Grade 12 Applied Mathematics Achievement Test

Marking Guide

June 2019



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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.

Contents

General Marking Instructions	1
Marking Keys	5
Relations and Functions	7
Probability	. 15
Financial Mathematics	. 22
Design and Measurement	. 30
Logical Reasoning	. 34
Exemplars	. 39
Appendices	. 91
Appendix A: Table of Questions by Unit and Learning Outcome	. 93
Appendix B: Irregularities in Provincial Tests	. 95
Irregular Test Booklet Report	. 97

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 Training for sample marking.

Once marking is completed, please forward the *Scoring Sheets* to Manitoba Education and Training using the envelope provided (for more information, see the administration manual).

Marking

Explanations for student errors for selected-response questions have been provided, if applicable.

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 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.

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., cm² instead of cm³, 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).

El	E2	E3	E4	ES	E6
Final Answer	Notation	Transcription/ Transposition	Whole Units	Units	Rounding
Preli	minary Mark	Commu – (Number of	nication Errors error types ×	(0.5) = Final	Mark
	46	- (2×0.5)	= 4	15

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 Training 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.

Yongfei Wu Assessment Consultant Grade 12 Applied Mathematics Telephone: 204-945-4035 Toll-Free: 1-800-282-8069, ext. 4035 Email: <u>yongfei.wu@gov.mb.ca</u>

Marking Keys

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

RELATIONS AND FUNCTIONS

Question 1Total: 1 markLearning Outcome: 12.A.R.1Question Type: Selected Response

Select the best answer.

A stadium field is shaped like a parabola so that rainwater runs off to the sides. The surface of the field can be modelled by the following function:

$$y = -0.000\ 234(x - 80)^2 + 1.5$$

where *x* represents the distance from the left side of the field and *y* represents the height of the field.



What is the width of the field?

- A) 0.75 ft.
- B) 1.5 ft.
- C) 80 ft.

(D)) 160 ft.

Student Error A: maximum ÷ 2 B: maximum C: axis of symmetry

Question 2	Total: 1 mark
Learning Outcome: 12.A.R.1	Question Type: Constructed Response

In an experiment, a water balloon is dropped from the roof of a school. The height of the water balloon from the ground is a function of time. The height is expressed in metres and the time is expressed in seconds. The domain of this function is [0, 1.43].

Give one reason that explains why the domain is restricted.

The domain is restricted to 1.43 seconds because after 1.43 seconds, the water balloon hits the ground.

OR—

The domain is restricted to beginning at 0 seconds because the equation does not model the height of the water balloon before it is dropped.

Other reasons are possible.

Marking Key

1 *mark for appropriate reason*

Question 3

Total: 2 marks

Learning Outcome: 12.A.R.1

Question Type: Constructed Response

Taryn cooks a roast and records its internal temperature at specific times throughout the cooking process. Her findings are shown in the table below.

Time (hours)	1	2	5	8
Temperature (°F)	70	120	150	175

a) Determine the cubic regression equation that best models the data in this situation.

(1 mark)

 $y = 1.39x^3 - 21.11x^2 + 103.61x - 13.89$

b) The next time Taryn cooks a roast, she would like its internal temperature to be 160°F. Determine how long it will take the roast to reach this temperature.

OR

(1 mark)

$$Y_2 = 160$$

CALC 5: intersect (7.420..., 160)
 $x = 7.42$





	Marking Key
0	1 mark for correct answer in (a)
0	1 mark for consistent answer in (b)

Learning Outcome: 12.A.R.2

Scientists have determined that when the weight of an adult electric eel is known, its length can be modelled using the following equation:

$$y = 22.4 \ln(x) - 28.7$$



where *x* is the eel's weight in pounds and *y* is the length of the eel in inches.

a) Using the equation, determine the length of an eel that weighs 18 pounds.

(1 mark)

CALC 1: value x = 18, y = 36.04

The length of an eel that weighs 18 pounds is 36.04 inches.

b) Provide one limitation of the equation that models this relationship.

(1 mark)

The weight of an eel cannot be infinite.

OR—

The weight of an eel must be greater than or equal to 3.60 pounds because the length must be a positive number.

Other limitations are possible.

