Grade 12
Applied Mathematics
Achievement Test

Student Booklet

June 2025

Manitoba

Grade 12 Applied Mathematics Achievement Test:
Student Booklet (June 2025)

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Manitoba Education and Early Childhood Learning
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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.

Grade 12 Applied Mathematics
Achievement Test

Description

Time Required to Complete the Test: 3 hours **Total Possible Marks: 68**
Additional Time Allowed: 30 minutes

Unit	Marks
Relations and Functions	17.5
Probability	16
Financial Mathematics	17
Design and Measurement	9.5
Logical Reasoning	8

Directions

- Show all your work and clearly indicate your final answer.
- Indicate your input values by writing them in your booklet or printing a copy if using a technology tool.
- State any assumptions you make.
- When rounding, express your answers in decimal or percentage form to at least the nearest hundredth (two decimal places), except for monetary values or when otherwise indicated.

  Example: $\frac{15}{29} = 0.52$ or 51.72%
- When no tax calculation is necessary, the wording "taxes included" will be used. When you are required to add taxes, the wording "plus GST and/or PST" will be used and current tax rates will be given (e.g., GST = 5%, PST = 7%).

Note: Rounding too soon in your solution may result in an inaccurate final answer for which full marks will not be awarded.

A clearly communicated answer

— is easily identified in the response space

— includes the parameters in the equation, and "$y =$", "sin", "ln", or "x", as applicable

— includes the units of measure, where applicable

— includes labels, units, scales for the axes on graphs, and key characteristics of functions (e.g., maximum, minimum, intercepts, and appropriate shape)

— is expressed as an exact value or is appropriately rounded

Marks may be deducted for errors relating to any of the above.

Electronic communication between students through phones, email, or file sharing during the test is strictly prohibited.

Terminology Sheet

Some questions may include directing words such as *calculate* and *determine*. These directing words are explained below.

Directing words	The question is asking for…
Calculate/Determine	a mathematical formula, an algebraic equation, or a numerical calculation to solve a problem
Complete	a table, diagram, or graph to be filled in
Create/Draw/Use a graphic organizer	a visual representation of information such as a graph, tree diagram, chart, list, Venn diagram, truth table, or Pascal's triangle
Describe/Explain	words or symbols, diagrams, charts or graphs, or other methods that clearly show what you are thinking
Indicate	a stated or shown answer
Justify	reasons or facts that support a position by using mathematical computations, words, or diagrams
Select	a circled answer
State/Write	a word, sentence, or number, without an explanation

Formula Sheet: Applied Mathematics

Relations and Functions

$$y = ax + b$$

$$y = ax^2 + bx + c$$

$$y = ax^3 + bx^2 + cx + d$$

$$y = ab^x$$

$$y = a + b\ln(x)$$

$$y = a\sin(bx + c) + d$$

Probability

$$P(A \cup B) = P(A) + P(B) - P(A \cap B)$$

$$P(A \cap B) = P(A) \times P(B)$$

$$P(A \cap B) = P(A) \times P(B|A)$$

$${}_nP_r = \frac{n!}{(n-r)!}$$

$${}_nC_r = \frac{n!}{r!(n-r)!}$$

Financial Mathematics

$$t = \frac{72}{i}$$

$$I = Prt$$

$$A = P\left(1 + \frac{r}{n}\right)^{nt}$$

$$\text{Net worth} = \text{Total assets} - \text{Total liabilities}$$

$$\text{Debt-to-equity ratio (\%)} = \frac{(\text{Total liabilities} - \text{Mortgage})}{\text{Net worth}} \times 100$$

