Grade 12
Applied Mathematics
Achievement Test

Marking Guide

Use in conjunction with *Exemplars*

January 2025

Manitoba

Grade 12 applied mathematics achievement test.
Marking guide. January 2025

This resource is available in print and electronic formats.

ISBN: 978-0-7711-6660-0 (print)

ISBN: 978-0-7711-6658-7 (pdf)

Manitoba Education and Early Childhood Learning
Winnipeg, Manitoba, Canada

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.

While the department is committed to making its publications as accessible as possible, some parts of this document are not fully accessible at this time.

Available in alternate formats upon request.

Contents

General Marking Instructions

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. 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 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

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.

(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

(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)
- does not include units with labels on a graph

(E6) 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).

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

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

Relations and Functions

Question 1 — Total: 1 mark

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

The population of a town increases at a rate of 15% per year.

Select the "b" value in the exponential function $y = ab^x$, given this situation.

A) 0.15

B) 0.85

C) 1.15

D) 1.85

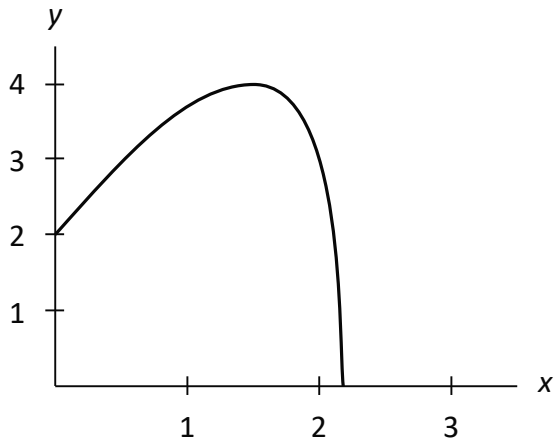
Marking Key

Correct answer: C

Question 2 — Total: 1 mark

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

The domain has been restricted on the following graph. Select the type of function represented.



A) cubic

B) logarithmic

C) quadratic

D) sinusoidal

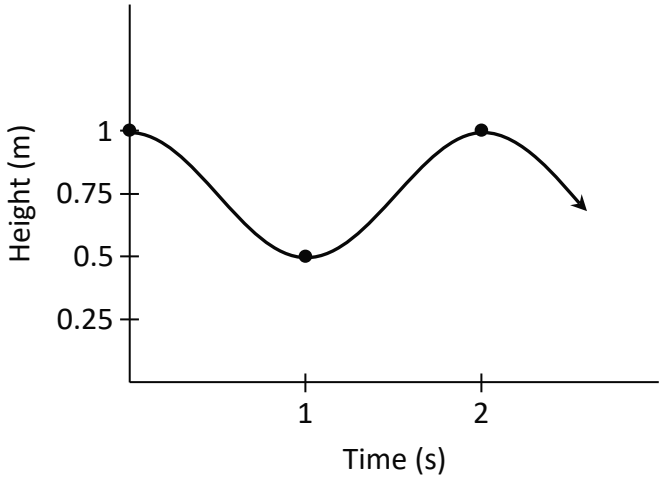
Marking Key

Correct answer: A

Question 3 — Total: 1 mark

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

A baby is in a swing. The following graph represents the height of the baby as a function of time.



State the amplitude of the graph.

$$\frac{1-0.5}{2}=0.25$$

The amplitude is 0.25 m.

Marking Key

1 1 mark for answer

Question 4 — Total: 2 marks

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

The following equation models the relationship between time and the number of apples on a tree:

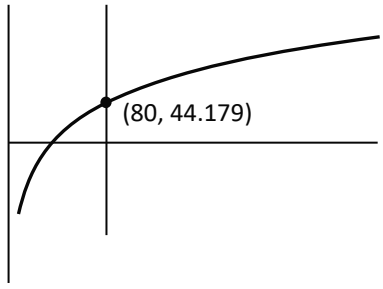
$$T = -76.94 + 27.64\ln(a)$$

where T represents the time (in days)
and a represents the number of apples.

a) Determine on which day the tree will have 80 apples. (*1 mark*)

CALC 1: value $x = 80$, $y = 44.179\ 2\ldots$

OR



$x = 80$
click on intersection

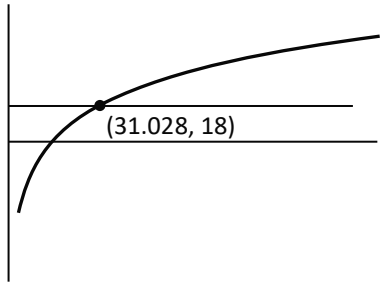
The tree will have 80 apples on day 44.

b) Determine the number of apples on day 18. (*1 mark*)

$Y_2 = 18$

CALC 5: intersect (31.027 6…, 18)

OR



$y = 18$
click on intersection

There will be 31 apples on day 18.

