Grade 12
Applied Mathematics
Achievement Test

Marking Guide

June 2016

Manitoba

After the administration of this test, print copies of this resource will be available for purchase from the Manitoba Learning Resource Centre (formerly the Manitoba Text Book Bureau). Order online at www.mtbb.mb.ca.

This resource will also be available on the Manitoba Education and Advanced Learning website at www.edu.gov.mb.ca/k12/assess/ archives/index.html.

Websites are subject to change without notice.

Disponible en français.

Available in alternate formats upon request.

Contents

General Marking Instructions

Please ensure that
- the student booklet number matches the number on the *Scoring Sheet*
- **only a pencil is used to complete the *Scoring Sheet***
- the final test mark is recorded on the *Scoring Sheet*
- the *Scoring Sheet* is complete and a copy has been made for school records

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Do not make any marks in the student booklets. Booklets may be selected by Manitoba Education and Advanced Learning for sample marking.

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

Marking

Explanations for student errors for selected-response questions have been provided, if applicable.

To receive full marks for a 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. Explanation or justification can be given through a labelled diagram, in words, by showing mathematical operations for answer verification, or by providing output from a technological tool. For this reason, appropriate flexibility is required when marking student responses.

Errors

Marks are deducted if conceptual or communication errors are committed.

Conceptual 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.

Communication Errors

Communication errors are errors that are not related to the concepts and are tracked on the *Scoring Sheet* in a separate section. There will be a 0.5 mark deduction for each type of communication error committed, regardless of the number of errors committed for that type (see example on next page).

Ⓔ⁽¹⁾   Notation

- does not include braces when using set notation
- does not include a box when using a Venn diagram
- does not include one of the following in the equation: "$y =$", "sin", "ln", or "x", or writes parameters separately from the equation

Ⓔ⁽²⁾   Units

- does not include the dollar sign for monetary values
- uses incorrect units of measure
- does not include the units in the final answer
- confuses square and cubic units (e.g., cm^2 instead of cm^3, or vice versa)
- does not include units with labels on a graph

Ⓔ⁽³⁾   Transcription/Transposition

- makes a transcription error (inaccurate transferring of information)
- makes a transposition error (changing order of digits)

Ⓔ⁽⁴⁾   Final Answer

- does not express monetary values to two decimal places
- does not include a percent sign
- does not identify the answer (e.g., TVM solver, Venn diagram)
- does not use a contextual variable when stating the domain or the range in set notation
- incorrectly states the final answer

Ⓔ⁽⁵⁾   Rounding

- rounds incorrectly
- rounds too soon
- does not express the answer to the appropriate number of decimal places

Ⓔ⁽⁶⁾   Whole Units

- does not use whole units for materials purchased in design and measurement questions
- does not use whole units in contextual questions involving discrete data (e.g., people)

The total mark deduction for communication errors for any student response is not to exceed the marks awarded for that response. For example, a student awarded one mark on a question is limited to two communication error deductions for that question.

Scoring

The marks allocated to questions are based on the concepts associated with the learning outcomes in the curriculum. For each question, shade in the circle on the *Scoring Sheet* that represents the mark awarded based on the concepts. A total of these marks will provide the preliminary mark.

The student's final mark is determined by subtracting the communication errors from the preliminary mark.

Example:

A student has a preliminary mark of 46. The student committed one E1 error (0.5 mark deduction) and three E4 errors (0.5 mark deduction).

E1	E2	E3	E4	E5	E6
Notation	Units	Transcription/ Transposition	Final Answer	Rounding	Whole Units

$$\begin{array}{ccccc} & & \text{Communication Errors} & & \\ \text{Preliminary Mark} & - & (\text{Number of error types} \times 0.5) & = & \text{Final Mark} \\ 46 & - & (2 \times 0.5) & = & 45 \end{array}$$

Irregularities in Provincial Tests

During the administration of provincial tests, supervising teachers may encounter irregularities. Markers may also encounter irregularities during local marking sessions. Appendix B provides examples of such irregularities as well as procedures to follow to report irregularities.

If 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 any issue arises that cannot be resolved locally during marking, please call Manitoba Education and Advanced Learning 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 marking keys.

> King Luu
> Assessment Consultant
> Grade 12 Applied Mathematics
> Telephone: 204-945-4035
> Toll-Free: 1-800-282-8069, ext. 4035
> Email: king.luu@gov.mb.ca

Marking Keys

Please note that this *Marking Guide* contains
screen captures taken from a TI–84 Plus graphing calculator.

RELATIONS AND FUNCTIONS

Question 1	Total: 1 mark
Learning Outcome: 12A.R.2	Question Type: Selected Response

Use the graph below to answer the following question and select the best answer.
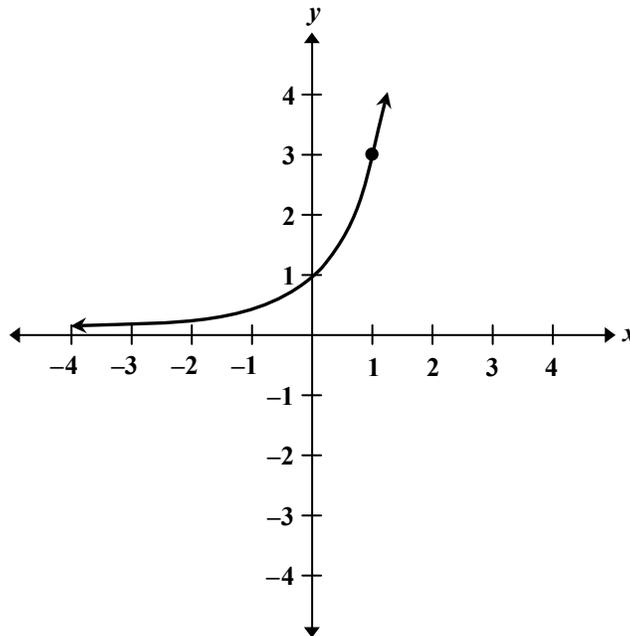
Which function does the graph represent?

A. $y = 1(2)^x$

B. $y = \dfrac{1}{3}(2)^x$

C. $y = 1(3)^x$

D. $y = 1\left(\dfrac{1}{3}\right)^x$

Use the graph below to answer the following question and select the best answer.

Time (h)
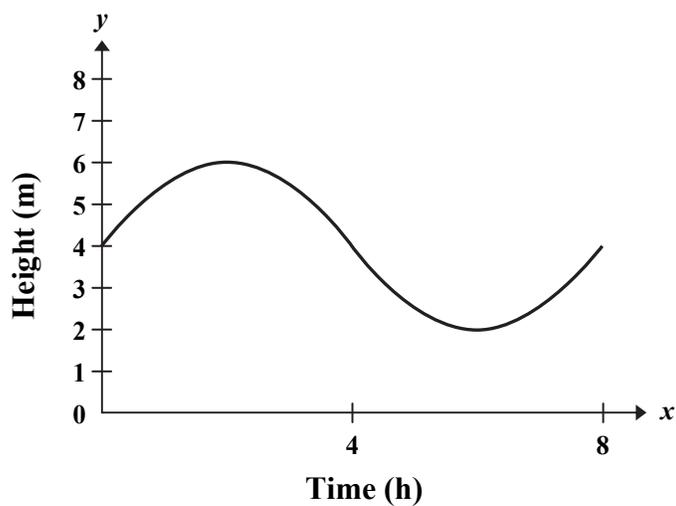
Which of the following statements is true?

A. **The amplitude of the function is 2.**

B. The period of the function is 4.

C. The equation of the midline is $y = 2$.

D. The domain of the function is $[2, 6]$.

Question 3 — Total: 4 marks

A certain medication destroys diseased cells in a person's body. The number of diseased cells decreases for a short time after a dose of the medication is administered and then increases again. This situation varies sinusoidally and is modelled by the following equation:

$$c = 350 \sin(3.14t + 1.57) + 650$$

where t represents the time (in weeks) and c represents the diseased cell count.

a) **If the initial dose of medication is administered at $t = 0$, when is the second dose administered?**

(1 mark)

After 2 weeks.

b) **What is the range of this function?**

(1 mark)

$$[300, 1000]$$

OR——

$$\{300 \le c \le 1000\}$$

OR——

The range is 300 to 1000.

c) **A patient claims to feel well when the diseased cell count is below 500. At $t = 2.5$ weeks, will the patient be feeling well? Show your work.**

(2 marks)

$$\boxed{\text{TRACE}}\ t = 2.5$$
$$c = 651.672\,28...$$

No, the patient will not be feeling well since the number of diseased cells will be more than 500.

Marking Key
❶ 1 mark for correct answer in (a)
❷ 1 mark for correct answer in (b)
❸ 1 mark for appropriate work in (c)
❹ 1 mark for correct answer in (c)

Question 4   **Total: 3 marks**

Learning Outcome: 12A.R.1   **Question Type: Constructed Response**
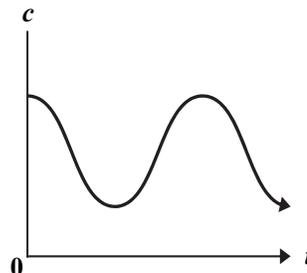
The Gateway Arch in St. Louis, in the United States, approximates a parabola. Steven learns that the arch is 192 m wide. (Diagram is not drawn to scale.)

At 2.5 m from his starting point, Steven measures the height of the arch to be 10 m.
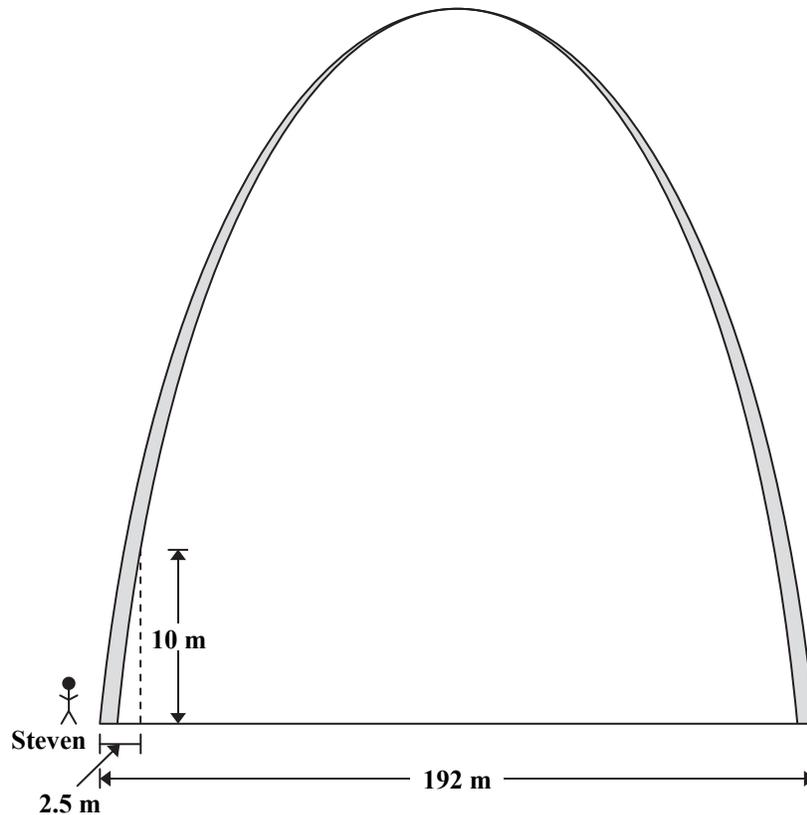
a) Determine the quadratic equation that models the shape of the arch. Show your work. Express all coefficients in the equation to a minimum of three (3) decimal places.

(2 marks)   **OR**

x	y
0	0
2.5	10
192	0
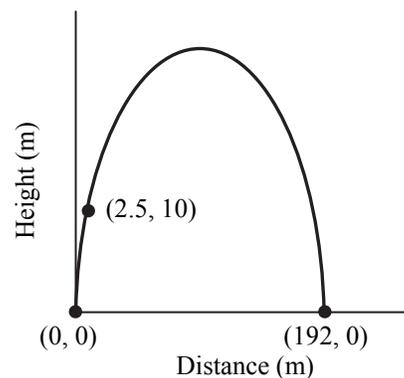
$$y = -0.021x^2 + 4.053x$$

b) **Calculate the arch's maximum height.**

(1 mark)

$$\boxed{\text{2nd}}\ \boxed{\text{TRACE}}\ 4\text{: Maximum}$$

$$y = 194.532\ 98...$$

The maximum height is 194.53 m.

Using rounded values in (a), the answer is 195.56 m.

