

Grade 12  
Applied Mathematics  
Achievement Test

# Marking Guide

Use in conjunction with *Exemplars*

June 2026

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

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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.

## 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.



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# Contents

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General Marking Instructions	1
Marking Keys	5
Relations and Functions	7
Probability	14
Financial Mathematics	21
Design and Measurement	27
Logical Reasoning	32
Appendices	37
Appendix A: Table of Questions by Unit and Learning Outcome	39
Appendix B: Irregularities in Provincial Tests	41
Irregular Test Booklet Report	43

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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 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:

- Ⓐ an arithmetic error
- Ⓟ a procedural error (not a conceptual error)
- Ⓘ a lack of clarity in the explanation, the description, or the justification
- Ⓣ a terminology error in the explanation

### **E1 Final Answer**

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- 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**

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- 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**

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- 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.,  $\text{cm}^2$  instead of  $\text{cm}^3$ , or vice versa)

### **E6 Rounding**

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- 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).

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

Communication Errors			
Preliminary Mark	–	(Number of error types × 0.5)	= Final Mark
46	–	(2 × 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  
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# Marking Keys

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## Relations and Functions

---

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

---

Select the equation of a cubic function that has the following characteristics:

- extends from quadrant II to quadrant IV
- has a negative  $y$ -intercept

A)  $y = -2x^3 + 2x^2 - x + 4$

B)  $y = 2x^3 - 2x^2 - x - 4$

C)  $y = -2x^3 + 2x^2 - x - 4$

D)  $y = 2x^3 + 2x^2 + x + 4$

---

**Marking Key**

Correct answer: C

---

**Question 2****Total: 1 mark****Learning Outcome: 12.A.R.3****Question Type: Selected Response**

---

Select the period of the following sinusoidal equation:

$$y = 2.50\sin(1.50x) - 6.50$$

- A) -6.50
- B) -0.97
- C) 1.50
- D) **4.19**

---

**Marking Key**

Correct answer: D

---

**Question 3****Total: 3 marks****Learning Outcome: 12.A.R.1****Question Type: Constructed Response**

---

A football player kicks a ball. The height of the ball before it hits the ground is modelled by the following equation:

$$h = -32.15t^2 + 72.18t + 3.5$$

where  $h$  represents the height of the ball (in feet)  
and  $t$  represents the time (in seconds).

a) State the initial height of the football.

(0.5 mark)

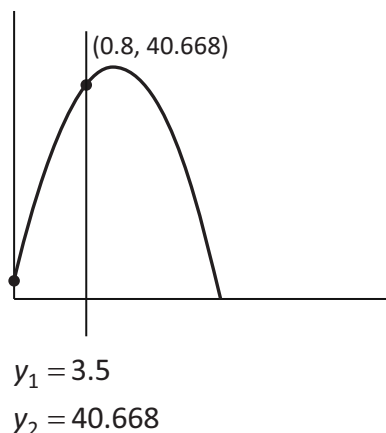
The initial height of the football is 3.5 feet.

b) Determine the change in the height of the ball in the first 0.8 seconds.

(1.5 marks)

When  $x = 0.8$   
 $y = 40.668$

**OR**



$$\begin{aligned}\Delta y &= 40.668 - 3.5 \\ &= 37.168\end{aligned}$$

The change in height is 37.17 feet.

c) State the range of the equation in this situation.

(1 mark)

$$[0, 44.01] \quad \text{OR} \quad \{h \mid 0 \leq h \leq 44.01\}$$

---

**Marking Key**

- 1 0.5 mark for answer in (a)
- 2 1 mark for consistent second  $y$ -value in (b)
- 3 0.5 mark for consistent difference in (b)
- 4 0.5 mark for consistent upper and lower bounds of the range in (c)
- 5 0.5 mark for inclusivity of both upper and lower bounds in (c)

**Question 4****Total: 3 marks**

Learning Outcome: 12.A.R.2

Question Type: Constructed Response

To treat an infection, Laertes takes medication. One pill contains 500 mg of medication. Once taken, the body filters out 60% of the medication every 5 hours.

- a) State the exponential regression equation that models the remaining quantity in Laertes' body as a function of time, in hours.

You may use the table below.

<b>Time (h)</b>	0	5	10	15
<b>Remaining Quantity (mg)</b>	500	200	80	32

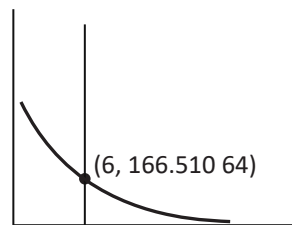
(1 mark)

Regression equation:  $y = 500(0.83)^x$  **OR**  $y = 500(0.40)^{\frac{x}{5}}$

- b) State the quantity of medication remaining in Laertes' body 6 hours after taking the pill.

(1 mark)

When  $x = 6$   
 $y = 166.51$

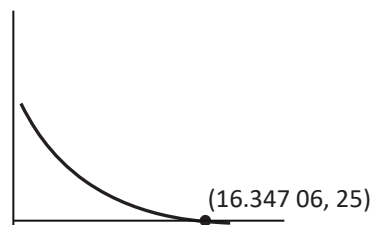
**OR**

There is 166.51 mg of medication remaining.

