Processes of Mathematics: 2

Annotation for Step B, Using the Rubric: This response demonstrates a general understanding and analysis of the problem. A reasonable strategy of using proportional reasoning to determine the value of side x is indicated. The justification, presented as an explanation, for why this value is correct is only partially developed: "I divided 3 by 84 to get the scale, then divided 21 by 28. The minor mathematical error of stating "3 is divided by 84" instead of "84 is divided by 3" does not detract from the overall understanding of the process used to solve the problem. This justification is supported by the correct quotient of 28. The explanation for how the change in the length would affect the value of side x is partially developed: "the scale would end up being 14...divide 21 by 14." Connections to the concept of similarity are missing.

Sample Student Response #8

Cedric is making a scale model of his school. The dimensions of his school and of his model are shown below.



Note: The figures are not drawn to scale.

Step A

What is the length, in feet, of side x of the model?

.75 feet

Step B

- Use what you know about similar polygons to justify why your value of side x is correct. Use words, numbers, and/or symbols in your justification.
- If Cedric changes the length of his model from 3 feet to 6 feet, explain how this change will affect the value of side x . Use words, numbers, and/or symbols in your explanation.

$$84 \div 6 = 14$$

$$21 \div 14 = 1.5$$

the side x will increase
from .75 to 1.5.

$$84 \div 3 = 28$$

$$21 \div 28 = .75$$

Score for Sample Student Response #8:

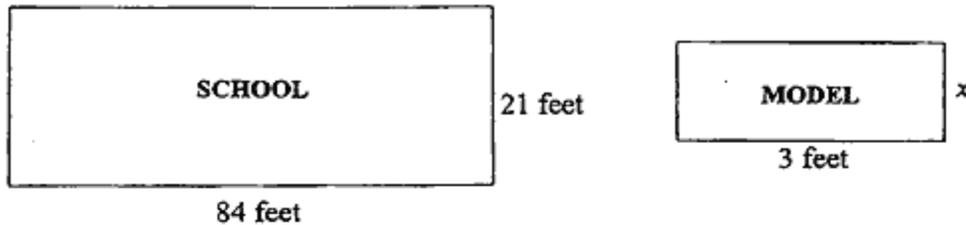
Step A - Content (Knowledge of Geometry): 1

Step B - Processes of Mathematics: 2

Annotation for Step B, Using the Rubric: This response demonstrates a general understanding and analysis of the problem. A reasonable strategy of using proportional reasoning to determine the value for side x is indicated. The justification, presented as a numerical explanation, for why this value is correct, is only partially developed: " $84/3=28...21/28= .75$." The explanation for how the change will affect the value of side x is clear: " $84/6=14...21/14=1.5$." Appropriate supportive numbers are provided. However, connections to the concepts of similarity and scale are missing.

Sample Student Response #9

Cedric is making a scale model of his school. The dimensions of his school and of his model are shown below.



Note: The figures are not drawn to scale.

Step A

What is the length, in feet, of side x of the model?

75 feet

Step B

- Use what you know about similar polygons to justify why your value of side x is correct. Use words, numbers, and/or symbols in your justification.
- If Cedric changes the length of his model from 3 feet to 6 feet, explain how this change will affect the value of side x . Use words, numbers, and/or symbols in your explanation.

WELL, THE MODEL IS THE EXACT SAME SHAPE AS THE
SCHOOL, ONLY SMALLER. SO DIVIDE 84 BY 3 TO
GET 28. NEXT DIVIDE 21 BY 28 TO GET .75. TO
CHECK, MULTIPLY .75 X 28 TO GET 21.