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

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

Design and Measurement

Prism: $\text{Surface area} = Ph + 2B$

$\text{Volume} = Bh$

Pyramid: $\text{Surface area} = B + \frac{1}{2}Ps$

$\text{Volume} = \frac{1}{3}Bh$

Cube: $\text{Surface area} = 6l^2$

$\text{Volume} = l^3$

Rectangular prism: $\text{Surface area} = 2lw + 2lh + 2wh$

$\text{Volume} = lwh$

Triangular prism: $\text{Surface area} = bh + l(a + b + c)$

$\text{Volume} = \frac{1}{2}bhl$

Square-based pyramid: $\text{Surface area} = b^2 + 2bs$

$\text{Volume} = \frac{1}{3}b^2h$

Sphere: $\text{Surface area} = 4\pi r^2$

$\text{Volume} = \frac{4}{3}\pi r^3$

Cylinder: $\text{Surface area} = 2\pi r^2 + 2\pi rh$

$\text{Volume} = \pi r^2 h$

Cone: $\text{Surface area} = \pi r^2 + \pi rs$

$\text{Volume} = \frac{1}{3}\pi r^2 h$

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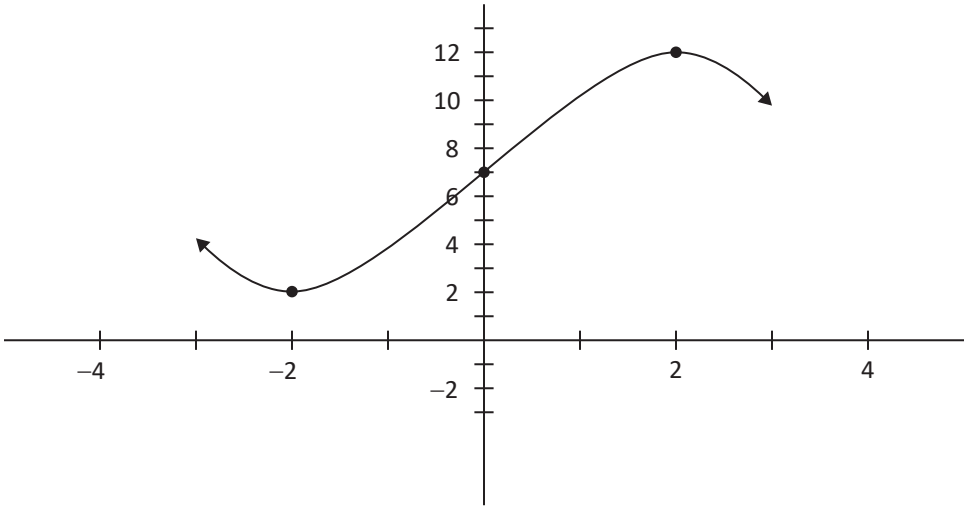
Relations and Functions

Question 1 — Total: 1 mark

101

Using the graph below, select the period of the sinusoidal function.



A) 4

B) 5

C) 8

D) 10

Question 2 — Total: 1 mark

102

Select the end behaviour of a quadratic function of the form $y = ax^2 + bx + c$ where $a > 0$.

The graph extends from:

A) quadrant I to quadrant III

B) quadrant II to quadrant I

C) quadrant II to quadrant IV

D) quadrant IV to quadrant III

Question 3 — Total: 3 marks

A rock is launched from the top of a cliff. It follows a parabolic path modelled by the following function:

$$H(t) = -3.85t^2 + 16.6t + 25$$

where $H(t)$ represents the height of the rock (in metres)
and t represents the time (in seconds).

a) Determine the maximum height reached by the rock. (*1 mark*) 103

b) Determine the total amount of time the rock is in the air. (*1 mark*) 104

c) Determine at what time(s) the rock is 20 m above the ground. (*1 mark*) 105

Question 4 — Total: 4.5 marks

The population of Bachstein is growing at a rate of approximately 4.5% per year. The population in 2016 was 15 829.

a) Determine the exponential regression equation that models the population growth, expressed to the nearest thousandth (three decimal places). You may use the table below. (*2 marks*) 106

Time (years since 2016)	Population

Regression equation: _____

b) Determine the population of Bachstein in 2026 using your equation in (a). (*1 mark*) 107

c) When the population reaches 30 000, Bachstein will build a new shopping mall. Determine in which year the population will reach 30 000. (*1.5 marks*) 108

Question 5 — Total: 3 marks

The average monthly temperatures in Oslo, Norway were recorded every second month beginning in January (month 1 = January) as follows.

