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Grade 12  
Applied Mathematics  
Standards Test

# Marking Guide

June 2011

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*Ce document est disponible en français.*

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# General Marking Instructions

**Please do not make any marks in the test booklets. Any marks in a test booklet will have to be erased by departmental staff before the sample marking if the booklet is selected.**

Please ensure that

- the student booklet number and the number on the *Answer/Scoring Sheet* (Written Test) and *Scoring Sheet* (Inquiry Task) are identical
- **only a pencil is used to complete the *Answer/Scoring Sheets* and *Scoring Sheets*, by both students and markers**
- each student's final result is recorded, by booklet number, on the corresponding *Answer/Scoring Sheet* and *Scoring Sheet*
- the totals for the Written Test and the Inquiry Task are written at the bottom of the sheets
- the *Answer/Scoring Sheet* and *Scoring Sheet* are complete, and a copy has been made for school records

Once marking is completed, please forward the *Answer/Scoring Sheets* and *Scoring Sheets* to Manitoba Education in the envelope provided (for more information, see the administration manual).

## Marking the Multiple-Choice Questions

Please refer to the answer key provided on page 5.

## Marking the Constructed-Response Questions

Please allow a flexibility of  $\pm 3$  mm and  $\pm 3^\circ$  when marking scale diagrams in the Vectors Unit.

### **Restricted-response questions (with or without explanation)**

Each question of this type is designed to elicit a well-defined response according to the associated learning outcomes and relevant mathematical processes. Its purpose is to determine whether a student meets the standard for the course (level 2) as it relates to the knowledge and skills associated with the question.

To receive full marks for the question, a student's response must be complete and correct. Partial marks may be awarded for an "appropriate strategy" with execution errors. **An appropriate strategy is defined as one that is consistent with the learning outcomes and mathematical processes associated with the question and, if properly executed, would lead to the correct answer.**

Some questions require a form of explanation or justification from students. Depending on the student's learning style, the explanation or justification can be given through a labelled diagram, in words, by showing mathematical operations for answer verification, or by referring to a software or calculator program. For this reason, appropriate flexibility is required when marking student responses.

### **Open-response questions**

Each question of this type is designed to elicit student responses at any of the three levels of achievement as defined in the *Senior 4 Mathematics: Manitoba Curriculum Framework of Outcomes and Senior 4 Standards* (Applied Mathematics section). The rubrics contain the language of the curricular standards in order to facilitate marking in a manner that is consistent with those standards. The recommended procedure for marking this type of question is as follows:

1. Read the corresponding learning outcomes in the document *Senior 4 Applied Mathematics: A Foundation for Implementation* (2000).
2. Read the possible solutions provided in this document.
3. Study the student exemplars provided and the rationales for the assigned marks in relation to the marking key.
4. Carefully view all of the student's response and decide which of the three levels of achievement ("exceptional understanding," "good understanding," or "limited understanding") best applies. This process will narrow down the number of possible marks that can be assigned to the response.
5. Compare the features of the student's response with the marking key. Where other answering methods are possible, the answer key attempts to address the most common solutions.

### **Student Errors**

As a guiding principle, students should only be penalized once for each error committed in the context of a test question. For example, students may choose an inappropriate strategy for a question but carry it through correctly and arrive at an incorrect answer. In such cases, students should be penalized for having selected an inappropriate strategy for the task at hand, but should be given credit for having arrived at an answer consistent with their choice of strategy.

#### **Trivial errors**

These are errors for which no marks are to be deducted. In order to be considered trivial, an error must be conceptually unrelated to the learning outcomes associated with the question and not lead to a mathematically incorrect answer. Some examples include not rounding a final answer, transposition errors, expressing percentages as decimals, expressing decimals as percentages, and not including units in the final answer.

## Technical communication errors

These are errors of mathematical notation that are conceptually related to the learning outcomes associated with the question but which can lead to mathematically correct answers.

The student

- forgets to use brackets on matrices
- does not express transition matrices in decimal or percentage form
- does not state a scale when using scale diagrams as a strategy
- forgets more than one arrowhead in scale vector diagrams or required vector sketches
- does not buy materials in whole units or rounds to whole units too soon
- forgets to include or incorrectly places “y =”, “sin”, or “x” when asked for equations
- does not draw a clearly labelled graph—a clearly labelled graph will include labels with units on both axes, an indication of scales on both axes, and an appropriate shape
- does not include the final outcomes when asked for sample spaces

Students are to be penalized no more than half of a mark per question for each technical communication error, and only when the corresponding criterion was awarded.

## Irregularities in Standards Tests

During the administration of standards tests, supervising teachers may encounter irregularities. Markers may also encounter irregularities during local marking sessions. Appendices D and E provide examples of such irregularities as well as procedures to follow to report irregularities.

If an *Answer/Scoring Sheet* or a *Scoring Sheet* is marked with “0” and/or “NR” only (e.g., student was present but did not attempt any questions) please document this on the *Irregular Test Booklet Report*.

## Assistance

If, during marking, any issue arises that cannot be resolved locally, please call Manitoba Education at the earliest opportunity to advise us of the situation and seek assistance if necessary.

You must contact the Assessment Consultant responsible for this project before making any modifications to the answer/marking keys or scoring rubrics.

Barbara Riou  
Assessment Consultant  
Grade 12 Applied Mathematics Standards Test  
Telephone: 204-945-4035  
Toll-Free: 1-800-282-8069, ext. 4035  
Email: [barbara.riou@gov.mb.ca](mailto:barbara.riou@gov.mb.ca)



# Answer Key for Multiple-Choice Questions

| Question | Answer | Learning Outcome |
|----------|--------|------------------|
| 1        | D      | A2               |
| 2        | B      | C3               |
| 3        | C      | D1               |
| 4        | A      | D2               |
| 5        | B      | E1               |
| 6        | B      | E2               |
| 7        | D      | G1               |
| 8        | A      | H1               |
| 9        | C      | H1               |

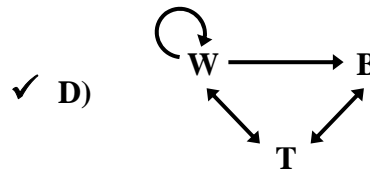
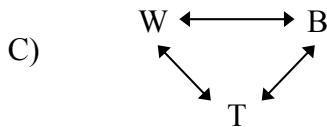
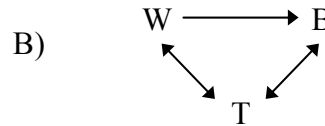
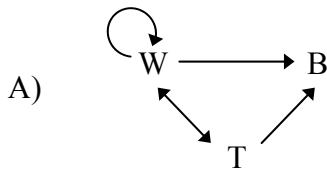
| MULTIPLE-CHOICE QUESTIONS<br>QUESTIONS À CHOIX MULTIPLE  |                      |
|--|----------------------|
| <b>Fill in the best answer for each question.<br/>Choisir la meilleure réponse pour chaque question.</b> |                      |
| 1    (A) (B) (C) (D)   | 6    (A) (B) (C) (D) |
| 2    (A) (B) (C) (D)   | 7    (A) (B) (C) (D) |
| 3    (A) (B) (C) (D)   | 8    (A) (B) (C) (D) |
| 4    (A) (B) (C) (D)   | 9    (A) (B) (C) (D) |
| 5    (A) (B) (C) (D)   |                      |



Explanations for common errors have been provided if applicable.

1. Determine the diagram that represents the following matrix.

$$\begin{matrix} & W & B & T \\ W & \left[ \begin{array}{ccc} 1 & 1 & 1 \\ 0 & 0 & 1 \\ 1 & 1 & 0 \end{array} \right] \\ B & & & \\ T & & & \end{matrix}$$



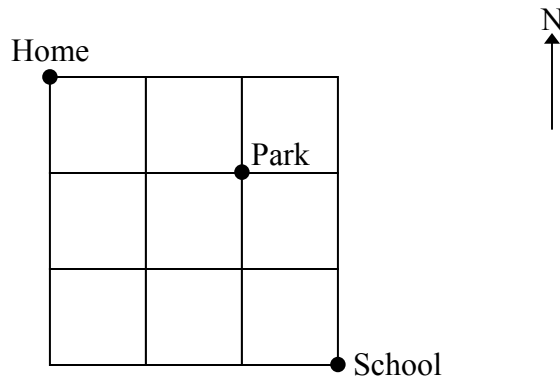
**Common Errors**  
 A: finding only one way between T and B  
 B: missing W to W  
 C: finding two ways between W and B and missing W to W

2. David has purchased a computer valued at \$2575.00. The rate at which the computer depreciates in value is 12% per year. What will be the value of David's computer after four years?

- A) \$1339.00
- ✓ B) **\$1544.22**
- C) \$2266.00
- D) \$4051.81

**Common Errors**  
 A:  $2575 - 4(2575 \times 0.12)$   
 C:  $2575 \times 0.88$   
 D:  $2575 \times 1.12^4$

3. Celine travels from home to school every day. The following diagram shows all of the possible routes she can take.



If Celine can only travel south or east, how many routes are possible if she passes by the park on her way to school?

- A) 3
- B) 6
- ✓ C) 9
- D) 20

**Common Errors**

- A: stopping at the park at 3 routes out of 20
- B:  $3 + 3$  instead of  $3 \times 3$
- D: total number of routes

4. In how many different ways can the letters of the word “GOLDEYES” be arranged where each of the arrangements begins with the letter “G”?

- ✓ A) 2520
- B) 5040
- C) 20 160
- D) 40 320

**Common Errors**

- B: not eliminating identical combinations
- C: not keeping 1st letter in correct position
- D: not keeping 1st letter in correct position and not eliminating identical combinations

5. A survey shows that 95% of high school graduates are employed. If there are 220 graduates, determine the population standard deviation for the number of graduates who are employed.

A) 1.64

✓ B) 3.23

C) 14.46

D) 209

**Common Errors**

A: invNorm (0.95)

C:  $\sqrt{np}$

D:  $n \times p$

6. Diane scored 81% on a test. The class average was 78% with a standard deviation of 1.5%.

What is Diane's  $z$ -score?

A) -2

✓ B) 2

C) 24

D) 29

**Common Errors**

A:  $(78 - 81) \div 5$

C:  $78 - (81 \div 1.5)$

D:  $81 - (78 \div 1.5)$

7. Which of the following sinusoidal functions has a period of 10?

A)  $y = 6.28 \sin(1.59x)$

B)  $y = 1.59 \sin(6.28x)$

C)  $y = 0.628 \sin(10x)$

✓ D)  $y = 10 \sin(0.628x)$

**Common Errors**

A: using  $\frac{10}{2\pi}$  as the  $b$  value

B: same answer as in A but switching  $a$  and  $b$  values

C: using 10 as the  $b$  value

8. The owners of an electronics firm had sales of \$100 000.00 in their first year of business. If their sales increased by \$15 000.00 each year for the 8 years that followed, what were the sales in their fifth year of business?

✓ A) **\$160 000.00**

B) \$175 000.00

C) \$205 000.00

D) \$220 000.00

**Common Errors**

B: going 5 years after the first (sixth year)

C: using 8th year

D: going 8 years after the first (ninth year)

9. A ball is dropped from a height of 2 metres. After each bounce, it rises to 60% of its previous height. After how many bounces does the ball reach a height of less than 0.1 metres for the first time?

A) 3

B) 5

✓ C) **6**

D) 7

**Common Errors**

A: subtracting 0.8 each time

B: one bounce too early

D: one bounce too late

## **Marking Keys and Scoring Rubrics for Constructed-Response Questions**

Please note that this *Marking Guide* contains authentic screen captures taken from a TI-83 Plus graphing calculator.



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**Question No. 10 and Answer**


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10. The following information was gathered for the number of books sold, by category (mystery, health, and science), at two different bookstores during the week of July 1 to 7.

|                           |
|---------------------------|
| <b>Total:<br/>3 marks</b> |
|---------------------------|

Store A: 82 mystery, 65 health, 90 science  
 Store B: 31 mystery, 19 health, 45 science

- a) Create a matrix  $S$  to show the number of books sold at both stores during the week of July 1 to 7.

(1 mark)

$$S = \begin{matrix} & \begin{matrix} \text{Mystery} & \text{Health} & \text{Science} \end{matrix} \\ \begin{matrix} \text{Store A} \\ \text{Store B} \end{matrix} & \begin{bmatrix} 82 & 65 & 90 \\ 31 & 19 & 45 \end{bmatrix} \end{matrix}$$

- b) If mystery books sell for \$9.00 each, health books sell for \$25.00 each, and science books sell for \$37.00 each, determine the total value of the books sold at each store. Show your work using matrix operations.

(2 marks)

$$\begin{matrix} & \begin{matrix} \text{Mystery} & \text{Health} & \text{Science} \end{matrix} \\ \begin{matrix} \text{Store A} \\ \text{Store B} \end{matrix} & \begin{bmatrix} 82 & 65 & 90 \\ 31 & 19 & 45 \end{bmatrix} \end{matrix} \times \begin{bmatrix} 9 \\ 25 \\ 37 \end{bmatrix} = \begin{matrix} \text{Store A} \\ \text{Store B} \end{matrix} \begin{bmatrix} 5693 \\ 2419 \end{bmatrix}$$

Marker Note(s):

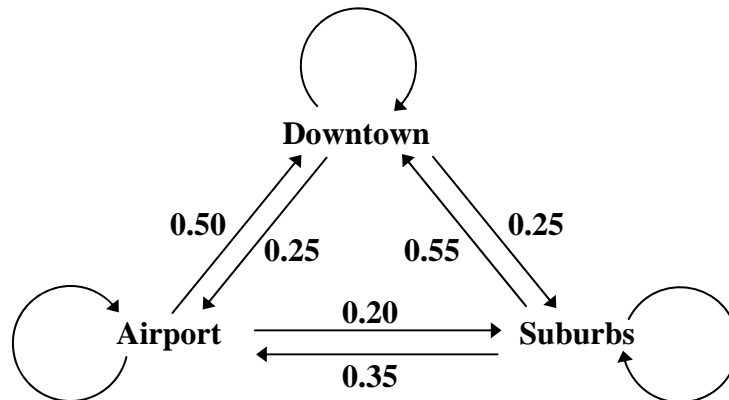
→ Maximum 0.5 mark deduction per question if student forgets to use brackets on matrices.

| Marking Key |                                    |
|-------------|------------------------------------|
| ❶           | 1 mark for correct matrix in (a)   |
| ❷           | 1 mark for appropriate work in (b) |
| ❸           | 1 mark for correct answer in (b)   |

**Question No. 11 and Answer**

11. A study on the taxi industry in Winnipeg reports the following daily movements of taxis between three locations: downtown, airport, and suburbs.

**Total:  
5 marks**



a) Create a transition matrix  $T$  to represent this situation.

(2 marks)

$$T = \begin{matrix} & \begin{matrix} \text{Downtown} & \text{Airport} & \text{Suburbs} \end{matrix} \\ \begin{matrix} \text{Downtown} \\ \text{Airport} \\ \text{Suburbs} \end{matrix} & \left[ \begin{array}{ccc} 0.50 & 0.25 & 0.25 \\ 0.50 & 0.30 & 0.20 \\ 0.55 & 0.35 & 0.10 \end{array} \right] \end{matrix}$$

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## Question No. 11 continued

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- b) The following matrix  $A$  represents the current number of taxis present at each location.

$$A = \begin{matrix} & \text{Downtown} & \text{Airport} & \text{Suburbs} \\ \begin{bmatrix} 180 & 160 & 90 \end{bmatrix} \end{matrix}$$

The mayor of Winnipeg wants a daily movement pattern where 150 to 170 taxis would always be present at the airport. Using matrix operations, show that the current daily movements do not accomplish this.

(1 mark)

$$A \times T = \begin{matrix} & \text{Downtown} & \text{Airport} & \text{Suburbs} \\ \begin{bmatrix} 220 & 125 & 86 \end{bmatrix} \end{matrix}$$

OR

---

$$A \times T^{100} = \begin{matrix} & \text{Downtown} & \text{Airport} & \text{Suburbs} \\ \begin{bmatrix} 219 & 122 & 88 \end{bmatrix} \end{matrix}$$

*Other answers are possible.*

- c) Change your transition matrix in (a) to model a movement pattern that would allow for the desired number of taxis at the airport. Using matrix operations, show that the number of taxis will stabilize between 150 and 170.

(2 marks)

$$T = \begin{matrix} & \text{Downtown} & \text{Airport} & \text{Suburbs} \\ \begin{matrix} \text{Downtown} \\ \text{Airport} \\ \text{Suburbs} \end{matrix} \begin{bmatrix} 0.50 & 0.25 & 0.25 \\ 0.25 & 0.55 & 0.20 \\ 0.55 & 0.35 & 0.10 \end{bmatrix} \end{matrix}$$

$$A \times T^{100} = A \times T^{101} = \begin{matrix} & \text{Downtown} & \text{Airport} & \text{Suburbs} \\ \begin{bmatrix} 178 & 166 & 86 \end{bmatrix} \end{matrix}$$

*Other answers are possible.*

## Question No. 11 continued

### Scoring Rubric

| General Performance Indicators   |  |
|--|--|
| <b>Level 1—limited understanding</b>   |  |
| <b>1 mark</b><br><b>weak attempt: inappropriate strategy or no strategy</b><br>1 criterion correct | <b>2 marks</b><br><b>reasonable attempt: appropriate strategy with major errors or omissions</b><br>2 criteria correct |
| <b>Level 2—good understanding</b>  |  |
| <b>3 marks</b><br><b>reasonable strategy, minor errors and/or omissions</b><br>3 criteria correct  | <b>4 marks</b><br><b>sound strategy, mostly complete, minor errors</b><br>4 criteria correct                           |
| <b>Level 3—exceptional understanding</b>   |  |
| <b>5 marks</b><br><b>complete and correct</b><br>5 criteria correct                                |  |

**Marker Note(s):**

- Maximum 0.5 mark deduction per question if student forgets to use brackets on matrices.
- Maximum 0.5 mark deduction per question if student does not express transition matrices in decimal or percentage form.
- Award a maximum of 1 mark in (c) if movement pattern does not stabilize between 150 and 170.