IF CEDRIC CHANGES THE LENGTH OF HIS
MODEL FROM 3 FEET, THIS WOULD AFFECT SIDE
 x BECAUSE YOU WOULD HAVE TO DIVIDE 84 BY 6
INSTEAD OF 3 TO GET 14. AND 21 DIVIDED BY 14 IS 1.5

Score for Sample Student Response #9:

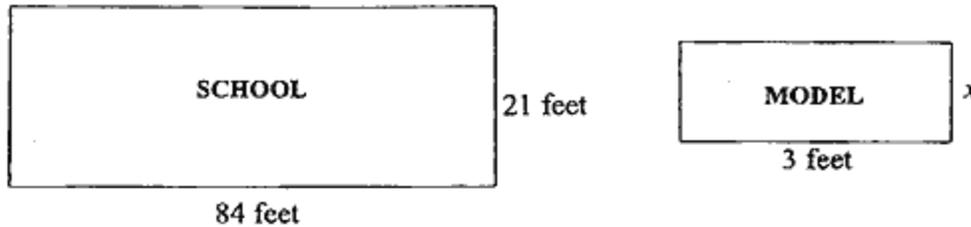
Step A - Content (Knowledge of Geometry): 1

Step B - Processes of Mathematics: 3

Annotation for Step B, Using the Rubric: This response demonstrates a comprehensive understanding and analysis of the problem. The application of a reasonable strategy in the context of the problem is indicated. The justification for why the value of side x is correct is clear, fully developed and logical: "Divide 84 by 3 to get 28...divide 21 by 28 to get .75. To check, multiply $.75 \times 28$ to get 21." The connection to similar polygons is clear and stated explicitly: "The model is the same shape as the school only smaller." The explanation of how the change will affect the values of side x is clear, fully developed and logical: "Divide 84 by 6 instead of 3 to get 14...and 21 divided by 14 is 1.5." Appropriate supportive numbers are provided.

Sample Student Response #10

Cedric is making a scale model of his school. The dimensions of his school and of his model are shown below.



Note: The figures are not drawn to scale.

Step A

What is the length, in feet, of side x of the model?

.75 feet

Step B

- Use what you know about similar polygons to justify why your value of side x is correct. Use words, numbers, and/or symbols in your justification.
- If Cedric changes the length of his model from 3 feet to 6 feet, explain how this change will affect the value of side x . Use words, numbers, and/or symbols in your explanation.

On the actual school building, one side was 84 feet and the other was 21 feet. 21 feet is one fourth of 84 feet. Since the school and the model are similar objects, side x will be one fourth of 3 feet. If Cedric was to double the value of the 3 foot side from 3 feet to 6 feet, then the value of side x would double too. It would change from .75 feet to 1.5 feet.

Score for Sample Student Response #10:

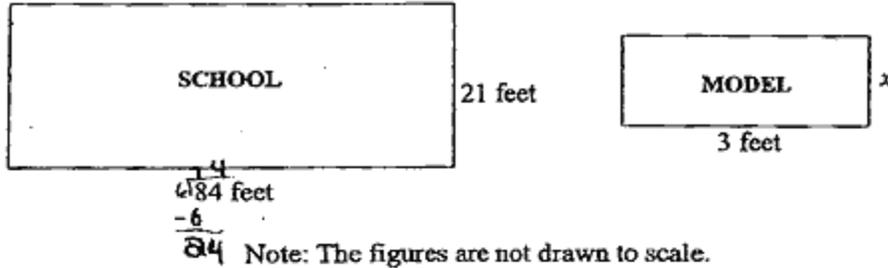
Step A - Content (Knowledge of Geometry): 1

Step B - Processes of Mathematics: 3

Annotation for Step B, Using the Rubric: This response demonstrates a comprehensive understanding and analysis of the problem. The application of a reasonable strategy in the context of the problem is indicated. The justification for how the value for side x was determined is clear, fully developed and logical: "21 feet is one fourth of 84 feet... side x will be one fourth of 3 feet." The connection to the concept of similar polygons is clear as the same scale is used throughout because, "The school and the model are similar objects." The explanation of how the change would affect the value of side x is clear, fully developed and logical: "If Cedric doubled the value of the 3 foot side... the value of side x would double too." Supportive numbers are provided: "It would change from .75 feet to 1.5 feet."

Sample Student Response # 11

Cedric is making a scale model of his school. The dimensions of his school and of his model are shown below.



Note: The figures are not drawn to scale.

Step A

What is the length, in feet, of side x of the model?

$\frac{3}{4}$ feet

Step B

- Use what you know about similar polygons to justify why your value of side x is correct. Use words, numbers, and/or symbols in your justification.
- If Cedric changes the length of his model from 3 feet to 6 feet, explain how this change will affect the value of side x . Use words, numbers, and/or symbols in your explanation.