Time (months)	1	3	5	7	9	11
Temperature (°C)	0	5	17	23	16	4

a) State a possible sinusoidal regression equation that models the temperature as a function of time. (*1 mark*) 109

b) A tourist is planning to travel to Oslo and needs to know what type of clothing to pack. Determine the temperature they should expect in August. (*1 mark*) 110

c) State the range of the situation using the regression curve from part (a). (*1 mark*) 111

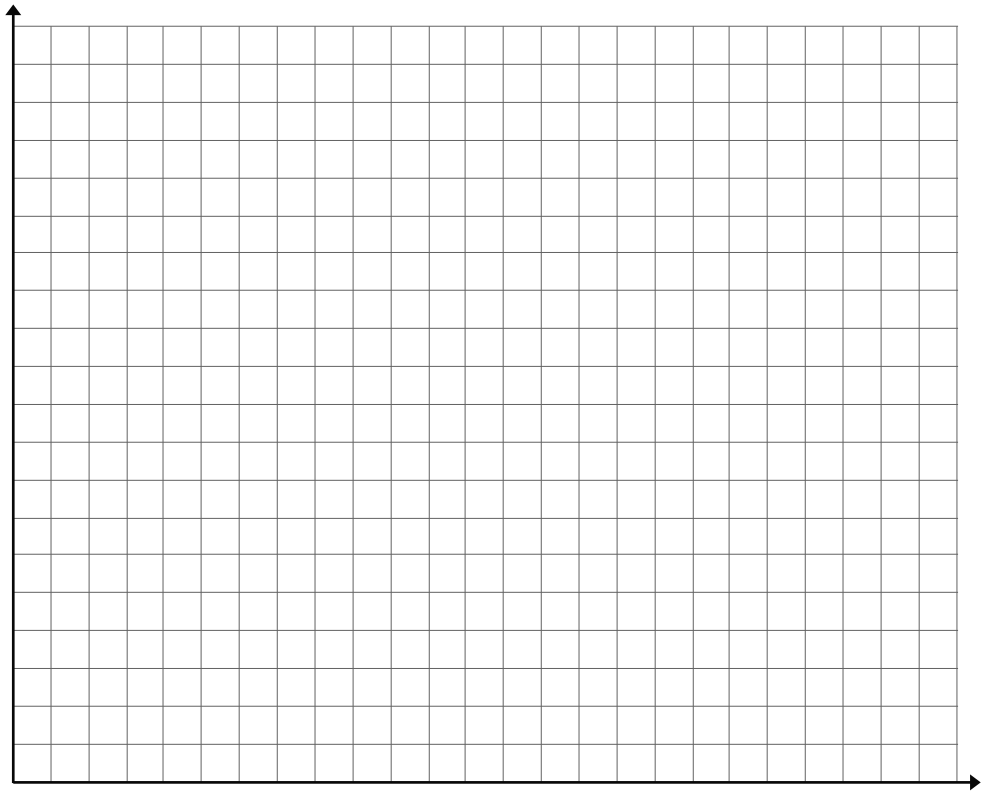
Question 6 — Total: 5 marks

The sound intensity decreases according to a logarithmic function as Peter moves away from an air conditioner.

Distance (metres)	10	20	30	40	50
Sound Intensity (decibels)	41.84	30.40	23.68	18.88	15.20

112

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



113

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

114

c) Determine Peter's distance from the air conditioner when the sound intensity is zero decibels. (*1 mark*)

Probability

Question 7 — Total: 1 mark

115

The probability of rain during the picnic tomorrow is 35%.

Select the odds in favour of rain during the picnic tomorrow.

A) 7 : 20

B) 13 : 20

C) 7 : 13

D) 13 : 7

Question 8 — Total: 1 mark

116

Select the answer that best shows mutually exclusive events.

A) The set of positive integers from 1 to 8 and the set of even numbers from 1 to 12.

B) Rolling a 6 and an even number on a regular six-sided die.

C) The set of prime numbers from 1 to 10 and the set of multiples of 2 from 1 to 10.

D) Rolling a 5 and an even number on a regular six-sided die.

Question 9 — Total: 4 marks

A parking lot has 3 different blue cars and 4 different white cars.

a) State the number of ways the cars can be parked in a row. (*1 mark*) 117

b) Determine the number of ways the 7 cars can be parked if the 3 blue cars must be parked beside each other. (*2 marks*) 118

c) State the probability that the 3 blue cars are parked beside each other. (*1 mark*) 119

Question 10 — Total: 2 marks

120

The probability of an event occuring can be shown on the line below.