- c) Determine the time when only 25 mg of medication remain in Laertes' body.

(1 mark)

When  $y = 25$   
 $x = 16.35$

**OR**

At 16.35 h, the remaining quantity is 25 mg.

**Marking Key**

- 1 0.5 mark for initial value in (a)
- 2 0.5 mark for rate of change with correct exponent in (a)
- 3 1 mark for consistent answer in (b)
- 4 0.5 mark for appropriate work in (c)
- 5 0.5 mark for consistent answer in (c)

*Marker Note:*

→ If rounded values are used from the equation in (a), accept 163.47 mg in (b) and 16.08 h in (c).

**Question 5****Total: 3 marks**

Learning Outcome: 12.A.R.2

Question Type: Constructed Response

Erin invests \$5000.00. She buys an investment where interest is compounded continuously at a rate of 7%. The approximate growth of her investment is modelled by the following equation:

$$t = \frac{\ln\left(\frac{A}{5000}\right)}{0.07}$$

where  $A$  represents the value of the investment (in dollars)  
and  $t$  represents the time (in years).

- a) Explain why the domain in this situation is  $D: [5000, \infty)$ .  
(1 mark)

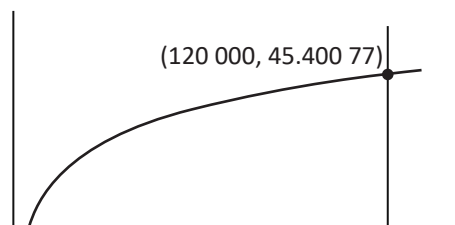
The initial amount invested is \$5000.00 and the investment will only grow.

**Other explanations are possible.**

- b) State when this investment is worth \$120 000.00.  
(1 mark)

When  $x = 120\,000.00$   
 $y = 45.40$

**OR**

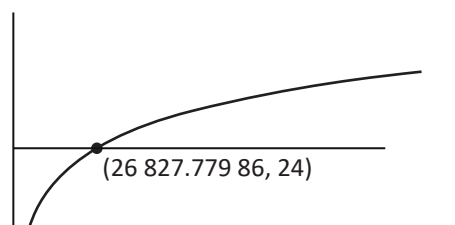


The investment is worth \$120 000.00 after 45.40 years.

- c) Determine the value of the investment after 24 years.  
(1 mark)

When  $y = 24$   
 $x = 26\,827.78$

**OR**



The value of the investment after 24 years is \$26 827.78.

**Marking Key**

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

**Question 6****Total: 4 marks**

Learning Outcome: 12.A.R.3

Question Type: Constructed Response

Kulraj visits an amusement park and goes on a swing ride. Their height is recorded during the ride, as shown in the following table.

Time (s)	0	2	4	6	8
Height (m)	7	5	3	5	7

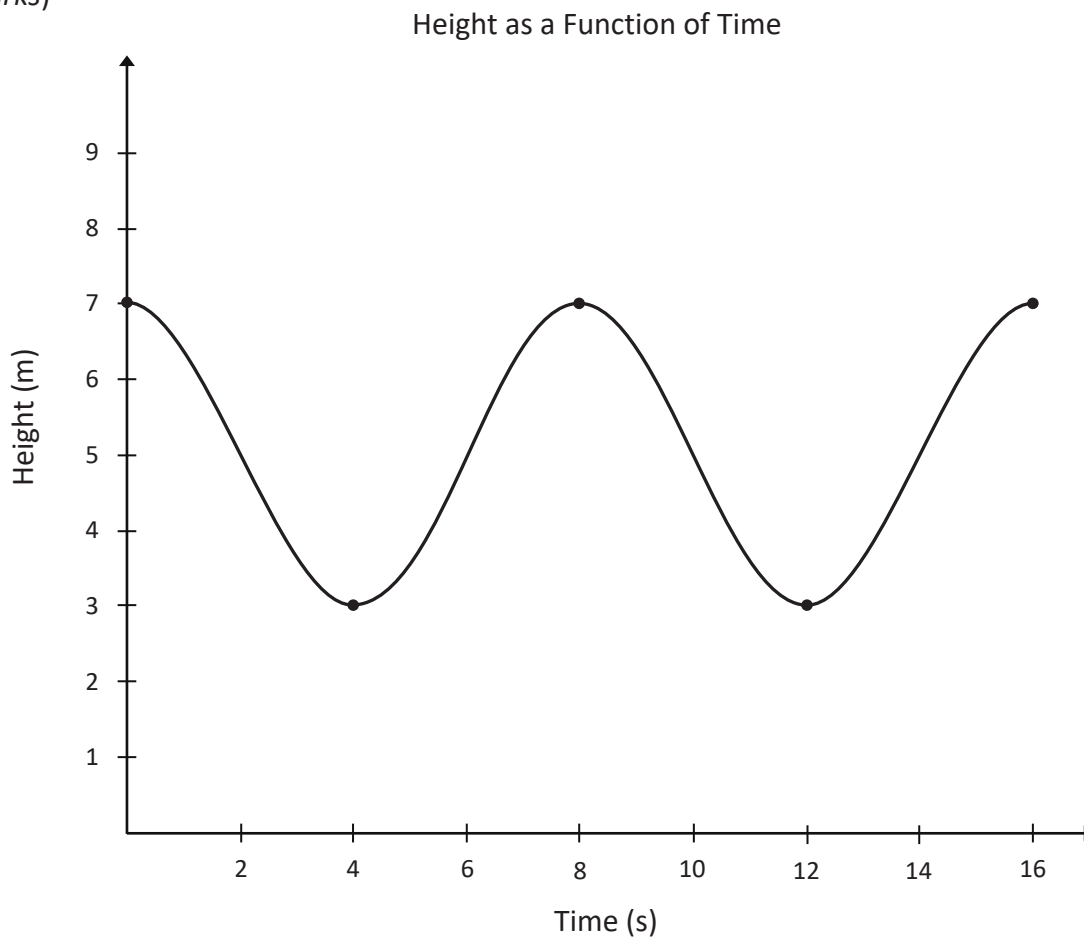
a) State the sinusoidal regression equation that models this situation.