### Marking Key

|          |   |
|----------|---|
| <b>1</b> | <i>1 mark for correct diagonal in (a)</i>   |
| <b>2</b> | <i>1 mark for correct rest of matrix in (a)</i>   |
| <b>3</b> | <i>1 mark for correct matrix operations in (b)</i>  |
| <b>4</b> | <i>1 mark for correct transition matrix showing an increase in movement to the airport or a decrease in movement away from the airport in (c)</i> |
| <b>5</b> | <i>1 mark for correct matrix operations showing stabilization in (c)</i>  |

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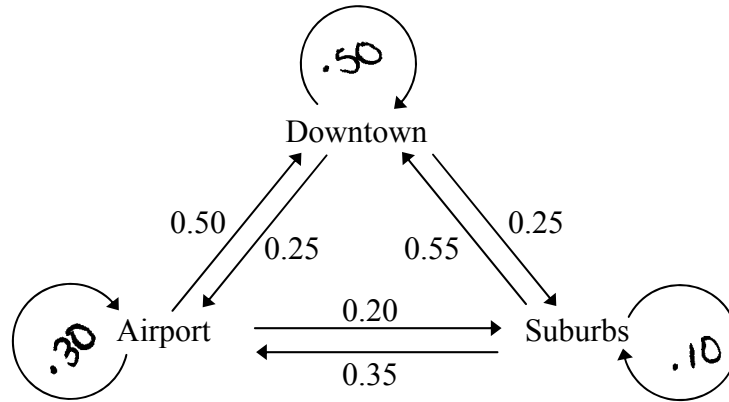
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## Exemplar 1

---

11. A study on the taxi industry in Winnipeg reports the following daily movements of taxis between three locations: downtown, airport, and suburbs.

Total:  
5 marks



- a) Create a transition matrix  $T$  to represent this situation.

(2 marks)

$$T = \begin{array}{l} \text{Downtown} \\ \text{Airport} \\ \text{Suburbs} \end{array} = \begin{array}{l} \text{Downtown} \\ \text{Airport} \\ \text{Suburbs} \end{array} \begin{bmatrix} .50 & .25 & .25 \\ .50 & .30 & .20 \\ .55 & .35 & .10 \end{bmatrix}$$

## Exemplar 1 continued

- b) The following matrix  $A$  represents the current number of taxis present at each location.

$$A = \begin{matrix} & \begin{matrix} \text{Downtown} & \text{Airport} & \text{Suburbs} \end{matrix} \\ \begin{matrix} \text{Downtown} \\ \text{Airport} \\ \text{Suburbs} \end{matrix} & \begin{bmatrix} 180 & 160 & 90 \end{bmatrix} \end{matrix}$$

The mayor of Winnipeg wants a daily movement pattern where 150 to 170 taxis would always be present at the airport. Using matrix operations, show that the current daily movements do not accomplish this.

(1 mark)

$$A \times T = C = \begin{matrix} & \begin{matrix} \text{Downtown} & \text{Airport} & \text{Suburbs} \end{matrix} \\ \begin{matrix} \text{Downtown} \\ \text{Airport} \\ \text{Suburbs} \end{matrix} & \begin{bmatrix} 219 & 124 & 86 \end{bmatrix} \end{matrix}$$

**4 marks:**

- ① → 1 mark for correct diagonal in (a)
- ② → 1 mark for correct rest of matrix in (a)
- ③ → 1 mark for correct matrix operations in (b)
- ④ → 1 mark for correct transition matrix showing an increase in movement to the airport or a decrease in movement away from the airport in (c)

- c) Change your transition matrix in (a) to model a movement pattern that would allow for the desired number of taxis at the airport. Using matrix operations, show that the number of taxis will stabilize between 150 and 170.

(2 marks)

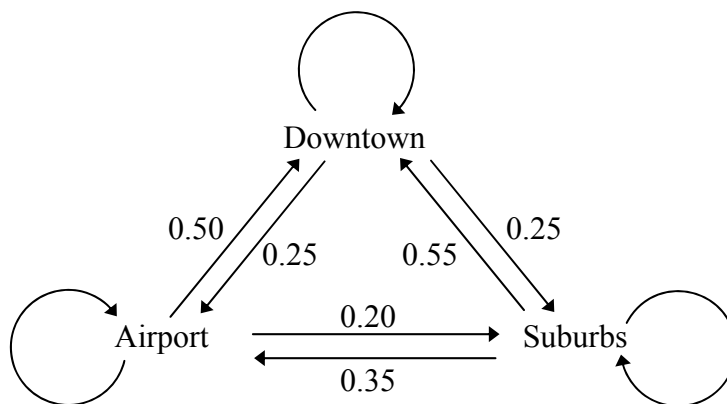
$$T = \begin{matrix} & \begin{matrix} \text{Downtown} & \text{Airport} & \text{Suburbs} \end{matrix} \\ \begin{matrix} \text{Downtown} \\ \text{Airport} \\ \text{Suburbs} \end{matrix} & \begin{bmatrix} .25 & .50 & .25 \\ .50 & .30 & .20 \\ .55 & .35 & .10 \end{bmatrix} \end{matrix}$$

$$A \times T = D = \begin{matrix} & \begin{matrix} \text{Downtown} & \text{Airport} & \text{Suburbs} \end{matrix} \\ \begin{matrix} \text{Downtown} \\ \text{Airport} \\ \text{Suburbs} \end{matrix} & \begin{bmatrix} 174 & 169 & 86 \end{bmatrix} \end{matrix}$$

## Exemplar 2

11. A study on the taxi industry in Winnipeg reports the following daily movements of taxis between three locations: downtown, airport, and suburbs.

Total:  
5 marks



- a) Create a transition matrix  $T$  to represent this situation.

(2 marks)

$$T = \begin{array}{l} \text{Downtown} \\ \text{Airport} \\ \text{Suburbs} \end{array} \begin{array}{c} \text{Downtown} \\ \text{Airport} \\ \text{Suburbs} \end{array} \begin{bmatrix} 0.50 & 0.25 & 0.25 \\ 0.50 & 0.30 & 0.20 \\ 0.55 & 0.35 & 0.10 \end{bmatrix}$$

## Exemplar 2 continued

- b) The following matrix  $A$  represents the current number of taxis present at each location.

$$A = \begin{matrix} & \begin{matrix} \text{Downtown} & \text{Airport} & \text{Suburbs} \end{matrix} \\ \begin{matrix} \text{Downtown} \\ \text{Airport} \\ \text{Suburbs} \end{matrix} & \begin{bmatrix} 180 & 160 & 90 \end{bmatrix} \end{matrix}$$

The mayor of Winnipeg wants a daily movement pattern where 150 to 170 taxis would always be present at the airport. Using matrix operations, show that the current daily movements do not accomplish this.

(1 mark)

$$\begin{matrix} & \begin{matrix} \text{D} & \text{A} & \text{S} \end{matrix} \\ \begin{matrix} \text{D} \\ \text{A} \\ \text{S} \end{matrix} & \begin{bmatrix} 90 & 45 & 45 \\ 80 & 48 & 32 \\ 49.5 & 31.5 & 9 \end{bmatrix} \end{matrix}$$

+  
+  
124.5

**2 marks:**

- ① → 1 mark for correct diagonal in (a)
- ② → 1 mark for correct rest of matrix in (a)

- c) Change your transition matrix in (a) to model a movement pattern that would allow for the desired number of taxis at the airport. Using matrix operations, show that the number of taxis will stabilize between 150 and 170.

(2 marks)

$$T = \begin{matrix} & \begin{matrix} \text{Downtown} & \text{Airport} & \text{Suburbs} \end{matrix} \\ \begin{matrix} \text{Downtown} \\ \text{Airport} \\ \text{Suburbs} \end{matrix} & \begin{bmatrix} 100 & 50 & 50 \\ 100 & 60 & 40 \\ 66 & 42 & 12 \end{bmatrix} \end{matrix}$$

+  
+  
152

$$A = \begin{matrix} & \begin{matrix} \text{D} & \text{A} & \text{S} \end{matrix} \\ \begin{matrix} \text{D} \\ \text{A} \\ \text{S} \end{matrix} & \begin{bmatrix} 200 & 200 & 120 \end{bmatrix} \end{matrix}$$

## Question No. 12 and Answer

12. Julian wonders if the bank will lend him money to go on a holiday. His financial situation is as follows:

Total:  
5 marks

- He has invested \$8000.00 in mutual funds.
- He has \$1500.00 in a chequing account and \$2500.00 in a savings account.
- He has invested \$5000.00 in an RRSP.
- He has a registered pension plan valued at \$9000.00.
- He has purchased a house valued at \$250 000.00 and his mortgage is \$150 000.00.
- He has purchased a car valued at \$35 000.00 and has an outstanding balance of \$30 000.00 on the loan.
- He owes \$4500.00 on a stereo system and has a debt of \$5200.00 on his credit card.
- He owes \$20 000.00 on his line of credit.

- a) Complete a statement of net worth for Julian, indicating the total assets, total liabilities, and net worth.

(3 marks)

See next page.

- b) Calculate Julian's debt equity ratio. Based on his debt equity ratio, do you think the bank will lend him money? Explain your answer.

(2 marks)

$$\frac{\$209\,700.00 - \$150\,000.00}{\$101\,300.00} = 0.59 = 59\%$$

No, the bank will not lend him money since his debt equity ratio is over 50%.

Marker Note(s):

→ If only one value is omitted or placed in the wrong section (assets or liabilities), deduct only 1 mark in (a).

| Marking Key |   |
|-------------|---|
| ①           | 1 mark for correct total assets in (a)      |
| ②           | 1 mark for correct total liabilities in (a) |
| ③           | 1 mark for net worth in (a)                 |
| ④           | 1 mark for debt equity ratio in (b)         |
| ⑤           | 1 mark for explanation in (b)               |

## Question No. 12 continued

### Statement of Net Worth

#### ASSETS (WHAT YOU OWN)

|                              |              |
|------------------------------|--------------|
| 1. Liquid/Current Assets     |              |
| i. Bank Accounts             | 4000.00      |
| ii. Cash                     |              |
| Total Liquid Assets          | \$4000.00    |
| 2. Semi-Liquid Assets        |              |
| i. Mutual Funds              | 8000.00      |
| ii. Stocks/Bonds             |              |
| iii. RRSPs                   | 5000.00      |
| iv. Registered Pension Plan  | 9000.00      |
| v. Life Insurance/Cash Value |              |
| Total Semi-Liquid Assets     | \$22 000.00  |
| 3. Non-Liquid Assets         |              |
| i. Principal Residence       | 250 000.00   |
| ii. Vehicles                 | 35 000.00    |
| iii. Other                   |              |
| Total Non-Liquid Assets      | \$285 000.00 |

**a) TOTAL ASSETS** **\$311 000.00**

#### LIABILITIES (WHAT YOU OWE)

|                       |                 |
|-----------------------|-----------------|
| 4. Short-Term Debt    |                 |
| i. Credit Card        | 5200.00         |
| ii. Short-Term Loans  | 4500.00         |
| Total Short-Term Debt | \$9700.00       |
| 5. Long-Term Debt     |                 |
| i. Mortgage           | 150 000.00      |
| ii. Line of Credit    | 20 000.00       |
| iii. Other            | (car) 30 000.00 |
| Total Long-Term Debt  | \$200 000.00    |

**a) TOTAL LIABILITIES** **\$209 700.00**

**a) NET WORTH** assets – liabilities = \$311 000.00 – \$209 700.00 = **\$101 300.00**

**b) DEBT EQUITY RATIO**  

$$\frac{\text{total liabilities} - \text{mortgage}}{\text{net worth}} = \frac{\$209\,700.00 - \$150\,000.00}{\$101\,300.00} = \mathbf{0.59} = \mathbf{59\%}$$

**Note:** To calculate the Debt Equity Ratio, subtract the mortgage from the total liabilities, then divide by the net worth.

---

## Exemplar 1

---

12. Julian wonders if the bank will lend him money to go on a holiday. His financial situation is as follows:

Total:  
5 marks

- He has invested \$8000.00 in mutual funds.
- He has \$1500.00 in a chequing account and \$2500.00 in a savings account.
- He has invested \$5000.00 in an RRSP.
- He has a registered pension plan valued at \$9000.00.
- He has purchased a house valued at \$250 000.00 and his mortgage is \$150 000.00.
- He has purchased a car valued at \$35 000.00 and has an outstanding balance of \$30 000.00 on the loan.
- He owes \$4500.00 on a stereo system and has a debt of \$5200.00 on his credit card.
- He owes \$20 000.00 on his line of credit.

a) Complete a statement of net worth for Julian, indicating the total assets, total liabilities, and net worth.

(3 marks)

b) Calculate Julian's debt equity ratio. Based on his debt equity ratio, do you think the bank will lend him money? Explain your answer.

(2 marks)

*The bank probably wouldn't  
have a problem lending him money.*

**3 marks:**

❶ → 1 mark for correct total assets in (a)

❸ → 1 mark for net worth in (a)

❹ → 1 mark for debt equity ratio in (b)

Note: Mark ❺ was not awarded since the student does not refer to the 50% rule.

## Exemplar 1 continued

### Statement of Net Worth

#### ASSETS (WHAT YOU OWN)

|                              |                |
|------------------------------|----------------|
| 1. Liquid/Current Assets     |                |
| i. Bank Accounts             | \$1500, \$2500 |
| ii. Cash                     |                |
| Total Liquid Assets          | \$4000         |
| 2. Semi-Liquid Assets        |                |
| i. Mutual Funds              | \$8000         |
| ii. Stocks/Bonds             |                |
| iii. RRSPs                   | \$5000         |
| iv. Registered Pension Plan  | \$9000         |
| v. Life Insurance/Cash Value |                |
| Total Semi-Liquid Assets     | \$22000        |
| 3. Non-Liquid Assets         |                |
| i. Principal Residence       | \$250000       |
| ii. Vehicles                 | \$35000        |
| iii. Other                   |                |
| Total Non-Liquid Assets      | \$285000       |

#### TOTAL ASSETS

\$311000

#### LIABILITIES (WHAT YOU OWE)

|                       |          |
|-----------------------|----------|
| 4. Short-Term Debt    |          |
| i. Credit Card        | \$5200   |
| ii. Short-Term Loans  | \$4500   |
| Total Short-Term Debt | \$9700   |
| 5. Long-Term Debt     |          |
| i. Mortgage           | \$150000 |
| ii. Line of Credit    | \$30000  |
| iii. Other            | \$4500   |
| Total Long-Term Debt  | \$184500 |

#### TOTAL LIABILITIES

\$194200

#### NET WORTH

\$116800

#### DEBT EQUITY RATIO

.378

**Note:** To calculate the Debt Equity Ratio, subtract the mortgage from the total liabilities, then divide by the net worth.

---

## Exemplar 2

---

12. Julian wonders if the bank will lend him money to go on a holiday. His financial situation is as follows:

Total:  
5 marks

- He has invested \$8000.00 in mutual funds.
- He has \$1500.00 in a chequing account and \$2500.00 in a savings account.
- He has invested \$5000.00 in an RRSP.
- He has a registered pension plan valued at \$9000.00.
- He has purchased a house valued at \$250 000.00 and his mortgage is \$150 000.00.
- He has purchased a car valued at \$35 000.00 and has an outstanding balance of \$30 000.00 on the loan.
- He owes \$4500.00 on a stereo system and has a debt of \$5200.00 on his credit card.
- He owes \$20 000.00 on his line of credit.

a) Complete a statement of net worth for Julian, indicating the total assets, total liabilities, and net worth.

(3 marks)

b) Calculate Julian's debt equity ratio. Based on his debt equity ratio, do you think the bank will lend him money? Explain your answer.

(2 marks)

No, his debt equity ratio should not exceed 50% for the bank to lend him money.

**3 marks:**

- ② → 1 mark for correct total liabilities in (a)
- ③ → 1 mark for net worth in (a)
- ⑤ → 1 mark for explanation in (b)

## Exemplar 2 continued

### Statement of Net Worth

#### ASSETS (WHAT YOU OWN)

|                              |                |
|------------------------------|----------------|
| 1. Liquid/Current Assets     |                |
| i. Bank Accounts             | 4000           |
| ii. Cash                     |                |
| Total Liquid Assets          | 4000           |
| 2. Semi-Liquid Assets        |                |
| i. Mutual Funds              | 8000           |
| ii. Stocks/Bonds             |                |
| iii. RRSPs                   | 5000           |
| iv. Registered Pension Plan  | 9000           |
| v. Life Insurance/Cash Value |                |
| Total Semi-Liquid Assets     | 22000          |
| 3. Non-Liquid Assets         |                |
| i. Principal Residence       | 100 000        |
| ii. Vehicles                 | 5000           |
| iii. Other                   |                |
| Total Non-Liquid Assets      | 105000         |
| <b>TOTAL ASSETS</b>          | <b>131 000</b> |

#### LIABILITIES (WHAT YOU OWE)

|                          |               |
|--------------------------|---------------|
| 4. Short-Term Debt       |               |
| i. Credit Card           | 5200          |
| ii. Short-Term Loans     | 30 000        |
| Total Short-Term Debt    | 35200         |
| 5. Long-Term Debt        |               |
| i. Mortgage              | 150 000       |
| ii. Line of Credit       | 20 000        |
| iii. Other               | 4500          |
| Total Long-Term Debt     | 174500        |
| <b>TOTAL LIABILITIES</b> | <b>209700</b> |
| <b>NET WORTH</b>         | <b>-78700</b> |
| <b>DEBT EQUITY RATIO</b> | <b>.76%</b>   |

**Note:** To calculate the Debt Equity Ratio, subtract the mortgage from the total liabilities, then divide by the net worth.

### Question No. 13 and Answer

13. Paulette and Roger purchase a house for \$210 000.00 and have saved \$25 000.00 for a down payment. They obtain a mortgage amortized over 20 years at an interest rate of 5.25% compounded semi-annually.

