

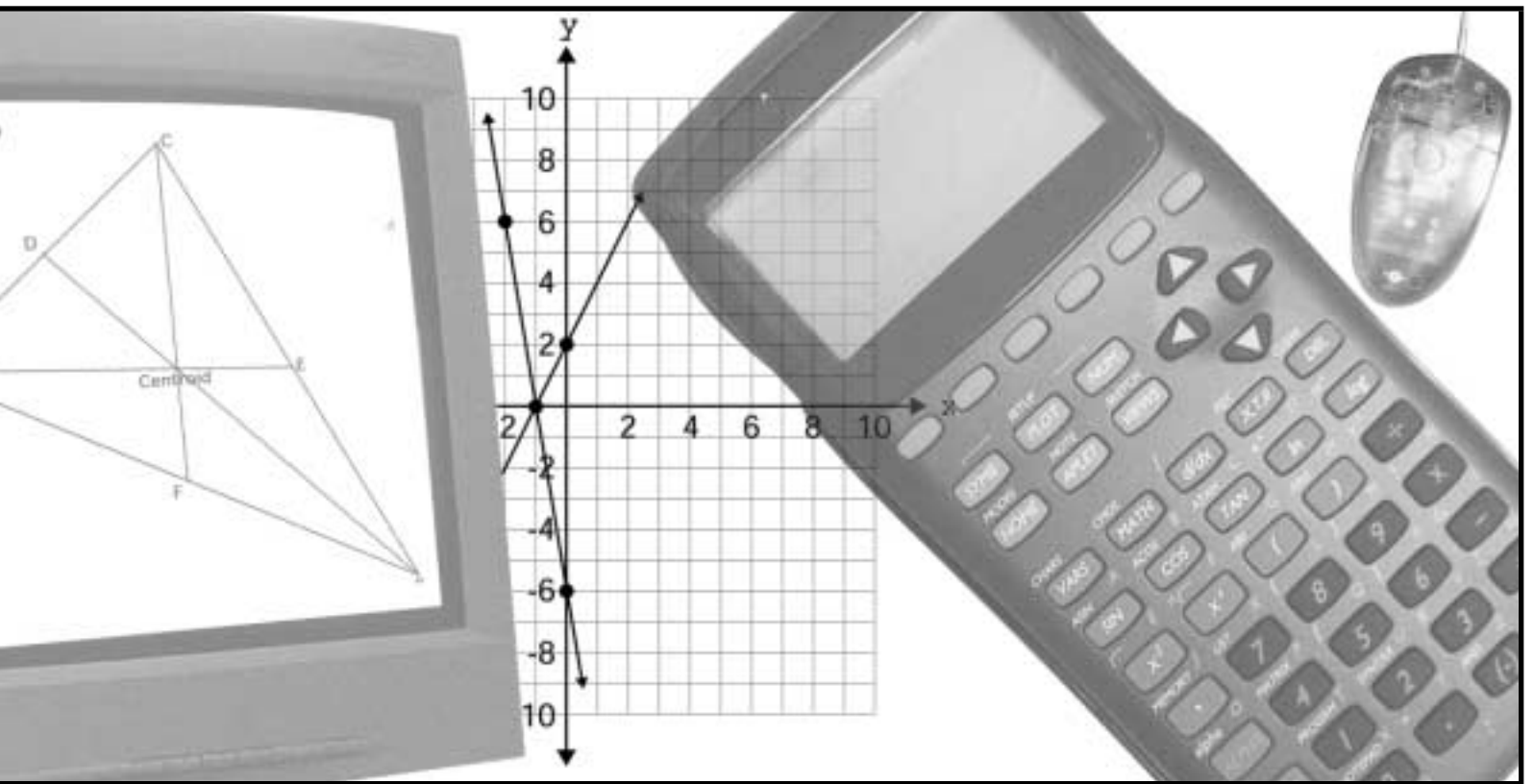
Grade 9 Assessment of Mathematics, 2000–2001

Release Items

Academic Program



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Multiple-Choice Questions

Release Materials



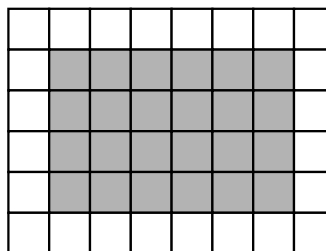
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Directions to Students about Answering Multiple-Choice Questions

- For this part of the assessment, make sure that you have the following materials along with *Booklet 1*:
 - a *Student Answer Sheet*
 - an HB pencil and an eraser
 - a ruler and a protractor
 - a scientific calculator or a graphing calculator
 - some paper for rough work
- Be sure to read the problem and all four answer choices for each question carefully. When you choose an answer, fill in the circle on your answer sheet that goes with that answer.
- Always choose the best answer. Mark only one answer for each question.
- There are 24 questions in *Booklet 1*. Try to answer all of them. Do not spend too much time on any one question.
- Figures in this section are not drawn to scale.
- Now do the following sample question. Fill in your choice on your *Student Answer Sheet* in the sample question box.

Sample Question


Find the area of the shaded region in the rectangle below.



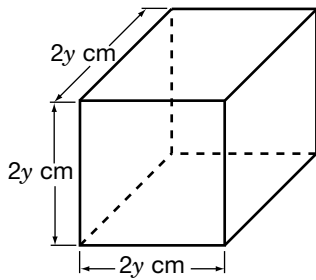
 1 square unit

- A 16 square units
- B 24 square units
- C 30 square units
- D 36 square units

For the sample question, you should have filled in the circle \textcircled{B} on your answer sheet. If you did not mark the circle that goes with B, erase the answer you marked and fill in the correct answer.

- You will have **30 min** to do the 24 multiple-choice questions.
- When you see the  sign, you have completed *Booklet 1*. Check your answers. Then wait quietly for directions from your teacher.

1. Each side of a cube is $2y$ cm long. What is the volume of the cube?



- A $8y^3 \text{ cm}^3$
 B $6y \text{ cm}^3$
 C $4y^3 \text{ cm}^3$
 D $2y \text{ cm}^3$
2. The total cost, C , in dollars, of running an advertisement in a newspaper is made up of an initial cost of \$12, plus a charge of \$5 per day, where n represents the number of days.



Which equation represents this relationship?

- F $C = 12n + 5$
 G $C = 12 + 5n$
 H $C = (12 + 5)n$
 J $C = 12 + 5 \div n$

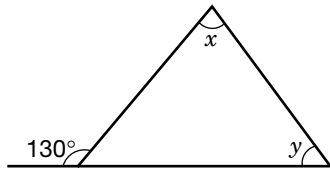
3. The cost, C , in dollars to print leaflets, n , is given by the formula
 $C = 35 + 0.03n$.



What is the cost of printing 900 leaflets?

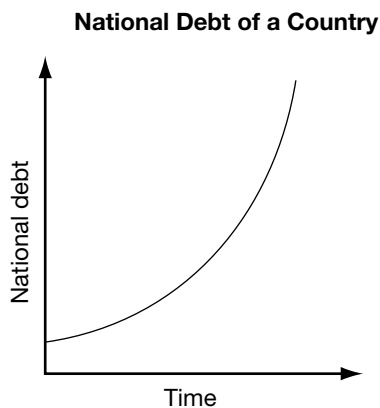
- A \$27.00
 B \$35.00
 C \$37.70
 D \$62.00
4. Simplify the following expression.
 $(x^2 + 4x + 3) + x(3 - x)$
- F $x + 3$
 G $3x$
 H $7x + 3$
 J $-2x^2 + 4x + 3$

5. Pat draws this figure.



What is the relationship between the angles in this diagram?

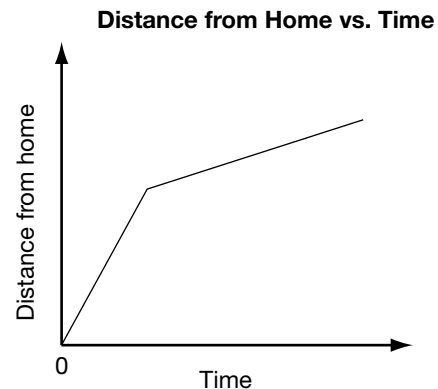
- A $y = x$
 - B $y = x + 50^\circ$
 - C $x + y = 50^\circ$
 - D $x + y = 130^\circ$
6. Study the following graph that shows the relationship between the national debt of a country and time.



Which statement is true?

- F The national debt is growing linearly.
- G The national debt is growing non-linearly.
- H As time increases, the national debt decreases.
- J As time increases, the national debt stays constant.

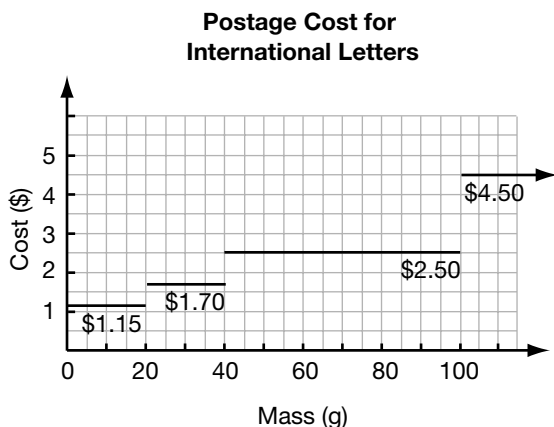
7. In the morning, Sylvie left home to go to school. The graph below shows her distance from home versus time.



