Manitoba Education and Training Cataloguing in Publication Data

Grade 12 applied mathematics achievement test. Marking guide. January 2017

This resource is available in print and electronic formats.
ISBN: 978-0-7711-7438-4 (print)

1. Educational tests and measurements—Manitoba.
3. Mathematics—Examinations, questions, etc.
4. Mathematics—Study and teaching (Secondary)—Manitoba.
I. Manitoba. Manitoba Education and Training.
510.76

Manitoba Education and Training
School Programs Division
Winnipeg, Manitoba, Canada

All exemplars found in this resource are copyright protected and should not be extracted, accessed, or reproduced for any purpose other than for their intended educational use in this resource. Sincere thanks to the students who allowed their original material to be used.

Permission is hereby given to reproduce this resource for non-profit educational purposes provided the source is cited.

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 Training website at www.edu.gov.mb.ca/k12/assess/archives/index.html.
Websites are subject to change without notice.

Disponible en français.

While the department is committed to making its publications as accessible as possible, some parts of this document are not fully accessible at this time.
Available in alternate formats upon request.
Contents

General Marking Instructions ................................................................. 1

Marking Keys...................................................................................... 5

Exemplars .......................................................................................... 37

Appendices ......................................................................................... 85

Appendix A: Table of Questions by Unit and Learning Outcome .......... 87
Appendix B: Irregularities in Provincial Tests ....................................... 89

Irregular Test Booklet Report .............................................................. 91
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

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

Once marking is completed, please forward the Scoring Sheets to Manitoba Education and Training 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)

When a given response includes multiple types of communication errors, deductions are indicated in the order in which the errors occur in the response. No communication errors are recorded for work that has not been awarded marks. The total deduction may not exceed the marks awarded.
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).

\[
\begin{align*}
\text{Preliminary Mark} & - (\text{Number of error types} \times 0.5) = \text{Final Mark} \\
46 & - (2 \times 0.5) = 45
\end{align*}
\]

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 Training 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.

Allison Potter  
Assessment Consultant  
Grade 12 Applied Mathematics  
Telephone: 204-945-3411  
Toll-Free: 1-800-282-8069, ext. 3411  
Email: allison.potter@gov.mb.ca
Marking Keys

Please note that this *Marking Guide* contains screen captures taken from a TI–84 Plus graphing calculator.
Use the graph below to answer the following question and select the best answer.

The median of the graph is

A. 2
B. 3
C. 5
D. 8
Yang kicks a soccer ball off the ground. The height of the ball is tracked over time. The ball reaches a maximum height of 20 m at 2.1 seconds.

State the domain and range of the quadratic function that models the height of the soccer ball from when it is kicked until it hits the ground.

**Domain:**

\[ \{0 \leq x \leq 4.2\} \]

**OR**

\[ [0, 4.2] \]

**OR**

Time \( x \) is greater than or equal to 0 but less than or equal to 4.2 seconds.

**Range:**

\[ \{0 \leq y \leq 20\} \]

**OR**

\[ [0, 20] \]

**OR**

Height \( y \) is greater than or equal to 0 but less than or equal to 20 m.

*Other variables may be used.*

---

**Marking Key**

1. 1 mark for correct domain
2. 1 mark for correct range
Stephanie experiments with the frequency of waves in a ripple tank during her Physics class. At the beginning of the experiment, she places a ruler into the tank and measures the median height of the water to be 10 cm. The water then rises to a maximum height of 13 cm at 1 second.

a) Determine the sinusoidal regression equation that models the relationship between the height of the water and time. Show your work.

(2 marks)

<table>
<thead>
<tr>
<th>Time (s)</th>
<th>Height (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>10</td>
</tr>
<tr>
<td>1</td>
<td>13</td>
</tr>
<tr>
<td>2</td>
<td>10</td>
</tr>
<tr>
<td>3</td>
<td>7</td>
</tr>
<tr>
<td>4</td>
<td>10</td>
</tr>
</tbody>
</table>

\[ y = 3 \sin(1.57x) + 10 \]

b) Determine the height of the water at 15 seconds.

(1 mark)

CALC 1: value \( x = 15, y = 7 \)

The height is at 7 cm.

c) Stephanie changes the settings of the motor to generate waves more quickly. Write an equation that can model this change if all other conditions remain the same.

(1 mark)

\[ y = 3 \sin(2x) + 10 \]

Other answers are possible.

Marker Note(s):

An equation with a \( b \) value > 1.57 is appropriate, provided that \( a, c, \) and \( d \) values are constant.

<table>
<thead>
<tr>
<th>Marking Key</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 mark for appropriate work in (a)</td>
</tr>
<tr>
<td>1 mark for consistent answer in (a)</td>
</tr>
<tr>
<td>1 mark for consistent answer in (b)</td>
</tr>
<tr>
<td>1 mark for appropriate equation in (c)</td>
</tr>
</tbody>
</table>
The average price of an electronic device is based on its memory capacity. The following equation models this relationship:

\[ P = -24.22 + 15.15 \ln c \]

where \( P \) represents the average price in dollars and \( c \) represents the memory capacity in gigabytes (GB).

a) What is the average price of a 256 GB device?

(1 mark)

\[
\text{CALC I: value } x = 256, \ y = 59.79
\]

The average price of a 256 GB device is $59.79.

b) Provide one limitation of the equation that models this relationship.

(1 mark)

Storage capacity is finite.

OR

The price of a device cannot be negative.

OR

The equation will only model the price of electronic devices at a given time, as the price of technology changes frequently.

Other answers are possible.

Marking Key

1 mark for correct answer in (a)
1 mark for appropriate limitation in (b)
Pam drives her car over a nail. As a result, one of the tires on her car starts to lose air pressure. Her tire pressure sensor provides the following data:

<table>
<thead>
<tr>
<th>$t$ (h)</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>6</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>$P$ (psi)</td>
<td>40</td>
<td>32</td>
<td>26</td>
<td>21</td>
<td>10</td>
<td>5</td>
</tr>
</tbody>
</table>

where $P$ represents the air pressure (in psi) and $t$ represents the time (in hours).

a) Create a clearly labelled graph by plotting the given data. Draw a curve of best fit.

\[(3 \text{ marks})\]

b) Determine the regression equation that best models the data in this situation.

\[(1 \text{ mark})\]

\[P = 39.26(0.81)^t\]
c) The car becomes unsafe to drive when the tire pressure is 14 psi or under. How many hours can Pam safely drive her car after driving over the nail?

Express your final answer to the nearest hundredth (two decimal places). Show your work.

(2 marks)

CALC 5: intersect (4.876..., 14)

\[ t = 4.88 \]

Pam can drive safely for 4.88 hours.

**Marker Note(s):**

→ Award mark ❶ with an ❷ communication error for a correct graph with one incorrect data point.

→ Award mark ❷ for 4.89 hours; answer reflects the use of rounded values in (b).

