Grade 12
Applied Mathematics
Achievement Test

Marking Guide

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Winnipeg, Manitoba, Canada

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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.
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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.

Students are expected to round all final answers to two decimal places unless otherwise indicated in the question, or if the answer terminates to a whole number or one decimal place. More than two decimal places are acceptable if rounded correctly, except for monetary values or when the context of the question implies whole units be used (e.g., people, cans of paint).

**Errors**

Marks are deducted if conceptual or communication errors are committed. A 0.5 mark deduction will also apply each time a student makes one of the following errors:
- an arithmetic error
- a procedural error (not a conceptual error)
- a lack of clarity in the explanation, the description, or the justification

**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 is a 0.5 mark deduction for each type of communication error committed, with a maximum deduction of 3 marks from the total test mark. Each communication error can only be deducted once per test and committing a second error of the same type does not further affect a student’s mark.

1. **Final Answer**
   - does not include a percent sign
   - does not identify the answer (e.g., TVM solver, Venn diagram)
   - does not use the given contextual variables
   - incorrectly states the final answer

2. **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
   - does not change “y ~” to “y =” when writing an equation

3. **Transcription/Transposition**
   - makes a transcription error (inaccurate transferring of information)
   - makes a transposition error (changing order of digits)
   - inaccurately plots one point on a scatter plot

4. **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)

5. **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., cm² instead of cm³, or vice versa)
   - does not include units with labels on a graph

6. **Rounding**
   - rounds incorrectly
   - rounds too soon
   - does not express the answer to the appropriate number of decimal places, including monetary values to two decimal places

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 E6 errors (0.5 mark deduction).

<table>
<thead>
<tr>
<th>Final Answer</th>
<th>Notation</th>
<th>Transcription/Transposition</th>
<th>Whole Units</th>
<th>Units</th>
<th>Rounding</th>
</tr>
</thead>
</table>
| Communication Errors | Preliminary Mark \( - \) \( (\text{Number of error types} \times 0.5) \) = Final Mark

46 \( - \) \( (2 \times 0.5) \) = 45

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” 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.

Yongfei Wu
Assessment Consultant
Grade 12 Applied Mathematics
Telephone: 204-945-4035
Toll-Free: 1-800-282-8069, ext. 4035
Email: yongfei.wu@gov.mb.ca
Marking Keys

Please note that this *Marking Guide* contains screen captures taken from a TI–84 Plus graphing calculator.
A stadium field is shaped like a parabola so that rainwater runs off to the sides. The surface of the field can be modelled by the following function:

\[ y = -0.000234(x - 80)^2 + 1.5 \]

where \( x \) represents the distance from the left side of the field and \( y \) represents the height of the field.

What is the width of the field?

A) 0.75 ft.
B) 1.5 ft.
C) 80 ft.
D) 160 ft.
In an experiment, a water balloon is dropped from the roof of a school. The height of the water balloon from the ground is a function of time. The height is expressed in metres and the time is expressed in seconds. The domain of this function is $[0, 1.43]$.

Give one reason that explains why the domain is restricted.

The domain is restricted to 1.43 seconds because after 1.43 seconds, the water balloon hits the ground.

OR

The domain is restricted to beginning at 0 seconds because the equation does not model the height of the water balloon before it is dropped.

Other reasons are possible.

Marking Key

|   | 1 mark for appropriate reason |
Question 3  Total: 2 marks

Learning Outcome: 12.A.R.1  Question Type: Constructed Response

Taryn cooks a roast and records its internal temperature at specific times throughout the cooking process. Her findings are shown in the table below.

<table>
<thead>
<tr>
<th>Time (hours)</th>
<th>1</th>
<th>2</th>
<th>5</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature (°F)</td>
<td>70</td>
<td>120</td>
<td>150</td>
<td>175</td>
</tr>
</tbody>
</table>

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

(1 mark)

\[ y = 1.39x^3 - 21.11x^2 + 103.61x - 13.89 \]

b) The next time Taryn cooks a roast, she would like its internal temperature to be 160°F. Determine how long it will take the roast to reach this temperature.

(1 mark)

\[ Y_2 = 160 \]

CALC 5: intersect  (7.420..., 160)

\[ x = 7.42 \]

It will take 7.42 hours.

Marking Key

1 mark for correct answer in (a)
1 mark for consistent answer in (b)
Scientists have determined that when the weight of an adult electric eel is known, its length can be modelled using the following equation:

$$y = 22.4 \ln(x) - 28.7$$

where $x$ is the eel’s weight in pounds and $y$ is the length of the eel in inches.

a) Using the equation, determine the length of an eel that weighs 18 pounds.

(1 mark)

$$\text{CALC} 1: \text{value } x = 18, y = 36.04$$

The length of an eel that weighs 18 pounds is 36.04 inches.

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

(1 mark)

The weight of an eel cannot be infinite.

\text{OR}

The weight of an eel must be greater than or equal to 3.60 pounds because the length must be a positive number.

Other limitations are possible.

Marking Key

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>I mark for correct answer in (a)</td>
</tr>
<tr>
<td>2</td>
<td>I mark for appropriate limitation in (b)</td>
</tr>
</tbody>
</table>
A boat is propelled by a paddle wheel with a diameter of 14 feet. Each paddle takes 90 seconds to complete one revolution. The logo on one paddle reaches a maximum height of 11 feet above the water after the boat is in motion for 10 seconds.

a) Determine a possible sinusoidal equation that models the height of the logo over time. Show your work.

\[ y = 7 \sin(0.07x + 0.87) + 4 \]

Other equations are possible.

b) Determine how long the logo is underwater during one revolution. Show your work.

\[
\begin{align*}
\text{CALC} &\text{ 2: zero } (41.212\,476, 0) \\
\text{CALC} &\text{ 2: zero } (68.787\,524, 0)
\end{align*}
\]

68.787 524 – 41.212 476 = 27.575 048

The logo is underwater for 27.58 seconds.

**Marking Key**

1. 1 mark for appropriate work in (a)
2. 0.5 mark for two consistent values in (a)
3. 0.5 mark for remaining two consistent values in (a)
4. 1 mark for appropriate work in (b)
5. 1 mark for consistent answer in (b)
An Australian farmer records the rabbit population on his farm over the course of one year. The table below represents his data.

<table>
<thead>
<tr>
<th>Time (months)</th>
<th>1</th>
<th>4</th>
<th>7</th>
<th>9</th>
<th>11</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of rabbits</td>
<td>25</td>
<td>50</td>
<td>100</td>
<td>150</td>
<td>240</td>
</tr>
</tbody>
</table>

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

(3 marks)

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

(1 mark)

\[ y = 20.17(1.25)^x \]
c) Using your equation in (b), determine how long it will take for the rabbit population to reach 400.

(1 mark)

\[ Y_2 = 400 \]

CALC 5: intersect (13.265..., 400)

\[ x = 13.27 \]

It will take 13.27 months for the rabbit population to reach 400.

\[ OR \]

\[ y = 400 \]

click on intersection

\[ x = 13.27 \]

d) At a different farm, there are 300 rabbits at the beginning of the following year. This rabbit population increases, but less quickly than on the first farm. Write an exponential equation that models this situation.

(1 mark)

\[ y = 300(1.17)^x \]

Other equations are possible.

Marker Note(s):
→ In Desmos, if Log Mode is unchecked, \( a = 20.354 \) and \( b = 1.251 05 \).

<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>
<tr>
<td>4</td>
</tr>
<tr>
<td>5</td>
</tr>
<tr>
<td>6</td>
</tr>
<tr>
<td>7</td>
</tr>
</tbody>
</table>
THIS PAGE WAS INTENTIONALLY LEFT BLANK.
PROBABILITY

Question 7

Learning Outcome: 12.A.P.1

Select the best answer.

Cintra scores a goal on 11\% of the shots she takes.

Identify the odds against her scoring a goal.

A) 11:89
B) 89:11
C) 11:100
D) 89:100
Corbin wants to create an image of himself on his cellphone. There are 7 choices for hair colour, 3 choices for hair length, and 9 choices for a hat.

Using these options, how many different images in total can he create with or without a hat?
Show your work.

**Method A:**

with a hat: \( 7 \times 3 \times 9 = 189 \)

\( \text{colour} \quad \uparrow \quad \text{length} \quad \leftarrow \quad \text{hat} \)

without a hat: \( 7 \times 3 = 21 \)

\( \text{colour} \quad \uparrow \quad \text{length} \)

\( 189 + 21 = 210 \)

He can create 210 different images.

