

Grade 12
Applied Mathematics
Achievement Test

Student Booklet

June 2018

Manitoba Education and Training Cataloguing in Publication Data

Grade 12 applied mathematics achievement test. Student
booklet. June 2018

This resource is available in print and electronic formats.

ISBN: 978-0-7711-7973-0 (print)

ISBN: 978-0-7711-7974-7 (pdf)

1. Educational tests and measurements—Manitoba.
 2. Mathematical ability—Testing.
 3. Mathematics—Examinations, questions, etc.
 4. Mathematics—Study and teaching (Secondary)—Manitoba.
- I. Manitoba. Manitoba Education and Training.
510.76

Manitoba Education and Training
Winnipeg, Manitoba, Canada

All images found in this resource are copyright protected and should not be extracted, accessed, or reproduced for any purpose other than for their intended educational use in this resource.

Permission is hereby given to reproduce this resource for non-profit educational purposes provided the source is cited.

After the administration of this test, print copies of this resource will be available for purchase from the Manitoba Learning Resource Centre.
Order online at www.manitobalrc.ca.

This resource will also be available on the Manitoba Education and Training 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.

GRADE 12 APPLIED MATHEMATICS ACHIEVEMENT TEST

DESCRIPTION

Total Possible Marks: 61

Time: 3 hours

Unit	Marks
Relations and Functions	15
Financial Mathematics	16
Design and Measurement	7
Probability	17
Logical Reasoning	6

DIRECTIONS

Remember to

- indicate your input values by writing them in your booklet or printing a copy if using a technology tool
- express your answers in decimal and percentage form to the nearest hundredth (two decimal places) when rounding, unless otherwise indicated

Example: $\frac{15}{29} = 0.52$ or 51.72%

- state any assumptions you make

A “graphic organizer” is a visual representation of information. Examples include a tree diagram, a chart, a list, a Venn diagram, a truth table, Pascal’s triangle, etc.

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, and scales for the axes on graphs
- 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.

RELATIONS AND FUNCTIONS

Question 1**Total: 1 mark**

Select the answer that best completes the statement.

101

The end behaviour of a cubic function with a negative leading coefficient extends from:

- A) quadrant II to quadrant IV
- B) quadrant III to quadrant I
- C) quadrant I to quadrant III
- D) quadrant IV to quadrant II

Question 2

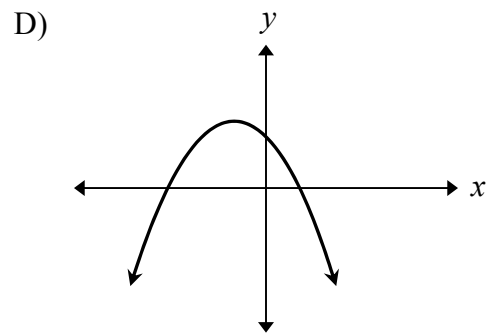
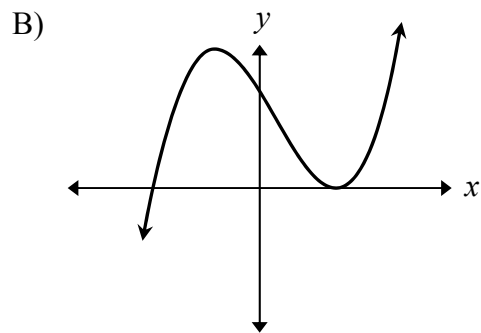
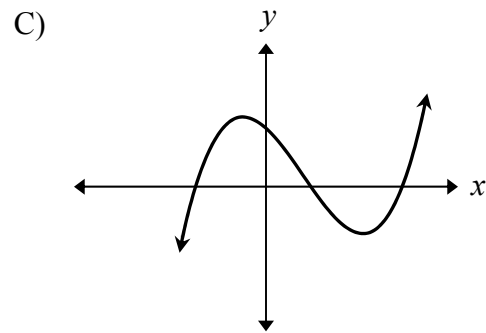
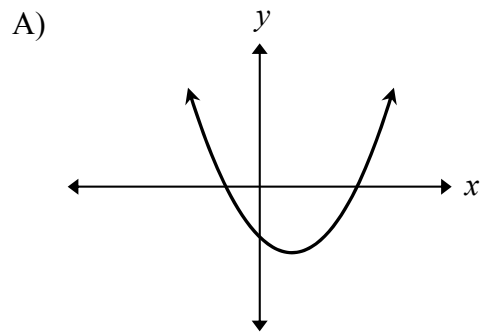
Total: 1 mark

Select the best answer.