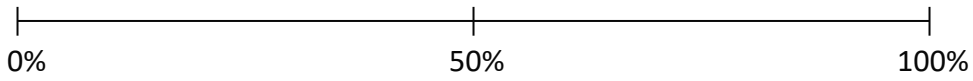
Draw the following symbols on the line.

◯: The probability that it will snow in Manitoba in the winter.

□: The probability of flipping two coins that both land on heads.

△: The probability of rolling a number greater than 4 on a regular six-sided die.

◇: The probability that a randomly-selected student has a birthday in June.



Question 11 — Total: 2 marks

Milo has 3 pairs of pants (blue, green, and red) and 2 sweaters (yellow and maroon) that are clean to wear for the dance on Friday.

a) Use a graphic organizer to show all possible outcomes for this situation. (*1 mark*) 121

b) State the odds against Milo wearing the red pants and the maroon sweater. (*1 mark*) 122

Question 12 — Total: 3 marks

A student council must consist of 7 members. There are 12 students and 5 teachers that volunteer. The student council must include 2 or 3 teachers.

a) Determine the number of ways that the student council can be formed. (*2 marks*) 123

b) Determine the probability that the student council has exactly three teachers. (*1 mark*) 124

Question 13 — Total: 1 mark

125

There are five pairs of socks: red, purple, blue, green, and yellow.

Determine the number of ways the 10 socks can be arranged.

Question 14 — Total: 2 marks

126

Your school is drawing tickets for three prizes. There are 100 tickets sold.

You have purchased 5 tickets. Determine the probability that you win all three prizes if the tickets are not replaced.

Financial Mathematics

Question 15 — Total: 1 mark

127

The table below shows the value of a savings account earning simple interest.

Year	Value
0	$6500.00
1	$6633.25
3	$6899.75

Select the annual simple interest rate earned by this account.

A) 1.54%

B) 2.00%

C) 2.01%

D) 2.05%

Question 16 — Total: 1 mark

128

Nadia invests $10 000.00 in stocks.

Using the Rule of 72, select the estimated interest rate that would double their investment in 24 years.

A) 3%

B) 6%

C) 9%

D) 12%

Question 17 — Total: 7 marks

Tess has $20 000.00 saved and is considering investing her money for a time period of 20 years. She has the following two options:

Option 1: She invests the entire sum of $20 000.00 in an account that earns 5.09%, compounded monthly.

Option 2: She spends half the money on a trip to Costa Rica. She invests the remaining $10 000.00 and deposits an additional $125.00 per month into an account that earns 5.09%, compounded monthly.

a) Determine the value of Tess's investment after 20 years if she chooses Option 1. (*2 marks*) 129

b) Determine the value of Tess's investment after 20 years if she chooses Option 2. (*2 marks*) 130

c) Calculate Tess's rate of return if she chooses Option 1. (*1 mark*) 131

d) Calculate Tess's rate of return if she chooses Option 2. (*1.5 marks*) 132

e) Justify which option Tess should choose. (*0.5 mark*) 133

Question 18 — Total: 4 marks

Xavier and Pierce buy a house valued at $410 000.00 and have $35 000.00 saved for a down payment. The bank offers a mortgage at an interest rate of 6.05%, compounded semi-annually with an amortization period of 25 years.

a) Determine their monthly mortgage payment. (*2 marks*) 134

b) Determine the value of their house after 12 years if the house appreciates in value by 1.85% annually. (*2 marks*) 135

Question 19 — Total: 3 marks

Lori is a farmer in Rivers, Manitoba and is buying a new tractor. Lori is applying for a bank loan and has the following financial situation:

- Her farm (land and equipment) is valued at $820 000.00.
- She owes $45 000.00 on the equipment.
- Her house is valued at $535 000.00 with a mortgage of $454 000.00.
- She has $12 000.00 in a savings account.
- She owes a total of $85 000.00 on a line of credit.

a) Calculate her net worth. (*1 mark*) 136

b) Calculate her debt-to-equity ratio. (*1 mark*) 137

c) Explain if the bank would lend her money based on her debt-to-equity ratio. (*1 mark*) 138

Question 20 — Total: 1 mark

139

Sylke buys an electric bike to commute to university in the fall.