Which sequence of events below is best represented by the graph?

- A She runs for several minutes. Then she tires and walks instead.
- B She walks for several minutes. Then she turns around and goes home.
- C She walks for several minutes. Then she stops to chat with a neighbour.
- D She walks for several minutes. Then she sees Ken ahead and runs to meet him.

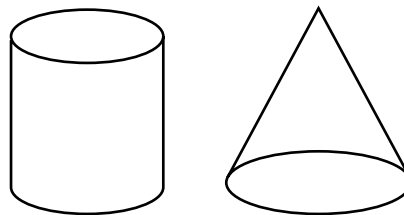
8. The graph shows how the cost of postage for an international letter is related to the mass of the letter.



Elaine mailed two separate letters to the same address. If the masses of the letters were 19 g and 36 g, how much would she have saved by mailing them together in a single envelope? Do not include the mass of the envelopes in your calculation.

- (F) \$0.35
- G \$0.80
- H \$0.90
- J \$2.85

9. Yin measures a solid cylinder and a solid cone and finds that the solids have the same height and same base diameter.



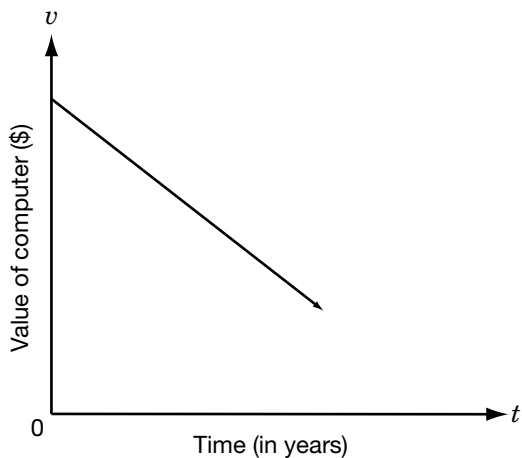
Which of the following statements is true?

- (A) The volume of the cylinder is equal to three times the volume of the cone.
- B The total surface areas of the cylinder and cone are the same.
- C The volumes of the cylinder and cone are the same.
- D The total surface area of the cylinder is equal to three times the total surface area of the cone.

10. A computer is expected to decrease in value over time. The relationship between the value, v , of the computer in dollars after t years is written as the following equation:

$$v = -300t + 2100$$

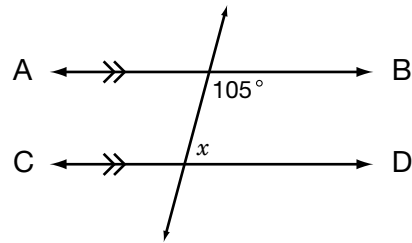
A line representing the relationship is graphed.



What does the v -intercept of the line represent?

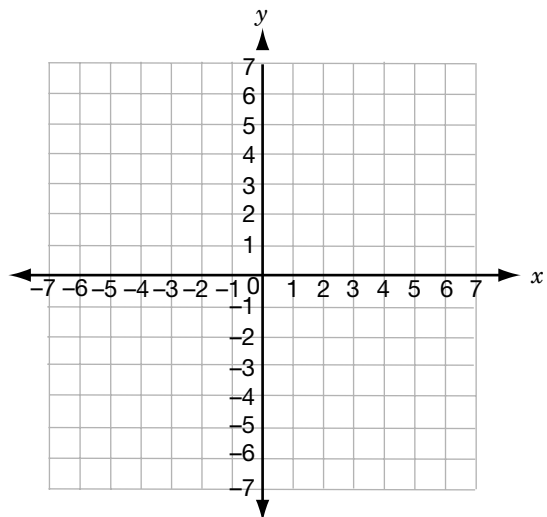
- F the decrease in value per year
- G** the initial value of the computer
- H the number of years until the value is \$0
- J the number of years the computer will work

11. In the figure below, AB is parallel to CD .



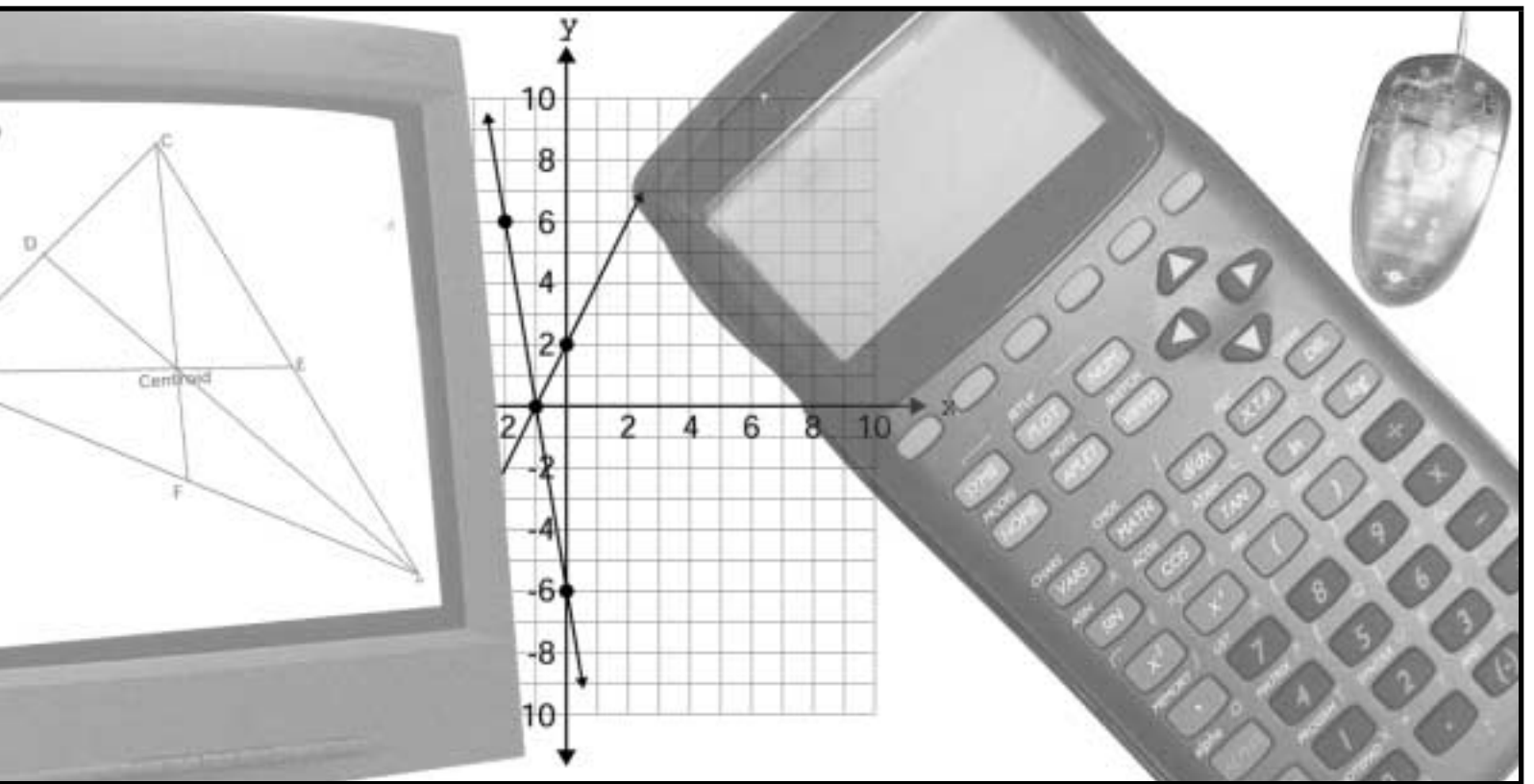
What is the value of x ?

- A** 75°
 - B 85°
 - C 95°
 - D 105°
12. What are the coordinates of the point of intersection of the lines $y = -x + 1$ and $x = 3$?



