Grade 12
Applied Mathematics
Achievement Test

Marking Guide

Use in conjunction with *Exemplars*

January 2026

Manitoba

Grade 12 Applied Mathematics Achievement Test:
Marking Guide (January 2026)

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

Websites are subject to change without notice.

Disponible en français.

Preamble

This document is one of a series of two documents.

- *Grade 12 Applied Mathematics Achievement Test: Exemplars*
- ***Grade 12 Applied Mathematics Achievement Test: Marking Guide***

The *Marking Guide* provides guidelines for marking the test. These guidelines include marking keys for each question.

Contents

General Marking Instructions

Please ensure that

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

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

Once marking is completed, please forward the *Scoring Sheets* to Manitoba Education and Early Childhood Learning using the envelope provided. For more information, see the administration manual.

Marking

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. Explanations use words to clearly express what students are thinking. Justifications can be provided through a labelled diagram, in words, by showing mathematical operations for answer verification, or by providing written outputs from a technological tool. For this reason, appropriate flexibility is required when marking student responses.

Students are expected to round all final answers to at least the nearest hundredth (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

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.

Conceptual Errors

Errors that are conceptually related to the learning outcomes associated with the question will result in a 1 mark deduction.

Communication Errors

Communication errors, as indicated on the following page, 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.

Other Errors

A 0.5 mark deduction will also apply each time a student makes one of the following errors:

- **AE** an arithmetic error
- **PE** a procedural error (not a conceptual error)
- **LC** a lack of clarity in the explanation, the description, or the justification
- **TE** a terminology error in the explanation

(E1) 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

(E2) 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 "$y \sim$" to "$y =$" when writing an equation
- does not include titles and/or labels, with units, on a graph

(E3) 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

(E4) 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)

(E5) 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)

(E6) Rounding

- rounds incorrectly
- rounds inappropriately
- 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).

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

$$\text{Preliminary Mark} - \underbrace{(\text{Number of error types} \times 0.5)}_{\text{Communication Errors}} = \text{Final Mark}$$

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

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 Early Childhood Learning at the earliest opportunity to advise us of the situation and seek assistance if necessary.

You must contact the Assessment Consultant responsible for this project before making any modifications to the marking keys.

Youyi Sun
Assessment Consultant
Grade 12 Applied Mathematics
Telephone: 431-277-8337
Email: youyi.sun@gov.mb.ca

Marking Keys

Relations and Functions

Question 1 — Total: 1 mark

Learning Outcomes: 12.A.R.1, 12.A.R.2, 12.A.R.3 — **Question Type: Selected Response**

Select the function that could have a domain of $(-\infty, \infty)$ and a range of $(-\infty, 2]$.

A) cubic

B) quadratic

C) sinusoidal

D) logarithmic

Marking Key

Correct answer: B

Question 2 — Total: 1 mark

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

During an experiment, 1.5 L of water is boiled and the remaining volume, in litres, is measured over time, in minutes.

Select the equation that could model this situation.

A) $V = 1.5t^2$

B) $V = 1.5\sin t$

C) $\boldsymbol{V = 1.5(0.85)^t}$

D) $V = 1.5(1.05)^t$

Marking Key

Correct answer: C

Question 3 — Total: 3 marks

Learning Outcome: 12.A.R.3 — **Question Type: Constructed Response**

A dog's lung volume at rest can be modelled by the following sinusoidal function:

$$V = 0.37\sin 1.57t + 0.45$$

where V represents the lung volume (in litres)
and t represents the time (in seconds).

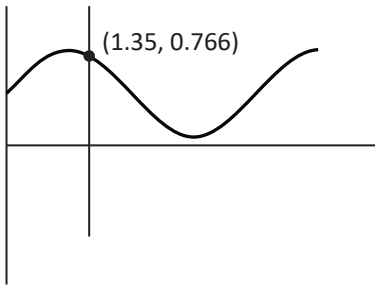
a) State the dog's lung volume at 1.35 seconds.

(*1 mark*)

When $x = 1.35$

$y = 0.765\,68$

OR



The dog's lung volume is 0.77 L.

b) Determine the period of the function.

(*1 mark*)

$$P = \frac{2\pi}{1.57}$$

$$= 4.002\,03$$

OR

Using 2 points from the graph.

e.g., $9.004\,56 - 5.002\,54 = 4.002\,02$

The period is 4.00 seconds.

c) Explain what the period represents in this situation.

(*1 mark*)

The period represents the amount of time required to inhale and exhale once.

Other explanations are possible.

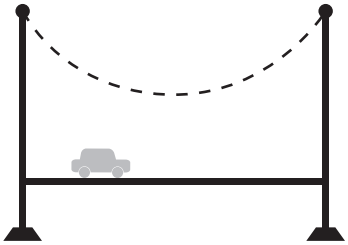
Marking Key

1. 1 mark for answer in (a)
2. 0.5 mark for appropriate work in (b)
3. 0.5 mark for consistent answer in (b)
4. 1 mark for appropriate explanation in (c)

Question 4 — Total: 4 marks

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

A car drives across a suspension bridge that has a support cable attached between two towers as shown in the diagram.



- The two towers are 480 m apart and have a height of 92 m above the road.
- When the car is 11 m from the left tower, the height of the cable is 85 m above the road.

a) Complete the table below.

(*1 mark*)

Horizontal Distance (m)	Height (m)
0	92
11	85
480	92

b) Determine the quadratic equation that models the shape of the cable, expressed to the nearest ten thousandth (four decimal places).

(*1 mark*)

$$y = 0.001\,356\,85x^2 - 0.651\,289x + 92$$

Quadratic equation: $y = 0.001\,4x^2 - 0.651\,3x + 92$

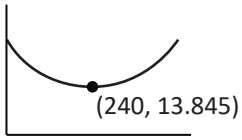
c) Determine the height of the cable when the car is halfway between the two towers.

(*1 mark*)

When $x = 240$

$y = 13.845$

OR



The height of the cable is 13.85 m.

d) State the range of the function in this situation.

