ONAP

Ontario Numeracy Assessment Package

SAMPLER
Measurement

8

MEASUREMENT

The Measurement strand of the Ontario Curriculum for Grade 7 identifies seven Mathematical Process Expectations: problem solving, reasoning and proving, reflecting, selecting tools and computational strategies, connecting, representing, and communicating. Using these process expectations, students study, learn, and apply concepts and skills organized under the big ideas/headings of Attributes, Units, and Measurement Sense; and Measurement Relationships.

The following chart highlights key knowledge and skill development as students move from Grade 7 to 8.

GRADE 7	GRADE 8
• research and report on real-life applications of area measurement	• research, describe, and report on real-life applications of volume and capacity measurement
• solve problems that require conversion between metric units of measure (e.g., millimetres and centimetres, grams and kilograms, millilitres and litres, square centimetres and square metres)	• solve problems that require conversions involving metric units of area, volume, and capacity (e.g., millimetres and centimetres, grams and kilograms, square centimetres and square metres)
• estimate and calculate the area of composite two-dimensional shapes by decomposing into shapes with known area relationships	• measure the circumference, radius, and diameter of circular objects, using concrete materials
• determine the relationship for calculating the area of a trapezoid and generalize to develop a formula	• determine the relationships for calculating the circumference and the area of a circle, and generalize to develop the formula
• solve problems involving the estimation and calculation of the area of a trapezoid	• solve problems involving the estimation and calculation of the circumference and the area of a circle
• determine the surface area of right prisms	• determine the surface area of a cylinder
• determine the relationship between the height, the area of the base, and the volume of right prisms with simple polygonal bases, and generalize to develop the formula	• determine the relationship between the area of the base and height and the volume of a cylinder, and generalize to develop the formula
• sketch different polygonal prisms that share the same volume	
• solve problems that involve the surface area and volume of right prisms and that require conversion between metric measures of capacity and volume	• solve problems that involve the surface area and the volume of cylinders

For each strand of the curriculum, ONAP provides three types of assessment materials. Consider the following points when administering the assessments for the strand.

Part A: Activating Prior Knowledge (page 99)

- The activities in Part A have been created to activate students' knowledge before they complete the Part B assessment or the Part C performance tasks.
- No score is assigned during this part of the assessment.
- It is recommended that you spend one or two periods working on and discussing the activities provided in this part.

Part B: Concepts and Skills Assessment (page 107)

- The assessment in Part B addresses each of the specific expectations within the two overall expectations in the Measurement strand.
- Students will be responding to a mix of questions: short response, fill-in-the-blank, and multiple choice.
- Most students will be able to complete the entire assessment in a 60-minute period. Individual students may be allowed additional time to complete the assessment if needed as long as they complete the assessment in one sitting.

Part C: Performance-Based Assessment Tasks (page 125)

- The two performance tasks in Part C are designed to provide insights into how well students are able to perform in terms of the categories of the Ontario Achievement Chart: Knowledge and Understanding, Thinking, Communication and Application.
- All of the overall expectations for this strand have been assessed through the Concept and Skills Assessment in Part B.
- It is recommended that you select one performance task for the Measurement strand.
- Each task is designed to be completed in a 45- to 60-minute period. If necessary, provide additional time as long as students complete the task in one sitting.

Part A: Activating Prior Knowledge

Administration

To activate students' knowledge of the Measurement strand, choose one or both of the following activities to work on prior to administering the assessments. Introductory and culminating suggestions are provided for each. No score is assigned for these activities.

Timing

It is recommended that you spend one or two periods working on and discussing the activities provided in this part.

Accommodating Students with Special Needs

Observe students as they complete the activities. While the activities in this section are not designed as a formal diagnostic assessment, you may want to consider whether students who are having extreme difficulties with the activities are ready to participate in the full ONAP assessment for this grade level. Observations at this stage might also indicate students who will need special accommodations during the assessment, such as having someone read questions to them or scribe responses.

Activity 1: The Climbing Conversion

Materials

- BLM A1: *Activity 1: The Climbing Conversion—Game Cards* (one per student pair)
- BLM A2: *Activity 1: The Climbing Conversion—Game Board* (one per student)
- scissors

Introducing the Activity

In preparation for playing this game, review conversions using metres and kilometres, and metres and millimetres. Ask students:

- How many metres are in 1 km? (*1000*)
- How many kilometres are in 1 m? (*0.001*)
- How many millimetres are in 1 m? (*1000*)
- How many metres are in 1 mm? (*0.001*)

As well, review conversions between the area units of square metres and square centimetres. Ask students:

- How many centimetres are in 1 m? (*100*)
- How many square centimetres are in 1 m^2? (100×100*, or 10 000*)
- How many metres are in 1 cm? (*0.01*)
- How many square metres are in 1 cm^2? (0.01×0.01*, or 0.0001*)

Record the following area conversions on the board for students' reference:
1 m^2 = 10 000 cm^2 1 cm^2 = 0.0001 m^2

Distribute BLM A1: *Activity 1: The Climbing Conversion—Game Cards* and BLM A2: *Activity 1: The Climbing Conversion—Game Board* to students to use for this activity.

Procedure

Number of players: two
Goal: to fill the spaces on the game board with game cards so that the calculated numerical answers on the cards are placed in order from greatest to least
How to play:

- Step 1—Players cut out the cards and lay them out face up.
- Step 2—Players take turns choosing a card, completing the conversion, and placing the card on their game board. They will try to place the cards so that the numerical values that they calculate are placed in order from greatest to least. Players may use a turn to change the position of a card on their game board, but they must wait for their next turn to choose a new card.
- Step 3—Play continues until one player has covered all the spaces on his or her game board.

Students may play subsequent games using the remaining cards.

Variation:
Students choose five cards that will give them the greatest or least total. Before starting to play, the two students must decide whether they are aiming for the greatest or least total. They must use the conversion number that they calculate, but do not need to include the unit of measure.

Culminating Discussion

1. What strategies helped as you played the game?
   When I filled in the top of the board, I started with cards that had the larger unit on the left side because I knew that the number for the equivalent smaller unit would be large. When I filled in the bottom of the board, I looked for cards with the smaller unit on the left side. I also noticed that cards that converted square metres to square centimetres had big numbers in the blank.

2. Which conversions were the most difficult?
   I had to think more about converting area units than I did about converting units for length. Sometimes it was a little hard to convert the units if there was a decimal in one of the numbers.

3. Did the game become more challenging as you played a second time with fewer cards?
   Yes, because I picked the easiest numbers to convert in the first game.

Answers

Activity cards:

120 mm = 12.0 cm	*0.5000 m^2 = 5000 cm^2*
3500 L = 3.500 kL	*4000 mL = 4.000 L*
5250 g = 5.250 kg	*7 km = 7000 m*
30 000 cm^2 = 3.000 m^2	*8000 m = 8.000 km*
74 500 m = 74.500 km	*4.0000 m^2 = 40 000 cm^2*
324.0 cm = 3240 mm	*20 000 cm^2 = 2.0000 m^2*
14.0 m^2 = 140 000 cm^2	*5.60 L = 5600 mL*
19.0 g = 1900 cg	*89.0 m = 8900 cm*

70 000 g = <u>70.000</u> kg *35 000 g = <u>35.000</u> kg*
2500 cm^2 *= <u>0.250</u>* m^2 *80 000* cm^2 *= <u>8.0000</u>* m^2

Activity 2: Capacity—Least to Greatest

Materials

- BLM A3: *Activity 2: Capacity—Least to Greatest* (one per student)
- a metric measuring cup (for the teacher)
- 10 cm × 10 cm × 10 cm cube (for the teacher)

Introducing the Activity

Review the relationship between the base area and volume of prisms. As well, review the formula for calculating the area of the trapezoid, $A = (a + b) \div 2 \times h$, where a and b are the parallel sides and h is the height.

Demonstrate the relationship between volume and capacity. Fill a 10 cm × 10 cm × 10 cm (or 1000 cm^3) cube with 1000 mL of accurately measured water to demonstrate that the volume of the cube is 1000 cm^3 and its capacity is 1000 mL or 1 L.

Distribute BLM A3: *Activity 2: Capacity—Least to Greatest* and have students examine the information given for the three vases. Have them predict the order from least to greatest capacity. Then have them calculate the capacity of each container and order them. Students may work individually or in pairs.

Culminating Discussion

1. How did your prediction compare to your calculated answer?
   I predicted that the order from least to greatest capacity would be A, C, B, but the calculated order was A, B, C. I shouldn't have thought that just because vase B was tallest it would have the greatest capacity.
2. Explain how you calculated the capacity of vase C.
   I imagined three separate prisms. Two were trapezoid-based prisms and one was a square-based prism, which was in the middle.
   To get the volume of each, I multiplied the area of the base by the height of the prism. Then I added the volumes together. Finally, I converted the total volume to capacity.

Answers

Least to greatest capacity: A, B, C

Vase A
Area of base: $10 \times 6 = 60\ cm^2$
Height: 15 cm
Volume: $60\ cm^2 \times 15\ cm = 900\ cm^3$
Capacity: 900 mL or 0.9 L

Vase B
Area of base: $[(8 + 6) \div 2] \times 5 = 35\ cm^2$
Height = 30 cm
Volume: $35\ cm^2 \times 30\ cm = 1050\ cm^3$
Capacity: 1050 mL or 1.050 L

Vase C

Base consists of 2 trapezoids and 1 square.
Area of base: $(3 + 7) \div 2 \times 4 + (3 \times 3) + (3 + 7) \div 2 \times 4 = 49\ cm^2$
Height: 25 cm
Volume: $49\ cm^2 \times 25\ cm = 1225\ cm^3$
Capacity: 1225 mL or 1.225 L

OR

Each trapezoid prism:
Area of trapezoid: $[(7 + 3) \div 2] \times 4 = 20\ cm^2$
Height: 25 cm
Volume: $20\ cm^2 \times 25\ cm = 500\ cm^3$

Rectangular prism in the middle:
Area of square base: $3 \times 3 = 9\ cm^2$
Height: 25 cm
Volume: $9\ cm^2 \times 25\ cm = 225\ cm^3$

Total volume: $500\ cm^3 + 500\ cm^3 + 225\ cm^3 = 1225\ cm^3$
Capacity: 1225 mL or 1.225 L

Activity 1: The Climbing Conversion—Game Cards

120 mm = ________ cm	0.5000 m^2 = ________ cm^2
3500 L = ________ kL	4000 mL = ________ L
5250 g = ________ kg	7 km = ________ m
30 000 cm^2 = ________ m^2	8000 m = ________ km
74 500 m = ________ km	4.0000 m^2 = ________ cm^2
324.0 cm = ________ mm	20 000 cm^2 = ________ m^2
14.0 m^2 = ________ cm^2	5.60 L = ________ mL
19.0 g = ________ cg	89.0 m = ________ cm
70 000 g = ________ kg	35 000 g = ________ kg
2500 cm^2 = ________ m^2	80 000 cm^2 = ________ m^2

Name: ______________________________ **Date:** ______________________

Activity 1: The Climbing Conversion—Game Board

How to play:

Step 1 Cut out the game cards and lay them out face up.

Step 2 Take turns choosing a card, completing the conversion, and placing the card on the game board. Try to place the cards so that the numerical values that you calculate are in order from greatest to least. You may use a turn to change the position of a card on the game board, but then you must wait for your next turn to choose a card.

Step 3 Play continues until one player has covered all spaces on his or her game board.

↓	
↓	
↓	
↓	
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Name: ______________________________ **Date:** ______________________

Activity 2: Capacity—Least to Greatest (page 1)

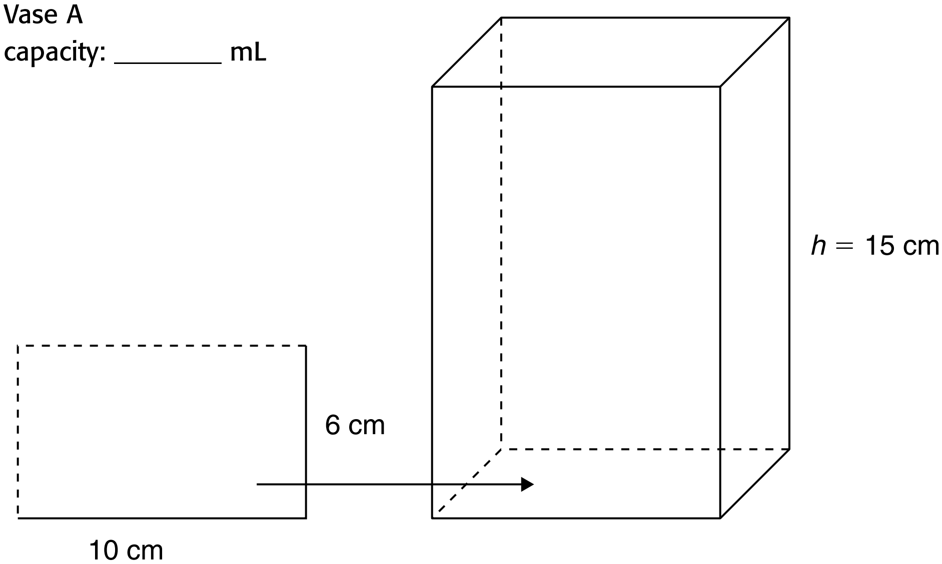
Predict the order of the three vases from least to greatest capacity.

_____ _____ _____

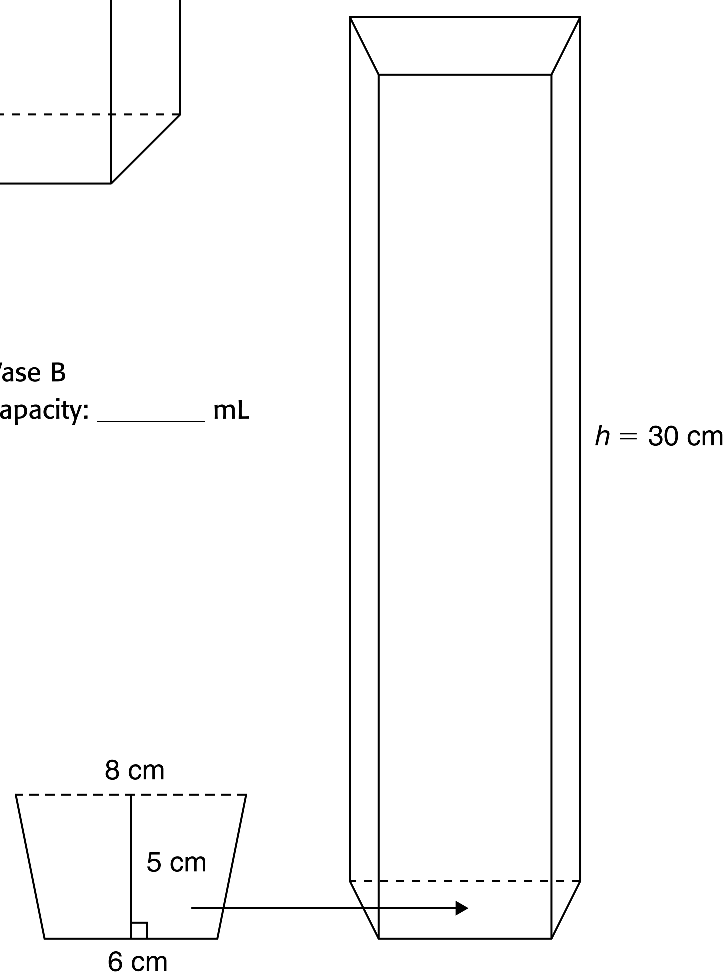
Calculate the capacity of each vase, and then list them in order

from least to greatest capacity: _____ _____ _____

Vase A
capacity: ________ mL



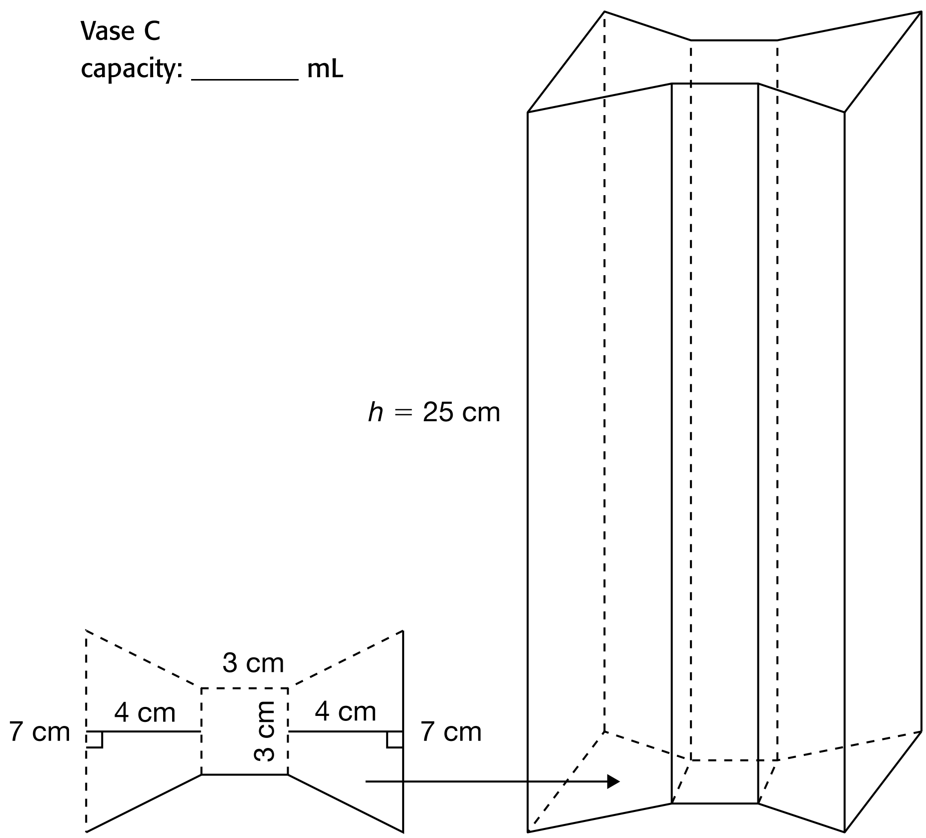
Vase B
capacity: ________ mL



Name: ______________________ **Date:** ______________________

Activity 2: Capacity—Least to Greatest (page 2)

Vase C
capacity: ________ mL



Part B: Concepts and Skills Assessment

Administration

This assessment addresses each of the specific expectations within the two overall expectations in the Measurement strand. Part B includes several styles of questions: short response, fill-in-the-blank, and multiple choice.