1 *mark for correct answer in (a)*

2 *1 mark for appropriate limitation in (b)*

Question 5

Total: 4 marks

Learning Outcome: 12.A.R.3

Question Type: Constructed Response

A boat is propelled by a paddle wheel with a diameter of 14 feet. Each paddle takes 90 seconds to complete one revolution. The logo on one paddle reaches a maximum height of 11 feet above the water after the boat is in motion for 10 seconds.



Diagram is not drawn to scale.

a) Determine a possible sinusoidal equation that models the height of the logo over time. Show your work.

(2	marks)
----	--------

Time (s)	Height (ft.)
10	11
32.5	4
55	-3
77.5	4
100	11

$$y = 7\sin(0.07x + 0.87) + 4$$

Other equations are possible.

b) Determine how long the logo is underwater during one revolution. Show your work.

(2 marks)

 CALC
 2: zero
 (41.212 476, 0)

 CALC
 2: zero
 (68.787 524, 0)

68.787 524 - 41.212 476 = 27.575 048

The logo is underwater for 27.58 seconds.

	Marking Key
0	<i>1 mark for appropriate work in (a)</i>
0	0.5 mark for two consistent values in (a)
€	0.5 mark for remaining two consistent values in (a)
4	<i>1 mark for appropriate work in (b)</i>
6	1 mark for consistent answer in (b)

Question 6

Total: 6 marks

Learning Outcome: 12.A.R.2

Question Type: Constructed Response

An Australian farmer records the rabbit population on his farm over the course of one year. The table below represents his data.

Time (months)	1	4	7	9	11
Number of rabbits	25	50	100	150	240

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

(3 marks)



b) Determine the exponential regression equation that best models the data in this situation. *(1 mark)*

$$y = 20.17(1.25)^{x}$$

c) Using your equation in (b), determine how long it will take for the rabbit population to reach 400.

(1 mark)



It will take 13.27 months for the rabbit population to reach 400.

d) At a different farm, there are 300 rabbits at the beginning of the following year. This rabbit population increases, but less quickly than on the first farm. Write an exponential equation that models this situation.

(1 mark)

$$y = 300(1.17)^{x}$$

Other equations are possible.

Marker Note(s):

 \rightarrow In Desmos, if \Box Log Mode is unchecked, a = 20.354 and b = 1.251 05.

Marking Key				
0	<i>1 mark for communicating the context of the graph with appropriate title and/or labels</i>			
	<i>in (a)</i>			
0	1 mark for using an appropriate domain and range (i.e., window settings/grid range) for			
	the context of the question in (a)			
₿	<i>1 mark for correctly plotting the data in (a)</i>			
4	<i>1 mark for correct equation in (b)</i>			
6	1 mark for consistent answer in (c)			
6	0.5 mark for correct a value in (d)			
6	0.5 mark for $1 \le b \le 1.25$ in (d)			

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PROBABILITY

Question 7	Total: 1 mark
Learning Outcome: 12.A.P.1	Question Type: Selected Response

Select the best answer.

Cintra scores a goal on 11% of the shots she takes.

Identify the odds against her scoring a goal.

A) 11:89



- C) 11:100
- D) 89:100

Question 8	Total: 2 marks
Learning Outcome: 12.A.P.4	Question Type: Constructed Response

Corbin wants to create an image of himself on his cellphone. There are 7 choices for hair colour, 3 choices for hair length, and 9 choices for a hat.

Using these options, how many different images in total can he create with or without a hat? Show your work.

Method A:

with a hat: $\underline{7} \times \underline{3} \times \underline{9} = 189$ without a hat: $\underline{7} \times \underline{3} = 21$ $\overrightarrow{7} \uparrow \overleftarrow{5}$ $\overrightarrow{7} \uparrow$ colour length hat colour length

189 + 21 = 210

He can create 210 different images.

Marking Key

• *1 mark for correct case with a hat*

2 0.5 mark for correct case without a hat

6 0.5 mark for consistent sum of cases

OR-

Method B:



He can create 210 different images.

	Marking Key
0	1 mark for appropriate work
0	1 mark for consistent answer

Question 9	Total: 2 marks
Learning Outcomes: 12.A.P.2, 12.A.L.2	Question Type: Constructed Response

There are 21 students in an applied math class. On a test, 10 students used an app, 14 students used a graphing calculator, and 4 students used both.