(*1 mark*)

$[13.85, 92]$ ***OR*** $\{y \mid 13.85 \le y \le 92\}$

Marking Key

1. 1 mark for correct table in (a)
2. 1 mark for consistent equation in (b)
3. 0.5 mark for appropriate work in (c)
4. 0.5 mark for consistent height in (c)
5. 0.5 mark for consistent upper and lower bounds of the range in (d)
6. 0.5 mark for inclusivity of both upper and lower bounds in (d)

Marker Note:

→ If rounded values are used from the equation in (b), accept 16.33 m in (c) and (d).

Question 5 — Total: 2.5 marks

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

The following equation models the relationship between a tree's height and its age:

$$h = 6.01 + 6.30 \ln A$$

where h represents the height of the tree (in feet)
and A represents the age of the tree (in years).

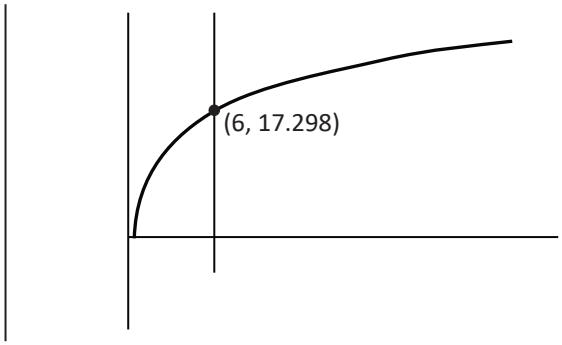
a) State the height of the tree when it is 6 years old.

(*1 mark*)

When $x = 6$

$y = 17.298$

OR



The height of the tree is 17.30 feet.

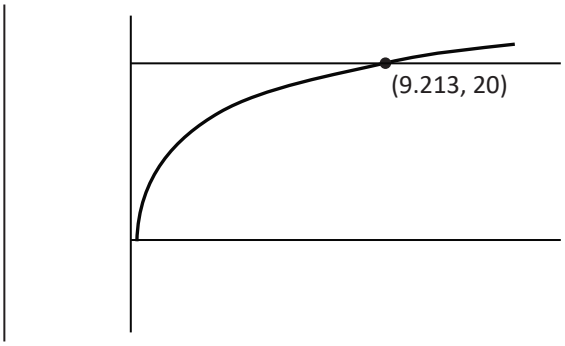
b) The tree was planted in the year 2020. Determine in which year the tree will reach a height of 20 feet.

(*1.5 marks*)

When $y = 20$

$x = 9.213$

OR



$$\text{Year} = 2020 + 9.213$$
$$= 2029.213$$

The tree will reach a height of 20 feet in 2029.

Marking Key

1. 1 mark for height of tree in (a)
2. 0.5 mark for appropriate work in (b)
3. 0.5 mark for consistent age of the tree in (b)
4. 0.5 mark for consistent year in (b)

Question 6 — Total: 4 marks

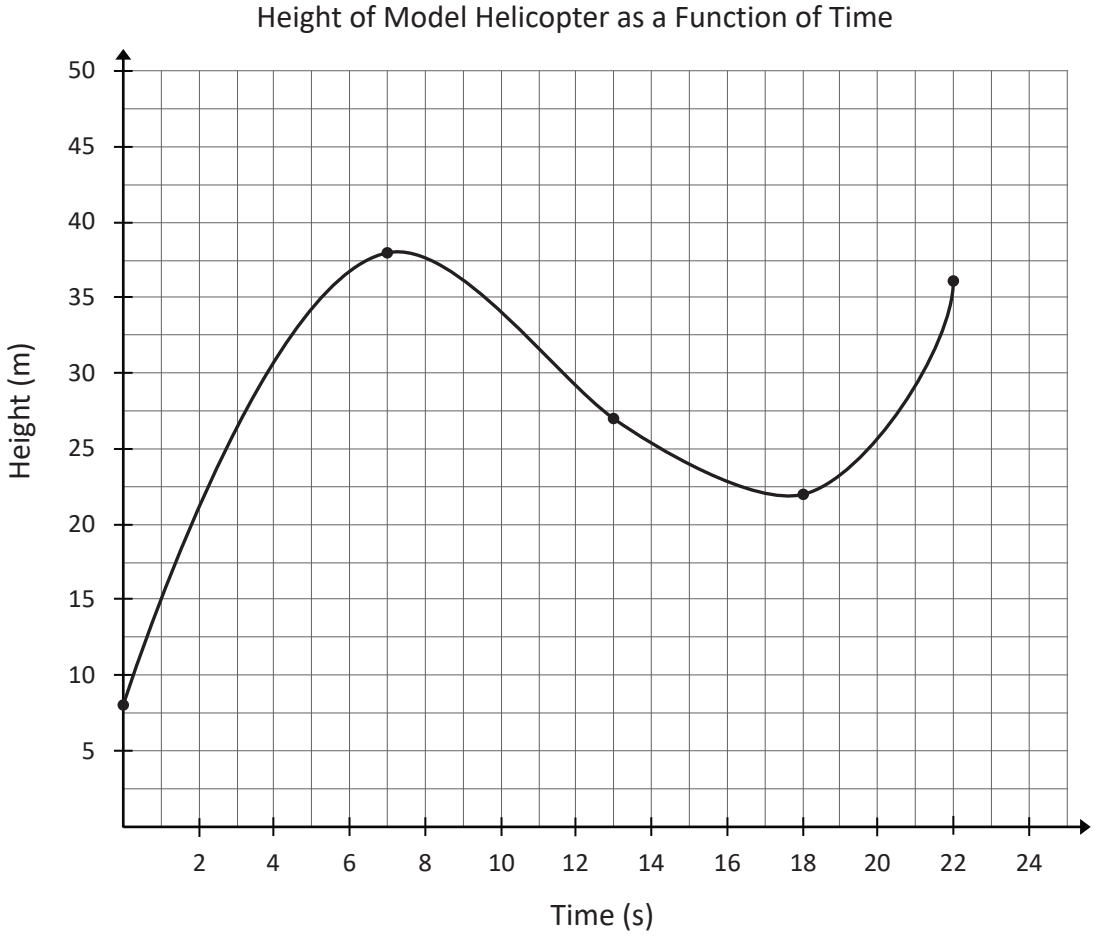
Learning Outcome: 12.A.R.1 — **Question Type: Constructed Response**

For a science fair project, Jaelyn flies a model helicopter and records the following data.