Timing

Most students will be able to complete the entire assessment in a 60-minute period. If necessary, provide students with additional time to complete the assessment as long as they complete it in one sitting.

Materials

FOR THE TEACHER	FOR EACH STUDENT	OPTIONAL MATERIALS
• Individual Student Scoring Guide: pp. 119–121 • Class Tracking Sheet: pp. 122–123 • ONAP 8 CD-ROM (optional)	• Assessment Part B: pp. 109–117 • pencil • eraser • ruler	• centimetre cubes • centimetre grid paper

Introducing the Assessment

Inform students that they will be completing an assessment to help you get to know what they have learned about math in earlier grades. Tell students that it is important that they answer the questions as fully as possible. To communicate effectively, they can use pictures, numbers, words, and/or diagrams to represent their thinking.

Encourage students to use other material, such as centimetre cubes or centimetre grid paper, that they think might help them to answer the questions.

Note: *Calculators are not recommended during this assessment.*

Accommodating Students with Special Needs

If individuals or groups of students have difficulties with reading, consider reading the questions aloud as they complete the assessment.

If individual students have difficulties explaining their thinking in writing, consider providing scribes to record for the students, or encourage students to show and explain their thinking using concrete materials.

Some students will require additional time to complete the assessment. You may wish to note this accommodation in your anecdotal notes about the students. However, there should be no reduction of the student's overall score in terms of the amount of time it takes the student to complete the assessment.

Scoring the Assessment

A detailed Individual Student Scoring Guide is provided on pages 119 to 121. The guide is designed to be completed for each student. The individual scores can then be used to fill in the Class Tracking Sheet on pages 122 to 123. Alternatively, you may record student results directly on the Class Tracking Sheet. The results may also be recorded electronically using the ONAP 8 CD-ROM.

While great care has been taken to consider the range of possible answers for each question, there will be times when you will need to apply your professional judgment to score an individual answer. You may use the Curriculum Correlation chart provided on page 124 to help you to determine whether the student has demonstrated the intended concept knowledge or skill based on the overall and specific expectations being assessed by the particular question.

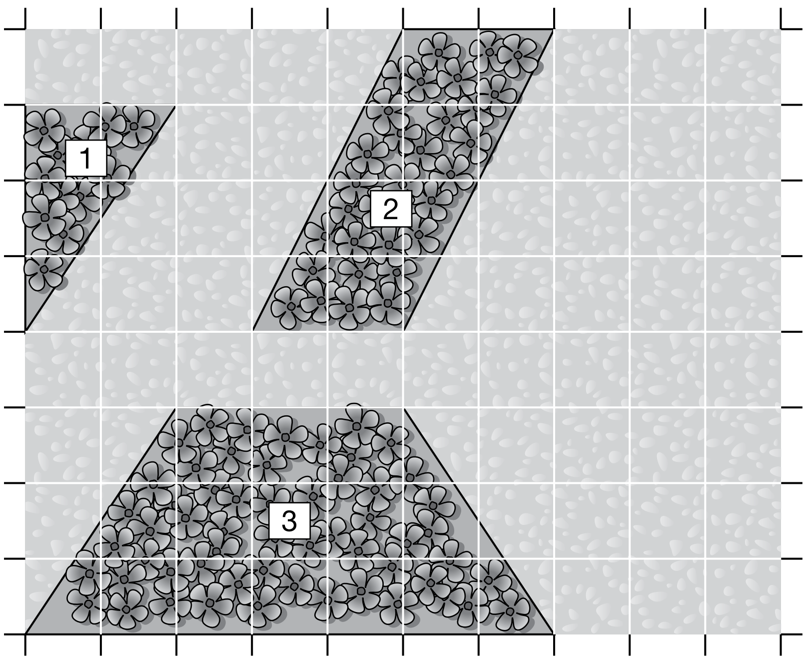
At times, a student may provide an answer that you think does not completely represent his or her knowledge and skill level. You may ask probing questions to better assess the student's overall understanding.

Some questions are delivered in more than one part (a and b) and are given more than one point. Should a student's answer in one part reveal that a correct answer in the other part was arrived at for the wrong reason, a score of zero should be given for both parts.

Name: ______________________________ **Date:** ____________________

Measurement

1. Three flower beds were created in a rectangular area 10 m by 8 m, as shown below. Small stones were spread between the flower beds.



Scale: 1 cm represents 1 m

a) What is the total area of the flower beds? ____________________

Show your work.

Name: ______________________________ **Date:** ______________________

b) What is the total area covered by the small stones? ____________

Show your work.

2. The Caramel Candy Company is designing a new container for its caramel candy. The container must have a volume of 300 cm^3.

a) Sketch and label the dimensions of two possible containers that are rectangular prisms.

b) Sketch and label the dimensions of a triangular base for a triangular prism container that also has a volume of 300 cm^3. What is the height of the container?

Name: ______________________ **Date:** ______________________

3. **a)** How many 160 cm lengths of ribbon can be cut from a ribbon that is 8 m long?

A 500

B 20

C 50

D 5

b) A craft store sells model paint in 250 mL bottles. A litre of the model paint costs $44.84. What is the cost for one 250 ml bottle?

A $17.93

B $4.48

C $11.21

D $112.10

4. Andy is putting a new countertop in his kitchen.

a) A countertop is 1 m $\times$ 1 m. What is the area of the countertop in square centimetres (cm^2)?

____

b) What is the ratio of the number of square metres (m^2) to the number of square centimetres (cm^2) for a given area?

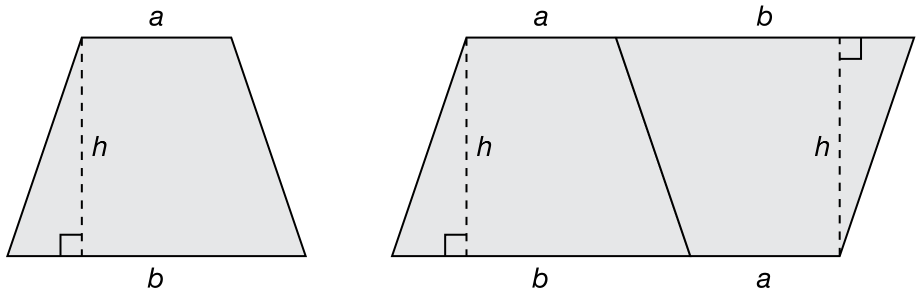
____

c) Use the ratio from part **b)** to determine the number of square centimetres (cm^2) in a countertop that is 5.75 m^2.

____

Name: ______________________ **Date:** ______________________

5. Viraf wants a formula for the area of a trapezoid. He knows the area of a parallelogram. So he made two copies of the trapezoid into a parallelogram.



a) What is the formula for the area of the parallelogram? Use the variables in the diagram.

____

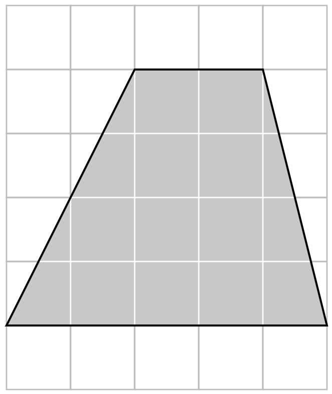
b) What is the formula for the area of each trapezoid? Use the variables in the diagram.

____

c) How are the formulas in **5 a)** and **5 b)** related?

Name: ______________________________ **Date:** ____________________

6. Angelo's class is participating in a math olympics. Each team is designing a team logo. This is Angelo's team logo.



a) What is the area of the whole grid? ______ square units
How can you estimate the area of the trapezoid?

Explain your thinking.

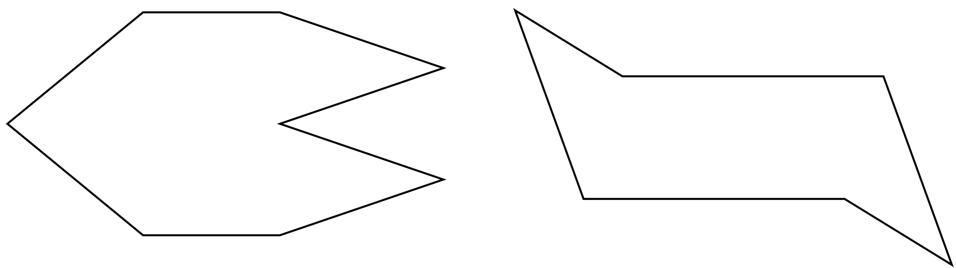
The area of the trapezoid is about ______ square units.

b) Calculate the area of the trapezoid. Was your estimate reasonable?

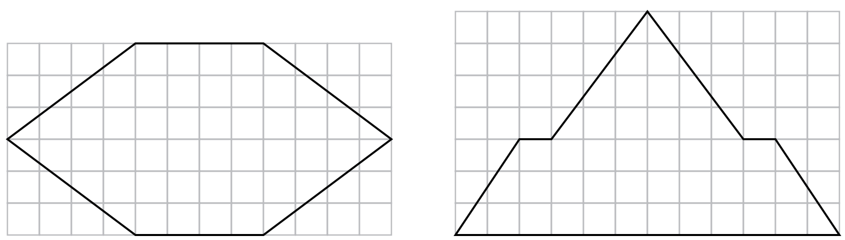
Show your work.

Name: ______________________________ **Date:** ______________________

7. a) Look at the polygons. Draw lines to show how each could be broken up into parallelograms, triangles, or trapezoids so that you can use formulas to calculate the area of the whole polygon.



b) Calculate the area of each polygon below.

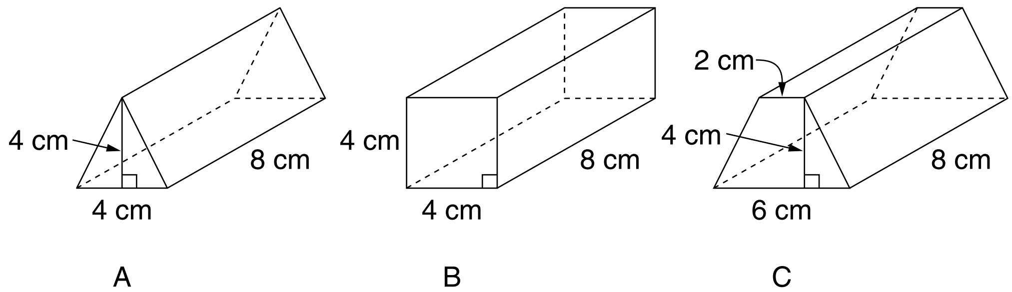


__________ square units __________ square units

Show your work.

Name: ______________________ **Date:** ______________________

8. Examine the prisms.



a) Complete the chart for each shape.

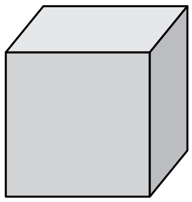
	Dimensions (cm)		
Prism	**Area of base (cm²)**	**Height (cm)**	**Volume (cm³)**
A			
B			
C			

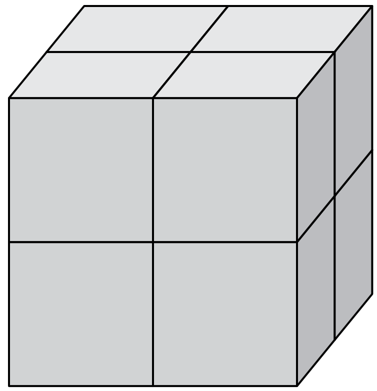
b) What relationship did you use to determine the volume?

____

Name: ______________________ Date: ______________________

9. a) Calculate the volume and the surface area of cubes in the table below.





Length (cm)	Width (cm)	Height (cm)	Volume (cm^3)	Surface area (cm^2)
1	1	1		
2	2	2		
3	3	3		
4	4	4		

b) If the pattern in the table continues, will the volume and surface area of a cube ever be the same numerical value?

Explain your thinking.

Name: ______________________________ **Date:** ______________________

10. The Dolphin Swim Club is building a new lap pool for training. The pool is 2 m deep, 25 m long, and 10 m wide.

a) What is the volume of the pool? ____________________

b) The pool is filled so that the water is 1.5 m deep. How many litres of water are in the pool?

Show your work.

______________ L of water are in the pool.

c) What is the total surface area of the sides and bottom of the pool? ____________________

Show your work.

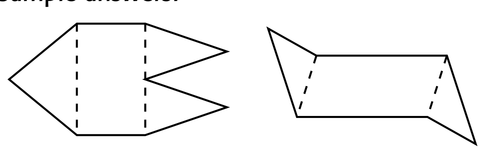
The total surface area is ________________ m^2.