**Marking Key**

<table>
<thead>
<tr>
<th></th>
<th>1 mark for correct case with a hat</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>0.5 mark for correct case without a hat</td>
</tr>
<tr>
<td>3</td>
<td>0.5 mark for consistent sum of cases</td>
</tr>
</tbody>
</table>

**OR**

**Method B:**

\( 7 \times 3 \times 10 = 210 \)

\( \text{colour} \quad \uparrow \quad \text{length} \quad \leftarrow \quad \text{with or without a hat} \)

He can create 210 different images.

**Marking Key**

<table>
<thead>
<tr>
<th></th>
<th>1 mark for appropriate work</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>1 mark for consistent answer</td>
</tr>
</tbody>
</table>
There are 21 students in an applied math class. On a test, 10 students used an app, 14 students used a graphing calculator, and 4 students used both.

What is the probability that a randomly selected student used only an app on the test? Show your work.

The probability is \( \frac{6}{21} \), or 0.29, or 28.57%.

**Marking Key**

1. 1 mark for appropriate work
2. 1 mark for consistent answer
Pedro is walking from the train station to the convention centre and must withdraw money at the bank on his way. He can only walk south and east. How many different ways can he get to the convention centre? Show your work.

There are 40 different ways.

OR

ESSS    EESSS
\[
\frac{4!}{3!} \times \frac{5!}{3!2!} = 4 \times 10 = 40
\]

There are 40 different ways.

Marking Key

1 mark for appropriate work
1 mark for consistent answer
There are 5 biology books, 4 math books, and 7 history books randomly placed on a shelf.

a) Luis selects 2 books, one after the other. Determine the probability that both books are on the same subject. Show your work.

(3 marks)

\[
P(\text{2 same-subject books}) = P(\text{biology, biology}) + P(\text{math, math}) + P(\text{history, history})
= \left(\frac{5}{16} \times \frac{4}{15}\right) + \left(\frac{4}{16} \times \frac{3}{15}\right) + \left(\frac{7}{16} \times \frac{6}{15}\right)
= \frac{20}{240} + \frac{12}{240} + \frac{42}{240}
= \frac{74}{240}
\]

The probability is \(\frac{37}{120}\), 0.31, or 30.83%.

b) Are the events in (a) independent or dependent? Explain.

(1 mark)

The events in (a) are dependent because the books are not replaced. Therefore, the probability changes for the second selection of each book.

<table>
<thead>
<tr>
<th>Marking Key</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. 1 mark for correctly considering dependency in (a)</td>
</tr>
<tr>
<td>2. 1 mark for correctly multiplying the number of same-subject books in (a)</td>
</tr>
<tr>
<td>3. 1 mark for consistent sum in (a)</td>
</tr>
<tr>
<td>4. 1 mark for correct explanation in (b)</td>
</tr>
</tbody>
</table>
Question 12  
Total: 3 marks  
Question Type: Constructed Response

Construction work has slowed travel near Dauphin, Manitoba. Harry must drive through the construction zone to get to work. The probability that he will be delayed because of the construction is 45%. If he is delayed, the probability he will get to work on time is 70%. If he is not delayed, the probability he will get to work on time is 85%.

a) Use a graphic organizer to show all possible outcomes for this situation.

\[ P(\text{on time}) = 0.70 \]
\[ P(\text{not on time}) = 0.30 \]
\[ P(\text{delayed}) = 0.45 \]
\[ P(\text{not delayed}) = 0.55 \]

\[ P(\text{on time}) = 0.85 \]
\[ P(\text{not on time}) = 0.15 \]

\[ P(\text{on time}) = P(\text{delayed, on time}) + P(\text{not delayed, on time}) \]
\[ = 0.45(0.70) + 0.55(0.85) \]
\[ = 0.7825 \]

The probability is \( \frac{313}{400} \), 0.78, or 78.25%.

Marking Key

1. 1 mark for appropriate graphic organizer in (a)
2. 0.5 mark for \( P(\text{delayed, on time}) \) in (b)
3. 0.5 mark for \( P(\text{not delayed, on time}) \) in (b)
4. 1 mark for consistent sum in (b)
A group of friends is ordering a meal of 3 pizzas and 2 salads from a restaurant. The restaurant offers 6 types of pizzas and 4 types of salads.

If all pizzas and salads chosen must be different from one another, how many meal options do the friends have? Show your work.

\[
\binom{6}{3} \times \binom{4}{2} \\
= 20 \times 6 \\
= 120
\]

There are 120 meal options.

**Marker Note(s):**

→ Award a maximum of 1 mark if permutations are used instead of combinations.

**Marking Key**

<table>
<thead>
<tr>
<th></th>
<th>1 mark for appropriate work</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>1 mark for consistent answer</td>
</tr>
</tbody>
</table>
A dealership has 6 cars, 2 vans, and 4 trucks for sale.

a) An employee is asked to park all of these vehicles in a row. How many different ways can this be done if all of the cars must be together, all of the vans must be together, and all of the trucks must be together? Show your work.

(2 marks)

\[ 6!2!4!3! = 207360 \]

There are 207 360 different ways.

b) Diane visits the dealership and decides to buy one of the trucks. The price of this truck is $36 500.00, taxes included. She has $4000.00 for a down payment. The balance will be financed at an interest rate of 2.99%, compounded monthly, for 7 years. Calculate her monthly payment. Show your work.

(2 marks)

Her monthly payment is $429.29.
c) What is the total amount Diane will pay to buy the truck?

(1 mark)

Total amount = $429.29 \times 84 + $4000.00
= $36 060.36 + $4000.00
= $40 060.36

The total amount Diane will pay is $40 060.36.

Marker Note(s):
→ Award a maximum of 1 mark in (b) for one incorrect input value; award no marks for two or more incorrect input values.

<table>
<thead>
<tr>
<th>Marking Key</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 0.5 mark for 6!2!4! in (a)</td>
</tr>
<tr>
<td>2 0.5 mark for 3! in (a)</td>
</tr>
<tr>
<td>3 1 mark for correctly multiplying factorials in (a)</td>
</tr>
<tr>
<td>4 1 mark for appropriate work in (b)</td>
</tr>
<tr>
<td>5 1 mark for consistent answer in (b)</td>
</tr>
<tr>
<td>6 0.5 mark for consistent total monthly payments in (c)</td>
</tr>
<tr>
<td>7 0.5 mark for consistent total amount in (c)</td>
</tr>
</tbody>
</table>
Question 15

Learning Outcome: 12.A.FM.1

Select the best answer.

Renasha deposits $1200.00 into a savings account that earns simple interest at a rate of 1.72% annually.

What is the total value of Renasha’s account at the end of one year?

A) $20.64

B) $1220.64

C) $1447.68

D) $3264.00
Mr. Chen is moving to Manitoba and is looking for a place to live.

State two reasons why Mr. Chen would prefer renting a house instead of buying a similar house.

No down payment is needed.

OR

Mr. Chen would not be responsible for maintenance.

OR

If Mr. Chen needed to relocate, he would not need to sell the house.

Other reasons are possible.

**Marking Key**

<table>
<thead>
<tr>
<th></th>
<th>1 mark for one appropriate reason</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>1 mark for a second appropriate reason</td>
</tr>
</tbody>
</table>
Nadia hopes to save enough money over a 6-year period to go on a trip estimated to cost $11 600.00. To start saving, she deposits $1250.00 into an account that earns an interest rate of 4.21%, compounded monthly.

a) If she makes monthly payments of $110.00 into this account, how much money will she have at the end of the 6-year period? Show your work.

\[
\begin{align*}
N &= 72 \\
I &= 4.21 \\
P &= 1250 \\
F &= 110 \\
PMT &= 10660.77948 \\
P &= 12 \\
C &= 12 \\
PMT &= \text{BEGIN}
\end{align*}
\]

She will have $10 600.78 at the end of the 6-year period.

b) What is the minimum number of additional monthly payments Nadia needs to make in order to save enough money for the trip?

\[
78.72 - 72 = 6.72
\]

Nadia needs to make a minimum of 7 additional monthly payments.

Marker Note(s):
→ Award a maximum of 1 mark in (a) for one incorrect input value; award no marks for two or more incorrect input values.

<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>
<tr>
<td>4</td>
</tr>
</tbody>
</table>
Marshall and Kim are renting a house that they hope to purchase. They pay $1800.00 in annual
heating costs and know that the annual property taxes are $2500.00. Their combined gross
income is $5200.00 per month.

**a)** Based on the gross debt service ratio (GDSR), what is the maximum monthly mortgage
payment they can afford? Show your work.

\[
0.32 = \frac{\left( \text{monthly mortgage payment} + \frac{2500.00}{12} + \frac{1800.00}{12} \right)}{5200.00}
\]

\[
0.32 = \frac{\left( \text{monthly mortgage payment} + 208.33 + 150.00 \right)}{5200.00}
\]

\[
1664.00 = \text{monthly mortgage payment} + 358.33
\]

\[
1305.67 = \text{monthly mortgage payment}
\]

The maximum monthly mortgage payment they can afford is $1305.67.