- F** $(3, -2)$
- G $(3, 2)$
- H $(2, 3)$
- J $(-2, 3)$





Short Answer Items


Release Materials



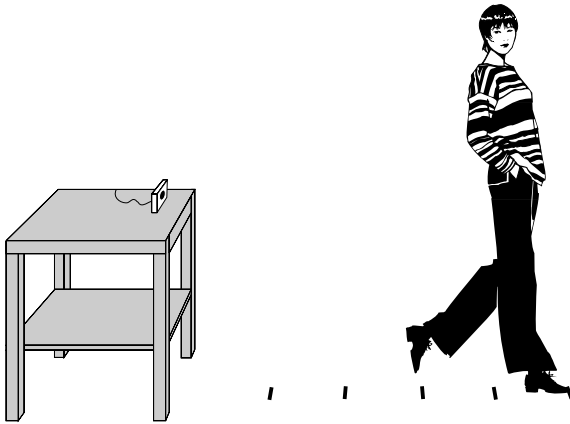
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Directions to Students about Answering Short Answer Items

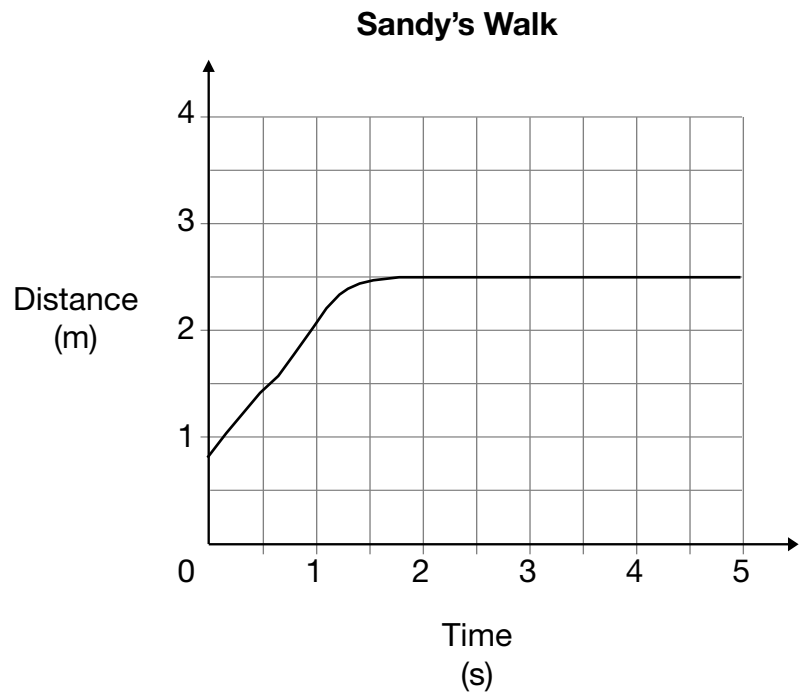
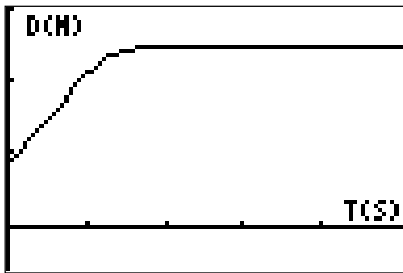
1. For this part of the assessment, make sure you have the following items along with *Booklet 3*:
 - a pencil and an eraser or a pen
 - a scientific or a graphing calculator
 - a ruler and a protractor
2. Do all of your work (even rough work) in *Booklet 3*.
3. You will have 30 min to do these 10 items. That means you have about 3 min for each one. Give yourself time to answer all of the questions.
4. Figures in this section are not drawn to scale.
5. These questions are designed to get you to think deeply about the mathematics you know but they do not require you to write a great deal. Be sure to watch for the terms listed in the *Key Words and Phrases in Instructions* and do just what the prompt asks you to do.

For example, the question might ask you to “**Explain** your answer.” The *Key Words and Phrases in Instructions* sheet says, “**Explain** means to use words and symbols to make your solutions clear and understandable.” As soon as you can explain a mathematical reason for the answer, do so. You do not need to provide lots of calculations to illustrate your point.
6. In short answer questions, you do not have to provide lots of examples to illustrate your answer. Write a short answer.
7. You have **30 min** to work.
8. When you see the  sign, you have completed *Booklet 3*. Check your answers. Then wait quietly for directions from your teacher.

1. Sandy walked away from a motion detector.



Below is a screen captured from the graphing calculator and a graph representing her walk.



Describe Sandy's walk using mathematical language.

Use any of the information presented above.

Sandy began her walk at about 80 cm away from the motion detector. She walked at a constant rate until she was 2.5 m away from the motion detector, which was at time 1.5 seconds. She then remained standing still until 5 seconds were up.

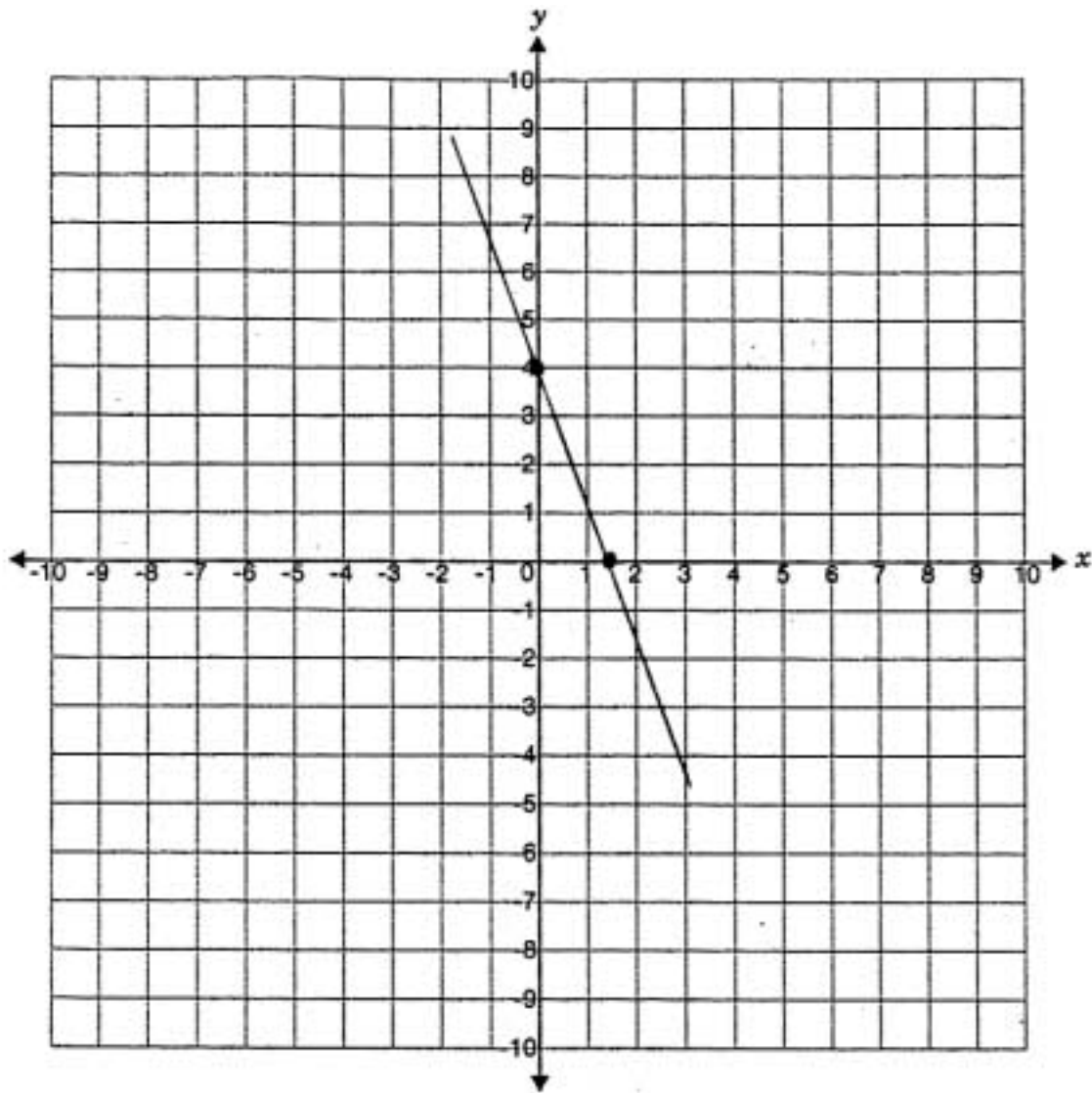
Coding Guide for Question 1

Question Number	Codes			Category and Strand
	0	1	2	
1	<ul style="list-style-type: none"> • description of walk is incorrect or • description of walk includes one correct feature and the rest is incorrect or missing (e.g., Sandy began with a brisk walking speed and reached a comfortable speed that she could keep) 	<ul style="list-style-type: none"> • description of walk is correct and includes two of the following features: <ul style="list-style-type: none"> – initial position (≈ 0.8 m) – final position (2.5 m) – distance travelled (≈ 1.7 m) – action of stopping – she walks away from the motion detector – speed is constant – speed (≈ 1 m/s) – travel time (≈ 1.5 s) – amount of time stopped (≈ 3.5 s) 	<ul style="list-style-type: none"> • description of walk is correct and includes three or more of the following features: <ul style="list-style-type: none"> – initial position (≈ 0.8 m) – final position (2.5 m) – distance travelled (≈ 1.7 m) – action of stopping – she walks away from the motion detector – speed is constant – speed (≈ 1 m/s) – travel time (≈ 1.5 s) – amount of time stopped (≈ 3.5 s) 	AP R

Assigned Code and Rationale for Student Work

Question	Code	Rationale
1	2	<ul style="list-style-type: none"> • The general description of the walk includes discussion of Sandy's starting position, direction, rate and stopping position. The student response contains three or more features stated in the scoring guide: an initial position of 80 cm, travel time of 1.5 seconds and a final position of 2.5 m away from the motion detector.

2. **Graph** the line with a y -intercept of 4 and a slope of $\frac{1}{2}$.