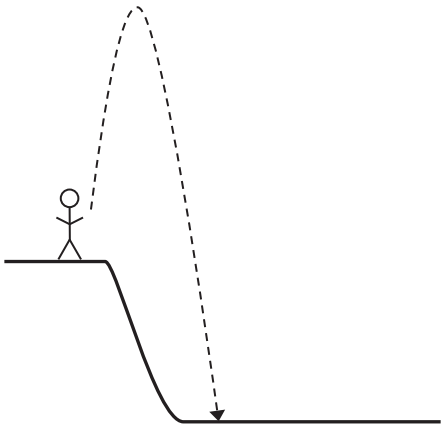
Marking Key

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 5 — Total: 3 marks

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

Avery is on top of a hill. From 15 m above the ground, he throws a stone in the air. The stone reaches its maximum height of 31.53 m after 1.84 s. The stone hits the ground after 4.37 s.



a) State the quadratic regression equation that models this situation. You may use the table below. (*1 mark*)

Time (s)	Height (m)
0	15
1.84	31.53
4.37	0

Regression equation: $y = -4.91x^2 + 18.01x + 15$

b) Determine how much time the stone is above 25 m. (*2 marks*)

$Y_2 = 25$

CALC 5: intersect

$x_1 = 0.681\ldots$

$x_2 = 2.988\ldots$

$2.988\ldots - 0.681\ldots = 2.307\ldots$

The stone was above 25 m for 2.31 s.

Marking Key

1. 1 mark for equation in (a)
2. 0.5 mark for consistent first x-value in (b)
3. 0.5 mark for consistent second x-value in (b)
4. 1 mark for consistent difference in (b)

Marker Note:

$\rightarrow$ If rounded values are used from the equation in (a), the stone was above 25 m for 2.30 s.

Question 6 — Total: 3 marks

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

The pitch of a siren changes over time. Ryan collects the following data:

Time (s)	0.295	0.687	1.080	1.473	1.865
Pitch (Hz)	962	865	770	865	962

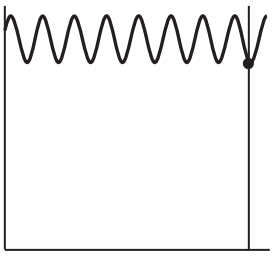
a) State a possible sinusoidal regression equation that models the pitch of the siren as a function of time. (*1 mark*)

$$y = 96.02\sin\left(3.97x + 0.42\right) + 866.02$$

b) Determine the pitch of the siren at 12 seconds. (*1 mark*)

CALC 1: value $x = 12$, $y = 788.405\ldots$

OR



$x = 12$
click on intersection
$y = 788.405$

The pitch of the siren is 788.41 Hz at 12 seconds.

c) State the range of this situation. (*1 mark*)

$[770, 962.03]$ ***OR*** $\{770 \le y \le 962.03\}$

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 appropriate work in (b)
4. 0.5 mark for consistent answer in (b)
5. 0.5 mark for consistent upper and lower bounds of the range in (c)
6. 0.5 mark for inclusivity of both upper and lower bounds in (c)

Marker Note:

→ In Desmos, in degree mode, award marks 1 and 2 for $y = 96.02\sin\left(227.47x + 24.34\right) + 866.02$.