**b)** If they have saved $30 000.00 for a down payment, what is the maximum house price they
can afford based on a 25-year amortization period at an interest rate of 4.64%, compounded
semi-annually? Show your work.

\[
\begin{align*}
N &= 300 \\
I &= 4.64 \\
P &= 250022.61 \\
PMT &= -1305.67 \\
FV &= 0 \\
P/V &= 12 \\
C/V &= 2 \\
PMT: &\text{END BEGIN}
\end{align*}
\]

\[
232 \, 622.61 + 30 \, 000.00
\]

\[
= 262 \, 622.61
\]

The maximum house price they can afford is $262 622.61.

**Marker Note(s):**

→ Award a maximum of 1 mark in (b) for one incorrect input value; award no marks for two or
more incorrect input values.

**Marking Key**

- 0.5 mark for correctly converting annual costs to monthly costs in (a)
- 0.5 mark for correct substitution into formula in (a)
- 1 mark for consistent answer in (a)
- 1 mark for consistent value of mortgage in (b)
- 1 mark for consistent maximum house price in (b)
Amor and Angélique each want to retire at age 65. They start investing in tax-free savings accounts (TFSA) at different ages in their lives.

- At age 28, Amor starts investing $240.00 per month into a TFSA that earns an interest rate of 2.95%, compounded monthly.
- At age 42, Angélique makes an initial deposit of $5000.00 and starts investing $350.00 per month into a TFSA that earns an interest rate of 3.50%, compounded monthly.

a) What is the value of each of their TFSAs at age 65? Show your work.

(4 marks)

\[
\begin{align*}
\text{Amor} & : N=444,\ IS=2.95,\ PV=0,\ FMT=240,\ P/Y=12,\ C/Y=12,\ \text{BEGIN} \\
\text{Angélique} & : N=276,\ IS=3.5,\ PV=5000,\ FMT=350,\ P/Y=12,\ C/Y=12,\ \text{BEGIN}
\end{align*}
\]

The value of Amor’s TFSA is $192,789.31 while Angélique’s is $159,259.67.

b) Explain why a small long-term investment may be worth more than a large short-term investment.

(1 mark)

A small long-term investment may earn more interest compared to a large short-term investment.

Marker Note(s):
→ For each TFSA value, award a maximum of 1 mark in (a) for one incorrect input value; award no marks for two or more incorrect input values.

<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>
<tr>
<td>4</td>
</tr>
<tr>
<td>5</td>
</tr>
</tbody>
</table>
DESIGN AND MEASUREMENT

Question 20

Learning Outcome: 12.A.D.1

Total: 1 mark

Select the best answer.

A wheelbarrow is able to transport 6 cubic feet of soil per load.

What is the minimum number of loads required to fill the following garden with soil?

![Diagram of a garden with dimensions 14 ft. by 4 ft. by 1.5 ft.]

A) 3
B) 5
C) 14
D) 504

Student Error

A: \( \frac{84}{6^2} \)
B: \( \frac{84}{14 + 4} \)
D: \( 84 \times 6 \)
Question 21

You are in charge of purchasing enough sports drink for the participants of a 5-kilometre race. There are 300 participants and you assume they will each drink the equivalent of 2 cups of sports drink. The cups are cone shaped with the following dimensions:

\[
\text{Volume of one cup} = \frac{\pi r^2 h}{3} = \frac{\pi (4)^2 (7)}{3} = 117.286\ldots \text{ cm}^3
\]

Total volume = \(117.286\ldots \text{ cm}^3 \times 600\) cups = 70 371.68 cm³

A volume of 70 371.68 cm³ must be purchased.

b) Each container of sports drink costs $5.00 and contains 8 L (1 L = 1000 cm³) of drink. How much will you spend on sports drink, before taxes?

Possible solution:

\[
\frac{70 371.68 \text{ cm}^3}{1000 \text{ cm}^3/L} = 70.371 68 \text{ L}
\]

\[
\frac{70.371 68 \text{ L}}{8 \text{ L}} = 8.80 \therefore 9 \text{ containers}
\]

9 containers \(\times\) $5.00 = $45.00

You will spend $45.00 on sports drink.

Marking Key

- 1 mark for correct volume of one cup in (a)
- 1 mark for consistent total volume in (a)
- 0.5 mark for consistent number of containers in (b)
- 0.5 mark for consistent total cost in (b)
You are to design a bedroom. The bedroom design must satisfy the following conditions:

- The bedroom must be rectangular.
- The bedroom must include one dresser, one desk, and one bed chosen from the furniture options below.

<table>
<thead>
<tr>
<th>Furniture Options</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Dresser</strong></td>
</tr>
<tr>
<td>Tall</td>
</tr>
<tr>
<td>1.5 × 4</td>
</tr>
<tr>
<td><strong>Dimensions (ft.)</strong> (width × length)</td>
</tr>
<tr>
<td>1.5 × 4</td>
</tr>
<tr>
<td>6</td>
</tr>
<tr>
<td>559.00</td>
</tr>
</tbody>
</table>

(a) Draw or describe the bedroom design, including dimensions, where

- one of the dimensions of the bedroom floor must be at least 10 feet
- the area of the bedroom must be between double and triple the area occupied by the total of all the furniture

(2 marks)

**Sample Design 1:** (minimum)

Tall dresser: 6 ft²
Small desk: 8 ft²
Queen bed: 24 ft²
\[ \text{Area of furniture: } 38 \text{ ft}^2 \]

\[ \text{Area of bedroom: } 38 \text{ ft}^2 \times 2 = 76 \text{ ft}^2 \]

Dimensions: 10 ft. × 7.6 ft.

**Sample Design 2:** (maximum)

Wide dresser: 9 ft²
Large desk: 12 ft²
King bed: 30 ft²
\[ \text{Area of furniture: } 51 \text{ ft}^2 \]

\[ \text{Area of bedroom: } 51 \text{ ft}^2 \times 3 = 153 \text{ ft}^2 \]

Dimensions: 15.3 ft. × 10 ft.

Other answers are possible.
b) You must also install flooring in the bedroom. Flooring must be purchased in whole units. You can buy carpet or hardwood.

- You must include an additional 10% to the area for installation and waste.
- The carpet costs $14.40 per yd².
- The hardwood costs $19.80 per yd².

Calculate the cost of the flooring before taxes.

(2 marks)

Sample Design 1: (minimum)  
Area of bedroom: \( \frac{76 \text{ ft}^2}{9 \text{ ft}^2/\text{yd}^2} = 8.44 \text{ yd}^2 \)

\[ 8.44 \text{ yd}^2 \times 1.1 = 9.28 \text{ yd}^2 : 10 \text{ yd}^2 \]

\[ 10 \text{ yd}^2 \times $14.40/\text{yd}^2 = $144.00 \]

Sample Design 2: (maximum)  
Area of bedroom: \( \frac{153 \text{ ft}^2}{9 \text{ ft}^2/\text{yd}^2} = 17 \text{ yd}^2 \)

\[ 17 \text{ yd}^2 \times 1.1 = 18.70 \text{ yd}^2 : 19 \text{ yd}^2 \]

\[ 19 \text{ yd}^2 \times $19.80/\text{yd}^2 = $376.20 \]

Other answers are possible.

c) Calculate the total cost of the furniture and the flooring, plus GST and PST.
(Note: GST = 5%, PST = 8%)

(1 mark)

Sample Design 1: (minimum)  
Cost of furniture:
- Dresser $559.00
- Desk $379.00
- Bed $1669.00
Subtotal $2607.00

Cost of flooring: $144.00
Subtotal $2751.00

GST $137.55
PST $220.08
Total $3108.63

Sample Design 2: (maximum)  
Cost of furniture:
- Dresser $729.00
- Desk $449.00
- Bed $1779.00
Subtotal $2957.00

Cost of flooring: $376.20
Subtotal $3333.20

GST $166.66
PST $266.66
Total $3766.52

Other answers are possible.