ONAP INDIVIDUAL STUDENT SCORING GUIDE
GRADE 8: MEASUREMENT—PART B

Name: ______________________________ **Date:** ______________________

Overall Expectation 7m31 (Attributes, Units, and Measurement Sense): **Report on research into real-life applications of area measurements.**		
7m33 1. a)	**1 point** for calculating with one error OR **2 points** for the correct process and calculations; e.g., *Area of shape 1:* $2 \times 3 \div 2 = 3\ m^2$ *Area of shape 2:* $2 \times 4 = 8\ m^2$ *Area of shape 3:* $(7 + 3) \times 3 \div 2 = 15\ m^2$ *Total area of the gardens:* $3\ m^2 + 8\ m^2 + 15\ m^2 = 26\ m^2$	
7m33 1. b)	**1 point** for calculating with one error OR **2 points** for calculating correctly; e.g., *Rectangle:* $10\ m^2 \times 8\ m^2 = 80\ m^2$ *Flower beds:* $26\ m^2$ *Stone:* $80\ m^2 - 26\ m^2 = 54\ m^2$ NOTE: Give points for correct process and calculations even if answer to a) is incorrect.	
	Total for Overall Expectation 7m31	____ 4
Overall Expectation 7m32 (Measurement Relationships): **Determine the relationships among units and measurable attributes, including the area of a trapezoid and the volume of a right prism.**		
7m34 2. a)	**1 point** for two correctly labelled sketches of containers NOTE: Possible dimensions include but are not limited to 3 cm × 10 cm × 10 cm; or 6 cm × 5 cm × 10 cm; or 15 cm × 2 cm × 10 cm	
7m34 2. b)	**1 point** for a correctly labelled sketch of a triangle and a recorded prism height; e.g., a sketch of a triangle with height labelled 6 cm and base labelled 10 cm, and *prism height is 10 cm* or a sketch of a triangle with height labelled 10 cm and base labelled 10 cm, and *prism height is 6 cm.* NOTE: It is the base and height of the triangular base that are required; these are not sides unless the triangle sketched is a right triangle.	
7m35 3. a)	D 5 **1 point**	
7m35 3. b)	C $11.21 **1 point**	

Measurement

7m36 4. a)	$100 \times 100 = 10\ 000\ \text{cm}^2$ **1 point**	
7m36 4. b)	1:10 000; or 1 m to 10 000 cm **1 point**	
7m36 4. c)	$5.75 \times 10\ 000 = 57\ 500\ \text{cm}^2$ **1 point**	
7m37 5. a)	$A = (a + b) \times h$; or $A = (a \times h) + (b \times h)$ **1 point**	
7m37 5. b)	$A = (a + b) \div 2 \times h$; or $A = (a + b) \times h \div 2$; or $A = \frac{(a \times h)}{2} + \frac{(b \times h)}{2}$ **1 point**	
7m37 5. c)	**1 point** for a brief explanation; e.g., *The area of each congruent trapezoid is* $\frac{1}{2}$ *the area of the parallelogram.* AND **1 point** for a complete explanation of why they are related; e.g., *I can make a parallelogram from two trapezoids, but one needs to be upside down. I know the formula for the area of a rectangle and I know that the area of one of the trapezoids will be half. It is still base × height, but I need to divide by 2. The base is the sum of the two lengths, or the top and bottom of the trapezoid.*	
7m38 6. a)	**1 point** for a reasonable explanation; e.g., *The area of the grid is 30 square units. The area of the trapezoid is about* $\frac{1}{2}$ *of the grid so it's about 15 square units.*	
7m38 6. b)	14 square units **1 point** for the correct area and relating it to estimate; e.g., Sample calculation: *Trapezoid*: $(2 + 5) \div 2 \times 4 = 14$ *square units* *My calculation is close to my estimate.*	
7m39 7. a)	Sample answers:  **1 point** for one correct answer OR **2 points** for two correct answers	

7m39 7. b)	48 square units; 42 square units **1 point** for one correct answer OR **2 points** for two correct answers with explanations; e.g., *The polygon on the left is made up of 2 triangles and a square. The square has an area of* $6 \times 4 = 24$ *square units and each triangle has an area of* $\frac{1}{2} \times 6 \times 4 = 12$ *square units.* $24 + 12 + 12 = 48$ *square units* *The polygon on the right is made up of a triangle with area* $\frac{1}{2} \times 6 \times 4 = 12$ *square units and a trapezoid with area* $(12 + 8) \times 3 \div 2 = 30$ *square units.* $12 + 30 = 42$ *square units*	
7m40 8. a)	A: 8, 8, 64; B: 16, 8, 128 or 32, 4, 128; C: 16, 8, 128 **1 point** for 6 to 8 correct answers OR **2 points** for all 9 answers correct	
7m40 8. b)	area of base times height **1 point**	
7m41 9. a)	Volume: 1, 8, 27, 64 Surface area: 6, 24, 54, 96 **1 point** for 6 or 7 answers correct OR **2 points** for all 8 answers correct	
7m41 9. b)	**1 point** for identifying that the numbers will be the same, accompanied by a reasonable explanation; e.g., *Yes, a 6 cm* $\times$ *6 cm* $\times$ *6 cm cube will have a volume of 216* cm^3 *and a surface area of 216* cm^2*. This makes sense because there are six surfaces, so the surface area will be 6* $\times$ *6 cm* $\times$ *6 cm.*	
7m42 10. a)	$2\text{ m} \times 25\text{ m} \times 10\text{ m} = 500\text{ m}^3$ **1 point**	
7m42 10. b)	$150\text{ cm} \times 2500\text{ cm} \times 1000\text{ cm} = 375\,000\,000\text{ cm}^3$ $= 375\,000\,000\text{ mL}$ $= 375\,000\text{ L}$ **1 point** for correctly calculating the volume AND **1 point** for correctly converting to litres	
7m42 10. c)	$2(2 \times 10) + 2(2 \times 25) + (10 \times 25)$ $= 40 + 100 + 250$ $= 390\text{ m}^2$ **1 point**	
	Total for Overall Expectation 7m32	___ 27

ONAP GRADE 8: MEASUREMENT

Date: ______________________________ **Grade:** _________ **School:** ____

Overall Expectation			**7m31 (Attributes, Units, and Measurement Sense)** Report on research into real-life applications of area measurements.						
Specific Expectation #			7m33		Total	7m34		7m35	
Question #			1. a)	1. b)		2. a)	2. b)	3. a)	3. b)
Student Name	Gender (M/F)	IEP/ ELL	**2**	**2**	**4**	**1**	**1**	**1**	**1**

CLASS TRACKING SHEET – PART B

Board: ____ **Teacher Name:** __________________________________

7m32 (Measurement Relationships)
Determine the relationships among units and measurable attributes, including the area of a trapezoid and the volume of a right prism.

7m36			7m37			7m38		7m39		7m40		7m41		7m42			Total
4. a)	4. b)	4. c)	5. a)	5. b)	5. c)	6. a)	6. b)	7. a)	7. b)	8. a)	8. b)	9. a)	9. b)	10. a)	10. b)	10. c)	
1	**1**	**1**	**1**	**1**	**2**	**1**	**1**	**2**	**2**	**2**	**1**	**2**	**1**	**1**	**2**	**1**	**27**

ONTARIO CURRICULUM CORRELATION TO ONAP MEASUREMENT 8 — PART B NOTE: This correlation is to the Grade 7 Ontario Curriculum Expectations.	
Overall Expectation 7m31 (Attributes, Units, and Measurement Sense): **Report on research into real-life applications of area measurements.**	
Question Number	**Specific Expectation**
1. a)–b)	**7m33:** research and report on real-life applications of area measurements (e.g., building a skateboard; painting a room)
Overall Expectation 7m32 (Measurement Relationships): **Determine the relationships among units and measurable attributes, including the area of a trapezoid and the volume of a right prism.**	
Question Number	**Specific Expectation**
2. a)–b)	**7m34:** sketch different polygonal prisms that share the same volume
3. a)–b)	**7m35:** solve problems that require conversion between metric units of measure (e.g., millimetres and centimetres, grams and kilograms, millilitres and litres)
4. a)–c)	**7m36:** solve problems that require conversion between metric units of area (i.e., square centimetres, square metres)
5. a)–c)	**7m37:** determine, through investigation using a variety of tools (e.g., concrete materials, dynamic geometry software) and strategies, the relationship for calculating the area of a trapezoid, and generalize to develop the formula [i.e., Area = (sum of lengths of parallel sides × height) ÷ 2]
6. a)–b)	**7m38:** solve problems involving the estimation and calculation of the area of a trapezoid
7. a)–b)	**7m39:** estimate and calculate the area of composite two-dimensional shapes by decomposing into shapes with known area relationships (e.g., rectangle, parallelogram, triangle)
8. a)–b)	**7m40:** determine, through investigation using a variety of tools and strategies (e.g., decomposing right prisms; stacking congruent layers of concrete materials to form a right prism), the relationship between the height, the area of the base, and the volume of right prisms with simple polygonal bases (e.g., parallelograms, trapezoids), and generalize to develop the formula (i.e., Volume = area of base × height)
9. a)–b)	**7m41:** determine, through investigation using a variety of tools (e.g., nets, concrete materials, dynamic geometry software, Polydrons), the surface area of right prisms
10. a)–c)	**7m42:** solve problems that involve the surface area and volume of right prisms and that require conversion between metric measures of capacity and volume (i.e., millilitres and cubic centimetres)

Part C: Performance-Based Assessment

Administration

The two performance tasks in Part C are designed to provide insight into how well students are able to perform in terms of the categories of the Ontario Achievement Chart: Knowledge and Understanding, Thinking, Communication, and Application.

Since all of the specific and overall expectations for this strand have been assessed through the Concepts and Skills Assessment in Part B, it is recommended that you select one performance task for the Measurement strand.

Read all parts of the problem orally to students. Tell students that they should provide detailed answers to the problem, including showing how they solved the problem. Remind students that they may use pictures, numbers, words, diagrams, and/or charts to explain effectively how they solved the problem.

Timing

Each task is designed to be completed in a 45- to 60-minute period. If necessary, provide additional time as long as students complete the task in one sitting.

Accommodating Students with Special Needs

If individual students have difficulties explaining their thinking in writing, consider providing scribes to record for the students or encourage students to show and explain their thinking using concrete materials.

Scoring the Assessment

A generic rubric based on the Ontario Achievement Chart for Mathematics is provided on page 135 to assist with scoring student responses to the tasks. Spend some time reviewing the anchors and rationales provided for each level of achievement on pages 136 to 151. The four categories should be considered as interrelated, reflecting the wholeness and interconnectedness of learning. Each student's performance should therefore be determined holistically by selecting the level that best describes the student's overall achievement.

Sometimes a student will not achieve at the same level for each criterion within a category or across categories. For example, a student may perform at Level 3 on Knowledge and Understanding, Thinking, and Application but at Level 2 on Communication. While you may determine that, overall, the student performed most consistently at Level 3, you may want to make a note that this student would benefit from additional instruction in the area of Communication.

Note: *When scoring student work on the performance tasks, it is appropriate to note what you observed and heard while the student worked on the task.*

Once you have completed scoring the students' assessments, you may record the results electronically using the ONAP 8 CD-ROM, or using the Performance Class Tracking Sheet provided on page 134.

Next Steps

Strategies for improving performance in the four areas of the Achievement Chart are provided in the ONAP introduction, pages 18 and 19.

Performance Task 1: Activity Fair—What's My Sign?

Materials

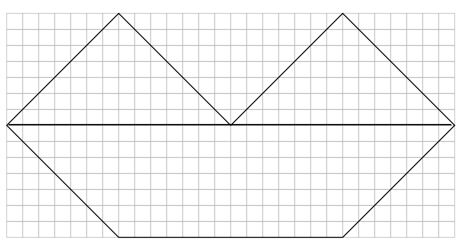
FOR THE TEACHER	FOR EACH STUDENT	OPTIONAL MATERIALS
• BLM C1: *Performance Task 1: Activity Fair—Sample Sign Design:* p. 129 • Performance Task Class Tracking Sheet: p. 134 • Performance Task Rubric: p. 135 • Anchors and rationales: pp. 136–151 • ONAP 8 CD-ROM (optional)	• BLM C1: *Performance—Task 1: Activity Fair—What's My Sign?* pp. 130–131 • pencil • eraser • ruler • pencil crayons	• centimetre grid paper

Introducing the Task

For this task, students apply their measurement skills to design a promotional sign. This sign must be between 1.5 m^2 and 2.5 m^2 and must include at least two of the following polygons: parallelograms, triangles, or trapezoids.

Tell students that they will
- design a sign based on both geometrical design and measurement guidelines
- explain their design strategy

Display the design from BLM C1: *Performance Task 1: Activity Fair—Sample Sign Design* on the overhead. Point out the scale you are using and record it:
1 grid length represents 10 cm
Then work through the area calculation with the class.



Area of 2 triangles: $\dfrac{2 \times (140\text{ cm} \times 70\text{ cm})}{2} = 9800\text{ cm}^2$

Area of trapezoid: $(140\text{ cm} + 280\text{ cm}) \times 70\text{ cm} \div 2 = 14\,700\text{ cm}^2$

Total area: $9800\text{ cm}^2 + 14\,700\text{ cm}^2 = 24\,500\text{ cm}^2$, or 2.45 m^2

Have students use BLM C2: *Performance Task 1: Activity Fair—What's My Sign?* to complete this activity. Explain that their signs should be very different from the sample.

Performance Task 2: Design Glass Boxes

Materials

FOR THE TEACHER	FOR EACH STUDENT	OPTIONAL MATERIALS
• Performance Task Class Tracking Sheet: p. 134 • Performance Task Rubric: p. 135 • Anchors and rationales: pp. 136–151 • ONAP 8 CD-ROM (optional)	• BLM C2: *Performance Task 2: Design Glass Boxes* pp. 132–133 • pencil • eraser • protractor	• centimetre grid paper

Introducing the Task

In this activity, students will be designing three boxes, each being a rectangular prism with a volume of 1000 cm^3. The boxes must all have different dimensions. Students will identify the design with the least surface area. Then they will determine the height of a box with a specific hexagonal base and a specific volume. Finally, they will design a pentagonal prism box with a volume within a specific range.

Tell students that they will

- sketch different rectangular prisms that have the same volume
- determine the surface area of each rectangular prism, and identify the box with the least surface area
- determine the height for a hexagonal prism with a given base and volume
- design a triangular prism with a volume within a given range and explain their design strategy

Have students use BLM C2: *Performance Task 2: Design Glass Boxes* to complete this activity.

Answers

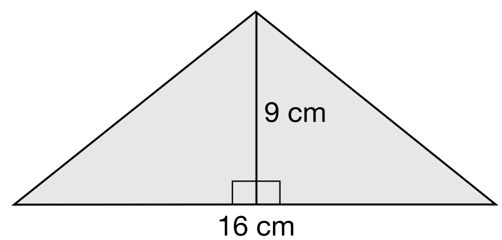
1. a) Possible solutions:

Box	*Length*	*Width*	*Height*	*Volume (cm^3)*	*Surface area (cm^2)*
1	*20*	*5*	*10*	*1000*	*700*
2	*25*	*4*	*10*	*1000*	*780*
3	*10*	*10*	*10*	*1000*	*600*

b) *The 10 cm × 10 cm × 10 cm cube should be made of red glass.*

2. *Area of the base:*
   Area $= (10\text{ cm} + 6\text{ cm}) \times 4\text{ cm}$
   $= 64\text{ cm}^2$
   Volume: 770 cm^3
   Height: $770\text{ cm}^3 \div 64\text{ cm}^2 = 12.03125$ *or about* 12 cm
   NOTE: Accept an estimate of 11 or 12 cm.

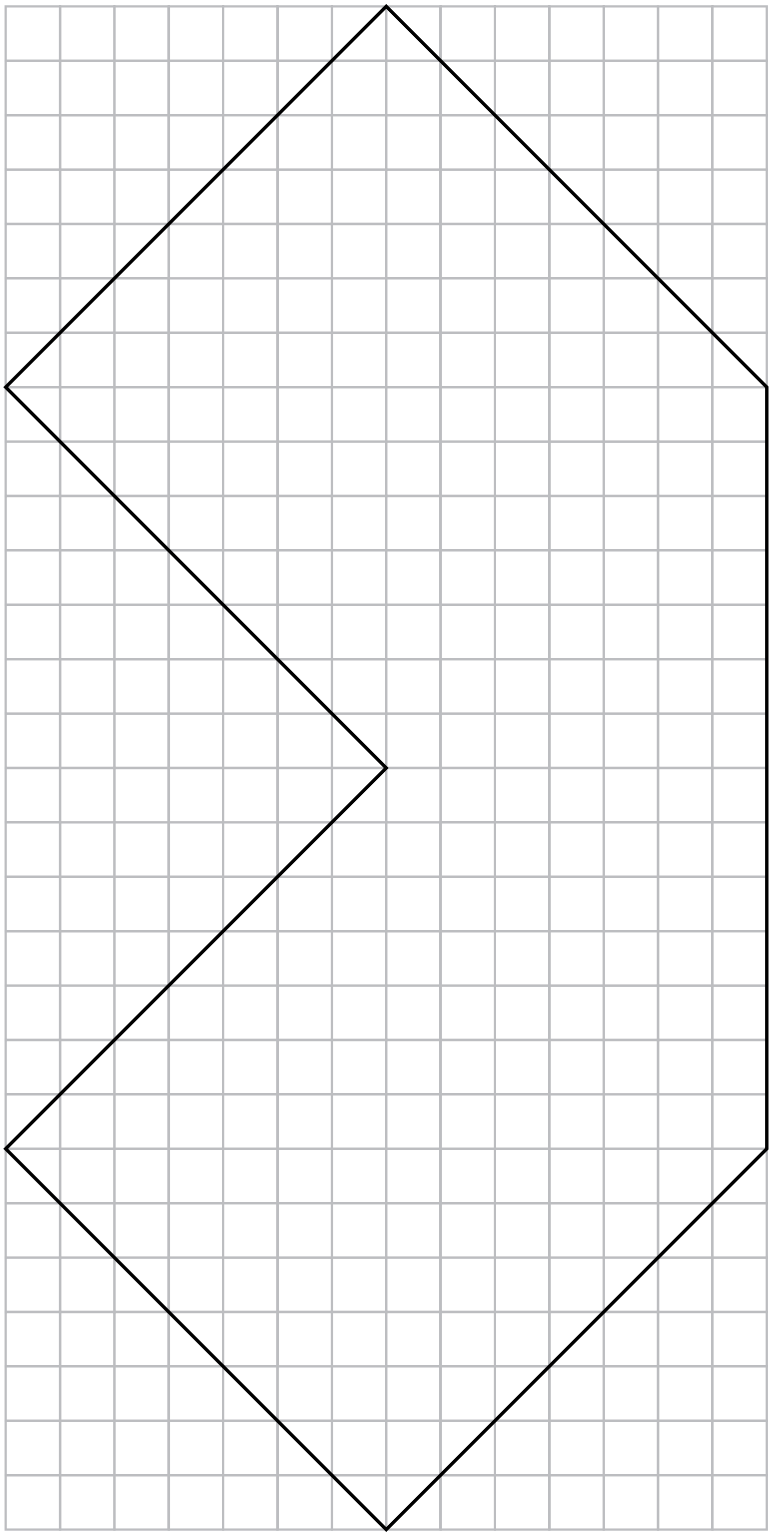
3. *Strategy: The hexagonal prism in question 2, with a height of 12 cm and the given base, has a volume close to* 770 cm^3, *which is between* 600 cm^3 *and* 800 cm^3.