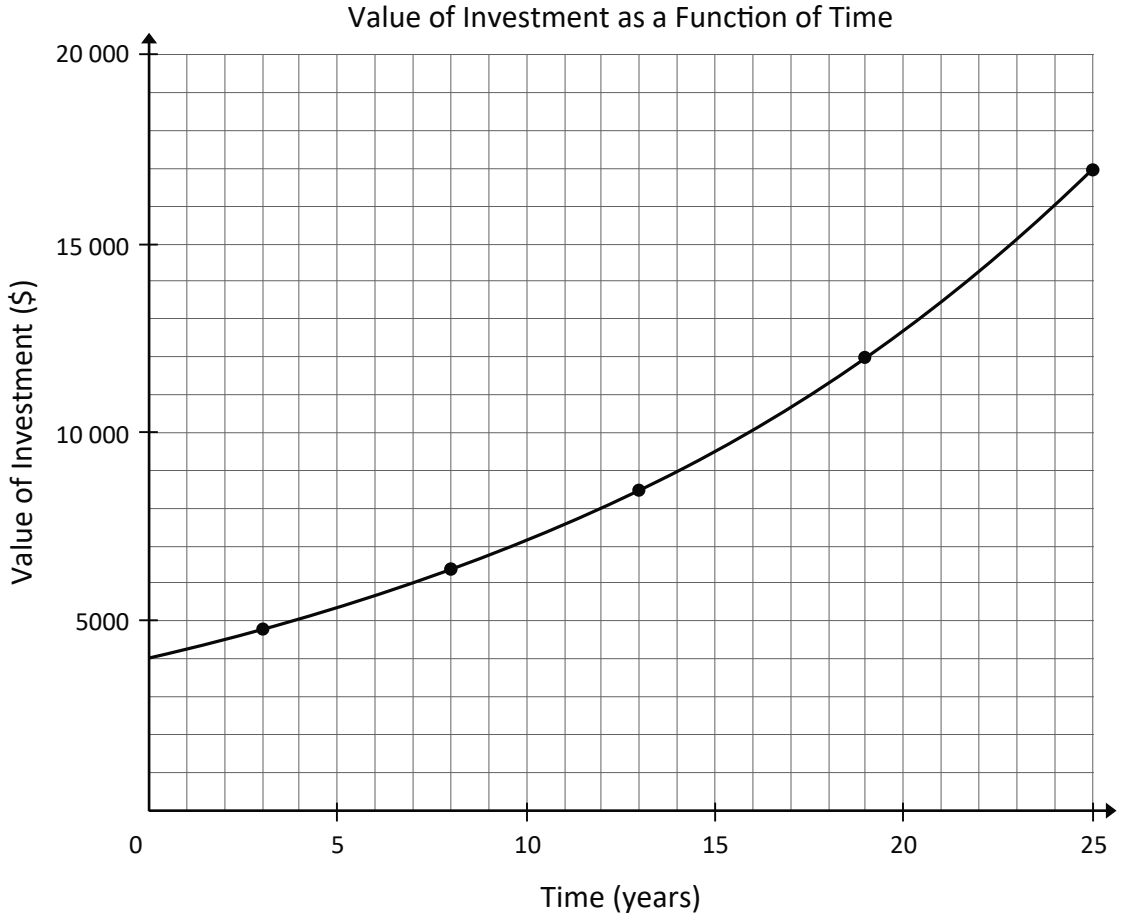
Question 7 — Total: 7 marks

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

Joel made an investment that increased in value.

Time (years)	3	8	13	19	25
Value of Investment ($)	4764	6375	8531	12 102	17 167

a) Create a clearly labelled graph by plotting the given data. Draw a curve of best fit. (*3 marks*)



b) State the exponential regression equation that models this situation. (*1 mark*)

$$y = 3999.82(1.06)^x$$

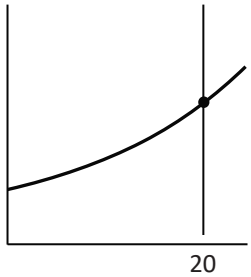
c) State the initial amount of Joel's investment. (*1 mark*)

The initial amount of Joel's investment was $3999.82.

d) Determine the value of Joel's investment at 20 years. (*1 mark*)

CALC 1: value $x = 20$, $y = 12\ 827.99$

OR



$x = 20$
click on intersection
$y = 12\ 827.99$

The value of Joel's investment at 20 years was \$12 827.99.

Financial Mathematics

e) Calculate the rate of return at 20 years. (*1 mark*)

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

$$= \frac{(\$12\ 827.99 - \$3999.82)}{\$3999.82} \times 100$$

$$= 220.71\%$$

The rate of return was 220.71%.

Marking Key

1. 1 mark for communicating the context of the graph with appropriate title and/or labels in (a)
2. 0.5 mark for using an appropriate domain (i.e., window settings/grid range) for the context of the question in (a)
3. 0.5 mark for using an appropriate range (i.e., window settings/grid range) for the context of the question in (a)
4. 1 mark for plotting the data in (a)
5. 0.5 mark for consistent initial value in (b)
6. 0.5 mark for consistent rate of change in (b)
7. 1 mark for consistent initial value in (c)
8. 0.5 mark for appropriate work in (d)
9. 0.5 mark for consistent answer in (d)
10. 1 mark for consistent rate of return in (e)

Marker Notes:

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

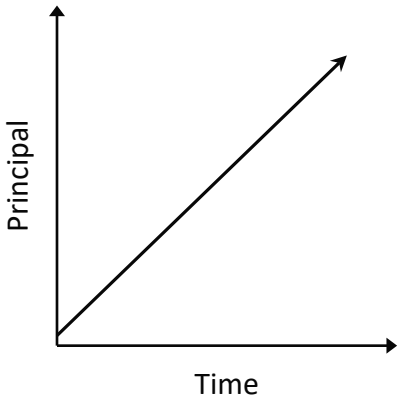
→ In Desmos, if ☐Log Mode is unchecked, $a = 3999.72$, $b = 1.06$, the initial amount of the investment = \$3999.72, the value of the investment at 20 years = \$12 828.06, and the rate of return = 220.72%.