**Marking Key**

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1 mark for communicating the context of the graph with appropriate title and/or labels in (a)</td>
</tr>
<tr>
<td>2</td>
<td>1 mark for using an appropriate domain and range (i.e., window settings/grid range) for the context of the question in (a)</td>
</tr>
<tr>
<td>3</td>
<td>1 mark for correctly plotting the data in (a)</td>
</tr>
<tr>
<td>4</td>
<td>1 mark for correct equation in (b)</td>
</tr>
<tr>
<td>5</td>
<td>1 mark for appropriate work in (c)</td>
</tr>
<tr>
<td>6</td>
<td>1 mark for consistent answer in (c)</td>
</tr>
</tbody>
</table>
## Probability

### Question 6

**Total: 1 mark**

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

*Select the best answer.*

Which of the following expressions represents the number of ways to create a 4-digit passcode for your phone using the digits 0 to 9, if repetition is allowed?

- **A.** \(10 \times 9 \times 8 \times 7\)
- **B.** \(10^4\)
- **C.** \(\binom{10}{4}\)
- **D.** \(10P_4\)

### Question 7

**Total: 1 mark**

**Learning Outcome:** 12A.P.6  
**Question Type:** Selected Response

*Select the best answer.*

Scott can choose from 8 toppings to make a pizza. How many pizzas can be made with 3 different toppings?

- **A.** 6
- **B.** 56
- **C.** 336
- **D.** 6720

---

**Student Error**

- **A:** no repetition
- **C:** order matters, no repetition
- **D:** no repetition

**Student Error**

- **A:** 3!
- **C:** \(8P_3\)
- **D:** \(\frac{8!}{3!}\)
Joseph has 20 cards; 4 cards of each of the following colours: red, blue, yellow, green, and purple.

a) What is the probability of randomly drawing 2 red cards in a row if the first card is replaced before drawing the second card?

\[ \text{(1 mark)} \]

**Independent:**

\[
P(A \text{ and } B) = P(A) \times P(B)
\]

\[
P(\text{red and red}) = P(\text{red}) \times P(\text{red})
\]

\[
= \frac{4}{20} \times \frac{4}{20}
\]

\[
= \frac{1}{5} \times \frac{1}{5}
\]

\[
= \frac{1}{25}
\]

The probability is \( \frac{1}{25} \), 0.04, or 4%.

b) What is the probability of randomly drawing 2 red cards in a row if the first card is not replaced before drawing the second card?

\[ \text{(1 mark)} \]

**Dependent:**

\[
P(A \text{ and } B) = P(A) \times P(B|A)
\]

\[
P(\text{red and red}) = P(\text{red}) \times P(\text{red}| \text{first card red})
\]

\[
= \frac{4}{20} \times \frac{3}{19}
\]

\[
= \frac{3}{95}
\]

The probability is \( \frac{3}{95} \), 0.03, or 3.16%.
c) Explain which part, (a) or (b), is an example of dependent events.

(1 mark)

Part (b) is an example of dependent events because there are fewer cards to choose from when the first card is not replaced.

*Other answers are possible.*
If 4 coins are tossed at the same time, what is the probability that they will land as either all heads or as all tails? Show your work.

\[
P = \left( \frac{1}{2} \times \frac{1}{2} \times \frac{1}{2} \times \frac{1}{2} \right) \times 2
\]

\[
= \frac{1}{8}
\]

The probability is \( \frac{1}{8} \), 0.13, or 12.50%.

**OR**

The probability is \( \frac{1}{8} \), 0.13, or 12.50%.

**Marking Key**

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1 mark for appropriate work</td>
</tr>
<tr>
<td>2</td>
<td>1 mark for consistent answer</td>
</tr>
</tbody>
</table>
Last year, it was reported that 50.30% of Mathmatica’s population was 40 years of age or older.

That same year, 65.74% of people 40 years of age or older saw a doctor and 60.09% of people younger than 40 years of age saw a doctor.

If Mathmatica’s population last year was 1 265 400, determine how many people in Mathmatica did not see a doctor. Show your work.

\[
P(\text{did not see doctor}) = (0.503 \ 0)(0.342 \ 6) + (0.497 \ 0)(0.399 \ 1) \\
= 0.370 \ 680 \ 5
\]

\[0.370 \ 680 \ 5 \times 1 \ 265 \ 400 = 469 \ 059.104 \ 7\]

Last year, 469 059 people did not see a doctor.

Marker Note(s):
→ Answer may vary depending on rounding but the probability must be expressed to a minimum of 2 decimal places (e.g., 0.37 or more precise).

<table>
<thead>
<tr>
<th>Marking Key</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 mark for appropriate work</td>
</tr>
<tr>
<td>2 mark for correct probability</td>
</tr>
<tr>
<td>3 mark for consistent total</td>
</tr>
</tbody>
</table>
The probability that Louise will go out for dinner tonight is 0.4. The probability that she will watch a movie is 0.7. The probability she will do neither is 0.2.

a) Draw a Venn diagram to represent this situation.

(1 mark)

\[ \begin{array}{ccc} \text{Dinner} & \cup & \text{Movie} \\ 0.1 & 0.3 & 0.4 \\ 0.2 \end{array} \]

b) Determine the probability that Louise does only one of these activities.

(1 mark)

\[ 0.1 + 0.4 = 0.5 \]

The probability that she does only one of these activities is 0.5.
A coach randomly selects 5 players from a team of 18 to line up for a shot on goal.

a) How many different 5-player arrangements are possible?

(1 mark)

\[ 18 \, P_5 = 1 \, 028 \, 160 \]

There are 1,028,160 possible arrangements.

b) If Dustin and Andrew are 2 of the 18 players, what is the probability that Dustin will shoot first and Andrew will shoot second? Show your work. Express your answer as a fraction or round to the nearest thousandth (three decimal places).

(2 marks)

\[ \frac{1}{18} \times \frac{1}{17} = \frac{1}{306} \]

\[ \frac{16 \times 15 \times 14}{1 \, 028 \, 160} = 0.003 \]

The probability is \( \frac{1}{306} \), 0.003, or 0.327%.

---

<table>
<thead>
<tr>
<th>Marking Key</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
</tr>
<tr>
<td>2</td>
</tr>
<tr>
<td>3</td>
</tr>
</tbody>
</table>
Which of the following graphs shows the total amount of interest paid over the course of a 25-year mortgage?

A.  

B.  

C.  

D.
According to the Rule of 72, a reasonable estimate for the time it would take to double an investment of $24 000.00 at an interest rate of 6.00%, compounded monthly is

A. 3 years  
B. 4 years  
C. 12 years  
D. 18 years
Imani is going to buy a car. She can afford monthly payments of $600.00. The dealer offers two financing options:

**Option 1:** financing over 60 months at a rate of 0.90% compounded monthly

**Option 2:** financing over 60 months at a rate of 2.90% compounded monthly with an instant rebate of $3000.00 at the time of purchase

Which option allows Imani to purchase a more expensive car? Show your work.

<table>
<thead>
<tr>
<th>Option 1</th>
<th>Option 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>N=60 (i=0.9) (%) (\Rightarrow PV=35189.11491) (\text{PMT}=-600) (FV=0) (P/Y=12) (C/Y=12) (PMT:END\text{ BEGIN})</td>
<td>N=60 (i=2.9) (%) (\Rightarrow PV=33474.1353) (\text{PMT}=-600) (FV=0) (P/Y=12) (C/Y=12) (PMT:END\text{ BEGIN})</td>
</tr>
<tr>
<td>$35 189.11</td>
<td>$33 474.14 + $3000.00</td>
</tr>
<tr>
<td></td>
<td>= $36 474.14</td>
</tr>
</tbody>
</table>

Option 2 allows Imani to purchase a more expensive car.