Time (s)	0	7	13	18	22
Height (m)	8	38	27	22	36

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

(*2 marks*)



b) State the cubic regression equation that models this situation.

(*1 mark*)

$$y = 0.029\,64\ldots x^3 - 1.059\,55\ldots x^2 + 10.236\,70\ldots x + 8.015\,08\ldots$$

$$y = 0.03x^3 - 1.06x^2 + 10.24x + 8.02$$

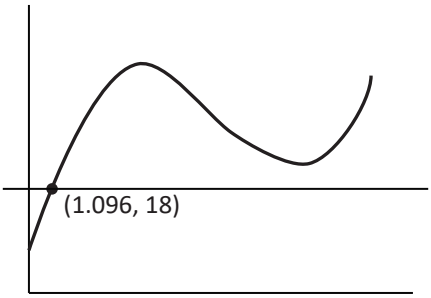
c) Determine the time when the model helicopter was at a height of 18 m, using the regression equation.

(*1 mark*)

When $y = 18$

$x = 1.096$

OR



The model helicopter was at a height of 18 m at 1.10 s.

Marking Key

1. 0.5 mark for using an appropriate domain for the context of the question in (a)
2. 0.5 mark for using an appropriate range for the context of the question in (a)
3. 1 mark for plotting the data and appropriate shape of the cubic curve in (a)
4. 1 mark for consistent cubic equation in (b)
5. 0.5 mark for appropriate work in (c)
6. 0.5 mark for consistent answer in (c)

Marker Notes:

→ If no data is graphed, no marks will be awarded for (a).

→ An arrowhead is acceptable on the upper boundary of the curve.

Probability

Question 7 — Total: 1 mark

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

Select the situation that represents mutually exclusive events.

A) Selecting a number that is prime and less than 10.

B) Rolling a multiple of 3 and an even number on a 6-sided die.

C) Drawing a 4-sided shape that is a rectangle and a parallelogram.

D) Selecting a number that is an 8 and an odd number.

Marking Key

Correct answer: D

Question 8 — Total: 2 marks

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

There are 4 green marbles, 3 red marbles, and 1 blue marble in a bag.

a) State the odds in favour of drawing a green marble from the bag.

(*1 mark*)

The odds in favour are $4:4$ or $1:1$.

b) State the odds against drawing a blue marble from the bag.

(*1 mark*)

The odds against are $7:1$.

Marking Key

1. 1 mark for answer in (a)
2. 1 mark for answer in (b)

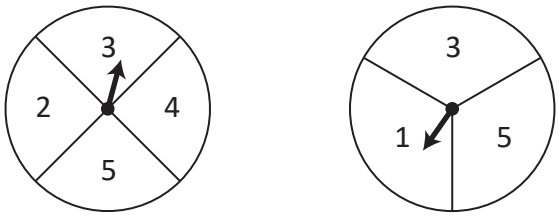
Marker Note:

→ Award a maximum of 1 mark if student consistently uses probability instead of odds.

Question 9 — Total: 3 marks

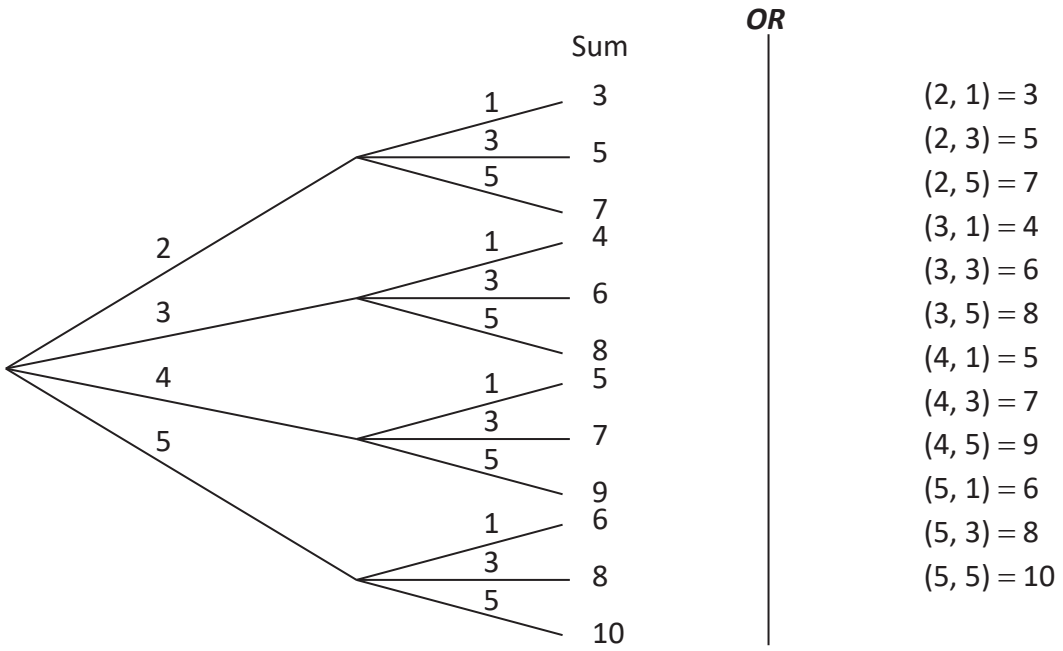
Learning Outcomes: 12.A.P.1, 12.A.P.3 — **Question Type: Constructed Response**

A student is playing a game using the two spinners shown below. The student spins each spinner once and adds the results.