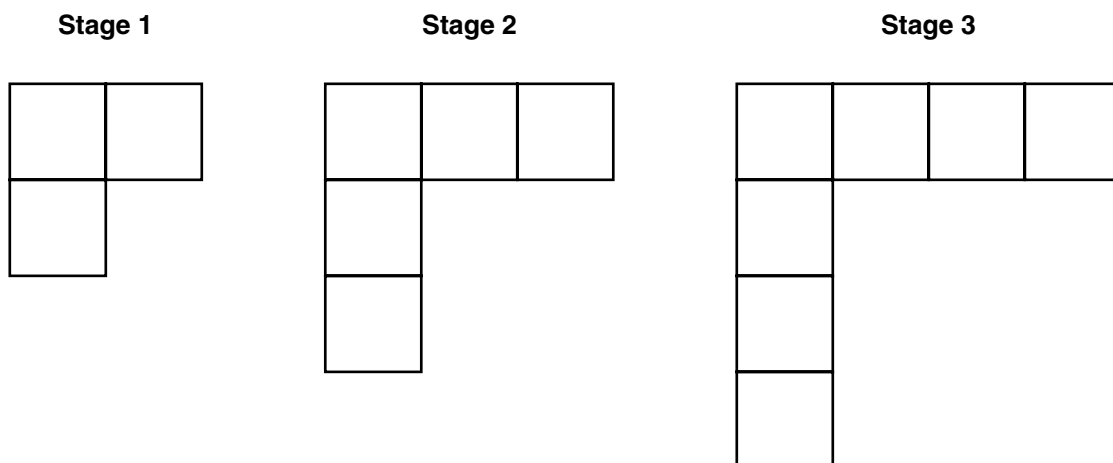
Coding Guide for Question 2

Question Number	Codes			Category and Strand
	0	1	2	
2	<ul style="list-style-type: none"> more than one error in graphing the line 	<ul style="list-style-type: none"> one error in graphing the line (e.g., the line drawn has slope 2 or $-\frac{1}{2}$ or the intercept of 4 has been drawn as an x-intercept) no line drawn through two or more correct points 	<ul style="list-style-type: none"> correct graph (e.g., y-intercept of 4 and x-intercept of -8 or y-intercept of 4 and slope of $\frac{1}{2}$) Note: arrows at the ends of the line are not necessary 	KU G

Assigned Code and Rationale for Student Work

Question	Code	Rationale
2	1	<ul style="list-style-type: none"> The y-intercept of 4 is graphed correctly, but there is an error in determining the slope.

3. Louis and Marcia are investigating how many tiles they need to make a certain pattern shown below.



They gather data for the first five stages.

Stage	Number of tiles
1	3
2	5
3	7
4	9
5	11

They have been asked to find the number of tiles needed for Stage 50.

- Louis wants to extend the table and use the patterns he sees to find the answer.
- Marcia wants to model the data with a formula and calculate the answer.

Evaluate their mathematical models and tell which method you would choose.

Give reasons for your answer.

Louis

6	13	14	29
7	15	15	31
8	17	16	33
9	19	17	35
10	21	18	37
11	23	19	39
12	25	20	41
13	27	21	43
		22	45

Marcia $50 \times 2 + 1 = 101$
 stage 50 = 101 tiles
 formula = $a_1 + 2(x-1)$
 Marcia's way takes less time to perform.
 It is more mathematical
 easy to prove your work

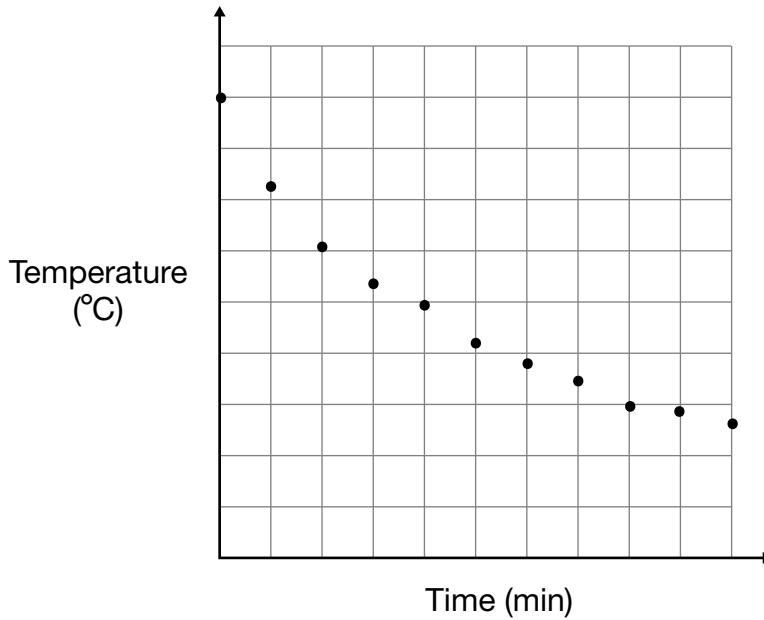
Coding Guide for Question 3

Question Number	Codes			Category and Strand
	0	1	2	
3	<ul style="list-style-type: none"> provides no evidence of logical reasoning or selects an approach to the question with no reasons given 	<ul style="list-style-type: none"> provides evidence of reasoning that is somewhat logical or incomplete with or without an appropriate conclusion (e.g., makes reference to only one method: “I would pick Louis’s method because I know I can do that” or “I would pick Marcia’s because it is quicker.”) 	<ul style="list-style-type: none"> provides evidence of logical reasoning that makes reference to both methods, with appropriate conclusion based on reasoning (e.g., “I would pick Marcia’s because I could find a formula easily and that would be faster than writing out 50 rows of the table.”) 	PS N

Assigned Code and Rationale for Student Work

Question	Code	Rationale
3	2	<ul style="list-style-type: none"> Both Marcia’s and Louis’s methods are shown and an appropriate conclusion has been drawn based on the student’s previous work.

4. A temperature probe is placed in a cup of hot water. A temperature reading is taken from the probe every minute. The results are shown on the graph below.



Describe the relationship between temperature and time (e.g., describe how the temperature of the water changes over time, predict what will happen in future readings). Suggest scales for the axes.

The water cools down every minute. The water ^{temperature} dropped a lot towards the beginning but gradually started to decrease less and less each minute. It will warm until it meets the temperature around it.

Coding Guide for Question 4

Question Number	Codes			Category and Strand
	0	1	2	
4	<ul style="list-style-type: none"> incorrect description (e.g., temperature increases) 	<ul style="list-style-type: none"> incomplete description of relationship between temperature and time (e.g., temperature decreases; water gets colder; as time increases, temperature decreases) 	<ul style="list-style-type: none"> complete, general description of relationship between temperature and time (e.g., temperature decreases with time and then levels off) <p>Note: scales may or may not be mentioned</p>	PS R

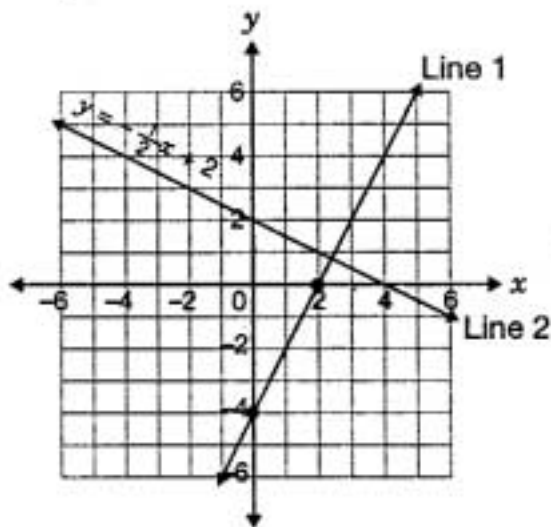
Assigned Code and Rationale for Student Work

Question	Code	Rationale
4	2	<ul style="list-style-type: none"> The complete relationship between temperature and time is described in the student response.

5. Two lines are shown on the graph below.

Line 1 passes through the points (0, -4) and (2, 0).

Line 2 has the equation $y = -\frac{1}{2}x + 2$.



$$\text{slope} = \frac{\text{rise}}{\text{run}}$$

$$= \frac{4}{2}$$
$$= 2$$

$$\text{slope} = \frac{\text{rise}}{\text{run}}$$

$$= \frac{-2}{1}$$
$$= -2$$

Explain what is different about the slopes of the two lines.

They both have the same slope but Line 2 is negative and Line 1 is positive.