I divided 84 by 3. I got 28. This means that there is 28 feet to one foot of the model. Since 28 is bigger than 21 it becomes a fraction. When you simplify it you get $\frac{3}{4}$. It will change it because instead of it being 28ft = 1ft of the model it will be 14ft = 1ft of the model.

Score for Sample Student Response # 11:

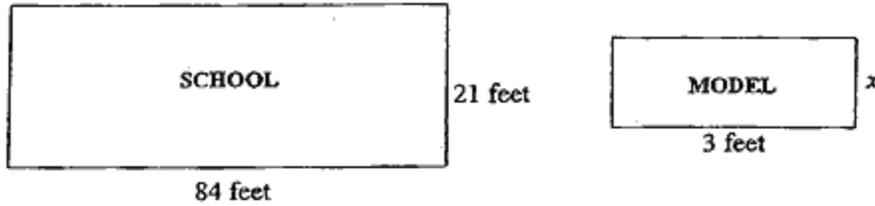
Step A - Content (Knowledge of Geometry): 1

Step B - Processes of Mathematics: 2

Annotation for Step B, Using the Rubric: This response demonstrates a general understanding and analysis of the problem. A reasonable strategy of using proportional reasoning to determine the value of side x is indicated. The justification, presented as an explanation, for why this value is correct is only partially developed: "I divided 84 by 3... it becomes a fraction... $\frac{3}{4}$." Connections to the concept of similarity are implied: "There is 28 feet to one foot of the model." The explanation for how the change in the length would affect the value of side x is partially developed: "It would be 14ft=1ft of the model." Compare to Sample Student Response #7.

Sample Student Response #12

Cedric is making a scale model of his school. The dimensions of his school and of his model are shown below.



Note: The figures are not drawn to scale.

Step A

What is the length, in feet, of side x of the model?

.75 feet

Step B

- Use what you know about similar polygons to justify why your value of side x is correct. Use words, numbers, and/or symbols in your justification.
- If Cedric changes the length of his model from 3 feet to 6 feet, explain how this change will affect the value of side x . Use words, numbers, and/or symbols in your explanation.

When you make a model your sides still have to be equivalent to the normal size. I figured out that you had to divide 84ft by 28 to get a quotient of 3ft. You would have to do the same for side x 21 divided by 28 = .75 ft.

Score for Sample Student Response #12:

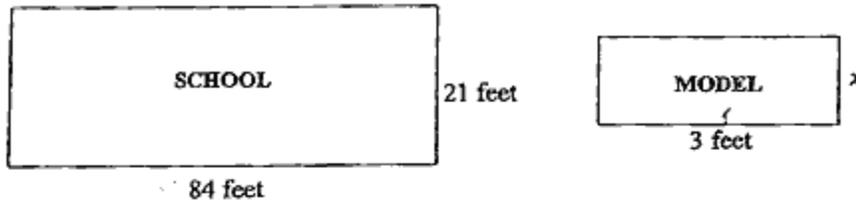
Step A - Content (Knowledge of Geometry): 1

Step B - Processes of Mathematics: 1

Annotation for Step B, Using the Rubric: This response demonstrates a minimal understanding and analysis of the problem. The justification for why the value of side x is correct is feasible: "Divide 84ft by 28 to get a quotient of 3ft... do the same for side x ." The connection to similar polygons having the same shape and proportionally sized is implied: "When you make a model your sides still have to be equivalent to the normal size." The explanation for how the change will affect the value for side x is missing. Compare to Sample Student Response #5.

Sample Student Response #13

Cedric is making a scale model of his school. The dimensions of his school and of his model are shown below.



Note: The figures are not drawn to scale.

Step A

What is the length, in feet, of side x of the model?

1.5 feet

Step B

- Use what you know about similar polygons to justify why your value of side x is correct. Use words, numbers, and/or symbols in your justification.
- If Cedric changes the length of his model from 3 feet to 6 feet, explain how this change will affect the value of side x . Use words, numbers, and/or symbols in your explanation.