<u>Marker Note(s):</u>
→ *Regression equations may vary depending on the software used.*

Marking Key
❶   *1 mark for appropriate work in (a)*
❷   *1 mark for consistent answer in (a)*
❸   *1 mark for consistent answer in (b)*

Question 5

Total: 6 marks

Learning Outcome: 12A.R.2   **Question Type: Constructed Response**

The ice thickness on Lake Mathitoba is measured weekly every winter. The data for one season is shown in the table below:

Time (day)	7	14	21	28	35	42	49
Ice thickness (cm)	5.2	17.4	26.8	32.4	37.1	42.6	44.3

a)   Determine the logarithmic regression equation that models this data.

(1 mark)

$$y = -35.84 + 20.62 \ln(x)$$

b)   Create a clearly labelled graph of the equation in (a).
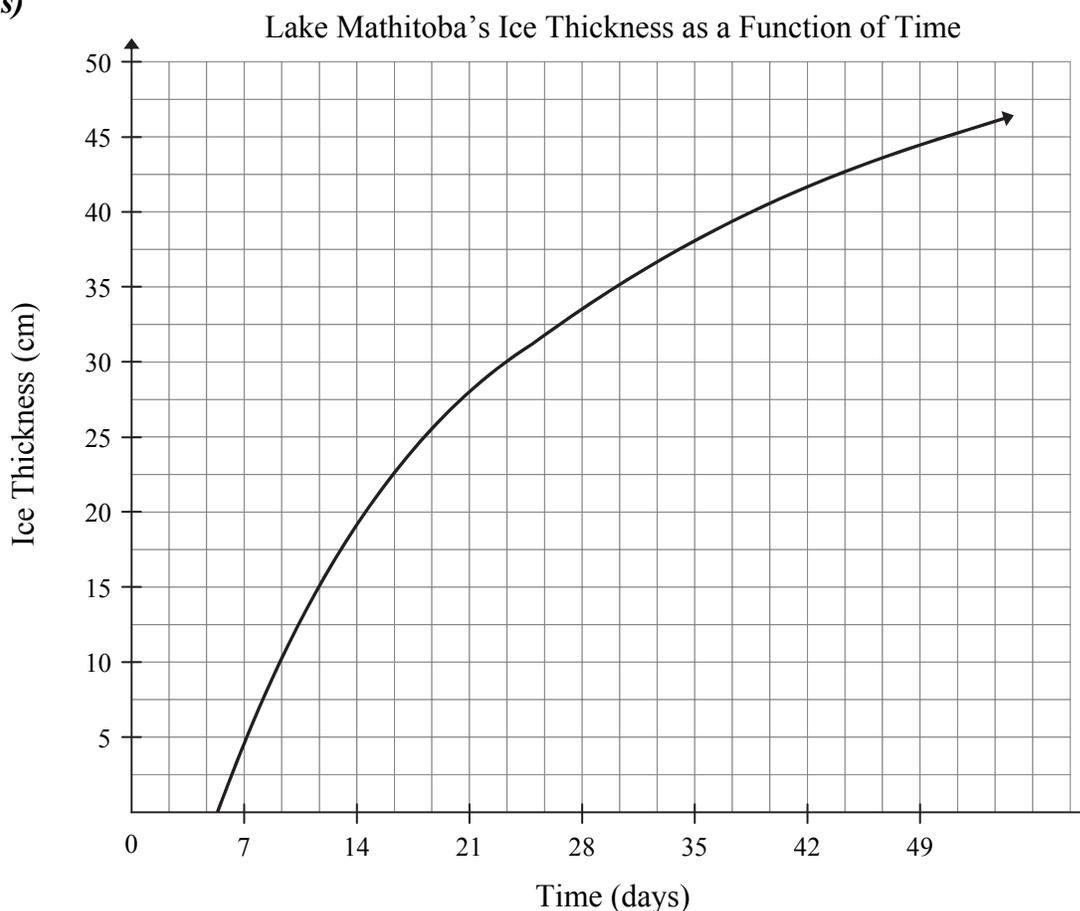
(3 marks)

Lake Mathitoba's Ice Thickness as a Function of Time

c) **It is considered safe to operate a vehicle on lake ice if it is at least 30 cm thick. Use your equation in (a) to determine the first full day it will be safe to drive on the ice. Show your work.**

(2 marks)

$$\boxed{2nd} \ \boxed{TRACE} \ 5: \text{Intersect} \quad y = 30$$

$$x = 24.36$$

It will be safe to drive on the ice on the 25th day.

Marker Note(s):
→ *Regression equations may vary depending on the software used.*

Marking Key
❶ *1 mark for correct equation in (a)*
❷ *1 mark for communicating the context of the graph with appropriate title and/or labels in (b)*
❸ *1 mark for using an appropriate domain and range (i.e., window settings/grid range) for the context of the question in (b)*
❹ *1 mark for an appropriate shape that illustrates key characteristics of the function (e.g., maximum, minimum, asymptotes, intercepts) in (b)*
❺ *1 mark for appropriate work in (c)*
❻ *1 mark for consistent answer in (c)*

PROBABILITY

Question 6 | Total: 1 mark

Learning Outcome: 12A.P.1 | **Question Type: Selected Response**

Select the best answer.

The odds in favour of Philip winning a badminton match are 5 : 4.

What is the probability that Philip will lose the match?

A. 0.20

B. **0.44**

C. 0.56

D. 0.80

Student Error
A: $\dfrac{1}{5}$
C: $\dfrac{5}{9}$
D: $\dfrac{4}{5}$

Question 7 | Total: 1 mark

Learning Outcome: 12A.P.3 | **Question Type: Selected Response**

Select the best answer.

Elaine has a bag containing 5 red pens and 10 blue pens. She randomly picks two pens out of the bag (no replacement).

What is the probability that Elaine picked two red pens?

A. $\dfrac{4}{45}$

B. $\dfrac{2}{21}$

C. $\dfrac{1}{9}$

D. $\dfrac{1}{3}$

Student Error
A: $\left(\dfrac{5}{15}\right)\left(\dfrac{4}{15}\right)$
C: $\left(\dfrac{5}{15}\right)\left(\dfrac{5}{15}\right)$
D: $\left(\dfrac{5}{15}\right)$

Question 8

Total: 3 marks

Learning Outcome: 12A.P.5   **Question Type: Constructed Response**

Evan is arranging 8 different bicycles in a rack at his school.

a) How many ways can the bicycles be arranged in the rack?

(1 mark)

$$8! = 40\ 320$$

There are 40 320 ways.

b) How many ways can the bicycles be arranged in the rack if 3 students want their bicycles placed together? Show your work.
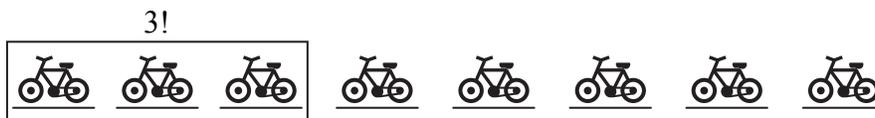
(2 marks)

$$\underset{\substack{\text{arrangements of} \\ \text{3 bicycles together}}}{3!} \times \underset{\substack{\text{arrangements} \\ \text{of groups}}}{6!} = 4320$$

There are 4320 ways.

Marking Key
❶ *1 mark for correct answer in (a)*
❷ *1 mark for appropriate work in (b)*
❸ *1 mark for consistent answer in (b)*

Question 9	Total: 2 marks
Learning Outcome: 12A.P.6	**Question Type: Constructed Response**

Rosalind wants to make a trail mix for a snack. She has 15 ingredients to choose from.

What is the total number of different mixes Rosalind can create containing 3, 4, or 5 ingredients? Show your work.

$$3 \text{ ingredients} \quad \text{or} \quad 4 \text{ ingredients} \quad \text{or} \quad 5 \text{ ingredients}$$

$$\quad\quad {}_{15}C_3 \quad\quad + \quad\quad {}_{15}C_4 \quad\quad + \quad\quad {}_{15}C_5$$

$$= \quad 455 \quad\quad + \quad\quad 1365 \quad\quad + \quad\quad 3003$$

$$= 4823$$

There are 4823 different mixes.

Marking Key	
❶	*1 mark for appropriate work*
❷	*1 mark for consistent answer*

Question 10   Total: 2 marks

Learning Outcome: 12A.P.1   **Question Type: Constructed Response**

Given the following collection of objects:

$$\blacksquare \diamondsuit \triangle \triangle \blacksquare \triangle \blacksquare \triangle \triangle \diamondsuit \diamondsuit \blacksquare$$

a)   **Calculate the probability of randomly choosing ■.**

(1 mark)

Original collection of objects:

Probability of choosing ■ at random

$$P(\blacksquare) = \frac{4}{12}$$
$$= \frac{1}{3}$$

b)   **How can the collection be changed so that the probability of choosing ■ is exactly 40%?**

(1 mark)

The probability can be increased by

<center>**OR**</center>

taking away 2 ◈ or △   adding 2 ■ and 1 ◈ or △

$\blacksquare \diamondsuit \triangle \triangle \blacksquare \triangle \blacksquare \triangle \diamondsuit \blacksquare$ $\blacksquare \diamondsuit \triangle \triangle \blacksquare \triangle \blacksquare \triangle \triangle \diamondsuit \diamondsuit \blacksquare + \blacksquare \blacksquare + \diamondsuit$

$$P(\blacksquare) = \frac{4}{10}$$
$$= 0.4 \text{ or } 40\%$$

$$P(\blacksquare) = \frac{6}{15}$$
$$= 0.4 \text{ or } 40\%$$

Other answers are possible.

Marking Key	
❶	*1 mark for correct answer in (a)*
❷	*1 mark for appropriate change to collection in (b)*

Question 11
Total: 3 marks

Question Type: Constructed Response

Tim has a set of cards numbered 1 to 15. He randomly draws one card.

Consider the following events:

   Event A: drawing a card that is a multiple of 2

   Event B: drawing a card that is a multiple of 3

a)   **Are these events mutually exclusive? Justify your answer.**

(1 mark)

These events are not mutually exclusive because there are
two numbers (6 and 12) that are both a multiple of 2 and a multiple of 3.

b)   **What is the probability of drawing a numbered card that is a multiple of 2 or a
multiple of 3? Show your work.**

(2 marks)

$$A = \{2, 4, 6, 8, 10, 12, 14\}$$
$$B = \{3, 6, 9, 12, 15\}$$

$$P(A \text{ or } B) = P(A) + P(B) - P(A \text{ and } B)$$

$$P(\text{multiple of 2 or multiple of 3}) = P(\text{multiple of 2}) + P(\text{multiple of 3}) - P(\text{both})$$
$$= \frac{7}{15} + \frac{5}{15} - \frac{2}{15}$$
$$= \frac{10}{15}$$
$$= \frac{2}{3}$$

The probability is $\frac{2}{3}$, 0.67, or 66.67%.

Marking Key
❶   *1 mark for appropriate justification in (a)*
❷   *1 mark for appropriate work in (b)*
❸   *1 mark for consistent answer in (b)*

Question 12

Total: 2 marks

You are asked to take a 3-question multiple-choice quiz. Each question has 4 possible answers, one of which is correct.

a)   If you randomly pick an answer for each question, what is the probability that all 3 answers are wrong?

(1 mark)

$$\left(\frac{3}{4}\right)\left(\frac{3}{4}\right)\left(\frac{3}{4}\right) = \frac{27}{64}$$

The probability is $\frac{27}{64}$, 0.42, or 42.19%.

b)   What is the probability of getting at least one of the questions correct?

(1 mark)

$$1 - \frac{27}{64} = \frac{37}{64}$$

The probability is $\frac{37}{64}$, 0.58, or 57.81%.

Marking Key	
❶	*1 mark for correct answer in (a)*
❷	*1 mark for consistent answer in (b)*

Question 13
Total: 2 marks

Learning Outcome: 12A.P.4   **Question Type: Constructed Response**

Student ID codes are made up using any two upper case letters of the alphabet followed by any two digits.

a)   How many ID codes are possible?

(1 mark)

$$26 \times 26 \times 10 \times 10 = 67\ 600$$

67 600 codes are possible.

b)   How many ID codes are possible given the following conditions?
- **Repetition is not allowed.**
- **The letters "I" and "O" cannot be used.**

(1 mark)

$$24 \times 23 \times 10 \times 9 = 49\ 680$$

49 680 codes are possible.

Marking Key	
❶	*1 mark for correct answer in (a)*
❷	*1 mark for consistent answer in (b)*

FINANCIAL MATHEMATICS

Question 14	Total: 1 mark
Learning Outcome: 12A.FM.1	Question Type: Selected Response

Select the best answer.