(1 mark)

$$y = 2\sin(0.79x + 1.57) + 5$$

b) Create a clearly labelled graph of the equation in (a) over the domain  $[0, 16]$ .

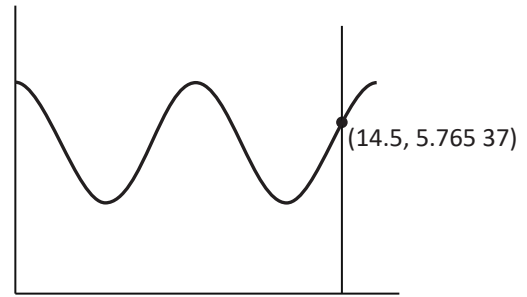
(2 marks)



- c) State the height of Kulraj at 14.5 seconds.  
(1 mark)

When  $x = 14.5$   
 $y = 5.77$  m

**OR**



At 14.5 seconds, the height is 5.77 m.

---

### Marking Key

- 1 0.5 mark for two values in (a)
- 2 0.5 mark for remaining two values in (a)
- 3 0.5 mark for using an appropriate domain for the context of the question in (b)
- 4 0.5 mark for using an appropriate range for the context of the question in (b)
- 5 1 mark for plotting the data and appropriate shape of the sinusoidal curve in (b)
- 6 1 mark for consistent answer in (c)

# Probability

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**Question 7****Total: 3 marks****Learning Outcome: 12.A.P.3****Question Type: Constructed Response/Selected Response**

---

There are 9 apples and 6 oranges in a fruit bowl.

- a) Phoebe selects two fruits to eat from the bowl.

Determine the probability that both fruits are the same.

(2 marks)

$$P(2 \text{ same fruit}) = P(\text{apple, apple}) + P(\text{orange, orange})$$

$$= \left(\frac{9}{15}\right)\left(\frac{8}{14}\right) + \left(\frac{6}{15}\right)\left(\frac{5}{14}\right)$$

$$= \frac{72}{210} + \frac{30}{210}$$

$$= \frac{102}{210}$$

The probability is  $\frac{102}{210}$ ,  $\frac{17}{35}$ , 0.49, or 48.57%.

- b) Select the event that represents the scenario in (a).

(1 mark)

- A) **dependent events**
- B) independent events
- C) events with replacement
- D) events with equal probability

---

**Marking Key**

- 1 0.5 mark for considering dependency in the numerator in (a)
- 2 0.5 mark for considering dependency in the denominator in (a)
- 3 0.5 mark for multiplying the number of same fruit in (a)
- 4 0.5 mark for consistent sum in (a)
- 5 1 mark for correct answer in (b) (Correct answer: A)

---

**Question 8****Total: 3 marks****Learning Outcome: 12.A.P.4****Question Type: Constructed Response**

---

Monica is arranging a row of picture frames over her fireplace. She has 4 different rectangular frames and 3 different circular frames.

- a) Determine the number of ways the frames can be arranged if she wants a rectangular frame at both ends.

(1.5 marks)

$$\underline{4} \times \underline{5} \times \underline{4} \times \underline{3} \times \underline{2} \times \underline{1} \times \underline{3} = 1440$$

There are 1440 ways.

- b) Determine the number of ways the frames can be arranged if the rectangular frames must be grouped together and the circular frames must be grouped together.

(1.5 marks)

$$2!3!4! = 288$$

There are 288 ways.

---

**Marking Key**

- ① 0.5 mark for rectangular frames at both ends in (a)
- ② 0.5 mark for remaining frames in the middle in (a)
- ③ 0.5 mark for consistent product in (a)
- ④ 0.5 mark for  $3!4!$  in (b)
- ⑤ 0.5 mark for  $2!$  in (b)
- ⑥ 0.5 mark for multiplying factorials in (b)

---

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

---

Janice rolls a 12-sided die.