I got the answer 1.5 feet. I got this by dividing 3 by 2. I did this because I thought the side looked like half of the other side. If you changed it to 6 it would change the effect, because ^{this is} you would divide by 2 & then get 3.

Score for Sample Student Response #13:

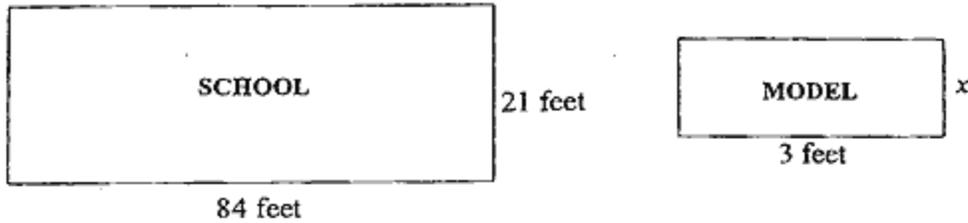
Step A - Content (Knowledge of Geometry): 0

Step B - Processes of Mathematics: 0

Annotation for Step B, Using the Rubric: This response is completely incorrect. Compare to Sample Student Response #1.

Sample Student Response #14

Cedric is making a scale model of his school. The dimensions of his school and of his model are shown below.



Note: The figures are not drawn to scale.

Step A

What is the length, in feet, of side x of the model?

7 feet

Step B

- Use what you know about similar polygons to justify why your value of side x is correct. Use words, numbers, and/or symbols in your justification.
- If Cedric changes the length of his model from 3 feet to 6 feet, explain how this change will affect the value of side x . Use words, numbers, and/or symbols in your explanation.

To find the length of side x I first divided 84 by 3 ft. (the width) My answer was 28. Then I subtracted the length of the school which was 21 from 28. My answer was 7. $x = 7$. If Cedric changes the length of the model from 3 feet to 6 feet the x 's value would increase.

Score for Sample Student Response #14:

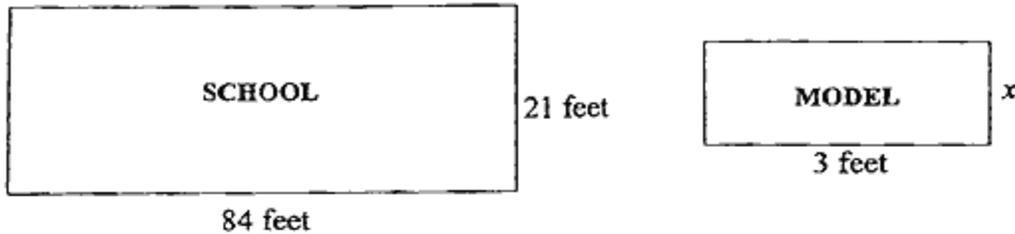
Step A - Content (Knowledge of Geometry): 0

Step B - Processes of Mathematics: 1

Annotation for Step B, Using the Rubric: This response demonstrates a minimal understanding and analysis of the problem. A partial application of a strategy in the context of the problem is indicated. The justification for why the length of side x is correct is logically flawed but supports the answer in Step A: "I first divided 84ft by 3ft... then I subtracted... 21 from 28." The explanation for how the change in the length of the model will change with value of side x is minimal: "The x 's value would increase." Supportive numbers are not provided. Compare to Sample Student Response #2.

Sample Student Response # 15

Cedric is making a scale model of his school. The dimensions of his school and of his model are shown below.



Note: The figures are not drawn to scale.

Step A

What is the length, in feet, of side x of the model?

0.75 feet

Step B

- Use what you know about similar polygons to justify why your value of side x is correct. Use words, numbers, and/or symbols in your justification.
- If Cedric changes the length of his model from 3 feet to 6 feet, explain how this change will affect the value of side x . Use words, numbers, and/or symbols in your explanation.

Similar models are in exact proportion to the actual school. So $\frac{21}{84} = \frac{1}{4}$ and $\frac{x}{3} = \frac{1}{4}$ so x is 0.75. This makes the polygons similar. If he changes 3 to 6 then $\frac{21}{84} = \frac{1}{4}$ and $\frac{x}{6} = \frac{1}{4}$ so x is 1.5 because they are still in exact proportion or similar.