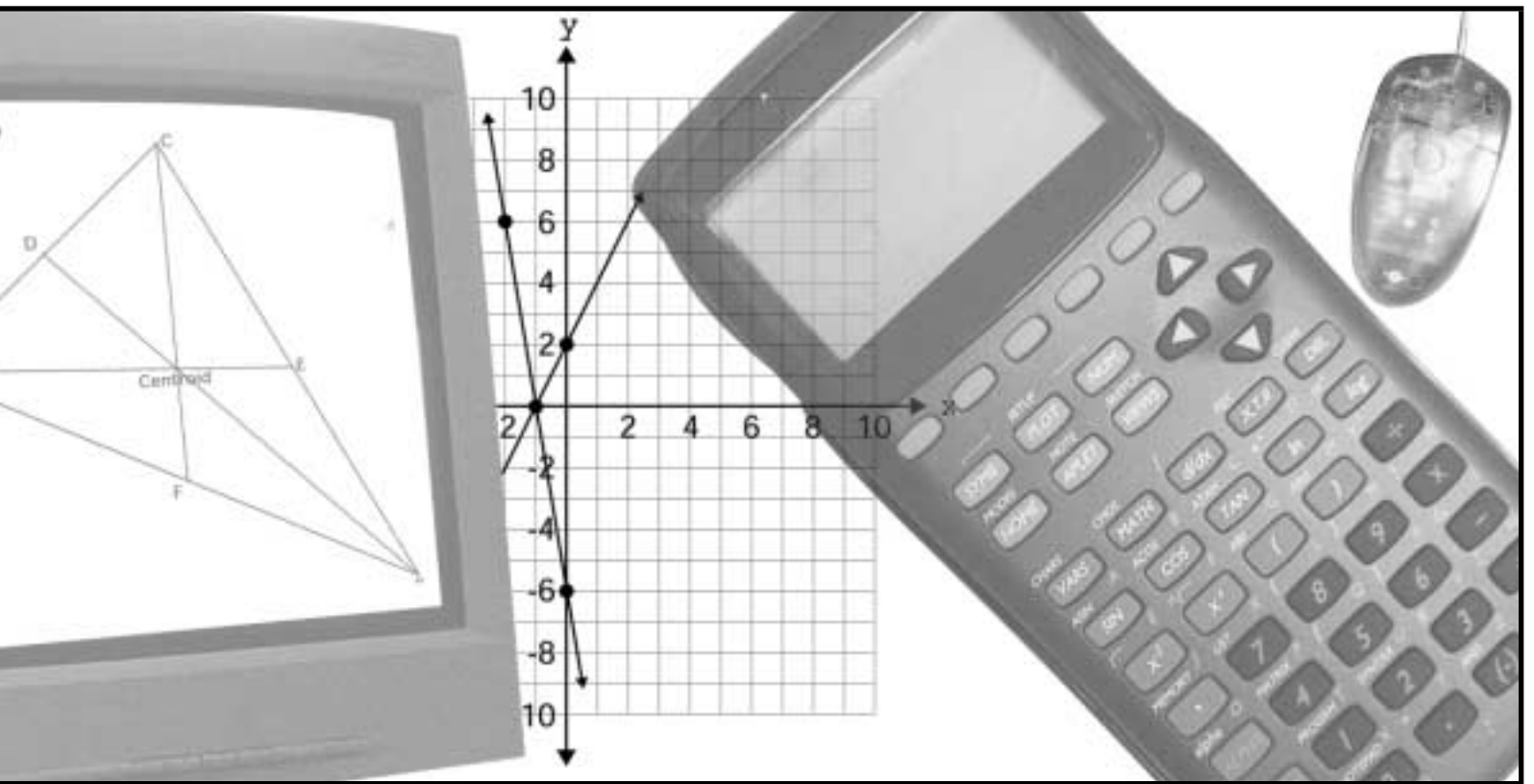


Coding Guide for Question 5

Question Number	Codes			Category and Strand
	0	1	2	
5	<ul style="list-style-type: none"> inappropriate properties listed (i.e., not slope properties) 	<ul style="list-style-type: none"> a partially accurate comment on one of the following: signs, direction, or steepness (e.g., same slope but L1 is positive and L2 is negative, or L1 is negative and L2 is positive) or no direct reference to each line (e.g., one line is positive and the other is negative) 	<ul style="list-style-type: none"> accurately comments on one of the following: signs, direction or steepness with direct reference to each line (e.g., line 1 is steeper than line 2) 	AP G

Assigned Code and Rationale for Student Work

Question	Code	Rationale
5	1	<ul style="list-style-type: none"> A partially accurate comment comparing the slopes of the two lines is provided. The student is correct in stating that the slope of line 2 is negative, while the slope of line 1 is positive.



Tasks

Release Materials




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Directions to Students about Answering Tasks

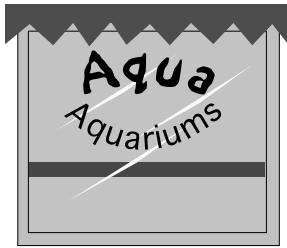
1. For this part of the assessment, make sure you have the following items along with *Booklet 2*:
 - a pencil and an eraser or a pen
 - a scientific or a graphing calculator
 - a ruler and a protractor
2. Do all of your work (even your rough work) in *Booklet 2*.
3. You will have 40 min to do 3 tasks. Allow about 15 min for Tasks 1 and 2 and about 10 min for Task 3. Give yourself time to answer all of the questions.
4. Figures in this section are not drawn to scale.
5. The tasks are designed to allow you an opportunity to show what you know and what you can do. Provide as much information as you can to show your understanding. Your teacher may be marking some of your work. In addition, someone who does not know your work will mark all of it, including what your teacher has marked. So, you must provide clear, well-organized answers to illustrate your complete understanding and ability to communicate in mathematics.
6. Make sure you follow directions from the *Key Words and Phrases in Instructions* sheet. It is provided for you so you will know the kind of question that is being asked.

For example, the question might ask you to “**Show your work.**” Read the *Key Words and Phrases in Instructions* sheet. It says to record all calculations. If you use your calculator, you need to show what calculations you do. If you sketch a graph in the process of getting to your solution, show the sketch and label it. Use proper and correct mathematical conventions when you present your work.
7. When using a calculator, write down the numbers and operations that you carried out on the calculator.

For example: Find the area of a circle with diameter of 7 cm.

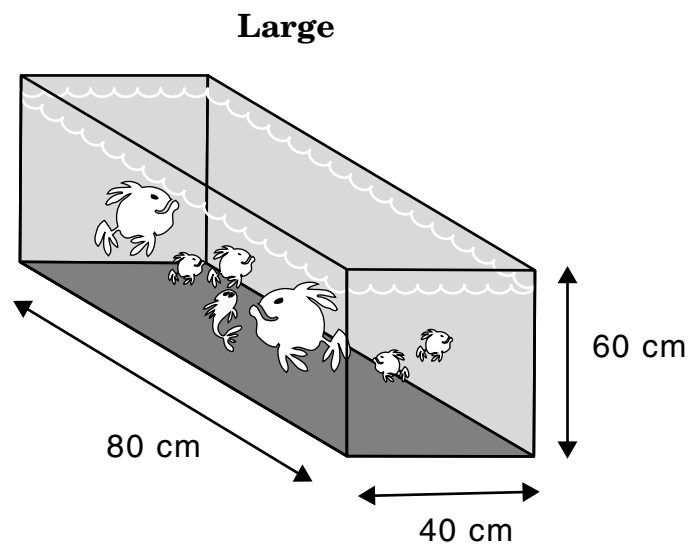
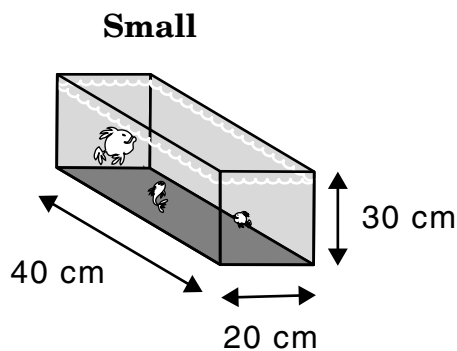
You need to write $A = \pi(3.5)^2$ as well as the answer you got on your calculator.
8. There are always many different ways to solve a problem. Use your broad range of mathematical knowledge to present a complete and creative solution to each question.
9. You have **40 min** to work.
10. When you see the  sign, you have completed the work for the day. Check your answers. Then wait quietly for directions from your teacher.

Task 1: Aquarium



Aqua Aquariums sells aquariums in the shape of rectangular prisms. The aquariums are available in two sizes, small and large, with dimensions as shown. Each aquarium has glass sides and bottom, but no top.

NOTE: These aquariums are NOT drawn to scale.



a) Calculate the volume of each aquarium.

Small

$$\begin{aligned} V &= lwh \\ &= 40 \times 20 \times 30 \\ &= 24\,000 \text{ cm}^3 \end{aligned}$$

Large

$$\begin{aligned} V &= lwh \\ &= 80 \times 40 \times 60 \\ &= 192\,000 \text{ cm}^3 \end{aligned}$$

- b) Calculate the total outside surface area of each aquarium.

HINT: The aquariums have no tops.