What is the probability that a randomly selected student used only an app on the test? Show your work.



The probability is $\frac{6}{21}$, $\frac{2}{7}$, 0.29, or 28.57%.

	Marking Key
	1 mark for appropriate work
0	1 mark for consistent answer

Question 10	Total: 2 marks
Learning Outcomes: 12.A.P.4, 12.A.P.5	Question Type: Constructed Response

Pedro is walking from the train station to the convention centre and must withdraw money at the bank on his way. He can only walk south and east. How many different ways can he get to the convention centre? Show your work.





OR-

```
ESSS EEESS

\frac{4!}{3!} \times \frac{5!}{3!2!}
= 4 \times 10
= 40
```

There are 40 different ways.

the many

ſ	0	1 mark for appropriate work
	0	1 mark for consistent answer

Question 11	Total: 4 marks
Learning Outcome: 12.A.P.3	Question Type: Constructed Response

There are 5 biology books, 4 math books, and 7 history books randomly placed on a shelf.

a) Luis selects 2 books, one after the other. Determine the probability that both books are on the same subject. Show your work.

(3 marks)

 $P(2 \text{ same-subject books}) = P(biology, biology}) + P(math, math) + P(history, history)$

$$= \left(\frac{5}{16} \times \frac{4}{15}\right) + \left(\frac{4}{16} \times \frac{3}{15}\right) + \left(\frac{7}{16} \times \frac{6}{15}\right)$$
$$= \frac{20}{240} + \frac{12}{240} + \frac{42}{240}$$
$$= \frac{74}{240}$$

The probability is $\frac{37}{120}$, 0.31, or 30.83%.

b) Are the events in (a) independent or dependent? Explain.

(1 mark)

The events in (a) are dependent because the books are not replaced. Therefore, the probability changes for the second selection of each book.

	Marking Key
0	<i>1 mark for correctly considering dependency in (a)</i>
0	1 mark for correctly multiplying the number of same-subject books in (a)
6	<i>1 mark for consistent sum in (a)</i>
4	1 mark for correct explanation in (b)

Question 12	Total: 3 marks
Learning Outcomes: 12.A.P.2, 12.A.P.3	Question Type: Constructed Response

Construction work has slowed travel near Dauphin, Manitoba. Harry must drive through the construction zone to get to work. The probability that he will be delayed because of the construction is 45%. If he is delayed, the probability he will get to work on time is 70%. If he is not delayed, the probability he will get to work on time is 85%.

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





Other graphic organizers are possible.

b) Determine the probability that Harry will get to work on time. Show your work. *(2 marks)*

P(on time) = P(delayed, on time) + P(not delayed, on time)= 0.45(0.70) + 0.55(0.85)= 0.782 5

The probability is $\frac{313}{400}$, 0.78, or 78.25%.

	Marking Key
0	<i>1 mark for appropriate graphic organizer in (a)</i>
0	0.5 mark for P(delayed, on time) in (b)
€	0.5 mark for P(not delayed, on time) in (b)
4	1 mark for consistent sum in (b)

Question 13	Total: 2 marks
Learning Outcome: 12.A.P.6	Question Type: Constructed Response

A group of friends is ordering a meal of 3 pizzas and 2 salads from a restaurant. The restaurant offers 6 types of pizzas and 4 types of salads.

If all pizzas and salads chosen must be different from one another, how many meal options do the friends have? Show your work.

 ${}_{6}C_{3} \times {}_{4}C_{2}$ $= 20 \times 6$ = 120

There are 120 meal options.

Marker Note(s):

Г

 \rightarrow Award a maximum of 1 mark if permutations are used instead of combinations.

	Marking Key
	1 mark for appropriate work
0	1 mark for consistent answer

1

Question 14	Total: 5 marks
Learning Outcomes: 12.A.P.5, 12.A.FM.1	Question Type: Constructed Response

A dealership has 6 cars, 2 vans, and 4 trucks for sale.

a) An employee is asked to park all of these vehicles in a row. How many different ways can this be done if all of the cars must be together, all of the vans must be together, and all of the trucks must be together? Show your work.

(2 marks)

6!2!4!3! = 207 360

There are 207 360 different ways.