Total:  
3 marks

- a) Determine Paulette and Roger's monthly mortgage payment. Show your work.

(2 marks)

```
N=240
I%=5.25
PV=185000
PMT=-1240.7780...
FV=0
P/Y=12
C/Y=2
PMT:  END  BEGIN
```

Their monthly payment will be \$1240.78.

- b) How much will they have paid in interest after the first 10 years?

(1 mark)

```
ΣInt(1,120)
-79839.00954
```

They will have paid \$79 839.01 in interest.

#### Marking Key

- |   |                                    |
|---|------------------------------------|
| ① | 1 mark for appropriate work in (a) |
| ② | 1 mark for correct answer in (a)   |
| ③ | 1 mark for correct answer in (b)   |

---

**Question No. 14 and Answer**


---

14. Catherine, Suzanne, and Donald are on the last hole of their game of miniature golf. They each have a chance to win a free game if they can get a hole in one. The probability of each getting a hole in one is 20%, 25%, and 30% respectively.

|                           |
|---------------------------|
| <b>Total:<br/>3 marks</b> |
|---------------------------|

- a) What is the probability that no one will win a free game?

(1 mark)

$$\begin{aligned} P(\text{no one will win a free game}) &= 0.8 \times 0.75 \times 0.7 \\ &= 0.42 \text{ or } 42\% \end{aligned}$$

- b) What is the probability that exactly two of them will win a free game? Show your work.

(2 marks)

$$\begin{aligned} P(\text{two will win a free game}) &= (0.2 \times 0.25 \times 0.7) + (0.2 \times 0.75 \times 0.3) + (0.8 \times 0.25 \times 0.3) \\ &= 0.035 + 0.045 + 0.06 \\ &= 0.14 \text{ or } 14\% \end{aligned}$$

| <b>Marking Key</b> |   |
|--------------------|---|
| <b>1</b>           | <i>1 mark for correct answer in (a)</i>   |
| <b>2</b>           | <i>1 mark for appropriate work in (b)</i> |
| <b>3</b>           | <i>1 mark for correct answer in (b)</i>   |

---

**Question No. 15 and Answer**


---

15. A survey of 500 students showed that:

**Total:**  
**3 marks**

- 93 are enrolled in a French course
- 78 are enrolled in a Spanish course
- 21 are enrolled in both a French course and a Spanish course

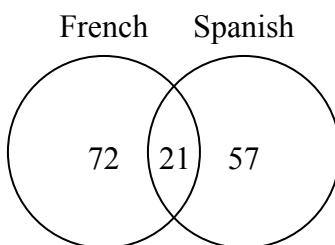
a) How many students are enrolled in only a Spanish course?

(1 mark)

$$78 - 21 = 57 \text{ students}$$

b) If a student is selected at random, what is the probability that he is enrolled in a French course or a Spanish course? Show your work.

(2 marks)



$$72 + 21 + 57 = 150$$

$$\begin{aligned} P(\text{F or S}) &= \frac{150}{500} = \frac{3}{10} \text{ or } 0.3 \\ &= 30\% \end{aligned}$$

OR

$$\begin{aligned} P(\text{F or S}) &= P(\text{F}) + P(\text{S}) - P(\text{F and S}) \\ &= \frac{93}{500} + \frac{78}{500} - \frac{21}{500} \\ &= \frac{150}{500} = \frac{3}{10} \text{ or } 0.3 \\ &= 30\% \end{aligned}$$

| <b>Marking Key</b> |   |
|--------------------|---|
| <b>1</b>           | <i>1 mark for correct answer in (a)</i>   |
| <b>2</b>           | <i>1 mark for appropriate work in (b)</i> |
| <b>3</b>           | <i>1 mark for correct answer in (b)</i>   |

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## Question No. 16 and Answer

16. A baker randomly recorded the weights of different loaves of bread and noted the following information:

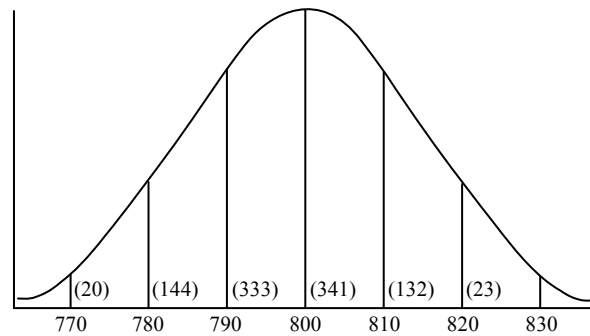
Total:  
4 marks

|                               |       |       |       |       |       |       |       |       |       |       |       |       |
|-------------------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| Weight of a loaf of bread (g) | 772.5 | 777.5 | 782.5 | 787.5 | 792.5 | 797.5 | 802.5 | 807.5 | 812.5 | 817.5 | 822.5 | 827.5 |
| Frequency                     | 3     | 17    | 44    | 100   | 141   | 192   | 191   | 150   | 90    | 42    | 14    | 9     |

For the data above, the mean is 800 grams and the standard deviation is 10 grams.

- a) The baker thinks that the weights of the loaves of bread are normally distributed. Indicate two reasons that prove she is correct. Show your work using statistics.

(2 marks)



$$\left. \begin{array}{l} -1\sigma \text{ to } 1\sigma \\ \text{range is from } 790 \text{ to } 810 \end{array} \right\} \begin{array}{l} \frac{674}{993} \text{ or } 67.8\% \text{ of the numbers fall in this range} \\ \text{(normal is } 68\%) \end{array}$$

$$\left. \begin{array}{l} -2\sigma \text{ to } 2\sigma \\ \text{range is from } 780 \text{ to } 820 \end{array} \right\} \begin{array}{l} \frac{950}{993} \text{ or } 95.7\% \text{ of the numbers fall in this range} \\ \text{(normal is } 95\%) \end{array}$$

She is correct since this is very close to the 68-95-99 rule.

---

## Question No. 16 continued

---

- b) What is the probability of selecting a loaf of bread that weighs more than 815 grams? Show your work using statistics.

(2 marks)

```
normalcdf(815, E9  
9.800, 10)  
.0668072287
```

The probability is 6.7%.

| <b>Marking Key</b> |   |
|--------------------|---|
| <b>1</b>           | <i>1 mark for first reason with support in (a)</i>  |
| <b>2</b>           | <i>1 mark for second reason with support in (a)</i> |
| <b>3</b>           | <i>1 mark for appropriate work in (b)</i>           |
| <b>4</b>           | <i>1 mark for correct answer in (b)</i>             |

## Exemplar 1

16. A baker randomly recorded the weights of different loaves of bread and noted the following information:

Total:  
4 marks

|                                      |       |       |       |       |       |       |       |       |       |       |       |       |
|--------------------------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| <b>Weight of a loaf of bread (g)</b> | 772.5 | 777.5 | 782.5 | 787.5 | 792.5 | 797.5 | 802.5 | 807.5 | 812.5 | 817.5 | 822.5 | 827.5 |
| <b>Frequency</b>                     | 3     | 17    | 44    | 100   | 141   | 192   | 191   | 150   | 90    | 42    | 14    | 9     |

For the data above, the mean is 800 grams and the standard deviation is 10 grams.

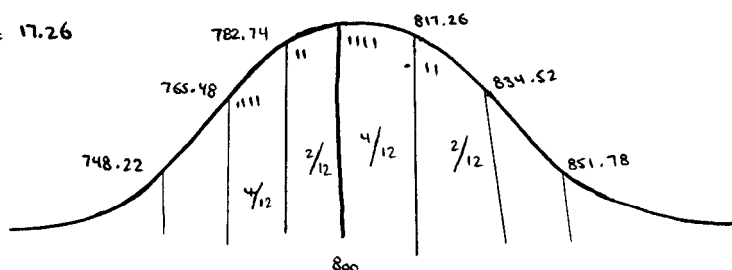
↑ put into list  
2<sup>nd</sup> var stats

- a) The baker thinks that the weights of the loaves of bread are normally distributed. Indicate two reasons that prove she is correct. Show your work using statistics.

(2 marks)

$$\bar{x} = 800$$

$$\sigma = 17.26$$



- follows the rule of 68% - 95% - 99%

- equal distribution of mass in each standard deviation

- b) What is the probability of selecting a loaf of bread that weighs more than 815 grams? Show your work using statistics.

(2 marks)

$$817.5 / 822.5 / 829.5 = 3/12$$

**1 mark:**

④ → 1 mark for correct answer in (b)

## Exemplar 2

16. A baker randomly recorded the weights of different loaves of bread and noted the following information:

Total:  
4 marks

|                               |       |       |       |       |       |       |       |       |       |       |       |       |
|-------------------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| Weight of a loaf of bread (g) | 772.5 | 777.5 | 782.5 | 787.5 | 792.5 | 797.5 | 802.5 | 807.5 | 812.5 | 817.5 | 822.5 | 827.5 |
| Frequency                     | 3     | 17    | 44    | 100   | 141   | 192   | 191   | 150   | 90    | 42    | 14    | 9     |

For the data above, the mean is 800 grams and the standard deviation is 10 grams.

- a) The baker thinks that the weights of the loaves of bread are normally distributed. Indicate two reasons that prove she is correct. Show your work using statistics.

(2 marks)

Winstats Program

Statz - overall

$$\sigma = 10.12$$

$$\bar{x} = 800$$

$$800 - 10.12 = 789.88$$

$$800 + 10.12 = 810.12$$

$$\frac{674}{993} = 67.88\%$$

$$800 - 2(10.12) = 779.76$$

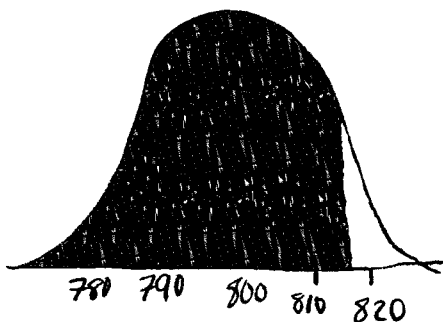
$$800 + 2(10.12) = 820.24$$

$$\frac{950}{993} = 95.67\%$$

The data is normally distributed because 67.88% is very close to 68% and 95.67% is very close to 95%.

- b) What is the probability of selecting a loaf of bread that weighs more than 815 grams? Show your work using statistics.

(2 marks)



$$\text{probability} = .93 \text{ or } 93\%$$

**3 marks:**

- ① → 1 mark for first reason with support in (a)
- ② → 1 mark for second reason with support in (a)
- ③ → 1 mark for correct answer in (b)

---

**Question No. 17 and Answer**


---

17. A math student recently surveyed 300 students from his high school and found that 36 were left handed. He then calculated the 95% confidence interval for the number of left-handed students and made the following statement.

**Total:  
3 marks**

“The number of left-handed students is between 24.97 and 47.03.”

- a) What information should be added to his statement to make it complete?

(1 mark)

The statement must include “I am 95% certain that the...”.

- b) Are the values indicated in the student’s statement correct? Show your work using statistics.

(2 marks)

```
1-PropZInt
x:36
n:300
C-Level:.95
Calculate
```

```
1-PropZInt
(.08323,.15677)
p=.12
n=300
```

$$0.083\ 23 \times 300 = 24.97$$

$$0.156\ 77 \times 300 = 47.03$$

Yes, these values are correct.

| <b>Marking Key</b> |   |
|--------------------|---|
| <b>①</b>           | <i>1 mark for including “95%” in the statement in (a)</i> |
| <b>②</b>           | <i>1 mark for appropriate work in (b)</i>                 |
| <b>③</b>           | <i>1 mark for correct answer in (b)</i>                   |

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## Question No. 18 and Answer

18. The volume of air inside the lungs varies with time as people breathe in and out. The volume of air inside the lungs of a sleeping person is modelled by the following sinusoidal equation:

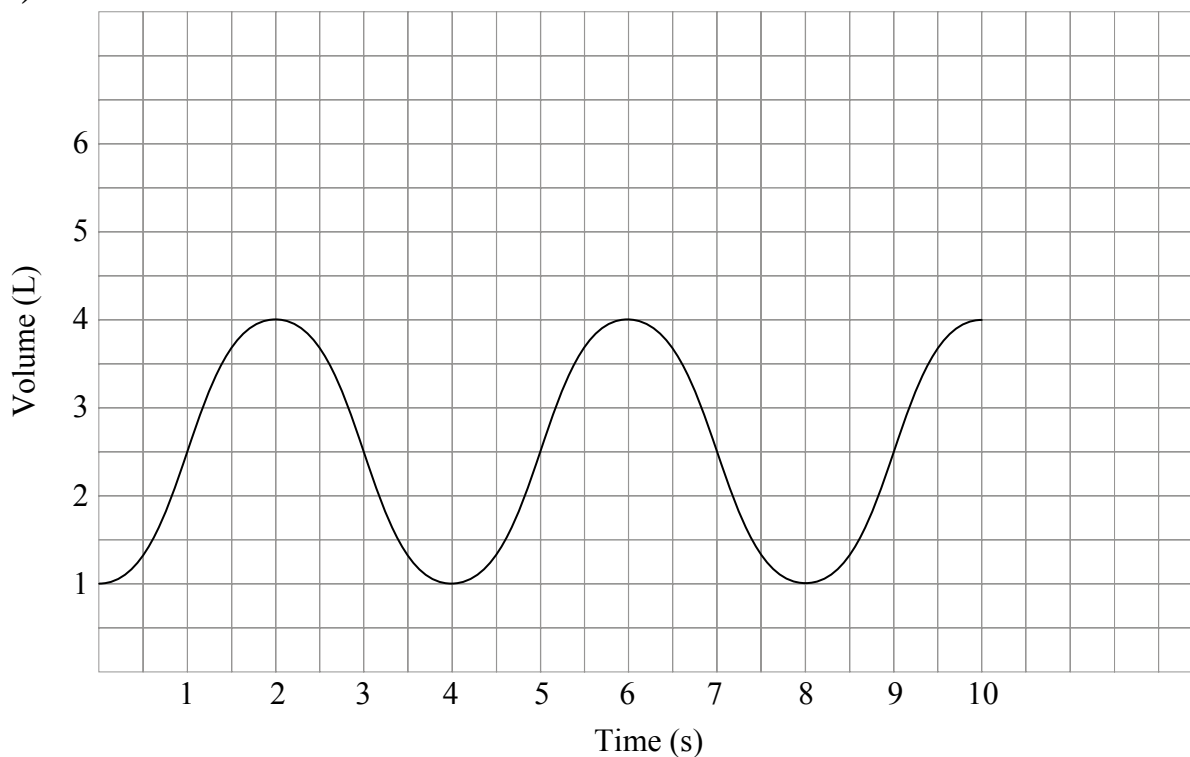
Total:  
4 marks

$$y = 1.5\sin(1.57x - 1.57) + 2.5$$

where  $x$  is the time in seconds and  
 $y$  is the volume of air in litres.

- a) Draw a clearly labelled graph which represents the volume of air in a sleeping person's lungs over a period of at least 10 seconds. Indicate the maximum and minimum values.

(2 marks)



maximum value = 4

minimum value = 1

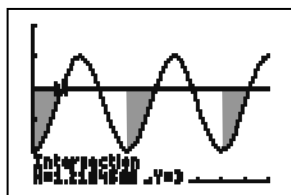
## Question No. 18 continued

- b) When a sleeping person breathes out, the volume reaches its minimum value.  
When a person breathes in, they snore until the volume reaches 3 litres.



Using the sinusoidal equation, determine the total amount of time a person will be snoring during the first 10 seconds. Show your work and indicate your answer to 2 decimal places.

(2 marks)



$$1.22 \times 3 = 3.66 \text{ seconds}$$

They will be snoring for 3.66 seconds.

**Marker Note(s):**

→ Maximum 0.5 mark deduction per question if student does not draw a clearly labelled graph.  
A clearly labelled graph will include labels with units on both axes, an indication of scales on both axes, and an appropriate shape.

| <b>Marking Key</b> |  |
|--------------------|--|
| <b>1</b>           | 1 mark for appropriate shape of graph in (a)         |
| <b>2</b>           | 1 mark for correct maximum and minimum values in (a) |
| <b>3</b>           | 1 mark for appropriate work in (b)                   |
| <b>4</b>           | 1 mark for correct answer in (b)                     |

---

## Exemplar 1

---

18. The volume of air inside the lungs varies with time as people breathe in and out. The volume of air inside the lungs of a sleeping person is modelled by the following sinusoidal equation:

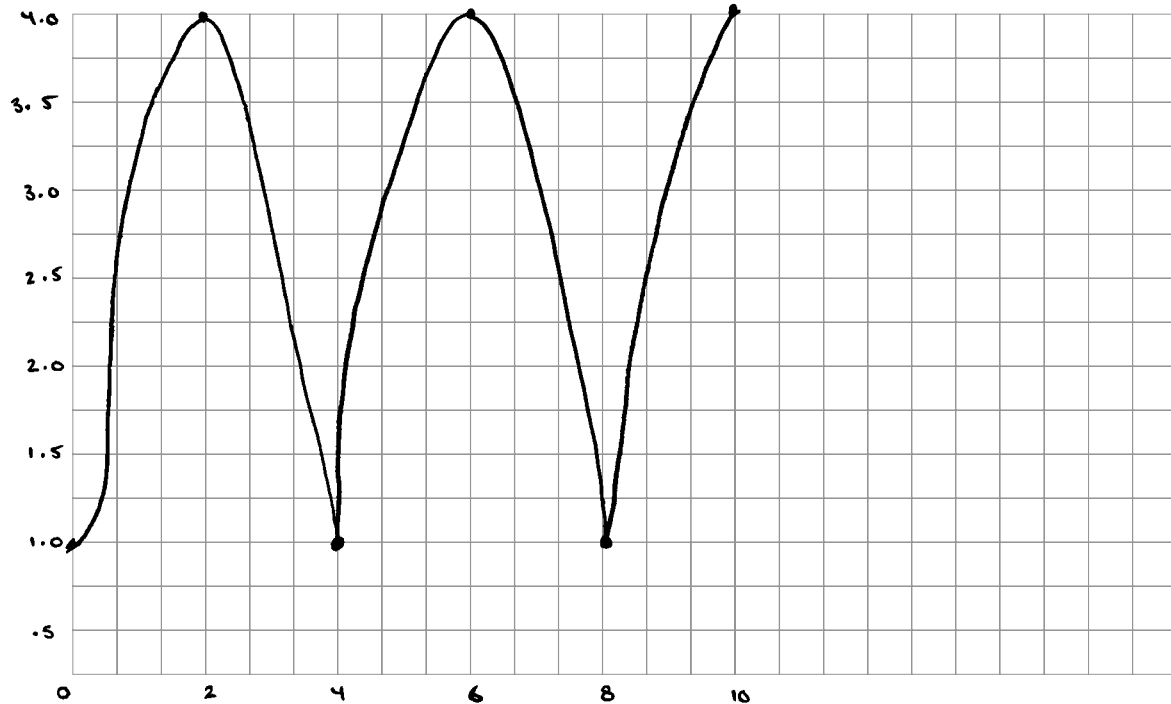
Total:  
4 marks

$$y = 1.5 \sin(1.57x - 1.57) + 2.5$$

where  $x$  is the time in seconds and  
 $y$  is the volume of air in litres.