   So, I can use similar dimensions for a triangular base, sketch it, and calculate its area.
   Area of base:
   Triangle: $(16\text{ cm} \times 9\text{ cm}) \div 2 = 72\text{ cm}^2$
   With this base area, a height of 10 cm would give a volume of 720 cm^3, *which is between* 600 cm^3 *and* 800 cm^3.

Performance Task 1: Activity Fair—Sample Sign Design

Provided for teachers to create overhead transparency.



Name: ______________________________ **Date:** ______________________

Performance Task 1: Activity Fair—What's My Sign? (page 1)

Glenview School is hosting an Activity Fair for all the clubs in the school to recruit new members. Each club will make an interestingly shaped sign for its display area. The committee has provided these guidelines:

- The signs must be about 2 m^2 (no smaller than 1.5 m^2 and no larger than 2.5 m^2).
- The signs should have an interesting shape that can be decomposed into other polygons such as parallelograms, triangles, and trapezoids.
- The sign may not be a single rectangle, triangle, or trapezoid.

Design your own sign. Calculate the area of your sign and remember to include the scale for your drawing below.

Scale: ______________________________

Name: ______________________________ **Date:** ____________________

Performance Task 1: Activity Fair—What's My Sign? (page 2)

Explain your design strategy.

Name: ________________________ **Date:** ________________

Performance Task 2: Design Glass Boxes (page 1)

Rebecca is taking stained-glass lessons. She wants to make three decorative glass boxes with lids. Each box will be a rectangular prism and have a volume of 1000 cm^3, but will have different dimensions. For one of the boxes, she plans to use red glass, which is the most expensive. She wants this box to have the least surface area possible.

1. a) Design and draw three different boxes with lids and label which box should be made of red glass. Fill in the chart with the dimensions of each of your boxes.

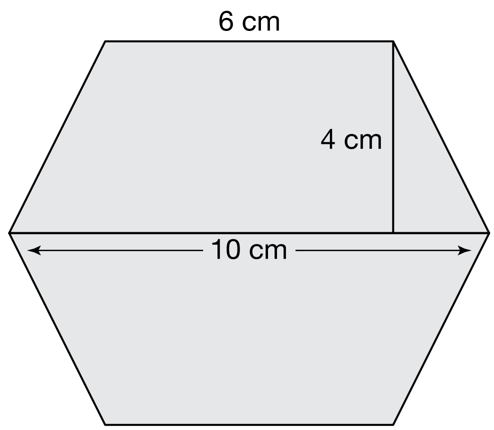
Box	Length	Width	Height	Volume (cm^3)	Surface area (cm^2)
1					
2					
3					

b) Which box should be made of red glass? ____________________

Name: ______________________ **Date:** ______________________

Performance Task 2: Design Glass Boxes (page 2)

2. Rebecca has enough blue glass left to make a box that is a hexagonal prism. The dimensions of the base are shown on the diagram below. Rebecca wants the box to have a volume of close to 770 cm^3. How tall should she make it?



Show your work.

3. Design a box that is a triangular prism with a volume of between 600 cm^3 and 800 cm^3. Explain your design strategy.

ONAP PERFORMANCE TASK CLASS TRACKING SHEET
GRADE 8: MEASUREMENT
PART C

Date: ______________________ **Grade:** ______________________

School: ______________________ **Board:** ______________________

Teacher Name: ______________________

Performance Task Title: ______________________

Student Name	Level 1–4	Comments

Performance Task Rubric

Assessment of Learning — What to Look For in Student Work

CATEGORY	LEVEL 1	LEVEL 2	LEVEL 3	LEVEL 4
Knowledge and Understanding	• demonstrates a limited or inaccurate understanding of the concepts needed to solve the problem • demonstrates a limited or inaccurate knowledge of the specific concepts, terms, or procedural skills that have been taught	• demonstrates some understanding of the concepts needed to solve the problem • demonstrates some knowledge of the specific concepts, terms, or procedural skills that have been taught	• demonstrates considerable understanding of the concepts needed to solve the problem • demonstrates considerable knowledge of the specific concepts, terms, or procedural skills that have been taught	• demonstrates a thorough understanding of the concepts needed to solve the problem • demonstrates a thorough knowledge of the specific concepts, terms, or procedural skills that have been taught
Thinking	• demonstrates a limited understanding of the problem • shows little or no evidence of a plan • uses a strategy and attempts to solve the problem but does not arrive at an answer	• demonstrates some understanding of the problem • shows some evidence of a plan • carries out the plan to some extent by using a strategy and develops a partial and/or incorrect solution	• demonstrates considerable understanding of the problem • shows evidence of an appropriate plan • carries out the plan effectively by using an appropriate strategy and solving the problem	• demonstrates a thorough understanding of the problem • shows evidence of a thorough plan • shows flexibility and insight when carrying out the plan by trying and adapting when necessary one or more strategies to solve the problem
Communication	• provides a limited or inaccurate explanation/ justification that lacks clarity or logical thought • communicates with limited effectiveness (may include words, pictures, symbols, and/or numbers)	• provides a partial explanation/justification that shows some clarity and logical thought • communicates with some effectiveness (may include words, pictures, symbols, and/or numbers)	• provides a complete, clear, and logical explanation/ justification • communicates with considerable effectiveness (may include words, pictures, symbols, and/or numbers)	• provides a thorough, clear, and insightful explanation/justification • communicates with a high degree of effectiveness (may include words, pictures, symbols, and/or numbers)
Application	• demonstrates a limited ability to apply mathematical knowledge and skills	• demonstrates some ability to apply mathematical knowledge and skills	• demonstrates considerable ability to apply mathematical knowledge and skills	• demonstrates a sophisticated ability to apply mathematical knowledge and skills

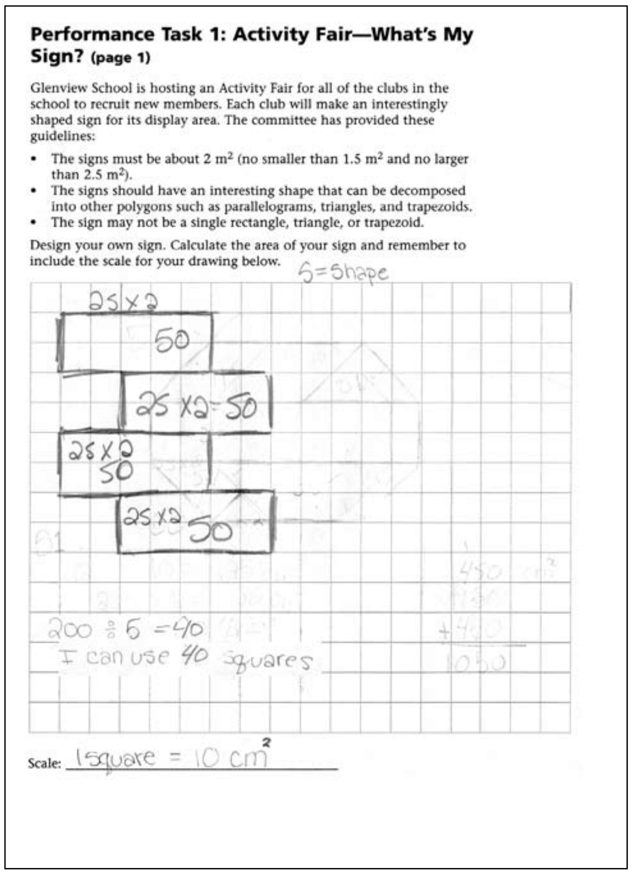
Performance Task 1: Activity Fair—What's My Sign? LEVEL 1 (Anchor 1)

Knowledge and Understanding
- demonstrates a limited understanding of estimating and calculating the area of composite two-dimensional shapes and using a scale, and the relationship between metric units for area

Communication
- communicates with limited effectiveness by using diagrams, equations, and written explanations, but mathematical misunderstandings result in justifications that lack clarity and logic

Thinking
- demonstrates a limited understanding of the problem
- displays some understanding of the problem by using one shape repeated in a unique pattern

Application
- exhibits a limited ability to apply mathematical knowledge and skills, as illustrated through some mathematical errors and inconsistencies related to scale
- uses inappropriate scale of 1 square = 10 cm^2; use of scale 1 cm = 5 cm is partially correct, although no units are given for calculations


Performance Task 1: Activity Fair—What's My Sign? (page 1)

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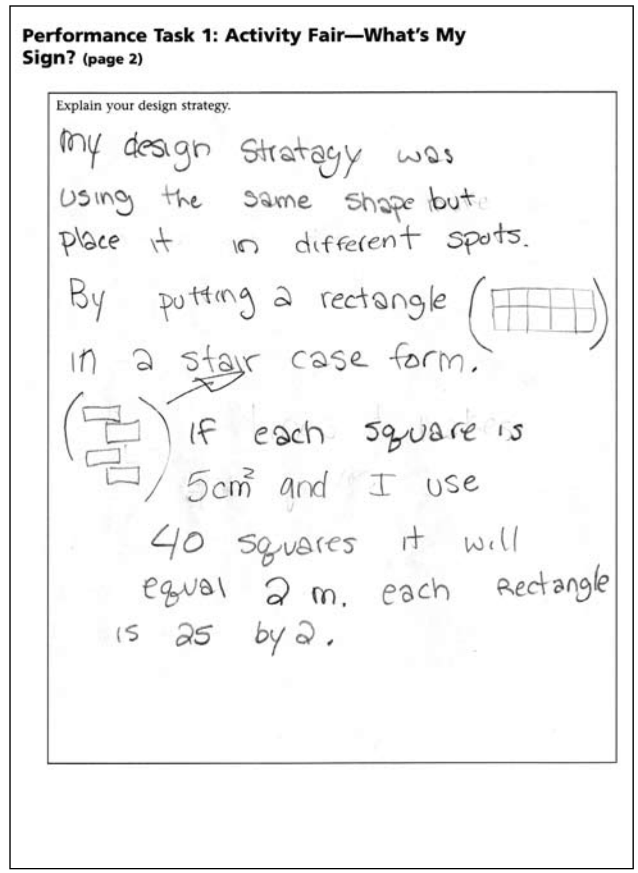
- The signs should have an interesting shape that can be decomposed into other polygons such as parallelograms, triangles, and trapezoids.
- The sign may not be a single rectangle, triangle, or trapezoid.

Design your own sign. Calculate the area of your sign and remember to include the scale for your drawing below.

Scale: 1 square = 10 cm^2


Performance Task 1: Activity Fair—What's My Sign? (page 2)

Explain your design strategy.

My design Stratagy was using the same shape but place it in different spots. By putting a rectangle in a stair case form. If each square is 5 cm^2 and I use 40 squares it will equal 2 m. each Rectangle is 25 by 2.

Performance Task 1: Activity Fair—What's My Sign? LEVEL 1 (Anchor 2)

Knowledge and Understanding

- demonstrates a limited understanding of estimating and calculating the area of composite two-dimensional shapes by decomposing into shapes with known area relationships

Communication

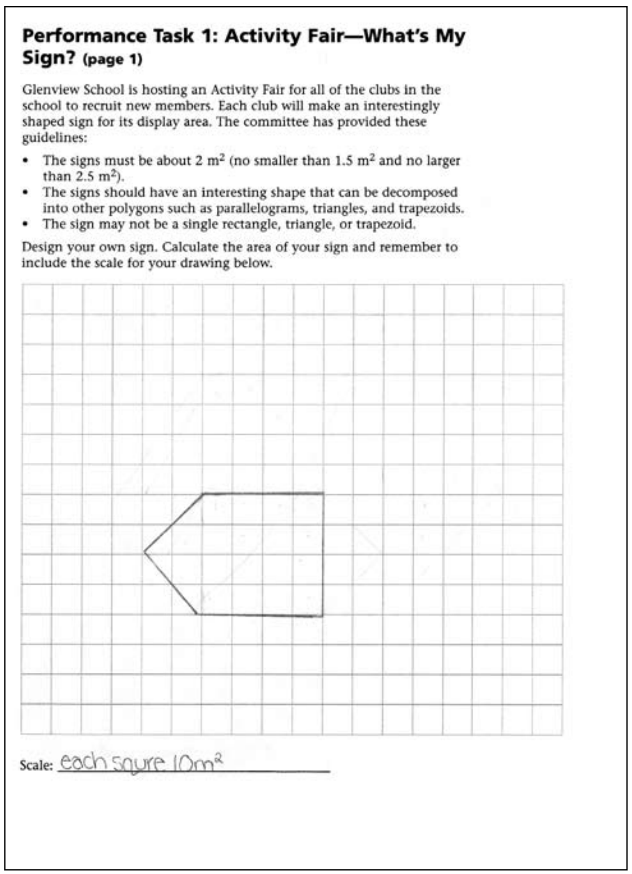
- communicates with limited effectiveness using diagrams and verbal explanations, but uses incorrect symbols for square units (switching from m^2 to m^3)

Thinking

- expresses some understanding of the problem and carries out a plan to arrive at a partial solution by designing a sign composed of more than one shape
- uses an incorrect plan to determine area calculations by applying a scale that is a ratio of square units rather than linear units

Application

- reveals limited and faulty understanding of scale and no evidence of an ability to convert metric units



Performance Task 1: Activity Fair—What's My Sign? (page 1)

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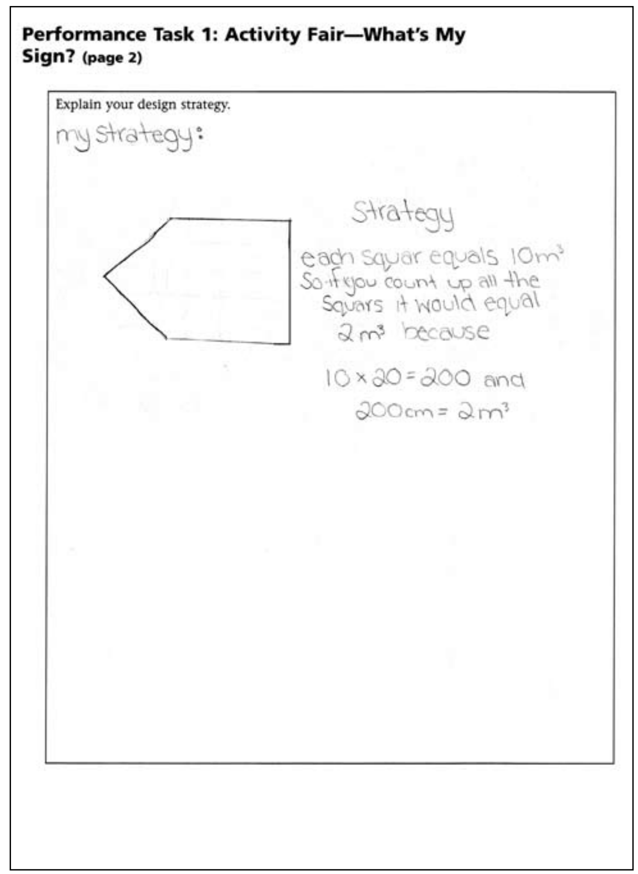
- The sign may not be a single rectangle, triangle, or trapezoid.

Design your own sign. Calculate the area of your sign and remember to include the scale for your drawing below.