FINANCIAL MATHEMATICS

b) Diane visits the dealership and decides to buy one of the trucks. The price of this truck is \$36 500.00, taxes included. She has \$4000.00 for a down payment. The balance will be financed at an interest rate of 2.99%, compounded monthly, for 7 years. Calculate her monthly payment. Show your work.

(2 marks)

N=84 1%=2.99 PV=32500 ● PMT= -429.28579 FV=0
Þ∕Y≚12 C∕Y=12 PMT: ⊒N ⊈ BEGIN

Her monthly payment is \$429.29.

c) What is the total amount Diane will pay to buy the truck?

(1 mark)

Total amount =
$$$429.29 \times 84 + $4000.00$$

= \$36 060.36 + \$4000.00
= \$40 060.36

The total amount Diane will pay is \$40 060.36.

Marker Note(s):

 \rightarrow Award a maximum of 1 mark in (b) for one incorrect input value; award no marks for two or more incorrect input values.

Marking Key	
	0.5 mark for 6!2!4! in (a)
0	0.5 mark for 3! in (a)
€	<i>1 mark for correctly multiplying factorials in (a)</i>
4	<i>1 mark for appropriate work in (b)</i>
6	1 mark for consistent answer in (b)
6	0.5 mark for consistent total monthly payments in (c)
0	0.5 mark for consistent total amount in (c)

Question 15

Learning Outcome: 12.A.FM.1

Question Type: Selected Response

Select the best answer.

Renasha deposits \$1200.00 into a savings account that earns simple interest at a rate of 1.72% annually.

What is the total value of Renasha's account at the end of one year?

A) \$20.64



C) \$1447.68

D) \$3264.00

Question 16Total: 2 marksLearning Outcome: 12.A.FM.2Question Type: Constructed Response

Mr. Chen is moving to Manitoba and is looking for a place to live.

State two reasons why Mr. Chen would prefer renting a house instead of buying a similar house.

No down payment is needed.

*OR*_____

Mr. Chen would not be responsible for maintenance.

OR—

If Mr. Chen needed to relocate, he would not need to sell the house.

Other reasons are possible.

	Marking Key
0	1 mark for one appropriate reason
0	1 mark for a second appropriate reason

Question 17	Total: 3 marks
Learning Outcomes: 12.A.FM.1, 12.A.FM.3	Question Type: Constructed Response

Nadia hopes to save enough money over a 6-year period to go on a trip estimated to cost \$11 600.00. To start saving, she deposits \$1250.00 into an account that earns an interest rate of 4.21%, compounded monthly.

a) If she makes monthly payments of \$110.00 into this account, how much money will she have at the end of the 6-year period? Show your work.

(2 marks)

N=72 I%=4.21 PV=-1250 PMT=-110 ■FV=10600.77948 P/Y=12 C/Y=12 PMT: INI BEGIN

She will have \$10 600.78 at the end of the 6-year period.

b) What is the minimum number of additional monthly payments Nadia needs to make in order to save enough money for the trip?

(1 mark)

■N=78.7207769 I%=4.21 PV=-1250 PMT=-110 FV=11600 P/Y=12 C/Y=12 PMT:]X BEGIN
--

78.72 - 72 = 6.72

Nadia needs to make a minimum of 7 additional monthly payments.

Marker Note(s):

 \rightarrow Award a maximum of 1 mark in (a) for one incorrect input value; award no marks for two or more incorrect input values.

Marking Key	
0	<i>1 mark for appropriate work in (a)</i>
0	<i>1 mark for consistent answer in (a)</i>
6	0.5 mark for consistent total number of payments in (b)
4	0.5 mark for consistent number of additional payments in (b)

Question 18	Total: 5 marks
Learning Outcome: 12.A.FM.1	Question Type: Constructed Response

Marshall and Kim are renting a house that they hope to purchase. They pay \$1800.00 in annual heating costs and know that the annual property taxes are \$2500.00. Their combined gross income is \$5200.00 per month.

a) Based on the gross debt service ratio (GDSR), what is the maximum monthly mortgage payment they can afford? Show your work.

$$0.32 = \frac{\begin{pmatrix} \text{monthly} \\ \text{mortgage} + \frac{\$2500.00}{12} + \frac{\$1800.00}{12} \\ \$5200.00 \\ \\ 0.32 = \frac{(\text{monthly mortgage payment} + \$208.33 + \$150.00)}{\$5200.00}$$

1664.00 = monthly mortgage payment + 358.33

\$1305.67 = monthly mortgage payment

The maximum monthly mortgage payment they can afford is \$1305.67.

b) If they have saved \$30 000.00 for a down payment, what is the maximum house price they can afford based on a 25-year amortization period at an interest rate of 4.64%, compounded semi-annually? Show your work.