Which of the following graphs shows the amount of principal paid on each payment over a 25-year mortgage?

A.

Principal Paid

Years

C.

Principal Paid

Years

B.

Principal Paid

Years

D.

Principal Paid

Years
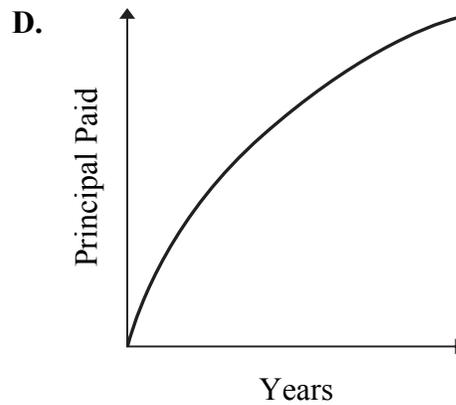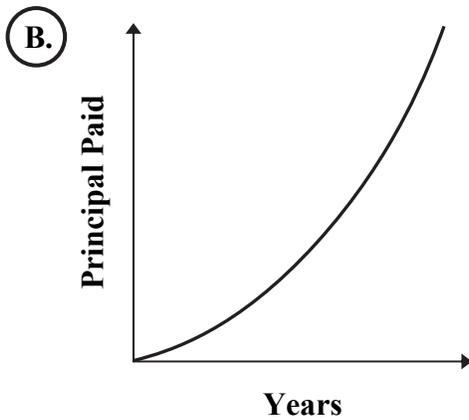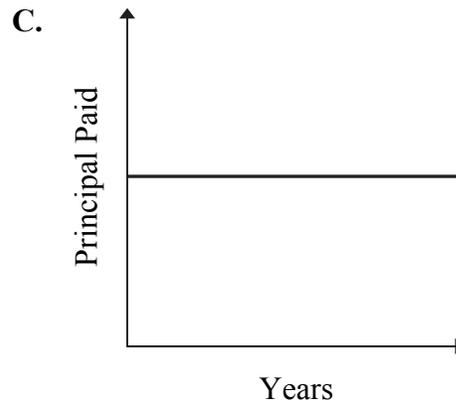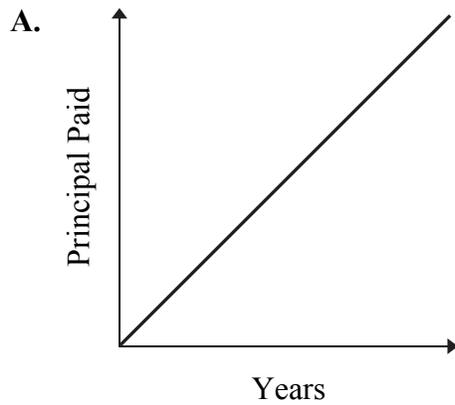
Question 15   Total: 1 mark

Learning Outcome: 12A.FM.2   **Question Type: Selected Response**

Select the best answer.

The price of a new car is $26 000 (taxes included). It depreciates at a rate of 20% per year. What is the approximate residual value of the car after 3 years?

A. $10 400

B. **$13 300**

C. $15 600

D. $20 800

Student Error

A: $\$26\,000 - \left(\$26\,000 \times 0.20 \times 3\right)$

C: $\$26\,000 \times \left(0.20 \times 3\right)$

D: $\$26\,000 \times 0.80$

Question 16   Total: 1 mark

Learning Outcome: 12A.FM.1   **Question Type: Selected Response**

Use the following information to answer this question and select the best answer.

Scenario 1: A loan of $30 000.00 at an interest rate of 7.00%, compounded monthly for 1 year

Scenario 2: A loan of $30 000.00 at an interest rate of 7.00%, compounded _____ for 1 year

Assuming no payments are made, which compounding period frequency in Scenario 2 would result in less interest than in Scenario 1?

A. every two weeks

B. daily

C. **semi-annually**

D. weekly

Question 17   Total: 2 marks

Mr. and Mrs. Murthy have a total monthly gross income of $6000.00. They are interested in purchasing a house with a mortgage payment of $1300.00 per month, annual heating costs of $2100.00, and annual property taxes of $3675.00.

Calculate the gross debt service ratio (GDSR). Determine if a bank is likely to offer them a mortgage. Justify your answer.

$$\text{GDSR (\%)} = \frac{\left(\begin{array}{ccc} \text{Monthly} & \text{Monthly} & \text{Monthly} \\ \text{mortgage} + \text{property} + \text{heating} \\ \text{payment} & \text{taxes} & \text{costs} \end{array}\right)}{\text{Gross monthly income}} \times 100$$

$$\text{GDSR (\%)} = \frac{\$1300.00 + \dfrac{\$2100.00}{12} + \dfrac{\$3675.00}{12}}{\$6000.00} \times 100 = 29.69\%$$

Yes, the bank will likely offer them a mortgage since the GDSR is below 32%.

Marking Key	
❶	*1 mark for appropriate work*
❷	*1 mark for appropriate justification by making reference to 32%*

Question 18

Total: 2 marks

List two advantages of leasing a vehicle over buying.

- lower monthly payment
- can change vehicle at the end of the lease period
- do not have to worry about selling the vehicle

Other answers are possible.

Marking Key	
❶	*1 mark for correct first advantage*
❷	*1 mark for correct second advantage*

Question 19
Total: 4 marks

Learning Outcome: 12A.FM.2   **Question Type: Constructed Response**

Gabrielle wants to buy a cabin at Lac du Bonnet that costs $165 000.00. She has saved $25 000.00 that she will use as a down payment. The bank will give her a 15-year mortgage for the balance at 3.49%, compounded semi-annually.

a) **What will Gabrielle's payment be every two weeks? Show your work.**

(2 marks)

```
N=390
I%=3.49
PV=140000
▪PMT=-460.45319…
FV=0
P/Y=26
C/Y=2
PMT:END BEGIN
```

Her payment will be $460.45.

b) **If the cabin appreciates in value an average of 3.00% per year, calculate the appreciated value of the cabin after 10 years.**

(1 mark)
$$\text{Future value} = (\$165\ 000.00)(1.03)^{10}$$
$$= \$221\ 746.20$$

The cabin will be valued at $221 746.20.

c) **How much equity will Gabrielle have in the cabin after 10 years?**

(1 mark)

$$\text{bal}(10 \times 26) = \$54\ 930.80$$
$$\text{Equity} = \$221\ 746.20 - \$54\ 930.80$$
$$= \$166\ 815.40$$

She will have $166 815.40 in equity after 10 years.

OR————————————————————————————————————

$$\text{Down payment} = \$25\ 000.00$$
$$\sum \text{Prn}(1,\ 260) = \$85\ 069.20$$
$$\text{Appreciation} = \$165\ 000.00 \times (1.03)^{10} - \$165\ 000.00$$
$$= \$56\ 746.20$$
$$\text{Equity} = \$25\ 000.00 + \$85\ 069.20 + \$56\ 746.20$$
$$= \$166\ 815.40$$

She will have $166 815.40 in equity after 10 years.

Marking Key
❶ *1 mark for appropriate work in (a)*
❷ *1 mark for consistent answer in (a)*
❸ *1 mark for correct appreciated value in (b)*
❹ *1 mark for consistent equity in (c)*

Question 20   Total: 6 marks

Learning Outcomes: 12A.FM.1, 12A.FM.3   **Question Type: Constructed Response**

At the age of 30, Alfred began investing \$350.00 monthly into an investment account at an interest rate of 7.00%, compounded monthly. When he turned 45, the interest rate on this investment decreased to 5.00%, compounded monthly. Alfred plans to continue making monthly investments until he retires at 58.

a)   **How much money will Alfred have in his account when he retires? Show your work.**

(3 marks)

To age of 45:

```
N=180
I%=7
PV=0
PMT=-350
■FV=110936.8039
P/Y=12
C/Y=12
PMT:END BEGIN
```

From age of 45 to 58:

```
N=156
I%=5
PV=-110936.8039
PMT=-350
■FV=288905.4889
P/Y=12
C/Y=12
PMT:END BEGIN
```

Alfred will have \$288 905.49 at retirement.

b)   **Alfred withdraws \$2000.00 per month from his account after he retires. If the interest rate remains at 5.00%, how many months can he withdraw \$2000.00?**

(1 mark)

```
■N=221.5045054
I%=5
PV=-288905.49
PMT=2000
FV=0
P/Y=12
C/Y=12
PMT:END BEGIN
```

He can make withdrawals for 221 months.

c) **Alfred's sister, Marianne, retires at the age of 60. Her portfolio is valued at $200 000.00, earning 5.00%, compounded monthly. If Marianne wants the money to last until she is 85 years old, what is the maximum she can withdraw each month? Show your work.**

(2 marks)

```
N=300
I%=5
PV=-200000
▪PMT=1169.180083
FV=0
P/Y=12
C/Y=12
PMT:END BEGIN
```

Marianne can withdraw a maximum of $1169.18 each month.

Marking Key	
❶	*1 mark for appropriate work in (a)*
❷	*1 mark for correct value of investment at age 45 in (a)*
❸	*1 mark for consistent value of investment at age 58 in (a)*
❹	*1 mark for consistent answer in (b)*
❺	*1 mark for appropriate work in (c)*
❻	*1 mark for consistent answer in (c)*

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DESIGN AND MEASUREMENT

Question 21	Total: 2 marks
Learning Outcome: 12A.D.1	Question Type: Constructed Response

Sheena is wrapping boxes using a roll of wrapping paper with a total area of 3.5 m². Each box has a 20 cm width, 20 cm length, and 40 cm height. If Sheena uses 20% extra paper on each box, how many boxes can she wrap? Show your work.

$$SA = Ph + 2B$$

$$= (4 \times 0.20 \text{ m})(0.40 \text{ m}) + 2(0.20 \text{ m})^2$$

$$= 0.40 \text{ m}^2$$

$$\text{extra paper} = 0.40 \text{ m}^2 \times 0.20$$

$$= 0.08 \text{ m}^2$$

$$\text{total for 1 box} = 0.48 \text{ m}^2$$

$$\frac{3.5 \text{ m}^2}{0.48 \text{ m}^2} = 7.29$$

$$\Rightarrow 7 \text{ boxes}$$

She can wrap 7 boxes.

Marking Key	
❶	*1 mark for correct area of paper needed to wrap one box*
❷	*1 mark for consistent number of boxes wrapped*

Question 22   **Total: 4 marks**

A traditional plains tipi is built using a rectangular canvas that is twice as long as it is wide. The diagram below shows how a semicircle would be cut out of a canvas with dimensions of 30 ft. (length) and 15 ft. (width). (Diagram is not drawn to scale.)
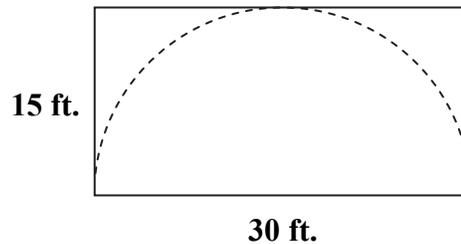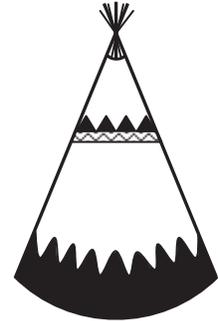
15 ft.

30 ft.

a)   **Calculate how much canvas is left over after the semicircle has been cut out.**

(2 marks)

$$\text{Area of rectangular piece} = 30 \text{ ft.} \times 15 \text{ ft.} = 450 \text{ ft}^2$$

$$\text{Area of semicircle} = \frac{\pi(15 \text{ ft.})^2}{2} = 353.43 \text{ ft}^2$$

$$\text{Leftover canvas} = 450 \text{ ft}^2 - 353.43 \text{ ft}^2$$

$$= 96.57 \text{ ft}^2$$

b) You would like to construct a tipi with both dimensions three times greater than those for the tipi in (a). Given that canvas is only sold in a rectangular shape, how much will the canvas cost if the price of canvas is $7.39/ft^2, plus taxes?
(Note: GST = 5%, PST = 8%)

(2 marks)

Area of rectangular canvas needed for the tipi:

90 ft. $\times$ 45 ft. = 4050 ft^2 ***OR***   450 ft^2 $\times$ 3^2 = 4050 ft^2

Cost of canvas: 4050 ft^2 $\times$ $7.39/ft^2 = $29 929.50

$$\begin{array}{r} \$1496.48 \ (GST) \\ + \quad \$2394.36 \ (PST) \\ \hline \$33\ 820.34 \end{array}$$

The canvas will cost $33 820.34.