- a) Draw a clearly labelled graph which represents the volume of air in a sleeping person's lungs over a period of at least 10 seconds. Indicate the maximum and minimum values.

(2 marks)



maximum value = 4.0

minimum value = 1.0

---

## Exemplar 1 continued

---

- b) When a sleeping person breathes out, the volume reaches its minimum value. When a person breathes in, they snore until the volume reaches 3 litres.



Using the sinusoidal equation, determine the total amount of time a person will be snoring during the first 10 seconds. Show your work and indicate your answer to 2 decimal places.

(2 marks)

$$y = 1.5 \sin(1.57x - 1.57) + 2.5$$

$$y = 3$$

intersect  $x = 9$

$$y = 3$$

an average person snores 9 times

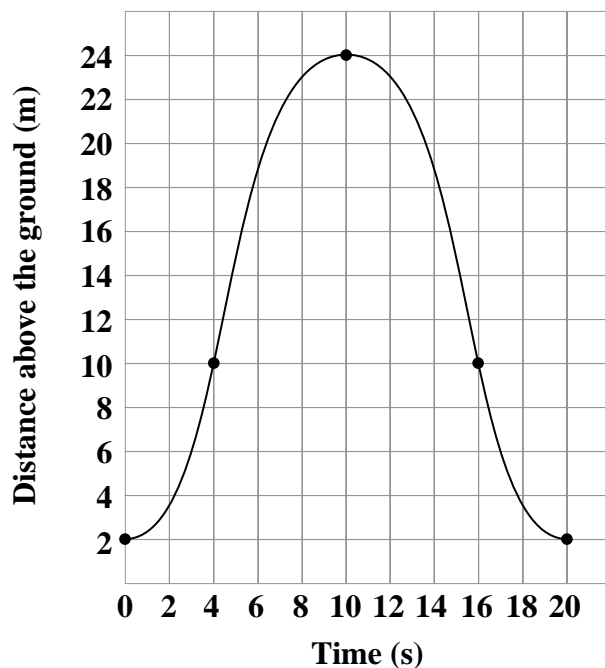
**1 mark:**

② → 1 mark for correct maximum and minimum values in (a)

Question No. 19 and Answer

19. The graph below represents one complete revolution of a Ferris wheel.

Total:  
4 marks



a) Determine the diameter of this Ferris wheel.

(1 mark)

diameter = 22 metres

b) Determine the sinusoidal equation which best represents the graph. Explain how you arrived at your answer. Indicate the input values if you use technology.

(2 marks)

| L1      | L2    | L3    |
|---------|-------|-------|
| 0       | 2     | ----- |
| 4       | 10    |       |
| 10      | 24    |       |
| 16      | 10    |       |
| 20      | 2     |       |
| -----   | ----- |       |
| L2(G) = |       |       |

$$y = 11.02 \sin(0.31x - 1.51) + 13$$

I entered the data into L1 and L2 and used SinReg to find the equation.

---

## Question No. 19 continued

---

c) In this situation, explain why the minimum value must be greater than 0.

(1 mark)

The minimum value must be greater than 0  
so that the Ferris wheel does not touch the ground.

*Marker Note(s):*

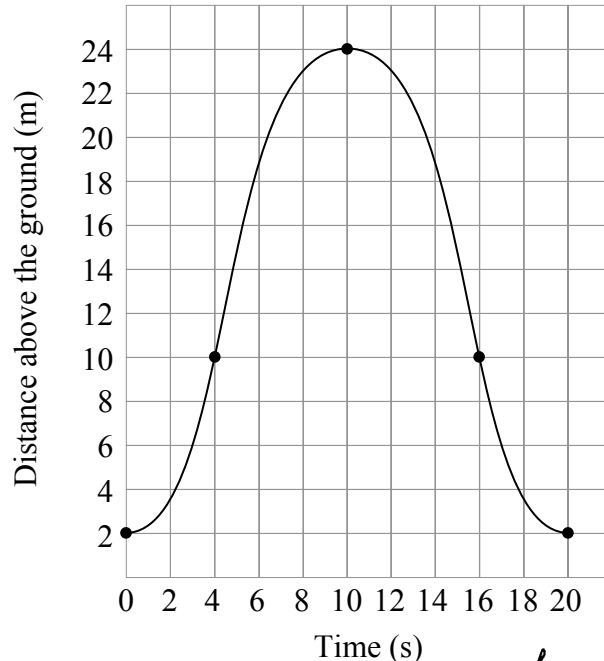
→ *Maximum 0.5 mark deduction per question if student forgets to include or incorrectly places “y =”, “sin”, or “x” when asked for equations.*

| <b>Marking Key</b> |  |
|--------------------|--|
| <b>1</b>           | <i>1 mark for correct answer in (a)</i>              |
| <b>2</b>           | <i>1 mark for correct sinusoidal equation in (b)</i> |
| <b>3</b>           | <i>1 mark for correct explanation in (b)</i>         |
| <b>4</b>           | <i>1 mark for correct explanation in (c)</i>         |

## Exemplar 1

19. The graph below represents one complete revolution of a Ferris wheel.

Total:  
4 marks



a) Determine the diameter of this Ferris wheel.

(1 mark)

2 - 24 is one round  
 $2 \times 2 = d \therefore d = 7$

The diameter is 7 m  
 1 round = 22 circumference  
 $= 22$   
 $\frac{22}{2\pi} = 3.5 = \sim$

b) Determine the sinusoidal equation which best represents the graph. Explain how you arrived at your answer. Indicate the input values if you use technology.

(2 marks)

$a = 11$  amp  
 $b = \frac{\pi}{10}$  period  
 $c = 0$  no shift  
 $d = 2$  shifted up 2  
 $\frac{2\pi}{b}$

$y = 11 \sin \frac{\pi}{10}(x) + 2$

0 - 20 P = 20

2 marks:

- ③ → 1 mark for correct explanation in (b)
- ④ → 1 mark for correct explanation in (c)

c) In this situation, explain why the minimum value must be greater than 0.

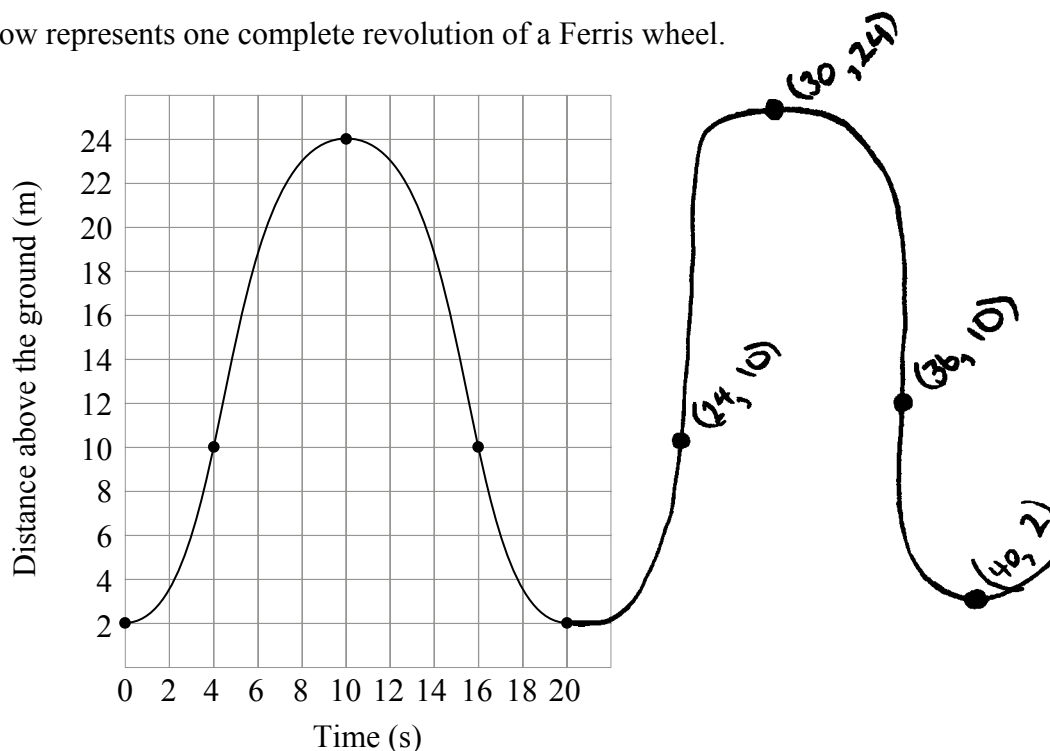
(1 mark)

because the wheel cannot come into contact with the ground or it would stop

## Exemplar 2

19. The graph below represents one complete revolution of a Ferris wheel.

Total:  
4 marks



a) Determine the diameter of this Ferris wheel.

(1 mark)

20.06

b) Determine the sinusoidal equation which best represents the graph. Explain how you arrived at your answer. Indicate the input values if you use technology.

(2 marks) (Graphmatica) data plot

| x  | y  |
|----|----|
| 0  | 2  |
| 4  | 10 |
| 10 | 24 |
| 16 | 10 |
| 20 | 2  |
| 24 | 10 |
| 30 | 24 |
| 36 | 10 |
| 40 | 2  |

$$y = 10.98 \sin(0.3131x + 4.73) + 3.14$$

**3 marks:**

- ② → 1 mark for correct sinusoidal equation in (b)
- ③ → 1 mark for correct explanation in (b)
- ④ → 1 mark for correct explanation in (c)

**Note:** No mark deduction for trivial error in the  $d$  value in (b).

c) In this situation, explain why the minimum value must be greater than 0.

(1 mark)

The minimum value must be greater than 0 because a Ferris wheel can't go below ground level.

**Question No. 20 and Answer**

20. Roland has a field where 1000 Christmas trees have been planted. Every year, he decides to sell 20% of his trees and plant 120 new trees.

**Total:  
3 marks**

a) How many trees will Roland have after 5 years? Show your work.

(2 marks)

b)

| Year | Number of Trees                 |
|------|---------------------------------|
| 0    | 1000                            |
| 1    | $(1000 \times 0.8) + 120 = 920$ |
| 2    | 856                             |
| 3    | 804.80                          |
| 4    | 763.84                          |
| 5    | <b>731.07</b>                   |
| ⋮    | ⋮                               |
| 99   | 600                             |
| 100  | <b>600</b>                      |

```

Plot1 Plot2 Plot3
nMin=0
u(n)=u(n-1)*0.8
+120
u(nMin)=1000
u(n)=
u(nMin)=
u(n)=
    
```

| n | u(n)   |
|---|--------|
| 0 | 1000   |
| 1 | 920    |
| 2 | 856    |
| 3 | 804.8  |
| 4 | 763.84 |
| 5 | 731.07 |
| 6 | 704.86 |

n=5

He will have 731 trees after 5 years.

OR

b)

| Year | Number of Trees                 |
|------|---------------------------------|
| 0    | 1000                            |
| 1    | $(1000 + 120) \times 0.8 = 896$ |
| 2    | 812.80                          |
| 3    | 746.24                          |
| 4    | 692.99                          |
| 5    | <b>650.39</b>                   |
| ⋮    | ⋮                               |
| 99   | 480                             |
| 100  | <b>480</b>                      |

He will have 650 trees after 5 years.

b) How many trees will there be when this pattern stabilizes?

(1 mark)

There will be 600 trees when this pattern stabilizes.

OR

There will be 480 trees when this pattern stabilizes.

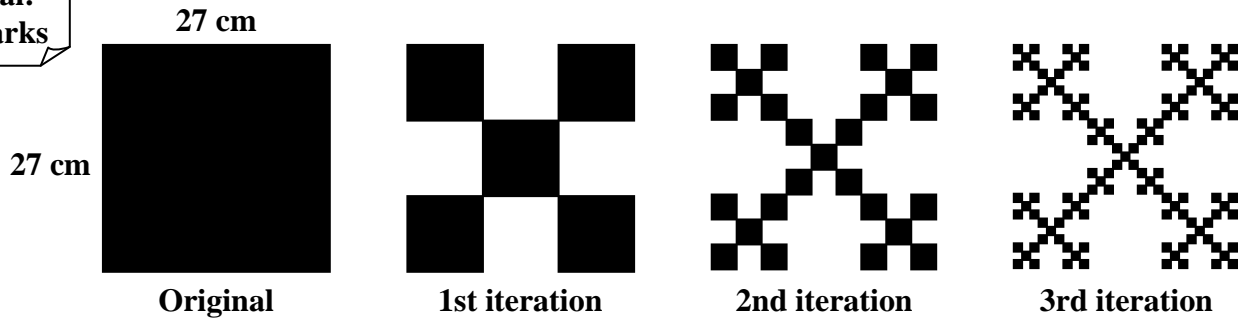
| Marking Key |                                    |
|-------------|------------------------------------|
| ①           | 1 mark for appropriate work in (a) |
| ②           | 1 mark for correct answer in (a)   |
| ③           | 1 mark for correct answer in (b)   |

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## Question No. 21 and Answer

21. Given the fractal below showing the original square and the first three iterations:

Total:  
4 marks



a) Complete the following table.

(3 marks)

|               | Area of One Black Square (cm <sup>2</sup> ) | Number of Black Squares | Total Area of Black Squares (cm <sup>2</sup> ) |
|---------------|---|-------------------------|--|
| Original      | 729   | 1                       | 729  |
| 1st iteration | 81  | 5                       | 405  |
| 2nd iteration | 9   | 25                      | 225  |
| ⋮             | ⋮   | ⋮                       | ⋮  |
| 6th iteration | 0.001 4                                     | 15 625                  | 21.43  |

b) Will the area of black squares eventually disappear from view? Explain your answer.

(1 mark)

Yes, the area of black squares will eventually disappear from view, since each new black square is one-ninth of the area of the previous black square.

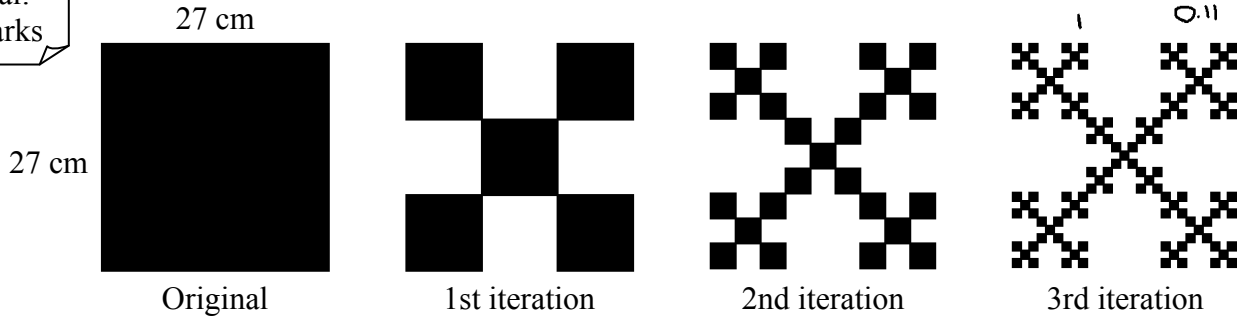
### Marking Key

- |   |   |
|---|---|
| ① | 1 mark for correctly completing the area of one black square column in (a)    |
| ② | 1 mark for correctly completing the number of black squares column in (a)     |
| ③ | 1 mark for correctly completing the total area of black squares column in (a) |
| ④ | 1 mark for correct explanation in (b)   |

## Exemplar 1

21. Given the fractal below showing the original square and the first three iterations:

Total:  
4 marks



a) Complete the following table.  
(3 marks)

|                      | Area of One Black Square (cm <sup>2</sup> ) | Number of Black Squares | Total Area of Black Squares (cm <sup>2</sup> ) |
|----------------------|---|-------------------------|--|
| <b>Original</b>      | 729   | 1                       | 729  |
| <b>1st iteration</b> | 81  | 5                       | 405  |
| <b>2nd iteration</b> | 9   | 25                      | 225  |
| ⋮                    | ⋮   | ⋮                       | ⋮  |
| <b>6th iteration</b> | $1.8 \times 10^{-6}$                        | 15625                   | 0.0281   |

b) Will the area of black squares eventually disappear from view? Explain your answer.  
(1 mark)