Marking Key

<table>
<thead>
<tr>
<th></th>
<th>0.5 mark for including one dresser, one desk, and one bed in (a)</th>
<th>1 mark for total surface area of bedroom with an appropriate width and size in (a)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.5 mark for appropriate dimensions of bedroom in (a)</td>
<td>1 mark for correct conversion to yd² in (b)</td>
</tr>
<tr>
<td>2</td>
<td>1 mark for consistent cost of flooring before taxes in (b)</td>
<td>0.5 mark for correct cost of furniture before taxes in (c)</td>
</tr>
<tr>
<td>3</td>
<td>0.5 mark for consistent total cost of bedroom, including cost of flooring and taxes in (c)</td>
<td>1 mark for consistent cost of flooring before taxes in (b)</td>
</tr>
</tbody>
</table>

OR

Marking Key

<table>
<thead>
<tr>
<th></th>
<th>0.5 mark for including one dresser, one desk, and one bed in (a)</th>
<th>1 mark for total surface area of bedroom with an appropriate width and size in (a)</th>
</tr>
</thead>
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<td>1</td>
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<tr>
<td>2</td>
<td>1 mark for consistent cost of flooring before taxes in (b)</td>
<td>0.5 mark for correct cost of furniture before taxes in (c)</td>
</tr>
<tr>
<td>3</td>
<td>0.5 mark for consistent total cost of bedroom, including cost of flooring and taxes in (c)</td>
<td>1 mark for consistent cost of flooring before taxes in (b)</td>
</tr>
</tbody>
</table>

OR
**LOGICAL REASONING**

**Question 23**

**Learning Outcome:** 12.A.L.3  
**Question Type:** Constructed Response  
**Total:** 2 marks

a) Create a true conditional statement using two of the statements given below.

- the number is positive
- the number is negative
- the number is less than zero
- the number is prime
- the number is odd
- the number is even
- the number is 5

(1 mark)

If the number is negative, then the number is less than zero.

**OR**

If the number is 5, then the number is odd.

**OR**

If the number is not positive, then the number is not prime.

**Other statements are possible.**

b) Write the inverse of the statement created in (a).

(1 mark)

If the number is not negative, then the number is not less than zero.

**OR**

If the number is not 5, then the number is not odd.

**OR**

If the number is positive, then the number is prime.

**Other statements are possible.**

**Marking Key**

1 mark for appropriate true conditional statement in (a)

1 mark for consistent inverse in (b)
The universal set \( B \) represents the breakfast items in Pierre’s backpack:

\[
B = \{ \text{apple, yogurt, granola bar} \}
\]

Pierre must choose at least one item to eat for breakfast.

Write all of Pierre’s breakfast options as subsets.

\[
\{ \text{apple} \} \\
\{ \text{yogurt} \} \\
\{ \text{granola bar} \} \\
\{ \text{apple, yogurt} \} \\
\{ \text{apple, granola bar} \} \\
\{ \text{yogurt, granola bar} \} \\
\{ \text{apple, yogurt, granola bar} \}
\]

Marker Note(s):
→ Award a maximum of 1.5 marks if more than seven subsets are included.

<table>
<thead>
<tr>
<th>Marking Key</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 0.5 mark for correctly identifying 4 subsets</td>
</tr>
<tr>
<td>2 0.5 mark for correctly identifying 5th subset</td>
</tr>
<tr>
<td>3 0.5 mark for correctly identifying 6th subset</td>
</tr>
<tr>
<td>4 0.5 mark for correctly identifying 7th subset</td>
</tr>
</tbody>
</table>
Students attend a field trip to the Canadian Museum of Human Rights. They have the option of visiting Gallery A, Gallery B, Gallery C, or any combination of these.

Their visits can be represented by the Venn diagram below.

Shade the Venn diagram to illustrate the students who visited either Gallery B or Gallery C ($B \cup C$).

Marking Key

| 1 | 1 mark for correct answer |
A magic square is an array that has the same sum in each row, column, and diagonal. This sum is called the magic number.

\[
\begin{array}{cccc}
7 & 20 & 11 & 12 \\
14 & 8 & 23 & 15 \\
20 & 6 & 13 & 11 \\
9 & 16 & 3 & 22 \\
\end{array}
\]

a) Determine the number in the array above that prevents it from being a magic square.

(1 mark)

The number in the array above that prevents it from being a magic square is 15.

b) What number should replace the number found in (a) to make the array a magic square?

(1 mark)

The number 5 should replace the number found in (a).

c) What is the magic number of the resulting magic square?

(1 mark)

The magic number of the resulting magic square is 50.

---

**Marking Key**

1. 1 mark for correct answer in (a)
2. 1 mark for correct answer in (b)
3. 1 mark for correct answer in (c)
Exemplars

Exemplars may contain screen captures taken from software or Internet pages.
Exemplar 1

Question 2

In an experiment, a water balloon is dropped from the roof of a school. The height of the water balloon from the ground is a function of time. The height is expressed in metres and the time is expressed in seconds. The domain of this function is \([0, 1.43]\).

Give one reason that explains why the domain is restricted.

the max is at the height of the roof, the balloon will not go into the ground so there is a restriction on the negative.

0 marks: no criteria met
Exemplar 2

Question 2

In an experiment, a water balloon is dropped from the roof of a school. The height of the water balloon from the ground is a function of time. The height is expressed in metres and the time is expressed in seconds. The domain of this function is $[0, 1.43]$.

Give one reason that explains why the domain is restricted.

\[
\begin{cases}
\text{both the height and the time can't be} \\
\text{less than zero.}
\end{cases}
\]

0.5 mark:

\[\begin{align*}
1 & \rightarrow 1 \text{ mark for appropriate reason} \\
4 & \rightarrow 0.5 \text{ mark deduction for lack of clarity}
\end{align*}\]
Exemplar 1

Question 3

Taryn cooks a roast and records its internal temperature at specific times throughout the cooking process. Her findings are shown in the table below.

<table>
<thead>
<tr>
<th>Time (hours)</th>
<th>1</th>
<th>2</th>
<th>5</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature (°F)</td>
<td>70</td>
<td>120</td>
<td>150</td>
<td>175</td>
</tr>
</tbody>
</table>

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

*(1 mark)*

\[ y = (2.05)x^3 + 31.74 + 49.85 \]

b) The next time Taryn cooks a roast, she would like its internal temperature to be 160°F. Determine how long it will take the roast to reach this temperature.

*(1 mark)*

5.2 hours

1 mark:

- 2 → 1 mark for consistent answer in (b)
- 1a → does not express the answer to the appropriate number of decimal places
Taryn cooks a roast and records its internal temperature at specific times throughout the cooking process. Her findings are shown in the table below.

<table>
<thead>
<tr>
<th>Time (hours)</th>
<th>1</th>
<th>2</th>
<th>5</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature (°F)</td>
<td>70</td>
<td>120</td>
<td>150</td>
<td>175</td>
</tr>
</tbody>
</table>

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

\[ y = ax^3 + bx^2 + cx + d \]

\[ a = 1.39 \]
\[ b = -2.12 \]
\[ c = 102.61 \]
\[ d = -13.9 \]

\[ y = 1.39x^3 - 2.12x^2 + 102.61x - 13.9 \]

(1 mark)

b) The next time Taryn cooks a roast, she would like its internal temperature to be 160°F. Determine how long it will take the roast to reach this temperature.

(1 mark)

It will take 5

1 mark:

1 → 1 mark for correct answer in (a)

2 → does not include one of the following in the equation: “\( y = \)”, “sin”, “ln”, or “\( x \)”, or writes parameters separately from the equation

3 → does not express the answer to the appropriate number of decimal places
Scientists have determined that when the weight of an adult electric eel is known, its length can be modelled using the following equation:

\[ y = 22.4 \ln(x) - 28.7 \]

where \(x\) is the eel’s weight in pounds and \(y\) is the length of the eel in inches.

a) Using the equation, determine the length of an eel that weighs 18 pounds.

\[ \begin{align*} 
  x &= 18 \\
  y &= 36.04 \\
\end{align*} \]

The eel is 36.04 inches long.

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

The eel cannot grow forever; it will die or reach its maximum size, and eel cannot be negative pounds.

2 marks:

- 1 mark for correct answer in (a)
- 1 mark for appropriate limitation in (b)

- 0 mark → does not express the answer to the appropriate number of decimal places
Exemplar 2

Question 4

Scientists have determined that when the weight of an adult electric eel is known, its length can be modelled using the following equation:

\[ y = 22.4 \ln(x) - 28.7 \]

where \( x \) is the eel’s weight in pounds and \( y \) is the length of the eel in inches.

a) Using the equation, determine the length of an eel that weighs 18 pounds.

\[ y = 22.4 \ln(18) - 28.7 \]
\[ y = 36.07 \text{ inches} \]

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

\[ \text{if the eel is less than a pound then the equation would not work} \]

\[ \text{ex: } y = 22.4 \ln(0.5) - 28.7 \]
\[ y = -41.23 \text{ in} \]

2 marks:
1 → 1 mark for correct answer in (a)
2 → 1 mark for appropriate limitation in (b)
3 → makes a transcription error (inaccurate transferring of information)
Exemplar 1

Question 5

A boat is propelled by a paddle wheel with a diameter of 14 feet. Each paddle takes 90 seconds to complete one revolution. The logo on one paddle reaches a maximum height of 11 feet above the water after the boat is in motion for 10 seconds.

a) Determine a possible sinusoidal equation that models the height of the logo over time. Show your work.