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

(*2 marks*)



Other graphic organizers are possible.

b) State the probability that the sum is 8.

(*1 mark*)

The probability is $\frac{2}{12}$, $\frac{1}{6}$, 0.17, or 16.67%.

Marking Key

1. 1 mark for appropriate graphic organizer in (a)
2. 1 mark for appropriate sums in (a)
3. 1 mark for consistent answer in (b)

Question 10 — Total: 4.5 marks

Learning Outcomes: 12.A.P.3, 12.A.P.6 — **Question Type: Constructed Response**

In a group of 15 randomly selected students:

- 10 students are only signed up for the Applied math course
- 5 students are only signed up for the Essential math course

a) Determine the number of 6-person committees that can be made with exactly 2 Applied math students.

(*1.5 marks*)

$$_{10}C_2 \times {}_5C_4 = 225$$

There are 225 committees.

b) Determine the number of 6-person committees that can be made with no more than 3 Essential math students.

(*3 marks*)

Method A:

$$_{15}C_6 - \left[\left({}_5C_4 \times {}_{10}C_2\right) + \left({}_5C_5 \times {}_{10}C_1\right)\right] = 4770$$

Method B:

$$\left({}_5C_0 \times {}_{10}C_6\right) + \left({}_5C_1 \times {}_{10}C_5\right) + \left({}_5C_2 \times {}_{10}C_4\right) + \left({}_5C_3 \times {}_{10}C_3\right) = 4770$$

There are 4770 committees.

Marking Key

1. 0.5 mark for $_{10}C_2$ in (a)
2. 0.5 mark for $_5C_4$ in (a)
3. 0.5 mark for consistent product in (a)

Method A

4. 1 mark for $_{15}C_6$ in (b)
5. 1 mark for $_5C_5 \times {}_{10}C_1$ in (b)
6. 0.5 mark for second consistent case in (b)
7. 0.5 mark for consistent difference in (b)

Method B

4. 1 mark for one correct case in (b)
5. 0.5 mark for second consistent case in (b)
6. 0.5 mark for third consistent case in (b)
7. 0.5 mark for fourth consistent case in (b)
8. 0.5 mark for consistent sum in (b)

Marker Note:

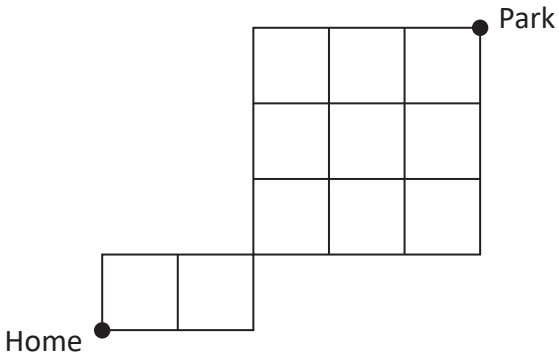
→ Award a maximum of 3.5 marks if student consistently uses permutations instead of combinations.

Question 11 — Total: 2 marks

Learning Outcomes: 12.A.P.4, 12.A.P.5 — **Question Type: Constructed Response**

Brent is walking to the park to meet some friends.

Determine the number of different paths Brent can take from his home to the park if he can only travel North and East.

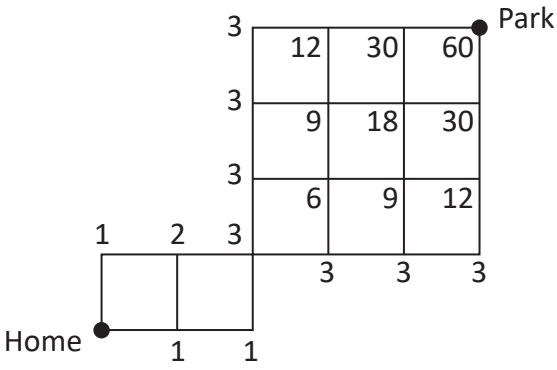


Method A:

$$\frac{3!}{2!}\times\frac{6!}{3!3!}=60$$

There are 60 paths.

Method B:



There are 60 paths.

Marking Key

1. 1 mark for appropriate work
2. 1 mark for consistent answer

Question 12 — Total: 3 marks

Learning Outcomes: 12.A.P.3, 12.A.P.4 — **Question Type: Constructed Response**

Using the digits 2, 3, 5, 6, 7:

a) State how many different 3-digit numbers can be made if repetition is allowed.

(*1 mark*)

$$\underline{5} \times \underline{5} \times \underline{5} = 125$$

There are 125 numbers.

b) Determine how many different 3-digit numbers are greater than 650 if repetition is allowed.

(*1.5 marks*)

Case 1: $\underset{6}{\underline{1}} \times \underset{5,\ 6,\ \text{or}\ 7}{\underline{3}} \times \underline{5} = 15$

Case 2: $\underset{7}{\underline{1}} \times \underline{5} \times \underline{5} = 25$

$$15 + 25 = 40$$

There are 40 numbers.

c) State the probability that a 3-digit number will be greater than 650 if repetition is allowed.

(*0.5 mark*)

The probability is $\frac{40}{125}$, $\frac{8}{25}$, 0.32, or 32%.

Marking Key

1. 1 mark for answer in (a)
2. 0.5 mark for a first case in (b)
3. 0.5 mark for the second case in (b)
4. 0.5 mark for consistent sum in (b)
5. 0.5 mark for consistent probability in (c)

Marker Note:

→ Award a maximum of 0.5 mark in (b) for $2 \times 3 \times 5 = 30$.

Question 13 — Total: 2 marks

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

There are 10 people in an office. They are split into three committees.

- One committee has 4 people.
- Two committees have 3 people each.
- A person can only be on one committee.

Determine the total number of ways these three committees can be formed.

$${}_{10}C_4 \times {}_6C_3 \times {}_3C_3 = 4200$$

OR

$${}_{10}C_3 \times {}_7C_3 \times {}_4C_4 = 4200$$

OR

$${}_{10}C_3 \times {}_7C_4 \times {}_3C_3 = 4200$$

There are 4200 ways these three committees can be formed.