Determine the probability that she rolls an odd number or a multiple of three.

$$P(\text{odd or multiple of three}) = P(\text{odd}) + P(\text{multiple of three}) - P(\text{both})$$

$$= \frac{6}{12} + \frac{4}{12} - \frac{2}{12}$$

$$= \frac{8}{12} \text{ or } \frac{2}{3}$$

The probability is  $\frac{8}{12}$ ,  $\frac{2}{3}$ , 0.67, or 66.67%.

---

**Marking Key**

- ① 0.5 mark for  $P(\text{odd})$
- ② 0.5 mark for  $P(\text{multiple of three})$
- ③ 0.5 mark for  $P(\text{both})$
- ④ 0.5 mark for consistent answer

---

**Question 10****Total: 1 mark****Learning Outcome: 12.A.P.5****Question Type: Constructed Response**

---

Rachel has been asked to state the expression to represent the total number of ways the letters can be arranged in the word **MANIFESTATION**.

They incorrectly stated the solution as:

$$13^P_{13}$$

Explain to Rachel how their error can be corrected.

The repeating letters need to be divided out from the total.

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**Marking Key**

- ① 1 mark for explanation

---

**Question 11****Total: 4 marks****Learning Outcomes: 12.A.P.1, 12.A.P.6****Question Type: Constructed Response**

---

Ross is an animal trainer. He is choosing 5 animals to participate at the next animal show. He has 6 dogs and 3 cats to choose from.

- a) Determine the number of ways the 5 animals can be chosen for the show.

(1 mark)

$${}_9C_5 = 126$$

There are 126 ways.

- b) Determine the number of ways the 5 animals can be chosen if he wants to bring exactly 2 cats.

(1.5 marks)

$${}_3C_2 \times {}_6C_3 = 60$$

There are 60 ways.

- c) State the probability that Ross chooses exactly 2 cats.

(0.5 mark)

The probability is  $\frac{60}{126}$ ,  $\frac{10}{21}$ , 0.48, or 47.62%.

- d) State the odds in favour of choosing exactly 2 cats.

(1 mark)

The odds in favour are 60:66 or 10:11.

---

**Marking Key**

- ① 0.5 mark for appropriate work in (a)
- ② 0.5 mark for consistent answer in (a)
- ③ 0.5 mark for  ${}_3C_2$  in (b)
- ④ 0.5 mark for  ${}_6C_3$  in (b)
- ⑤ 0.5 mark for consistent product in (b)
- ⑥ 0.5 mark for consistent probability in (c)
- ⑦ 1 mark for consistent odds in favour in (d)

*Marker Note:*

→ Deduct marks ① and ② (conceptual error) if student consistently uses permutations instead of combinations.

---

**Question 12****Total: 2 marks****Learning Outcome: 12.A.P.5****Question Type: Constructed Response**

---

Joey has 13 different coloured water bottles.

- a) Determine the number of ways Joey can arrange 3 water bottles on his kitchen counter if he has left 4 at school.

(1 mark)

$${}_9P_3 = 504$$

The water bottles can be arranged in 504 ways.

- b) Joey's school is collecting water bottles. He would like to donate 5 of his water bottles.

Determine how many ways the water bottles can be chosen.

(1 mark)

$${}_{13}C_5 = 1287$$

The water bottles can be chosen in 1287 ways.

---

**Marking Key**

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

---

**Question 13****Total: 2 marks****Learning Outcomes: 12.A.P.1, 12.A.P.2****Question Type: Constructed Response**

---

Chandler is playing in a badminton tournament. Based on his past performance, Chandler has determined that the probability of winning first place is  $\frac{1}{3}$ . The probability of finishing second place is  $\frac{3}{8}$ .

a) Determine the probability that Chandler does not place in the top two.

(1 mark)

$$\begin{aligned}P(\text{first or second})' &= 1 - \frac{1}{3} - \frac{3}{8} \\ &= \frac{24}{24} - \frac{8}{24} - \frac{9}{24} \\ &= \frac{7}{24}\end{aligned}$$

The probability is  $\frac{7}{24}$ , 0.29, or 29.17%.

b) State the odds against finishing in second place.

(1 mark)

The odds against are 5 : 3.

---

**Marking Key**

- ① 0.5 mark for appropriate work in (a)
- ② 0.5 mark for consistent answer in (a)
- ③ 1 mark for answer in (b)

## Financial Mathematics

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

---

Sam makes a one-time deposit of \$7000.00 into a savings account with an annual interest rate of 4.95%.

Select the compounding period that would result in the greatest amount of interest earned in Sam's account over a 5-year period.

- A) annually
- B) monthly
- C) weekly
- D) daily**

---

**Marking Key**

Correct answer: D

---

**Question 15****Total: 1 mark****Learning Outcome: 12.A.FM.2****Question Type: Selected Response**

---

The value of a collector car has appreciated 6.07% every year. Today, the car is worth \$164 900.

Select the value of the car 20 years ago.

- A) \$45 074.64
- B) \$50 742.20**
- C) \$148 006.22
- D) \$535 885.53

---

**Marking Key**

Correct answer: B

**Question 16****Total: 4 marks**

Learning Outcomes: 12.A.FM.1, 12.A.FM.2

Question Type: Constructed Response

Gunthar is comparing two different payment options for the latest smartphone.