Marking Key
❶   *1 mark for appropriate work in (a)*
❷   *1 mark for consistent answer in (a)*
❸   *1 mark for correct area of larger canvas in (b)*
❹   *1 mark for consistent answer with taxes included in (b)*

LOGICAL REASONING

Question 23   Total: 2 marks

Complete the truth table.

p	q	$\sim q$ (not q)	$p \Rightarrow \sim q$
True	**True**	False	False
True	**False**	True	True
False	**True**	False	True
False	**False**	True	True

Marking Key	
❶	*1 mark for correct ~ q column*
❷	*1 mark for consistent p ⇒ ~ q column*

Question 24
Total: 4 marks

Question Type: Constructed Response

There are 160 Grade 12 students attending a high school.

This semester, the science teacher noted that there are

- **30 students in Biology**
- **54 students in Chemistry**
- **43 students in Physics**
- **11 students in both Biology and Physics**
- **8 students in both Biology and Chemistry**
- **9 students in both Chemistry and Physics**
- **3 students taking all three courses**

a) **Use a Venn diagram to represent this situation.**

(3 marks)
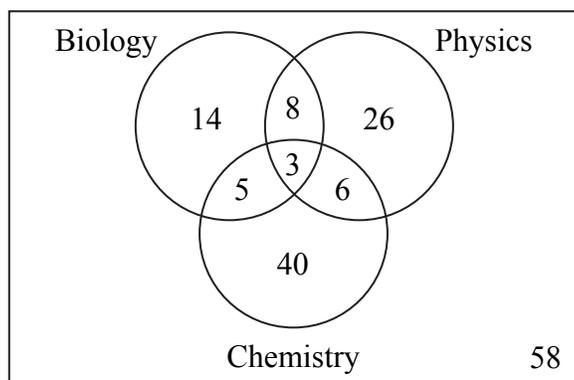
b) **How many students are taking Biology or Chemistry?**

(1 mark)

$$14 + 5 + 3 + 8 + 6 + 40 = 76$$

There are 76 students.

Marking Key
❶ *1 mark for correctly calculating and placing the number of students taking two or more science courses in (a)*
❷ *1 mark for consistent number of students taking exactly one science course in (a)*
❸ *1 mark for consistent number of students taking no science courses in (a)*
❹ *1 mark for consistent answer in (b)*

Question 25

Total: 2 marks

Paula is trying to solve the following puzzle. Each 2 × 2 box must contain the digits 1 to 4 only once. As well, each column and each row must contain the digits 1 to 4 only once.

Paula indicates that the ★ must be a "4". Explain why she is incorrect and solve the puzzle.

1	4	★ 3	2
3	**2**	1	4
2	3	4	**1**
4	1	2	3

Paula's solution is not possible since the "4" must go in the 2nd spot on the top row.
Therefore, the ★ must be a "3".

OR───

Paula's solution is not possible since the "4" must go in the 3rd or 4th spot in the 2nd row.
Therefore, the ★ cannot be a "4" because it is in the same 2 × 2 box.

Other explanations are possible.

Marking Key	
❶	*1 mark for appropriate explanation*
❷	*1 mark for correctly solving the puzzle*

Exemplars

Exemplars may contain screen captures
taken from software or Internet pages.

Exemplar 1

Question 3   **Total: 4 marks**

A certain medication destroys diseased cells in a person's body. The number of diseased cells decreases for a short time after a dose of the medication is administered and then increases again. This situation varies sinusoidally and is modelled by the following equation:

$$c = 350 \sin(3.14t + 1.57) + 650$$

where t represents the time (in weeks)
and c represents the diseased cell count.

a) If the initial dose of medication is administered at $t = 0$, when is the second dose administered?

(1 mark)

2 weeks.

b) What is the range of this function?

(1 mark)

$$1000 \geq Y \geq 300$$

(E1)   (E4)

c) A patient claims to feel well when the diseased cell count is below 500. At $t = 2.5$ weeks, will the patient be feeling well? Show your work.

(2 marks)

✱ See printout

no, the cell count is above 500

Exemplar 1 (continued)

Graphmatica - Untitled

File Edit View Options Tools Calculus Help

y = 350 sin (3.14x + 1.57) +650

Medication

Point Evaluate

Select an equation:

y = 350 sin (3.14x + 1.57) +650

● Solve for y. Enter value of x: 2.6

Solve for x. Enter value of y:
To find an off-screen solution,
you must also enter a guess for x

Results
x   y
2.5   651.6723

[Calculate]   [Close]

cell count

Time in Weeks

---

4 marks:
❶ → 1 mark for correct answer in (a)
❷ → 1 mark for correct answer in (b)
❸ → 1 mark for appropriate work in (c)
❹ → 1 mark for correct answer in (c)

....

(E1) → does not include braces when using set notation
(E4) → does not use a contextual variable when stating
the domain or the range in set notation
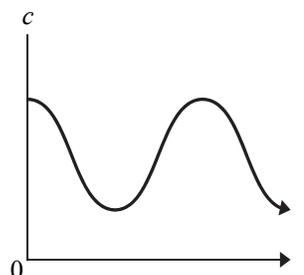
Exemplar 2

Question 3	Total: 4 marks

A certain medication destroys diseased cells in a person's body. The number of diseased cells decreases for a short time after a dose of the medication is administered and then increases again. This situation varies sinusoidally and is modelled by the following equation:

$$c = 350 \sin(3.14t + 1.57) + 650$$

where t represents the time (in weeks)
and c represents the diseased cell count.

a) If the initial dose of medication is administered at $t = 0$, when is the second dose administered?

(1 mark)

$$t = 2$$

b) What is the range of this function?

(1 mark)

$$(300, 1000)$$
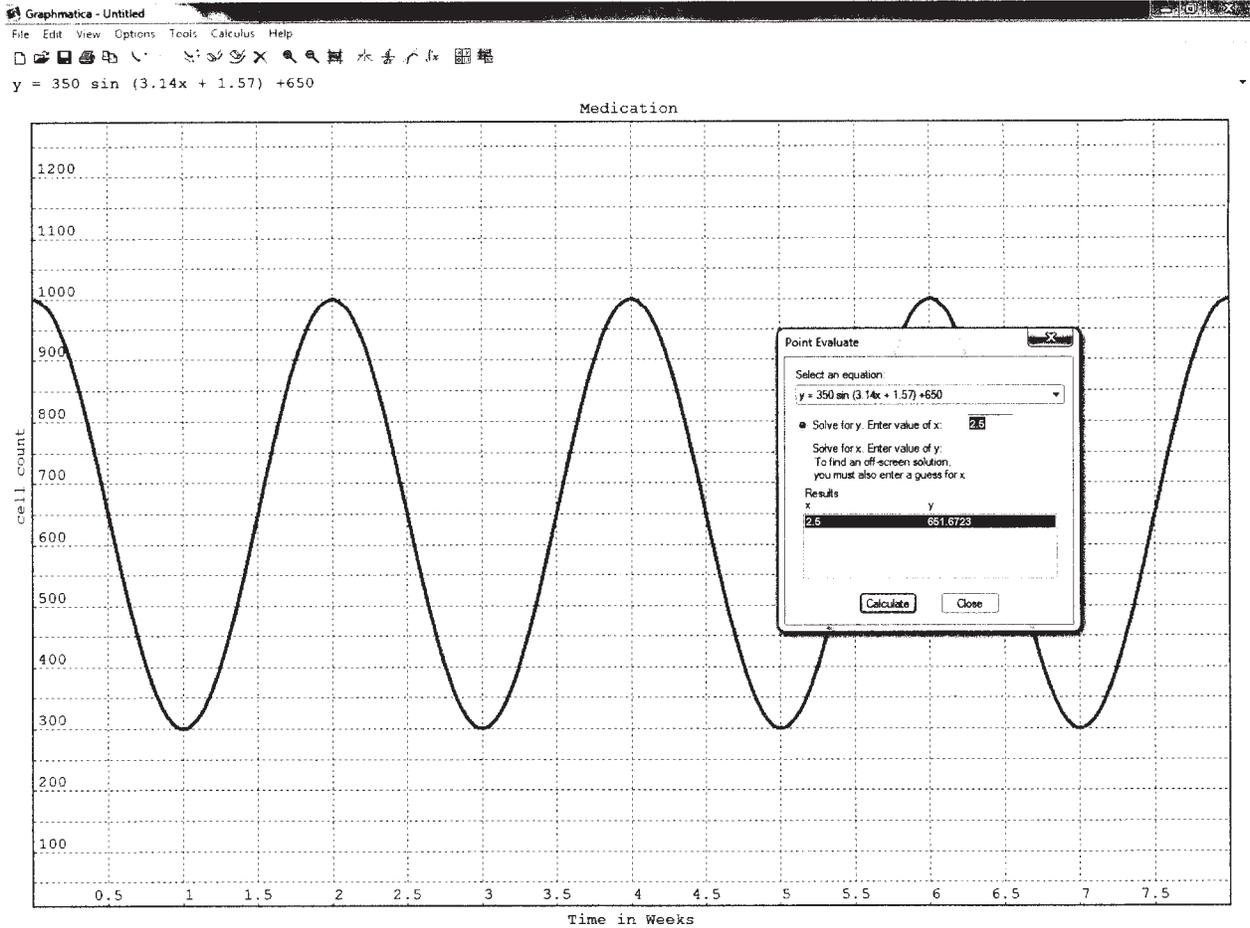
c) A patient claims to feel well when the diseased cell count is below 500. At $t = 2.5$ weeks, will the patient be feeling well? Show your work.

(2 marks) at the point 2.5 the patient will not be feeling well because the cell count is above 500, it's at 651.67
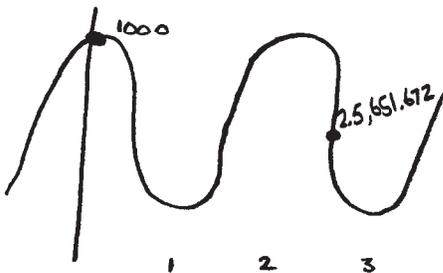
<div style="border:1px solid">

3 marks:

❶ → 1 mark for correct answer in (a)
❸ → 1 mark for appropriate work in (c)
❹ → 1 mark for correct answer in (c)

</div>

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Exemplar 1

Question 4	**Total: 3 marks**

The Gateway Arch in St. Louis, in the United States, approximates a parabola. Steven learns that the arch is 192 m wide. (Diagram is not drawn to scale.)

At 2.5 m from his starting point, Steven measures the height of the arch to be 10 m.
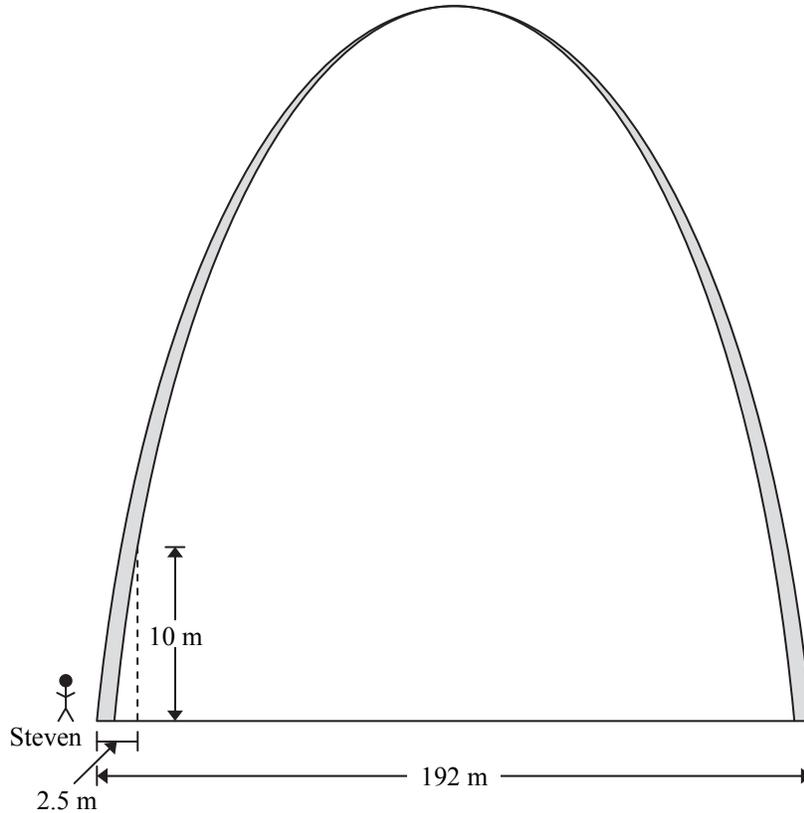
a) Determine the quadratic equation that models the shape of the arch. Show your work.
    Express all coefficients in the equation to a minimum of three (3) decimal places.