<p style="text-align: center;">Small</p> $ \begin{aligned} A_{\text{total}} &= wh + wh + lw + lh + lh \\ &= (20 \times 30) + (20 \times 30) + (40 \times 20) + (40 \times 30) + (40 \times 30) \\ &= 1200 + 800 + 2400 + 40 \times 30 \\ &= 4400 \text{ cm}^2 \end{aligned} $	<p style="text-align: center;">Large</p> $ \begin{aligned} A_{\text{total}} &= wh + wh + lw + lh + lh \\ &= (40 \times 60) + (40 \times 60) + (80 \times 40) + (80 \times 60) + (80 \times 60) \\ &= 4800 + 3200 + 9600 + 80 \times 60 \\ &= 17600 \text{ cm}^2 \end{aligned} $
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- c) The cost of materials required to build the aquariums is \$0.002/cm² of **surface area**. Determine the cost of materials required to build each aquarium. **Show your work.**

<p style="text-align: center;">Small</p> $ \begin{array}{r} 4400 \text{ cm}^2 \\ \times \quad \$0.002 \\ \hline \$8.80 \end{array} $	<p style="text-align: center;">Large</p> $ \begin{array}{r} 17600 \text{ cm}^2 \\ \times \quad \$0.002 \\ \hline \$35.20 \end{array} $
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- d) The cost of the materials required to build the large aquarium is 4 times the cost of the materials required to build the small aquarium.

$$35.20 \div 8.80 = 4$$

(check)

$$\begin{array}{r}
 8.80 \\
 \times 4.00 \\
 \hline
 35.20
 \end{array}$$

- e) The selling price of the small aquarium is \$24. The selling price of the large aquarium is \$115.

Do the selling prices of the aquariums seem appropriate according to your calculations? **Give reasons for your answer.**

I don't think the selling prices are appropriate because according to my calculations the small aquarium is only \$8.50 and they're selling it for \$24.00. I think that's too much to sell the aquarium for, it's 3 times as much as it costs to build it. And the large aquarium is only \$35.20, but it's selling for \$115.00, this is also too much, it's about 3 times as more of the cost to build it.

- f) Mohammed went into the store to buy an aquarium. After comparing the small and large aquariums, he tells the owner, "The large aquarium should only cost two times as much as the small aquarium."

He gives the following reasons:

- The dimensions of the large aquarium are two times bigger than those of the small aquarium.
- It takes two times more material to build the larger aquarium.

Explain the mathematical error in Mohammed's reasons.

HINT:
To answer this question, refer to your previous answers for help.

The error is that he's only thinking that the length of one side of the aquarium is changing by doubling, but when you double all the sides, you're increasing a lot more, so one side is about 3 or 4 times as larger. example →

the side of the small aquarium is 4 times as small as the side on the large.

∴ Each side on the large aquarium would be 4 times as large than the small, so the large needs 4 times as much material not only 2.

Extended Response Coding Guide — Academic Program
Task #1 — Aquarium

b – blank: nothing at all is written for the solution

u – unrelated or unengaged: the student has written “I don’t know” or a question mark; the student has simply rewritten the question exactly as posed; the student has offered unrelated comments or drawn pictures; the student has not engaged in the problem solution

Erasures – If it is rubbed out and readable, mark it. If it is rubbed out and not readable, give it a code of u.

Category	Parts	Codes	Descriptions
KUN	c), d)	1	<ul style="list-style-type: none"> no correct answers
		2	<ul style="list-style-type: none"> one correct answer, other answers are incorrect or missing [work may or may not be shown in c)]
		3	<ul style="list-style-type: none"> two correct answers, other answer is incorrect or missing [work may or may not be shown in c)]
		4	<ul style="list-style-type: none"> three correct answers with no supporting work in c)
		5	<ul style="list-style-type: none"> three correct answers based on multiplying to find cost and dividing to find proportion [i.e., \$8.80 and \$35.20 in part c) and 4 in part d) with correct supporting work in c)] Note: answers need only be correct based on work in previous sections Note: correct units not necessary
KUM	a)	1	<ul style="list-style-type: none"> no correct answers
		2	<ul style="list-style-type: none"> one correct answer, the other incorrect or missing or correct volume formula used with error(s) in calculations
		3	<ul style="list-style-type: none"> correct answers (i.e., 24 000 cm³, 192 000 cm³) Note: correct units not necessary
APM	b)	1	<ul style="list-style-type: none"> both answers incorrect and work shown is not appropriate to the context
		2	<ul style="list-style-type: none"> inappropriate selection of formula (e.g., $2lw + 2lb + lw$) with correct substitution or appropriate selection of formula with incorrect substitution
		3	<ul style="list-style-type: none"> partially appropriate selection of formula with correct substitution (e.g., calculation does not include bottom of aquarium)
		4	<ul style="list-style-type: none"> proper selection of formula for six sides with correct substitution (e.g., includes top of aquarium)
		5	<ul style="list-style-type: none"> proper selection of formula for five sides with correct substitution (i.e., correct answers: 4400 cm² and 17 600 cm²)
APN	e)	1	<ul style="list-style-type: none"> answers yes or no, no mention of previous calculations or selling price (e.g., “no it is not appropriate because I paid less for my aquarium”)
		2	<ul style="list-style-type: none"> answers yes or no, mentions previous calculations, no comparison to selling price (e.g., “no because in all my other calculations the large tank was 4 times bigger”) or answers yes or no, mentions selling price, no comparison to previous calculations
		3	<ul style="list-style-type: none"> answers yes or no, indirect comparison of previous calculations to selling price (e.g., “No because the price is too high, it only costs \$6.40 to make the small one and \$25.60 to make the large one. They need to make a profit but this is too high.”)
		4	<ul style="list-style-type: none"> answers yes or no, direct comparison to previous calculations, but no proportional comparison made to selling price (e.g., “\$24 × \$8.80 = \$15.30, \$115 × \$35.20 = \$79.80 no this isn’t fair, the companies are making too much profit.”)
		5	<ul style="list-style-type: none"> answers yes or no, direct proportional comparison between previous calculations and selling price (e.g., “It’s appropriate because the cost of materials for the large aquarium is 4 times the cost of materials for the small aquarium and the selling price of the large aquarium is 4.79 times the selling price of the small aquarium. The rate is almost the same so the selling prices are appropriate.”) Note: student work should be scored relative to answers in previous sections

**Extended Response Coding Guide — Academic Program
Task #1 — Aquarium**

b – blank: nothing at all is written for the solution

u – unrelated or unengaged: the student has written “I don’t know” or a question mark; the student has simply rewritten the question exactly as posed; the student has offered unrelated comments or drawn pictures; the student has not engaged in the problem solution

Erasures – If it is rubbed out and readable, mark it. If it is rubbed out and not readable, give it a code of u.

Category	Parts	Codes	Descriptions
PS N	f)	1	<ul style="list-style-type: none"> no explanation provided (e.g., “Mohammed is wrong” or “Mohammed is right”)
		2	<ul style="list-style-type: none"> provides explanation with errors or inconsistencies (e.g., “Mohammed is right, the large aquarium should cost twice as much”; “In part e) I saw that the large aquarium was priced too high, so Mohammed is right, it should cost less.”)
		3	<ul style="list-style-type: none"> provides correct explanation limited to the context of this problem, which follows from answer given in part b), c) or d) (e.g., “I calculated that it takes 4 times as much material to make the large aquarium, so it should cost 4 times as much.”)
		4	<ul style="list-style-type: none"> provides correct explanation of the error in Mohammed’s reasoning with reference to wider mathematical context (e.g., “The dimensions may be twice as large, but since the SA formula multiplies two dimensions together, this means the SA will be 4 times as large, so it will take 4 times as much material to make the large aquarium.”) Note: work is to be scored based on the answer in d)
CM	e), f) (presentation of thinking)	1	<ul style="list-style-type: none"> communication of thinking is rarely clear and does not reveal processes (e.g., work shown and explanations given in e) and f) reveal little of the thinking process and are unclear)
		2	<ul style="list-style-type: none"> communication is somewhat clear and reveals some processes (e.g., work shown and explanations given in e) and f) reveal some of the thinking process and are somewhat clear)
		3	<ul style="list-style-type: none"> communication is clear and reveals processes (e.g., work shown and explanations given in e) and f) reveal the thinking process and are clear)
	a), b), c), e) (mathematical conventions)	1	<ul style="list-style-type: none"> mathematical conventions are rarely used properly when required [e.g., does not include proper units (\$, cm², cm³) in a), b), c) and e) where appropriate]
		2	<ul style="list-style-type: none"> mathematical conventions are often used properly when required (e.g., includes units where appropriate and misuses equal signs consistently)
		3	<ul style="list-style-type: none"> mathematical conventions [use of symbols (+, =, etc.), units (\$, cm², cm³) and mathematical form] are used properly when required

Task #1 — Aquarium
Assigned Codes and Rationale for Student Work

Category and Strands	Portion of Task	Code	Rationale
KU N	c), d)	5	<ul style="list-style-type: none"> Proper use of multiplication and division to arrive at three correct answers for parts c) and d).
KU M	a)	3	<ul style="list-style-type: none"> Correct answers of 24 000 and 192 000 for the volume of the two aquariums. Note: proper units are assessed under communication of mathematical conventions
AP M	b)	5	<ul style="list-style-type: none"> Appropriate selection of a formula to determine the surface area for five sides of each aquarium. Correct substitutions are made into these formulae.
AP N	e)	5	<ul style="list-style-type: none"> A direct proportional comparison has been made by the student to arrive at a decision based on previous calculations.
PS N	f)	4	<ul style="list-style-type: none"> The student explains the mathematical error using an appropriate model and provides justification to support his/her stated conclusion.
CM	e), f)	3	<ul style="list-style-type: none"> The student's written explanations for parts e) and f) are clear, logical and succinct.
CM	a), b), c), e)	3	<ul style="list-style-type: none"> Proper mathematical form and correct units are used as required throughout these parts of the task.