Question 8 — Total: 1 mark

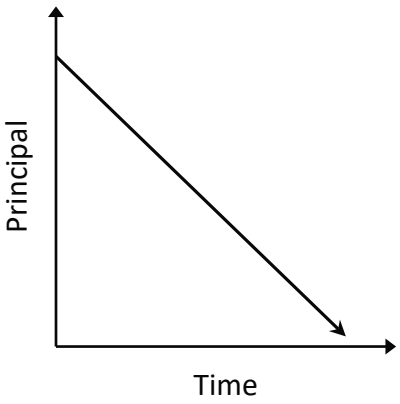
Learning Outcomes: 12.A.FM.1, 12.A.R.2 — **Question Type: Selected Response**

Select the graph that best demonstrates the amount of principal paid on a mortgage, compounded semi-annually, over an amortization period of 25 years

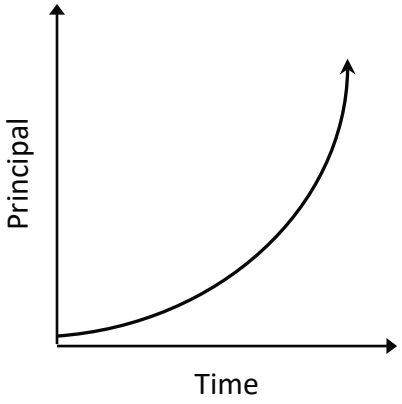
A)



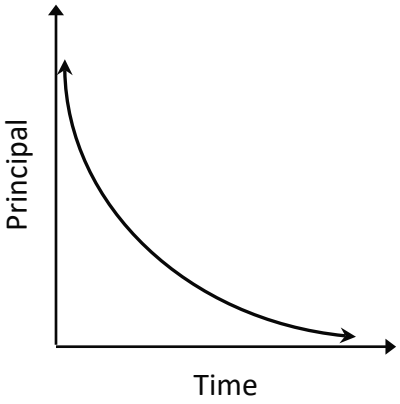
C)



B)



D)



Marking Key

Correct answer: B

Question 9 — Total: 1 mark

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

Jason bought a house for $325 000.00 five years ago.

- He made a down payment of $25 000.00.
- He has paid $45 000.00 of the principal.
- The value of the house has appreciated to $360 000.00.

Select Jason's current equity in the house.

A) $70 000.00

B) $105 000.00

C) $360 000.00

D) $385 000.00

Marking Key

Correct answer: B

Question 10 — Total: 2 marks

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

Omar has $65 000.00 to invest. His bank provides two options.

Option 1: Guaranteed investment certificates (GICs)

Option 2: Stocks

State one advantage for each option.

GICs

- low risk to lose money
- guaranteed interest rate

Stocks

- possibility of a higher rate of return

Other answers are possible.

Marking Key

1. 1 mark for appropriate GIC advantage
2. 1 mark for appropriate stock advantage

Question 11 — Total: 4 marks

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

Callie wants to buy a house in a new neighbourhood.

- The average property taxes in the neighbourhood are $4500.00 per year.
- The average heating costs are $200.00 per month.
- Her gross family income is $78 000.00 per year.

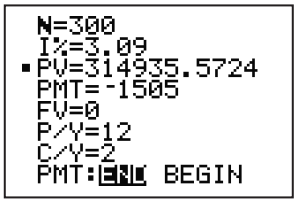
a) Determine the maximum monthly mortgage payment for which Callie would qualify when using the gross debt service ratio. (*2 marks*)

$$32\% = \frac{\text{Monthly mortgage payment} + \left(\frac{\$4500.00}{12}\right) + \$200.00}{\left(\frac{\$78\,000.00}{12}\right)} \times 100$$

$$\text{Monthly mortgage payment} = \$1505.00$$

The maximum monthly mortgage payment would be $1505.00.

b) The bank offers Callie a mortgage at an interest rate of 3.09%, compounded semi-annually and amortized over 25 years. Based on your answer in (a), determine the maximum mortgage she could afford. (*2 marks*)



The maximum mortgage she could afford is $314 935.57.

Marking Key

1. 0.5 mark for monthly property taxes and gross monthly family income in (a)
2. 0.5 mark for using 32% in (a)
3. 0.5 mark for substitution in (a)
4. 0.5 mark for consistent answer in (a)
5. 1 mark for appropriate work in (b)
6. 1 mark for consistent mortgage value in (b)

Question 12 — Total: 1 mark

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

Suchitra invests $13 000.00 at an interest rate of 6.00%.

Using the Rule of 72, estimate the number of years it will take for her investment to reach a value of $52 000.00.

$$t = \frac{72}{i}$$
$$= \frac{72}{6}$$
$$= 12 \text{ years}$$

$13 000.00
$26 000.00 — 12 years
$52 000.00 — 12 years

$$12 + 12 = 24 \text{ years}$$

Marking Key

1. 0.5 mark for doubling time (12 years)
2. 0.5 mark for consistent answer

THIS PAGE WAS INTENTIONALLY LEFT BLANK.

Question 13 — Total: 6 marks

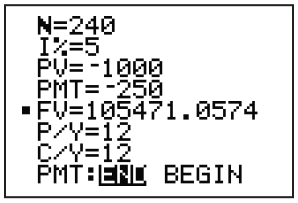
Learning Outcomes: 12.A.FM.1, 12.A.FM.3 — **Question Type: Constructed Response**

Geoff and Jamie are 38 years old and plan to retire at age 60.

Geoff started to invest when he turned 18 years old.