<table>
<thead>
<tr>
<th>Time (s)</th>
<th>Height (ft.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>-3</td>
</tr>
<tr>
<td>22.5</td>
<td>4</td>
</tr>
<tr>
<td>45</td>
<td>11</td>
</tr>
<tr>
<td>67.5</td>
<td>4</td>
</tr>
<tr>
<td>90</td>
<td>-3</td>
</tr>
</tbody>
</table>

\[ y = 7 \sin (0.07x - 1.57) + 4 \]

b) Determine how long the logo is underwater during one revolution. Show your work.

\[ y = 0 \]
\[ x = 13.79 \text{ sec} \]
\[ \frac{76.21}{62.42} \text{ sec above water} \]
\[ 90 - 62.92 = 27.08 \text{ sec underwater} \]
Exemplar 2

Question 5

A boat is propelled by a paddle wheel with a diameter of 14 feet. Each paddle takes 90 seconds to complete one revolution. The logo on one paddle reaches a maximum height of 11 feet above the water after the boat is in motion for 10 seconds.

a) Determine a possible sinusoidal equation that models the height of the logo over time. Show your work.

\begin{align*}
\text{Time (s)} & \quad \text{Height (ft.)} \\
& \quad \hline \\
& \quad \hline \\
& \quad \hline
\end{align*}

Diagram is not drawn to scale.

b) Determine how long the logo is underwater during one revolution. Show your work.

\begin{align*}
\text{minimum } h &= -3 \\
\text{midline } \frac{\text{maximum} + \text{minimum}}{2} &= \frac{11 + (-3)}{2} \\
&= 4 \\
\text{amplitude } &= 7 \\
\text{graph: } h &= 7\sin\frac{\pi}{45}(t - 10) + 4
\end{align*}

Diagram is not drawn to scale.

4 marks:

1. 1 mark for appropriate work in (a)
2. 0.5 mark for two consistent values in (a)
3. 0.5 mark for remaining two consistent values in (a)
4. 1 mark for appropriate work in (b)
5. 1 mark for consistent answer in (b)
THIS PAGE WAS INTENTIONALLY LEFT BLANK.
Exemplar 1

Question 6  

An Australian farmer records the rabbit population on his farm over the course of one year. The table below represents his data.

<table>
<thead>
<tr>
<th>Time (months)</th>
<th>1</th>
<th>4</th>
<th>7</th>
<th>9</th>
<th>11</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of rabbits</td>
<td>25</td>
<td>50</td>
<td>100</td>
<td>150</td>
<td>240</td>
</tr>
</tbody>
</table>

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

(3 marks)

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

(1 mark)  

\[ y = a(b)^x \]  

\[ y = 20.354(1.25105)^x \]
Exemplar 1 (continued)

c) Using your equation in (b), determine how long it will take for the rabbit population to reach 400.

\[ y = 400 \]
\[ x = 13.796 \]

It will take 13.30 months.

(1 mark)

---

d) At a different farm, there are 300 rabbits at the beginning of the following year. This rabbit population increases, but less quickly than on the first farm. Write an exponential equation that models this situation.

\[ y = 300 \cdot (1.85169)^x \]

(1 mark)

---

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 correct equation in (b)
5 → 1 mark for consistent answer in (c)
An Australian farmer records the rabbit population on his farm over the course of one year. The table below represents his data.

<table>
<thead>
<tr>
<th>Time (months)</th>
<th>1</th>
<th>4</th>
<th>7</th>
<th>9</th>
<th>11</th>
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</thead>
<tbody>
<tr>
<td>Number of rabbits</td>
<td>25</td>
<td>50</td>
<td>100</td>
<td>150</td>
<td>240</td>
</tr>
</tbody>
</table>

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

\[ y = 2.19x^2 + (-5.56)x + 31.07 \]

b) Determine the exponential regression equation that best models the data in this situation.
Exemplar 2 (continued)

c) Using your equation in (b), determine how long it will take for the rabbit population to reach 400.

(1 mark)

\[ 14.32 \text{ months} \]


d) At a different farm, there are 300 rabbits at the beginning of the following year. This rabbit population increases, but less quickly than on the first farm. Write an exponential equation that models this situation.

(1 mark)

4 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 consistent answer in (c)
5 → makes a transcription error (inaccurate transferring of information)
Exemplar 1

Question 8  
Total: 2 marks

Corbin wants to create an image of himself on his cellphone. There are 7 choices for hair colour, 3 choices for hair length, and 9 choices for a hat.

Using these options, how many different images in total can he create with or without a hat?

Show your work.

\[ 7 \times 3 \times 9 = 189 \text{ possible options with} \]
\[ 7 \times 3 = 21 \text{ options without} \]

189 possible options for Corbin’s image

1.5 marks:

1 → 1 mark for correct case with a hat
2 → 0.5 mark for correct case without a hat
3 → 0.5 mark for consistent sum of cases
4 → 0.5 mark deduction for arithmetic error
Exemplar 2

Question 8

Total: 2 marks

Corbin wants to create an image of himself on his cellphone. There are 7 choices for hair colour, 3 choices for hair length, and 9 choices for a hat.

Using these options, how many different images in total can he create with or without a hat? Show your work.

\[
\text{With hat:} \quad 7 \times 3 \times 9 = 189 \text{ images}
\]

\[
\text{Without hat:} \quad 7 \times 3 = 21 \text{ images}
\]

He can create 189 image with hat
or create 21 image without hat

1.5 marks:
1 → 1 mark for correct case with a hat
2 → 0.5 mark for correct case without a hat
Exemplar 1

Question 9

There are 21 students in an applied math class. On a test, 10 students used an app, 14 students used a graphing calculator, and 4 students used both.

What is the probability that a randomly selected student used only an app on the test? Show your work.

\[
\frac{6}{21} = \frac{2}{7}
\]

2 marks:

₁ → 1 mark for appropriate work
₂ → 1 mark for consistent answer
₃ → does not include a box when using a Venn diagram
There are 21 students in an applied math class. On a test, 10 students used an app, 14 students used a graphing calculator, and 4 students used both.

What is the probability that a randomly selected student used only an app on the test? Show your work.

\[
\frac{6}{21} = 28.57\% \\
\text{chance}
\]

2 marks:

1. → 1 mark for appropriate work
2. → 1 mark for consistent answer
3. → does not include a box when using a Venn diagram
Pedro is walking from the train station to the convention centre and must withdraw money at the bank on his way. He can only walk south and east. How many different ways can he get to the convention centre? Show your work.

There is 45 paths to the Convention Centre.
Pedro is walking from the train station to the convention centre and must withdraw money at the bank on his way. He can only walk south and east. How many different ways can he get to the convention centre? Show your work.

Pedro can walk 14 different ways if he must withdraw money at the bank on his way.
Exemplar 1

Question 11  
Total: 4 marks

There are 5 biology books, 4 math books, and 7 history books randomly placed on a shelf.

a) Luis selects 2 books, one after the other. Determine the probability that both books are on the same subject. Show your work.

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

\[
\begin{align*}
\text{Biology} & \quad \frac{5}{16} \times \frac{4}{16} = 0.078 \rightarrow 7.8\% \\
\text{Math} & \quad \frac{4}{16} + \frac{3}{16} = 0.69\% \\
\text{History} & \quad \frac{7}{16} \times \frac{6}{16} = 0.41\% \\
\end{align*}
\]

b) Are the events in (a) independent or dependent? Explain.

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

\[
\left\{ \begin{array}{l}
\text{dependent, because the selection} \\
\text{of the first book determines} \\
\text{which book must be selected} \\
\text{next}
\end{array} \right. 
\]

1.5 marks:
- ① → 1 mark for correctly multiplying the number of same-subject books in (a)
- ④ → 1 mark for correct explanation in (b)
- ⑥ → 0.5 mark deduction for lack of clarity
Exemplar 2

Question 11  
There are 5 biology books, 4 math books, and 7 history books randomly placed on a shelf.

a) Luis selects 2 books, one after the other. Determine the probability that both books are on the same subject. Show your work.

(3 marks)

\[
P(\text{Both same}) = \frac{5}{16} \cdot \frac{4}{15} + \frac{4}{16} \cdot \frac{3}{15} + \frac{7}{16} \cdot \frac{6}{15}
\]

\[
P = 0.08 + 0.05 + 0.175
\]

\[
P(\text{Both same}) = 0.205 \\
= 30.50\%
\]

b) Are the events in (a) independent or dependent? Explain.

(1 mark)

They are dependent because the second pick depends on the first book being taken out.