**Option 1: Buy**

- The cost of the phone is \$1271.44, taxes included.
- There is a down payment of \$350.00.
- The remaining balance is financed with monthly payments at an interest rate of 7.99% compounded monthly over 2 years.

**Option 2: Rent**

- Make monthly payments of \$51.05 for 2 years.

a) Determine the monthly payment for Option 1.

(2 marks)

$$\$1271.44 - \$350.00 = \$921.44$$

TVM Solver:

Number of payments:	24
Interest rate:	7.99
Present value:	921.44
Payments: ■	-41.670 033 04
Future value:	0
Payments per year:	12
Compounds per year:	12

The monthly payment for Option 1 is \$41.67.

b) Determine the total cost for Option 1.

(1 mark)

$$\begin{aligned} \text{Total cost} &= (\$41.67)(2)(12) + \$350.00 \\ &= \$1000.08 + \$350.00 \\ &= \$1350.08 \end{aligned}$$

The total cost for Option 1 is \$1350.08.

c) Gunthar plans to get a new phone in 2 years.

Justify which option Gunthar should choose.

(1 mark)

**Option 1:**

- own the phone
- lower monthly payment

**Option 2:**

- lower total cost of \$1225.20 over 2 years
- no down payment

**Other justifications are possible.**

**Marking Key**

- 1.5 marks for appropriate work in (a) (deduct 0.5 mark for every incorrect input)
- 0.5 mark for consistent monthly payment in (a)
- 0.5 mark for appropriate work in (b)
- 0.5 mark for consistent answer in (b)
- 1 mark for appropriate justification in (c)

**Question 17****Total: 5 marks****Learning Outcomes: 12.A.FM.1, 12.A.FM.3****Question Type: Constructed Response**

Dene and Malia both plan to retire in 27 years. They each invest in a registered retirement savings plan (RRSP) that earns 3.10% compounded annually.

**Investment 1:** Dene starts investing immediately, depositing \$150.00 semi-monthly.

**Investment 2:** Malia starts investing 7 years before retirement, depositing \$1500.00 monthly.

a) Determine the value of the RRSP when Dene retires.

(2 marks)

*TVM Solver:*

Number of payments:	648
Interest rate:	3.10
Present value:	0
Payments:	-150.00
Future value: ■	150 871.846 9
Payments per year:	24
Compounds per year:	1

The value of the RRSP will be \$150 871.85.

b) Determine the value of the RRSP when Malia retires.

(2 marks)

*TVM Solver:*

Number of payments:	84
Interest rate:	3.10
Present value:	0
Payments:	-1500.00
Future value: ■	140 297.333 4
Payments per year:	12
Compounds per year:	1

The value of the RRSP will be \$140 297.33.

c) Explain a disadvantage for one of the investments.

(1 mark) **Disadvantage for Investment 1:**

- deposits over a long period of time

***Other explanations are possible.***

**Disadvantage for Investment 2:**

- high payment amount

---

**Marking Key**

- 1.5 marks for appropriate work in (a) (deduct 0.5 mark for every incorrect input)
- 0.5 mark for consistent answer in (a)
- 1.5 marks for appropriate work in (b) (deduct 0.5 mark for every incorrect input)
- 0.5 mark for consistent answer in (b)
- 1 mark for appropriate disadvantage for Investment 1 or Investment 2 in (c)

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**Question 18****Total: 4 marks****Learning Outcomes: 12.A.FM.1, 12.A.FM.3****Question Type: Constructed Response**

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After high school, Dakota invests \$10.00 each day for 5 years in a tax-free savings account (TFSA), with an interest rate of 4.75% compounded monthly.

- a) Determine the value of his investment after 5 years.

(2 marks)

*TVM Solver:*

Number of payments:	1825
Interest rate:	4.75
Present value:	0
Payments:	-10.00
Future value: ■	20 593.090 92
Payments per year:	365
Compounds per year:	12

The value of his investment will be \$20 593.09.

- b) He plans to withdraw the full amount over the next 10 years by making biweekly withdrawals.

Determine the amount of each withdrawal if the interest rate remains at 4.75% compounded monthly.

(2 marks)

*TVM Solver:*

Number of payments:	260
Interest rate:	4.75
Present value:	-20 593.09
Payments: ■	99.546 584 74
Future value:	0
Payments per year:	26
Compounds per year:	12

The amount of each withdrawal will be \$99.55.

---

**Marking Key**

- ① 1.5 marks for appropriate work in (a) (deduct 0.5 mark for every incorrect input)
- ② 0.5 mark for consistent answer in (a)
- ③ 1.5 marks for appropriate work in (b) (deduct 0.5 mark for every incorrect input)
- ④ 0.5 mark for consistent answer in (b)

---

**Question 19****Total: 3 marks****Learning Outcome: 12.A.FM.3****Question Type: Constructed Response**

---

Mr. Beans has \$3000.00 in a savings account, a car worth \$37 000.00, some long-term investments worth \$35 000.00, and a loan for \$32 000.00.

He owns a house valued at \$175 000.00. He has a mortgage of \$160 000.00.

a) Calculate his net worth.