---

**Marking Key**

1. 1 mark for appropriate work
2. 1 mark for consistent loan amount for Option 1
3. 1 mark for consistent loan amount for Option 2
4. 1 mark for correct choice of option, including $3000.00 rebate
Your friend has $10 000.00 and is considering an investment in stocks, a guaranteed investment certificate (GIC), or rare collectibles.

Choose one of the three investments mentioned above and indicate one advantage and one disadvantage for your choice.

**Stocks:**
- Advantage: There is the potential for a higher rate of return in a shorter period of time.
- Disadvantage: Stocks are volatile, so there is a risk of principal loss.

**OR**

**GIC:**
- Advantage: It is a safe investment.
- Disadvantage: The interest rate is low.

**OR**

**Rare Collectibles:**
- Advantage: Objects are tangible and can be enjoyed.
- Disadvantage: It may be difficult to find a buyer willing to pay the perceived value of the object.

*Other answers are possible.*

---

**Marking Key**

<table>
<thead>
<tr>
<th></th>
<th>1 mark for appropriate advantage of investment choice</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1 mark for appropriate disadvantage of investment choice</td>
</tr>
</tbody>
</table>
Question 17

When she turned 25, Alexa began investing $400.00 monthly into a mutual fund account producing average returns of 6.00%, compounded monthly. Alexa will stop contributing when she retires at age 55.

a) How much money will her investment be worth at retirement? Show your work.

(2 marks)

Her investment will be worth $401 806.02 at retirement.

b) Alexa will withdraw $2500.00 per month from her account after retiring. If the average return rate stays the same, how old will she be when the account balance is zero? Show your work.

(2 marks)

She will be 82 years old when the account balance is zero.

Marking Key

1 mark for appropriate work in (a)
1 mark for consistent answer in (a)
1 mark for appropriate work in (b)
1 mark for consistent answer in (b)
THIS PAGE WAS INTENTIONALLY LEFT BLANK.
Shirley and Cameron have just moved to Brandon and are considering the two following housing options:

**Option 1: House for purchase**
- purchase price of $249,000.00
- down payment of $50,000.00 required
- 25-year mortgage at an interest rate of 3.00%, compounded semi-annually

**Option 2: Apartment for rent**
- monthly payments of $1300.00
- monthly parking fees of $60.00

a) What would be Shirley and Cameron’s monthly mortgage payment with Option 1? Show your work.

\[
\text{PMT} = -
\]

Shirley and Cameron’s monthly mortgage payment would be $941.76.
b) What will be the total amount paid for each option at the end of 10 years?

\[(2 \text{ marks})\]

Total amount paid for Option 1:
\[\left(\$941.76 \times 10 \times 12\right) + \$50\ 000.00 = \$163\ 011.20\]

Total amount paid for Option 2:
\[\left(\$1300.00 + \$60.00\right) \times 10 \times 12 = \$163\ 200.00\]

c) State one advantage of renting the apartment.

\[(1 \text{ mark})\]

They should rent because a down payment is not required.

\[\text{OR}\]

They should rent because it provides more freedom to move.

\textit{Other answers are possible.}

\begin{table}[h]
\centering
\begin{tabular}{|l|l|}
\hline
\textbf{Marking Key} & \\
\hline
1 & 1 mark for appropriate work in (a) \\
2 & 1 mark for consistent monthly mortgage payment in (a) \\
3 & 1 mark for consistent total amount paid for Option 1 in (b) \\
4 & 1 mark for consistent total amount paid for Option 2 in (b) \\
5 & 1 mark for appropriate advantage in (c) \\
\hline
\end{tabular}
\end{table}
Eleni is placing cups onto a 7 in. by 10 in. tray. Each cup has a circumference of 10 in.

Determine the maximum number of cups she can place on the tray. Show your work.

\[
2\pi r = 10 \text{ in.}
\]
\[
r = \frac{10}{2\pi} = 1.59 \text{ in.}
\]

Diameter of one cup = \(2 \times 1.59 = 3.18\) in.

Number of cups that can be placed length wise = \(\frac{10}{3.18} \div 3\)

Number of cups that can be placed width wise = \(\frac{7}{3.18} \div 2\)

Total number of cups that can be placed on the tray = \(3 \times 2 = 6\) cups

**Marker Note(s):**
→ If student finds the area of the tray and divides by the area of the cup, award a maximum of 1 mark.

**Marking Key**

1. 1 mark for correct diameter of one cup
2. 1 mark for consistent total number of cups
You want to build a garden.

- The garden is square.
- The side length is between 8 ft. and 10 ft.
- The garden is enclosed using boards stacked two boards high.
- There are 12 metal supports used to connect the structure.
- The garden is filled with soil to a depth of 15 in.

Below is the price list for materials:

<table>
<thead>
<tr>
<th>Item</th>
<th>Cost (plus GST and PST)</th>
</tr>
</thead>
<tbody>
<tr>
<td>metal supports</td>
<td>$2.00 each</td>
</tr>
<tr>
<td>boards</td>
<td>$2.50/linear foot</td>
</tr>
<tr>
<td>soil</td>
<td>$12.00/yard³</td>
</tr>
</tbody>
</table>

Determine the total cost of building your garden. All items must be purchased in whole units. Show your work. (Note: GST = 5%, PST = 8%)

Boards: $P = 8 \text{ ft.} \times 4 = 32 \text{ ft.}$ $V = 8 \text{ ft.} \times 8 \text{ ft.} \times 1.25 \text{ ft.} = 80 \text{ ft}^3$

$\therefore 32 \times 2 = 64 \text{ linear ft. needed}$ $\therefore 80 \text{ ft}^3 \div 27 \text{ yd}^3/\text{ft}^3 = 2.96 \text{ yd}^3 \approx 3 \text{ yd}^3$

Cost:

<table>
<thead>
<tr>
<th>Supports: 12 supports $\times$ $$2.00/support</th>
<th>$8 \text{ ft.}$</th>
<th>OR</th>
<th>$9 \text{ ft.}$</th>
<th>OR</th>
<th>$10 \text{ ft.}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$= $24.00$</td>
<td>$= $24.00$</td>
<td>$= $24.00$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Boards: __linear ft. $\times$ $$2.50$/linear ft.</td>
<td>$= $160.00$</td>
<td>$= $180.00$</td>
<td>$= $200.00$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Soil: __yd³ $\times$ $$12.00$/yd³</td>
<td>$= $36.00$</td>
<td>$= $48.00$</td>
<td>$= $60.00$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Subtotal</td>
<td>$= $220.00$</td>
<td>$= $252.00$</td>
<td>$= $284.00$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>GST</td>
<td>$= $11.00$</td>
<td>$= $12.60$</td>
<td>$= $14.20$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PST</td>
<td>$= $17.60$</td>
<td>$= $20.16$</td>
<td>$= $22.72$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>$= $248.60$</td>
<td>$= $284.76$</td>
<td>$= $320.92$</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Other answers are possible.

Marking Key

1. 1 mark for correct number of linear feet needed
2. 1 mark for correct volume of garden
3. 1 mark for consistent conversion to cubic yards
4. 1 mark for consistent total cost, including taxes
a) What is the volume of a rubber hockey puck? (Diagram is not drawn to scale.)

\[ V = \pi r^2 h \]
\[ = \pi (3.81 \text{ cm})^2 (2.54 \text{ cm}) \]
\[ = 115.83 \text{ cm}^3 \]

b) How many pucks can be produced for $1000.00 if it costs $0.24 to print a logo on each puck and rubber costs $0.0036 per cm\(^3\)?