*because they will be too small*

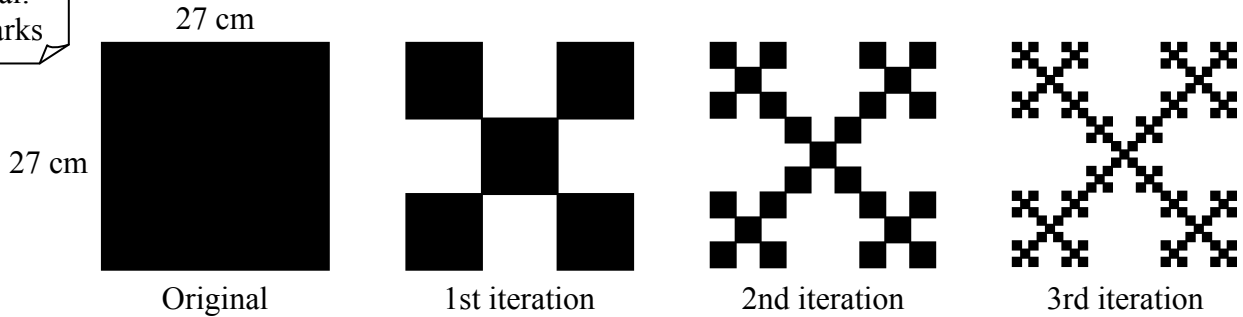
**3 marks:**

- ② → 1 mark for correctly completing the number of black squares column in (a)
- ③ → 1 mark for correctly completing the total area of black squares column in (a)
- ④ → 1 mark for correct explanation in (b)

## Exemplar 2

21. Given the fractal below showing the original square and the first three iterations:

Total:  
4 marks



a) Complete the following table.  
(3 marks)

|                      | Area of One Black Square (cm <sup>2</sup> ) | Number of Black Squares | Total Area of Black Squares (cm <sup>2</sup> ) |
|----------------------|---|-------------------------|--|
| <b>Original</b>      | 729   | 1                       | 729  |
| <b>1st iteration</b> | 81  | 5                       | 405  |
| <b>2nd iteration</b> | 9   | 25                      | 225  |
| ⋮                    | ⋮   | ⋮                       | ⋮  |
| <b>6th iteration</b> | 1/729                                       | 78125                   | 107.17   |

3:1 125  
4:1/9 625  
5:1/81 15625  
6:1/729

b) Will the area of black squares eventually disappear from view? Explain your answer.  
(1 mark)

yes

**2 marks:**

① → 1 mark for correctly completing the area of one black square column in (a)

② → 1 mark for correctly completing the total area of black squares column in (a)

# **Marking Keys and Scoring Rubrics for the Inquiry Task**

**Inquiry Task Question No. 1 and Answer**

**DESIGN AND MEASUREMENT**

1. You decide to build a stand for your television, game console, and Blu-ray player based on the diagram below.

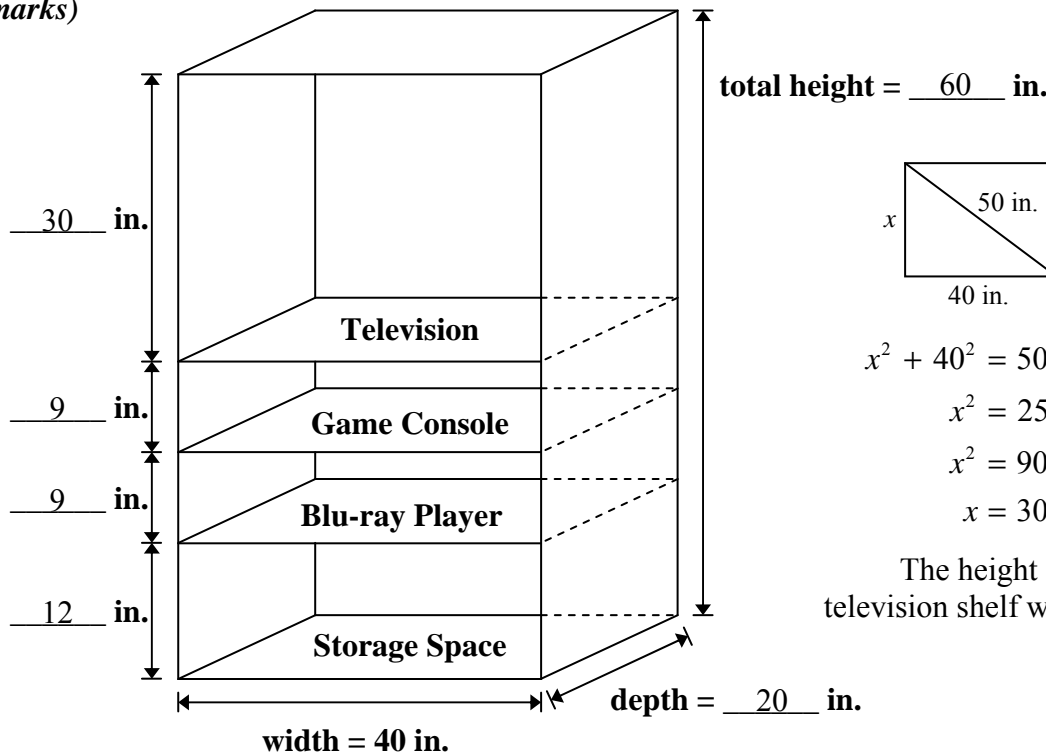
**Total:  
10 marks**

The stand must meet the following specifications:

- The total height of the stand must be at most 84 in.
- The width of the stand must be 40 in.
- For stability, the depth of the stand must be at least one-third of the total height.
- The top shelf must accommodate a television with a diagonal length of at least 50 in.
- The shelves for the game console and Blu-ray player must each be at least 8 in. high.
- The storage space at the bottom of the stand must be at least 12 in. high.

a) Label the following diagram with your dimensions for the height of each shelf, the total height, and the depth.

(2 marks)



*Other answers are possible.*

Mark(s):

- ① → 1 mark for appropriate heights of shelves and total height
- ② → 1 mark for appropriate depth of stand

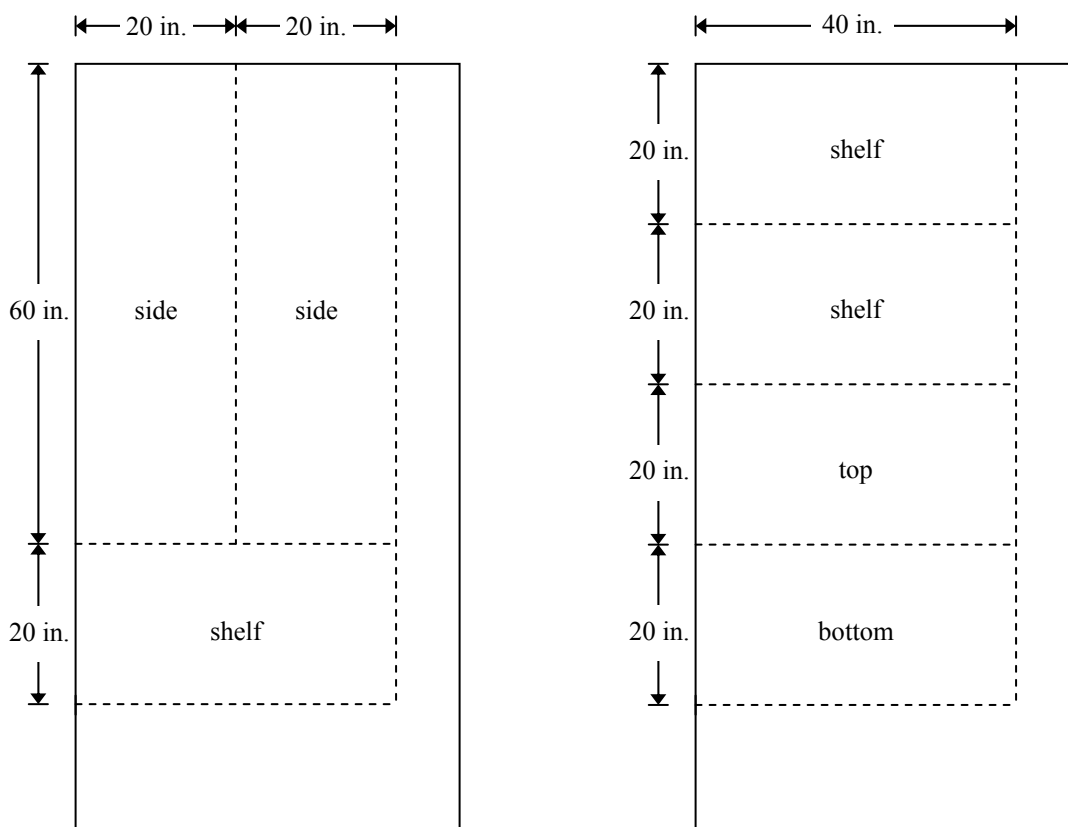
## Question No. 1 continued

b) Based on the diagram in (a) and the following specifications, determine the minimum number of sheets of plywood needed to build your stand.

- The sides, top, bottom, and shelves of the stand must be built with  $\frac{3}{4}$  in. plywood.
- The back of the stand must be built with  $\frac{3}{8}$  in. plywood.
- Plywood is purchased in 48 in.  $\times$  96 in. sheets.
- Smaller pieces of plywood cannot be fastened together to make a larger piece.

Support your answer by including sketches with dimensions showing how you would cut the sheets of plywood.

(3 marks)



I would need 2 sheets of  $\frac{3}{4}$  in. plywood and 1 sheet of  $\frac{3}{8}$  in. plywood.

*Other answers are possible.*

Mark(s):

- ③ → 1 mark for sketches showing correct number and dimensions of the top, bottom, and shelves
- ④ → 1 mark for sketches showing correct number and dimensions of the sides
- ⑤ → 1 mark for minimum number of sheets of plywood

---

## Question No. 1 continued

---

- c) You must apply two coats of paint to all the surfaces, not including the edges, before the stand is assembled. All the edges will be laminated. How many cans of paint will you need if each one-litre can covers 9000 square inches?

(2 marks)

Area of sides and shelves:

$$2(60 \times 20) + 5(40 \times 20) = 6400 \text{ in.}^2$$

Area of back:

$$60 \text{ in.} \times 40 \text{ in.} = 2400 \text{ in.}^2$$

Total area to be painted:

$$6400 \text{ in.}^2 + 2400 \text{ in.}^2 = 8800 \text{ in.}^2$$

$$8800 \text{ in.}^2 \times 2 \text{ sides} = \mathbf{17\ 600 \text{ in.}^2} \text{ (mark 6)}$$

Amount of paint needed:

$$17\ 600 \text{ in.}^2 \times 2 \text{ coats} = 35\ 200 \text{ in.}^2$$

$$\frac{35\ 200 \text{ in.}^2}{9000 \text{ in.}^2/\text{l.}} = 3.91 \text{ litres}$$

$$= 3.91 \text{ cans}$$

Marker Note(s):

→ No mark deduction for not rounding up the number of cans of paint.

Mark(s):

6 → 1 mark for correct total surface area of all pieces

7 → 1 mark for correct number of cans of paint



## Question No. 1 continued

### Scoring Rubric

| General Performance Indicators   |  |   |  |
|--|--|---|--|
| Level 1—limited understanding  |  |   |  |
| <b>1 mark</b><br><b>weak attempt: inappropriate strategy or no strategy</b><br>1 criterion correct | <b>2 marks</b><br><b>reasonable attempt: inappropriate strategy, major errors or omissions</b><br>2 criteria correct | <b>3 marks</b><br><b>reasonable attempt: inappropriate strategy but carried through correctly</b><br>3 criteria correct |  |
| Level 2—good understanding   |  |   |  |
| <b>4 marks</b><br><b>sound strategy with major errors</b><br>4 criteria correct                    | <b>5 marks</b><br><b>sound strategy with minor errors</b><br>5 criteria correct                                      | <b>6 marks</b><br><b>mostly complete with some omissions</b><br>6 criteria correct                                      | <b>7 marks</b><br><b>almost complete and correct, major errors</b><br>7 criteria correct |
| Level 3—exceptional understanding  |  |   |  |
| <b>8 marks</b><br><b>complete, two minor errors, trivial errors</b><br>8 criteria correct          | <b>9 marks</b><br><b>complete, one minor error</b><br>9 criteria correct   | <b>10 marks</b><br><b>complete and correct</b><br>10 criteria correct   |  |

Marker Note(s):

- Maximum 0.5 mark deduction per question if student does not buy materials in whole units or rounds to whole units too soon (only if the student was awarded the mark for total cost).
- No mark deduction for not rounding up the number of cans of paint.

| Marking Key |    |  |
|-------------|----|--|
| ①           | a) | <i>1 mark for appropriate heights of shelves and total height</i>                                |
| ②           |    | <i>1 mark for appropriate depth of stand</i>   |
| ③           | b) | <i>1 mark for sketches showing correct number and dimensions of the top, bottom, and shelves</i> |
| ④           |    | <i>1 mark for sketches showing correct number and dimensions of the sides</i>                    |
| ⑤           |    | <i>1 mark for minimum number of sheets of plywood</i>  |
| ⑥           | c) | <i>1 mark for correct total surface area of all pieces</i>                                       |
| ⑦           |    | <i>1 mark for correct number of cans of paint</i>  |
| ⑧           | d) | <i>1 mark for including all required materials</i>   |
| ⑨           |    | <i>1 mark for correct total cost, including taxes</i>  |
| ⑩           | e) | <i>1 mark for correct number of cases</i>  |

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## Exemplar 1

---

### DESIGN AND MEASUREMENT

1. You decide to build a stand for your television, game console, and Blu-ray player based on the diagram below.

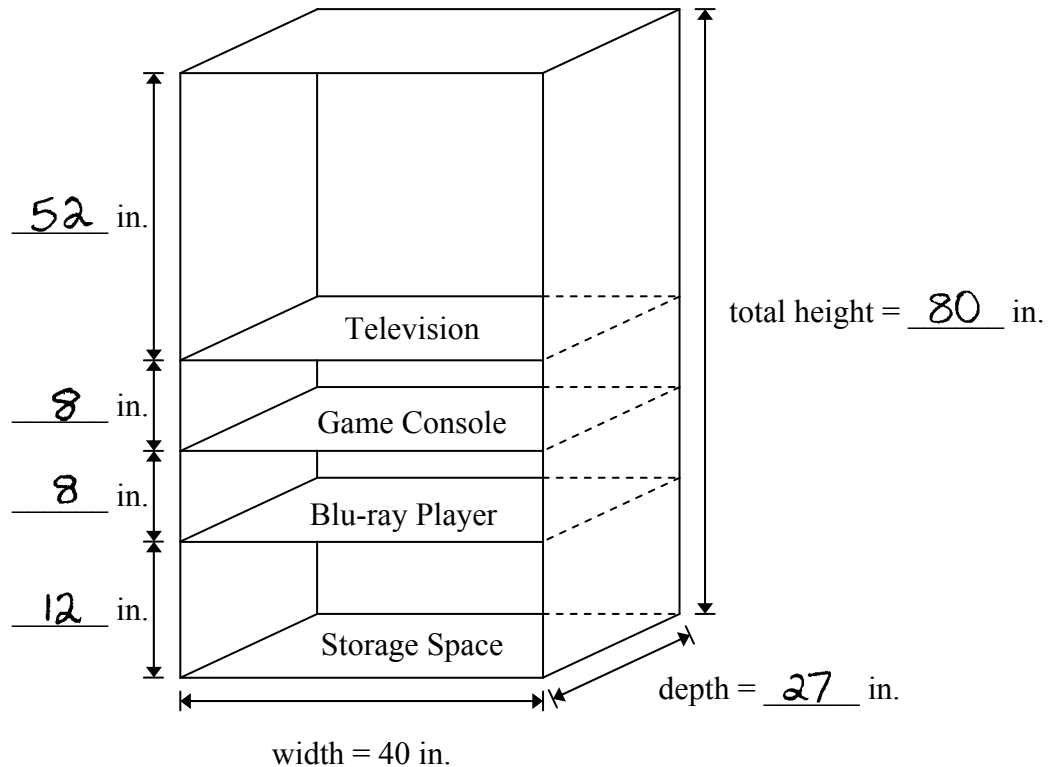
Total:  
10 marks

The stand must meet the following specifications:

- The total height of the stand must be at most 84 in.
- The width of the stand must be 40 in.
- For stability, the depth of the stand must be at least one-third of the total height.
- The top shelf must accommodate a television with a diagonal length of at least 50 in.
- The shelves for the game console and Blu-ray player must each be at least 8 in. high.
- The storage space at the bottom of the stand must be at least 12 in. high.

- a) Label the following diagram with your dimensions for the height of each shelf, the total height, and the depth.

(2 marks)



## Exemplar 1 continued

b) Based on the diagram in (a) and the following specifications, determine the minimum number of sheets of plywood needed to build your stand.

- The sides, top, bottom, and shelves of the stand must be built with  $\frac{3}{4}$  in. plywood.
- The back of the stand must be built with  $\frac{3}{8}$  in. plywood.
- Plywood is purchased in 48 in.  $\times$  96 in. sheets.
- Smaller pieces of plywood cannot be fastened together to make a larger piece.

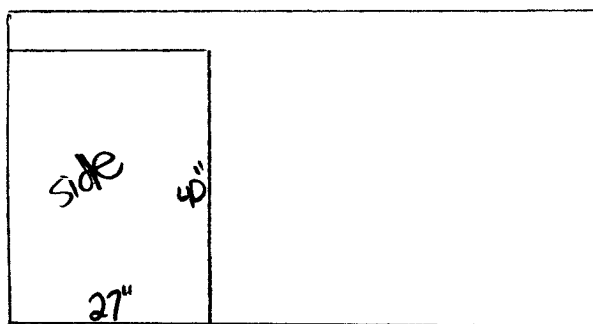
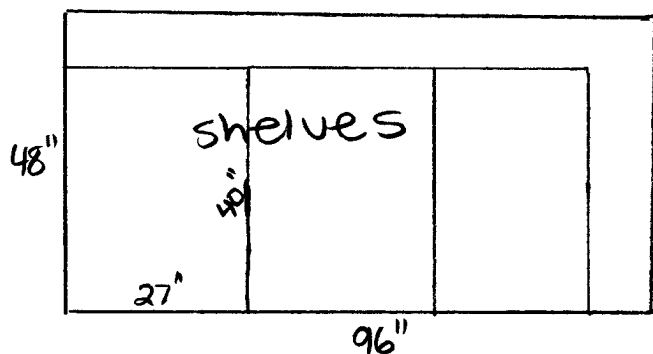
Support your answer by including sketches with dimensions showing how you would cut the sheets of plywood.