4 marks:

1 → 1 mark for correctly considering dependency in (a)
2 → 1 mark for correctly multiplying the number of same-subject books in (a)
3 → 1 mark for consistent sum in (a)
4 → 1 mark for correct explanation in (b)

→ rounds too soon
Exemplar 1

Question 12

Total: 3 marks

Construction work has slowed travel near Dauphin, Manitoba. Harry must drive through the construction zone to get to work. The probability that he will be delayed because of the construction is 45%. If he is delayed, the probability he will get to work on time is 70%. If he is not delayed, the probability he will get to work on time is 85%.

a) Use a graphic organizer to show all possible outcomes for this situation.

(1 mark)

b) Determine the probability that Harry will get to work on time. Show your work.

(2 marks)

\[ (0.45)(0.7) = 0.315 \]
\[ (0.55)(0.85) = 0.4675 \]

\[ 0.315 + 0.4675 = 0.7825 \]

2 marks:

1 → 1 mark for appropriate graphic organizer in (a)
2 → 0.5 mark for \( P(\text{delayed, on time}) \) in (b)
3 → 0.5 mark for \( P(\text{not delayed, on time}) \) in (b)
Exemplar 2

Question 12

Total: 3 marks

Construction work has slowed travel near Dauphin, Manitoba. Harry must drive through the construction zone to get to work. The probability that he will be delayed because of the construction is 45%. If he is delayed, the probability he will get to work on time is 70%. If he is not delayed, the probability he will get to work on time is 85%.

a) Use a graphic organizer to show all possible outcomes for this situation.

(1 mark)

b) Determine the probability that Harry will get to work on time. Show your work.

(2 marks)

\[ (0.55 \times 0.15) + (0.45 \times 0.70) \]

\[ = 0.3975 \times 100 \]

\[ = 39.75\% . \]

2.5 marks:

1 → 1 mark for appropriate graphic organizer in (a)
2 → 0.5 mark for \( P(\text{delayed, on time}) \) in (b)
3 → 1 mark for consistent sum in (b)
A group of friends is ordering a meal of 3 pizzas and 2 salads from a restaurant. The restaurant offers 6 types of pizzas and 4 types of salads.

If all pizzas and salads chosen must be different from one another, how many meal options do the friends have? Show your work.

\[
\frac{6!}{3!} \times \frac{4!}{2!} = \frac{120}{1} \times \frac{12}{2} = 1440 \text{ options}
\]

1 mark: 1 mark for using permutations instead of combinations as per marker note
A group of friends is ordering a meal of 3 pizzas and 2 salads from a restaurant. The restaurant offers 6 types of pizzas and 4 types of salads.

If all pizzas and salads chosen must be different from one another, how many meal options do the friends have? Show your work.

\[
\begin{align*}
\text{Pizza} & \quad \text{Salad} \\
\binom{6}{3} & \quad \binom{4}{1} \\
= 20 & \quad = 4 \\
\end{align*}
\]

\[= 20 \text{ different meal options.}\]

1 mark:

- 1 mark for appropriate work

- E3: makes a transposition error (changing order of digits)
Exemplar 1

Question 14 Total: 5 marks

A dealership has 6 cars, 2 vans, and 4 trucks for sale.

a) An employee is asked to park all of these vehicles in a row. How many different ways can this be done if all of the cars must be together, all of the vans must be together, and all of the trucks must be together? Show your work.

\[ \binom{12}{6} \cdot \binom{12}{2} \cdot \binom{12}{4} = 924 \cdot 66 \cdot 495 = 30187080 \]

b) Diane visits the dealership and decides to buy one of the trucks. The price of this truck is $36,500.00, taxes included. She has $4000.00 for a down payment. The balance will be financed at an interest rate of 2.99%, compounded monthly, for 7 years. Calculate her monthly payment. Show your work.

Monthly payment would be $428.22
Exemplar 1 (continued)

c) What is the total amount Diane will pay to buy the truck?

(1 mark)

\[
\begin{align*}
\text{total amount will be} & \quad 35\,970.38 + 4000.00 \\
\text{down payment} & \\
\text{will be} & \quad 39\,970.38
\end{align*}
\]

3 marks:
- 1 mark for appropriate work in (b)
- 1 mark for consistent answer in (b)
- 0.5 mark for consistent total monthly payments in (c)
- 0.5 mark for consistent total amount in (c)
- makes a transcription error (inaccurate transferring of information)
A dealership has 6 cars, 2 vans, and 4 trucks for sale.

a) An employee is asked to park all of these vehicles in a row. How many different ways can this be done if all of the cars must be together, all of the vans must be together, and all of the trucks must be together? Show your work.

\[3! = 6; \quad 6! = 720; \quad 2! = 2; \quad 4! = 24\]

\[6 	imes 720 + 2 + 24 = 752 \text{ ways}\]

b) Diane visits the dealership and decides to buy one of the trucks. The price of this truck is $36 500.00, taxes included. She has $4000.00 for a down payment. The balance will be financed at an interest rate of 2.99%, compounded monthly, for 7 years. Calculate her monthly payment. Show your work.

\[N = 84; \quad i = 2.99\% \quad \text{compounded monthly}; \quad FV = 0; \quad P/Y = 12; \quad C/Y = 12\]

Her monthly payment would be $482.12
Exemplar 2 (continued)

c) What is the total amount Diane will pay to buy the truck?

(1 mark)

$482,12 \times 84$

$= 40498,08$

She will pay a total of

$40498,08$
Mr. Chen is moving to Manitoba and is looking for a place to live.

State two reasons why Mr. Chen would prefer renting a house instead of buying a similar house.

<table>
<thead>
<tr>
<th>Reason 1:</th>
</tr>
</thead>
<tbody>
<tr>
<td>buying - its in your name so its your responsibility if anything goes bad</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Reason 2:</th>
</tr>
</thead>
<tbody>
<tr>
<td>renting - lower monthly payments</td>
</tr>
</tbody>
</table>

---

**0.5 mark:**

1. 1 mark for one appropriate reason (Reason 1)
2. 0.5 mark deduction for lack of clarity
Exemplar 2

Question 16

Mr. Chen is moving to Manitoba and is looking for a place to live.

State two reasons why Mr. Chen would prefer renting a house instead of buying a similar house.

Reason 1:

won’t need to pay land ownership taxes

Reason 2:

cheaper than buying a house

1 mark:

→ 1 mark for one appropriate reason (Reason 1)
Exemplar 1

Question 17

Nadia hopes to save enough money over a 6-year period to go on a trip estimated to cost $11,600.00. To start saving, she deposits $1250.00 into an account that earns an interest rate of 4.21%, compounded monthly.

a) If she makes monthly payments of $110.00 into this account, how much money will she have at the end of the 6-year period? Show your work.

\[
N = 6 \times 12 = 72 \\
I = 4.21 \\
FV = 1250 \\
PMT = 110 \\
FV = 7383.78 \\
\text{She will have}$7383.78 \text{ at the end of 6 years.}
\]

b) What is the minimum number of additional monthly payments Nadia needs to make in order to save enough money for the trip?

\[
11600 - 7383.78 \rightarrow \text{to}\ 4216.22
\]

\[
4216.22 \div 110 / \text{month} = 38.33\text{ months}
\]

Nadia needs an extra 39 monthly payments
Nadia needs to start making more money.

1 mark:

\(\Rightarrow \) 1 mark for consistent answer in (a)
Nadia hopes to save enough money over a 6-year period to go on a trip estimated to cost $11,600.00. To start saving, she deposits $1,250.00 into an account that earns an interest rate of 4.21%, compounded monthly.

a) If she makes monthly payments of $110.00 into this account, how much money will she have at the end of the 6-year period? Show your work.

(2 marks)

\[
N = 6 \times 12 \\
I = 4.21 \\
\text{PV} = -1,250 \\
PMT = -110 \\
FV = ? \\
\text{PY} = 12 \\
\text{CY} = 12
\]

\[FV = \$7,383.78\]

b) What is the minimum number of additional monthly payments Nadia needs to make in order to save enough money for the trip?