Task 2: Babysitters' Club

Nadia and Lisa are comparing their **weekly earnings** from babysitting. The following graph shows their earnings compared to the number of hours they worked in the week.

a) Lisa says:

“If we both work **less than 5 hours** or **more than 15 hours**, I earn more than you do.”

Label Lisa's line with her name. Write Nadia's name on the other line.



b) Describe what the graph shows about how each girl is paid for her week of work. Include specific mathematical details about hourly rates of pay.

Lisa charges 30 dollars for the first up to ten hours and then charges 12 dollars an hour. Nadia charges 7 dollars an hour from the start.



- c) Sana also offers babysitting in the home. She lives on the edge of town and travels by bus to the home where she babysits.

Sana charges a family a set fee of **\$15.00 per week** to cover her bus pass **plus an additional \$4.00 per hour**.

Draw the graph for Sana's earnings on the graph in question a). Label your line.



- d) Your neighbour needs a babysitter for 12 h this week. How much would each of the three girls charge for this 12 h of babysitting? **Show your work** or explain how you get each answer.

$$\begin{aligned} \text{Lisa: } & \$30 + 2 \times 12 = \$54.00 \\ \text{Sana: } & \$15 + 4 \times 12 = \$63 \\ \text{Nadia: } & \$7 \times 12 = \$84 \end{aligned}$$

- e) Several neighbours have inquired about babysitters. Some require a lot of hours of babysitting per week while others require very few hours. They have asked you which of the babysitters charges the least. What would your answer be? **Explain** your reasoning. Be specific about the time intervals.

I would recommend Nadia for up to five hours, Lisa for 5-13.5 hours and Sana for 13.5+ up because judy by the graph that is when they are cheapest.

Extended Response Coding Guide — Academic Program

Task #2 — Babysitters' Club

b – blank: nothing at all is written for the solution

u – unrelated or unengaged: the student has written “I don’t know” or a question mark; the student has simply rewritten the question exactly as posed; the student has offered unrelated comments or drawn pictures; the student has not engaged in the problem solution

Erasures – If it is rubbed out and readable, mark it. If it is rubbed out and not readable, give it a code of u.

Category	Parts	Codes	Descriptions
KUR	c)	1	<ul style="list-style-type: none"> all points are incorrect
		2	<ul style="list-style-type: none"> one correct point [e.g., the vertical intercept (0, 15) has been plotted]
		3	<ul style="list-style-type: none"> at least two correct points have been plotted but line has not been drawn or is incorrect
		4	<ul style="list-style-type: none"> line drawn correctly going through two or more correct points [e.g., straight line through (0, 15), (1, 19), (2, 23), ...]
APR	a)	1	<ul style="list-style-type: none"> neither line is labelled correctly
		2	<ul style="list-style-type: none"> one line is labelled correctly
		3	<ul style="list-style-type: none"> both lines are labelled correctly
	b)	1	<ul style="list-style-type: none"> none of the information stated is correct
		2	<ul style="list-style-type: none"> stated information is correct or partially correct but contains no details about hourly rates of pay (e.g., “Nadia earns more than Lisa” or refers to slopes of A and B)
		3	<ul style="list-style-type: none"> stated information is correct for both girls but hourly rates of pay are missing or incorrect (e.g., “Lisa is paid a flat rate for so many hours, then an hourly rate after that. Nadia earns the same hourly rate no matter how much she works.”) Note: based on graph labels
		4	<ul style="list-style-type: none"> identifies one appropriate babysitting rate (e.g., Nadia earns \$6/h or Lisa earns a flat rate of \$30 then she earns \$12/h after that) (Note: based on graph labels)
		5	<ul style="list-style-type: none"> identifies both babysitting rates (e.g., “Lisa is paid a flat rate of \$30 for up to 10 hours, then she is paid \$12/h after that. Nadia earns \$6/h no matter how many hours she works.”) Note: based on graph labels
	d)	1	<ul style="list-style-type: none"> chooses inappropriate tool(s) to arrive at amounts that don't fit the problem
		2	<ul style="list-style-type: none"> chooses appropriate tool(s) (e.g., calculations or graph as labelled) and arrives at one or two amounts that fit the problem
		3	<ul style="list-style-type: none"> chooses appropriate tool (e.g., calculations or graph as labelled) and arrives at amount of pay for each babysitter that fits the problem (i.e., dollar amounts close to 54 for Lisa, 72 for Nadia and 63 for Sana)
	PSR	e)	1
2			<ul style="list-style-type: none"> simple repetition of hourly pay rate details with no comparison or reference to graph (e.g., “Pick Sana because she charges only \$15 flat fee and \$4 an hour”)
3			<ul style="list-style-type: none"> logical reasoning leads to appropriate and largely incomplete conclusion (e.g., least cost is stated for only one time interval)
4			<ul style="list-style-type: none"> logical reasoning leads to appropriate and somewhat incomplete conclusion (e.g., least cost is stated for only two time intervals, or the conclusion does not address precise time intervals: “For few hours Nadia charges the least. For many hours Sana charges the least. In the middle Lisa charges the least.”)
5			<ul style="list-style-type: none"> logical reasoning leads to appropriate and complete conclusion that includes full details about time intervals (e.g., “hire Nadia for 5 h or less; hire Lisa for 5 h to 13 h; hire Sana for more than 13 h”)
CM	b), d), e) (presentation of thinking)	1	<ul style="list-style-type: none"> communication is unclear and does not reveal the thinking process
		2	<ul style="list-style-type: none"> communication is somewhat clear and reveals some of the thinking process
		3	<ul style="list-style-type: none"> communication is clear and reveals the thinking process
	b), d) (mathematical conventions)	1	<ul style="list-style-type: none"> mathematical conventions are rarely used properly
		2	<ul style="list-style-type: none"> mathematical conventions are sometimes used properly
		3	<ul style="list-style-type: none"> mathematical conventions are used properly (e.g., proper units and equal signs)

Task #2 — Babysitters' Club
Assigned Codes and Rationale for Student Work

Category and Strands	Portion of Task	Code	Rationale
KU R	c)	4	<ul style="list-style-type: none"> The line is drawn correctly through two appropriate points.
AP R	a)	3	<ul style="list-style-type: none"> The student correctly labels line A as Lisa and line B as Nadia.
AP R	b)	4	<ul style="list-style-type: none"> Identifies Lisa's correct babysitting rate of pay and errs in stating Nadia's hourly rate as \$7/h instead of \$6/h.
AP R	d)	3	<ul style="list-style-type: none"> Uses an appropriate method to model each girl's charge for 12 hours of babysitting. <p>Note: calculation errors were not considered</p>
PS R	e)	5	<ul style="list-style-type: none"> Student's conclusion examines the scope of the problem when stating three different scenarios for the cheapest rate.
CM	b), d), e)	3	<ul style="list-style-type: none"> Clear and well-organized explanations reveal the student's thinking process.
CM	b), d)	3	<ul style="list-style-type: none"> Proper mathematical form is used as required. Units and symbols (e.g., \$ and hours) are displayed where appropriate.

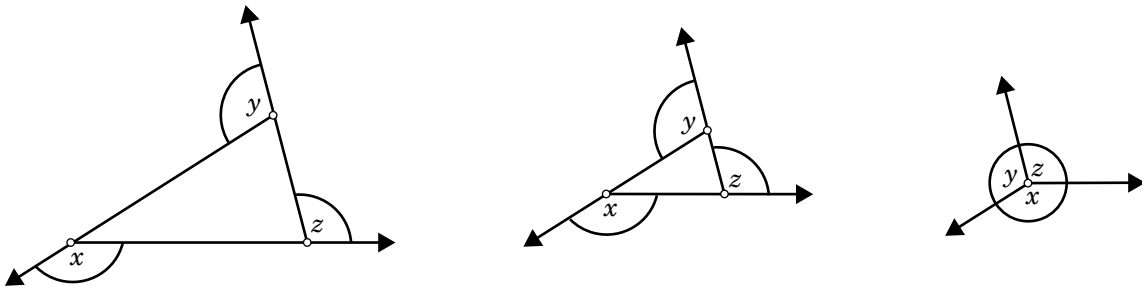
Task 3: Interior and Exterior Angles

Sandra is doing a dynamic geometry investigation of the **sum of the exterior angles** in polygons.

She uses dynamic geometry software. You don't have to use this software to do this task.

She constructs a triangle using rays instead of line segments.

She shrinks the triangle until it looks like three rays coming from a point, as shown below.