(2 marks)

X	Y
0	0
2.5	10
189.5	10

$192 - 2.5 = 189.5$

$y = ax^2 + bx + c$

$y = -0.02111x^2 + 4.05277x$
$\quad - (2.01 \times 10^{-10})$

$x =$ distance from starting point
$y =$ height

Exemplar 1 (continued)

b) Calculate the arch's maximum height.

(1 mark)

$$X = 95.99 \qquad \boxed{y = 194.52\,m}$$

> **3 marks:**
> ❶ → 1 mark for appropriate work in (a)
> ❷ → 1 mark for consistent answer in (a)
> ❸ → 1 mark for consistent answer in (b)

# Exemplar 2

The Gateway Arch in St. Louis, in the United States, approximates a parabola. Steven learns that the arch is 192 m wide. (Diagram is not drawn to scale.)

At 2.5 m from his starting point, Steven measures the height of the arch to be 10 m.
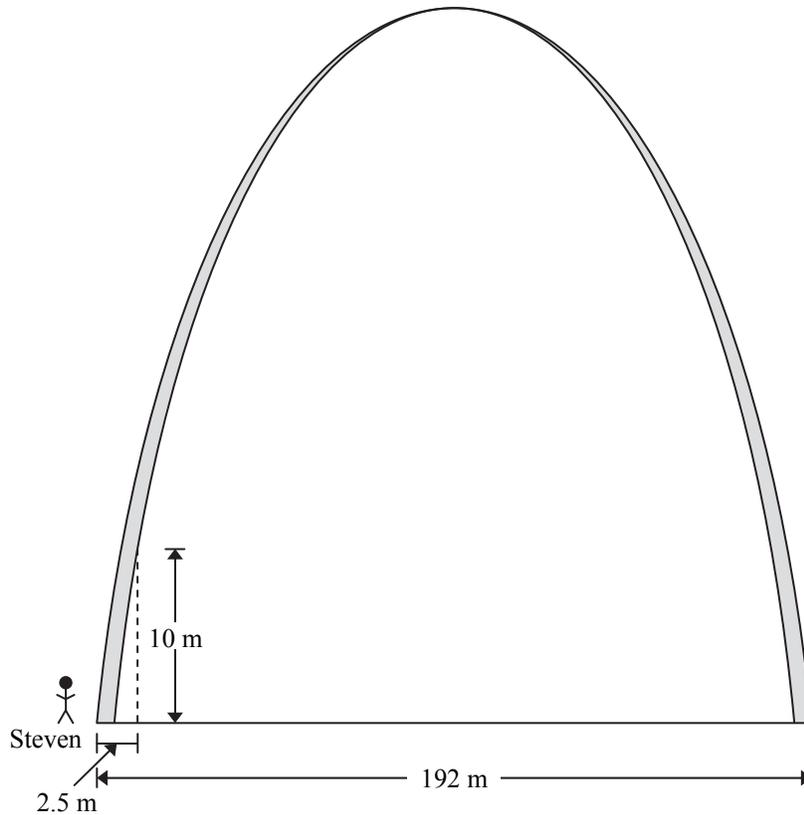
a) Determine the quadratic equation that models the shape of the arch. Show your work. Express all coefficients in the equation to a minimum of three (3) decimal places.

(2 marks)

$$y = ax^2 + bx + c$$

$$y = -2.5x^2 + 10x + 192$$

Exemplar 2 (continued)

b) Calculate the arch's maximum height.

(1 mark)

maximum = 202 m

Graphed it and traced it

1 mark:
❸ → 1 mark for consistent answer in (b)

Exemplar 1

Question 5	Total: 6 marks

The ice thickness on Lake Mathitoba is measured weekly every winter. The data for one season is shown in the table below:

Time (day)	7	14	21	28	35	42	49
Ice thickness (cm)	5.2	17.4	26.8	32.4	37.1	42.6	44.3

a) Determine the logarithmic regression equation that models this data.

(1 mark)

$$y = a + b \ln x$$
$$y = -35.8 + 20.6 \ln x$$

(E5)

b) Create a clearly labelled graph of the equation in (a).

(3 marks)

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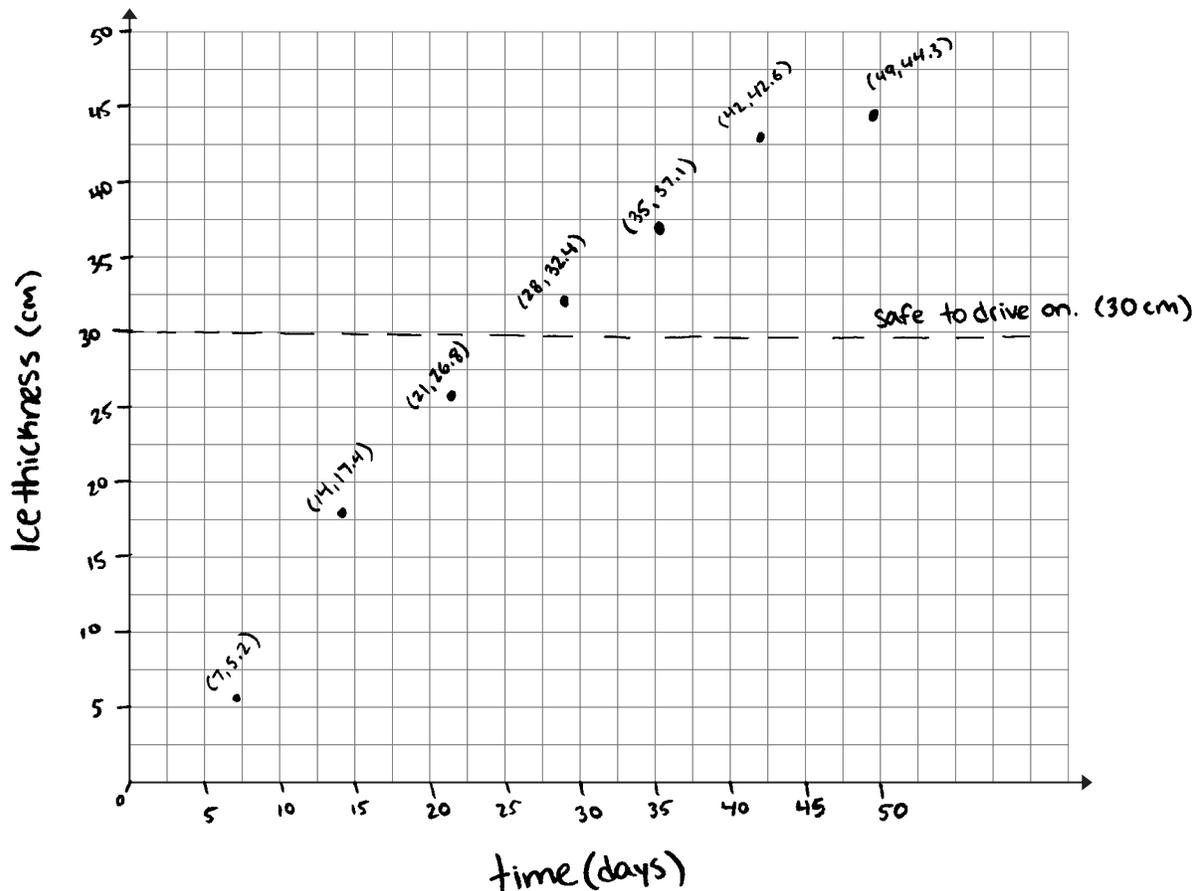
Exemplar 1 (continued)

c) It is considered safe to operate a vehicle on lake ice if it is at least 30 cm thick. Use your equation in (a) to determine the first full day it will be safe to drive on the ice. Show your work.

(2 marks)

$$y = -35.8 + 20.6 \ln x$$

$$y = -35.8 + 20.6 \ln(25) = \boxed{30.5}$$

---

4 marks:

❶ → 1 mark for correct equation in (a)

❷ → 1 mark for communicating the context of the graph with appropriate title and/or labels in (b)

❸ → 1 mark for using an appropriate domain and range (i.e., window settings/grid range) for the context of the question in (b)

❺ → 1 mark for appropriate work in (c)

· ·

ⒺⒻ → does not express the answer to the appropriate number of decimal places

Exemplar 2

Question 5   **Total: 6 marks**

The ice thickness on Lake Mathitoba is measured weekly every winter. The data for one season is shown in the table below:

Time (day)	7	14	21	28	35	42	49
Ice thickness (cm)	5.2	17.4	26.8	32.4	37.1	42.6	44.3

a) Determine the logarithmic regression equation that models this data.

(1 mark)

$$y = ax + b$$
$$y = 0.91x + 3.97$$

b) Create a clearly labelled graph of the equation in (a).
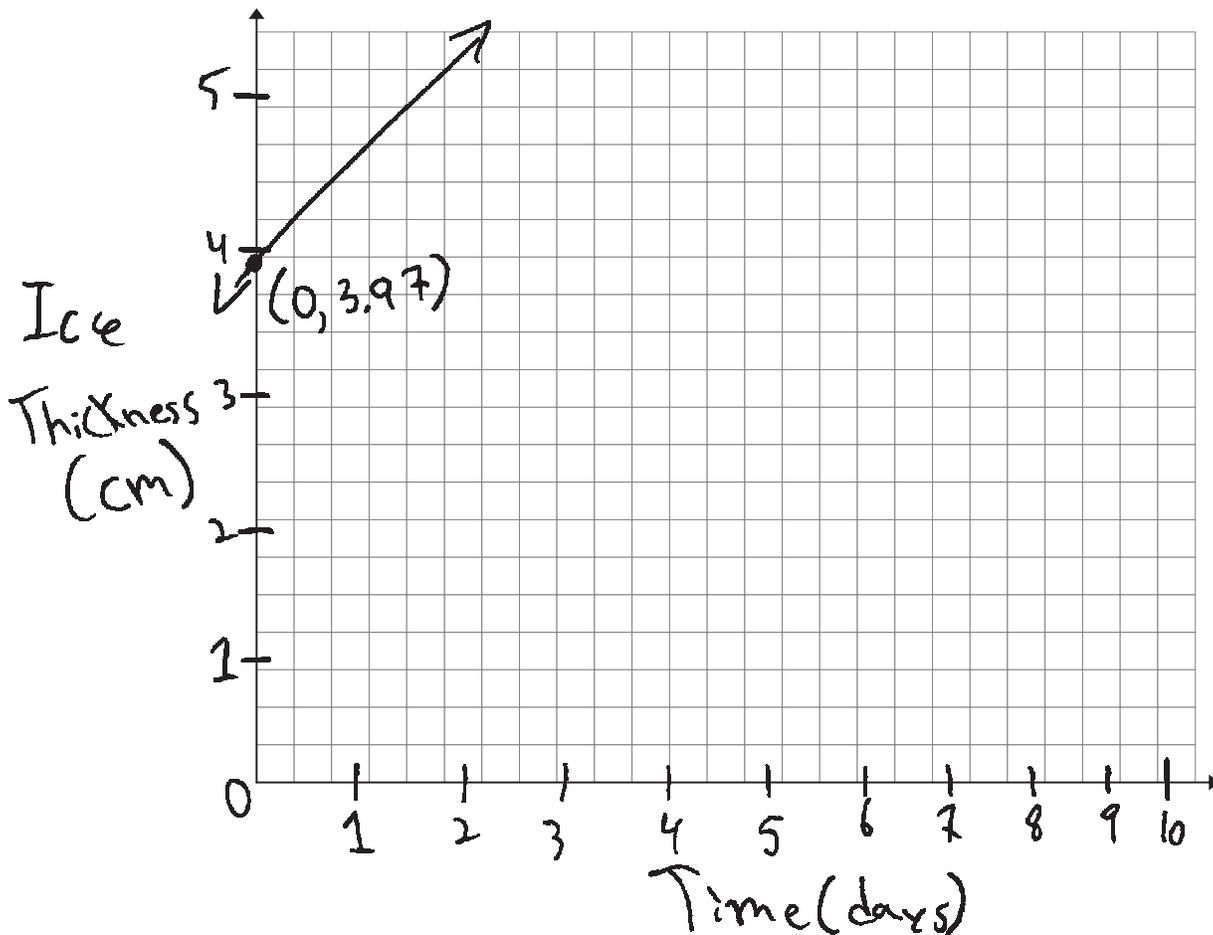
(3 marks)

Exemplar 2 (continued)

c)   It is considered safe to operate a vehicle on lake ice if it is at least 30 cm thick. Use your equation in (a) to determine the first full day it will be safe to drive on the ice. Show your work.