(1 mark)

\[11,600 - 7,383.78 = \frac{4,216.22}{12} = \$351.35 \text{ per month for a year}\]

\[\text{OK she pays $1,685.56 every month for 6 years}\]

1.5 marks:

1 → 1 mark for appropriate work in (a)
2 → 1 mark for consistent answer in (a)
0 → 0.5 mark deduction for procedural error
Exemplar 1

Question 18

Marshall and Kim are renting a house that they hope to purchase. They pay $1800.00 in annual heating costs and know that the annual property taxes are $2500.00. Their combined gross income is $5200.00 per month.

a) Based on the gross debt service ratio (GDSR), what is the maximum monthly mortgage payment they can afford? Show your work.

\[
\text{GDSR} = \frac{\text{Gross Income}}{\text{Annual Property Taxes} + \text{Annual Heating Costs}}
\]

\[
\text{GDSR} = \frac{5200}{2500 + 1800} = \frac{5200}{4300} = 1.209
\]

\[
The \text{max. } \text{monthly mortgage payment } = \text{GDSR} \times \text{Gross Income} = 1.209 \times 5200 = 6285.6
\]

b) If they have saved $30 000.00 for a down payment, what is the maximum house price they can afford based on a 25-year amortization period at an interest rate of 4.64%, compounded semi-annually? Show your work.

\[
\text{P} = \frac{\text{PMT} \times (1 + r)^n}{r} (1 + r)^n - 1
\]

\[
\text{PMT} = \frac{\text{Gross Income} - \text{Annual Property Taxes} - \text{Annual Heating Costs}}{12} = \frac{5200 - 2500 - 1800}{12} = 66.67
\]

\[
\text{r} = \frac{4.64\%}{2} = 0.0232
\]

\[
\text{n} = 25 \times 2 = 50
\]

\[
\text{P} = \frac{66.67 \times (1 + 0.0232)^{50}}{0.0232} (1 + 0.0232)^{50} - 1 = 286071.63
\]

Total: 5 marks
Exemplar 1 (continued)

<table>
<thead>
<tr>
<th>Transaction Type</th>
<th>Investment</th>
<th>Retirement Plan</th>
<th>Loan</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Payment Frequency (per year)</th>
<th>1</th>
<th>2</th>
<th>4</th>
<th>12</th>
<th>24</th>
<th>26</th>
<th>365</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Compound Frequency (per year)</th>
<th>1</th>
<th>2</th>
<th>4</th>
<th>12</th>
<th>24</th>
<th>26</th>
<th>365</th>
</tr>
</thead>
</table>

| Financial Details | Present Value: 286071.63 | Future Value: 0.00 | Monthly Deposit: 1605.67 | Interest Rate (%): 4.6 | # Years: 25 | Make Deposit at: start or end of period |

| Financial Summary | Principal Paid: 286071.63 | Interest Earned: 195629.37 | Total Future Value: 481701.00 |

3.5 marks:
1 → 0.5 mark for correctly converting annual costs to monthly costs in (a)
2 → 0.5 mark for correct substitution into formula in (a)
3 → 1 mark for consistent answer in (a)
4 → 1 mark for appropriate work in (b)
5 → 1 mark for consistent value of mortgage in (b)
6 → 0.5 mark deduction for arithmetic error
Exemplar 2

Question 18

Marshall and Kim are renting a house that they hope to purchase. They pay $1800.00 in annual heating costs and know that the annual property taxes are $2500.00. Their combined gross income is $5200.00 per month.

a) Based on the gross debt service ratio (GDSR), what is the maximum monthly mortgage payment they can afford? Show your work.

(2 marks)

\[
\text{GDSR} = \frac{\text{monthly mortgage} + \text{heating costs} + \text{property taxes}}{\text{monthly income}}
\]

\[
\frac{2500 + 1800 + 2500}{5200} = 0.5833
\]

They can have a maximum monthly mortgage of $1300.

b) If they have saved $30 000.00 for a down payment, what is the maximum house price they can afford based on a 25-year amortization period at an interest rate of 4.64%, compounded semi-annually? Show your work.

(3 marks)

\[
\text{N} = 25 \times 2 = 50
\]

\[
1 = 4.64\
\text{PV} = -30\,000
\]

\[
\text{PMT} = 0
\]

\[
\# \text{FV} = 0 \rightarrow 94,438.23
\]

They can afford a max price of $94,438.23.

1 mark:

1 → 0.5 mark for correctly converting annual costs to monthly costs in (a)
2 → 0.5 mark for correct substitution into formula in (a)
Exemplar 1

Question 19

Amor and Angélique each want to retire at age 65. They start investing in tax-free savings accounts (TFSA) at different ages in their lives.

- At age 28, Amor starts investing $240.00 per month into a TFSA that earns an interest rate of 2.95%, compounded monthly.
- At age 42, Angélique makes an initial deposit of $5000.00 and starts investing $350.00 per month into a TFSA that earns an interest rate of 3.50%, compounded monthly.

a) What is the value of each of their TFSA at age 65? Show your work.

(b) Explain why a small long-term investment may be worth more than a large short-term investment.

(4 marks)

b) Explain why a small long-term investment may be worth more than a large short-term investment.

(1 mark)

3 marks:

- 1 mark for consistent value of Amor’s TFSA in (a)
- 1 mark for appropriate work for Angélique in (a)
- 1 mark for consistent value of Angélique’s TFSA in (a)
- does not include the dollar sign for monetary values
Exemplar 2

Question 19  Total: 5 marks

Amor and Angélique each want to retire at age 65. They start investing in tax-free savings accounts (TFSA) at different ages in their lives.

- At age 28, Amor starts investing $240.00 per month into a TFSA that earns an interest rate of 2.95%, compounded monthly.
- At age 42, Angélique makes an initial deposit of $5000.00 and starts investing $350.00 per month into a TFSA that earns an interest rate of 3.50%, compounded monthly.

a) What is the value of each of their TFSAs at age 65? Show your work.

(4 marks)

\[ \begin{align*}
\text{Amor} & \quad N = 37 \text{(12)} = 444 \\
& \quad I = 2.95 \\
& \quad PV = 0 \\
& \quad Pmt = -240 \\
& \quad FV = \text{Solve} = 192,789.31 \\
& \quad P/Y = 12 \\
& \quad C/Y = 12 \\
\end{align*} \]

\[ \begin{align*}
\text{Angélique} & \quad N = 23 \text{(12)} = 276 \\
& \quad I = 3.5 \\
& \quad PV = 0 \\
& \quad Pmt = -350 \\
& \quad FV = \text{Solve} = 148,089.28 \\
& \quad P/Y = 12 \\
& \quad C/Y = 12 \\
\end{align*} \]

b) Explain why a small long-term investment may be worth more than a large short-term investment.

(1 mark)

because the small term allows you to carry more free cash to spend during the long-term investment

3 marks:

① → 1 mark for appropriate work for Amor in (a)
② → 1 mark for consistent value of Amor’s TFSA in (a)
③ → 1 mark for consistent value of Angélique’s TFSA in (a)
⑤ → does not include the dollar sign for monetary values
Exemplar 1

Question 21

You are in charge of purchasing enough sports drink for the participants of a 5-kilometre race. There are 300 participants and you assume they will each drink the equivalent of 2 cups of sports drink. The cups are cone shaped with the following dimensions:

a) What volume of sports drink must you purchase? Show your work.

\[ V = \frac{1}{3} \pi r^2 h \]

\[ V = \frac{1}{3} \pi (8)^2 (7) \]

\[ V = \frac{351.8583772}{3} \]

\[ V = 117.2861254 \text{ cm}^3 \]

b) Each container of sports drink costs $5.00 and contains 8 L (1 L = 1000 cm³) of drink. How much will you spend on sports drink, before taxes?

\[ \text{Number of containers} = \frac{117.2861254 \times 300}{8} \]

\[ = 41,298,072 \text{ containers} \]

\[ \text{Total cost} = \frac{351.8583772 \times 300}{1000} \]

\[ = 351.8583772 \]

2 marks:

1. 1 mark for correct volume of one cup in (a)
2. 0.5 mark for consistent number of containers in (b)
3. 0.5 mark for consistent total cost in (b)
**Exemplar 2**

**Question 21**

You are in charge of purchasing enough sports drink for the participants of a 5-kilometre race. There are 300 participants and you assume they will each drink the equivalent of 2 cups of sports drink. The cups are cone shaped with the following dimensions:

![Cone diagram](image)

a) What volume of sports drink must you purchase? Show your work.

\[
V = \frac{1}{3} \pi r^2 h
\]

\[
= \frac{1}{3} \pi (4)^2 (7) = 175.93 \times 600
\]

\[10558 \text{ cm}^3\text{ is the volume I would buy}\]

(2 marks)

2 marks:

- 1 mark for consistent total volume in (a)
- 0.5 mark for consistent number of containers in (b)
- 0.5 mark for consistent total cost in (b)

- rounds too soon

b) Each container of sports drink costs $5.00 and contains 8 L \((1 \text{ L} = 1000 \text{ cm}^3)\) of drink. How much will you spend on sports drink, before taxes?

(1 mark)

\[
8 \times 1000 = 8000
\]

\[
\frac{10558}{8000} = 13.194 \text{ rounds}
\]

\[
1 \times 5 = \$70
\]
You are in charge of purchasing enough sports drink for the participants of a 5-kilometre race. There are 300 participants and you assume they will each drink the equivalent of 2 cups of sports drink. The cups are cone shaped with the following dimensions:

![Cone diagram](image)

a) What volume of sports drink must you purchase? Show your work.