Score for Sample Student Response # 15:

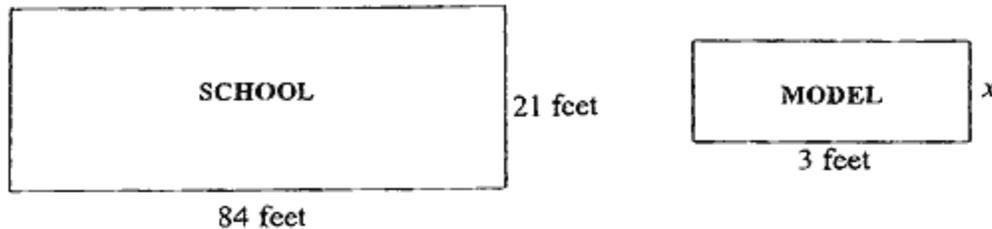
Step A - Content (Knowledge of Geometry): 1

Step B - Processes of Mathematics: 3

Annotation for Step B, Using the Rubric: This response demonstrates a comprehensive understanding and analysis of the problem. The application of a reasonable strategy in the context of the problem is indicated. The justification for how the value for side x was determined is clear, fully developed and logical: " $21/84=1/4$ and $x/3=1/4$ so x is 0.75." The connection to the concept of similar polygons is clear: "similar models are in exact proportion to the actual school... This makes the polygons similar." The explanation of how the change would affect the value of side x is clear, fully developed and logical: " $x/6$ is 14 so x is 1.5." Supportive numbers are provided. Compare to Sample Student Response #10.

Sample Student Response #16

Cedric is making a scale model of his school. The dimensions of his school and of his model are shown below.



Note: The figures are not drawn to scale.

Step A

What is the length, in feet, of side x of the model?

12 feet

Step B

- Use what you know about similar polygons to justify why your value of side x is correct. Use words, numbers, and/or symbols in your justification.
- If Cedric changes the length of his model from 3 feet to 6 feet, explain how this change will affect the value of side x . Use words, numbers, and/or symbols in your explanation.

I think it's 12 feet because I divided
21 by 3 and got 7. Then I did $84 \div 7 = 12$. It
will affect the value because the side with
 x value will have to increase to make the
model as accurate as it can be.

Score for Sample Student Response #16:

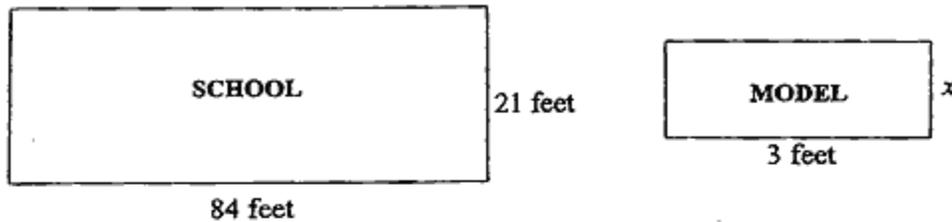
Step A - Content (Knowledge of Geometry): 0

Step B - Processes of Mathematics: 1

Annotation for Step B, Using the Rubric: This response demonstrates a minimal understanding and analysis of the problem. An application of a strategy of using proportions is indicated. However, the justification for the value of side x is logically flawed as the proportion is reversed. The explanation of how the value of side x will change is minimal: "The side with the x value will have to increase." Supportive information and/or numbers are not provided. Connections to the concept of similarity are missing. Compare to Sample Student Response #3.

Sample Student Response #17

Cedric is making a scale model of his school. The dimensions of his school and of his model are shown below.



Note: The figures are not drawn to scale.

Step A

What is the length, in feet, of side x of the model?

x : .75 feet

Step B

- Use what you know about similar polygons to justify why your value of side x is correct. Use words, numbers, and/or symbols in your justification.
- If Cedric changes the length of his model from 3 feet to 6 feet, explain how this change will affect the value of side x . Use words, numbers, and/or symbols in your explanation.

Side x : .75. I know this because $84 \div 3 = 28$, and $21 \div 28$ rounds to .75. If Cedric changes the length from 3 to 6 feet, side x = 1.5 feet, because $84 \div 6 = 14$ and $21 \div 14 = 1.5$.