(2 marks)

$y_1 = 0.91x + 3.97$

$y_2 = 30$

2nd → trace → Intersect | x = 28.66

Y = 30

On day 29 it will be safe.

<table>
<tr><td colspan="2">3 marks:</td></tr>
<tr><td>❷ →</td><td>1 mark for communicating the context of the graph with appropriate title and/or labels in (b)</td></tr>
<tr><td>❺ →</td><td>1 mark for appropriate work in (c)</td></tr>
<tr><td>❻ →</td><td>1 mark for consistent answer in (c)</td></tr>
</table>

Exemplar 3

	Question 5					**Total: 6 marks**	

The ice thickness on Lake Mathitoba is measured weekly every winter. The data for one season is shown in the table below:

$\times$ **Time (day)**	7	14	21	28	35	42	49
y **Ice thickness (cm)**	5.2	17.4	26.8	32.4	37.1	42.6	44.3

a)   Determine the logarithmic regression equation that models this data.

(1 mark)

$$y = a + b \ln(x)$$

$$y = -35.84 + 20.62 \ln(x)$$

b)   Create a clearly labelled graph of the equation in (a).
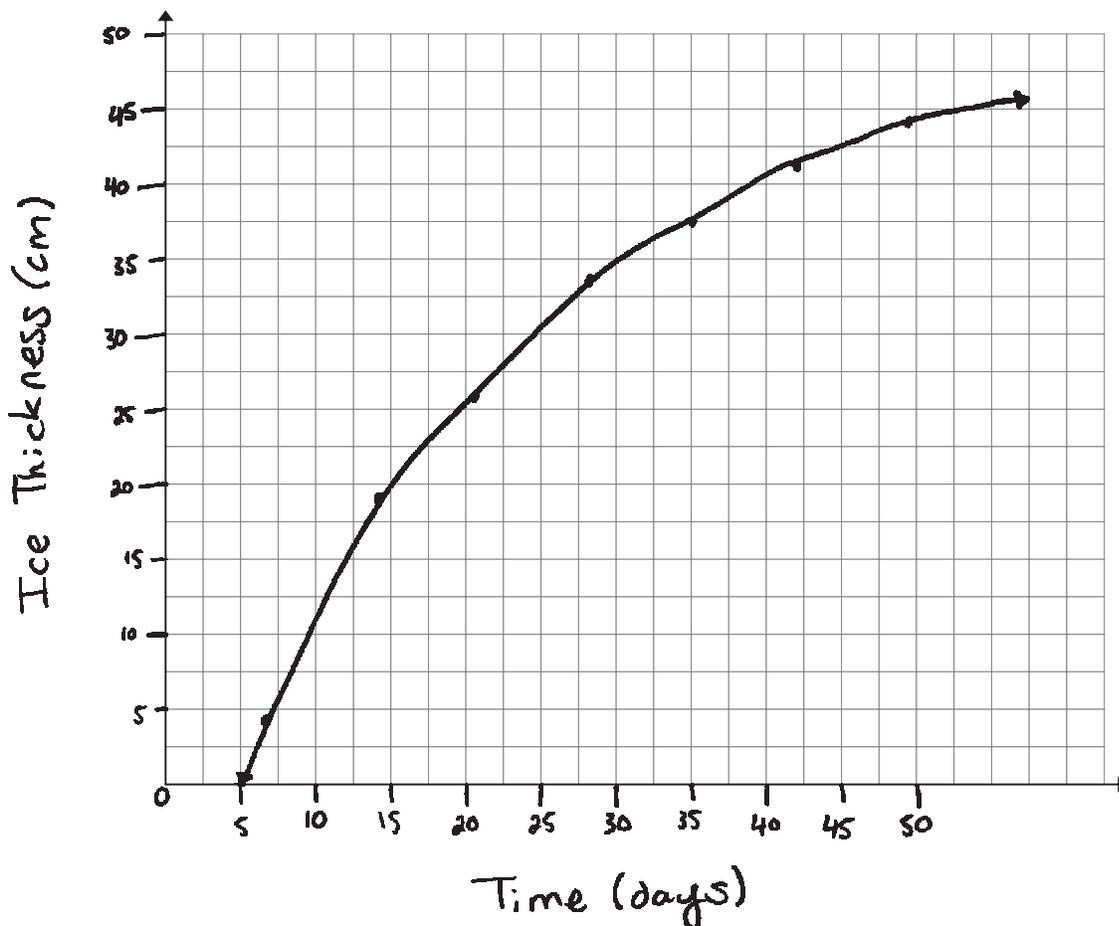
(3 marks)

Exemplar 3 (continued)

c) It is considered safe to operate a vehicle on lake ice if it is at least 30 cm thick. Use your equation in (a) to determine the first full day it will be safe to drive on the ice. Show your work.

(2 marks)

$y2 = 30 \rightarrow$ 2nd $\rightarrow$ trace $\rightarrow$ intersect $\rightarrow x = 24.358667$

The first day it will be safe to drive on the ice is day 24.

(E5)

---

5 marks:
❶ → 1 mark for correct equation in (a)
❷ → 1 mark for communicating the context of the graph with appropriate title and/or labels in (b)
❹ → 1 mark for an appropriate shape that illustrates key characteristics of the function (e.g., maximum, minimum, asymptotes, intercepts) in (b)
❺ → 1 mark for appropriate work in (c)
❻ → 1 mark for consistent answer in (c)

⋯⋯⋯⋯⋯⋯⋯⋯⋯⋯⋯⋯⋯⋯⋯⋯⋯⋯⋯⋯⋯⋯⋯⋯⋯⋯⋯⋯

(E5) → rounds incorrectly

Exemplar 1

Question 8   **Total: 3 marks**

Evan is arranging 8 different bicycles in a rack at his school.

a)   How many ways can the bicycles be arranged in the rack?

(1 mark)

$$8! \quad = 40320$$

b)   How many ways can the bicycles be arranged in the rack if 3 students want their bicycles placed together? Show your work.

(2 marks)

$$6! \, 3! = 720$$

<div style="border: 1px solid black; padding: 10px;">

2 marks:
❶ → 1 mark for correct answer in (a)
❸ → 1 mark for consistent answer in (b)

</div>

Exemplar 2

Question 8   Total: 3 marks

Evan is arranging 8 different bicycles in a rack at his school.

a) How many ways can the bicycles be arranged in the rack?

(1 mark)

$$8! = 40320$$

b) How many ways can the bicycles be arranged in the rack if 3 students want their bicycles placed together? Show your work.

(2 marks)

$$\frac{8!}{3!} = 6720$$

| **1 mark:** |
| ❶ → 1 mark for correct answer in (a) |

Exemplar 1

Question 9   **Total: 2 marks**

Rosalind wants to make a trail mix for a snack. She has 15 ingredients to choose from.

What is the total number of different mixes Rosalind can create containing 3, 4, or 5 ingredients? Show your work.

$$15_P4 = 32760$$

$$15_P3 = 2730$$

$$15_P5 = 360360$$

$$32760 + 2730 + 360360 = 395850$$

Rosalind can create a mix 395,850 ways

---

1 mark:
❷ → 1 mark for consistent answer

Exemplar 2

Question 9   **Total: 2 marks**

Rosalind wants to make a trail mix for a snack. She has 15 ingredients to choose from.

What is the total number of different mixes Rosalind can create containing 3, 4, or 5 ingredients? Show your work.

$$_{15}C_3 = 455$$

$$_{15}C_4 = 1365$$

$$_{15}C_5 = 3003$$

<table>
<tr><td>1 mark:</td></tr>
<tr><td>❶ → 1 mark for appropriate work</td></tr>
</table>

Exemplar 1

Question 10   Total: 2 marks

Given the following collection of objects:

■◇△△■△■△△◇◇■

a)   Calculate the probability of randomly choosing ■.

(1 mark)

$$\frac{4}{12} = 0.33\,\%$$

(E4)

b)   How can the collection be changed so that the probability of choosing ■ is exactly 40%?

(1 mark)

can add another ▨ so $^{5}/_{12} = 0.42\,\%$.

1 mark:
❶ → 1 mark for correct answer in (a)
(E4) → incorrectly states the final answer

Exemplar 2

Question 10   **Total: 2 marks**

Given the following collection of objects:

■◈△△■△■△△◈◈■

a)   Calculate the probability of randomly choosing ■.

(1 mark)

$$\frac{4}{12} = .333$$

$$33.33\,\%$$

b)   How can the collection be changed so that the probability of choosing ■ is exactly 40%?

(1 mark)

Remove 2 of the other objects.

$$\frac{4}{10} = .4$$

$$40.00\,\%$$

2 marks:
❶ → 1 mark for correct answer in (a)
❷ → 1 mark for appropriate change to collection in (b)

Exemplar 1

Question 11   **Total: 3 marks**

Tim has a set of cards numbered 1 to 15. He randomly draws one card.

Consider the following events:

    Event A: drawing a card that is a multiple of 2

    Event B: drawing a card that is a multiple of 3

a)   Are these events mutually exclusive? Justify your answer.

(1 mark)

The events are not mutually exclusive because they share outcomes

2,4,8,10 14   6 12   3,9, 15

b)   What is the probability of drawing a numbered card that is a multiple of 2 or a multiple of 3? Show your work.

(2 marks)

2,4,8 10,14   6 12   3,9, 15

1,5,7,11,13

multiple of 2 = $\frac{7}{15}$ = .47 or 46.67%

multiple of 3 = $\frac{5}{15}$ = .33 or 33.33%

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1 mark:
❶ → 1 mark for appropriate justification in (a)

Exemplar 2

Question 11	**Total: 3 marks**

Tim has a set of cards numbered 1 to 15. He randomly draws one card.
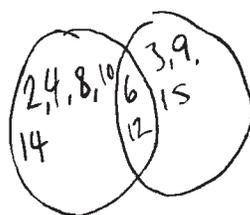
Consider the following events:

> **Event A:** drawing a card that is a multiple of 2

> **Event B:** drawing a card that is a multiple of 3

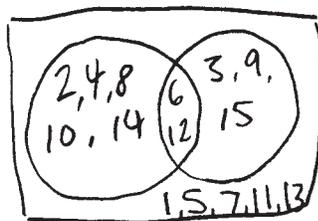a) Are these events mutually exclusive? Justify your answer.

(1 mark)

> No because Tim can have a card that is a multiple
> of 2 and a multiple of 3.

b) What is the probability of drawing a numbered card that is a multiple of 2 or a multiple of 3? Show your work.

(2 marks)

$$P(A \text{ or } B) = P(0.47) + P(0.33) - P(0.13) = P(0.67)$$

$$\underline{67 \%}$$

↑
(E5)

---

3 marks:
❶ → 1 mark for appropriate justification in (a)
❷ → 1 mark for appropriate work in (b)
❸ → 1 mark for consistent answer in (b)

···

(E5) → does not express the answer to the
appropriate number of decimal places

Exemplar 1

Question 12   **Total: 2 marks**

You are asked to take a 3-question multiple-choice quiz. Each question has 4 possible answers, one of which is correct.

a)   If you randomly pick an answer for each question, what is the probability that all 3 answers are wrong?

(1 mark)

$$\frac{4}{\text{any answer}} \times \frac{4}{\text{any answer}} \times \frac{4}{\text{any answer}} = 64 \text{ ways to answer}$$

$$\frac{3}{\text{incorrect}} \times \frac{3}{\text{incorrect}} \times \frac{3}{\text{incorrect}} = 27$$

$$P(\text{all incorrect}) = \boxed{\frac{27}{64}}$$

b)   What is the probability of getting at least one of the questions correct?

(1 mark)

$$\frac{1}{\text{correct}} \times \frac{3}{\text{incorrect}} \times \frac{3}{\text{incorrect}} = 9$$

$$+$$

$$\frac{1}{\text{correct}} \times \frac{1}{\text{correct}} \times \frac{3}{\text{incorrect}} = 3$$ $$= 13$$

$$+$$

$$\frac{1}{\text{correct}} \times \frac{1}{\text{correct}} \times \frac{1}{\text{correct}} = 1$$

$$P(\text{at least 1 correct}) = \boxed{\frac{13}{64}}$$

> **1 mark:**
> ❶ → 1 mark for correct answer in (a)

Exemplar 2

Question 12   **Total: 2 marks**

You are asked to take a 3-question multiple-choice quiz. Each question has 4 possible answers, one of which is correct.

a) If you randomly pick an answer for each question, what is the probability that all 3 answers are wrong?