Marking Key

1. 0.5 mark for ${}_{10}C_4$ or ${}_{10}C_3$
2. 0.5 mark for committee 2
3. 0.5 mark for committee 3
4. 0.5 mark for consistent product of combinations

Marker Note:

→ Award a maximum of 1 mark if student consistently uses permutations instead of combinations.

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Financial Mathematics

Question 14 — Total: 1 mark

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

The table below shows the value of a speedboat over a two-year period.

Year	Value
0	$53 000.00
1	$40 810.00
2	$31 423.70

Select the annual rate of depreciation.

A) 23%

B) 41%

C) 59%

D) 77%

Marking Key

Correct answer: A

Question 15 — Total: 1.5 marks

Learning Outcome: 12.A.FM.3 — **Question Type: Constructed Response**

Blaire's parents invest $10 000.00 when Blaire is born to use towards college. The investment has an annual interest rate of 8.00%.

Using the rule of 72, determine approximately how much money Blaire will have when they are 18 years old.

$$t = \frac{72}{i} = \frac{72}{8} = 9 \text{ years to double the investment}$$

0 years: $10 000.00

9 years: $20 000.00

18 years: $40 000.00

Blaire will have $40 000.00 when they are 18 years old.

Marking Key

1. 0.5 mark for correct years to double the investment
2. 0.5 mark for doubling value
3. 0.5 mark for consistent answer

Question 16 — Total: 5.5 marks

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

Cody will retire in 40 years. He starts to build a financial portfolio. The portfolio consists of the following investments:

Investment 1: He invests $12 000.00 in a bond earning simple interest at an annual interest rate of 6.00%.

Investment 2: He makes regular monthly deposits of $500.00 in a tax-free savings account (TFSA) with an annual interest rate of 3.45% compounded monthly.

a) Determine the value of Investment 1 when Cody retires.

(*1 mark*)

$$I = Prt$$

$$= (\$12\,000.00)(0.06)(40)$$

$$= \$28\,800.00$$

$$\text{Future value} = \$12\,000.00 + \$28\,800.00$$

$$= \$40\,800.00$$

The value will be $40 800.00.

b) Determine the value of Investment 2 when Cody retires.

(*2 marks*)

TVM Solver:

Number of payments:	480
Interest rate:	3.45
Present value:	0
Payments:	-500.00
Future value: ■	516 006.831 9
Payments per year:	12
Compounds per year:	12

The value will be $516 006.83.

c) Determine the total amount Cody invested into his portfolio when he retires.

(*1 mark*)

$$\text{Amount invested in portfolio} = \$12\,000.00 + (\$500.00 \times 12 \times 40)$$

$$= \$12\,000.00 + \$240\,000.00$$

$$= \$252\,000.00$$

Cody will have invested $252 000.00.

d) State the value of Cody's portfolio when he retires.

(*0.5 mark*)

$$\text{Value of portfolio} = \$40\,800.00 + \$516\,006.83$$

$$= \$556\,806.83$$

The value of the portfolio will be $556 806.83.

e) Determine the average rate of return on Cody's portfolio when he retires.

(*1 mark*)

$$\text{Rate of return (\%)} = \frac{\left(\begin{array}{c}\text{Current value} \\ \text{of portfolio}\end{array} - \begin{array}{c}\text{Previous value} \\ \text{of portfolio}\end{array}\right)}{\text{Previous value of portfolio}} \times 100$$

$$= \frac{(\$556\,806.83 - \$252\,000.00)}{\$252\,000.00} \times 100$$

$$= \frac{\$304\,806.83}{\$252\,000.00} \times 100$$

$$= 120.96\%$$

The rate of return will be 120.96%.

Marking Key

1. 0.5 mark for interest in (a)
2. 0.5 mark for consistent value of investment in (a)
3. 1.5 marks for appropriate work in (b) (deduct 0.5 mark for each incorrect input)
4. 0.5 mark for consistent answer for the correct output in (b)
5. 0.5 mark for total principal paid in Investment 2 in (c)
6. 0.5 mark for consistent sum of principal paid in (c)
7. 0.5 mark for consistent value of portfolio in (d)
8. 0.5 mark for appropriate work in (e)
9. 0.5 mark for consistent rate of return in (e)

Question 17 — Total: 4 marks

Learning Outcomes: 12.A.FM.2, 12.A.FM.3 — **Question Type: Constructed Response**

Kultaj is hoping to buy a house valued at $340 000.00. She has saved $50 000.00 to use on a down payment. The bank offers a 25-year mortgage at an annual interest rate of 5.25% compounded semi-annually.

a) Determine Kultaj's monthly mortgage payment.

(*2 marks*)

TVM Solver:

Number of payments:	300
Interest rate:	5.25
Present value:	290 000.00
Payments: ■	-1728.162 2...
Future value:	0
Payments per year:	12
Compounds per year:	2

Her monthly mortgage payment is $1728.16.

b) Kultaj has a gross annual income of $90 000.00. The monthly property taxes for the house would be $390.00 and the monthly heating cost would be approximately $240.00. Determine the gross debt service ratio (GDSR).

(*1 mark*)

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

$$= \frac{\$1728.16 + \$390.00 + \$240.00}{\$7500.00} \times 100$$

$$= 31.44\%$$

The GDSR is 31.44%.

c) Explain if the bank would lend her money based on the GDSR.

(*1 mark*)

The bank would lend her money because the GDSR is less than 32%.

Marking Key

1. 1.5 marks for appropriate work in (a) (deduct 0.5 mark for each incorrect input)
2. 0.5 mark for consistent answer for the correct output in (a)
3. 0.5 mark for gross monthly income in (b)
4. 0.5 mark for consistent GDSR in (b)
5. 1 mark for appropriate explanation with reference to 32% in (c)

Question 18 — Total: 4 marks

Learning Outcomes: 12.A.FM.1, 12.A.FM.2 — **Question Type: Constructed Response**

Janelle wants to buy a new laptop for $1275.00, taxes included.