Score for Sample Student Response #17:

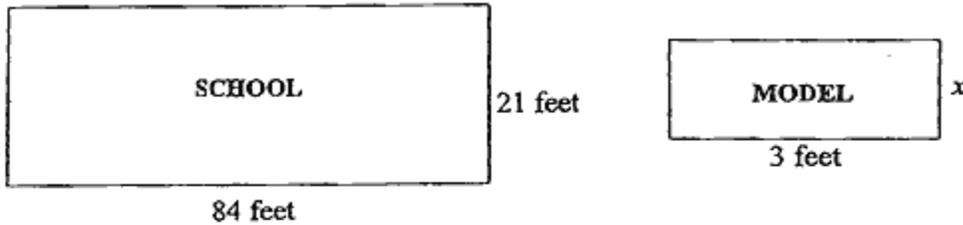
Step A - Content (Knowledge of Geometry): 1

Step B - Processes of Mathematics: 2

Annotation for Step B, Using the Rubric: This response demonstrates a general understanding and analysis of the problem. A reasonable strategy of using proportional reasoning to determine the value for side x is indicated. The justification, presented as a numerical explanation, for why this value is correct, is only partially developed: " $84 \div 3 = 28$... $21 \div 28$ rounds to .75." The explanation for how the change will affect the value of side x is clear: " $84 \div 6 = 14$... $21 \div 14 = 1.5$." Appropriate supportive numbers are provided. However, connections to the concepts of similarity and scale are missing. Compare to Sample Student Response #8.

Sample Student Response #18

Cedric is making a scale model of his school. The dimensions of his school and of his model are shown below.



Note: The figures are not drawn to scale.

Step A

What is the length, in feet, of side x of the model?

2 feet

Step B

- Use what you know about similar polygons to justify why your value of side x is correct. Use words, numbers, and/or symbols in your justification.
- If Cedric changes the length of his model from 3 feet to 6 feet, explain how this change will affect the value of side x . Use words, numbers, and/or symbols in your explanation.

If Cedric changes the length of his model 3 feet to six feet, then the x -side would be 4 instead of 2 feet because you would have to multiply by 2.

Score for Sample Student Response #18:

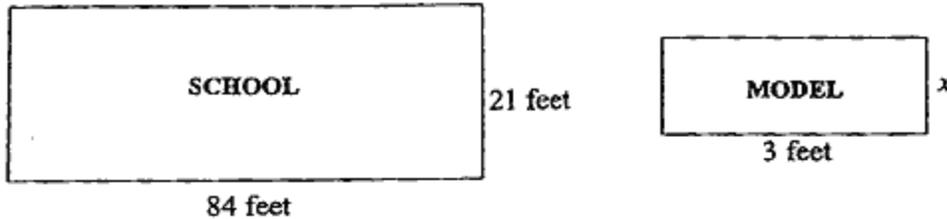
Step A - Content (Knowledge of Geometry): 0

Step B - Processes of Mathematics: 1

Annotation for Step B, Using the Rubric: This response demonstrates a minimal understanding and analysis of the problem. An application of a strategy of using proportions is indicated. The justification for the value of side x is missing. The explanation for how the change will affect the value of side x is logically flawed but is consistent with the answer given in Step A: "the x -side would be 4 instead of 2... you would have to multiply by 2." Connections to the concept of similarity are missing. Compare to Sample Student Response #4.

Sample Student Response #19

Cedric is making a scale model of his school. The dimensions of his school and of his model are shown below.



Note: The figures are not drawn to scale.

Step A

What is the length, in feet, of side x of the model?

.75 feet

Step B

- Use what you know about similar polygons to justify why your value of side x is correct. Use words, numbers, and/or symbols in your justification.
- If Cedric changes the length of his model from 3 feet to 6 feet, explain how this change will affect the value of side x . Use words, numbers, and/or symbols in your explanation.

Similar polygons share all the same characteristics except size. The size is found by using a scale factor. To find this size I divided the length (21) into the width (84) and got 4 so 21 is $\frac{1}{4}$ of 84. So I divided 3 by 4 and got $x = .75$ and $.75 \times 4 = 3$ so it checks. If the length becomes 6 divide 6 by 4 and get 1.5 for x .