102

A cubic function has two x -intercepts and a positive y -intercept.

The graph that has these characteristics is:



Question 3

Total: 3 marks

The heart pumps blood throughout the body. As the blood leaves the heart, it is replaced with new blood.

Muna's heart contains 70 mL of blood. With each heartbeat, the volume of original blood in her heart is reduced by 53% and replaced with new blood.

- a) Determine the exponential regression equation that models the volume of original blood remaining in Muna's heart as a function of the number of heartbeats. Show your work.

103

(2 marks)

- b) Using your equation in (a), determine the volume of original blood remaining in Muna's heart after 6 heartbeats.

104

(1 mark)

Question 4

Total: 5 marks

The following equation models the path of a basketball as it is shot by Sarah:

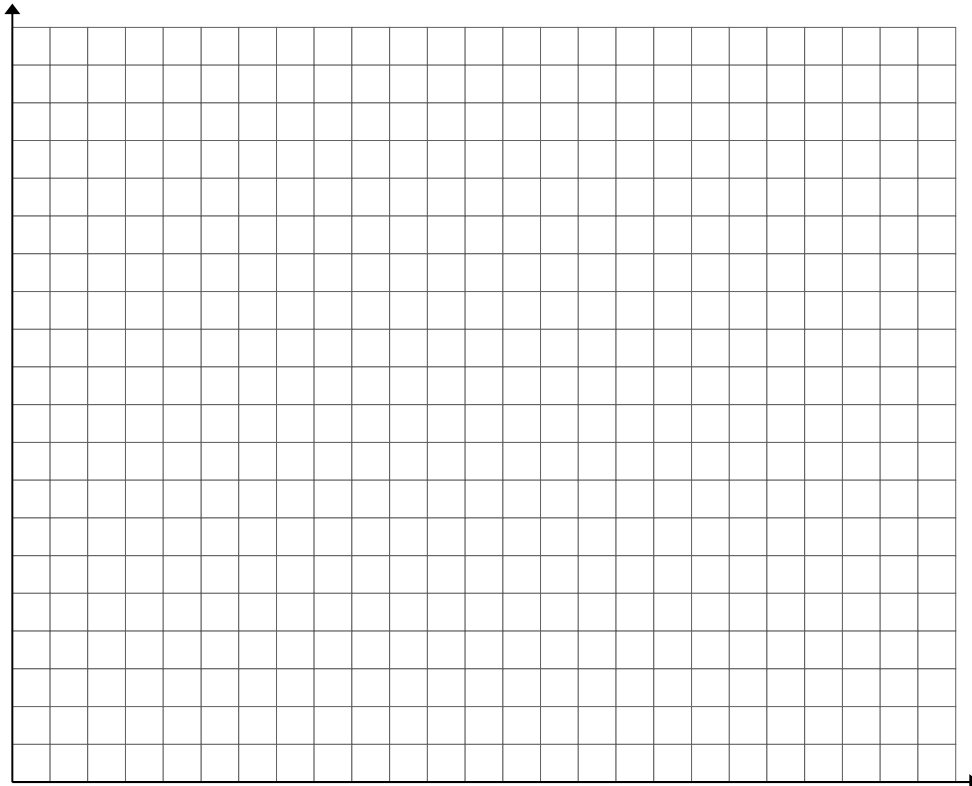
$$h = -0.51d^2 + 4.72d + 6.09$$

where h represents the height in feet
and d represents the horizontal distance, in feet, the ball has travelled.

- a) Create a clearly labelled graph of the equation.

(3 marks)

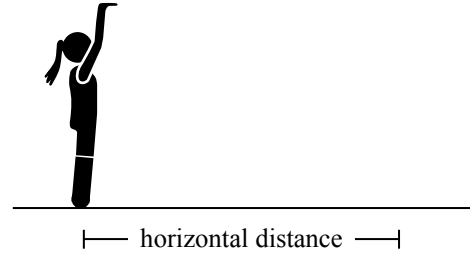
105



- b) The standard height for a basketball net is 10 feet. Sarah shoots the ball and it goes directly through the net on its way down. Using the given equation, determine how far, horizontally, the ball was from the net when it was shot. Show your work.