(3 marks)

(2 marks)

N=300 I%=4.64 ●PV=232622.6108 PMT=-1305.67 FV=0 P∕Y=12
C∕Y=2 PMT: [⊒2] BEGIN

\$232 622.61 + \$30 000.00

= \$262 622.61

The maximum house price they can afford is \$262 622.61.

Marker Note(s):

 \rightarrow Award a maximum of 1 mark in (b) for one incorrect input value; award no marks for two or more incorrect input values.

Marking Key	
0	0.5 mark for correctly converting annual costs to monthly costs in (a)
0	0.5 mark for correct substitution into formula in (a)
€	<i>1 mark for consistent answer in (a)</i>
4	<i>1 mark for appropriate work in (b)</i>
6	1 mark for consistent value of mortgage in (b)
6	<i>1 mark for consistent maximum house price in (b)</i>

Question 19	Total: 5 marks
Learning Outcome: 12.A.FM.3	Question Type: Constructed Response

Amor and Angélique each want to retire at age 65. They start investing in tax-free savings accounts (TFSA) at different ages in their lives.

- At age 28, Amor starts investing \$240.00 per month into a TFSA that earns an interest rate of 2.95%, compounded monthly.
- At age 42, Angélique makes an initial deposit of \$5000.00 and starts investing \$350.00 per month into a TFSA that earns an interest rate of 3.50%, compounded monthly.
- a) What is the value of each of their TFSAs at age 65? Show your work.

(4 marks)



The value of Amor's TFSA is \$192 789.31 while Angélique's is \$159 259.67.

b) Explain why a small long-term investment may be worth more than a large short-term investment.

(1 mark)

A small long-term investment may earn more interest compared to a large short-term investment.

Marker Note(s):

 \rightarrow For each TFSA value, award a maximum of 1 mark in (a) for one incorrect input value; award no marks for two or more incorrect input values.

Marking Key		
0	<i>1 mark for appropriate work for Amor in (a)</i>	
0	1 mark for consistent value of Amor's TFSA in (a)	
€	1 mark for appropriate work for Angélique in (a)	
4	1 mark for consistent value of Angélique's TFSA in (a)	
6	1 mark for appropriate explanation in (b)	

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Question 20

Learning Outcome: 12.A.D.1

Select the best answer.

A wheelbarrow is able to transport 6 cubic feet of soil per load.

What is the minimum number of loads required to fill the following garden with soil?





U	$\mathbf{\nabla}$	

84

 6^{2} 84

14 + 4

Question Type: Selected Response

Total: 1 mark

Question 21	Total: 3 marks
Learning Outcome: 12.A.D.1	Question Type: Constructed Response

You are in charge of purchasing enough sports drink for the participants of a 5-kilometre race. There are 300 participants and you assume they will each drink the equivalent of 2 cups of sports drink. The cups are cone shaped with the following dimensions:



a) What volume of sports drink must you purchase? Show your work.

(2 marks)

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

 $= \frac{\pi (4)^2 (7)}{3}$
Total volume $= 117.286... \text{ cm}^3 \times 600 \text{ cups}$
 $= 70 \ 371.68 \text{ cm}^3$

A volume of 70 371.68 cm³ must be purchased.

b) Each container of sports drink costs 5.00 and contains $8 L (1 L = 1000 cm^3)$ of drink. How much will you spend on sports drink, before taxes?

(1 mark) Possible solution: $\frac{70\ 371.68\ \text{cm}^3}{1000\ \text{cm}^3/\text{L}} = 70.371\ 68\ \text{L}$ $\frac{70.371\ 68\ \text{L}}{8\ \text{L}} = 8.80 \therefore 9 \text{ containers}$ 9 containers × \$5.00 = \$45.00

You will spend \$45.00 on sports drink.