Cost of one puck:
\[ (115.83 \text{ cm}^3 \times $0.0036 \text{ per cm}^3) + $0.24 = $0.6570 \]

Total number:
\[ \frac{$1000.00}{$0.6570} = 1522.07 \]

A total of 1522 pucks can be produced.

Marker Note(s):
→ Award marks 2 and 3 if the student rounds the unit price of the puck to $0.66 and obtains 1515 pucks as a final answer.

Marking Key

1. 1 mark for correct answer in (a)
2. 1 mark for correct unit cost of puck in (b)
3. 1 mark for consistent answer in (b)
Select the best answer.

Given the following pattern:

```
J | K
---
K | K
---
L | K
---
S | L
---
K | K
---
S | K
---
J | K
---
/ | K
```

Which of the following continues this pattern?

A. 
```
S | J
---
K | /
```

B. 
```
S | J
---
K | \
```

C. 
```
S | L
---
K | \
```

D. 
```
L | S
---
\ | K
```
You have 3 pails with volumes of 2 L, 3 L, and 5 L.

The 5 L pail is filled with water. The other pails are empty.

Using only these pails, explain how to measure out exactly 4 L of water into the 5 L pail.

- Fill the 3 L pail with water from the 5 L pail, leaving 2 L in the 5 L pail.
- Fill the 2 L pail with water from the 3 L pail, leaving 1 L in the 3 L pail.
- Pour 2 L of water from the 2 L pail into the 5 L pail to get 4 L of water.

*Other answers are possible.*

<table>
<thead>
<tr>
<th>Marking Key</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 mark for appropriate strategy</td>
</tr>
<tr>
<td>2 mark for correct answer</td>
</tr>
</tbody>
</table>
Consider the original statement:

“If students are in Grade 12, then they will graduate this June.”

a) Write the converse of the statement.

(1 mark)

“If students graduate this June, then they are in Grade 12.”

b) Determine if a biconditional statement is possible. If yes, write the biconditional statement. If not, provide a counterexample.

(1 mark)

No, a biconditional statement is not possible.

“Grade 12 students may not have enough credits to graduate.”

Other answers are possible.

Marking Key

<table>
<thead>
<tr>
<th>1</th>
<th>1 mark for correct answer in (a)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>1 mark for correct counterexample in (b)</td>
</tr>
</tbody>
</table>
Exemplars

Exemplars may contain screen captures taken from software or Internet pages.
Yang kicks a soccer ball off the ground. The height of the ball is tracked over time. The ball reaches a maximum height of 20 m at 2.1 seconds.

State the domain and range of the quadratic function that models the height of the soccer ball from when it is kicked until it hits the ground.

**Domain:** \( \mathbb{R} \)

**Range:** \( 0 \leq y \leq 20 \)
Yang kicks a soccer ball off the ground. The height of the ball is tracked over time. The ball reaches a maximum height of 20 m at 2.1 seconds.

State the domain and range of the quadratic function that models the height of the soccer ball from when it is kicked until it hits the ground.

**Domain:** 
$\left(0, 2.1\right)$

**Range:** 
$\left(0, 20\right)$
Exemplar 1

Question 3

Stephanie experiments with the frequency of waves in a ripple tank during her Physics class. At the beginning of the experiment, she places a ruler into the tank and measures the median height of the water to be 10 cm. The water then rises to a maximum height of 13 cm at 1 second.

a) Determine the sinusoidal regression equation that models the relationship between the height of the water and time. Show your work.

\[
y = a \sin(bx + c) + d
\]

\[
\begin{array}{c|c}
 x & y \\
 0 & 10 \\
 1 & 13 \\
 2 & 10 \\
 3 & 7 \\
 4 & 10 \\
 5 & 13 \\
\end{array}
\]

\[
y = 3 \sin(1.571x) + 10
\]

b) Determine the height of the water at 15 seconds.

\[
y = 3 \sin(1.571(15)) + 10
\]

\[
y = 11.20 \text{ cm}
\]

b) Determine the height of the water at 15 seconds.

\[
y = 3 \sin(1.571(15)) + 10
\]

\[
y = 11.20 \text{ cm}
\]

\[
\text{when } x = 15
\]

\[
y = 11.20 \text{ cm}
\]

c) Stephanie changes the settings of the motor to generate waves more quickly. Write an equation that can model this change if all other conditions remain the same.

\[
y = a \sin(bx + c) + d
\]

\[
y = 3 \sin(3x) + 10
\]

3 marks:

1 → 1 mark for appropriate work in (a)
2 → 1 mark for consistent answer in (a)
3 → 1 mark for appropriate equation in (c)
Stephanie experiments with the frequency of waves in a ripple tank during her Physics class. At the beginning of the experiment, she places a ruler into the tank and measures the median height of the water to be 10 cm. The water then rises to a maximum height of 13 cm at 1 second.

a) Determine the sinusoidal regression equation that models the relationship between the height of the water and time. Show your work.

(2 marks)

\[ y = 3 \sin(1x - 5) + 10 \]

b) Determine the height of the water at 15 seconds.

(1 mark)

\[ y = \text{height cm} \]

15 sec. height will be 8.37 cm

c) Stephanie changes the settings of the motor to generate waves more quickly. Write an equation that can model this change if all other conditions remain the same.

(1 mark)

\[ y = 3 \sin(2x - 5) + 10 \]
Exemplar 1

Question 4

The average price of an electronic device is based on its memory capacity. The following equation models this relationship:

\[ P = -24.22 + 15.15 \ln c \]

where \( P \) represents the average price in dollars and \( c \) represents the memory capacity in gigabytes (GB).

a) What is the average price of a 256 GB device?

(1 mark)

\[ \text{C} = 256 \]

\[ P = $59.79 \]

The average price of a 256 GB device will be $59.79

b) Provide one limitation of the equation that models this relationship.

(1 mark)

That the memory capacity in gigabytes cannot be less than 0.

2 marks:

1 → 1 mark for correct answer in (a)
2 → 1 mark for appropriate limitation in (b)
Exemplar 2

Question 4  

The average price of an electronic device is based on its memory capacity. The following equation models this relationship:

\[ P = -24.22 + 15.15 \ln c \]

where \( P \) represents the average price in dollars and \( c \) represents the memory capacity in gigabytes (GB).

a) What is the average price of a 256 GB device?

(1 mark)

\[ 2nd \rightarrow \text{Trace} \rightarrow \text{Intersect} \]

\[ x = 26.80 \]

b) Provide one limitation of the equation that models this relationship.

(1 mark)

\[ X \text{ cannot equal below 0} \]

1 mark:

- 1 mark for appropriate limitation in (b)
- does not use a contextual variable when stating the domain or the range in set notation
Exemplar 1

Question 5

Pam drives her car over a nail. As a result, one of the tires on her car starts to lose air pressure. Her tire pressure sensor provides the following data:

<table>
<thead>
<tr>
<th>$t$ (h)</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>6</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>$P$ (psi)</td>
<td>40</td>
<td>32</td>
<td>26</td>
<td>21</td>
<td>10</td>
<td>5</td>
</tr>
</tbody>
</table>

where $P$ represents the air pressure (in psi) and $t$ represents the time (in hours).

a) Create a clearly labelled graph by plotting the given data. Draw a curve of best fit.