(1 mark)

Assets:			
\$3000.00			
\$37 000.00	Liabilities:		Net worth:
\$35 000.00	\$32 000.00		\$ 250 000.00
+ \$175 000.00	+ \$160 000.00		– \$192 000.00
<hr/>	<hr/>		<hr/>
\$250 000.00	\$192 000.00		\$58 000.00

His net worth is \$58 000.00.

b) Calculate his debt-to-equity ratio.

(1 mark)

$$\begin{aligned}\text{Debt-to-equity ratio (\%)} &= \frac{(\text{Total liabilities} - \text{Mortgage})}{\text{Net worth}} \times 100 \\ &= \frac{\$192\,000.00 - \$160\,000.00}{\$58\,000.00} \times 100 \\ &= 55.172\%\end{aligned}$$

His debt-to-equity ratio is 55.17%.

c) Mr. Beans wants to borrow more money to build a garage.

Explain if a bank would lend him the money.

(1 mark)

No, because his debt-to-equity ratio is more than 50%.

---

**Marking Key**

- 1 0.5 mark for total assets and liabilities in (a)
- 2 0.5 mark for consistent net worth in (a)
- 3 0.5 mark for appropriate work in (b)
- 4 0.5 mark for consistent debt-to-equity ratio in (b)
- 5 1 mark for appropriate explanation with reference to 50% in (c)

## Design and Measurement

---

**Question 20****Total: 1 mark****Learning Outcome: 12.A.D.1****Question Type: Selected Response**

---

Jordan is completing a research project on Central Park in New York City. The park is a rectangular shape with a width of 874 yards and a length of 4375 yards. In the 1870s, the total cost to build the park was \$14 000 000.00.

Select the cost of constructing the park per square yard.

- A) \$0.27
- B) \$3.66**
- C) \$1333.59
- D) \$2667.17

---

**Marking Key**

Correct answer: B

---

**Question 21****Total: 1.5 marks****Learning Outcome: 12.A.D.1****Question Type: Constructed Response**

---

Tala is in Switzerland and is buying chocolates to bring home. The price of chocolate is 28 Swiss francs per kilogram. Tala buys 450 grams of chocolates.

Determine the cost, in Canadian dollars, if 1 Swiss franc is equal to 1.59 Canadian dollars.

$$\frac{1000 \text{ g}}{1 \text{ kg}} = \frac{450 \text{ g}}{x}$$

$$x = 0.45 \text{ kg of chocolate}$$

$$0.45 \times 28 = 12.6 \text{ Swiss francs}$$

$$\frac{1 \text{ Swiss franc}}{\$1.59} = \frac{12.6 \text{ Swiss francs}}{x}$$

$$x = \$20.03$$

The cost is \$20.03.

---

**Marking Key**

- ① 0.5 mark for conversion of weight
- ② 0.5 mark for consistent cost in Swiss francs
- ③ 0.5 mark for consistent cost in Canadian dollars

---

**Question 22****Total: 2 marks****Learning Outcome: 12.A.D.1****Question Type: Constructed Response**

---

Sujin is visiting Egypt. He goes to a pyramid-shaped visitor centre and he learns that the volume of the pyramid is  $648 \text{ m}^3$  and the height of the pyramid is 13.5 m.

- a) Determine the area of the base of the pyramid.

(1 mark)

$$V = \frac{1}{3} Bh$$

$$648 = \frac{1}{3} B(13.5)$$

$$B = 144 \text{ m}^2$$

The area of the base of the pyramid is  $144 \text{ m}^2$ .

- b) Calculate the total cost, plus GST and RST, to tile the base if the tiles cost  $\$50.00/\text{m}^2$ .  
(Note: GST = 5%, RST = 7%)

(1 mark)

$$144(\$50.00) = \$7200.00$$

$$\$7200.00 \times 0.05 = \$360.00$$

$$\$7200.00 \times 0.07 = \$504.00$$

$$\$7200.00 + \$360.00 + \$504.00 = \$8064.00$$

The total cost to tile the base is  $\$8064.00$ .

---

**Marking Key**

- ① 0.5 mark for appropriate work in (a)
- ② 0.5 mark for consistent area of base in (a)
- ③ 0.5 mark for total cost of tiles before taxes in (b)
- ④ 0.5 mark for total cost including taxes in (b)

---

**Question 23****Total: 5 marks****Learning Outcome: 12.A.D.1****Question Type: Constructed Response**

---

Lukas and Greta are building an inground fish pond in the shape of a cylinder.

- The radius of the pond is 0.75 m.
- The pond is 35 cm deep.

a) Determine the volume of dirt to be removed to build the pond.

(1 mark)

$$\begin{aligned}V &= \pi r^2 h \\ &= \pi (0.75)^2 (0.35) \\ &= 0.618\ 5\dots\ \text{m}^3\end{aligned}$$

The volume of dirt to be removed is 0.62 m<sup>3</sup>.

**OR**

$$\begin{aligned}V &= \pi r^2 h \\ &= \pi (75)^2 (35) \\ &= 618\ 501.053\ 6\dots\ \text{cm}^3\end{aligned}$$

The volume of dirt to be removed is 618 501.05 cm<sup>3</sup>.

b) A plastic liner is placed in the hole to hold the water.