(2 marks)



Question 5**Total: 5 marks**

A satellite was launched from Cape Canaveral and set to orbit the Earth. Instruments measured its distance from the equator at certain time intervals, using positive numbers to indicate distances north of the equator and negative numbers to indicate distances south as shown below.

Time (minutes)	20	40	60	80	100
Distance from equator (miles)	3929	637	-2468	-254	3620

- a) Determine the sinusoidal regression equation that models this data.

(1 mark)

107

- b) After 180 minutes in orbit, the satellite passes directly over Cape Canaveral. How far is Cape Canaveral from the equator?

(1 mark)

108

- c) Determine the northern and southern limits of the satellite's path relative to the equator.
(2 marks)

- d) Determine the period for this sinusoidal model.
(1 mark)

FINANCIAL MATHEMATICS

Question 6**Total: 1 mark**

Select the best answer.

111

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

Year	Value
0	\$58 500
1	\$42 100
2	\$30 300

The value of this vehicle depreciates at an annual rate of:

- A) 72%
- B) 52%
- C) 39%
- D) 28%

Question 7**Total: 3 marks**

Johannes wants to apply for a bank loan. Information regarding his financial situation is given below.

- He has a house valued at \$225 000.00 with a mortgage of \$175 000.00.
- He has a cottage valued at \$115 000.00 with a mortgage of \$75 000.00.
- He has \$9000.00 in his savings account.
- He owes a total of \$25 000.00 on his credit cards.

112

a) Calculate his net worth.

(1 mark)

113

b) Calculate his debt-to-equity ratio.

(1 mark)

114

c) Based on his debt-to-equity ratio, would the bank lend him money? Explain.

(1 mark)

Question 8**Total: 2 marks**

115

Rémi deposited a sum of money into an account 36 years ago that earned an annual interest rate of 8.00%. Today, there is \$12 800.00 in his account.

Use the Rule of 72 to estimate the initial amount that Rémi deposited.

Question 9**Total: 2 marks**

116

Mr. Smythe makes a one-time donation to a university. The university decides to invest this money and use only the amount earned in simple interest from the investment to finance a scholarship.

- The initial amount of the donation was \$650 000.00.
- The amount earned in simple interest annually is \$40 000.00.
- The university awards the scholarship to one student each year.

At what interest rate must the donation be invested to obtain the \$40 000.00 needed to award the scholarship each year? Show your work.

Question 10

Total: 3 marks

Bonnie and Claude want to buy a house. They can afford monthly payments of \$1125.00. The bank offers them a mortgage at an interest rate of 3.10%, compounded semi-annually, with an amortization period of 25 years.

- a) What is the maximum amount of money the bank will lend them for their mortgage?
Show your work.

117

(2 marks)

- b) If they have \$30 000.00 saved for a down payment, what is the maximum house price they can afford?

118

(1 mark)

Question 11

Total: 5 marks

Bernard is exploring financing options for a new house. The bank offers him a mortgage of \$245 827.00 at an interest rate of 3.75%, compounded semi-annually. He has the following payment options:

Option 1: monthly payments of \$1260.00

Option 2: biweekly payments of \$630.00

- a) How many years will it take Bernard to pay off the mortgage with each option?
Show your work.

119

(3 marks)

- b) If Bernard makes biweekly payments instead of monthly payments, how much money will he save? Show your work.

120

(2 marks)

DESIGN AND MEASUREMENT

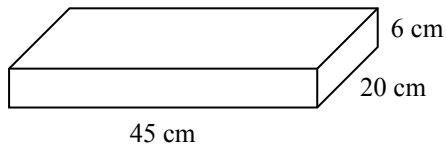
Question 12

Total: 1 mark

Select the best answer.

121

Melia baked the following cake and will ice the top and the sides.