(2 marks)

\[
\frac{1}{3} \pi r^2 h = V
\]

\[
46.9 \text{ cm}^3
\]

\[
46.9 \times 600 = 28,148 \text{ cm}^3
\]

b) Each container of sports drink costs $5.00 and contains 8 L (1 L = 1000 cm³) of drink. How much will you spend on sports drink, before taxes?

(1 mark)

\[
\frac{28,148}{8} \times 5 = 175.93
\]

2 marks:

- 1 mark for consistent total volume in (a)
- 0.5 mark for consistent number of containers in (b)
- 0.5 mark for consistent total cost in (b)

- Does not use whole units for materials purchased in design and measurement questions
- Rounds too soon
You are to design a bedroom. The bedroom design must satisfy the following conditions:

- The bedroom must be rectangular.
- The bedroom must include one dresser, one desk, and one bed chosen from the furniture options below.

<table>
<thead>
<tr>
<th>Furniture Options</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Dresser</strong></td>
</tr>
<tr>
<td>Tall</td>
</tr>
<tr>
<td>Dimensions (ft.) (width × length)</td>
</tr>
<tr>
<td>Area (ft²)</td>
</tr>
<tr>
<td>Cost ($)</td>
</tr>
</tbody>
</table>

(a) Draw or describe the bedroom design, including dimensions, where

- one of the dimensions of the bedroom floor must be at least 10 feet
- the area of the bedroom must be between double and triple the area occupied by the total of all the furniture

(2 marks)

Dimensions of bedroom: 10 ft. × 12 ft.
b) You must also install flooring in the bedroom. Flooring must be purchased in whole units. You can buy carpet or hardwood.

- You must include an additional 10% to the area for installation and waste.
- The carpet costs $14.40 per yd².
- The hardwood costs $19.80 per yd².

Calculate the cost of the flooring before taxes.

\[
\frac{120 \text{ ft}^2}{1 \text{ yd}^2} = \frac{9 \text{ ft}^2}{120 \text{ ft}^2} = 13.33\text{ yd}^2
\]

\[
14 \times 0.10 = 1.4
\]

\[
15 \times 14.40 = 216
\]

\[
\text{Cost of flooring before taxes: } $216
\]

c) Calculate the total cost of the furniture and the flooring, plus GST and PST.
(Note: GST = 5%, PST = 8%)

\[
\begin{align*}
\text{Total cost before taxes: } &216 + 294.591 = 510.591 \\
\text{GST: } &510.591 \times 0.05 = 25.52955 \\
\text{PST: } &510.591 \times 0.08 = 40.84728 \\
\text{Total cost: } &510.591 + 25.52955 + 40.84728 = 577.96883
\end{align*}
\]

\[
\text{Total cost: } \approx $578.00
\]
Exemplar 2

Question 22

You are to design a bedroom. The bedroom design must satisfy the following conditions:

- The bedroom must be rectangular.
- The bedroom must include one dresser, one desk, and one bed chosen from the furniture options below.

<table>
<thead>
<tr>
<th>Furniture Options</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Dresser</strong></td>
</tr>
<tr>
<td>Tall</td>
</tr>
<tr>
<td>1.5 × 4</td>
</tr>
<tr>
<td><strong>Dimensions (ft.)</strong> (width × length)</td>
</tr>
<tr>
<td>6</td>
</tr>
<tr>
<td>559.00</td>
</tr>
</tbody>
</table>

a) Draw or describe the bedroom design, including dimensions, where

- one of the dimensions of the bedroom floor must be at least 10 feet
- the area of the bedroom must be between double and triple the area occupied by the total of all the furniture

(2 marks)

Dimensions of bedroom: **20 ft. × 10 ft.**
Exemplar 2 (continued)

b) You must also install flooring in the bedroom. Flooring must be purchased in whole units. You can buy carpet or hardwood.

• You must include an additional 10% to the area for installation and waste.
• The carpet costs $14.40 per yd².
• The hardwood costs $19.80 per yd².

Calculate the cost of the flooring before taxes.

(2 marks)

\[
egin{align*}
20 \times 10 &= 200 \text{ ft}^2 = 22.22 \text{ yd}^2 \\
22.22 \times 1.10 &= 24.44 \text{ yd}^2 \\
24.44 \times 14.40 &= 351.94
\end{align*}
\]


c) Calculate the total cost of the furniture and the flooring, plus GST and PST. (Note: GST = 5%, PST = 8%)

(1 mark)

\[
\begin{align*}
559 + 379 + 1669 &= 2607 \\
351.94 + 2607 &= 2958.94 \\
2958.94 \times 1.13 &= 3343.60
\end{align*}
\]

4 marks:

1 → 0.5 mark for including one dresser, one desk, and one bed in (a)
2 → 0.5 mark for appropriate dimensions of bedroom in (a)
3 → 1 mark for correct conversion to yd² in (b)
4 → 1 mark for consistent cost of flooring before taxes in (b)
5 → 0.5 mark for correct cost of furniture before taxes in (c)
6 → 0.5 mark for consistent total cost of bedroom, including cost of flooring and taxes in (c)
7 → makes a transcription error (inaccurate transferring of information)
8 → does not use whole units for materials purchased in design and measurement questions
Exemplar 1

Question 23

Total: 2 marks

a) Create a true conditional statement using two of the statements given below.
   - the number is positive
   - the number is negative
   - the number is less than zero
   - the number is prime
   - the number is odd
   - the number is even
   - the number is 5

(1 mark)

The number is negative if the number is less than 0

b) Write the inverse of the statement created in (a).

(1 mark)

If the number is not negative, the number is not less than 0

0 marks: no criteria met
Exemplar 2

Question 23

Total: 2 marks

a) Create a true conditional statement using two of the statements given below.

- the number is positive
- the number is negative
- the number is less than zero
- the number is prime
- the number is odd
- the number is even
- the number is 5

(1 mark)

If the number is odd, then the number is 5.

b) Write the inverse of the statement created in (a).

(1 mark)

If the number is not odd, then the number is not 5.

1 mark:

1 mark for consistent inverse in (b)
The universal set $B$ represents the breakfast items in Pierre’s backpack:

$$B = \{\text{apple, yogurt, granola bar}\}$$

Pierre must choose at least one item to eat for breakfast.

Write all of Pierre’s breakfast options as subsets.

$$\begin{align*}
\{\text{Apple}\} \\
\{\text{Yogurt}\} \\
\{\text{Granola Bar}\} \\
\{\text{Apple, Yogurt}\} \\
\{\text{Apple, Granola Bar}\} \\
\{\text{Yogurt, Granola Bar}\} \\
\{\text{Apple, Yogurt, Granola Bar}\}
\end{align*}$$

2 marks:

1. → 0.5 mark for correctly identifying 4 subsets
2. → 0.5 mark for correctly identifying 5th subset
3. → 0.5 mark for correctly identifying 6th subset
4. → 0.5 mark for correctly identifying 7th subset

→ does not include braces when using set notation
The universal set \( B \) represents the breakfast items in Pierre’s backpack:

\[
B = \{ \text{apple, yogurt, granola bar} \}
\]

Pierre must choose at least one item to eat for breakfast.

Write all of Pierre’s breakfast options as subsets.

\[
\begin{align*}
\{\text{apple}\} \quad & \rightarrow \quad 0.5 \text{ mark for correctly identifying 4 subsets} \\
\{\text{apple, yogurt}\} \quad & \rightarrow \quad 0.5 \text{ mark for correctly identifying 5th subset} \\
\{\text{yogurt}\} \quad & \rightarrow \quad 0.5 \text{ mark for correctly identifying 6th subset}
\end{align*}
\]
Exemplar 1

Question 26  
Total: 3 marks

A magic square is an array that has the same sum in each row, column, and diagonal. This sum is called the magic number.

\[
\begin{array}{cccc}
7 & 20 & 11 & 12 \\
14 & 8 & 23 & 15 \\
20 & 6 & 13 & 11 \\
9 & 16 & 3 & 22 \\
\end{array}
\]

a) Determine the number in the array above that prevents it from being a magic square.

(1 mark)

\[
60
\]

b) What number should replace the number found in (a) to make the array a magic square?

(1 mark)

\[
50
\]

c) What is the magic number of the resulting magic square?

(1 mark)

\[
50
\]

1 mark:
\[\{\} \rightarrow 1 \text{ mark for correct answer in (c)}\]
Appendices
## Appendix A:
### Table of Questions by Unit and Learning Outcome

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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 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: _____________________________________________________________________