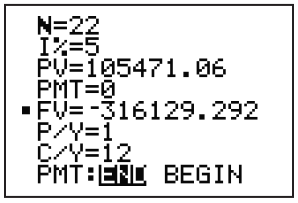
- He made an initial investment of $1000.00.
- He invested $250.00 per month at an interest rate of 5.00%, compounded monthly, until he turned 38 years old.

a) Determine the value of Geoff's investment at age 38. (*2 marks*)



The value of Geoff's investment is $105 471.06.

b) Geoff stops monthly investments at 38 years old and lets the investment earn interest until he turns 60 years old. The interest rate will remain at 5.00%, compounded monthly. Determine the value of Geoff's investment when he turns 60. (*2 marks*)

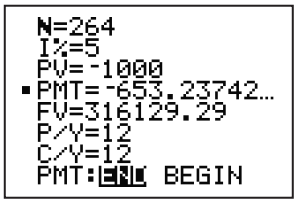


The value of Geoff's investment will be $316 129.29.

Jamie starts to invest at 38 years old.

- She makes an initial investment of $1000.00.
- She makes monthly deposits at an interest rate of 5.00%, compounded monthly, until she turns 60 years old.

c) Determine the monthly deposit amount Jamie should make to match Geoff's total investment in (b). (*2 marks*)



The monthly deposit amount Jamie should make is $653.24.

Marking Key

1. 1 mark for appropriate work in (a)
2. 1 mark for consistent answer in (a)
3. 1 mark for appropriate work in (b)
4. 1 mark for consistent answer in (b)
5. 1 mark for appropriate work in (c)
6. 1 mark for consistent answer in (c)

Probability

Question 14 — Total: 1 mark

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

The probability of the sidewalk being shovelled by the time Shipra gets home from work is 0.71.

Select the odds against the sidewalk being shovelled by the time Shipra gets home from work.

A) 71 : 100

B) 71 : 29

C) 29 : 71

D) 29 : 100

Marking Key

Correct answer: C

Question 15 — Total: 1 mark

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

Select the best answer, given that $P(A)=\frac{7}{15}$, $P(B)=\frac{4}{15}$, and $P(A\cup B)=\frac{8}{15}$.

A) Events *A* and *B* are dependent events.

B) Events *A* and *B* are mutually exclusive events.

C) Events *A* and *B* are complementary events.

D) Events *A* and *B* are non-mutually exclusive events.

Marking Key

Correct answer: D

Question 16 — Total: 1 mark

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

The Cree expression NIKISKINOHAMAKAN translates as “I am teaching” in English.

State the expression to represent the total number of ways the letters can be arranged. Leave the answer in factorial form.

$$\frac{16!}{3!3!3!3!}$$

Marking Key

1. 0.5 mark for 16! in numerator
2. 0.5 mark for 3!3!3!3! in denominator

Question 17 — Total: 2 marks

Learning Outcomes: 12.A.P.1, 12.A.P.5 — **Question Type: Constructed Response**

There are 12 people enrolled in a fitness class. They must be divided into three equal groups and rotate through three stations.

a) State the number of possible ways the people in one group can be seated on a rowing machine if there are 4 rowing machines. (*1 mark*)

$${}_4P_4 = 24 \quad \textbf{\textit{OR}} \quad 4! = 24$$

There are 24 ways.

b) State the odds in favour of a group beginning their workout on the rowing machines if there are three workout stations. (*1 mark*)

$$1:2$$

The odds are $1:2$.

Marking Key

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

Question 18 — Total: 4 marks

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

There are 8 students in a drama class going on a field trip to see a play. At the theatre, they must sit in a row of seats.

a) State the number of ways the students can be seated. (*1 mark*)

$$8! = 40\,320$$

There are 40 320 ways.

b) Determine the number of ways the students can be seated if Payton and Alex, 2 of the students, sit together. (*2 marks*)

$$2!7! = 10\,080$$

There are 10 080 ways.

c) Payton and Alex are no longer allowed to sit together.

State the number of ways the students can be seated. (*1 mark*)

$$8! - 2!7! = 30\,240 \quad \textbf{\textit{OR}} \quad {}_7P_2 \times 6! = 30\,240$$

There are 30 240 ways.

Marking Key

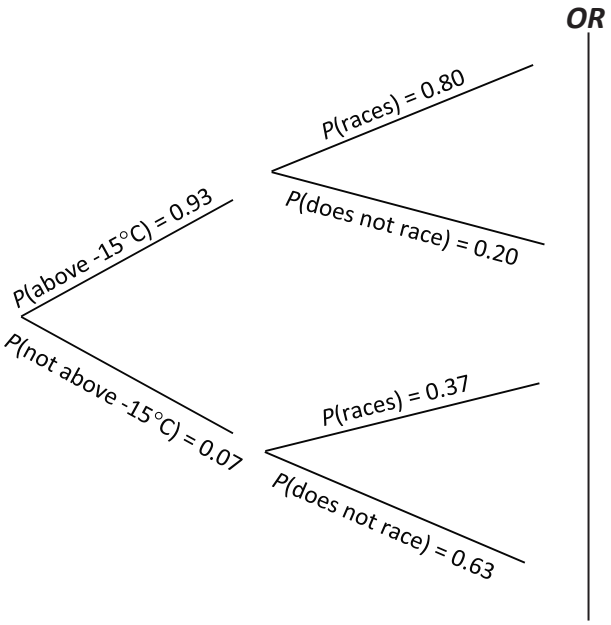
1. 1 mark for answer in (a)
2. 0.5 mark for 2! or ${}_2P_2$ in (b)
3. 0.5 mark for 7! or ${}_7P_7$ in (b)
4. 1 mark for consistent product in (b)
5. 1 mark for consistent answer in (c)