Scale: each squre 10m²



Performance Task 1: Activity Fair—What's My Sign? (page 2)

Explain your design strategy.

my strategy:

Strategy

each squar equals 10m³
So if you count up all the
Squars it would equal
2m³ because

10 × 20 = 200 and
200cm = 2m³

Performance Task 1: Activity Fair—What's My Sign? LEVEL 2 (Anchor 1)

Knowledge and Understanding

- demonstrates understanding of estimating and calculating the area of composite two-dimensional shapes by decomposing into shapes with known area relationships; a scale is not specified
- shows limited understanding of converting between metric units of measurement for area

Communication

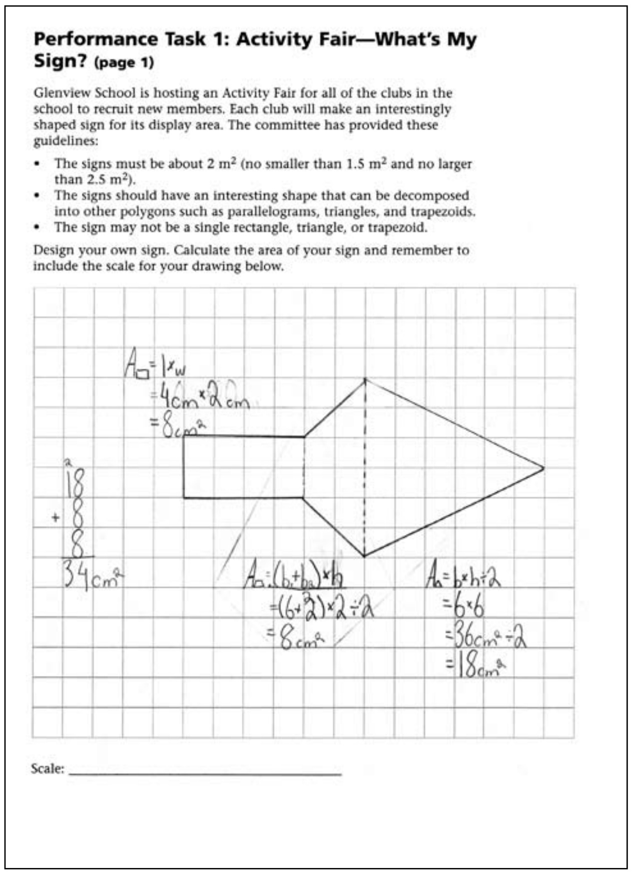
- communicates with some effectiveness through the use of clear diagrams and related calculations, and is able to articulate the point at which the solution strategy ends

Thinking

- demonstrates an understanding of the problem and carries out a plan to arrive at a partial solution by designing a sign composed of the required shapes; recognizes the need to employ a scale but is unable to identify one

Application

- displays some ability to apply mathematical knowledge related to the area of composite shapes but does not show evidence of using a scale or converting area measurements



Performance Task 1: Activity Fair—What's My Sign? (page 1)

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- The signs should have an interesting shape that can be decomposed into other polygons such as parallelograms, triangles, and trapezoids.
- The sign may not be a single rectangle, triangle, or trapezoid.

Design your own sign. Calculate the area of your sign and remember to include the scale for your drawing below.

$A_{\square} = l \times w$
$= 4cm \times 2cm$
$= 8cm^2$

$18 + 8 + 8 = 34cm^2$

$A = (b_1 + b_2) \times h$
$= (6 + 2) \times 2 \div 2$
$= 8cm^2$

$A = b \times h \div 2$
$= 6 \times 6$
$= 36cm^2 \div 2$
$= 18cm^2$

Scale: ____________

Performance Task 1: Activity Fair—What's My Sign? (page 2)

Explain your design strategy.

Easy to make the sign and calculate the area for the rectangle, trappazoid and, triangle.
$(l \times w)$ $((b_1+b_2) \times h \div 2)$ $(b \times h \div 2)$

Although hard to get scale even using tens.

Performance Task 1: Activity Fair—What's My Sign? LEVEL 2 (Anchor 2)

Knowledge and Understanding
- demonstrates some understanding of estimating and calculating the area of composite two-dimensional shapes by decomposing into shapes with known area relationships
- shows good understanding of using scale in area calculations, but makes inaccurate conversions between area units

Communication
- communicates with some effectiveness through the use of clear and labelled diagrams
- articulates a limited explanation of design strategy; the shapes are explained but no reference is made to the area specifications

Thinking
- exhibits some understanding of the problem by designing a sign that meets some of the criteria and carries out a plan to arrive at an incorrect solution (area conversion is incorrect and does not satisfy the design criteria)

Application
- displays some ability to apply mathematical knowledge related to the area of composite shapes but is not able to apply correct conversions to the area measurements

Performance Task 1: Activity Fair—What's My Sign? (page 1)

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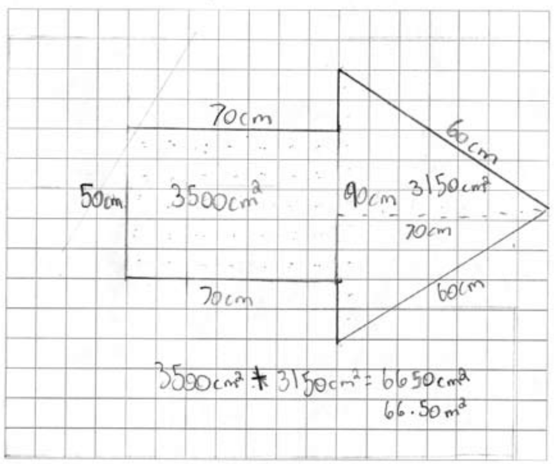
Design your own sign. Calculate the area of your sign and remember to include the scale for your drawing below.



Scale: 1 Square equills 10cm.

Performance Task 1: Activity Fair—What's My Sign? (page 2)

Explain your design strategy.

I made an arrow by putting a triangle and a rectangle and adding these areas together.

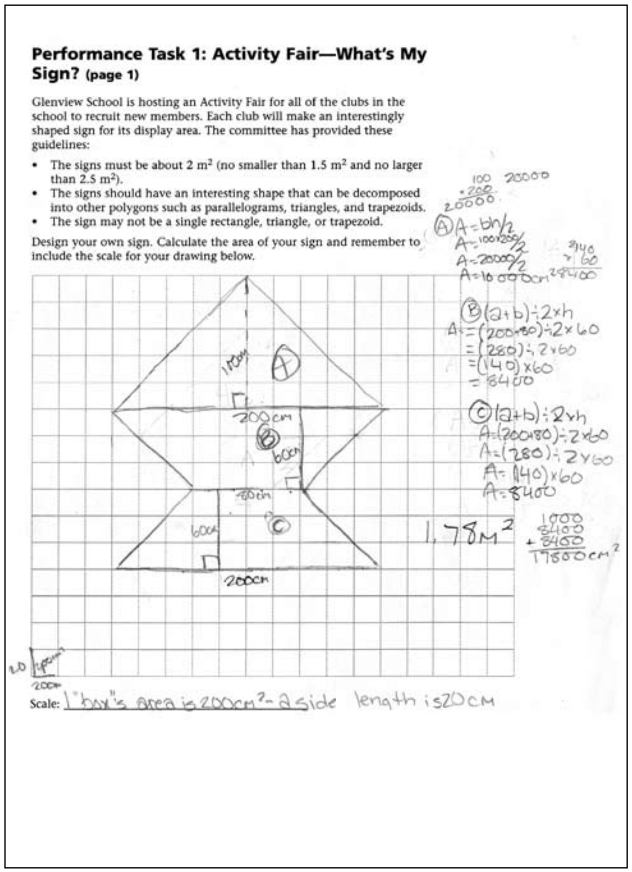
Performance Task 1: Activity Fair—What's My Sign? LEVEL 3 (Anchor 1)

Knowledge and Understanding
- reveals considerable ability to estimate and calculate the area of composite two-dimensional shapes by decomposing into shapes with known area relationships
- demonstrates considerable understanding of converting between metric units of measure for area

Communication
- communicates with some effectiveness using a diagram linked by letters to corresponding calculations; minor transcribing error in the scale
- provides a clear and logical explanation for the design strategy but inaccurately notates scale, and calculates one area as 200 cm^2 instead of 400 cm^2

Thinking
- exhibits considerable understanding of the problem by drawing a sign composed of more than one shape and then developing a strategy to select a scale that will meet the area requirements
- transcribes the areas of the decomposed shapes inaccurately, which leads to an incorrect combined area; the total area is actually 2.68 m^2, which is beyond the design parameters
- does not take advantage of the symmetry of the bottom part of the shape to simplify calculations

Application
- expresses considerable ability to apply mathematical knowledge of both area unit conversions and area relationships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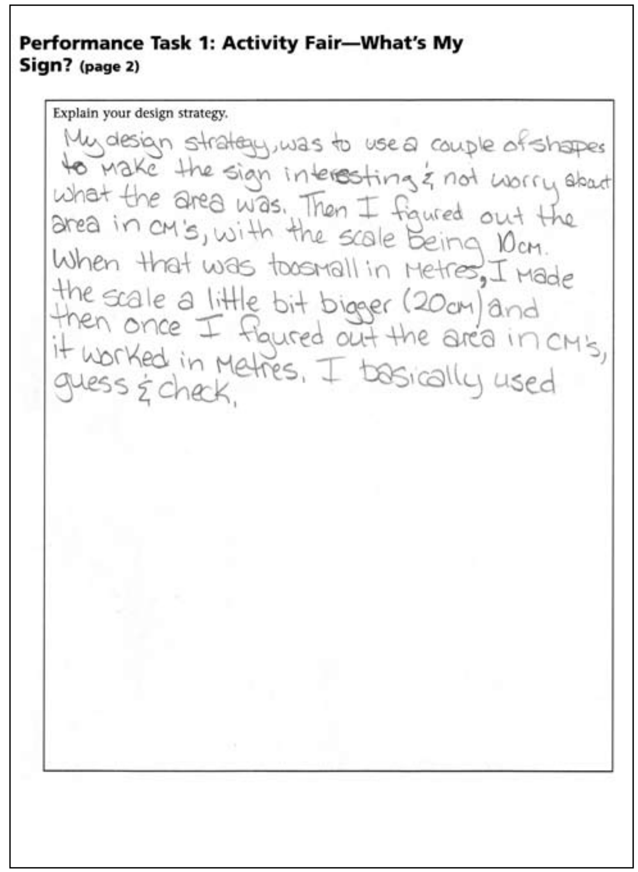
- The signs should have an interesting shape that can be decomposed into other polygons such as parallelograms, triangles, and trapezoids.
- The sign may not be a single rectangle, triangle, or trapezoid.

Design your own sign. Calculate the area of your sign and remember to include the scale for your drawing below.

Scale: 1 "box's" area is 200cm² - a side length is 20cm


Performance Task 1: Activity Fair—What's My Sign? (page 2)

Explain your design strategy.

My design strategy was to use a couple of shapes to make the sign interesting & not worry about what the area was. Then I figured out the area in cm's, with the scale being 10cm. When that was too small in metres, I made the scale a little bit bigger (20cm) and then once I figured out the area in cm's, it worked in metres. I basically used guess & check.

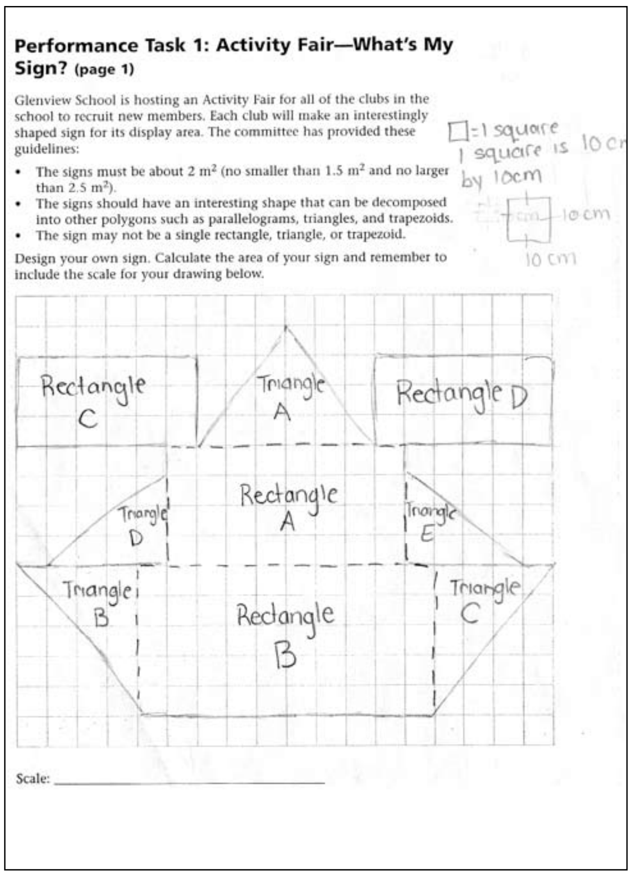
Performance Task 1: Activity Fair—What's My Sign? LEVEL 3 (Anchor 2)

Knowledge and Understanding
- demonstrates considerable ability to estimate and calculate the area of composite two-dimensional shapes by decomposing into shapes with known area relationships
- displays considerable understanding of converting between metric units of measure for area

Communication
- communicates with considerable effectiveness using a clear diagram and well-referenced calculations; there is a slight error in the communication of the combination of partial areas (the answer is correct but not all partial areas are listed)
- provides no explanation for design strategy

Thinking
- exhibits considerable understanding of the problem
- shows evidence of an appropriate plan although it is not communicated thoroughly or accurately (states division by 100, but actually divides by 10 000, which is correct)

Application
- demonstrates a considerable ability to apply mathematical knowledge of both area unit conversions and area relationships



Performance Task 1: Activity Fair—What's My Sign? (page 1)

Glenview School is hosting an Activity Fair for all of the clubs in the school to recruit new members. Each club will make an interestingly shaped sign for its display area. The committee has provided these guidelines:

- The signs must be about 2 m^2 (no smaller than 1.5 m^2 and no larger than 2.5 m^2).
- The signs should have an interesting shape that can be decomposed into other polygons such as parallelograms, triangles, and trapezoids.
- The sign may not be a single rectangle, triangle, or trapezoid.

Design your own sign. Calculate the area of your sign and remember to include the scale for your drawing below.

Scale: ______

Performance Task 1: Activity Fair—What's My Sign? (page 2)

Explain your design strategy.

Area of Triangle A:
a = b×h ÷ 2
= 60×40 ÷ 2
= 2400 ÷ 2
= 1200 cm²

Area of Triangle B:
a = b×h ÷ 2
= 40×50 ÷ 2
= 2000 ÷ 2
= 1000 cm²

* the area of Triangle B is the same to the area of Triangle C

Area of Triangle C: 1000 cm²

Area of Rectangle A:
a = l × w
= 80 × 40
= 3200 cm²

Area of Rectangle B:
a = l×w
= 100 × 50
= 5000 cm²

Area of Triangle E: 600 cm²

* Next I need to add up the area of all the shapes to give me the total area.

Area of Triangle D:
a = b×h ÷ 2
= 40 × 30 ÷ 2
= 1200 ÷ 2
= 600 cm²

* the area of △D = the area of △E.

5000
3200
1800
1200
1000
1000
600
+ 600
16 200 cm²

16200 is the total area

I know need to divide the area in centimetres by one 100 which will give me my answer in metres.
16200 ÷ 10000 = 1.62 m²

∴ the overall area is 1.62 m²

Rectangle C:
a = l×w
= 60×30
= 1800 cm²

rectangle D = 1800 cm²

* the area of rectangle C is the same as rectangle D

Performance Task 1: Activity Fair—What's My Sign? LEVEL 4 (Anchor 1)

Knowledge and Understanding

- demonstrates a thorough understanding of a problem that requires conversion between metric units of measure for area
- exhibits a high level of ability to estimate and calculate the area of composite two-dimensional shapes by decomposing into shapes with known area relationships

Communication

- communicates with some effectiveness; includes an appropriate diagram but does not show calculations
- provides a clear and insightful explanation of the design strategy, particularly with respect to the determination of scale; note that scale should read either 1 cm : 10 cm or 1 : 10

Thinking

- shows evidence of a thorough plan
- displays flexibility and insight when carrying out the plan, particularly when determining scale

Application

- demonstrates a sophisticated ability to apply mathematical knowledge of both area unit conversions and area relationships

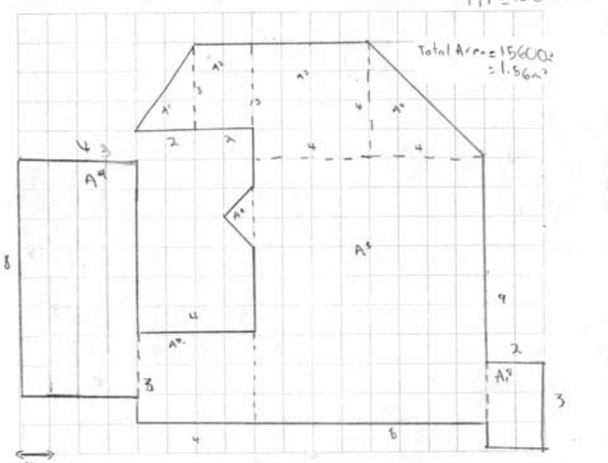
Performance Task 1: Activity Fair—What's My Sign? (page 1)

Glenview School is hosting an Activity Fair for all of the clubs in the school to recruit new members. Each club will make an interestingly shaped sign for its display area. The committee has provided these guidelines:

- The signs must be about 2 m^2 (no smaller than 1.5 m^2 and no larger than 2.5 m^2).
- The signs should have an interesting shape that can be decomposed into other polygons such as parallelograms, triangles, and trapezoids.
- The sign may not be a single rectangle, triangle, or trapezoid.

