Grade 12
Applied Mathematics
Achievement Test

Student Booklet

January 2014

Manitoba

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Disponible en français.

Available in alternate formats upon request.

GRADE 12 APPLIED MATHEMATICS
ACHIEVEMENT TEST

DESCRIPTION:

Total Possible Marks: 59 **Time: 3 hours**

Unit	Description	Marks
A	Relations and Functions	14
B	Probability	16
C	Financial Mathematics	16
D	Design and Measurement	6
E	Logical Reasoning	7

Formula Sheet: Applied Mathematics

Relations and Functions

$$y = ax + b$$

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

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

$$y = ab^x$$

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

$$y = a\log_b x$$

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

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

Financial Mathematics

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

$$I = Prt$$

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

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

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

$$\text{Gross debt service ratio} = \frac{\begin{pmatrix}\text{Monthly}\\ \text{mortgage}\\ \text{payment}\end{pmatrix} + \begin{pmatrix}\text{Monthly}\\ \text{property}\\ \text{taxes}\end{pmatrix} + \begin{pmatrix}\text{Monthly}\\ \text{heating}\\ \text{costs}\end{pmatrix}}{\text{Gross monthly income}} \times 100$$

$$\text{Rate of return} = \frac{\begin{pmatrix}\text{Current value}\\ \text{of portfolio}\end{pmatrix} - \begin{pmatrix}\text{Previous value}\\ \text{of portfolio}\end{pmatrix}}{\text{Previous value of portfolio}} \times 100$$

Probability

$$P(A \text{ or } B) = P(A) + P(B) - P(A \text{ and } B)$$

$$P(A \text{ and } B) = P(A) \times P(B)$$

$$P(A \text{ and } B) = P(A) \times P(B|A)$$

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

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

Design and Measurement

Prism: Surface area $= Ph + 2B$

Volume $= Bh$

Pyramid: Surface area $= B + \frac{Ps}{2}$ (s = slant height)

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

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

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

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

Volume $= \pi r^2 h$

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

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

TEST RESOURCES AND DIRECTIONS:

- You may consult your 8½″ × 11″ study sheet during the test.
- You may use a ruler, a graphing calculator, and computer software. You may also have access to the Internet for tools such as applets or a mortgage payment calculator. **Use of the Internet to access course notes, find definitions, communicate, or search for conceptual information about the course is prohibited during the test.**
- For short-answer and long-answer questions, you may print out diagrams from the computer or your calculator where applicable. Indicate your booklet number and the question number on the printouts. Remain seated and your teacher will distribute these printouts to you. Indicate in the response space of the question that the answer is on a printed sheet and staple it to the page.
- If you need more space to answer a question, extra paper may be provided by your teacher. Write your booklet number and the question number on any extra paper used and staple it into the booklet where your answer begins. Indicate in the response space of the question that the answer is on a separate sheet.
- Provide clear explanations or justifications where applicable. This can be done through labelled diagrams, in words, by showing mathematical operations to verify your answer, or by referring to a calculator or software program.
  - — If you refer to a calculator program, indicate all your input values.
  - — If you refer to a software program or a website, indicate all your input values and print or copy the screen showing the answers.
  - — If you refer to a spreadsheet, print a copy of the answers.
- 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.
- Round your final answers to two decimal places unless otherwise indicated.
- Always state your assumptions.

The following errors may result in a 0.5 mark deduction:

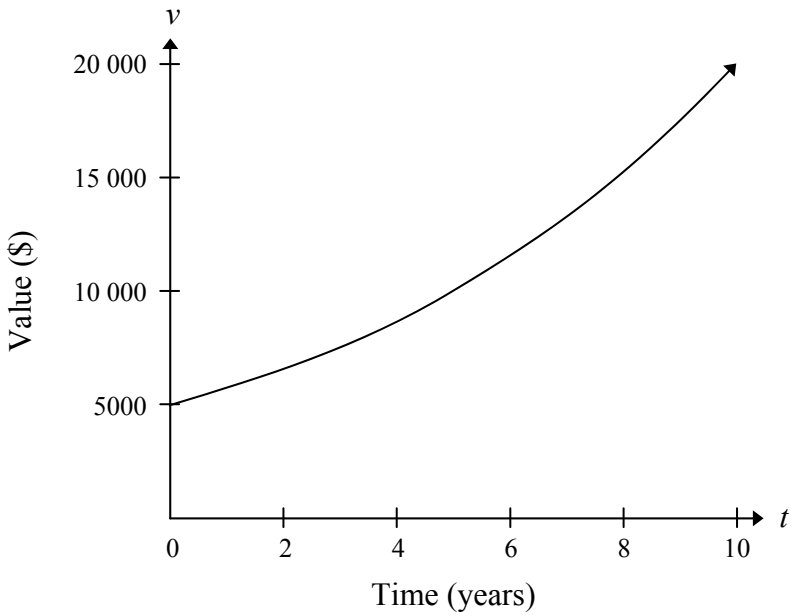
- not including one of the following in the equation: "y =", "sin", "ln", or "x", or writing parameters separately from the equation
- not including the units in the final answer
- not including one of the following on the graph: labels for the axes, units for the axes, or scales for the axes
- not stating or incorrectly stating the final answer
- rounding too soon or rounding incorrectly
- not using whole units appropriately
- making a transcription or transposition error

RELATIONS AND FUNCTIONS

Question 1 — Total: 1 mark

101

Select the equation below that is best represented by the following graph.



A) $v = 5000(0.15)^t$

B) $v = 5000(-0.15)^t$

C) $v = 5000(1.15)^t$

D) $v = 5000(0.15)^{-t}$

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Question 2 — Total: 3 marks

A community centre offered a new exercise program aimed at increasing lung capacity. The following data was obtained by measuring the lung capacity of a person at regular intervals during the program:

Days of Training	Lung Capacity (cm^3)
0	4 800 000
10	4 840 000
20	4 890 000
30	4 930 000
40	5 020 000
50	5 120 000
60	5 260 000

102

a) Determine the cubic equation that models this data.

(1 mark)

103

b) Explain why the domain of the function is limited in this situation.

(1 mark)

104

c) Explain why the range of the function is limited in this situation.

(1 mark)

Question 3 — Total: 3 marks

A golf ball is struck from an elevated platform at a golf course. The height of the golf ball above the ground is modelled by the equation:

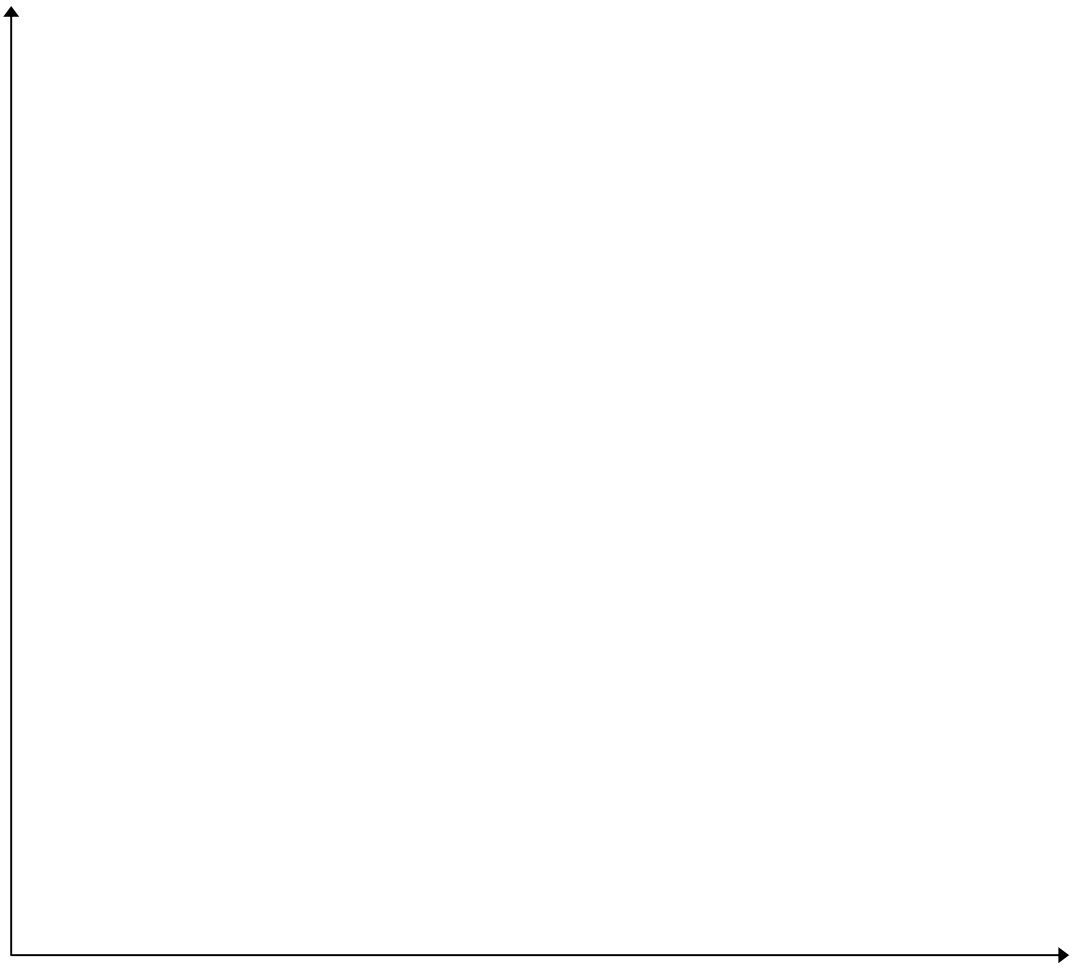
$$h = -5.33t^2 + 31.33t + 4.00$$

where h represents the height (in yards) above the ground
and t represents the time (in seconds) after the golf ball is struck.

105

a) Create a clearly labelled graph of the equation.

(2 marks)



b) Using a graphing calculator or graphing software, determine the maximum height of the golf ball.

(1 mark)

Question 4 — Total: 3 marks

The population of a city since 1996 is shown in the table below:

Population	27 500	28 000	28 500	29 600	30 700
Number of years since 1996	4	5	6	8	10

107

a) Determine the logarithmic equation that models this data.

(1 mark)

108

b) Using your equation in (a), predict the population of the city in 2016. Show your work.

(2 marks)

Question 5 — Total: 4 marks

The London Eye is a giant Ferris wheel in London, England. It has a maximum height of 135 m, a minimum height of 0 m, and one complete rotation takes 30 min. The passengers get on the ride at the bottom of the wheel.

109

a) Determine a sinusoidal equation that models this data. Explain how you arrived at your answer. Indicate the input values if you use a technology tool.

(2 marks)

110

b) How many minutes would a passenger be at least 100 m above the ground during one complete rotation? Show your work.

(2 marks)

PROBABILITY

Question 6 — Total: 1 mark

111

Assuming that repetition is allowed, how many different four-digit codes can be created using the digits 0, 1, 2, 3, 4, 5, and 6? Select the correct answer.

A) 28

B) 720

C) 840

D) 2401

Question 7 — Total: 1 mark

112

A national survey found that 83% of students like pizza. If three students are selected at random, what is the probability that all three students like pizza?

Question 8 — Total: 2 marks

There are 16 ducks on a pond and 7 of these ducks are female.

113

a) Determine the probability of randomly selecting a female duck.

(1 mark)

114

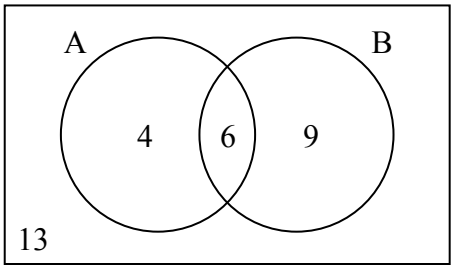
b) Determine the odds against selecting a female duck.