Determine the amount of plastic liner needed, in square metres, if you add 15% to account for overlap.

(1.5 marks)

$$\begin{aligned}\text{Surface area} &= \pi r^2 + 2\pi rh \\ &= \pi (0.75)^2 + 2\pi (0.75)(0.35) \\ &= 3.416\ 4\dots\ \text{m}^2\end{aligned}$$

$$3.416\ 4\dots \times 1.15 = 3.928\dots$$

The amount of plastic liner needed is 3.93 m<sup>2</sup>.

- c) Each goldfish needs 20 gallons of water to survive. The pond Lukas and Greta are building will hold 163 gallons.

State the maximum number of goldfish they can have.

(0.5 mark)

$$163 \div 20 = 8.15$$

They can have a maximum of 8 goldfish.

- d) Consider the following:

- The plastic liner costs \$12.80/m<sup>2</sup>, plus GST and RST.
- Each goldfish costs \$4.45, plus GST and RST.
- Water is free.
- The stone border for the pond costs \$284.00, plus GST and RST.

Calculate the total cost, plus GST and RST. (Note: GST = 5%, RST = 7%)

(2 marks)

$$\text{Plastic liner: } 3.93 \times \$12.80 = \$50.30 \qquad \text{Goldfish: } 8 \times \$4.45 = \$35.60$$

$$\$50.30 + \$35.60 + \$284.00 = \$369.90$$

$$\$369.90 \times 0.05 = \$18.50$$

$$\$369.90 \times 0.07 = \$25.89$$

$$\$369.90 + \$18.50 + \$25.89 = \$414.29$$

The total cost is \$414.29.

---

### Marking Key

- 1 0.5 mark for appropriate work in (a)
- 2 0.5 mark for consistent answer in (a)
- 3 0.5 mark for appropriate work calculating surface area in (b)
- 4 0.5 mark for consistent surface area in (b)
- 5 0.5 mark for consistent answer including overlap in (b)
- 6 0.5 mark for answer in (c)
- 7 0.5 mark for consistent cost of plastic liner in (d)
- 8 0.5 mark for consistent cost of goldfish in (d)
- 9 0.5 mark for consistent subtotal of cost in (d)
- 10 0.5 mark for consistent total cost including taxes in (d)

*Marker Note:*

→ Award full marks in (d) for \$415.30; this answer reflects using whole units for plastic liner.

## Logical Reasoning

---

**Question 24****Total: 1 mark****Learning Outcome: 12.A.L.3****Question Type: Selected Response**

---

Consider the following conditional statement:

“If I have a carrot, then I have a vegetable.”

Select the inverse.

- A) If I have a vegetable, then I have a carrot.
- B) If I don't have a carrot, then I don't have a vegetable.**
- C) If I don't have a vegetable, then I don't have a carrot.
- D) I have a carrot if and only if I have a vegetable.

---

**Marking Key**

Correct answer: B

---

**Question 25****Total: 4.5 marks****Learning Outcome: 12.A.L.2****Question Type: Constructed Response**

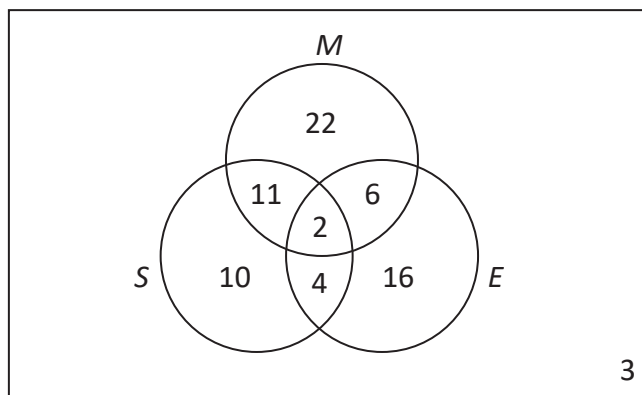
---

There are 74 students in grade 12 at Mencar Collegiate. The list of the number of students enrolled in each course, in the first semester, is displayed below.

- 41 take Math ( $M$ )
- 28 take English ( $E$ )
- 27 take Science ( $S$ )
- 8 take Math and English
- 11 take only Math and Science
- 6 take English and Science
- 2 take all three courses

a) Create a Venn diagram to represent this situation.

(3 marks)



b) State the number of students who do not take any of the three courses.

(0.5 mark)

There are 3 students who do not take any of the three courses.

c) State the number of students who take Math or Science but not English.

(1 mark)

There are 43 students who take Math or Science but not English.

---

**Marking Key**

- 1 0.5 mark for  $n((M \cap E) \setminus S) = 6$  in (a)
- 2 0.5 mark for  $n((S \cap E) \setminus M) = 4$  in (a)
- 3 0.5 mark for consistent number of students who take Math in (a)
- 4 0.5 mark for consistent number of students who take English in (a)
- 5 0.5 mark for consistent number of students who take Science in (a)
- 6 0.5 mark for consistent number of students who do not take any of the three courses in (a)
- 7 0.5 mark for consistent number of students who do not take any of the three courses in (b)
- 8 1 mark for consistent number of students who take Math or Science but not English in (c)

---

**Question 26****Total: 1.5 marks****Learning Outcome: 12.A.L.3****Question Type: Constructed Response**

---

Complete the truth table for the conditional statement  $q \rightarrow \sim p$ .