Marking Key			
	<i>1 mark for correct volume of one cup in (a)</i>		
0	<i>1 mark for consistent total volume in (a)</i>		
₿	0.5 mark for consistent number of containers in (b)		
4	0.5 mark for consistent total cost in (b)		

Question 22	Total: 5 marks
Learning Outcome: 12.A.D.1	Question Type: Constructed Response

You are to design a bedroom. The bedroom design must satisfy the following conditions:

- The bedroom must be rectangular.
- The bedroom must include one dresser, one desk, and one bed chosen from the furniture options below.

	Furniture Options					
	Dresser		Desk		Bed	
	Tall	Wide	Small	Large	Queen	King
Dimensions (ft.) (width × length)	1.5×4	1.5 × 6	2×4	2 × 6	4 × 6	5 × 6
Area (ft ²)	6	9	8	12	24	30
Cost (\$)	559.00	729.00	379.00	449.00	1669.00	1779.00

- a) Draw or describe the bedroom design, including dimensions, where
 - one of the dimensions of the bedroom floor must be at least 10 feet
 - the area of the bedroom must be between double and triple the area occupied by the total of all the furniture

OR

Sample Design 1: (minimum)

Tall dresser: 6 ft^2 Small desk: 8 ft^2 Queen bed: 24 ft^2 $\overline{38 \text{ ft}^2}$

Area of furniture: 38 ft²

Area of bedroom:
$$38 \text{ ft}^2 \times 2 = 76 \text{ ft}^2$$

$$A = 76 \text{ ft}^2$$

Dimensions: 10 ft. \times 7.6 ft.

Other answers are possible.

Sample Design 2: (maximum)

Wide dresser: 9 ft²
Large desk: 12 ft²
King bed: 30 ft²
$$51$$
 ft²

Area of furniture: 51 ft²

Area of bedroom: 51 $\text{ft}^2 \times 3 = 153 \text{ ft}^2$

$$A = 153 \text{ ft}^2$$

$$10 \text{ ft.}$$

$$15.3 \text{ ft.}$$

Dimensions: $15.3 \text{ ft.} \times 10 \text{ ft.}$
- b) You must also install flooring in the bedroom. Flooring must be purchased in whole units. You can buy carpet or hardwood.
 - You must include an additional 10% to the area for installation and waste. •
 - The carpet costs \$14.40 per yd².
 - The hardwood costs $$19.80 \text{ per yd}^2$. •

Calculate the cost of the flooring before taxes.

(2 marks)	OR
Sample Design 1: (minimum)	Sample Design 2: (maximu
Area of bedroom: $\frac{76 \text{ ft}^2}{9 \text{ ft}^2/\text{yd}^2} = 8.44 \text{ yd}^2$	Area of bedroom: $\frac{153 \text{ ft}^2}{9 \text{ ft}^2/\text{yd}^2}$
8.44 $yd^2 \times 1.1 = 9.28 yd^2 \therefore 10 yd^2$	$17 \text{ yd}^2 \times 1.1 = 18.70 \text{ yd}^2$.
$10 \ yd^2 \times \$14.40/yd^2 = \144.00	$19 \text{ yd}^2 \times \$19.80/\text{yd}^2 = \$$

Other answers are possible.

(1

um)

 $\frac{1}{2} = 17 \text{ yd}^2$ $\therefore 19 \text{ yd}^2$ \$376.20

c) Calculate the total cost of the furniture and the flooring, plus GST and PST. (Note: GST = 5%, PST = 8%)

mark)	OR				
	Sample Design 1:	(minimum)	Samp	le Design 2:	(maximum)
	Cost of furniture:		Cost	of furniture:	
	Dresser	\$559.00		Dresser	\$729.00
	Desk	\$379.00		Desk	\$449.00
	Bed	\$1669.00		Bed	\$1779.00
	Subtotal	\$2607.00		Subtotal	\$2957.00
	Cost of flooring:	\$144.00	Cost	of flooring:	\$376.20
	Subtotal	\$2751.00		Subtotal	\$3333.20
	GST	\$137.55		GST	\$166.66
	PST	\$220.08		PST	\$266.66
	Total	\$3108.63		Total	\$3766.52

Other answers are possible.