Score for Sample Student Response #19:

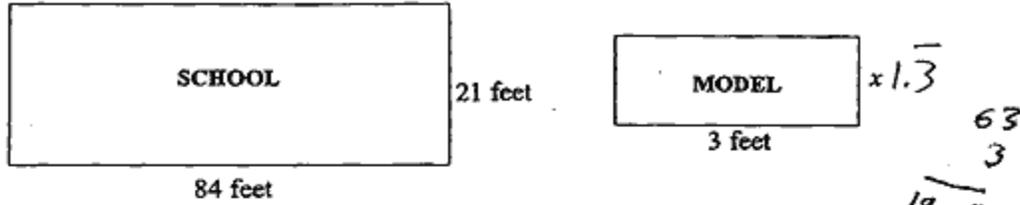
Step A - Content (Knowledge of Geometry): 1

Step B - Processes of Mathematics: 3

Annotation for Step B, Using the Rubric: This response demonstrates a comprehensive understanding and analysis of the problem. The application of a reasonable strategy in the context of the problem is indicated. The justification for why the value of side x is correct is clear, fully developed and logical: "[I used] a scale factor... 21 is $\frac{1}{4}$ of 84. So I divided 3 by 4 and got $x=.75$." The connection to similar polygons is clear and stated explicitly: "Similar polygons share all the same characteristics except for size," The explanation of how the change will affect the values of side x is clear, fully developed and logical: "Divide 6 by 4 and get 1.5 for x ." Appropriate supportive numbers are provided. Compare to Sample Student Response #9.

Sample Student Response #20

Cedric is making a scale model of his school. The dimensions of his school and of his model are shown below.



Note: The figures are not drawn to scale.

Step A

What is the length, in feet, of side x of the model?

1.3 feet

$$84 \div 63 = 1.3$$

Step B

- 1 • Use what you know about similar polygons to justify why your value of side x is correct. Use words, numbers, and/or symbols in your justification.
- 2 • If Cedric changes the length of his model from 3 feet to 6 feet, explain how this change will affect the value of side x . Use words, numbers, and/or symbols in your explanation.

1) I set up the proportion $\frac{21}{84} = \frac{x}{3}$. I multiplied 21 and 3 to get 63. Then I divided 84 by 63 to get 1.3.

2) If the length was changed from 3 to 6 the value of x will be greater because you are increasing the size & scale of the model.

Score for Sample Student Response #20:

Step A - Content (Knowledge of Geometry): 0

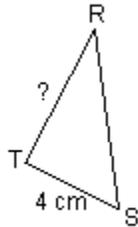
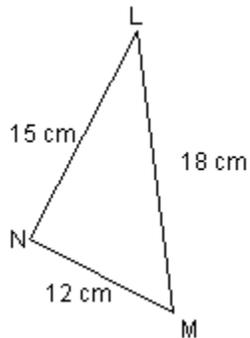
Step B - Processes of Mathematics: 1

Annotation for Step B, Using the Rubric: This response demonstrates a minimal understanding and analysis of the problem. An application of a strategy of using proportions is indicated; however, the justification for the value of side x is logically flawed as the proportion is solved incorrectly. The explanation for how the change will affect the value for side x is minimal: "The value of x will be greater." The connection to similar polygons having the same shape and proportional sized is implied: "You are increasing the size and the scale of the model." Compare to Sample Student Response #5.

Sample Item #2 - Selected Response (SR) Item

Mathematics Grade 8 Objective 2.D.1.a

Triangles LMN and RST, shown below, are similar.



Note: the figures are not drawn to scale

What is the length of \overline{RT} ?