Question 19 — Total: 3 marks

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

The probability that the temperature will be above -15°C on Saturday is 0.93. If the temperature is above -15°C, the probability that Tera will participate in a cross-country ski race on Saturday is 0.80. If the temperature is not above -15°C, the probability that Tera will participate in a cross-country ski race is 0.37.

a) Use a graphic organizer to show all possible outcomes for this situation. (*1 mark*)



OR

Possible Outcomes:
- above -15°C, races
- above -15°C, does not race
- not above -15°C, races
- not above -15°C, does not race

Other graphic organizers are possible.

b) Determine the probability that Tera will participate in the cross-country ski race on Saturday. (*2 marks*)

$$\begin{aligned} P(\text{races}) &= P(\text{above -15°C, races}) + P(\text{not above -15°C, races}) \\ &= (0.93)(0.80) + (0.07)(0.37) \\ &= 0.744 + 0.025\,9 \\ &= 0.769\,9 \end{aligned}$$

The probability is $\frac{7699}{10\,000}$, 0.77, or 76.99%.

Marking Key

1. 1 mark for appropriate graphic organizer in (a)
2. 0.5 mark for *P*(above -15°C, races) in (b)
3. 0.5 mark for *P*(not above -15°C, races) in (b)
4. 1 mark for consistent sum in (b)

Marker Note:

→ Award mark 1 for a list of all possible outcomes without probability values in (a).

Question 20 — Total: 3 marks

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

There are 13 students in Class A and 16 students in Class B that would like to volunteer at a dog shelter. Only 3 students will be randomly selected to volunteer.

a) Determine the number of ways at least 1 student in Class A can be chosen to volunteer. (*2 marks*)

Method A:

total number of ways $-$ groups with no students in Class A

$$ {}_{29}C_3 - {}_{16}C_3 \times {}_{13}C_0 = 3654 - 560 $$
$$ = 3094 $$

There are 3094 ways.

OR

Method B:

Case 1: 1 student in Class A, 4 students in Class B: $ {}_{13}C_1 \times {}_{16}C_2 = 1560 $

Case 2: 2 students in Class A, 3 students in Class B: $ {}_{13}C_2 \times {}_{16}C_1 = 1248 $

Case 3: 3 students in Class A, 2 students in Class B: $ {}_{13}C_3 \times {}_{16}C_0 = 286 $

$$ 1560 + 1248 + 286 = 3094 $$

There are 3094 ways.

b) Determine the probability that all 3 students chosen are from Class B. (*1 mark*)

$$ \frac{{}_{16}C_3 \times {}_{13}C_0}{{}_{29}C_3} = \frac{560}{3654} $$

The probability is $\frac{40}{261}$, 0.15, or 15.33%.

Marking Key—Method A

1. 1 mark for total number of ways in (a)
2. 0.5 mark for the complement in (a)
3. 0.5 mark for total number of ways minus the complement in (a)
4. 0.5 mark for consistent numerator in (b)
5. 0.5 mark for consistent denominator in (b)

Marking Key—Method B

1. 0.5 mark for ${}_{13}C_1 \times {}_{16}C_2$ in (a)
2. 0.5 mark for a second case in (a)
3. 0.5 mark for the third case in (a)
4. 0.5 mark for consistent sum in (a)
5. 0.5 mark for numerator in (b)
6. 0.5 mark for denominator in (b)

Marker Note:

→ Award a maximum of 2 marks if student consistently uses permutations instead of combinations.

Question 21 — Total: 2 marks

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

Danielle received a bag of chocolates for her birthday. There are 5 milk chocolates, 4 white chocolates, and 3 dark chocolates in the bag.

She randomly picks 2 chocolates from the bag, without replacement. Determine the probability that both chocolates are the same kind.

$$P(\text{milk, milk}) + P(\text{white, white}) + P(\text{dark, dark}) = \left(\frac{5}{12}\right)\left(\frac{4}{11}\right) + \left(\frac{4}{12}\right)\left(\frac{3}{11}\right) + \left(\frac{3}{12}\right)\left(\frac{2}{11}\right)$$

$$= \frac{38}{132}$$

The probability is $\frac{19}{66}$, 0.29, or 28.79%.