|--|

0	0.5 mark for including one dresser, one desk, and one bed in (a)
0	<i>1 mark for total surface area of bedroom with an appropriate width and size in (a)</i>
€	0.5 mark for appropriate dimensions of bedroom in (a)
4	1 mark for correct conversion to yd^2 in (b)
6	1 mark for consistent cost of flooring before taxes in (b)
6	0.5 mark for correct cost of furniture before taxes in (c)

0.5 mark for consistent total cost of bedroom, including cost of flooring and taxes in (c) 0

LOGICAL REASONING

Question 23Total: 2 marksLearning Outcome: 12.A.L.3Question Type: Constructed Response

a) Create a true conditional statement using two of the statements given below.

- the number is positive
- the number is negative
- the number is less than zero
- the number is prime
- the number is odd
- the number is even
- the number is 5

(1 mark)

If the number is negative, then the number is less than zero.

OR______ If the number is 5, then the number is odd.

If the number is not positive, then the number is not prime.

Other statements are possible.

b) Write the inverse of the statement created in (a).

(1 mark)

If the number is not negative, then the number is not less than zero.

OR—

If the number is not 5, then the number is not odd.

OR-

If the number is positive, then the number is prime.

Other statements are possible.

Marking Key

1 mark for appropriate true conditional statement in (a)
1 mark for consistent inverse in (b)

The universal set *B* represents the breakfast items in Pierre's backpack:

 $B = \{apple, yogurt, granola bar\}$

Pierre must choose at least one item to eat for breakfast.

Write all of Pierre's breakfast options as subsets.

{apple}
{yogurt}
{granola bar}
{apple, yogurt}
{apple, granola bar}
{yogurt, granola bar}
{apple, yogurt, granola bar}

Marker Note(s):

 \rightarrow Award a maximum of 1.5 marks if more than seven subsets are included.

	Marking Key		
0	0.5 mark for correctly identifying 4 subsets		
0	0.5 mark for correctly identifying 5th subset		
€	0.5 mark for correctly identifying 6th subset		
4	0.5 mark for correctly identifying 7th subset		

Question 25	Total: 1 mark
Learning Outcome: 12.A.L.2	Question Type: Constructed Response

Students attend a field trip to the Canadian Museum of Human Rights. They have the option of visiting Gallery A, Gallery B, Gallery C, or any combination of these.

Their visits can be represented by the Venn diagram below.

Shade the Venn diagram to illustrate the students who visited either Gallery B or Gallery C $(B \cup C)$.



Marking Key

1 *mark for correct answer*

Question 26	Total: 3 marks
Learning Outcome: 12.A.L.1	Question Type: Constructed Response

A magic square is an array that has the same sum in each row, column, and diagonal. This sum is called the magic number.

7	20	11	12
14	8	23	15
20	6	13	11
9	16	3	22

a) Determine the number in the array above that prevents it from being a magic square.

(1 mark)

The number in the array above that prevents it from being a magic square is 15.

b) What number should replace the number found in (a) to make the array a magic square? *(1 mark)*

The number 5 should replace the number found in (a).

c) What is the magic number of the resulting magic square?

(1 mark)

The magic number of the resulting magic square is 50.

	Marking Key
0	1 mark for correct answer in (a)
2	1 mark for correct answer in (b)
6	1 mark for correct answer in (c)

Exemplars may contain screen captures taken from software or Internet pages.

In an experiment, a water balloon is dropped from the roof of a school. The height of the water balloon from the ground is a function of time. The height is expressed in metres and the time is expressed in seconds. The domain of this function is [0, 1.43].

Give one reason that explains why the domain is restricted.

0 marks: → no criteria met

Question 2 Total: 1 mark

In an experiment, a water balloon is dropped from the roof of a school. The height of the water balloon from the ground is a function of time. The height is expressed in metres and the time is expressed in seconds. The domain of this function is [0, 1.43].

Give one reason that explains why the domain is restricted.

0.5 mark:

- $\mathbf{0} \rightarrow 1$ mark for appropriate reason
- $\square \rightarrow 0.5$ mark deduction for lack of clarity

Question 3

Taryn cooks a roast and records its internal temperature at specific times throughout the cooking process. Her findings are shown in the table below.

Time (hours)	1	2	5	8
Temperature (°F)	70	120	150	175

a) Determine the cubic regression equation that best models the data in this situation.