$p$	$q$	$p \rightarrow q$	$\sim p$	$q \rightarrow \sim p$
True	True	True	False	False
True	False	False	False	True
False	True	True	True	True
False	False	True	True	True

---

**Marking Key**

- 1 0.5 mark for filling out  $p \rightarrow q$  column
- 2 0.5 mark for filling out  $\sim p$  column
- 3 0.5 mark for filling out  $q \rightarrow \sim p$  column

---

**Question 27****Total: 1.5 marks****Learning Outcome: 12.A.L.1****Question Type: Constructed Response**

---

There are four students: Adisson, Brendan, Carson, and Danica. Each student has a favourite activity. The activities are chess, dance, soccer, and video games.

Determine each student's favourite activity, using the clues below.

- Adisson's activity requires more than one person.
- Brendan and the soccer player watch the dance recital.
- The chess player is a good friend of Adisson and Brendan.
- Carson favours dance or soccer.

You may use the chart below.

	Chess	Dance	Soccer	Video Games
Adisson	✗	✗	✓	✗
Brendan	✗	✗	✗	✓
Carson	✗	✓	✗	✗
Danica	✓	✗	✗	✗

**OR**

---

Adisson's favourite activity is soccer.

Brendan's favourite activity is video games.

Carson's favourite activity is dance.

Danica's favourite activity is chess.

---

**Marking Key**

- 1 0.5 mark for one correct activity
- 2 0.5 mark for a second correct activity
- 3 0.5 mark for the remaining correct activities



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# Appendices

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## Appendix A: Table of Questions by Unit and Learning Outcome

Relations and Functions		
Question	Learning Outcome(s)	Mark(s)
1	12.A.R.1	1
2	12.A.R.3	1
3 a)	12.A.R.1	0.5
3 b)	12.A.R.1	1.5
3 c)	12.A.R.1	1
4 a)	12.A.R.2	1
4 b)	12.A.R.2	1
4 c)	12.A.R.2	1
5 a)	12.A.R.2	1
5 b)	12.A.R.2	1
5 c)	12.A.R.2	1
6 a)	12.A.R.3	1
6 b)	12.A.R.3	2
6 c)	12.A.R.3	1
<b>Total: 15</b>		
Probability		
Question	Learning Outcome(s)	Mark(s)
7 a)	12.A.P.3	2
7 b)	12.A.P.3	1
8 a)	12.A.P.4	1.5
8 b)	12.A.P.4	1.5
9	12.A.P.2	2
10	12.A.P.5	1
11 a)	12.A.P.6	1
11 b)	12.A.P.6	1.5
11 c)	12.A.P.6	0.5
11 d)	12.A.P.1	1
12 a)	12.A.P.5	1
12 b)	12.A.P.5	1
13 a)	12.A.P.2	1
13 b)	12.A.P.1	1
<b>Total: 17</b>		

<b>Financial Mathematics</b>		
<b>Question</b>	<b>Learning Outcome(s)</b>	<b>Mark(s)</b>
14	12.A.FM.1	1
15	12.A.FM.2	1
16 a)	12.A.FM.1, 12.A.FM.2	2
16 b)	12.A.FM.1 12.A.FM.2	1
16 c)	12.A.FM.2	1
17 a)	12.A.FM.1, 12.A.FM.3	2
17 b)	12.A.FM.1, 12.A.FM.3	2
17 c)	12.A.FM.3	1
18 a)	12.A.FM.1, 12.A.FM.3	2
18 b)	12.A.FM.1, 12.A.FM.3	2
19 a)	12.A.FM.3	1
19 b)	12.A.FM.3	1
19 c)	12.A.FM.3	1
<b>Total: 18</b>		
<b>Design and Measurement</b>		
<b>Question</b>	<b>Learning Outcome(s)</b>	<b>Mark(s)</b>
20	12.A.D.1	1
21	12.A.D.1	1.5
22 a)	12.A.D.1	1
22 b)	12.A.D.1	1
23 a)	12.A.D.1	1
23 b)	12.A.D.1	1.5
23 c)	12.A.D.1	0.5
23 d)	12.A.D.1	2
<b>Total: 9.5</b>		
<b>Logical Reasoning</b>		
<b>Question</b>	<b>Learning Outcome(s)</b>	<b>Mark(s)</b>
24	12.A.L.3	1
25 a)	12.A.L.2	3
25 b)	12.A.L.2	0.5
25 c)	12.A.L.2	1
26	12.A.L.3	1.5
27	12.A.L.1	1.5
<b>Total: 8.5</b>		

**Total Marks for Test: 68**

## 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 they assisted a student during test administration
- student offering that they 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: \_\_\_\_\_

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

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

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

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

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

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

**For Department Use Only—After Marking Complete**

**Consultant:** \_\_\_\_\_

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