- The bike costs $3358.88, taxes included.
- She uses store financing which includes regular payments with the option to pay the bike off sooner.
- The bike is financed at a rate of 19.9%, compounded daily.

Explain a strategy Sylke could use to pay the least amount of interest possible on this bike.

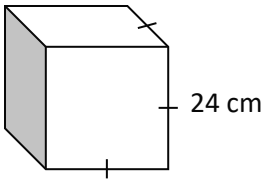
Design and Measurement

Question 21 — Total: 1 mark

140

Daniel is wrapping a present.

- The wrapping paper costs \$0.000 3/cm^2.
- The present is a cube with a side length of 24 cm.



Select the cost of wrapping the present.

A) \$0.86

B) \$1.04

C) \$4.15

D) \$10.37

Question 22 — Total: 1 mark

141

The volume of a pizza crust is 30 in^3.

Select the equation that could be used to find the height of the crust.

A) $h = 30 - r$

B) $h = 30\pi r^2$

C) $h = \frac{30}{\pi r^2}$

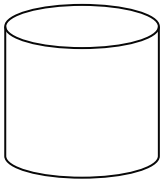
D) $h = \frac{30 - 2\pi r^2}{2\pi r}$

Question 23 — Total: 3.5 marks

Taylor has two fish tanks for goldfish.

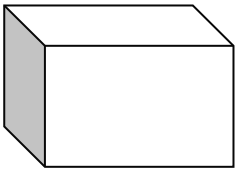
Tank 1

- The height is 45 cm.
- The diameter is 40 cm.



Tank 2

- The length is 40 cm.
- The width is 32 cm.
- The height is 42 cm.



a) Determine the volume of Tank 1. (*1 mark*) 142

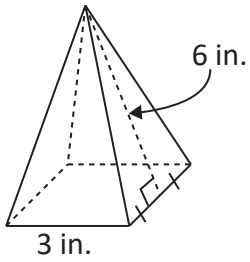
b) State the volume of Tank 2. (*1 mark*) 143

c) Calculate the number of goldfish Taylor can put into each tank if each goldfish requires 15 000 cm^3 of fresh water. (*1.5 marks*) 144

Question 24 — Total: 4 marks

A school needs 75 trophies for their awards night.

Each trophy is in the shape of a square-based pyramid and is covered in gold foil.



145

a) Determine the amount of gold foil needed to cover one trophy including the bottom. (*1 mark*)

146

b) Gold foil is sold by the roll. The roll measures 12.5 inches by 10 feet. Calculate the number of rolls needed to cover the 75 trophies. (*2 marks*)

147

c) Each roll costs $15.25, taxes included. Calculate the cost per trophy. (*1 mark*)

Logical Reasoning

Question 25 — Total: 2 marks

Consider the following conditional statement:

"If I'm in Sagkeeng First Nation, then I'm in Manitoba."

a) State the converse of the statement. (*1 mark*) 148

b) State the contrapositive of the statement. (*1 mark*) 149

Question 26 — Total: 4 marks

The 75 students attending a school camping trip were asked which of the following three activities they enjoy.

- 28 students enjoy fishing (*F*)
- 44 students enjoy kayaking (*K*)
- 31 students enjoy swimming (*S*)
- 16 students enjoy fishing and kayaking
- 13 students enjoy kayaking and swimming
- 3 students enjoy fishing and swimming but not kayaking
- 5 students enjoy all three activities

a) Create a Venn diagram to represent this situation. (*3 marks*) 150

b) State how many students only enjoy fishing. (*1 mark*) 151

Question 27 — Total: 2 marks

152

Complete the four equations below using the numbers 1, 3, 5, 7.

For each equation:

- use all four numbers once
- you may use any combination of the following operators $\times$, $\div$, $+$, $-$, $(\ )$. Operators may be used more than once.

Example: $(\ 7\ +\ 5\ )\div\ 3\ +\ 1\ = 5$

i) _____ _____ _____ _____ $= 1$

ii) _____ _____ _____ _____ $= 4$

iii) _____ _____ _____ _____ $= 7$

iv) _____ _____ _____ _____ $= 15$

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