(3 marks)

b) Determine the regression equation that best models the data in this situation.

(1 mark)

\[ 0.38x^2 + (-7.3x) + 39.42 \]
Exemplar 1 (continued)

c) The car becomes unsafe to drive when the tire pressure is 14 psi or under. How many hours can Pam safely drive her car after driving over the nail?

Express your final answer to the nearest hundredth (two decimal places). Show your work.

(2 marks)

5 marks:

1 → 1 mark for communicating the context of the graph with appropriate title and/or labels in (a)
2 → 1 mark for using an appropriate domain and range (i.e., window settings/grid range) for the context of the question in (a)
3 → 1 mark for correctly plotting the data in (a)
4 → 1 mark for appropriate work in (c)
5 → 1 mark for consistent answer in (c)
Pam drives her car over a nail. As a result, one of the tires on her car starts to lose air pressure. Her tire pressure sensor provides the following data:

<table>
<thead>
<tr>
<th>$t$ (h)</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>6</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>$P$ (psi)</td>
<td>40</td>
<td>32</td>
<td>26</td>
<td>21</td>
<td>10</td>
<td>5</td>
</tr>
</tbody>
</table>

where $P$ represents the air pressure (in psi) and $t$ represents the time (in hours).

a) Create a clearly labelled graph by plotting the given data. Draw a curve of best fit.

(3 marks)

b) Determine the regression equation that best models the data in this situation.

(1 mark)

$$y = -0.1015x^3 + 0.604x^2 + (-8.044)x + 40$$
Exemplar 2 (continued)

c) The car becomes unsafe to drive when the tire pressure is 14 psi or under. How many hours can Pam safely drive her car after driving over the nail?

Express your final answer to the nearest hundredth (two decimal places). Show your work.

(2 marks)

\[ \text{when } y = 14 \quad x = 4.69 \text{ hours} \]

Pam can safely drive her vehicle for 4.69 hrs

5 marks:

1. → 1 mark for communicating the context of the graph with appropriate title and/or labels in (a)
2. → 1 mark for using an appropriate domain and range (i.e., window settings/grid range) for the context of the question in (a)
3. → 1 mark for correctly plotting the data in (a)
4. → 1 mark for appropriate work in (c)
5. → 1 mark for consistent answer in (c)
6. → makes a transcription error (inaccurate transferring of information)
Exemplar 3

Question 5

Pam drives her car over a nail. As a result, one of the tires on her car starts to lose air pressure. Her tire pressure sensor provides the following data:

<table>
<thead>
<tr>
<th>$t$ (h)</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>6</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>$P$ (psi)</td>
<td>40</td>
<td>32</td>
<td>26</td>
<td>21</td>
<td>10</td>
<td>5</td>
</tr>
</tbody>
</table>

where $P$ represents the air pressure (in psi) and $t$ represents the time (in hours).

a) Create a clearly labelled graph by plotting the given data. Draw a curve of best fit.

(3 marks)

b) Determine the regression equation that best models the data in this situation.

(1 mark)

$y = 39.26 (0.81)^x$
Exemplar 3 (continued)

c) The car becomes unsafe to drive when the tire pressure is 14 psi or under. How many hours can Pam safely drive her car after driving over the nail?

Express your final answer to the nearest hundredth (two decimal places). Show your work.

(2 marks)

\[
\begin{align*}
y_1 &= 39.26 \times (0.81)^x \\
y_2 &= 14 \quad x = 4.88
\end{align*}
\]

Pam can safely drive for 4.88 hours.

6 marks:

① → 1 mark for communicating the context of the graph with appropriate title and/or labels in (a)
② → 1 mark for using an appropriate domain and range (i.e., window settings/grid range) for the context of the question in (a)
③ → 1 mark for correctly plotting the data in (a)
④ → 1 mark for correct equation in (b)
⑤ → 1 mark for appropriate work in (c)
⑥ → 1 mark for consistent answer in (c)
⑦ → makes a transcription error (inaccurate transferring of information)
Joseph has 20 cards; 4 cards of each of the following colours: red, blue, yellow, green, and purple.

a) What is the probability of randomly drawing 2 red cards in a row if the first card is replaced before drawing the second card?

\[
\frac{4}{20} \cdot \frac{3}{19} = \frac{12}{380} = \frac{6}{190} = \frac{3}{95}
\]

(1 mark)

b) What is the probability of randomly drawing 2 red cards in a row if the first card is not replaced before drawing the second card?

\[
\frac{4}{20} \cdot \frac{4}{19} = \frac{16}{400} = \frac{1}{25}
\]

(1 mark)
c) Explain which part, (a) or (b), is an example of dependent events.

(1 mark)

Part (a) is an example of dependent events because what card is picked next depends on what was chosen before.

2 marks:

2  →  1 mark for consistent answer in (b)
3  →  1 mark for appropriate explanation in (c)
Joseph has 20 cards; 4 cards of each of the following colours: red, blue, yellow, green, and purple.

a) What is the probability of randomly drawing 2 red cards in a row if the first card is replaced before drawing the second card? (1 mark)

\[
\frac{\binom{4}{1} \times 2}{\binom{20}{1}} = [0.4]
\]

b) What is the probability of randomly drawing 2 red cards in a row if the first card is not replaced before drawing the second card? (1 mark)

\[
\frac{\binom{4}{1} \times \binom{3}{1}}{\binom{20}{1} \times \binom{19}{1}} = [0.03]
\]
Exemplar 2 (continued)

c) Explain which part, (a) or (b), is an example of dependent events.

(1 mark)

Part (b) is an example of a dependant event because once the first card is taken out of the deck of cards it changes the probability of selecting a red card the next time you draw a card.

2 marks:

② → 1 mark for consistent answer in (b)
③ → 1 mark for appropriate explanation in (c)
Exemplar 1

Question 9

If 4 coins are tossed at the same time, what is the probability that they will land as either all heads or as all tails? Show your work.

\[
P_{\text{prob}} = \frac{1}{2} \times \frac{1}{2} \times \frac{1}{2} \times \frac{1}{2}
\]

\[
= \frac{1}{16} = 0.0625
\]

1 mark:

\[\Theta \rightarrow 1 \text{ mark for consistent answer} \]
Exemplar 2

Question 9  

If 4 coins are tossed at the same time, what is the probability that they will land as either all heads or as all tails? Show your work.

\[
\text{Case 1: All Heads} \quad \frac{1}{2} \cdot \frac{1}{2} \cdot \frac{1}{2} \cdot \frac{1}{2} = \frac{1}{16}
\]

\[
\frac{1}{16} + \frac{1}{16} = \frac{2}{16}
\]

\[
\text{Case 2: All Tails} \quad \frac{1}{2} \cdot \frac{1}{2} \cdot \frac{1}{2} \cdot \frac{1}{2} = \frac{1}{16}
\]

2 marks:

1 → 1 mark for appropriate work
2 → 1 mark for consistent answer
Exemplar 1

Question 10  

Last year, it was reported that 50.30% of Mathematica’s population was 40 years of age or older.

That same year, 65.74% of people 40 years of age or older saw a doctor and 60.09% of people younger than 40 years of age saw a doctor.