(1 mark)

1 - 1 2 3 4
2 - 1 2 3 4
3 - 1 2 3 4

$Q1 = 1/4 = 0.25$
$Q2 = 1/4 = 0.25$
$Q3 = 1/4 = 0.25$

0.75
×100

→ 75% chance of you getting all 3 incorrect.

b) What is the probability of getting at least one of the questions correct?

(1 mark)

$3/12 = 0.25 \times 100 = 25\%$.

There is a 25% chance you get 1 question right

1 mark:
❷ → 1 mark for consistent answer in (b)

Exemplar 1

Question 13	Total: 2 marks

Student ID codes are made up using any two upper case letters of the alphabet followed by any two digits.

a) How many ID codes are possible?

(1 mark)

0,1,2,3,4,5,6,7,8,9,10

$$\underline{26}\ \underline{26}\ \underline{11}\ \underline{11} = \boxed{81,796}$$

b) How many ID codes are possible given the following conditions?
  - Repetition is not allowed.
  - The letters "I" and "O" cannot be used.

(1 mark)

$$\underline{24}\ \underline{23}\ \underline{11}\ \underline{10} = \boxed{60,720}$$

---

1 mark:
❷ → 1 mark for consistent answer in (b)

Exemplar 2

Question 13   Total: 2 marks

Student ID codes are made up using any two upper case letters of the alphabet followed by any two digits.

a) How many ID codes are possible?

(1 mark)

$$\underset{\substack{\text{any} \\ \text{letter}}}{\frac{26}{}} \times \underset{\substack{\text{any} \\ \text{letter}}}{\frac{26}{}} \times \underset{\substack{\text{any} \\ \text{\#}}}{\frac{10}{}} \times \underset{\substack{\text{any} \\ \text{\#}}}{\frac{10}{}} = 67600 \text{ codes}$$

b) How many ID codes are possible given the following conditions?
- Repetition is not allowed.
- The letters "I" and "O" cannot be used.

(1 mark)

$$\underset{\substack{\text{any letter} \\ \text{but I/o}}}{\frac{24}{}} \times \underset{\substack{\text{any} \\ \text{letter}}}{\frac{23}{}} \times \underset{\substack{\text{any} \\ \text{\#}}}{\frac{10}{}} \times \underset{\substack{\text{any} \\ \text{\#}}}{\frac{10}{}} = 55200 \text{ codes}$$

1 mark:
❶ → 1 mark for correct answer in (a)

Exemplar 1

Question 17 Total: 2 marks

Mr. and Mrs. Murthy have a total monthly gross income of $6000.00. They are interested in purchasing a house with a mortgage payment of $1300.00 per month, annual heating costs of $2100.00, and annual property taxes of $3675.00.

Calculate the gross debt service ratio (GDSR). Determine if a bank is likely to offer them a mortgage. Justify your answer.

$$\text{Gross debt service ratio} = \frac{\text{monthly mortgage payment} + \text{monthly property taxes} + \text{monthly heating costs}}{\text{Gross monthly income}} \times 100$$

$$\text{GDSR} = \frac{1300 + 175 + 306.25}{6000} \times 100$$

$$2100 \div 12 = 175$$
$$3675 \div 12 = 306.25$$

$$= 29.69\%$$

yes, the bank will offer them a mortgage.

Exemplar 2

Question 17   Total: 2 marks

Mr. and Mrs. Murthy have a total monthly gross income of $6000.00. They are interested in purchasing a house with a mortgage payment of $1300.00 per month, annual heating costs of $2100.00, and annual property taxes of $3675.00.

under 32% is good

Calculate the gross debt service ratio (GDSR). Determine if a bank is likely to offer them a mortgage. Justify your answer.

$$\left(\frac{\text{monthly property tax} + \text{monthly heating} + \text{monthly mortgage}}{\text{gross household income}} \right) \times 100$$

$$\left(\frac{3675.00 + 2100.00 + 1300.00}{6000.00} \right) \times 100 = 117.92 \quad \text{(E4)}$$

NO, 117.92 is more than 32%.

1 mark:
❷ → 1 mark for appropriate justification by making reference to 32%

⋯⋯⋯⋯⋯⋯⋯⋯⋯⋯⋯⋯⋯⋯⋯⋯⋯⋯⋯⋯⋯

(E4) → does not include a percent sign

Exemplar 1

List two advantages of leasing a vehicle over buying.

° lower monthly payments

° don't have to worry about repairs

| **1 mark:** |
| ❶ → 1 mark for correct first advantage |

Exemplar 2

Question 18   **Total: 2 marks**

List two advantages of leasing a vehicle over buying.

— less initial money required for purchase
— line of credit to show responsible debt paying habits

<div style="border:1px solid #000; padding:8px; width:260px; float:right">

0 marks:
→ no criteria met

</div>

Exemplar 1

Gabrielle wants to buy a cabin at Lac du Bonnet that costs $165 000.00. She has saved $25 000.00 that she will use as a down payment. The bank will give her a 15-year mortgage for the balance at 3.49%, compounded semi-annually.

a)   What will Gabrielle's payment be every two weeks? Show your work.

(2 marks)

APPS TVM Solver

N – 420
I –3.49
PV –140 000
PMT – ___ Alpha Enter = –427.54335
FV – 0
P/Y –28
C/Y –2

$$165 000$$
$$-25 000$$
$$140000$$

Her Payments will be
$ 427.54

b)   If the cabin appreciates in value an average of 3.00% per year, calculate the appreciated value of the cabin after 10 years.

(1 mark)

$$165 000 \times 1.03^{10} = \$221 746.^{20}$$

c)   How much equity will Gabrielle have in the cabin after 10 years?

(1 mark)

$$221 746.20$$
$$-165 000.00$$
$$056 746 20$$

$ 56, 746.20

2 marks:
❷ → 1 mark for consistent answer in (a)
❸ → 1 mark for correct appreciated value in (b)

Exemplar 2

Question 19   Total: 4 marks

Gabrielle wants to buy a cabin at Lac du Bonnet that costs $165 000.00. She has saved $25 000.00 that she will use as a down payment. The bank will give her a 15-year mortgage for the balance at 3.49%, compounded semi-annually.

a) What will Gabrielle's payment be every two weeks? Show your work.

(2 marks)

$$\underline{\text{TVM}}$$

N	15 × 104 = 1560
I	3.49
PV	14000 ← (E3)
PMT	−115.06
FV	0
P/Y	104
C/Y	2

Her payment every 2 weeks will be $115.06.

$$\underline{\text{Down payment}}$$
$$165\,000 - 25\,000$$
$$= \$14\,0000$$

b) If the cabin appreciates in value an average of <u>3.00% per year</u>, calculate the appreciated value of the cabin after 10 years.

(1 mark)

$$\$165\,000 \times 1.03^{10} = \$221746.20$$

c) How much equity will Gabrielle have in the cabin after 10 years?

(1 mark)

$$\underline{\text{TVM}}$$

N	10 × 104 = 1040
I	3.49
PV	14000 ← (E3)
PMT	−115.06
FV	−54930.80
P/Y	104
C/Y	2

$$\$221746.20$$
$$-\$54930.80$$
$$\boxed{\$166815.40}$$

3 marks:
❷ → 1 mark for consistent answer in (a)
❸ → 1 mark for correct appreciated value in (b)
❹ → 1 mark for consistent equity in (c)

··

(E3) → makes a transcription error (inaccurate transferring of information)

Exemplar 1

Question 20   **Total: 6 marks**

At the age of 30, Alfred began investing $350.00 monthly into an investment account at an interest rate of 7.00%, compounded monthly. When he turned 45, the interest rate on this investment decreased to 5.00%, compounded monthly. Alfred plans to continue making monthly investments until he retires at 58.

a) How much money will Alfred have in his account when he retires? Show your work.

(3 marks)

30 - 45

N = 180
I = 7
Pv = 0
PMT = -350
Fv = 110 936.80
P/y = 12
C/y = 12

45 - 58

N = 156
I = 5
Pv = 0
PMT = -350
Fv = 76688.28
P/y = 12
C/y = 12

110936.80
+76 688.28
─────────
187625.08

He will have $187,625.08 in his account when he retires

b) Alfred withdraws $2000.00 per month from his account after he retires. If the interest rate remains at 5.00%, how many months can he withdraw $2000.00?

(1 mark)

$$\frac{187,625.08}{2000} = 93.81$$

94 months

↑
Ⓔ5

Exemplar 1 (continued)

c) Alfred's sister, Marianne, retires at the age of 60. Her portfolio is valued at $200 000.00, earning 5.00%, compounded monthly. If Marianne wants the money to last until she is 85 years old, what is the maximum she can withdraw each month? Show your work.

(2 marks)

N = 300
I = 5
Pv = 0
PMT = -33.584674
Fv = 200 000

P/y = 12
C/y = 12

The most she can take out is $33.58 per month.

Exemplar 2

Question 20   **Total: 6 marks**

At the age of 30, Alfred began investing $350.00 monthly into an investment account at an interest rate of 7.00%, compounded monthly. When he turned 45, the interest rate on this investment decreased to 5.00%, compounded monthly. Alfred plans to continue making monthly investments until he retires at 58.

a)   How much money will Alfred have in his account when he retires? Show your work.

(3 marks)

$$30 - 45 = \$110936.80$$

$$45 - 58 = \$76688.29$$

$$
\begin{array}{r}
\$110936.80 \\
+ \ \$76688.29 \\
\hline
\$187625.09
\end{array}
$$

∴ Alfreds account will have $187625.09 by the time he retires

b)   Alfred withdraws $2000.00 per month from his account after he retires. If the interest rate remains at 5.00%, how many months can he withdraw $2000.00?

(1 mark)

119.04 months

⬆

(E5)

Exemplar 2 (continued)

c) Alfred's sister, Marianne, retires at the age of 60. Her portfolio is valued at $200 000.00, earning 5.00%, compounded monthly. If Marianne wants the money to last until she is 85 years old, what is the maximum she can withdraw each month? Show your work.

(2 marks)

∴ She can withdraw a maximum of $ 1169.18

<div style="border: 1px solid black; padding: 10px;">

3 marks:

❷ → 1 mark for correct value of investment at age 45 in (a)
❹ → 1 mark for consistent answer in (b)
❻ → 1 mark for consistent answer in (c)

⋯⋯⋯⋯⋯⋯⋯⋯⋯⋯⋯⋯⋯⋯⋯⋯⋯⋯⋯⋯⋯⋯⋯⋯⋯⋯

(E5) → rounds incorrectly
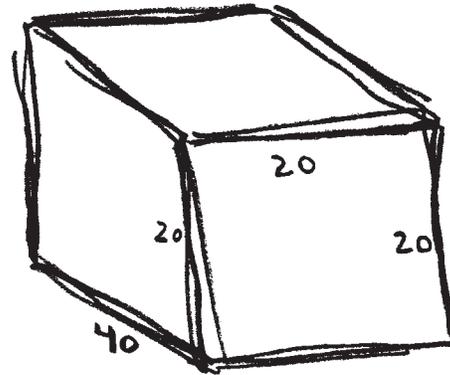
</div>

Question 21   **Total: 2 marks**

Sheena is wrapping boxes using a roll of wrapping paper with a total area of 3.5 m^2. Each box has a 20 cm width, 20 cm length, and 40 cm height. If Sheena uses 20% extra paper on each box, how many boxes can she wrap? Show your work.

$$(20 \times 2) + (20 \times 2) + (40 \times 2) = 160 \text{cm} = 1.6\text{m}$$

$$1.6 \times 1.2 = 1.92\text{m}$$

$$3.5\text{m}^2 / 1.92\text{m}^2 = 1.82 \text{ boxes She will be able to wrap}$$

So, one whole box

1 mark:
❷ → 1 mark for consistent number of boxes wrapped

Exemplar 2

Question 21	Total: 2 marks

Sheena is wrapping boxes using a roll of wrapping paper with a total area of 3.5 m². Each box has a 20 cm width, 20 cm length, and 40 cm height. If Sheena uses 20% extra paper on each box, how many boxes can she wrap? Show your work.

$3.5 m^2$

$350 cm^2$

$4 (40 \times 20) = 3200^2$

$2 (20 \times 20) = \dfrac{800^2}{4000^2_{cm} \times 1.2}$

$\boxed{4800 cm^2}$

Exemplar 1

A traditional plains tipi is built using a rectangular canvas that is twice as long as it is wide. The diagram below shows how a semicircle would be cut out of a canvas with dimensions of 30 ft. (length) and 15 ft. (width). (Diagram is not drawn to scale.)

15 ft.