Design your own sign. Calculate the area of your sign and remember to include the scale for your drawing below.

$2\ m^2 = 20000\ cm^2$
$1\ m^2 = 10000\ cm^2$



Scale: 1 : 10 cm

Performance Task 1: Activity Fair—What's My Sign? (page 2)

Explain your design strategy.

For my design I made a shape using 3 triangles, 5 rectangles and a square. I found the area of all 9 shapes with the scale of 1:1cm. The area was 156cm². I tried increasing the scale to ten to see if it would make it the proper size. It made it 15600cm² and I know in every 1m² there are 10 000cm². There for my shapes area ranged between 15000cm² (1.5m²) and 25000cm² (2.5m²).

Performance Task 1: Activity Fair—What's My Sign? LEVEL 4 (Anchor 2)

Knowledge and Understanding
- demonstrates an understanding of a problem that requires an understanding of relationships among linear and area units
- demonstrates ability to calculate the area of composite two-dimensional shapes by decomposing into shapes with known area relationships

Communication
- provides a clear explanation including appropriate diagrams and a justification of the solution's simplicity; note that units were used on only one term; note that scale should be either 1 : 100 or 1 cm : 100 cm, not 1 : 100 cm

Thinking
- exhibits a thorough understanding of the problem and, in fact, suggests a solution that is mathematically simple while still satisfying all of the criteria

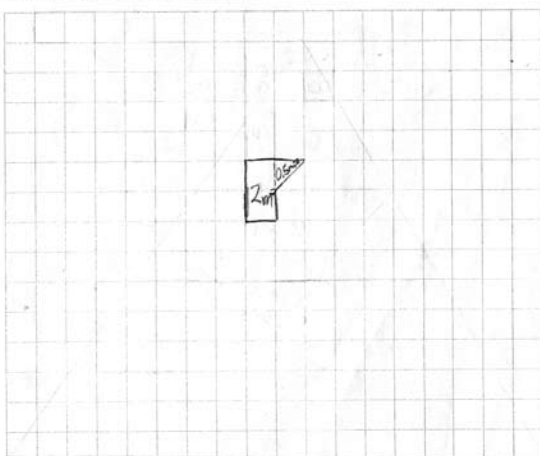
Application
- demonstrates a sophisticated ability to apply mathematical knowledge of both area conversions and area relationships

Performance Task 1: Activity Fair—What's My Sign? (page 1)

Glenview School is hosting an Activity Fair for all of the clubs in the school to recruit new members. Each club will make an interestingly shaped sign for its display area. The committee has provided these guidelines:

- The signs must be about 2 m^2 (no smaller than 1.5 m^2 and no larger than 2.5 m^2).
- The signs should have an interesting shape that can be decomposed into other polygons such as parallelograms, triangles, and trapezoids.
- The sign may not be a single rectangle, triangle, or trapezoid.

Design your own sign. Calculate the area of your sign and remember to include the scale for your drawing below.



Scale: 1:100 cm

Performance Task 1: Activity Fair—What's My Sign? (page 2)

Explain your design strategy.

I pretty much took the easy way out, the quetion said to design a sign that was between 1.5m² and 2.5m², mine is a scale 1:100 so that every cm. equals one metre. (my sign is 2.5 metres squared). The question also told me that my sign couldn't be a regular shape, so I simply added a small, 0.5 m², triangle to my 2m² rectangle.

Performance Task 2: Design Glass Boxes LEVEL 1 (Anchor 1)

Knowledge and Understanding
- demonstrates some understanding of volume but no understanding of surface area of right prisms
- exhibits limited understanding of calculating the volume of right prisms with simple polygonal bases

Communication
- provides limited explanations
- provides some appropriate diagrams and others that are inaccurate (in question 3, correct height is not indicated and diagram is not drawn reasonably to scale)

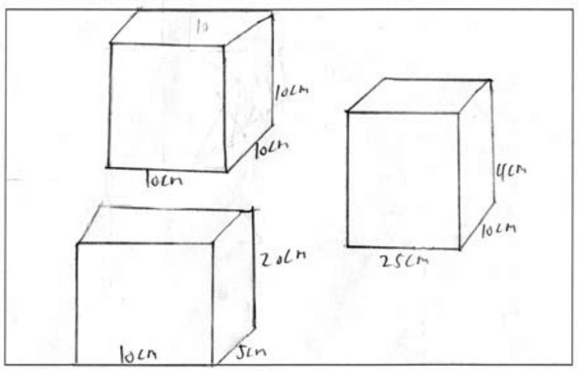
Thinking
- demonstrates limited understanding of the problem (in question 2, does not use the required information provided)

Application
- displays some ability to solve problems related to the volume, but not the surface area, of rectangular prisms; displays limited ability with formulas for hexagonal prisms and triangular prisms

Performance Task 2: Design Glass Boxes (page 1)

Rebecca is taking stained-glass lessons. She wants to make three decorative glass boxes with lids. Each box will be a rectangular prism and have a volume of 1000 cm^3 but will have different dimensions. For one of the boxes, she plans to use red glass, which is the most expensive. She wants this box to have the least surface area possible.

1. a) Design and draw three different boxes with lids and label which box should be made of red glass. Fill in the chart with the dimensions of each of your boxes.

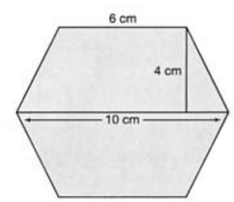


Box	Length	Width	Height	Volume (cm^3)	Surface Area (cm^2)
1	10 cm	10cm	10cm	1000cm³	100cm²
2	10 cm	5cm	20cm	1000cm³	200cm²
3	25cm	10cm	4cm	1000 cm³	100cm²

b) Which box should be made of red glass? 10cm by 10cm by 10cm.

Performance Task 2: Design Glass Boxes (page 2)

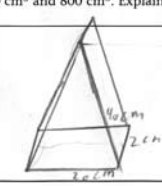
2. Rebecca has enough blue glass left to make a box that is a hexagonal prism. The dimensions of the base are shown on the diagram below. Rebecca wants the box to have a volume of close to 770 cm^3. How tall should she make it?



Show your work.

(a×b÷2) 10Y 70×20 = 1400 ÷ 2 = 700cm

3. Design a box that is a triangular prism with a volume of between 600 cm^3 and 800 cm^3. Explain your design strategy.



20×20×40cm = 1600cm³ ÷ 2 = 800cm³
Since you divide by 2 to calculate an area of a triangle I did (a×b÷2) to get 800cm³

Performance Task 2: Design Glass Boxes LEVEL 1 (Anchor 2)

Knowledge and Understanding
- demonstrates some understanding of volume and surface area of right prisms
- shows limited understanding of calculating the volume of right prisms with simple polygonal bases that are not rectangles
- provides calculations that are frequently inaccurate

Communication
- offers limited explanations
- provides some appropriate diagrams and others that are inaccurate

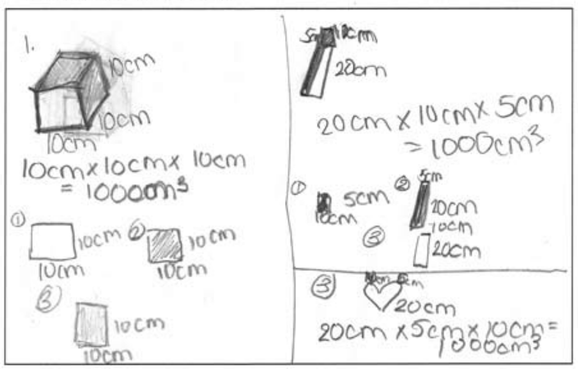
Thinking
- demonstrates limited understanding of the problem (fails to answer question 1b) and selects inappropriate strategies in questions 2 and 3)

Application
- displays some ability to solve problems related to the volume and surface area of rectangular prisms but displays limited ability with triangular prisms and hexagonal prisms

Performance Task 2: Design Glass Boxes (page 1)

Rebecca is taking stained-glass lessons. She wants to make three decorative glass boxes with lids. Each box will be a rectangular prism and have a volume of 1000 cm^3 but will have different dimensions. For one of the boxes, she plans to use red glass, which is the most expensive. She wants this box to have the least surface area possible.

1. a) Design and draw three different boxes with lids and label which box should be made of red glass. Fill in the chart with the dimensions of each of your boxes.

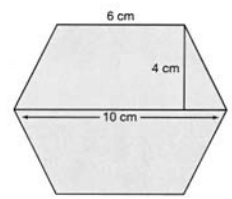


Box	Length	Width	Height	Volume (cm^3)	Surface Area (cm^2)
1	100cm	100cm	100cm	1000cm³	600 cm²
2	20cm	10cm	5cm	1000cm³	700cm²
3	5cm	6cm	20cm	1000cm³	40 cm²

b) Which box should be made of red glass? ____________

Performance Task 2: Design Glass Boxes (page 2)

2. Rebecca has enough blue glass left to make a box that is a hexagonal prism. The dimensions of the base are shown on the diagram below. Rebecca wants the box to have a volume of close to 770 cm^3. How tall should she make it?



Show your work.

10 cm x 6cm x 4cm = 240cm³
x 2
480 cm³

(a+b) x h ÷ 2

3. Design a box that is a triangular prism with a volume of between 600 cm^3 and 800 cm^3. Explain your design strategy.

10cm
40cm
20cm
20 cm x 40cm x 10cm =
800cm³

Performance Task 2: Design Glass Boxes LEVEL 2 (Anchor 1)

Knowledge and Understanding
- demonstrates some understanding of the volume of right prisms with simple polygonal bases as well as surface area of right prisms

Communication
- communicates with some effectiveness using both diagrams and formulas (does not explain strategy in question 3)

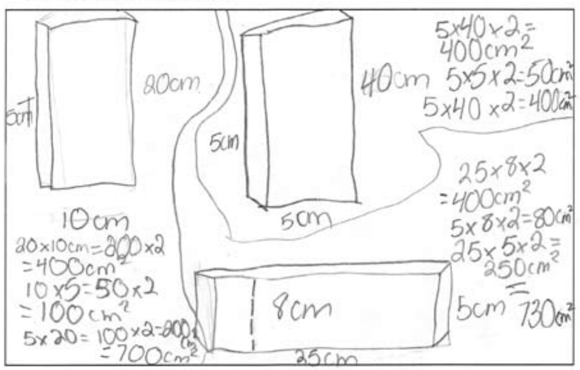
Thinking
- demonstrates some understanding of the problem, but uses inappropriate strategies in questions 2 and 3 (divides answer by 2 at the end, instead of multiplying 10 × 9)

Application
- exhibits some ability to apply knowledge of calculating the volume of right prisms to solve problems, particularly when the prism is rectangular

Performance Task 2: Design Glass Boxes (page 1)

Rebecca is taking stained-glass lessons. She wants to make three decorative glass boxes with lids. Each box will be a rectangular prism and have a volume of 1000 cm³ but will have different dimensions. For one of the boxes, she plans to use red glass, which is the most expensive. She wants this box to have the least surface area possible.

1. a) Design and draw three different boxes with lids and label which box should be made of red glass. Fill in the chart with the dimensions of each of your boxes.

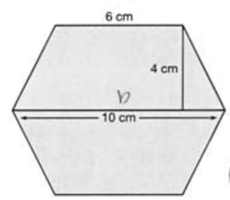


Box	Length	Width	Height	Volume (cm³)	Surface Area (cm²)
1	10	5	20	1000	700cm²
2	5	5	40	1000	850cm²
3	25	6	8	1000	730cm²

b) Which box should be made of red glass? 10x5x20

Performance Task 2: Design Glass Boxes (page 2)

2. Rebecca has enough blue glass left to make a box that is a hexagonal prism. The dimensions of the base are shown on the diagram below. Rebecca wants the box to have a volume of close to 770 cm³. How tall should she make it?

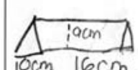


a+b÷2xh

Show your work.
8cm+10cm
= 16cm÷2
= 8cmx4
= 32x24cm
= 768cm²

She should make it 24cm tall.

3. Design a box that is a triangular prism with a volume of between 600 cm³ and 800 cm³. Explain your design strategy.



10cmx9cmx
16cm = 1440cm²÷2 = 720cm³

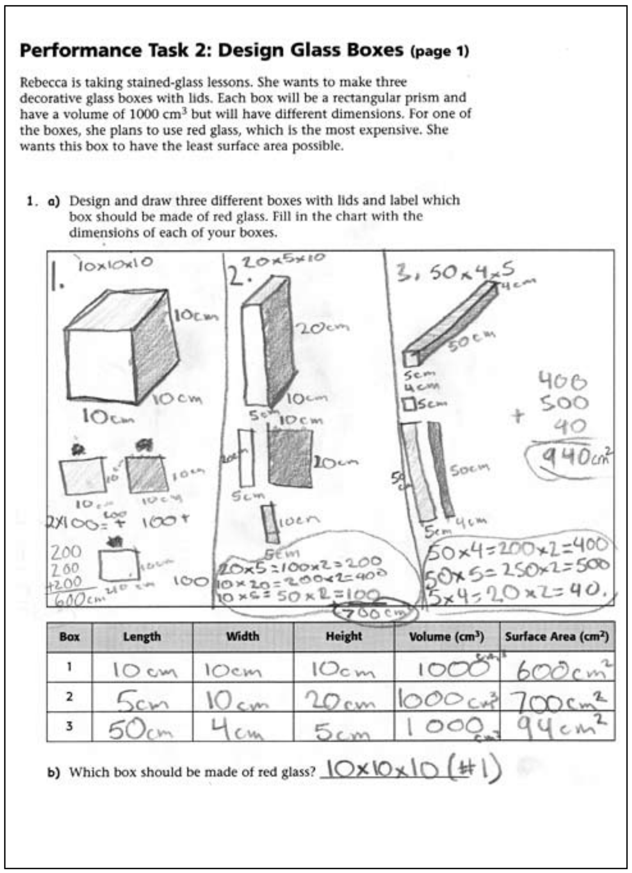
Performance Task 2: Design Glass Boxes LEVEL 2 (Anchor 2)

Knowledge and Understanding
- demonstrates some understanding of volume and surface area of right prisms
- expresses limited understanding of calculating the volume of right prisms with simple polygonal bases
- uses order of operations incorrectly in question 2

Communication
- provides some explanation through calculations and diagrams; does not provide strategy in question 3
- includes extraneous details for some answers

Thinking
- reveals a good understanding of volume and surface area of rectangular prisms; includes one calculation error
- demonstrates limited and incomplete strategies for determining volume of non-rectangular right prisms

Application
- displays some ability to apply mathematical knowledge of volume of prisms
- shows limited ability to apply formulas for calculating the area of a trapezoid or a triangle; question 2 is not fully answered



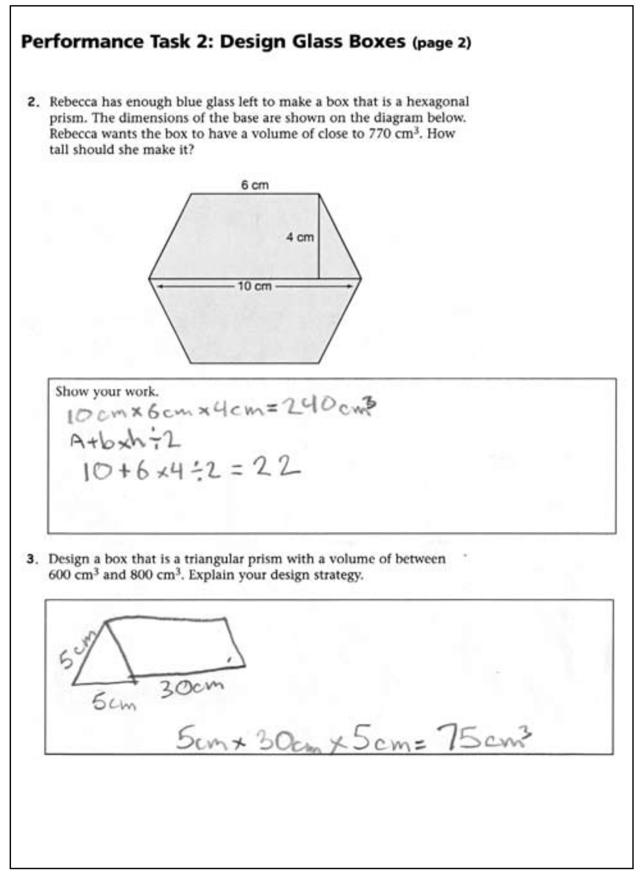
Performance Task 2: Design Glass Boxes (page 1)

Rebecca is taking stained-glass lessons. She wants to make three decorative glass boxes with lids. Each box will be a rectangular prism and have a volume of 1000 cm³ but will have different dimensions. For one of the boxes, she plans to use red glass, which is the most expensive. She wants this box to have the least surface area possible.