(3 marks)

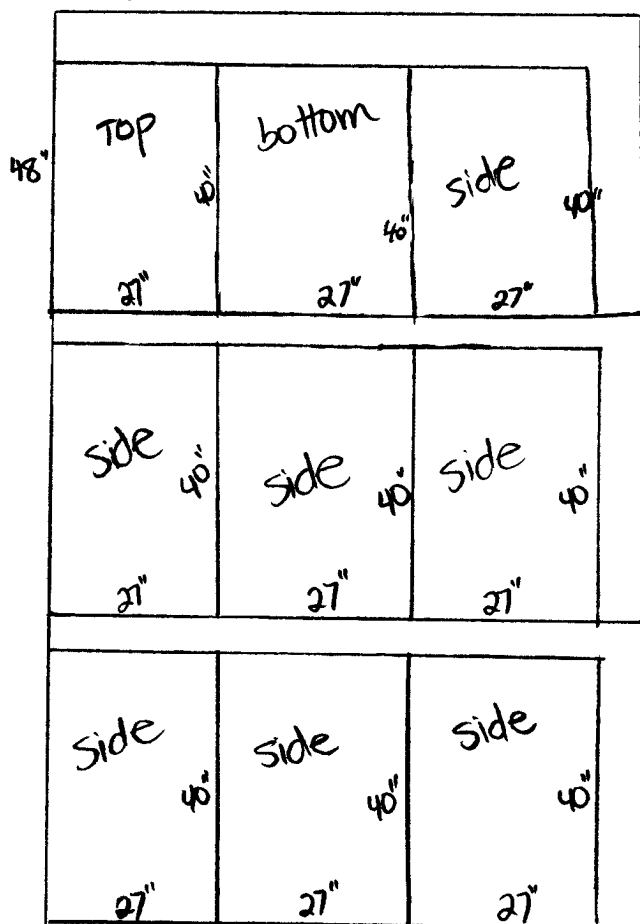
sides 4(80" x 27")

Top, bottom 2(40" x 27")

shelves 3(40" x 27")



minimum # sheets of plywood



---

## Exemplar 1 continued

---

- c) You must apply two coats of paint to all the surfaces, not including the edges, before the stand is assembled. All the edges will be laminated. How many cans of paint will you need if each one-litre can covers 9000 square inches?

(2 marks)

$$\text{Sides} = 8640 \text{ inch.}^2 \times 2 (\text{both sides}) = 17280$$

$$\text{Top, bottom} = 2160 \text{ inch.}^2 \times 2 = 4320$$

$$\text{Shelves} = 3240 \text{ inch}^2 \times 2 = 6480$$

$$\begin{array}{r} 17280 \\ 4320 \\ + 6480 \\ \hline 28080 \end{array} \div 9000 = 3.12$$

You will need 4 cans to cover everything.

## Exemplar 1 continued

- d) Calculate the total cost to build the stand, including taxes.  
(GST = 5%, PST = 7%)

- One  $\frac{3}{4}$  in. sheet of plywood costs \$49.95.
- One  $\frac{3}{8}$  in. sheet of plywood costs \$29.95.
- A one-litre can of paint costs \$14.95.
- The laminated edging costs \$19.95.

All materials must be purchased in whole units.

(2 marks)

$$\begin{array}{r}
 4 \times 49.95 = \$199.80 \\
 1 \times 29.95 = \$29.95 \\
 4 \times 14.95 = \$59.80 \\
 + 19.95 \\
 \hline
 \$309.50
 \end{array}$$

- e) A Blu-ray case has a volume of 20 cubic inches. Determine the maximum number of cases that could be kept in the storage space of your stand.

(1 mark)

$$L \times W \times h = \text{Volume}$$

$$27 \times 40 \times 8 = 8640 \text{ inches}^3$$

$$8640 \div 20 = 432 \text{ cases could be kept in the storage space}$$

| 5 marks: |    |   |
|----------|----|---|
| ①<br>②   | a) | 1 mark for appropriate heights of shelves and total height<br>1 mark for appropriate depth of stand |
| ③        | b) | 1 mark for sketches showing correct number and dimensions of the top, bottom, and shelves           |
| ④        | c) | 1 mark for correct total surface area of all pieces   |
| ⑤        | d) | 1 mark for including all required materials   |

---

## Exemplar 2

---

### DESIGN AND MEASUREMENT

1. You decide to build a stand for your television, game console, and Blu-ray player based on the diagram below.

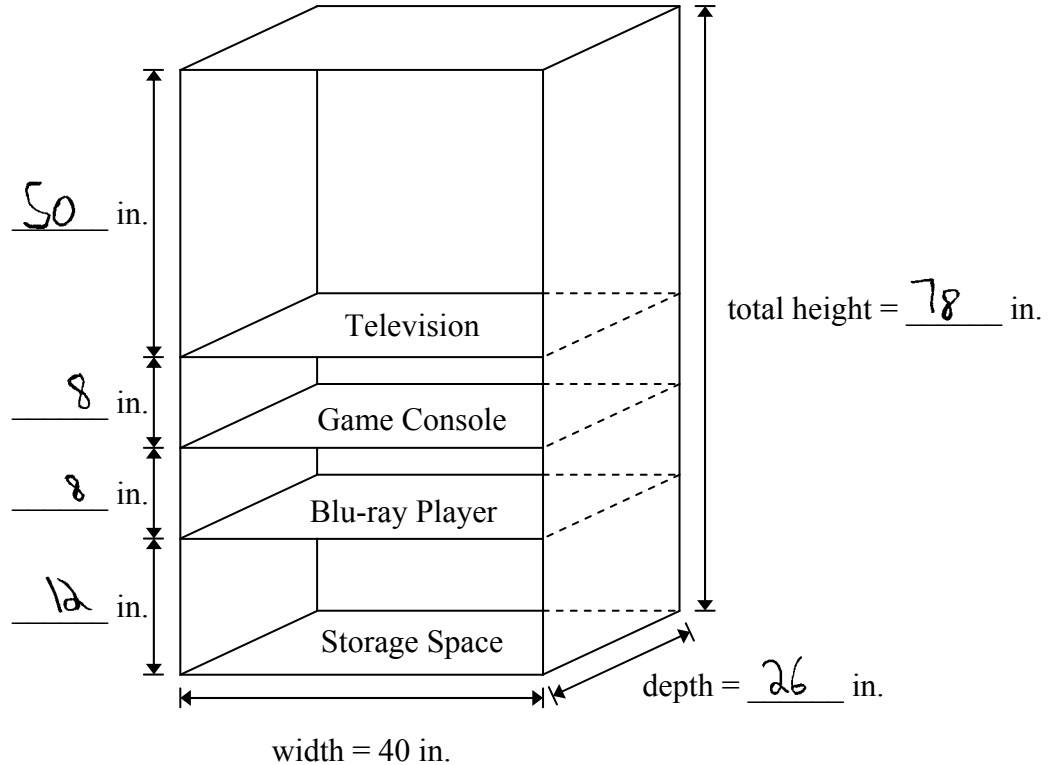
Total:  
10 marks

The stand must meet the following specifications:

- The total height of the stand must be at most 84 in.
- The width of the stand must be 40 in.
- For stability, the depth of the stand must be at least one-third of the total height.
- The top shelf must accommodate a television with a diagonal length of at least 50 in.
- The shelves for the game console and Blu-ray player must each be at least 8 in. high.
- The storage space at the bottom of the stand must be at least 12 in. high.

- a) Label the following diagram with your dimensions for the height of each shelf, the total height, and the depth.

(2 marks)



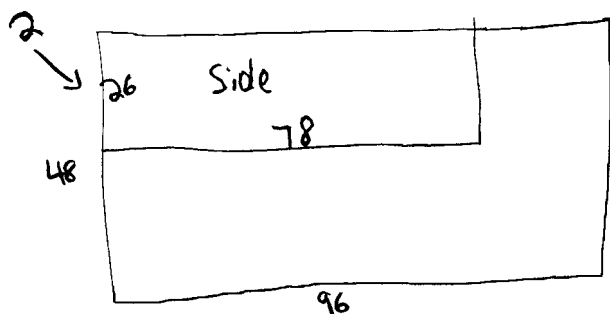
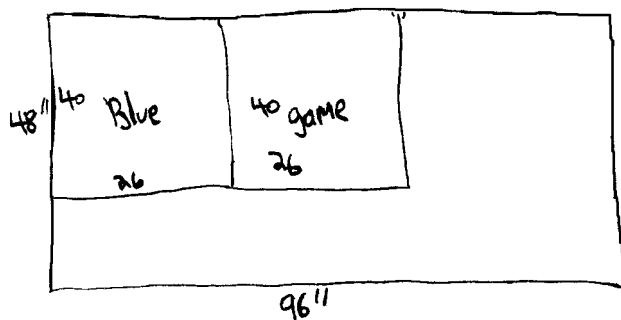
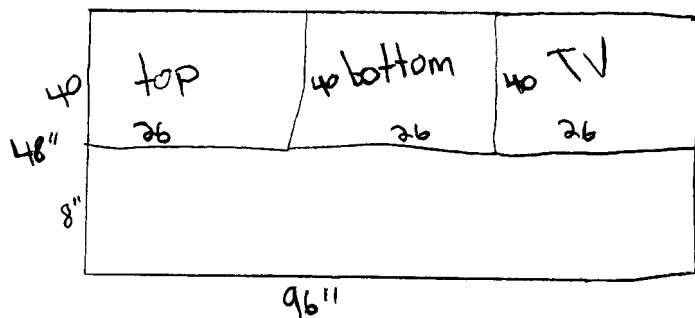
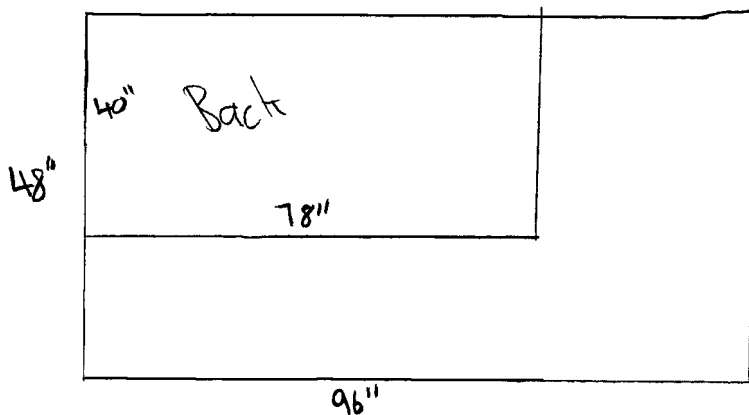
## Exemplar 2 continued

b) Based on the diagram in (a) and the following specifications, determine the minimum number of sheets of plywood needed to build your stand.

- The sides, top, bottom, and shelves of the stand must be built with  $\frac{3}{4}$  in. plywood.
- The back of the stand must be built with  $\frac{3}{8}$  in. plywood.
- Plywood is purchased in 48 in.  $\times$  96 in. sheets.
- Smaller pieces of plywood cannot be fastened together to make a larger piece.

Support your answer by including sketches with dimensions showing how you would cut the sheets of plywood.

(3 marks)



5 in total

---

## Exemplar 2 continued

---

- c) You must apply two coats of paint to all the surfaces, not including the edges, before the stand is assembled. All the edges will be laminated. How many cans of paint will you need if each one-litre can covers 9000 square inches?

(2 marks)

$$\begin{array}{r} 5 \quad 40'' \times 26'' = 5200 \text{ in}^2 \\ + \\ 2 \quad 40'' \times 78'' = 6240 \text{ in}^2 \\ + \\ 2 \quad 26'' \times 78'' = 4056 \end{array}$$

---

$$15496 \div 9000 = 1.7 \times 2 = 3.4$$

You will need 4 cans of paint

## Exemplar 2 continued

- d) Calculate the total cost to build the stand, including taxes.  
(GST = 5%, PST = 7%)

- One  $\frac{3}{4}$  in. sheet of plywood costs \$49.95.
- One  $\frac{3}{8}$  in. sheet of plywood costs \$29.95.
- A one-litre can of paint costs \$14.95.
- The laminated edging costs \$19.95.

All materials must be purchased in whole units.

(2 marks)

$$\begin{array}{r}
 4 \times 49.95 = 199.8 \\
 + \\
 29.95 \\
 4 \times 14.95 = 59.8 \\
 \hline
 \$289.55 + 19.95 = 309.5 \times 0.12 = 37.14 + 309.5 \\
 \\
 \$346.64
 \end{array}$$

- e) A Blu-ray case has a volume of 20 cubic inches. Determine the maximum number of cases that could be kept in the storage space of your stand.

(1 mark)

$$\frac{26 \times 40}{8} = \frac{130}{20} = 6.5 \quad \text{you can fit 6}$$

| 8 marks: |    |   |
|----------|----|---|
| ①        | a) | 1 mark for appropriate heights of shelves and total height                                |
| ②        |    | 1 mark for appropriate depth of stand   |
| ③        | b) | 1 mark for sketches showing correct number and dimensions of the top, bottom, and shelves |
| ④        |    | 1 mark for sketches showing correct number and dimensions of the sides                    |
| ⑤        |    | 1 mark for minimum number of sheets of plywood  |
| ⑦        | c) | 1 mark for correct number of cans of paint  |
| ⑧        | d) | 1 mark for including all required materials   |
| ⑨        |    | 1 mark for correct total cost, including taxes  |

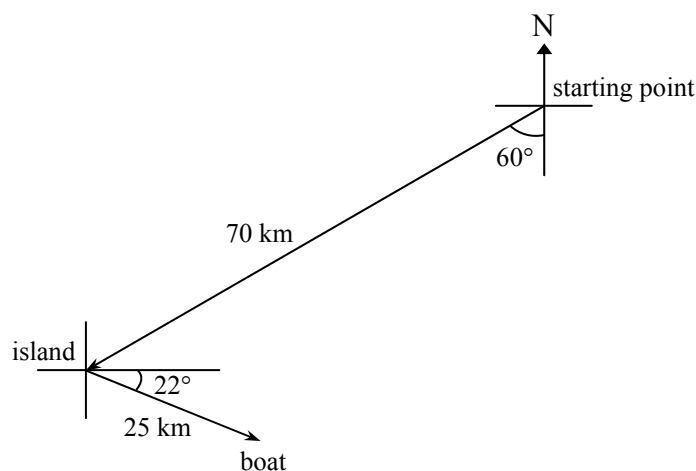
**Inquiry Task Question No. 2 and Answer****VECTORS**

2. Allan and Renée are in a boat travelling to an island that is 70 km away and at a bearing of  $240^\circ$  with respect to their starting point. Unfortunately, they run out of gas and end up 25 km from the island. The direction from the island to the boat is  $22^\circ$  south of east.

Total:  
9 marks

- a) Draw a vector sketch of this situation including all the magnitudes and directions.

(1 mark)



Marker Note(s):

→ Maximum 0.5 mark deduction per question if student forgets more than one arrowhead in scale vector diagrams or required vector sketches.

Mark(s):

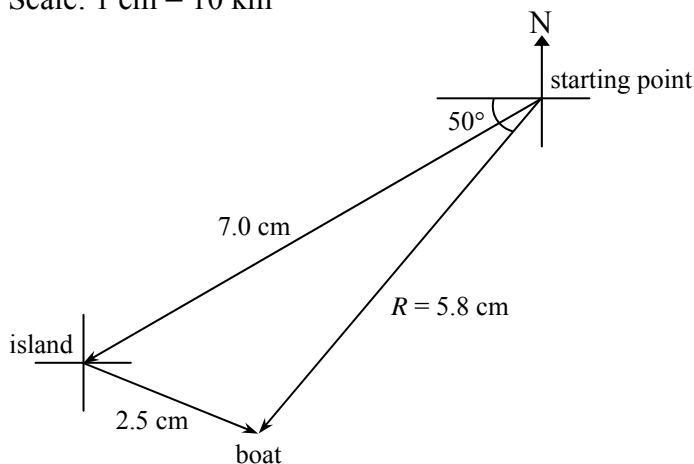
- ① → 1 mark for correct vector sketch

## Question No. 2 continued

- b) Determine the distance and direction of the boat with respect to its starting point when Allan and Renée run out of gas. Show your work.

(3 marks)

Scale: 1 cm = 10 km



They are 58 km from their starting point in a direction of W 50° S.

OR

|        |           |
|--------|-----------|
|        |           |
| SIDE   | ANGLE     |
| 25     | A 19.837  |
| 58.053 | B 52      |
| 70     | C 108.163 |

$$30^\circ + 19.84^\circ = 49.84^\circ$$

They are 58.05 km from their starting point in a direction of W 49.84° S.

Marker Note(s):

- Maximum 0.5 mark deduction per question if student does not state a scale when using scale diagrams as a strategy.
- Maximum 0.5 mark deduction per question if student forgets more than one arrowhead in scale vector diagrams or required vector sketches.
- Maximum 1 mark deduction per question if student uses the **same** incorrect directional method.

Mark(s):

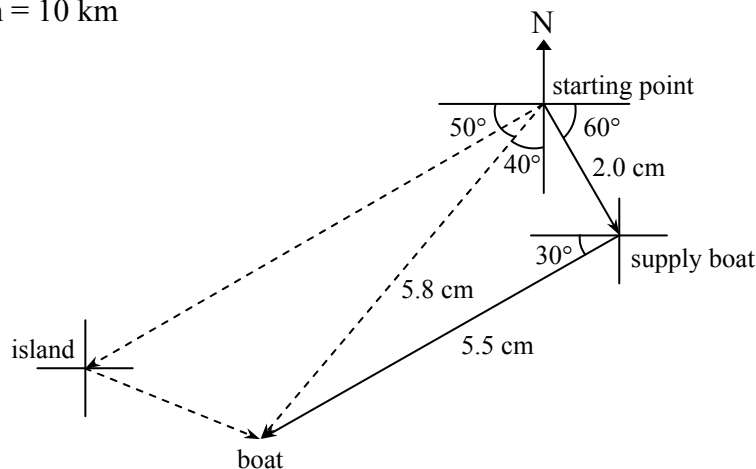
- |  |   |   |
|--|---|---|
| <ul style="list-style-type: none"> <li>② → 1 mark for appropriate work</li> <li>③ → 1 mark for correct distance</li> <li>④ → 1 mark for correct direction</li> </ul> | } | Award a maximum of 1 mark if student adds the vectors tail-to-tail. |
|--|---|---|

## Question No. 2 continued

- c) A rescue boat receives a distress signal from Allan and Renée and leaves from the same starting point. It must first set out in a direction of E 60° S to meet a supply boat in order to exchange equipment. Design a route for the rescue boat to get to Allan and Renée's boat in 80 km or less. Indicate all the distances and directions. Show your work.