From this, she concludes:

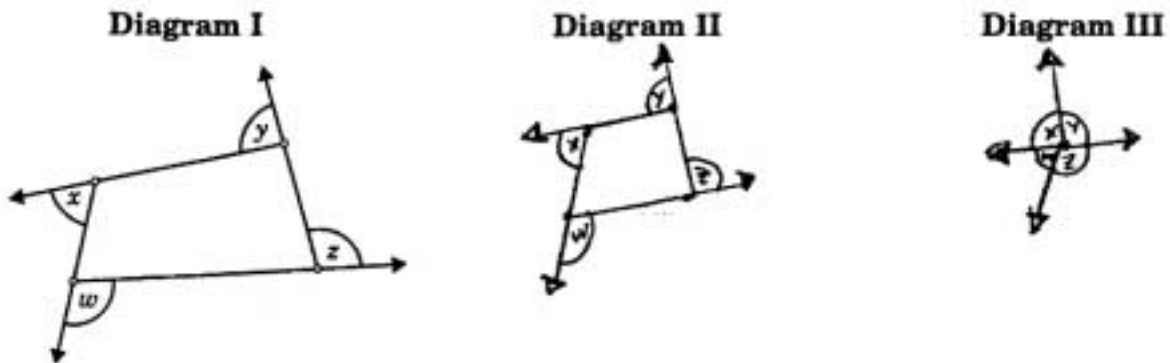
“The **sum of the exterior angles** of a triangle is 360° .”

a) Refer to the diagrams above to **explain** why you agree or disagree with this conclusion.

I agree with this conclusion because if you shrink a triangle so that it looks like just rays, you can draw a circle of 360° as shown in the third diagram above.

- b) Imagine Sandra starts with a **quadrilateral**.

Sketch two more diagrams like those in question a) to show what happens as Sandra shrinks the quadrilateral so that all four points get closer together.



- c) What conjecture can you make about the **sum of the exterior angles of any quadrilateral**?

The exterior angles of a quadrilateral equal up to 360° .

- d) Make a conjecture or prediction about the **sum of the exterior angles of any polygon**.

The sum of the exterior angles of any polygon is 360° .

e) Sandra's triangle shows three pairs of supplementary angles:

$$a + b = 180^\circ$$

$$c + d = 180^\circ$$

$$e + f = 180^\circ$$

These three pairs of angles add up to 540°
 $(180^\circ + 180^\circ + 180^\circ = 540^\circ)$.

The **exterior** angles $(b + d + f)$ add up to 360° .

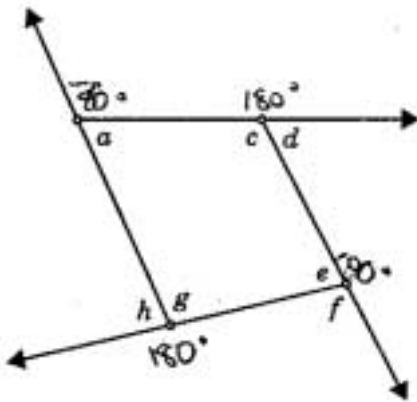
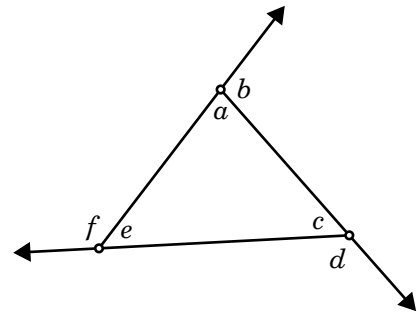
She calculates that the **interior** angles must add up to 180° $(540^\circ - 360^\circ = 180^\circ)$.

She concludes:

"The sum of the **interior** angles of a triangle $(a + c + e)$ is 180° ."

Construct a similar argument to explain why:

"The sum of the **interior** angles of a quadrilateral is 360° ."



$$a + b = 180^\circ$$

$$c + d = 180^\circ$$

$$e + f = 180^\circ$$

$$g + h = 180^\circ$$

These 4 pairs of angles
 add up to 720° .
 $(180^\circ + 180^\circ + 180^\circ + 180^\circ = 720^\circ)$

The exterior angles
 $(b + d + f + h)$ add up to 360° .

The interior angles must
 add up to 360° .
 $(720^\circ - 360^\circ = 360^\circ)$

Conclusion: The sum of the interior
 angles of a quadrilateral is 360° .



Extended Response Coding Guide — Academic Program
Task #3 — Interior and Exterior Angles

b – blank: nothing at all is written for the solution

u – unrelated or unengaged: the student has written “I don’t know” or a question mark; the student has simply rewritten the question exactly as posed; the student has offered unrelated comments or drawn pictures; the student has not engaged in the problem solution

Erasures – If it is rubbed out and readable, mark it. If it is rubbed out and not readable, give it a code of u.

Category	Parts	Codes	Descriptions
KUM	c), d)	1	<ul style="list-style-type: none"> one or more conjectures do not relate to the problem (e.g., sides are equal)
		2	<ul style="list-style-type: none"> one or more conjectures do not relate correctly to the sum of exterior angles (e.g., sums to 180°)
		3	<ul style="list-style-type: none"> one or more conjectures correctly relate to the problem in one part, other part is blank or incorrect
		4	<ul style="list-style-type: none"> one or more conjectures correctly relate to the problem with conclusion that the sum is 360°
APM	b)	1	<ul style="list-style-type: none"> diagrams do not show appropriate fitting to the context
		2	<ul style="list-style-type: none"> one diagram shows appropriate fitting to the context and the other diagram is missing or shows inappropriate fitting to the context
		3	<ul style="list-style-type: none"> both diagrams show partially appropriate fitting to the context or one diagram shows appropriate fitting to the context, the other shows inappropriate fitting to the context
		4	<ul style="list-style-type: none"> one diagram shows appropriate fitting to the context and the other shows partially appropriate fitting to the context
		5	<ul style="list-style-type: none"> both diagrams show appropriate fitting to the context
PSM	a)	1	<ul style="list-style-type: none"> no conclusion stated, illogical reasoning given or no conclusion stated, reasoning given that does not refer to the diagrams
		2	<ul style="list-style-type: none"> conclusion stated with illogical reasoning that refers to the diagrams (e.g., “I agree because I measured them with my protractor”) or conclusion stated with reasoning that does not refer to the diagrams or conclusion stated with no reasoning provided
		3	<ul style="list-style-type: none"> conclusion stated and supported with logical but incomplete reasoning that refers to the diagrams (e.g., “I agree. In the last diagram the angles make a full circle, so they must add to 360°”)
		4	<ul style="list-style-type: none"> conclusion stated and supported with complete and logical reasoning that includes reference to the fact that the angles stay fixed as the diagrams shrinks (e.g., “I agree. As the diagram shrinks the marked angles, which are the exterior angles of the triangle stay the same. In the last diagram they make a full circle, so they must add to 360°”)
	e)	1	<ul style="list-style-type: none"> argument is illogical
		2	<ul style="list-style-type: none"> argument does not connect to the given argument (e.g., “In a square each angle is 90° and there are four of them, so the total is 360°”) argument is partially logical and incomplete (e.g., each pair of angles add to 180°)
		3	<ul style="list-style-type: none"> argument is logical and does not refer to diagram (e.g., four groups of 180° makes 720°, 360°)
		4	<ul style="list-style-type: none"> argument is complete and logical (e.g., $a + b + c + d + e + f + g + h = 720^\circ$ but $b + d + f + h = 360^\circ$ so $a + c + e + g = 720^\circ - 360^\circ = 360^\circ$)
CM	b), d), e) (presentation of thinking)	1	<ul style="list-style-type: none"> communication is unclear and incomplete and does not reveal the thinking process
		2	<ul style="list-style-type: none"> communication is partially clear and complete and reveals some of the thinking process
		3	<ul style="list-style-type: none"> communication is clear and complete and reveals the thinking process
	b), d) (mathematical conventions)	1	<ul style="list-style-type: none"> mathematical conventions are rarely used properly when required [e.g., does not include proper units (i.e., $^\circ$) where appropriate, and most equations incomplete in e)]
		2	<ul style="list-style-type: none"> mathematical conventions are sometimes used properly when required [e.g., sometimes includes proper units (i.e., $^\circ$) where appropriate, and some equations are complete in e)]
		3	<ul style="list-style-type: none"> mathematical conventions are used properly when required [e.g., includes proper units (i.e., $^\circ$) where appropriate, and uses complete equations in e)]

Task #3 — Interior and Exterior Angles
Assigned Codes and Rationale for Student Work

Category and Strands	Portion of Task	Code	Rationale
KU M	c), d)	4	<ul style="list-style-type: none"> The student correctly states the conclusions that the sum of the exterior angles of a quadrilateral and any polygon is 360°.
AP M	b)	5	<ul style="list-style-type: none"> Appropriate sketches are provided in Diagram II and Diagram III. The student work displays the progression in the diagrams of shrinking to a point.
PS M	a)	4	<ul style="list-style-type: none"> The student's conclusion is logical with reference to the diagrams.
PS M	e)	4	<ul style="list-style-type: none"> A logical sequence of steps is evident in the problem-solving process to support the stated conclusion.
CM	a), e)	3	<ul style="list-style-type: none"> The presentation of thinking in the student's work is clear and complete.
CM	all	3	<ul style="list-style-type: none"> Proper use of mathematical symbols and form are evident in each portion of the task. Equations, use of degree symbols and labelling of angles are correct and consistent.