1. a) Design and draw three different boxes with lids and label which box should be made of red glass. Fill in the chart with the dimensions of each of your boxes.

Box	Length	Width	Height	Volume (cm³)	Surface Area (cm²)
1	10 cm	10cm	10cm	1000	600cm²
2	5cm	10cm	20cm	1000cm³	700cm²
3	50cm	4cm	5cm	1 000	94cm²

b) Which box should be made of red glass? 10x10x10 (#1)



Performance Task 2: Design Glass Boxes (page 2)

2. Rebecca has enough blue glass left to make a box that is a hexagonal prism. The dimensions of the base are shown on the diagram below. Rebecca wants the box to have a volume of close to 770 cm³. How tall should she make it?

Show your work.

10cm x 6cm x 4cm = 240cm³
A+bxh÷2
10 + 6 x 4 ÷ 2 = 22

3. Design a box that is a triangular prism with a volume of between 600 cm³ and 800 cm³. Explain your design strategy.

5cm x 30cm x 5cm = 75cm³

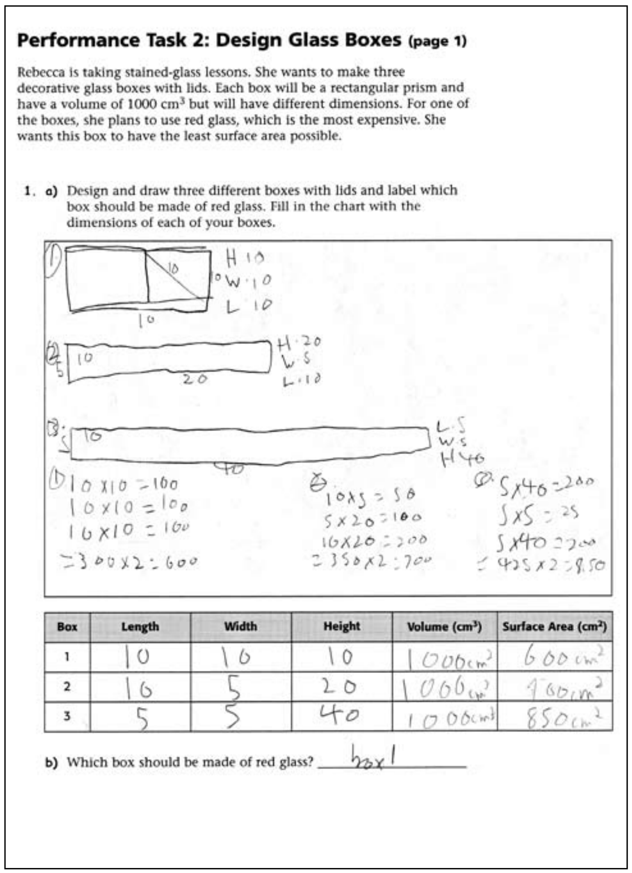
Performance Task 2: Design Glass Boxes LEVEL 3 (Anchor 1)

Knowledge and Understanding
- demonstrates a considerable understanding of the volume of right prisms with simple polygonal bases as well as the ability to calculate surface area of right prisms

Communication
- communicates with some effectiveness
- uses diagrams effectively and clearly identifies most calculations (written explanation in question 3 lacks clarity)

Thinking
- exhibits considerable understanding of the problem and shows evidence of appropriate plans
- carries out solution plans using effective strategies; the exception is question 3, where the explanation seems to indicate that the correct answer may have been arrived at for the wrong reasons (no need to divide 70 by 2, since 70 was calculated by dividing 140 by 2)

Application
- displays considerable ability to apply knowledge of volume and surface area to solve problems



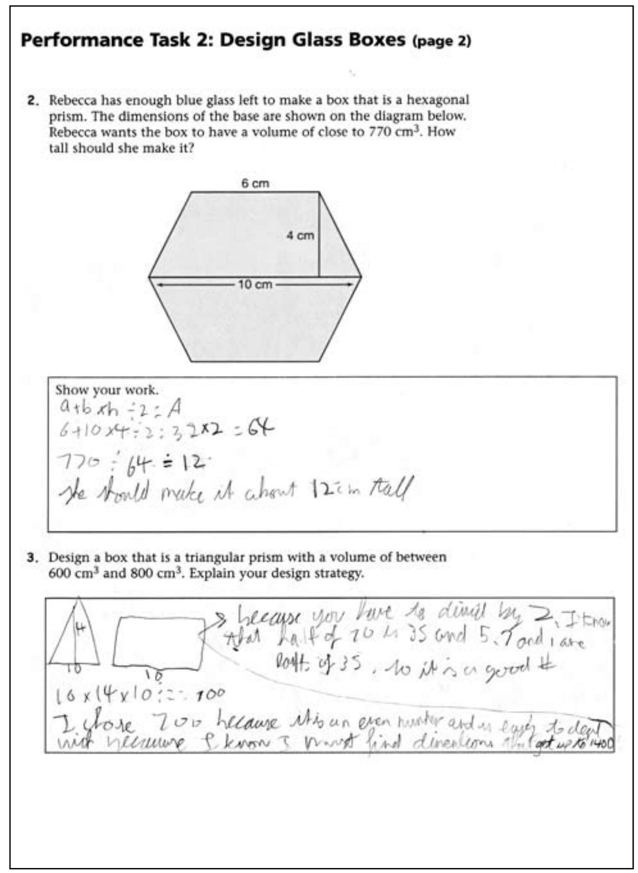
Performance Task 2: Design Glass Boxes (page 1)

Rebecca is taking stained-glass lessons. She wants to make three decorative glass boxes with lids. Each box will be a rectangular prism and have a volume of 1000 cm³ but will have different dimensions. For one of the boxes, she plans to use red glass, which is the most expensive. She wants this box to have the least surface area possible.

1. a) Design and draw three different boxes with lids and label which box should be made of red glass. Fill in the chart with the dimensions of each of your boxes.

Box	Length	Width	Height	Volume (cm³)	Surface Area (cm²)
1	10	10	10	1000cm³	600 cm²
2	10	5	20	1000cm³	700cm²
3	5	5	40	1000cm³	850cm²

b) Which box should be made of red glass? box 1



Performance Task 2: Design Glass Boxes (page 2)

2. Rebecca has enough blue glass left to make a box that is a hexagonal prism. The dimensions of the base are shown on the diagram below. Rebecca wants the box to have a volume of close to 770 cm³. How tall should she make it?

Show your work.

a+b×h÷2=A

6+10×4÷2=32×2=64

770÷64 ≐ 12

she should make it about 12cm tall

3. Design a box that is a triangular prism with a volume of between 600 cm³ and 800 cm³. Explain your design strategy.

10×14×10÷2=700

Performance Task 2: Design Glass Boxes LEVEL 3 (Anchor 2)

Knowledge and Understanding
- demonstrates an understanding of the volume of right prisms with simple polygonal bases
- shows some difficulty calculating surface area

Communication
- communicates with some effectiveness; clearly identifies most calculations
- provides written explanations where appropriate; diagram in question 3 lacks clarity and description of final measurements

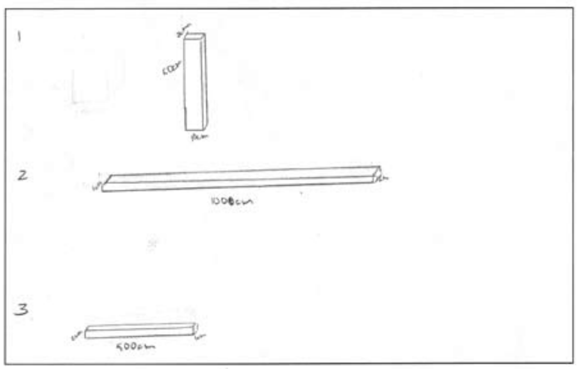
Thinking
- reveals considerable understanding of the problem, selects correct formulas, and uses efficient computational strategies to arrive at correct solutions, with the exception of two surface area calculations

Application
- displays ability to apply mathematical knowledge and skills (with two computational errors in question 1)
- uses understanding of the relationship between the volume of a rectangular prism and a triangular prism with the same dimensions to determine an answer in question 3

Performance Task 2: Design Glass Boxes (page 1)

Rebecca is taking stained-glass lessons. She wants to make three decorative glass boxes with lids. Each box will be a rectangular prism and have a volume of 1000 cm^3 but will have different dimensions. For one of the boxes, she plans to use red glass, which is the most expensive. She wants this box to have the least surface area possible.

1. a) Design and draw three different boxes with lids and label which box should be made of red glass. Fill in the chart with the dimensions of each of your boxes.

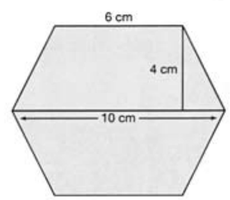


Box	Length	Width	Height	Volume (cm^3)	Surface Area (cm^2)
1	200cm	2cm	50cm	1000cm³	2090cm²
2	1000cm	1cm	1cm	1000cm³	4002cm²
3	500cm	2cm	1cm	1000cm³	4004cm²

b) Which box should be made of red glass? Box 2

Performance Task 2: Design Glass Boxes (page 2)

2. Rebecca has enough blue glass left to make a box that is a hexagonal prism. The dimensions of the base are shown on the diagram below. Rebecca wants the box to have a volume of close to 770 cm^3. How tall should she make it?



Show your work.

$A = \frac{(a+b)}{2} \times h \times 2$
$= (6cm + 10cm) \div 2 \times 4 \times 2$
$= (16cm \div 2 \times 4 \times 2$
$= 8cm \times 4 \times 2$
$= 32 cm^2 \times 2$
$= 64 cm^2$

$64 \overline{)770}$ → 12

$64 \times 12 = 768 cm^3$

She has to make it around 12cm.

3. Design a box that is a triangular prism with a volume of between 600 cm^3 and 800 cm^3. Explain your design strategy.

$V = (b \times h) \div 2 \times h$
$= (600cm \times 2cm) \div 2 \times 1cm$
$= 1200cm^2 \div 2 \times 1cm$
$= 600cm^2 \times 1cm$
$= 600cm^3$

I figured out what I have to do to make a rectangular prism with a volume of 1200cm³ so I can write the same base and height for the triangular prism. This works since the triangular prisms area would be divided to 600 then multiplyed by 1 which is 600cm³.

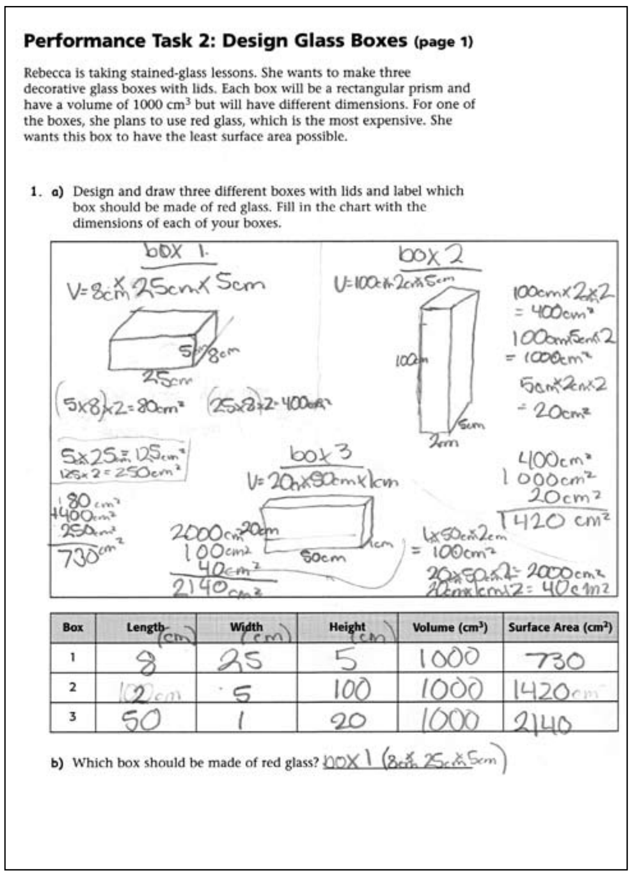
Performance Task 2: Design Glass Boxes LEVEL 4 (Anchor 1)

Knowledge and Understanding
- demonstrates a thorough understanding of the volume of right prisms with simple polygonal bases and the surface area of right prisms

Communication
- communicates with a high degree of effectiveness
- uses diagrams effectively, clearly identifies all calculations, and provides a written explanation where appropriate; in question 2, indicates why the standard formula for the area of a trapezoid is multiplied by 2 (there are two trapezoids)

Thinking
- demonstrates a thorough understanding of the problem, selects correct formulas, and uses efficient computational strategies to arrive at an accurate solution; accurately calculates the area of the base, and divides to determine the missing dimension

Application
- displays a sophisticated ability to apply knowledge of volume and surface area to solve problems



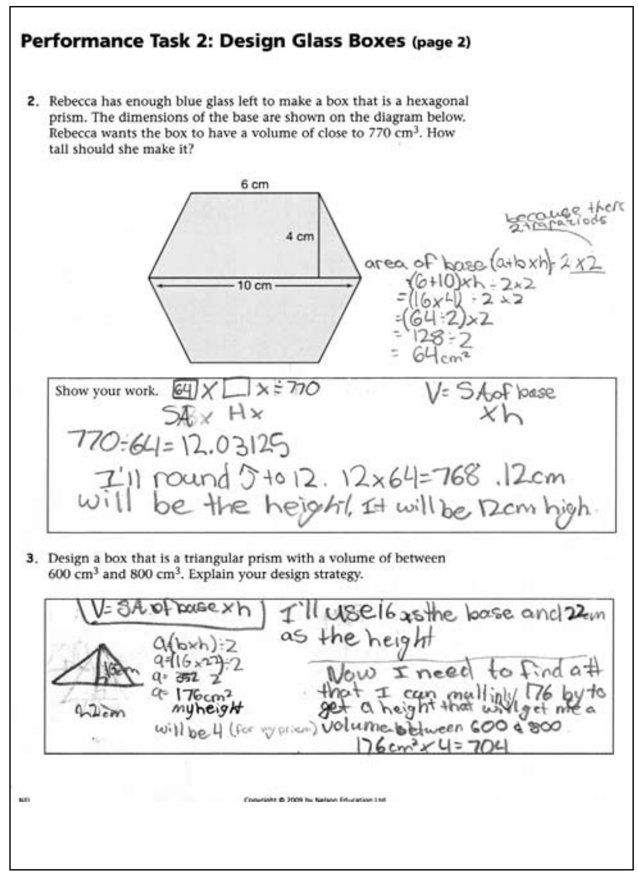
Performance Task 2: Design Glass Boxes (page 1)

Rebecca is taking stained-glass lessons. She wants to make three decorative glass boxes with lids. Each box will be a rectangular prism and have a volume of 1000 cm³ but will have different dimensions. For one of the boxes, she plans to use red glass, which is the most expensive. She wants this box to have the least surface area possible.

1. a) Design and draw three different boxes with lids and label which box should be made of red glass. Fill in the chart with the dimensions of each of your boxes.

Box	Length (cm)	Width (cm)	Height (cm)	Volume (cm³)	Surface Area (cm²)
1	8	25	5	1000	730
2	2 cm	5	100	1000	1420 cm²
3	50	1	20	1000	2140

b) Which box should be made of red glass? box 1 (8cm, 25cm, 5cm)



Performance Task 2: Design Glass Boxes (page 2)

2. Rebecca has enough blue glass left to make a box that is a hexagonal prism. The dimensions of the base are shown on the diagram below. Rebecca wants the box to have a volume of close to 770 cm³. How tall should she make it?

6 cm
4 cm
10 cm

area of base (a+b×h) ÷ 2 × 2 because there 2 trapezoids
= (6+10)×h ÷ 2 × 2
= (16×4) ÷ 2 × 2
= (64 ÷ 2) × 2
= 128 ÷ 2
= 64 cm²

Show your work. 64 × ☐ × = 770 SA × H × V = SA of base × h

770 ÷ 64 = 12.03125

I'll round 5 to 12. 12×64 = 768 .12 cm will be the height, It will be 12 cm high.