(3 marks)

Scale: 1 cm = 10 km



The rescue boat could travel a distance of 20 km in a direction of E 60° S, and then turn and travel a distance of 55 km in a direction of 30° south of west.

OR

|        |       |        |  |
|--------|-------|--------|--|
|        |       | 20.16  |  |
|        | 58.05 | 20     |  |
| 20.153 |       | 89.687 |  |
| 54.605 |       |        |  |
| 54.605 | A     | 70.16  |  |
| 20     | B     | 20.153 |  |
| 58.05  | C     | 89.687 |  |

The rescue boat could travel a distance of 20 km in a direction of E 60° S, and then turn and travel a distance of 54.61 km in a direction of 30.31° south of west.

*Other answers are possible.*

Marker Note(s):

- Maximum 0.5 mark deduction per question if student does not state a scale when using scale diagrams as a strategy.
- Maximum 0.5 mark deduction per question if student forgets more than one arrowhead in scale vector diagrams or required vector sketches.
- Maximum 1 mark deduction per question if student uses the **same** incorrect directional method.

Mark(s):

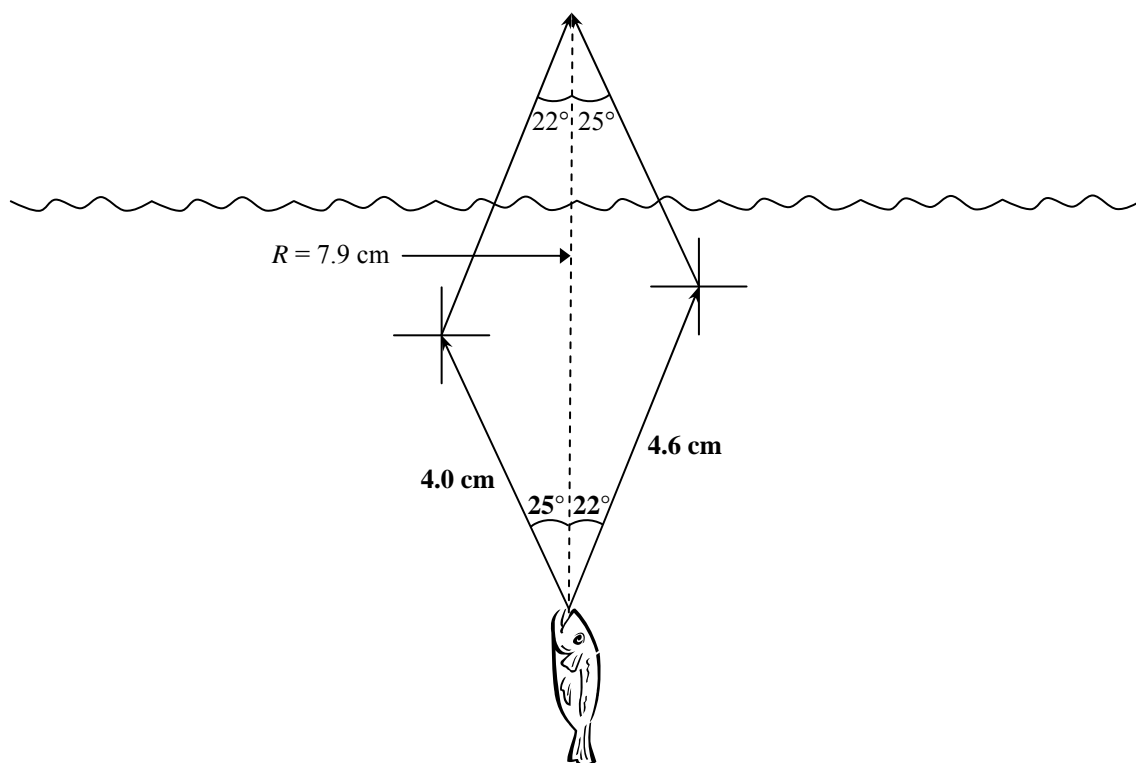
- ⑤ → 1 mark for first vector starting in a direction of E 60° S
- ⑥ → 1 mark for correct direction of second vector
- ⑦ → 1 mark for correct distances to the boat with a sum of 80 km or less

## Question No. 2 continued

- d) While waiting for the rescue boat, Allan and Renée decide to fish. By chance, they catch the same fish and pull on it with the forces indicated in the scale vector diagram below. Using the scale vector diagram, determine the magnitude of the resultant force, in newtons, acting on the fish. Show your work.

(2 marks)

Scale: 1 cm = 5 newtons



$$7.9 \text{ cm} \times 5 = 39.5 \text{ newtons}$$

The resultant force has a magnitude of 39.5 newtons.

Marker Note(s):

- Maximum 0.5 mark deduction per question if student forgets more than one arrowhead in scale vector diagrams or required vector sketches.
- Award no marks if student adds the vectors tail-to-tail.

Mark(s):

- ⑧ → 1 mark for appropriate work
- ⑨ → 1 mark for correct answer

## Question No. 2 continued

### Scoring Rubric

| General Performance Indicators   |  |   |  |
|--|--|---|--|
| Level 1—limited understanding  |  |   |  |
| <b>1 mark</b><br><b>weak attempt: inappropriate strategy or no strategy</b><br>1 criterion correct | <b>2 marks</b><br><b>reasonable attempt: inappropriate strategy, major errors or omissions</b><br>2 criteria correct | <b>3 marks</b><br><b>reasonable attempt: inappropriate strategy but carried through correctly</b><br>3 criteria correct |  |
| Level 2—good understanding   |  |   |  |
| <b>4 marks</b><br><b>sound strategy with major errors</b><br>4 criteria correct                    | <b>5 marks</b><br><b>sound strategy with minor errors</b><br>5 criteria correct                                      | <b>6 marks</b><br><b>mostly complete with some omissions</b><br>6 criteria correct                                      | <b>7 marks</b><br><b>almost complete and correct, minor errors</b><br>7 criteria correct |
| Level 3—exceptional understanding  |  |   |  |
| <b>8 marks</b><br><b>complete, one minor error</b><br>8 criteria correct                           |  | <b>9 marks</b><br><b>complete and correct</b><br>9 criteria correct   |  |

Marker Note(s):

- Maximum 0.5 mark deduction per question if student does not state a scale when using scale diagrams as a strategy.
- Maximum 0.5 mark deduction per question if student forgets more than one arrowhead in scale vector diagrams or required vector sketches.
- Maximum 1 mark deduction per question if student uses the *same* incorrect directional method.
- Award no marks if student adds the vectors tail-to-tail.

| Marking Key   |    |  |
|---|----|--|
| <b>1</b>  | a) | 1 mark for correct vector sketch                                     |
| <b>2</b>  | b) | 1 mark for appropriate work  |
| <b>3</b>  |    | 1 mark for correct distance  |
| <b>4</b>  |    | 1 mark for correct direction   |
| } Award a maximum of 1 mark if student adds the vectors tail-to-tail. |    |  |
| <b>5</b>  | c) | 1 mark for first vector starting in a direction of E 60° S           |
| <b>6</b>  |    | 1 mark for correct direction of second vector                        |
| <b>7</b>  |    | 1 mark for correct distances to the boat with a sum of 80 km or less |
| <b>8</b>  | d) | 1 mark for appropriate work  |
| <b>9</b>  |    | 1 mark for correct answer  |

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## Exemplar 1

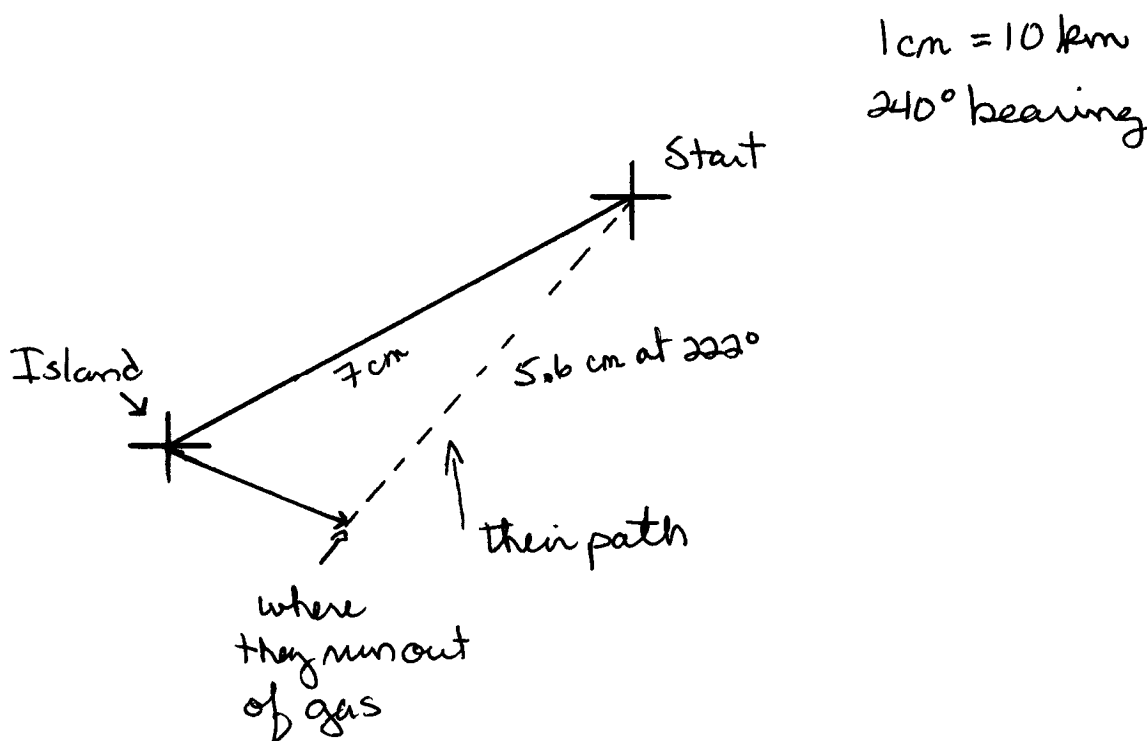
### VECTORS

2. Allan and Renée are in a boat travelling to an island that is 70 km away and at a bearing of  $240^\circ$  with respect to their starting point. Unfortunately, they run out of gas and end up 25 km from the island. The direction from the island to the boat is  $22^\circ$  south of east.

Total:  
9 marks

- a) Draw a vector sketch of this situation including all the magnitudes and directions.

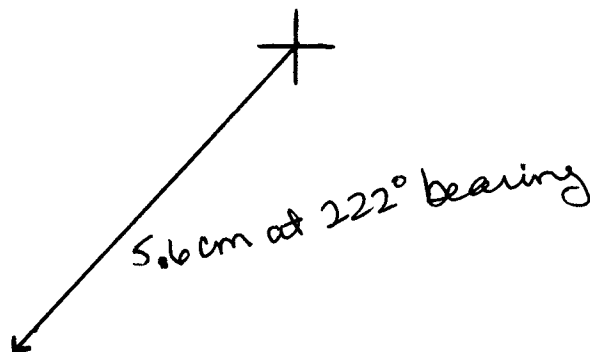
(1 mark)



- b) Determine the distance and direction of the boat with respect to its starting point when Allan and Renée run out of gas. Show your work.

(3 marks)

$1\text{ cm} = 10\text{ km}$



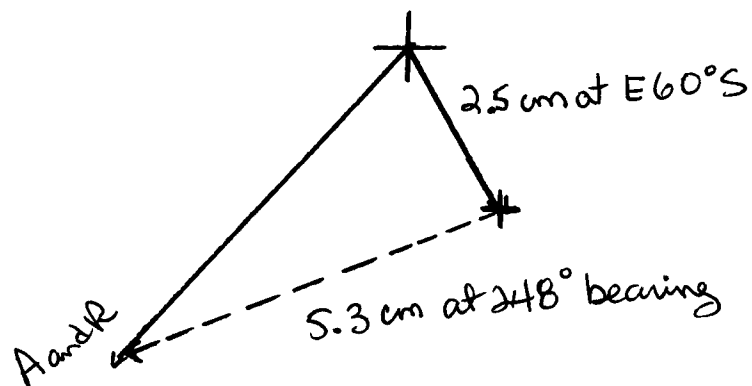
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## Exemplar 1 continued

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- c) A rescue boat receives a distress signal from Allan and Renée and leaves from the same starting point. It must first set out in a direction of  $E 60^\circ S$  to meet a supply boat in order to exchange equipment. Design a route for the rescue boat to get to Allan and Renée's boat in 80 km or less. Indicate all the distances and directions. Show your work.

(3 marks)



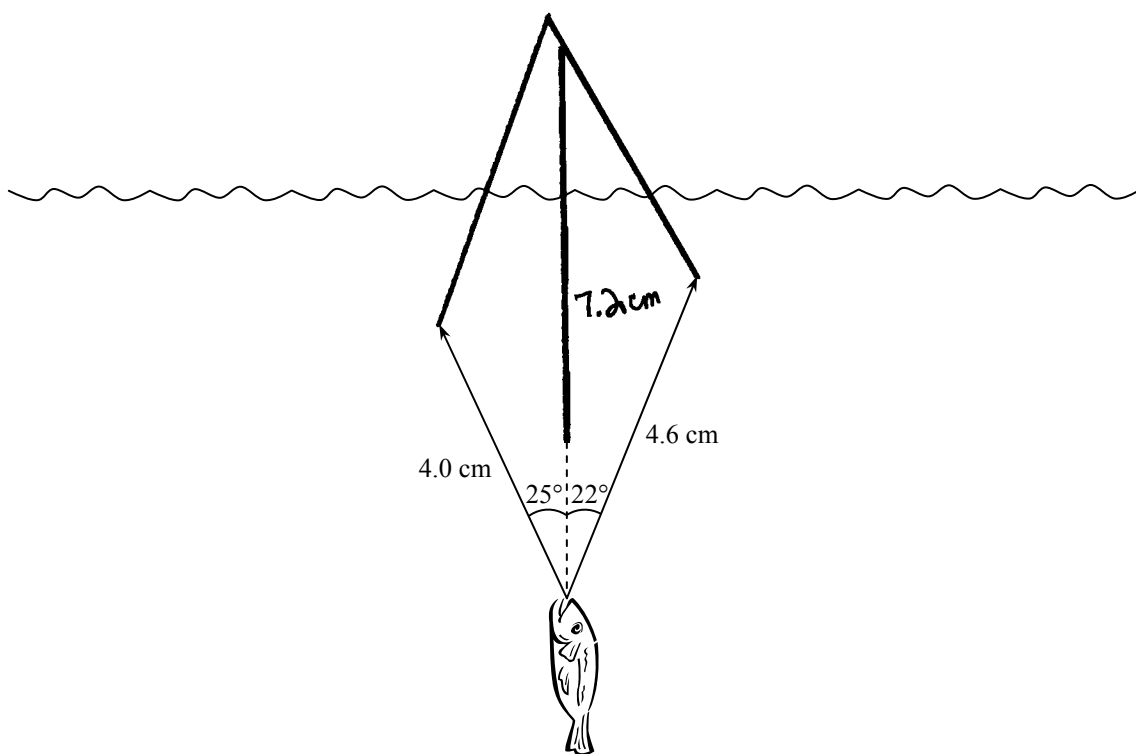
## Exemplar 1 continued

- d) While waiting for the rescue boat, Allan and Renée decide to fish. By chance, they catch the same fish and pull on it with the forces indicated in the scale vector diagram below. Using the scale vector diagram, determine the magnitude of the resultant force, in newtons, acting on the fish. Show your work.

(2 marks)

36 N

Scale: 1 cm = 5 newtons



| 6.5 marks:  |    |  |
|---|----|--|
| ❶   | a) | 1 mark for correct vector sketch                                     |
| ❷   | b) | 1 mark for appropriate work  |
| ❹   |    | 1 mark for correct direction   |
| ❺   | c) | 1 mark for first vector starting in a direction of E 60° S           |
| ❻   |    | 1 mark for correct direction of second vector                        |
| ❼   |    | 1 mark for correct distances to the boat with a sum of 80 km or less |
| ❽   | d) | 1 mark for appropriate work  |
| → deduction of 0.5 marks for forgetting more than one arrowhead in the scale vector diagram or required vector sketch |    |  |
| <b>Note:</b> No mark deduction for not stating the scale again in (c).  |    |  |

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## Exemplar 2

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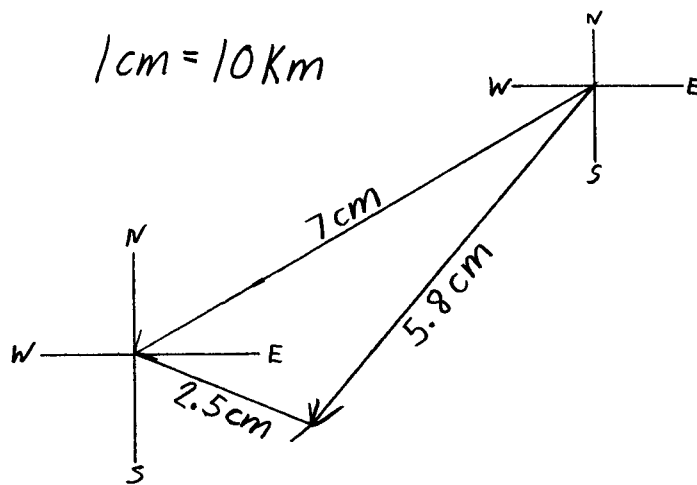
### VECTORS

2. Allan and Renée are in a boat travelling to an island that is 70 km away and at a bearing of  $240^\circ$  with respect to their starting point. Unfortunately, they run out of gas and end up 25 km from the island. The direction from the island to the boat is  $22^\circ$  south of east.