(1 mark)

Question 9 — Total: 2 marks

The following Venn diagram shows the enrolment of students in two extracurricular activities.

A: student council
B: golf



115

a) Are these two activities mutually exclusive? Explain your reasoning.

(1 mark)

116

b) Determine the probability that a student selected at random will not participate in either activity.

(1 mark)

Question 10 — Total: 2 marks

117

Laurel has a bag containing 5 blue marbles, 3 green marbles, and 2 red marbles.

Using the information above, create a scenario with 2 events that are dependent. Explain why they are dependent.

Question 11 — Total: 2 marks

118

An art gallery wants to display some photographs in a row on a wall. There are 2 different colour photographs and 2 different black-and-white photographs.

Using all 4 photographs, how many different arrangements are possible if the colour photographs and black-and-white photographs must alternate? Show your work.

Question 12 — Total: 3 marks

Based on the team's record, a local soccer team has a probability of 0.80 of winning their game on a sunny day. The probability of winning their game on a cloudy day is 0.60. The probability of cloudy weather on a given day is 0.30.

119

a) Use a graphic organizer to show all the possible outcomes for this situation. (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.)

(1 mark)

120

b) Determine the probability that the soccer team wins. Show your work.

(2 marks)

Question 13 — Total: 3 marks

A school principal is selecting students from a group of volunteers to organize a social event. There are 12 students in the group: 8 students from Class A and 4 students from Class B.

121

a) How many different groups of 5 students can be created if there are no restrictions?

(1 mark)

122

b) How many different groups of 5 students are possible which include at least 1 student from Class B? Show your work.

(2 marks)

FINANCIAL MATHEMATICS

Question 14 — Total: 1 mark

123

Genevieve wants to invest $3000.00 for two years and has two options.

Option 1: Invest in a Canada Savings Bond at a simple interest rate of 2.20%.

Option 2: Invest in a guaranteed investment certificate (GIC) at an interest rate of 2.20%, compounded annually.

Select the statement that is true.

A) The Canada Savings Bond will earn more interest.

B) The GIC has a higher level of risk.

C) Both investments will earn equal amounts of interest.

D) The GIC will earn more interest.

Question 15 — Total: 1 mark

124

According to the Rule of 72, what was the approximate annual interest rate of an investment that doubled in 12 years? Select the correct answer.

A) 2%

B) 6%

C) 12%

D) 24%

Question 16 — Total: 1 mark

125

Explain why someone would choose to rent instead of purchase a house.

Question 17 — Total: 1 mark

126

Aamina invests $7500.00 in a guaranteed investment certificate (GIC). What is the rate of return on her investment if the GIC is worth $7800.00 after one year?

Question 18 — Total: 1 mark

127

Seven years ago, Henri bought a house valued at $249 500.00. Determine the current value of his house if it appreciated at an average rate of 8.00% per year.

Question 19 — Total: 2 marks

You must choose between investing in the stock market or buying a 5-year guaranteed investment certificate (GIC).

128

a) Provide one disadvantage of investing in the stock market.

(1 mark)

129

b) Provide one disadvantage of buying the GIC.

(1 mark)

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Question 20 — Total: 4 marks

130

Petra and Sabine are comparing bank loans. Both plan to borrow $65 000.00 at an interest rate of 5.00% for 3 years.

- Petra's loan will be compounded quarterly and she will make quarterly payments.
- Sabine's loan will be compounded monthly and she will make monthly payments.

Calculate the total amount paid for each loan. Show your work.

Question 21 — Total: 5 marks

Luis wants a new computer. The total cost of the computer is $2014.00 (taxes included). He wonders which would be the better option, getting a loan to purchase the computer or leasing the computer.