- The store is offering a 0% interest rate promotion with no payments for 6 months.
- If the full amount is not paid within 6 months, interest will be charged from the date of purchase at an annual interest rate of 21.99% compounded monthly.

a) Janelle makes no payments during the first 6 months and is now charged interest. Determine the total amount Janelle will owe 6 months after the date of purchase.

(*2 marks*)

TVM Solver:

Number of payments:	6
Interest rate:	21.99
Present value:	1275.00
Payments:	0
Future value: ■	-1421.767 623
Payments per year:	12
Compounds per year:	12

Janelle will owe $1421.77.

b) After 6 months, Janelle starts making monthly payments of $200.00 at an annual interest rate of 21.99% compounded monthly. Determine how many months Janelle will take to pay off the loan.

(*2 marks*)

TVM Solver:

Number of payments: ■	7.686 059 862
Interest rate:	21.99
Present value:	1421.77
Payments:	-200.00
Future value:	0
Payments per year:	12
Compounds per year:	12

Janelle will take 8 months to repay the loan.

Marking Key

1. 1.5 marks for appropriate work in (a) (deduct 0.5 mark for each incorrect input)
2. 0.5 mark for consistent answer for the correct output in (a)
3. 1.5 marks for appropriate work in (b) (deduct 0.5 mark for each incorrect input)
4. 0.5 mark for consistent answer for the correct output in (b)

Question 19 — Total: 2 marks

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

Explain one advantage and one disadvantage of leasing a new vehicle compared to purchasing the same vehicle.

Advantages:

- access to newer vehicles
- always under manufacturer's warranty
- no long-term commitment

Disadvantages:

- mileage restrictions
- no equity
- no possibility of customization

Other answers are possible.

Marking Key

1. 1 mark for appropriate advantage
2. 1 mark for appropriate disadvantage

Design and Measurement

Question 20 — Total: 1 mark

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

The town of Kirksel has a water tower in the shape of a sphere. It holds 26 740 ft^3 of drinking water.

Select the radius of the water tower.

A) 18.55 ft.

B) 39.79 ft.

C) 46.13 ft.

D) 79.90 ft.

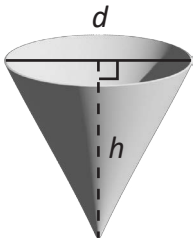
Marking Key

Correct answer: A

Question 21 — Total: 3 marks

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

Michelle has an ice cream cone.



- The diameter is 7 cm wide.
- The height is 12 cm high.

a) Calculate the surface area of the outside of the cone.

(*2 marks*)

$$a^2 + b^2 = c^2$$
$$3.5^2 + 12^2 = c^2$$
$$156.25 = c^2$$
$$12.5 = c$$

The slant height is 12.5 cm.

$$\text{Surface area} = \pi rs$$
$$= \pi(3.5)(12.5)$$
$$= 137.444\ldots$$

The surface area is 137.44 cm^2.

b) State the cost of coating 30% of the outside of the cone with chocolate if the chocolate costs \$0.04 per cm^2.

(*1 mark*)

$$(137.444\ldots)(0.30)(\$0.04) = \$1.649\ldots$$

The cost of the chocolate is \$1.65.

Marking Key

1. 1 mark for slant height in (a)
2. 0.5 mark for appropriate work calculating surface area in (a)
3. 0.5 mark for consistent surface area in (a)
4. 1 mark for consistent cost in (b)

Question 22 — Total: 1.5 marks

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

Corinne incorrectly calculated the surface area of a cylinder.

a) Indicate her mistake.

(*0.5 mark*)

$$\text{Surface area} = 2\pi(3.06) + 2\pi(3.06)(9)$$
$$= 19.226\,5\ldots + 173.038\,9\ldots$$
$$= 192.27\ \text{cm}^2$$

Method A:

She forgot to square the first radius.

Method B:

She should not have squared the second radius.

b) State the correct surface area.

(*1 mark*)

Method A:

$$\text{Surface area} = 2\pi r^2 + 2\pi rh$$
$$= 2\pi(3.06)^2 + 2\pi(3.06)(9)$$
$$= 58.833\,2\ldots + 173.038\,9\ldots$$
$$= 231.87\ \text{cm}^2$$

Method B:

$$\text{Surface area} = 2\pi r^2 + 2\pi rh$$
$$= 2\pi(3.06) + 2\pi\left(\sqrt{3.06}\right)(9)$$
$$= 19.226\,5\ldots + 98.919\,7\ldots$$
$$= 118.15\ \text{cm}^2$$

Marking Key

1. 0.5 mark for identifying the mistake in the formula in (a)
2. 1 mark for consistent answer in (b)

Question 23 — Total: 5 marks

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

Corbin wants to build a rectangular outdoor curling rink.

His backyard allows him to build a rink with a length from 48 ft. to 60 ft., and a width from 10 ft. to 20 ft.

a) State a possible set of dimensions for his rink.

(*0.5 mark*)

Minimum:

48 ft. by 10 ft.

Maximum:

60 ft. by 20 ft.

Other answers are possible.

b) His rink has a perimeter made of wood, one board high. A 12 ft. board costs $51.20, taxes included. Calculate the total cost of wood needed, using the dimensions you stated in (a).

(*1.5 marks*)

Minimum (10 boards):

$10 \times \$51.20 = \$512.00$

The cost is $512.00.

Maximum (14 boards):

$14 \times \$51.20 = \$716.80$

The cost is $716.80.

Other answers are possible.

c) Corbin needs to fill the rectangular rink with water in order to make ice. He wants a depth of 8 in. Determine the volume of water he needs.

(*1 mark*)

Minimum:

$$V = 48 \times 10 \times \frac{8 \text{ in.}}{12 \text{ in./ft.}}$$

$$= 320 \text{ ft}^3$$

The volume is 320 ft^3.