Total:  
9 marks

- a) Draw a vector sketch of this situation including all the magnitudes and directions.

(1 mark)



- b) Determine the distance and direction of the boat with respect to its starting point when Allan and Renée run out of gas. Show your work.

(3 marks)

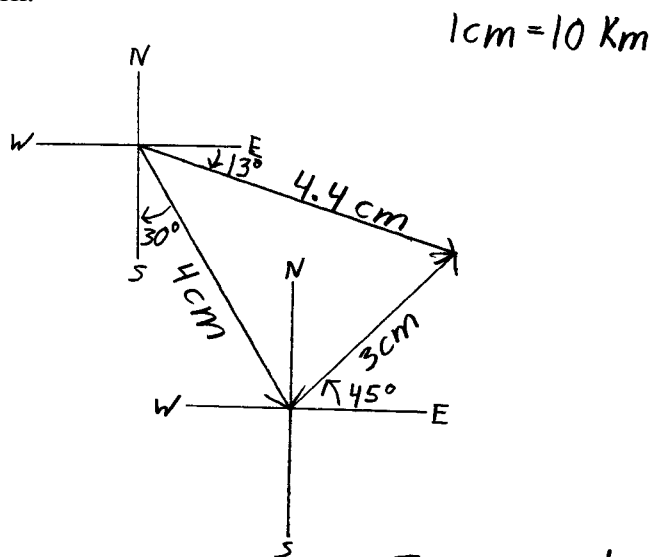
• Refer to part a.

The boat is 58 Km at  $50^\circ$  South of West from its starting point.

## Exemplar 2 continued

- c) A rescue boat receives a distress signal from Allan and Renée and leaves from the same starting point. It must first set out in a direction of E 60° S to meet a supply boat in order to exchange equipment. Design a route for the rescue boat to get to Allan and Renée's boat in 80 km or less. Indicate all the distances and directions. Show your work.

(3 marks)



40 Km E 60° S }  
 30 Km E 45° N }  
 44 Km E 13° S

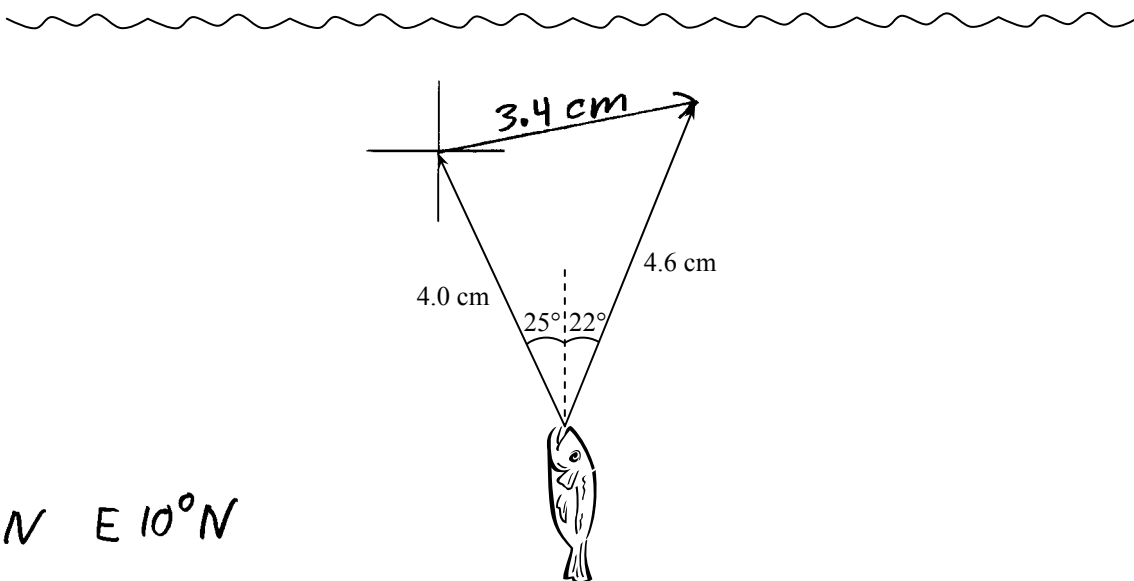
I assumed that I had to draw a possible route that could be used to find Allan and Renée's boat.

## Exemplar 2 continued

- d) While waiting for the rescue boat, Allan and Renée decide to fish. By chance, they catch the same fish and pull on it with the forces indicated in the scale vector diagram below. Using the scale vector diagram, determine the magnitude of the resultant force, in newtons, acting on the fish. Show your work.

(2 marks)

Scale: 1 cm = 5 newtons



17 N E 10° N

| 5 marks: |    |  |
|----------|----|--|
| ❶        | a) | 1 mark for correct vector sketch                           |
| ❷        |    | 1 mark for appropriate work                                |
| ❸        | b) | 1 mark for correct distance                                |
| ❹        |    | 1 mark for correct direction                               |
| ❺        | c) | 1 mark for first vector starting in a direction of E 60° S |

# Appendices



## APPENDIX A

### Table of Questions by Unit and Learning Outcome

| Unit*             | Question  | Type* | Learning Outcome | Mark |
|-------------------|-----------|-------|------------------|------|
| A                 | 1         | MC    | 2                | 1    |
| A                 | 10        | RR    | 1, 2             | 3    |
| A                 | 11        | OR    | 2                | 5    |
| <b>Total = 9</b>  |           |       |                  |      |
| B                 | Inquiry 2 | OR    | 1, 2, 3          | 9    |
| <b>Total = 9</b>  |           |       |                  |      |
| C                 | 2         | MC    | 3                | 1    |
| C                 | 12        | RRE   | 1, 4             | 5    |
| C                 | 13        | RR    | 2                | 3    |
| <b>Total = 9</b>  |           |       |                  |      |
| D                 | 3         | MC    | 1                | 1    |
| D                 | 4         | MC    | 2                | 1    |
| D                 | 14        | RR    | 3, 4, 5          | 3    |
| D                 | 15        | RR    | 4                | 3    |
| <b>Total = 8</b>  |           |       |                  |      |
| E                 | 5         | MC    | 1                | 1    |
| E                 | 6         | MC    | 2                | 1    |
| E                 | 16        | RRE   | 3                | 4    |
| E                 | 17        | RR    | 3                | 3    |
| <b>Total = 9</b>  |           |       |                  |      |
| F                 | Inquiry 1 | OR    | 1, 2, 3          | 10   |
| <b>Total = 10</b> |           |       |                  |      |
| G                 | 7         | MC    | 1                | 1    |
| G                 | 18        | RR    | 1, 3             | 4    |
| G                 | 19        | RRE   | 1, 2, 3          | 4    |
| <b>Total = 9</b>  |           |       |                  |      |
| H                 | 8         | MC    | 1                | 1    |
| H                 | 9         | MC    | 1                | 1    |
| H                 | 20        | RR    | 1                | 3    |
| H                 | 21        | RRE   | 2, 3             | 4    |
| <b>Total = 9</b>  |           |       |                  |      |

**\*Legend for Units:**

A: Matrices  
 B: Vectors  
 C: Personal Finance  
 D: Probability  
 E: Variability and Statistical Analysis  
 F: Design and Measurement  
 G: Periodic Functions  
 H: Sequences

**\*Legend for Question Types:**

MC: Multiple Choice  
 RR: Restricted Response  
 RRE: Restricted Response with Explanation  
 OR: Open Response



## APPENDIX B

### Table of Questions by Type and Learning Outcome

| Type*             | Question  | Unit* | Learning Outcome | Mark |
|-------------------|-----------|-------|------------------|------|
| MC                | 1         | A     | 2                | 1    |
| MC                | 2         | C     | 3                | 1    |
| MC                | 3         | D     | 1                | 1    |
| MC                | 4         | D     | 2                | 1    |
| MC                | 5         | E     | 1                | 1    |
| MC                | 6         | E     | 2                | 1    |
| MC                | 7         | G     | 1                | 1    |
| MC                | 8         | H     | 1                | 1    |
| MC                | 9         | H     | 1                | 1    |
| <b>Total = 9</b>  |           |       |                  |      |
| RR                | 10        | A     | 1, 2             | 3    |
| RR                | 13        | C     | 2                | 3    |
| RR                | 14        | D     | 3, 4, 5          | 3    |
| RR                | 15        | D     | 4                | 3    |
| RR                | 17        | E     | 3                | 3    |
| RR                | 18        | G     | 1, 3             | 4    |
| RR                | 20        | H     | 1                | 3    |
| <b>Total = 22</b> |           |       |                  |      |
| RRE               | 12        | C     | 1, 4             | 5    |
| RRE               | 16        | E     | 3                | 4    |
| RRE               | 19        | G     | 1, 2, 3          | 4    |
| RRE               | 21        | H     | 2, 3             | 4    |
| <b>Total = 17</b> |           |       |                  |      |
| OR                | 11        | A     | 2                | 5    |
| OR                | Inquiry 1 | F     | 1, 2, 3          | 10   |
| OR                | Inquiry 2 | B     | 1, 2, 3          | 9    |
| <b>Total = 24</b> |           |       |                  |      |

**\*Legend for Units:**

A: Matrices  
 B: Vectors  
 C: Personal Finance  
 D: Probability  
 E: Variability and Statistical Analysis  
 F: Design and Measurement  
 G: Periodic Functions  
 H: Sequences

**\*Legend for Question Types:**

MC: Multiple Choice  
 RR: Restricted Response  
 RRE: Restricted Response with Explanation  
 OR: Open Response



# APPENDIX C

## Sheets for Marking the Inquiry Tasks

| Inquiry Task 1: Design and Measurement   |    |   | Booklet Numbers |      |      |      |      |
|--|----|---|-----------------|------|------|------|------|
|  |    |   |                 |      |      |      |      |
| <b>1</b>   | a) | 1 mark for appropriate heights of shelves and total height                                |                 |      |      |      |      |
| <b>2</b>   |    | 1 mark for appropriate depth of stand   |                 |      |      |      |      |
| <b>3</b>   | b) | 1 mark for sketches showing correct number and dimensions of the top, bottom, and shelves |                 |      |      |      |      |
| <b>4</b>   |    | 1 mark for sketches showing correct number and dimensions of the sides                    |                 |      |      |      |      |
| <b>5</b>   |    | 1 mark for minimum number of sheets of plywood  |                 |      |      |      |      |
| <b>6</b>   | c) | 1 mark for correct total surface area of all pieces                                       |                 |      |      |      |      |
| <b>7</b>   |    | 1 mark for correct number of cans of paint  |                 |      |      |      |      |
| <b>8</b>   | d) | 1 mark for including all required materials   |                 |      |      |      |      |
| <b>9</b>   |    | 1 mark for correct total cost, including taxes  |                 |      |      |      |      |
| <b>10</b>  | e) | 1 mark for correct number of cases  |                 |      |      |      |      |
| Maximum 0.5 mark deduction per question if student does not buy materials in whole units or rounds to whole units too soon (mark <b>9</b> ). |    |   | -0.5            | -0.5 | -0.5 | -0.5 | -0.5 |
| <b>Totals</b>  |    |   |                 |      |      |      |      |

| Inquiry Task 1: Design and Measurement   |    |   | Booklet Numbers |      |      |      |      |
|--|----|---|-----------------|------|------|------|------|
|  |    |   |                 |      |      |      |      |
| <b>1</b>   | a) | 1 mark for appropriate heights of shelves and total height                                |                 |      |      |      |      |
| <b>2</b>   |    | 1 mark for appropriate depth of stand   |                 |      |      |      |      |
| <b>3</b>   | b) | 1 mark for sketches showing correct number and dimensions of the top, bottom, and shelves |                 |      |      |      |      |
| <b>4</b>   |    | 1 mark for sketches showing correct number and dimensions of the sides                    |                 |      |      |      |      |
| <b>5</b>   |    | 1 mark for minimum number of sheets of plywood  |                 |      |      |      |      |
| <b>6</b>   | c) | 1 mark for correct total surface area of all pieces                                       |                 |      |      |      |      |
| <b>7</b>   |    | 1 mark for correct number of cans of paint  |                 |      |      |      |      |
| <b>8</b>   | d) | 1 mark for including all required materials   |                 |      |      |      |      |
| <b>9</b>   |    | 1 mark for correct total cost, including taxes  |                 |      |      |      |      |
| <b>10</b>  | e) | 1 mark for correct number of cases  |                 |      |      |      |      |
| Maximum 0.5 mark deduction per question if student does not buy materials in whole units or rounds to whole units too soon (mark <b>9</b> ). |    |   | -0.5            | -0.5 | -0.5 | -0.5 | -0.5 |
| <b>Totals</b>  |    |   |                 |      |      |      |      |

| Inquiry Task 2: Vectors   |    |  | Booklet Numbers |      |      |      |      |
|---|----|--|-----------------|------|------|------|------|
|   |    |  |                 |      |      |      |      |
| 1   | a) | 1 mark for correct vector sketch                                     |                 |      |      |      |      |
| 2   | b) | 1 mark for appropriate work  |                 |      |      |      |      |
| 3   |    | 1 mark for correct distance  |                 |      |      |      |      |
| 4   |    | 1 mark for correct direction   |                 |      |      |      |      |
| 5   | c) | 1 mark for first vector starting in a direction of E 60° S           |                 |      |      |      |      |
| 6   |    | 1 mark for correct direction of second vector                        |                 |      |      |      |      |
| 7   |    | 1 mark for correct distances to the boat with a sum of 80 km or less |                 |      |      |      |      |
| 8   | d) | 1 mark for appropriate work  |                 |      |      |      |      |
| 9   |    | 1 mark for correct answer  |                 |      |      |      |      |
| Maximum 0.5 mark deduction per question if student does not state a scale when using scale diagrams as a strategy (marks 2, 5, 6, 7, and 8).                          |    |  | -0.5            | -0.5 | -0.5 | -0.5 | -0.5 |
| Maximum 0.5 mark deduction per question if student forgets more than one arrowhead in scale vector diagrams or required vector sketches (marks 1, 2, 5, 6, 7, and 8). |    |  | -0.5            | -0.5 | -0.5 | -0.5 | -0.5 |
| <b>Totals</b>   |    |  |                 |      |      |      |      |

| Inquiry Task 2: Vectors   |    |  | Booklet Numbers |      |      |      |      |
|---|----|--|-----------------|------|------|------|------|
|   |    |  |                 |      |      |      |      |
| 1   | a) | 1 mark for correct vector sketch                                     |                 |      |      |      |      |
| 2   | b) | 1 mark for appropriate work  |                 |      |      |      |      |
| 3   |    | 1 mark for correct distance  |                 |      |      |      |      |
| 4   |    | 1 mark for correct direction   |                 |      |      |      |      |
| 5   | c) | 1 mark for first vector starting in a direction of E 60° S           |                 |      |      |      |      |
| 6   |    | 1 mark for correct direction of second vector                        |                 |      |      |      |      |
| 7   |    | 1 mark for correct distances to the boat with a sum of 80 km or less |                 |      |      |      |      |
| 8   | d) | 1 mark for appropriate work  |                 |      |      |      |      |
| 9   |    | 1 mark for correct answer  |                 |      |      |      |      |
| Maximum 0.5 mark deduction per question if student does not state a scale when using scale diagrams as a strategy (marks 2, 5, 6, 7, and 8).                          |    |  | -0.5            | -0.5 | -0.5 | -0.5 | -0.5 |
| Maximum 0.5 mark deduction per question if student forgets more than one arrowhead in scale vector diagrams or required vector sketches (marks 1, 2, 5, 6, 7, and 8). |    |  | -0.5            | -0.5 | -0.5 | -0.5 | -0.5 |
| <b>Totals</b>   |    |  |                 |      |      |      |      |

# APPENDIX D

## Irregularities in Standards Tests

### A Guide for Local Marking

During the marking of standards tests, irregularities are occasionally encountered in test booklets. The following list provides examples of irregularities for which an *Irregular Test Booklet Report* (Appendix D) should be completed and sent to the Department:

- completely different penmanship in the same test booklet
- incoherent work with correct answers
- notes from a teacher indicating how he or she has assisted a student during test administration
- student offering that he or she received assistance on a question from a teacher
- student submitting work on unauthorized paper
- evidence of cheating or plagiarism
- disturbing or offensive content
- no responses provided by the student (all “NR”) or only incorrect responses (“0”)

Student comments or responses indicating that the student may be at personal risk of being harmed or of harming others are personal safety issues. This type of student response requires an immediate and appropriate follow-up at the school level. In this case, please ensure the Department is made aware that follow-up has taken place by completing an *Irregular Test Booklet Report*.

Except in the case of cheating or plagiarism where the result is a standards test mark of 0%, it is the responsibility of the division or the school to determine how they will proceed with irregularities. Once an irregularity has been confirmed, the marker prepares an *Irregular Test Booklet Report* documenting the situation, the people contacted, and the follow-up. The original copy of this report is to be retained by the local jurisdiction and a copy is to be sent to the Department along with the test materials.



## APPENDIX E

# Irregular Test Booklet Report

**Test:** \_\_\_\_\_

**Date marked:** \_\_\_\_\_

**Booklet No.:** \_\_\_\_\_

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**Problem(s) noted:** \_\_\_\_\_

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**Question(s) affected:** \_\_\_\_\_

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**Action taken or rationale for assigning marks:** \_\_\_\_\_

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**Follow-up:** \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

**Decision:** \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

**Marker's Signature:** \_\_\_\_\_

**Principal's Signature:** \_\_\_\_\_

|  |
|--|
| <p><b>For Department Use Only—After Marking Complete</b></p> <p><b>Consultant:</b> _____</p> <p><b>Date:</b> _____</p> |
|--|