If Mathematica’s population last year was 1 265 400, determine how many people in Mathematica did not see a doctor. Show your work.

\[
\begin{align*}
\text{Population} & \quad 0.5030 \text{ age} \geq 40 \\
& \quad 0.497 \text{ age} < 40 \\
& \quad 0.6574 \text{ age} \geq 40 \text{ saw dr.} \\
& \quad 0.3426 \text{ age} < 40 \text{ saw dr.} \\
& \quad 0.6009 \text{ saw dr.} \\
& \quad 0.3991 \text{ did not see dr.} \\
\end{align*}
\]

\[
\begin{align*}
\geq 40 & \quad 1265400 \times 0.5030 = 636496.2 \geq 40 \\
& \quad 636496.2 \times 0.6574 = 418432.1609 \approx 418433 \geq 40 \text{ saw a dr.} \\
\leq 40 & \quad 1265400 \times 0.497 = 628903.8 \leq 40 \\
& \quad 628903.8 \times 0.6009 = 377908.2969 \approx 377909 \leq 40 \text{ saw dr.} \\
\text{Total # of people who did not see dr.} & \quad 1265400 - 418433 - 377909 = 469058 \text{ people did not see a doctor.}
\end{align*}
\]

3 marks:

1 → 1 mark for appropriate work
2 → 1 mark for correct probability
3 → 1 mark for consistent total
Last year, it was reported that 50.30% of Mathematica’s population was 40 years of age or older.

That same year, 65.74% of people 40 years of age or older saw a doctor and 60.09% of people younger than 40 years of age saw a doctor.

If Mathematica’s population last year was 1 265 400, determine how many people in Mathematica did not see a doctor. Show your work.

\[
\begin{align*}
49.7\% & \text{ of } 40 \rightarrow \text{ Doctor } 60.09\% \\
\text{No Doctor } & 39.91\% \\
50.30\% & \text{ of } 40+ \rightarrow \text{ Doctor } 65.74\% \\
\text{No Doctor } & 34.26\% \\
0.497(0.6009) & = 0.2986 \\
0.503(0.6574) & = 0.3307 \\
0.2986 + 0.3307 & = 0.6293 \times 100 = 62.93\% \text{ saw a doctor} \\
100 - 62.93 & = 37.07\% \text{ saw no doctors} \\
1265400(0.3707) & = 469084 \\
469084 & \text{ did not see a doctor}
\end{align*}
\]

**3 marks:**

1. 1 mark for appropriate work
2. 1 mark for correct probability
3. 1 mark for consistent total
Exemplar 1

The probability that Louise will go out for dinner tonight is 0.4. The probability that she will watch a movie is 0.7. The probability she will do neither is 0.2.

a) Draw a Venn diagram to represent this situation.

(1 mark)

b) Determine the probability that Louise does only one of these activities.

(1 mark)
Exemplar 2

Question 11

The probability that Louise will go out for dinner tonight is 0.4. The probability that she will watch a movie is 0.7. The probability she will do neither is 0.2.

a) Draw a Venn diagram to represent this situation.

(1 mark)

b) Determine the probability that Louise does only one of these activities.

(1 mark)

\[ P(M \cap \overline{D}) = \frac{2}{5} \]
Exemplar 1

Question 12  Total: 3 marks

A coach randomly selects 5 players from a team of 18 to line up for a shot on goal.

a) How many different 5-player arrangements are possible?

(1 mark)

\[ 18P_5 = 1038\text{,}160 \]

b) If Dustin and Andrew are 2 of the 18 players, what is the probability that Dustin will shoot first and Andrew will shoot second? Show your work. Express your answer as a fraction or round to the nearest thousandth (three decimal places).

(2 marks)

\[ \frac{1}{18} \times \frac{1}{17} = \frac{1}{306} \approx 0.0032 = 0.32\% \]

3 marks:
1 \rightarrow 1 mark for correct answer in (a)
2 \rightarrow 1 mark for appropriate work in (b)
3 \rightarrow 1 mark for consistent answer in (b)
5 \rightarrow rounds incorrectly
Exemplar 2

Question 12 Total: 3 marks

A coach randomly selects 5 players from a team of 18 to line up for a shot on goal.

a) How many different 5-player arrangements are possible?

(1 mark)

\[ \binom{18}{5} = 8568 \]

b) If Dustin and Andrew are 2 of the 18 players, what is the probability that Dustin will shoot first and Andrew will shoot second? Show your work. Express your answer as a fraction or round to the nearest thousandth (three decimal places).

(2 marks)

\[ \binom{2}{2} = 1 \]
\[ \binom{16}{3} = 560 \]
\[ 1 \times 560 = 560 \]
\[ \frac{560}{8568} = 0.0654 \]

2 marks:
- 1 mark for appropriate work in (b)
- 1 mark for consistent answer in (b)
Exemplar 1

Question 15  Total: 4 marks

Imani is going to buy a car. She can afford monthly payments of $600.00. The dealer offers two financing options:

**Option 1:** financing over 60 months at a rate of 0.90% compounded monthly

**Option 2:** financing over 60 months at a rate of 2.90% compounded monthly with an instant rebate of $3000.00 at the time of purchase

Which option allows Imani to purchase a more expensive car? Show your work.

**Option 1:**
- \( N = 5 \times 12 \)
- \( I = 0.90 \)
- \( PV = 0 \)
- \( PMT = 600 \)
- \( FV = 26808.17 \)
- \( PLY = 12 \)
- \( CLY = 12 \)

**Option 2:**
- \( N = 5 \times 12 \)
- \( I = 2.90 \)
- \( PV = 0 \)
- \( PMT = 600 \)
- \( FV = 38690.66 + 3000 \)
- \( PLY = 12 \)
- \( CLY = 12 \)

Option 2 will give you an expensive car.

3 marks:
- ① → 1 mark for consistent loan amount for Option 1
- ② → 1 mark for consistent loan amount for Option 2
- ③ → 1 mark for correct choice of option, including $3000.00 rebate
Imani is going to buy a car. She can afford monthly payments of $600.00. The dealer offers two financing options:

Option 1: financing over 60 months at a rate of 0.90% compounded monthly

Option 2: financing over 60 months at a rate of 2.90% compounded monthly with an instant rebate of $3000.00 at the time of purchase

Which option allows Imani to purchase a more expensive car? Show your work.

Option 1 lets him purchase a more expensive car

3 marks:
① → 1 mark for appropriate work
② → 1 mark for consistent loan amount for Option 1
③ → 1 mark for consistent loan amount for Option 2
④ → does not express monetary values to two decimal places
Exemplar 1

Question 16

Your friend has $10 000.00 and is considering an investment in stocks, a guaranteed investment certificate (GIC), or rare collectibles.

Choose one of the three investments mentioned above and indicate one advantage and one disadvantage for your choice.

If they choose stocks, it is a great way to make a lot of money. But to own a stock it takes up a lot of time and you can lose money very easily if your stocks aren't doing well.

1 mark:

2 → 1 mark for appropriate disadvantage of investment choice
Exemplar 2

Question 16  

Your friend has $10 000.00 and is considering an investment in stocks, a guaranteed investment certificate (GIC), or rare collectibles.

Choose one of the three investments mentioned above and indicate one advantage and one disadvantage for your choice.

I would choose a GIC because it is a secure investment however, interest rates can be quite expensive.