3. Design a box that is a triangular prism with a volume of between 600 cm³ and 800 cm³. Explain your design strategy.

V = SA of base × h

I'll use 16 as the base and 22 cm as the height

a (b×h) ÷ 2
a = (16×22) ÷ 2
a = 352 ÷ 2
a = 176 cm²
my height will be 4 (for my prism)

Now I need to find a # that I can multiply 176 by to get a height that will get me a volume between 600 & 800
176 cm² × 4 = 704

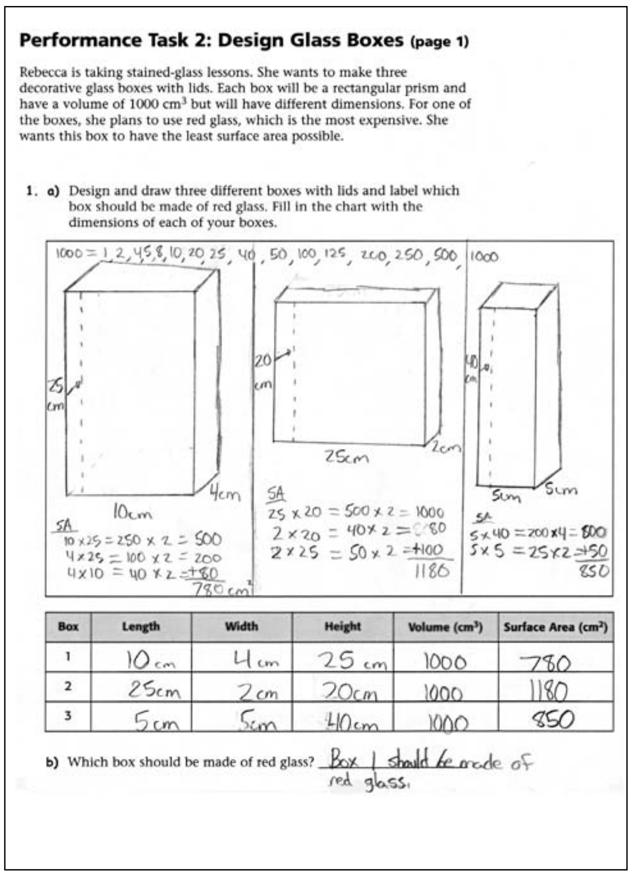
Performance Task 2: Design Glass Boxes LEVEL 4 (Anchor 2)

Knowledge and Understanding
- demonstrates a thorough understanding of the volume of right prisms with simple polygonal bases and of calculating surface area of right prisms

Communication
- communicates with a high degree of effectiveness
- uses diagrams effectively, clearly identifies all calculations, and provides a written explanation where appropriate

Thinking
- exhibits a thorough understanding of the problem, selects correct formulas, and uses appropriate computational strategies to arrive at an accurate solution
- applies the guess and check strategy in question 2 and logical reasoning in question 3

Application
- displays a sophisticated ability to apply knowledge of volume and surface area to solve problems



Performance Task 2: Design Glass Boxes (page 1)

Rebecca is taking stained-glass lessons. She wants to make three decorative glass boxes with lids. Each box will be a rectangular prism and have a volume of 1000 cm³ but will have different dimensions. For one of the boxes, she plans to use red glass, which is the most expensive. She wants this box to have the least surface area possible.

1. a) Design and draw three different boxes with lids and label which box should be made of red glass. Fill in the chart with the dimensions of each of your boxes.

1000 = 1, 2, 4, 5, 8, 10, 20, 25, 40, 50, 100, 125, 200, 250, 500, 1000

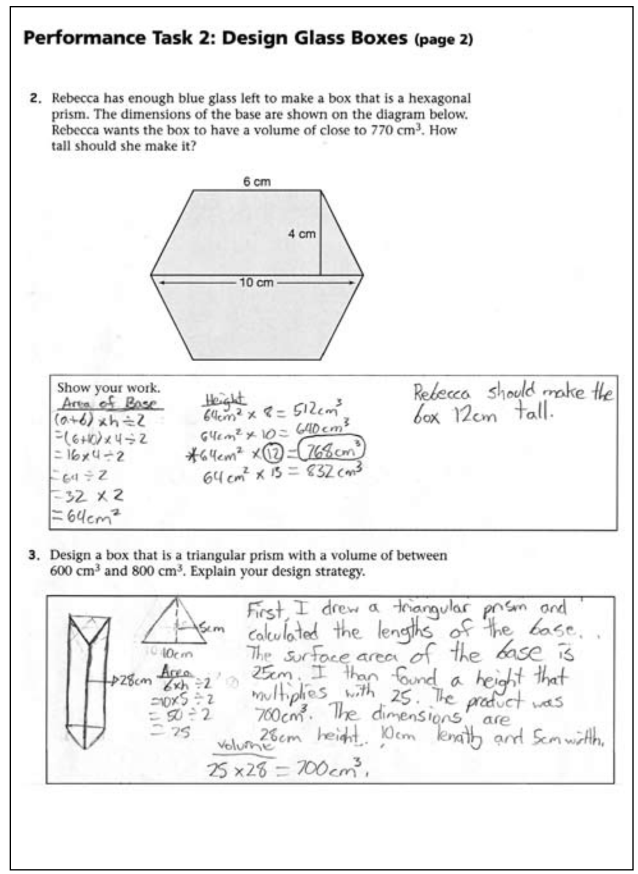
SA
10 x 25 = 250 x 2 = 500
4 x 25 = 100 x 2 = 200
4 x 10 = 40 x 2 = +80
780 cm²

SA
25 x 20 = 500 x 2 = 1000
2 x 20 = 40 x 2 = 80
2 x 25 = 50 x 2 = +100
1180

SA
5 x 40 = 200 x 4 = 800
5 x 5 = 25 x 2 = +50
850

Box	Length	Width	Height	Volume (cm³)	Surface Area (cm²)
1	10 cm	4 cm	25 cm	1000	780
2	25 cm	2 cm	20 cm	1000	1180
3	5 cm	5 cm	40 cm	1000	850

b) Which box should be made of red glass? Box 1 should be made of red glass.



Performance Task 2: Design Glass Boxes (page 2)

2. Rebecca has enough blue glass left to make a box that is a hexagonal prism. The dimensions of the base are shown on the diagram below. Rebecca wants the box to have a volume of close to 770 cm³. How tall should she make it?

Show your work.
Area of Base
(a+b) x h ÷ 2
= (6+10) x 4 ÷ 2
= 16 x 4 ÷ 2
= 64 ÷ 2
= 32 x 2
= 64 cm²

Height
64 cm² x 8 = 512 cm³
64 cm² x 10 = 640 cm³
64 cm² x 12 = 768 cm³
64 cm² x 13 = 832 cm³

Rebecca should make the box 12 cm tall.

3. Design a box that is a triangular prism with a volume of between 600 cm³ and 800 cm³. Explain your design strategy.

5 cm, 10 cm, 28 cm

Area
b x h ÷ 2
= 10 x 5 ÷ 2
= 50 ÷ 2
= 25

First, I drew a triangular prism and calculated the lengths of the base. The surface area of the base is 25 cm. I than found a height that multiplies with 25. The product was 700 cm³. The dimensions are 28 cm height, 10 cm length and 5 cm width.

volume
25 x 28 = 700 cm³.

Next Steps for Measurement

Instructional Next Steps for Overall Expectations

After summarizing individual and class performance on each the of overall expectations, you may find that there are areas that could be retaught to some students. The following suggestions have been provided to assist you in preparing tasks for individuals or small groups of students.

Overall Expectation 7m31 (Attributes, Units, and Measurement Sense)
Report on research into real-life applications of area measurements.

Background

This overall expectation is about applying an understanding of area to real life. By the end of Grade 7, students will have had many experiences calculating the area of two-dimensional shapes using a variety of strategies. For this expectation, students build on their foundational learning from earlier grades. By the end of Grade 7, students should

- understand that the area of an object is a two-dimensional attribute
- be familiar with standard units of area (square centimetre, square metre, and square kilometre)
- develop referents for each standard unit of area and be able to use units appropriately
- be able to calculate the area of composite shapes by applying area formulas for familiar shapes drawn inside or outside the shape in question
- recognize that the surface area of 3-D shapes may be calculated
- recognize that there are many real-life situations that require knowledge of area

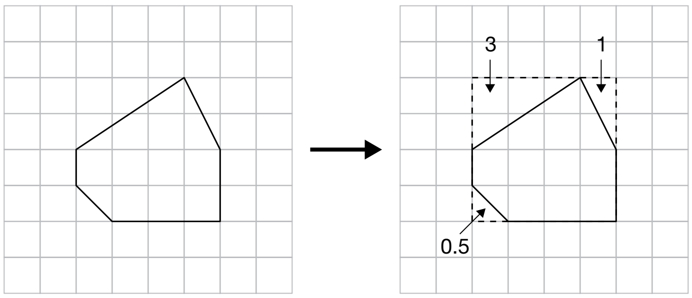
Strategies

Revisiting Formula Development

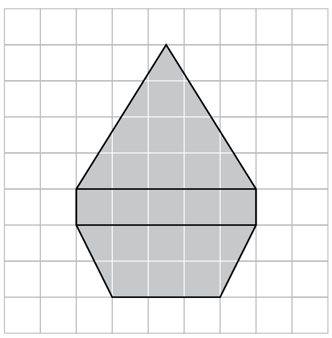
A formula describes a shape in terms of relationships among its component measurement attributes. By Grade 8, students will have developed and be able to use formulas for determining the areas of rectangles, parallelograms, triangles, and trapezoids. Students who apply a formula to the wrong shape or who have difficulty remembering a formula may need to review the development of the formula. For example, provide a rectangle on a centimetre grid and have students relate the number of rows and columns to the formula for area. Then have them draw a diagonal of the rectangle and determine the area of one of the resulting triangles. Have them relate this area to the area of the rectangle and develop the formula for the area of a triangle. Continue with the development of the formulas for the area of a parallelogram and a trapezoid as necessary.

Composing

Give students opportunities to decompose and/or redraw shapes onto shapes that have areas that can be calculated using a formula. For example,



A = area of square − area of 3 triangles
= 16 − (3 + 1 + 0.5) = 11.5 square units



A = area of triangle + area of rectangle + area of trapezoid
= 10 + 5 + 8
= 23 square units

Students need many experiences calculating the areas for composite shapes by decomposing them into shapes for which there are area formulas. In the first example above, the area of the rectangle that will enclose the shape is determined and then the "extra" areas are subtracted from the whole. This is not an easy relationship for some students to identify. In the second example, a shape is decomposed into three shapes for which there are known area formulas.

Have students practise determining area through decomposition and then share strategies so that everyone can see that there is more than one way to decompose a shape. Make mathematical connections between the strategies so that students will begin to understand area relationships and expand on the ways in which they can solve area problems independently.

Constructing

Help students make the connection between real life and area measurement by using contexts and references beyond formal mathematics instruction. For example, have students do one of the following:

- build a ramp for model cars/trains/hamsters, or design skateboard or snowboard ramps

- using centimetre grid paper, plan a number of interesting garden shapes for a new park or horticultural centre. Students can determine the area of each garden as well as the area of the paths between the gardens. Each garden could have a decorative stone border, and students could calculate the area of the stone border. Students should include a scale on their plans.

Overall Expectation 7m32 (Measurement Relationships)

Determine the relationships among units and measurable attributes, including the area of a trapezoid and the volume of a right prism.

Background

This overall expectation deals with relationships among units and measurable attributes. In Grade 7, students solve problems involving estimating and calculating the areas of familiar geometric shapes. They investigate and apply their understanding of relationships between metric units, areas of familiar shapes, base area and volume of right prisms, and surface area of right prisms. By the end of Grade 7, students should be able to

- solve problems that require conversion between metric units of measure
- develop the formula for the area of a trapezoid
- estimate and calculate the area of composite two-dimensional shapes by decomposing into shapes with known area relationships
- understand the relationship between the area of the base and the volume of right prisms
- sketch polygonal prisms
- determine surface area of right prisms

Having students use a hands-on approach means that the formulas are less likely to be forgotten, will be used in a flexible way, and are more likely to be expanded and adapted appropriately.

Strategies

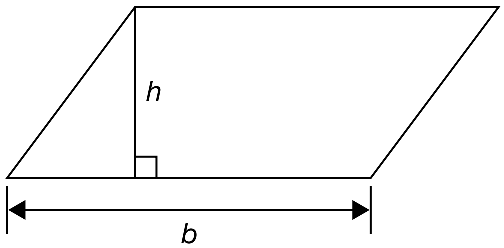
Unit Relationships

Use base ten blocks to help students visualize area units. Have them examine a hundreds block and relate this to a 10 cm by 10 cm area, or 100 cm^2. Have them outline a square metre using metre sticks and/or masking tape on the floor. Then have them place as many hundreds blocks as are available in that square, and imagine how many hundreds blocks it will take to completely cover the square. Relate this to a 100 cm by 100 cm area, which is the same as a 1 m by 1 m area, or 10 000 cm^2 or 1 m^2.

Have students design two possible mural sizes for the school hall. Explain that the murals will be rectangles and must have a total area of between 1.5 m^2 and 2.5 m^2. Explain that the murals will be created using square centimetre tiles. Have students then calculate the number of tiles that will be required for each of the murals.

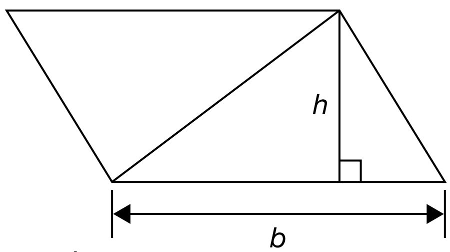
Developing Formulas

One development of the formula for a trapezoid depends on an understanding of the formula for a parallelogram.



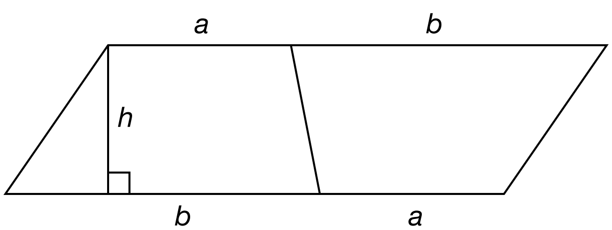
$A = bh$

A triangle can be one half the area of a parallelogram with the same base and height.



$A = \frac{1}{2}bh$

A trapezoid can be one half of the area of a parallelogram.



$A = h\left(\frac{a + b}{2}\right)$

Students need time to manipulate these relationships concretely and make connections to the formula before they will understand both the similarities and differences between the two formulas. Students will then be able to reconstruct their learning if memorization fails.

Have students investigate formula relationships using Power Polygons. Ask them to select pairs of congruent triangles and trapezoids. Have students combine each pair to form a parallelogram and then trace the pairs on paper. Then ask students to measure the dimensions of the triangles and trapezoids as well as the parallelograms that they have created. Finally, have students explain how the measurements relate to the formulas for triangles, trapezoids, and parallelograms. If Power Polygons are not available, students may use polygons cut from cardstock.

Measurement

Not Always Biggest

Have students draw nets for 3-D objects for which they are determining the surface area. Knowing that the surface area of a prism is simply the sum of the area of all of the faces is generally more helpful than memorizing a formula for a specific shape.

Provide students with three empty boxes (e.g., cereal boxes, cracker boxes, pencil boxes, etc.). Have them estimate the order for both volume and surface area. Then have students determine volume and surface area. Allow students to cut the boxes to create nets as they determine the surface area. Discuss any observations. Use the examples to link to the formula for surface area as simply a way of systematically organizing the areas of all the faces.

Building Prisms

Students who have difficulty determining the volume of right prisms that do not have a rectangular base may use cubes to help with their understanding. They can use the cubes to construct rectangular prisms, calculate the volume, and then use that information to generalize to other right prisms. Have students build a 5 cm $\times$ 4 cm base with centimetre cubes. They can place this on grid paper to confirm the area of the base. This prism has a volume of $5 \times 4 \times 1$. As layers are stacked, the total number of cubes changes predictably; $5 \times 4 \times 2$, $5 \times 4 \times 3$, $5 \times 4 \times 4$, and so on. Understanding this relationship, where cubes can be counted to verify calculations, will help students to understand that the volume of any prism is always the area of the base times the height. Students could use pattern blocks to create bases that are triangles, hexagons, trapezoids etc., and then stack layers to confirm that the formula for the volume of prisms (base area $\times$ height) applies to any base.