The surface area that needs to be iced is:

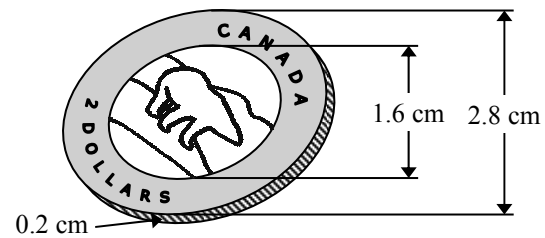
- A) 1290 cm^2
- B) 1680 cm^2
- C) 2580 cm^2
- D) 5400 cm^2

Question 13**Total: 2 marks**

122

A Canadian two-dollar coin consists of a gold-coloured centre and a silver-coloured outer ring. The coin has a diameter of 2.8 cm and is 0.2 cm thick while its centre has a diameter of 1.6 cm.

Diagram is not drawn to scale.



Calculate the volume of the silver-coloured outer ring of the coin.

Question 14

Total: 4 marks

A farmer is selling a cone-shaped pile of grain that has a diameter of 30 feet and a height of 20 feet. The grain needs to be transported to the market by truck.

123

- a) The grain box of the farmer's truck has a volume of 850 cubic feet. What is the minimum number of times the farmer must go to the market to transport all of the grain? Show your work.

(2 marks)

- b) Grain is sold by the whole bushel. This grain has a current value of \$8.50/bushel. If one bushel is equal to 1.24 cubic feet, calculate the value of the pile of grain. Show your work.

124

(2 marks)

PROBABILITY

Question 15**Total: 1 mark**

Select the best answer.

125

There are 16 girls and 11 boys enrolled in a physical education class. A volleyball team of 4 girls and 2 boys will be formed from this class.

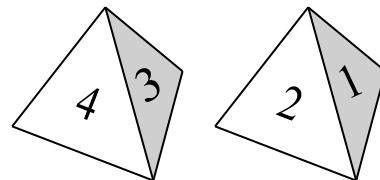
Which of the following expressions could be used to determine the number of teams possible?

- A) ${}_{27}C_6$
- B) ${}_{27}P_6$
- C) ${}_{16}C_4 \times {}_{11}C_2$
- D) ${}_{16}P_4 \times {}_{11}P_2$

Question 16**Total: 2 marks**

Rylan rolls two 4-sided dice with sides numbered 1 through 4. What is the probability that the sum of the rolled numbers is greater than or equal to 6? Show your work.

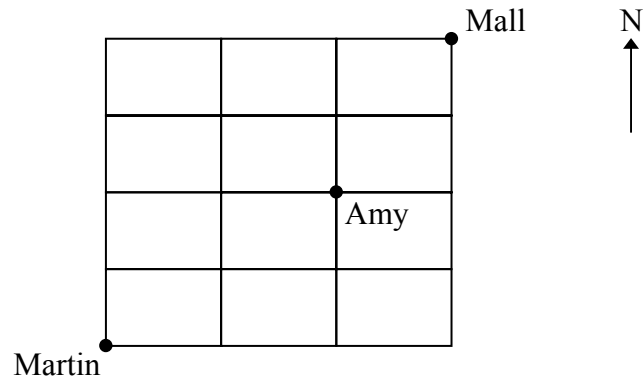
126



Question 17**Total: 2 marks**

127

How many different routes can Martin take to the mall if he can only travel north and east and wants to meet Amy on the way? Show your work.



Question 18

Total: 2 marks

Arif, Simba, and Maritza ran for student council treasurer. Of the 650 students who voted:

- 44% voted for Arif
- 36% voted for Simba
- the remaining students voted for Maritza

a) Determine the number of students that voted for Maritza.

(1 mark)

128

b) One of the students is selected at random. Determine the odds against this student having voted for Arif.

(1 mark)

129

Question 19

Total: 3 marks

Jack is late for the bus 15% of the time. When he is late for the bus, the probability that he will see Jill at the bus stop is 8%. When he is not late, the probability that he will see Jill at the bus stop is 82%.

- a) What is the probability that Jack did not see Jill today? Show your work.

130

(2 marks)

- b) Jack did not see Jill today. Using your answer in (a), what is the probability that Jack was late for the bus?

131

(1 mark)

Question 20

Total: 2 marks

Guy's baseball team is playing in a tournament. There are six teams entered in the tournament. All teams play each other once and each game is played on the same baseball field.

132

- a) Determine the total number of games played in the tournament.