- A. 4 cm
- B. 5 cm
- C. 6 cm
- D. 15 cm

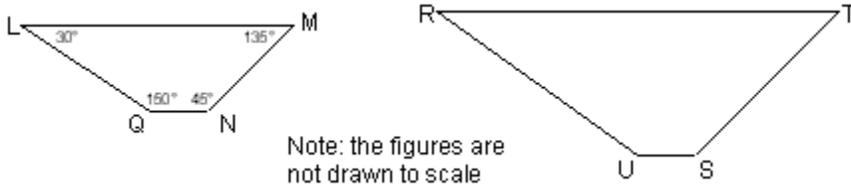
Correct Answer:

B

Sample Item #3 - Selected Response (SR) Item

Mathematics Grade 8 Objective 2.D.1.a

Trapezoid LMNQ and trapezoid RSTU, shown below, are similar.



What is the measure, in degrees, of $\angle R$

- A. 30°
- B. 45°
- C. 135°
- D. 150°

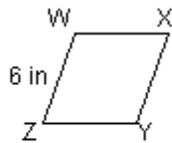
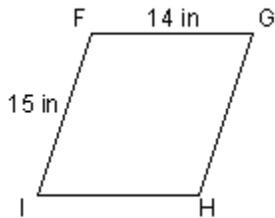
Correct Answer:

A

Sample Item #4 - Student Produced Response (SPR) Item

Mathematics Grade 8 Objective 2.D.1.a

Parallelograms FGHI and WXYZ are similar.



Note: the figures are not drawn to scale

What is the measure, in inches, of \overline{YZ} ?

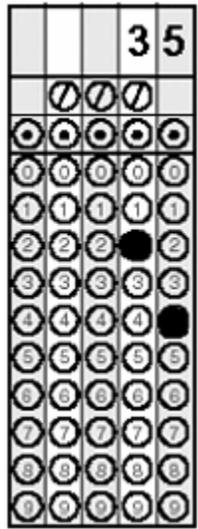
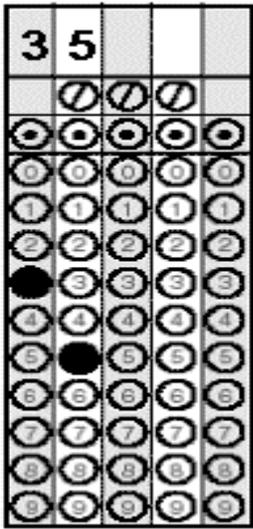
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0	0	0	0	0
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3	3	3	3	3
4	4	4	4	4
5	5	5	5	5
6	6	6	6	6
7	7	7	7	7
8	8	8	8	8
9	9	9	9	9

Correct Answer:
35

Answer Annotation

Answer:

or



Rubric - Extended Constructed Response (ECR)

Score 3

The response demonstrates a comprehensive understanding and analysis of a problem.

- Application of a reasonable strategy in the context of the problem is indicated.
- Explanation¹ of and/or justification² for the mathematical process(es) used to solve a problem is clear, fully developed, and logical.
- Connections and/or extensions made within mathematics or outside of mathematics are clear and stated explicitly.
- Supportive information and/or numbers are provided as appropriate.³

Score 2

The response demonstrates a general understanding and analysis of a problem.

- Application of a reasonable strategy in the context of the problem is indicated.
- Explanation¹ of and/or justification² for the mathematical process(es) used to solve a problem is feasible, but may be only partially developed.
- Connections and/or extensions made within mathematics or outside of mathematics are partial or overly general, or may be implied.
- Supportive information and/or numbers are provided as appropriate.³

Score 1

The response demonstrates a minimal understanding and analysis of a problem.

- Partial application of a strategy in the context of the problem is indicated.
- Explanation¹ of and/or justification² for the mathematical process(es) used to solve a problem is logically flawed or missing.
- Connections and/or extensions made within mathematics or outside of mathematics are flawed or missing.
- Supportive information and/or numbers may or may not be provided as appropriate.³

Score 0

The response is completely incorrect, irrelevant to the problem, or missing.⁴

Notes:

- 1 Explanation refers to students' ability to communicate how they arrived at the solution for an item using the language of mathematics.
- 2 Justification refers to students' ability to support the reasoning used to solve a problem, or to demonstrate why the solution is correct using mathematical concepts and principles.
- 3 Students need to complete rubric criteria for explanation, justification, connections and/or extensions as cued for in a given problem.
- 4 Merely an exact copy or paraphrase of the problem will receive a score of "0".

Rubric Document Date: August 2003