Marking Key

1. 0.5 mark for considering dependency in the denominator
2. 0.5 mark for considering dependency in the numerator
3. 0.5 mark for demonstrating multiplication in three cases
4. 0.5 mark for consistent sum

Design and Measurement

Question 22 — Total: 4 marks

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

Mandy makes 7 hats for a birthday party.

- The slant height of each hat is 5.996 in.
- The radius of each hat is 2.5 in.

a) State the surface area of one hat. (*1 mark*)

$$\begin{aligned}\text{Surface area} &= \pi rs \\ &= \pi(2.5)(5.996\ldots) \\ &= 47.092\ldots \text{ in}^2\end{aligned}$$

The surface area of one hat is 47.09 in^2.

b) Mandy adds 5% more paper per hat for gluing purposes. Determine the total amount of paper needed to make all 7 hats. (*1 mark*)

$$47.092\ldots \text{ in}^2 \times 1.05 = 49.447\ldots \text{ in}^2$$

$$49.447\ldots \text{ in}^2 \times 7 \text{ hats} = 346.132\ldots \text{ in}^2$$

The total amount of paper needed is 346.13 in^2.

c) Mandy adds a ribbon around the base of each hat.

- The ribbon is sold by the foot.
- The cost of ribbon is \$0.14 per foot, taxes included.

Determine the total cost to add a ribbon around the base of all 7 hats. (*2 marks*)

$$\begin{aligned} C &= 2\pi r \\ &= 2\pi(2.5) \\ &= 15.707\ldots \text{ in.} \end{aligned}$$

$$15.707\ldots \times 7 = 109.955\ldots \text{ in.}$$

$$\frac{109.955\ldots}{12} = 9.162\ldots \text{ ft.}$$

$$10 \times \$0.14 = \$1.40$$

The total cost will be \$1.40.

Marking Key

1. 1 mark for consistent surface area in (a)
2. 0.5 mark for consistent total amount of paper for one hat in (b)
3. 0.5 mark for consistent total amount of paper for all seven hats in (b)
4. 0.5 mark for circumference of one hat in (c)
5. 0.5 mark for consistent circumference of seven hats in (c)
6. 0.5 mark for converting either price or measurement in (c)
7. 0.5 mark for consistent total cost in (c)

Marker Note:

→ Award mark 2 for 49.444… in^2 and mark 3 for 346.111… in^2 in (b); these answers reflect using rounded values in (a).

Question 23 — Total: 4 marks

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

Zoey bought honey contained in a cylindrical pail.

- The pail has a diameter of 20 cm.
- The pail has a height of 25 cm.

a) Calculate the amount of honey in the pail, assuming the pail is filled to the top. (*1 mark*)

$$\begin{aligned}\text{Volume of pail} &= \pi r^2 h \\ &= \pi (10)^2 (25) \\ &= 7853.981\ldots \text{ cm}^3\end{aligned}$$

There is 7853.98 cm^3 of honey in the pail.

b) Zoey wants to empty the honey from the pail into jars. Each jar can contain 350 mL (1 mL = 1 cm^3) of honey. State the number of jars Zoey will need. (*1 mark*)

$$\begin{aligned}7853.981\ldots \div 350 &= 22.439\ldots \\ &= 23 \text{ jars}\end{aligned}$$

Zoey will need 23 jars.

c) Determine the minimum cost if a case of 6 jars costs \$5.40 and a single jar costs \$0.95, taxes included. (*2 marks*)

$$\begin{aligned}3 \text{ cases} \times \$5.40 &= \$16.20 \\ 5 \text{ jars} \times \$0.95 &= \$4.75 \\ \text{Total} &= \$20.95\end{aligned}$$

The minimum amount Zoey will pay is \$20.95.

Marking Key

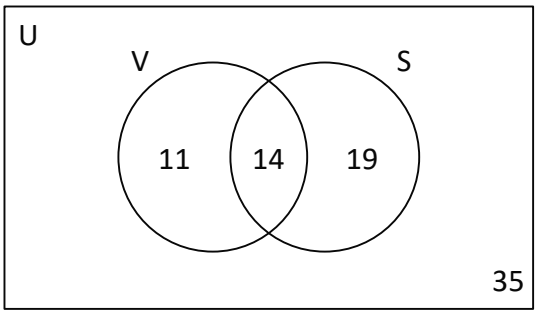
1. 0.5 mark for radius in (a)
2. 0.5 mark for consistent volume in (a)
3. 1 mark for consistent number of jars in (b)
4. 1 mark for consistent number of cases and jars in (c)
5. 1 mark for consistent minimum amount in (c)

Logical Reasoning

Question 24 — Total: 1 mark

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

The Venn diagram given below illustrates the relationship between athletes who play volleyball (V) and athletes who swim (S) at a high school.



Select which of the following statements is true.

A) There are 11 athletes who play volleyball.

B) There are 30 athletes who play volleyball or swim.

C) There are 46 athletes who do not swim.

D) There are 60 athletes at the high school.