(1 mark)

133

- b) Determine the probability that Guy's team plays the first game of the tournament.

(1 mark)

Question 21

Total: 3 marks

Shivani needs to create a new password for her computer. The password must begin with three upper case letters followed by five digits.

- a) How many passwords are possible if repetition is not allowed? Show your work.

134

(2 marks)

- b) How many passwords are possible if repetition is not allowed and the password must begin with the letter M?

135

(1 mark)

Question 22**Total: 3 marks**

Joe is getting dressed in the dark. The only socks in his drawer are 12 white socks and 10 green socks. He randomly picks two socks from the drawer, one after the other.

- a) What is the probability that both socks are the same colour? Show your work.

136

(2 marks)

LOGICAL REASONING

- b) Using logical reasoning, what is the minimum number of socks Joe would have to pick to guarantee a pair of the same-coloured socks?

137

(1 mark)

Question 23

Total: 1 mark

Select the best answer.

138

Given the following sets:

$$A = \{3, 4, 5, 6, 7, 8, 9, 10\}$$

$$B = \{8, 9, 10, 11, 12\}$$

$$C = \{8, 9, 10\}$$

Which of the following statements represents set C ?

A) $A' \cap B'$

B) $B \subset A$

C) $A \cup B$

D) $A \cap B$

Question 24**Total: 2 marks**

139

Given hypothesis, p , and conclusion, q , complete the truth table below.

p	q	$\sim p$	$\sim p \leftrightarrow q$
True	True		
True	False		
False	True		
False	False		

Question 25

Total: 2 marks

140

Mrs. Dela Cruz teaches German and Spanish. She has 31 students of which 21 study German and 17 study Spanish.

How many of Mrs. Dela Cruz's students study German only? Show your work.

END OF TEST

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

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

Formula Sheet: Applied Mathematics

Relations and Functions	Financial Mathematics
$y = ax + b$ $y = ax^2 + bx + c$ $y = ax^3 + bx^2 + cx + d$ $y = ab^x$ $y = a + b \ln(x)$ $y = a \log_b x$ $y = a \sin(bx + c) + d$ $y = a \cos(bx + c) + d$	$t = \frac{72}{i}$ $I = Prt$ $A = P \left(1 + \frac{r}{n} \right)^{nt}$ <p style="text-align: center;">Net worth = Total assets – Total liabilities</p> $\text{Debt-to-equity ratio (\%)} = \frac{(\text{Total liabilities} - \text{Mortgage})}{\text{Net worth}} \times 100$ $\text{Gross debt service ratio (\%)} = \frac{\left(\begin{array}{l} \text{Monthly mortgage} \\ \text{payment} \end{array} + \begin{array}{l} \text{Monthly property} \\ \text{taxes} \end{array} + \begin{array}{l} \text{Monthly heating} \\ \text{costs} \end{array} \right)}{\text{Gross monthly income}} \times 100$ $\text{Rate of return (\%)} = \frac{\left(\begin{array}{l} \text{Current value} \\ \text{of portfolio} \end{array} - \begin{array}{l} \text{Previous value} \\ \text{of portfolio} \end{array} \right)}{\text{Previous value of portfolio}} \times 100$
Probability	Design and Measurement
$P(A \text{ or } B) = P(A) + P(B) - P(A \text{ and } B)$ $P(A \text{ and } B) = P(A) \times P(B)$ $P(A \text{ and } B) = P(A) \times P(B A)$ ${}_n P_r = \frac{n!}{(n-r)!}$ ${}_n C_r = \frac{n!}{r!(n-r)!}$	<p style="text-align: center;">Prism: Surface area = $Ph + 2B$ Volume = Bh</p> <p style="text-align: center;">Pyramid: Surface area = $B + \frac{Ps}{2}$ (s = slant height) Volume = $\frac{Bh}{3}$</p> <p style="text-align: center;">Sphere: Surface area = $4\pi r^2$ Volume = $\frac{4}{3}\pi r^3$</p> <p style="text-align: center;">Cylinder: Surface area = $2\pi rh + 2\pi r^2$ Volume = $\pi r^2 h$</p> <p style="text-align: center;">Cone: Surface area = $\pi r^2 + \pi rs$ Volume = $\frac{\pi r^2 h}{3}$</p>