Option 1: Getting a loan

- interest rate of 6.25%, compounded monthly
- monthly payments for 2 years

Option 2: Leasing

- monthly payments of $80.00 (taxes included) for 2 years
- purchase the computer at the end of the lease for $400.00 (taxes included)

131

a) What would be Luis' monthly payment with Option 1? Show your work.

(2 marks)

132

b) Calculate the total cost for Option 1 and for Option 2.

(2 marks)

133

c) Which option should Luis choose? Explain your reasoning.

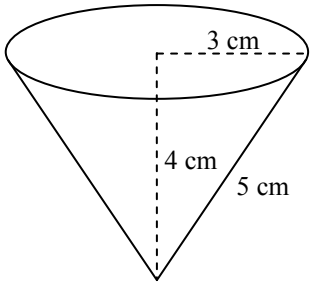
(1 mark)

DESIGN AND MEASUREMENT

Question 22 — Total: 1 mark

134

What is the minimum amount of paper required to create the cone-shaped paper cup shown below? (Diagram is not drawn to scale.)



Select the correct answer.

A) 37.70 cm^2

B) 47.12 cm^2

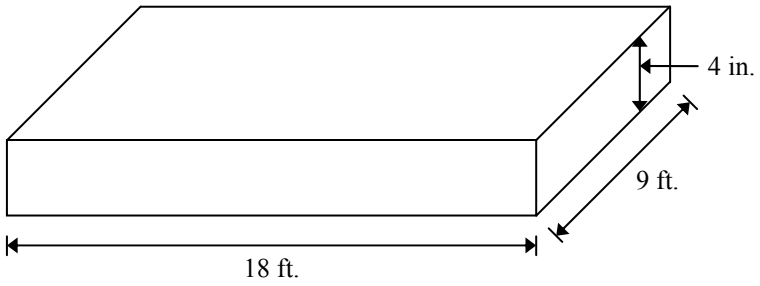
C) 75.40 cm^2

D) 113.10 cm^2

Question 23 — Total: 2 marks

135

A student was given the following diagram and was asked: "How many cubic yards of soil are required to fill this garden with 4 inches of soil?" (Diagram is not drawn to scale.)



The student provided this answer: $18 \times 9 \times \frac{1}{3} = 54 \text{ ft}^3 = 18 \text{ yd}^3$

Explain the student's error and provide the correct answer.

Question 24 — Total: 3 marks

A bathroom floor is covered by 15 floor tiles. Each tile measures 18 in. × 18 in.

136

a) How many floor tiles measuring 6 in. × 6 in. would be needed to cover the same area? Show your work.

(2 marks)

137

b) You would like to redo the floor with 6 in. × 6 in. tiles. These tiles are sold in packages of 5 tiles and cost $4.00 per package (taxes included). How much would it cost to buy the number of tiles you calculated in (a)?

(1 mark)

LOGICAL REASONING

Question 25 — Total: 1 mark

138

Given the statement: "If it is sunny outside, then I will walk to school."

Select the converse of this statement.

A) "If I will walk to school, then it is sunny outside."

B) "If it is not sunny outside, then I will not walk to school."

C) "If I will not walk to school, then it is not sunny outside."

D) "It is sunny if and only if I will walk to school."

Question 26 — Total: 1 mark

139

Given the following universal set: $U = \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10\}$

Give an example of two disjoint subsets of U.

Question 27 — Total: 2 marks

140

A survey was conducted on 50 randomly selected people to see what snacks they preferred.

Preferred Snack	Number of People
chocolate bar	20
potato chips	23
both snacks	9

How many people **do not like any** of the snacks indicated above? Show your work.

Question 28 — Total: 3 marks

Given the statement: "If a number is a multiple of 3, then it is a multiple of 9."

141

a) Provide a counterexample for the given statement.

(1 mark)

142

b) Write the contrapositive of the given statement.

(1 mark)

143

c) Write the inverse of the given statement.

(1 mark)

END OF TEST

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FOR WORK DONE ON THIS PAGE.

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