Marking Key

Correct answer: C

Question 25 — Total: 3 marks

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

Logically equivalent statements have the same truth tables.

a) Complete the truth table to show that $p \rightarrow q$ and $\sim q \rightarrow \sim p$ are logically equivalent. (*2 marks*)

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

b) Select the statement that $p \rightarrow q$ and $\sim q \rightarrow \sim p$ represent. (*1 mark*)

A) conditional statement and contrapositive statement

B) conditional statement and converse statement

C) inverse statement and contrapositive statement

D) inverse statement and converse statement

Marking Key

1. 0.5 mark for filling out $p \rightarrow q$ column in (a)
2. 0.5 mark for filling out $\sim q$ column in (a)
3. 0.5 mark for filling out $\sim p$ column in (a)
4. 0.5 mark for consistently filling out $\sim q \rightarrow \sim p$ column in (a)
5. 1 mark for answer in (b) (Correct answer: A)

Question 26 — Total: 2 marks

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

Given the following sets:

$A = \{\text{whole numbers}\}$

$B = \{\text{positive odd numbers}\}$

$C = \{\text{prime numbers}\}$

$D = \{\text{positive multiples of two}\}$

a) State an example of one set that is the subset of another using two of the sets above. (*1 mark*)

$B \subset A$ ***OR*** B is a subset of A.

OR

$C \subset A$ ***OR*** C is a subset of A.

OR

$D \subset A$ ***OR*** D is a subset of A.

b) State the two given sets that are disjoint. (*1 mark*)

$B \cap D = \{\ \}$

B and D are two disjoint sets.

Marking Key

1. 1 mark for example of one set that is the subset of another in (a)
2. 1 mark for example of two disjoint sets in (b)

Question 27 — Total: 1 mark

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

A printer is used to number the pages of a 60-page book.

State how many times the digit 5 appears in the page numbers.

5, 15, 25, 35, 45, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59

The digit 5 appears 16 times.

Marking Key

1. 1 mark for answer

Question 28 — Total: 2 marks

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

Vern conducted an experiment and stated:

"If the water is frozen, then the temperature of the water is below 0°C."

a) Write the converse of the statement. (*1 mark*)

"If the temperature of the water is below 0°C, then the water is frozen."

b) Write the contrapositive of Vern's original statement. (*1 mark*)

"If the temperature of the water is not below 0°C, then the water is not frozen."

Marking Key

1. 1 mark for converse of the statement in (a)
2. 1 mark for contrapositive of the statement in (b)

Marker Note:

→ Award a maximum of 0.5 mark if "if" or "then" is missing.

Appendices

Appendix A:
Table of Questions by Unit and Learning Outcome

Relations and Functions		
Question	**Learning Outcome(s)**	**Mark(s)**
1	12.A.R.2	1
2	12.A.R.1	1
3	12.A.R.3	1
4 a)	12.A.R.2	1
4 b)	12.A.R.2	1
5 a)	12.A.R.1	1
5 b)	12.A.R.1	2
6 a)	12.A.R.3	1
6 b)	12.A.R.3	1
6 c)	12.A.R.3	1
7 a)	12.A.R.2	3
7 b)	12.A.R.2	1
7 c)	12.A.R.2	1
7 d)	12.A.R.2	1
		Total: 17
Financial Mathematics		
Question	**Learning Outcome(s)**	**Mark(s)**
7 e)	12.A.FM.3	1
8	12.A.FM.1, 12.A.R.2	1
9	12.A.FM.2	1
10	12.A.FM.3	2
11 a)	12.A.FM.3	2
11 b)	12.A.FM.1	2
12	12.A.FM.3	1
13 a)	12.A.FM.1, 12.A.FM.3	2
13 b)	12.A.FM.1, 12.A.FM.3	2
13 c)	12.A.FM.1, 12.A.FM.3	2
		Total: 16

Probability		
Question	**Learning Outcome(s)**	**Mark(s)**
14	12.A.P.1	1
15	12.A.P.2	1
16	12.A.P.5	1
17 a)	12.A.P.5	1
17 b)	12.A.P.1	1
18 a)	12.A.P.4	1
18 b)	12.A.P.5	2
18 c)	12.A.P.5	1
19 a)	12.A.P.2	1
19 b)	12.A.P.3	2
20 a)	12.A.P.6	2
20 b)	12.A.P.6	1
21	12.A.P.3	2
		Total: 17
Design and Measurement		
Question	**Learning Outcome(s)**	**Mark(s)**
22 a)	12.A.D.1	1
22 b)	12.A.D.1	1
22 c)	12.A.D.1	2
23 a)	12.A.D.1	1
23 b)	12.A.D.1	1
23 c)	12.A.D.1	2
		Total: 8
Logical Reasoning		
Question	**Learning Outcome(s)**	**Mark(s)**
24	12.A.L.2	1
25 a)	12.A.L.3	2
25 b)	12.A.L.3	1
26 a)	12.A.L.2	1
26 b)	12.A.L.2	1
27	12.A.L.1	1
28 a)	12.A.L.3	1
28 b)	12.A.L.3	1
		Total: 9

Total Marks for Test: 67

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: _____