

Grade 12
Applied Mathematics
Achievement Test

Student Booklet

June 2026

Manitoba 

Grade 12 Applied Mathematics Achievement Test:
Student Booklet (June 2026)

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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	15
Probability	17
Financial Mathematics	18
Design and Measurement	9.5
Logical Reasoning	8.5

Directions

- Show all your work and clearly indicate your final answer.
- Indicate your input values by writing them in your booklet.
- 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 RST” will be used and current tax rates will be given (e.g., GST = 5%, RST = 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 units of measure, where applicable
- is expressed as an exact value or is appropriately rounded
- includes the parameters in the equation, and “y =”, “sin”, “ln”, or “x”, as applicable
- includes labels, units, scales for the axes on graphs, and key characteristics of functions (e.g., maximum, minimum, intercepts, and appropriate shape)
- includes number of payments, interest rate, present value, payments, future value, payments per year, and compounds per year in all financial calculations using a TVM solver

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 to clearly express what you are thinking (symbols, diagrams, charts, or graphs can be used to support your explanation)
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	Financial Mathematics
$y = ax + b$ $y = ax^2 + bx + c$ $y = ax^3 + bx^2 + cx + d$ $y = ab^x$ $y = a + b \ln(x)$ $y = a \sin(bx + c) + d$	$t = \frac{72}{i}$ $I = Prt$ $A = P \left(1 + \frac{r}{n} \right)^{nt}$ <p style="text-align: center;">Net worth = Total assets – Total liabilities</p>
Probability	$\text{Debt-to-equity ratio (\%)} = \frac{(\text{Total liabilities} - \text{Mortgage})}{\text{Net worth}} \times 100$
$P(A \cup B) = P(A) + P(B) - P(A \cap B)$ $P(A \cap B) = P(A) \times P(B)$ $P(A \cap B) = P(A) \times P(B A)$ ${}^n P_r = \frac{n!}{(n-r)!}$ ${}^n C_r = \frac{n!}{r!(n-r)!}$	$\text{Gross debt service ratio (\%)} = \frac{\left(\begin{array}{l} \text{Monthly mortgage} \\ \text{+ property taxes} \\ \text{+ heating costs} \end{array} \right)}{\text{Gross monthly income}} \times 100$ $\text{Rate of return (\%)} = \frac{\left(\begin{array}{l} \text{Current value of portfolio} \\ - \text{Previous value of portfolio} \end{array} \right)}{\text{Previous value of portfolio}} \times 100$
Design and Measurement	
<p>Prism: Surface area = $Ph + 2B$ Volume = Bh</p>	<p>Pyramid: Surface area = $B + \frac{1}{2}Ps$ Volume = $\frac{1}{3}Bh$</p>
<p>Cube: Surface area = $6l^2$ Volume = l^3</p>	<p>Sphere: Surface area = $4\pi r^2$ Volume = $\frac{4}{3}\pi r^3$</p>
<p>Rectangular prism: Surface area = $2lw + 2lh + 2wh$ Volume = lwh</p>	<p>Cylinder: Surface area = $2\pi r^2 + 2\pi rh$ Volume = $\pi r^2 h$</p>
<p>Triangular prism: Surface area = $bh + l(a + b + c)$ Volume = $\frac{1}{2}bhl$</p>	<p>Cone: Surface area = $\pi r^2 + \pi rs$ Volume = $\frac{1}{3}\pi r^2 h$</p>
<p>Square-based pyramid: Surface area = $b^2 + 2bs$ Volume = $\frac{1}{3}b^2 h$</p>	

NO MARKS WILL BE AWARDED FOR WORK DONE ON THIS PAGE.

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Relations and Functions

Question 1**Total: 1 mark**

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

101

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

Question 2

Total: 1 mark

102

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

Question 3

Total: 3 marks

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)

103

- b) Determine the change in the height of the ball in the first 0.8 seconds.
(1.5 marks)

104

- c) State the range of the equation in this situation.
(1 mark)

105

Question 4

Total: 3 marks

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.

106

You may use the table below.

Time (h)				
Remaining Quantity (mg)				

(1 mark)

Regression equation: _____

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

107

(1 mark)

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

108

(1 mark)

Question 5

Total: 3 marks

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)

109

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

110

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

111

Question 6

Total: 4 marks

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)

112

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

(2 marks)

113



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

Probability

Question 7

Total: 3 marks

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

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

115

Determine the probability that both fruits are the same.

(2 marks)

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

116

(1 mark)

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

Question 8

Total: 3 marks

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.

117

(1.5 marks)

- 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.

118

(1.5 marks)

Question 9

Total: 2 marks

119

Janice rolls a 12-sided die.

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

Question 10

Total: 1 mark

120

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.

Question 11

Total: 4 marks

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. 121
(1 mark)
- b) Determine the number of ways the 5 animals can be chosen if he wants to bring exactly 2 cats. 122
(1.5 marks)
- c) State the probability that Ross chooses exactly 2 cats. 123
(0.5 mark)
- d) State the odds in favour of choosing exactly 2 cats. 124
(1 mark)

Question 12

Total: 2 marks

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.

125

(1 mark)

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

126

Determine how many ways the water bottles can be chosen.

(1 mark)

Question 13

Total: 2 marks

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.

127

(1 mark)

- b) State the odds against finishing in second place.

128

(1 mark)

Financial Mathematics

Question 14

Total: 1 mark

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

129

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

Question 15

Total: 1 mark

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

130

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

Question 16

Total: 4 marks

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.

131

(2 marks)

b) Determine the total cost for Option 1.

132

(1 mark)

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

133

Justify which option Gunthar should choose.

(1 mark)

Question 17

Total: 5 marks

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)

134

- b) Determine the value of the RRSP when Malia retires.
(2 marks)

135

- c) Explain a disadvantage for one of the investments.
(1 mark)

136

Question 18

Total: 4 marks

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.

137

(2 marks)

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

138

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

(2 marks)

Question 19

Total: 3 marks

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.

139

(1 mark)

b) Calculate his debt-to-equity ratio.

140

(1 mark)

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

141

Explain if a bank would lend him the money.

(1 mark)

Design and Measurement

Question 20

Total: 1 mark

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.

142

Select the cost of constructing the park per square yard.

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

Question 21

Total: 1.5 marks

143

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.

Question 22

Total: 2 marks

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

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

144

(1 mark)

- 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%)

145

(1 mark)

Question 23

Total: 5 marks

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.

146

(1 mark)

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

147

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

(1.5 marks)

- 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)

- d) Consider the following:

- The plastic liner costs \$12.80/m², 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)

Logical Reasoning

Question 24

Total: 1 mark

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.

150

Question 25**Total: 4.5 marks**

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.

151

(3 marks)

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

152

(0.5 mark)

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

153

(1 mark)

Question 26**Total: 1.5 marks**

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

154

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

Question 27**Total: 1.5 marks**

155

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				

END OF TEST

NO MARKS WILL BE AWARDED FOR WORK DONE ON THIS PAGE.