1 mark:  

→ 1 mark for appropriate advantage of investment choice
Question 17

When she turned 25, Alexa began investing $400.00 monthly into a mutual fund account producing average returns of 6.00%, compounded monthly. Alexa will stop contributing when she retires at age 55.

a) How much money will her investment be worth at retirement? Show your work.

\[ N = 372 \]
\[ T = 3 \]
\[ PV = 0 \]
\[ PMT = -400 \]
\[ FV = 433680.37 \]
\[ P/Y = 12 \]
\[ C/Y = 12 \]
\[ PMT: BEGIN \]

Her investment will be worth $433680.37

(2 marks)

b) Alexa will withdraw $2500.00 per month from her account after retiring. If the average return rate stays the same, how old will she be when the account balance is zero? Show your work.

\[ N = 124.75 \]
\[ I = 6 \]
\[ PV = 0 \]
\[ PMT = -2500 \]
\[ FV = 433680.37 \]
\[ P/Y = 12 \]
\[ C/Y = 12 \]
\[ PMT: BEGIN \]

She will be 65 years old

10.40 years

(2 marks)

2 marks:

\( \rightarrow \) 1 mark for consistent answer in (a)
\( \rightarrow \) 1 mark for consistent answer in (b)
Exemplar 2

Question 17

When she turned 25, Alexa began investing $400.00 monthly into a mutual fund account producing average returns of 6.00%, compounded monthly. Alexa will stop contributing when she retires at age 55.

a) How much money will her investment be worth at retirement? Show your work.

(2 marks)

\[
\begin{align*}
N &= 360 \\
I/10 &= 6 \\
pV &= 0 \\
pMT &= 400 \\
FV &= 401806.02 \\
p/y &= 12 \\
c/y &= 12
\end{align*}
\]

\$ 401806.02

b) Alexa will withdraw $2500.00 per month from her account after retiring. If the average return rate stays the same, how old will she be when the account balance is zero? Show your work.

(2 marks)

\[
\begin{align*}
N &= 118.2529 \div 12 = 9.85 \\
I/10 &= 6 \\
pV &= 0 \\
pMT &= -2500 \\
FV &= 401806.02 \\
p/y &= 12 \\
c/y &= 12
\end{align*}
\]

65 years

3 marks:

1 → 1 mark for appropriate work in (a)
2 → 1 mark for consistent answer in (a)
3 → 1 mark for consistent answer in (b)
Shirley and Cameron have just moved to Brandon and are considering the two following housing options:

**Option 1: House for purchase**
- purchase price of $249 000.00
- down payment of $50 000.00 required
- 25-year mortgage at an interest rate of 3.00%, compounded semi-annually

**Option 2: Apartment for rent**
- monthly payments of $1300.00
- monthly parking fees of $60.00

a) What would be Shirley and Cameron’s monthly mortgage payment with Option 1? Show your work.

(2 marks)

They will have monthly payments of $941.76

TVM
Exemplar 1 (continued)

b) What will be the total amount paid for each option at the end of 10 years?

(2 marks)

\[ 199000 - 136589.71 = 62411.79 \text{ for option 1} \]

Option 2: \( (1300 \times 12 \times 10) + (60 \times 12 \times 10) \)

\[ 156000 + 7200 = 163200 \text{. 00 after 10 years} \]

2 marks:
- 1 mark for consistent monthly mortgage payment in (a)
- 1 mark for consistent total amount paid for Option 2 in (b)

c) State one advantage of renting the apartment.

(1 mark)

"for the apartment you don't have to pay interest."
Exemplar 2

Question 18  

Shirley and Cameron have just moved to Brandon and are considering the two following housing options:

Option 1: House for purchase
- purchase price of $249 000.00
- down payment of $50 000.00 required
- 25-year mortgage at an interest rate of 3.00%, compounded semi-annually

Option 2: Apartment for rent
- monthly payments of $1300.00
- monthly parking fees of $60.00

a) What would be Shirley and Cameron’s monthly mortgage payment with Option 1? Show your work.

(2 marks)

\[
\begin{align*}
N &= 25 \\
I &= 3 \\
FV &= 249000 \\
P &= 50000 \\
\text{PMT} &= -3618.61 \\
\text{FV} &= 249000 \\
P/Y &= 12 \\
C/Y &= 2 \\
\text{monthly mortgage payments will be} \\
&= 3618.61 \text{ (dollars)}
\end{align*}
\]
b) What will be the total amount paid for each option at the end of 10 years?

\[\text{Option 1} = 3618.51 \times 50 = 180925.5 + 50000 = 230925.5\]

\[\text{Option 2} = 120 \times 1300 = 156000 + 60 \times 120 = 163200\]

(2 marks)

\[\ddagger \] 1 mark for consistent total amount paid for Option 2 in (b)

\[\ddagger \] does not include the dollar sign for monetary values

\[\ddagger \] does not express monetary values to two decimal places

---

c) State one advantage of renting the apartment.

(1 mark)

\[\text{You do not have to pay mortgage making it cheaper}\]
Exemplar 1

Question 19 Total: 2 marks

Eleni is placing cups onto a 7 in. by 10 in. tray. Each cup has a circumference of 10 in.

Determine the maximum number of cups she can place on the tray. Show your work.

\[ C = 2\pi r \]
\[ 10 = 2\pi r \]
\[ r = 1.59 \text{ in} \]

\[ A = \pi r^2 \]
\[ A = \pi (1.59)^2 \]
\[ A = 7.94 \text{ in}^2 \]

\[ \text{L \cdot w} = 10 \times 7 = 70 \]

\[ \frac{70}{7.94} = 8.8 \]

So 8 cups

1 mark:

[2] → 1 mark for consistent total number of cups
Eleni is placing cups onto a 7 in. by 10 in. tray. Each cup has a circumference of 10 in.

Determine the maximum number of cups she can place on the tray. Show your work.

\[ C = 2\pi r \]

\[ 10 = 2\pi r \]

\[ r = \frac{10}{2\pi} \]

\[ d = 2 \times r = 2 \times \frac{10}{2\pi} = \frac{10}{\pi} \text{ in.} \]

\[ 3 \times 2 = 6 \text{ cups} \]

You can fit 6 cups on the tray.

1 mark:

\[ \boxed{\theta \rightarrow 1 \text{ mark for consistent total number of cups}} \]
Exemplar 1

Question 20

You want to build a garden.

- The garden is square.
- The side length is between 8 ft. and 10 ft.
- The garden is enclosed using boards stacked two boards high.
- There are 12 metal supports used to connect the structure.
- The garden is filled with soil to a depth of 15 in.