Maximum:

$$V = 60 \times 20 \times \frac{8 \text{ in.}}{12 \text{ in./ft.}}$$

$$= 800 \text{ ft}^3$$

The volume is 800 ft^3.

Other answers are possible.

d) Water costs \$2.00 per 35 ft^3. Determine the cost of water used in (c).

(*1 mark*)

Minimum:

$$\frac{320\ ft^3}{35\ ft^3} = 9.142\ 8\ldots$$

$$9.142\ 8\ldots \times \$2.00 = \$18.29$$

The cost is \$18.29.

Maximum:

$$\frac{800\ ft^3}{35\ ft^3} = 22.857\ 1\ldots$$

$$22.857\ 1\ldots \times \$2.00 = \$45.71$$

The cost is \$45.71.

Other answers are possible.

e) Corbin has a budget of \$800.00 for the rink. State how much money he has left over to purchase lights, after purchasing boards and water.

(*1 mark*)

Minimum:

$$\$800.00 - \$512.00 - \$18.29 = \$269.71$$

He has \$269.71 left over.

Maximum:

$$\$800.00 - \$716.80 - \$45.71 = \$37.49$$

He has \$37.49 left over.

Other answers are possible.

Marking Key

1. 0.5 mark for dimensions in (a)
2. 1 mark for number of boards in (b)
3. 0.5 mark for consistent cost in (b)
4. 0.5 mark for conversion in (c)
5. 0.5 mark for consistent volume in (c)
6. 0.5 mark for consistent amount of water in (d)
7. 0.5 mark for consistent cost in (d)
8. 1 mark for consistent surplus in (e)

Marker Note:

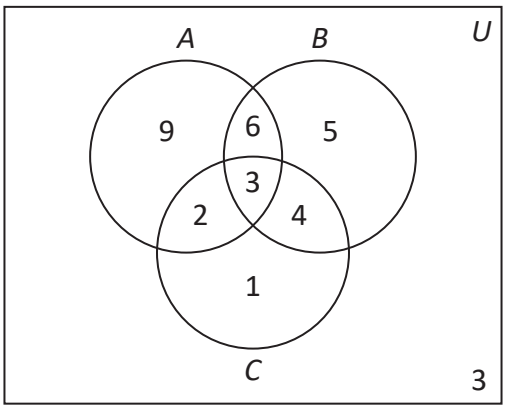
→ Accept answers using whole units of water in (d).

Logical Reasoning

Question 24 — Total: 1 mark

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

Given the Venn diagram below,



select the number of elements in $(A \cup B) \setminus C$.

A) 4

B) 10

C) 13

D) 20

Marking Key

Correct answer: D

Question 25 — Total: 2 marks

Learning Outcome: 12.A.L.3 — **Question Type: Constructed Response**

Consider the following true conditional statement:

"If I live in the capital city of Manitoba, then I live in Winnipeg."

a) Write the converse of the conditional statement above.

(*1 mark*)

"If I live in Winnipeg, then I live in the capital city of Manitoba."

b) State the biconditional statement if possible. Otherwise, state a counterexample.

(*1 mark*)

"I live in the capital city of Manitoba if and only if I live in Winnipeg."

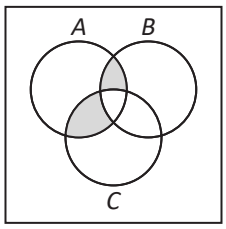
Marking Key

1. 1 mark for converse in (a)
2. 1 mark for biconditional statement in (b)

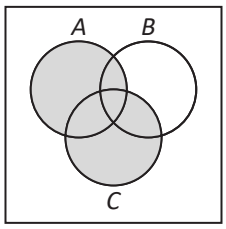
Question 26 — Total: 1.5 marks

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

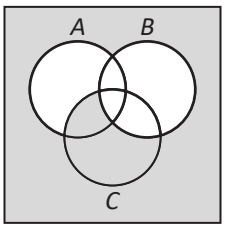
Match each set notation to its Venn diagram.



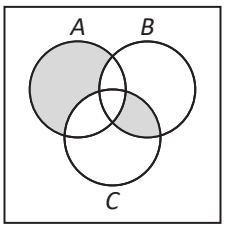
ii



i



iv



iii

i: $(A \cup C)$

ii: $\big((A \cap B) \setminus C\big) \cup \big((A \cap C) \setminus B\big)$

iii: $(A \setminus B \setminus C) \cup \big((B \cap C) \setminus A\big)$

iv: $(A \cup B \cup C)' \cup \big((A \cap C) \setminus B\big) \cup (C \setminus A \setminus B)$

Marking Key

1. 0.5 mark for correctly placing one set notation
2. 0.5 mark for correctly placing a second set notation
3. 0.5 mark for correctly placing the remaining set notations

Question 27 — Total: 3 marks

Learning Outcome: 12.A.L.3 — **Question Type: Constructed Response**

Given the following statements:

- I have a fruit.
- I am learning biology.
- I am learning systems.
- I am learning math.
- I can make a snack.
- I have a strawberry.
- I am studying plants.
- I am studying inequalities.

a) Using two of the above statements, write a conditional statement.

(*1 mark*)

"If I have a strawberry, then I have a fruit."

OR

"If I am studying plants, then I am learning biology."

Other answers are possible.

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

(*1 mark*)

"If I don't have a strawberry, then I do not have a fruit."

OR

"If I am not studying plants, then I am not learning biology."

Other answers are possible.

c) State a counterexample for either statement in (a) or (b).

(*1 mark*)

You can have a banana.

OR

You can be studying systems.

Other answers are possible.