30 ft.
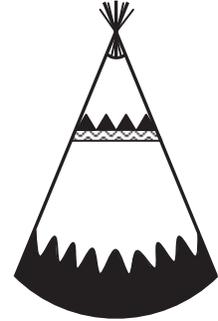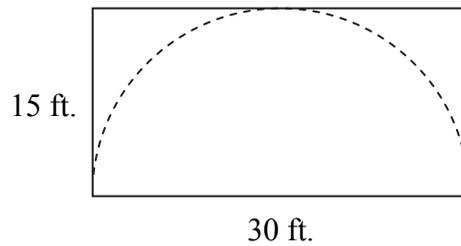
a) Calculate how much canvas is left over after the semicircle has been cut out.
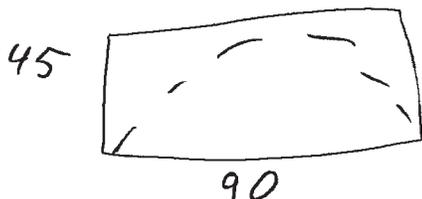
(2 marks)

$$r = 15$$

$$A = \frac{\pi r^2}{2}$$

$$A = \frac{\pi \, 15^2}{2}$$

$$A = 353.43 \, ft^2$$

Exemplar 1 (continued)

b) You would like to construct a tipi with both dimensions three times greater than those for the tipi in (a). Given that canvas is only sold in a rectangular shape, how much will the canvas cost if the price of canvas is $7.39/ft^2, plus taxes? (Note: GST = 5%, PST = 8%)

(2 marks)

45 [rectangle diagram] 90

$45 \times 90 = 4{,}050 \ ft^2$

$4050 \times 7.39 = 29{,}929.50$

$29{,}929.50 \times 1.13 = \boxed{\$ 33{,}820.335}$ ← E4

---

3 marks:
❶ → 1 mark for appropriate work in (a)
❸ → 1 mark for correct area of larger canvas in (b)
❹ → 1 mark for consistent answer with taxes included in (b)

··

E4 → does not express monetary values to two decimal places

Exemplar 2

Question 22   **Total: 4 marks**

A traditional plains tipi is built using a rectangular canvas that is twice as long as it is wide. The diagram below shows how a semicircle would be cut out of a canvas with dimensions of 30 ft. (length) and 15 ft. (width). (Diagram is not drawn to scale.)

15 ft.

30 ft.
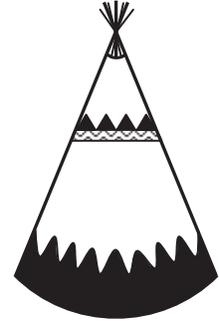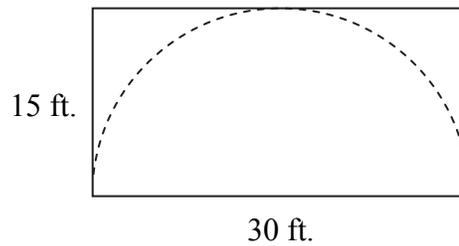
a)   Calculate how much canvas is left over after the semicircle has been cut out.

(2 marks)

Area   of   rectangle = $l \times w$

30 $\times$ 15   =   450 ft^2

Area   of   circle = πr^2

$\pi (15)^2 \div 2$ = 353.42

E5

450 - 353.42 = $\boxed{96.58 \text{ ft}^2}$

Exemplar 2 (continued)

b) You would like to construct a tipi with both dimensions three times greater than those for the tipi in (a). Given that canvas is only sold in a rectangular shape, how much will the canvas cost if the price of canvas is $7.39/ft^2, plus taxes? (Note: GST = 5%, PST = 8%)

(2 marks)

45 ft.

90 ft.
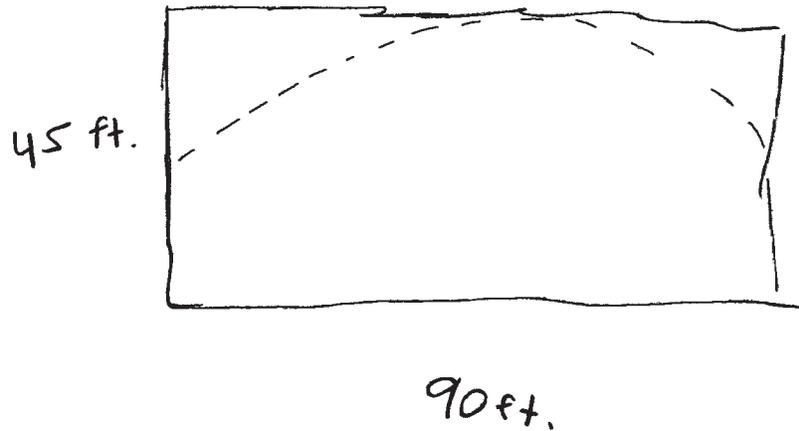
90 x 45 = 4050

4050/7.39

It will cost $548.03 ⟶ (E5)

---

3 marks:
❶ → 1 mark for appropriate work in (a)
❷ → 1 mark for consistent answer in (a)
❸ → 1 mark for correct area of larger canvas in (b)
....
(E5) → rounds incorrectly

Exemplar 1

Complete the truth table.

p	q	~q (not q)	p ⇒ ~q
True	True	F	F
True	False	T	T
False	True	T	T
False	False	F	T

1 mark:
❷ → 1 mark for consistent $p \Rightarrow \sim q$ column

Exemplar 1

Question 24   **Total: 4 marks**

There are 160 Grade 12 students attending a high school.

This semester, the science teacher noted that there are

- 30 students in Biology
- 54 students in Chemistry
- 43 students in Physics
- ~~11 students in both Biology and Physics~~
- ~~8 students in both Biology and Chemistry~~
- ~~9 students in both Chemistry and Physics~~
- ~~3 students taking all three courses~~

a) Use a Venn diagram to represent this situation.

(3 marks)

b) How many students are taking Biology or Chemistry?

(1 mark)

$$30 + 54 = 84$$

---

2 marks:
❷ → 1 mark for consistent number of students taking exactly one science course in (a)
❸ → 1 mark for consistent number of students taking no science courses in (a)

Exemplar 2

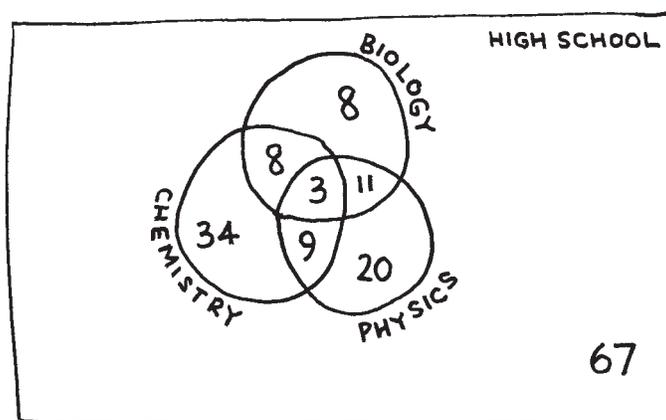**Question 24**   **Total: 4 marks**

There are 160 Grade 12 students attending a high school.

This semester, the science teacher noted that there are

- 30 students in Biology
- 54 students in Chemistry
- 43 students in Physics
- 11 students in both Biology and Physics
- 8 students in both Biology and Chemistry
- 9 students in both Chemistry and Physics
- 3 students taking all three courses

a)   Use a Venn diagram to represent this situation.
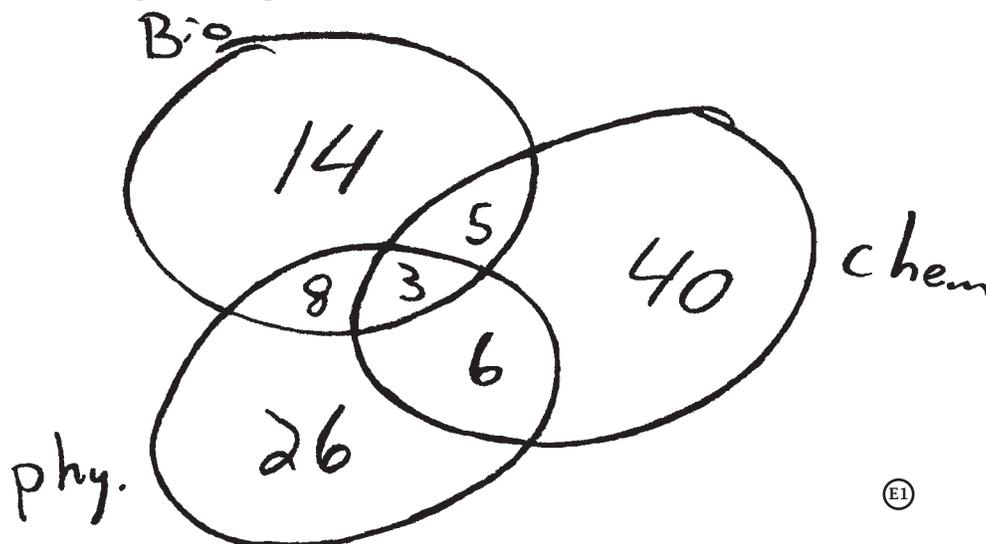
(3 marks)

b)   How many students are taking Biology or Chemistry?

(1 mark)

62

+---+
| **2 marks:** |
| ❶ → 1 mark for correctly calculating and placing the number |
| of students taking two or more science courses in (a) |
| ❷ → 1 mark for consistent number of students taking exactly |
| one science course in (a) |
| .... |
| Ⓔ¹ → does not include a box when using a Venn diagram |
+---+

Question 25   **Total: 2 marks**

Paula is trying to solve the following puzzle. Each 2 × 2 box must contain the digits 1 to 4 only once. As well, each column and each row must contain the digits 1 to 4 only once.

Paula indicates that the ★ must be a "4". Explain why she is incorrect and solve the puzzle.

★ could
either be a
4 or 3.

but ☐ has to
be the opposite

1	☐	★ ☐	2
3	2	1	4
2	✳	☐	1
4	1	2	3

Exemplar 2

Paula is trying to solve the following puzzle. Each 2 × 2 box must contain the digits 1 to 4 only once. As well, each column and each row must contain the digits 1 to 4 only once.

Paula indicates that the ★ must be a "4". Explain why she is incorrect and solve the puzzle.

1	4	★3	2
3	2	1	4
2	3	4	1
4	1	2	3

It must be a 3 because there is only 2 spots in the box. The 3 is over riding 1 spot leaving the other spot the only spot left for the 3 in that box. So the first must go in the other box

Appendices

Appendix A:
Table of Questions by Unit and Learning Outcome

Unit	Question	Type	Learning Outcome	Mark
A	1	SR	12A.R.2	1
A	2	SR	12A.R.3	1
A	3	CR	12A.R.3	4
A	4	CR	12A.R.1	3
A	5	CR	12A.R.2	6
				Total = 15
B	6	SR	12A.P.1	1
B	7	SR	12A.P.3	1
B	8	CR	12A.P.5	3
B	9	CR	12A.P.6	2
B	10	CR	12A.P.1	2
B	11	CR	12A.P.2	3
B	12	CR	12A.P.3	2
B	13	CR	12A.P.4	2
				Total = 16
C	14	SR	12A.FM.1	1
C	15	SR	12A.FM.2	1
C	16	SR	12A.FM.1	1
C	17	CR	12A.FM.2	2
C	18	CR	12A.FM.2	2
C	19	CR	12A.FM.2	4
C	20	CR	12A.FM.1, 12A.FM.3	6
				Total = 17
D	21	CR	12A.D.1	2
D	22	CR	12A.D.1	4
				Total = 6
E	23	CR	12A.L.3	2
E	24	CR	12A.L.2	4
E	25	CR	12A.L.1	2
				Total = 8

Legend for Units:

A: Relations and Functions
B: Probability
C: Financial Mathematics
D: Design and Measurement
E: Logical Reasoning

Legend for Question Types:

SR: Selected Response
CR: Constructed Response

Appendix B:
Irregularities in Provincial Tests

A Guide for Local Marking

During the marking of provincial tests, irregularities are occasionally encountered in test booklets. The following list provides examples of irregularities for which an *Irregular Test Booklet Report* 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 provincial 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.

Irregular Test Booklet Report

Test: _____

Date marked: _____

Booklet No.: _____

Problem(s) noted: _____

_____

_____

_____

_____

_____

Question(s) affected: _____

_____

_____

Action taken or rationale for assigning marks: _____

_____

_____

_____

_____

_____

_____

Follow-up: _____

_____

_____

_____

_____

_____

Decision: _____

_____

_____

_____

_____

_____

_____

Marker's Signature: _____

Principal's Signature: _____

For Department Use Only—After Marking Complete

Consultant: _____

Date: _____