Below is the price list for materials:

<table>
<thead>
<tr>
<th>Item</th>
<th>Cost (plus GST and PST)</th>
</tr>
</thead>
<tbody>
<tr>
<td>metal supports</td>
<td>$2.00 each</td>
</tr>
<tr>
<td>boards</td>
<td>$2.50/linear foot</td>
</tr>
<tr>
<td>soil</td>
<td>$12.00/yd³</td>
</tr>
</tbody>
</table>

Determine the total cost of building your garden. All items must be purchased in whole units.
Show your work. (Note: GST = 5%, PST = 8%)

\[
\text{TOTAL VOLUME: } L \times W \times H = \frac{15\text{ in} \times 1\text{ ft}}{12\text{ in}} = 1\text{.}25\text{ ft}
\]

\[
= 9\text{ ft} \times 9\text{ ft} \times 1\text{.25 ft} = 101.25\text{ ft}^3
\]

\[
1\text{ ft}^3 = 0.036\text{ yd}^3
\]

\[
101.25\text{ ft}^3 \times 0.036\text{ yd}^3 = 3.645\text{ yd}^3
\]

\[
\approx 4\text{ yd}^3
\]

\[
\text{SOIL: } 4\text{ yd}^3 \times $12.00 = $48.00
\]

\[
\text{BOARDS: } 9\text{ ft} \times 2.5\text{ ft} = 22.50\text{ sq ft} = 3 \times 7.50 \times 4 = $27.00
\]

\[
= 240\text{.00} + 12.5
\]

\[
= $282.50
\]

\[
\text{SUPPORTS: } 12 \times 2.00 = $24.00
\]

\[
\text{GST: } 354.50 \times 0.05 = $17.725
\]

\[
\text{PST: } 354.50 \times 0.08 = $28.36
\]

\[
\approx 400.59
\]

3 marks:

- 1 mark for correct volume of garden
- 1 mark for consistent conversion to cubic yards
- 1 mark for consistent total cost, including taxes
- makes a transcription error
You want to build a garden.

- The garden is square.
- The side length is between 8 ft. and 10 ft.
- The garden is enclosed using boards stacked two boards high.
- There are 12 metal supports used to connect the structure.
- The garden is filled with soil to a depth of 15 in.

Below is the price list for materials:

<table>
<thead>
<tr>
<th>Item</th>
<th>Cost (plus GST and PST)</th>
</tr>
</thead>
<tbody>
<tr>
<td>metal supports</td>
<td>$2.00 each</td>
</tr>
<tr>
<td>boards</td>
<td>$2.50/linear foot</td>
</tr>
<tr>
<td>soil</td>
<td>$12.00/yd³</td>
</tr>
</tbody>
</table>

Determine the total cost of building your garden. All items must be purchased in whole units. Show your work. (Note: GST = 5%, PST = 8%)

\[
\begin{align*}
\text{boards} & : 4 \times 2 = 8 \times 10 \\
& = \frac{80}{2.50} = 32 \\
\text{supports} & : 2 \times 12 = 24 \\
& = 32 + 24 = 56 \\
\text{Soil} & : \sqrt{whl} \\
& = (10)(10)(1.25) \\
& = 125 \text{ft}^3 \\
& = \frac{125}{81} \text{yd}^3 \\
& = 1.54 \text{yd}^3 \\
1 \text{yd}^3 & = 2.7 \text{ft}^3 \\
& = 80 \times 1.13 = 890.40
\end{align*}
\]

: The cost of building your garden is $890.40

2 marks:
1 → 1 mark for correct number of linear feet needed
2 → 1 mark for correct volume of garden
Exemplar 1

Question 21

Total: 3 marks

a) What is the volume of a rubber hockey puck? (Diagram is not drawn to scale.)

(1 mark)

\[ V = \pi r^2 h \]
\[ V = \pi (3.81)^2 (2.54) \]
\[ V \approx 115.83 \text{ cm}^3 \]

b) How many pucks can be produced for $1000.00 if it costs $0.24 to print a logo on each puck and rubber costs $0.0036 per cm\(^3\)?

(2 marks)

Cost of 1 puck
- Logo = $0.24
- Rubber: \$0.0036 (115.83) = $0.416988
  \[ \approx $0.42 \]

\$0.24 + $0.42 = \$0.66/puck

\[ \frac{\$1000.00}{\$0.66} = 1515.15 \]

\[ \therefore 1515 \text{ pucks can be produced for } \$1000.00 \]

3 marks:
1. 1 mark for correct answer in (a)
2. 1 mark for correct unit cost of puck in (b)
3. 1 mark for consistent answer in (b)
Exemplar 2

**Question 21**

<table>
<thead>
<tr>
<th></th>
<th>Total: 3 marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>a)</td>
<td>What is the volume of a rubber hockey puck? (Diagram is not drawn to scale.) (1 mark)</td>
</tr>
</tbody>
</table>

\[
\frac{7.62 \times \pi \div 2}{7.62 \times \pi \div 2} = 3.81
\]

\[
\text{Volume} = \pi r^2 h
= \pi (3.81^2)(2.54)
= 115.83 \text{ cm}^3
\]

b) How many pucks can be produced for $1000.00 if it costs $0.24 to print a logo on each puck and rubber costs $0.0036 per cm³? (2 marks)

\[
\frac{\$1000.00}{\$0.2436} = 4105.09
\]

\[
0.24 + 0.0036 = 0.2436
\]

\[4105.09 \text{ pucks can be made for } \$1000.00\]

2 marks:
1  →  1 mark for correct answer in (a)
2  →  1 mark for consistent answer in (b)
63  →  does not use whole units in contextual questions involving discrete data (e.g., people)
You have 3 pails with volumes of 2 L, 3 L, and 5 L.

The 5 L pail is filled with water. The other pails are empty.

Using only these pails, explain how to measure out exactly 4 L of water into the 5 L pail.

Take the 2L bucket and fill it up from the 5 L bucket, pour the 2L into the 3 L bucket. Then once again refill 2L bucket with water.

1 mark:
① → 1 mark for appropriate strategy
Exemplar 2

Question 23

You have 3 pails with volumes of 2 L, 3 L, and 5 L.

The 5 L pail is filled with water. The other pails are empty.

Using only these pails, explain how to measure out exactly 4 L of water into the 5 L pail.

To measure out exactly 4 L of water into the 5 L pail, do these steps:

1) Empty the 5 L that is filled with water in the 3 L pail and the 2 L pail (together they can hold 5 L of water).

2) Now the 5 L pail is empty.

3) Take the water that is in the 2 L pail and put it in the 5 L pail.

4) Now the 2 L pail is empty.

5) Fill the 2 L again with water from the 3 L pail.

6) Take the water that is in the 2 L pail and empty it into the 5 L pail.

7) Now there is exactly 4 L of water in the 5 L pail, 1 L of water in the 3 L pail, and 0 L in the 2 L pail.

2 marks:

1 → 1 mark for appropriate strategy
2 → 1 mark for correct answer
Consider the original statement:

“If students are in Grade 12, then they will graduate this June.”

a) Write the converse of the statement.

(1 mark)

If they will graduate in June, they are Grade 12 Students

b) Determine if a biconditional statement is possible. If yes, write the biconditional statement. If not, provide a counterexample.

(1 mark)

No

The grade 12 student could fail

1 mark:

θ → 1 mark for correct counterexample in (b)
Consider the original statement:

“If students are in Grade 12, then they will graduate this June.”

a) Write the converse of the statement.

(1 mark)

If students graduate this June, they are in Grade 12.

b) Determine if a biconditional statement is possible. If yes, write the biconditional statement. If not, provide a counterexample.

(1 mark)

Students graduate this June if, and only if, they are in Grade 12.
Appendices
### Appendix A:
**Table of Questions by Unit and Learning Outcome**

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

**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: _____________

______________________________________________________________________________

______________________________________________________________________________

______________________________________________________________________________

______________________________________________________________________________

______________________________________________________________________________

______________________________________________________________________________

______________________________________________________________________________