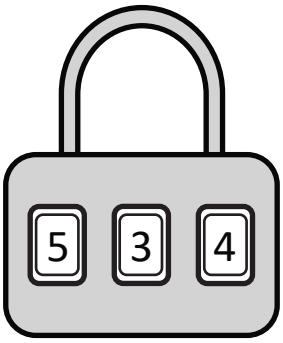
Marking Key

1. 1 mark for a conditional statement in (a)
2. 1 mark for inverse in (b)
3. 1 mark for counterexample in (c)

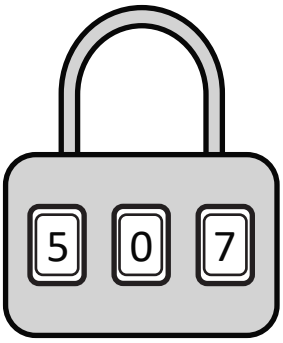
Question 28 — Total: 2 marks

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

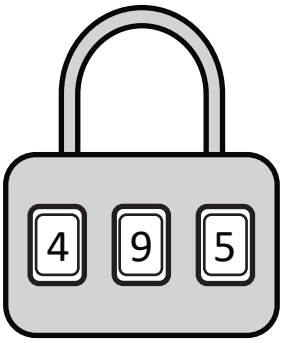
The following are clues to open a three-digit lock:



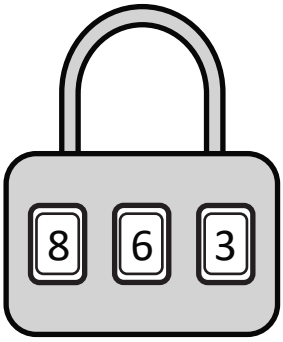
only one digit is correct and perfectly placed



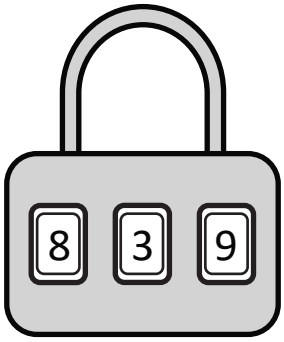
only one digit is correct but wrongly placed



two digits are correct but wrongly placed

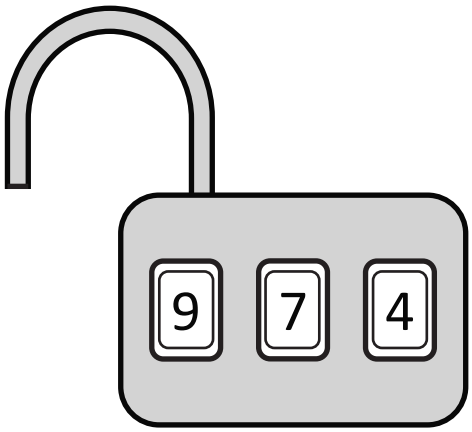


nothing is correct



only one digit is correct but wrongly placed

Determine the three-digit code.



Marking Key

1. 1 mark for correctly placing one digit
2. 0.5 mark for correctly placing a second digit
3. 0.5 mark for correctly placing the third digit

Appendices

Appendix A:
Table of Questions by Unit and Learning Outcome

Relations and Functions		
Question	**Learning Outcome(s)**	**Mark(s)**
1	12.A.R.1, 12.A.R.2, 12.A.R.3	1
2	12.A.R.2	1
3 a)	12.A.R.3	1
3 b)	12.A.R.3	1
3 c)	12.A.R.3	1
4 a)	12.A.R.1	1
4 b)	12.A.R.1	1
4 c)	12.A.R.1	1
4 d)	12.A.R.1	1
5 a)	12.A.R.2	1
5 b)	12.A.R.2	1.5
6 a)	12.A.R.1	2
6 b)	12.A.R.1	1
6 c)	12.A.R.1	1
		Total: 15.5
Probability		
Question	**Learning Outcome(s)**	**Mark(s)**
7	12.A.P.2	1
8 a)	12.A.P.1	1
8 b)	12.A.P.1	1
9 a)	12.A.P.1, 12.A.P.3	2
9 b)	12.A.P.1, 12.A.P.3	1
10 a)	12.A.P.3, 12.A.P.6	1.5
10 b)	12.A.P.3, 12.A.P.6	3
11	12.A.P.4, 12.A.P.5	2
12 a)	12.A.P.3, 12.A.P.4	1
12 b)	12.A.P.3, 12.A.P.4	1.5
12 c)	12.A.P.3, 12.A.P.4	0.5
13	12.A.P.6	2
		Total: 17.5

Financial Mathematics		
Question	**Learning Outcome(s)**	**Mark(s)**
14	12.A.FM.2	1
15	12.A.FM.3	1.5
16 a)	12.A.FM.1, 12.A.FM.3	1
16 b)	12.A.FM.1, 12.A.FM.3	2
16 c)	12.A.FM.1, 12.A.FM.3	1
16 d)	12.A.FM.1, 12.A.FM.3	0.5
16 e)	12.A.FM.1, 12.A.FM.3	1
17 a)	12.A.FM.2, 12.A.FM.3	2
17 b)	12.A.FM.2, 12.A.FM.3	1
17 c)	12.A.FM.2, 12.A.FM.3	1
18 a)	12.A.FM.1, 12.A.FM.2	2
18 b)	12.A.FM.1, 12.A.FM.2	2
19	12.A.FM.2	2
		Total: 18
Design and Measurement		
Question	**Learning Outcome(s)**	**Mark(s)**
20	12.A.D.1	1
21 a)	12.A.D.1	2
21 b)	12.A.D.1	1
22 a)	12.A.D.1	0.5
22 b)	12.A.D.1	1
23 a)	12.A.D.1	0.5
23 b)	12.A.D.1	1.5
23 c)	12.A.D.1	1
23 d)	12.A.D.1	1
23 e)	12.A.D.1	1
		Total: 10.5
Logical Reasoning		
Question	**Learning Outcome(s)**	**Mark(s)**
24	12.A.L.2	1
25 a)	12.A.L.3	1
25 b)	12.A.L.3	1
26	12.A.L.2	1.5
27 a)	12.A.L.3	1
27 b)	12.A.L.3	1
27 c)	12.A.L.3	1
28	12.A.L.1	2
		Total: 9.5

Total Marks for Test: 71

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 number: _____

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: _____