(1 mark)

 $Y = (2.05)^{2} + 31.74 + 49.85$

b) The next time Taryn cooks a roast, she would like its internal temperature to be 160°F. Determine how long it will take the roast to reach this temperature.

(1 mark)



1 mark: $\Theta \rightarrow 1$ mark for consistent answer in (b)
(E) \rightarrow does not express the answer to the appropriate number of decimal places

Question 3

Taryn cooks a roast and records its internal temperature at specific times throughout the cooking process. Her findings are shown in the table below.

Time (hours)	1	2	5	8
Temperature (°F)	70	120	150	175

a) Determine the cubic regression equation that best models the data in this situation.

(1 mark) $y = ax^{3}+bx^{2}+cx+d$ a = 1.39 b = -21.1 c = 103.61 d = -1.3.9 $y = 1.39^{3}+-2.1+10+1+-13.9$ $y = 1.39^{3}+-2.1+10+1+-13.9$ $y = 1.39^{3}+-2.1+10+1+-13.9$ $y = 1.39^{3}+-2.1+10+1+-13.9$

b) The next time Taryn cooks a roast, she would like its internal temperature to be <u>160</u>°F. Determine how long it will take the roast to reach this temperature.

(1 mark)

It will take 5

1 mark: $0 \rightarrow 1$ mark for correct answer in (a)
 E2 → does not include one of the following in the equation: "y =", "sin", "ln", or "x", or writes parameters separately from the equation E6 → does not express the answer to the appropriate number of decimal places

Scientists have determined that when the weight of an adult electric eel is known, its length can be modelled using the following equation:

$$y = 22.4 \ln(x) - 28.7$$



where x is the eel's weight in pounds and y is the length of the eel in inches.

a) Using the equation, determine the length of an eel that weighs 18 pounds.

(1 mark) 2nd there value
$$X=18$$

 $Y=36.04$
The eel- 36 inches long
b) Provide one limitation of the equation that models this relationship.
(1 mark) The eel cannot grow forever
it will die of Feuch it
Max Size.
eel cannot be negative pounds.
 $\frac{2 \text{ marks:}}{6 \rightarrow 1 \text{ mark for appropriate limitation in (b)}}$
 $6 \rightarrow does not express the answer to the
appropriate number of decimal places$

Scientists have determined that when the weight of an adult electric eel is known, its length can be modelled using the following equation:

$$y = 22.4 \ln(x) - 28.7$$



where x is the eel's weight in pounds and y is the length of the eel in inches.

a) Using the equation, determine the length of an eel that weighs 18 pounds.

(1 mark)



b) Provide one limitation of the equation that models this relationship.

(1 mark)

if the eel is less than a pound
the the equation would not work
$$ex: y = 22.4 \ln(0.5) - 28.7$$

 $y = -44.23$ in

2 marks:
$0 \rightarrow 1 \text{ mark for correct answer in (a)}$
$\mathbf{Q} \rightarrow 1$ mark for appropriate limitation in (b)
$(\mathbb{B}) \rightarrow \text{makes a transcription error (inaccurate transferring of information)}$

Total: 4 marks

A boat is propelled by a paddle wheel with a diameter of 14 feet. Each paddle takes 90 seconds to complete one revolution. The logo on one paddle reaches a maximum height of 11 feet above the water after the boat is in motion for 10 seconds.



Diagram is not drawn to scale.

a) Determine a possible sinusoidal equation that models the height of the logo over time. Show your work.

(2 marks)	Time (s)	Height (ft.)
	0	ち
	225	4
	45	
	67.5	4
	90	-3

b) Determine how long the logo is underwater during one revolution. Show your work. 7/2

(2 marks)
$$\begin{array}{c} 12 \text{ ero} \\ y=0 \\ x=13.79 \text{ sec} \end{array} \xrightarrow{76.21} \\ \hline -13.79 \\ \hline 62.42 \text{ sec} \\ above water \\ \hline 5ec \text{ orderwater} \\ \hline 3.5 \text{ marks:} \\ \hline 0 \rightarrow 1 \text{ mark for appropriate work in (a)} \\ \hline 0 \rightarrow 1 \text{ mark for appropriate work in (b)} \\ \hline 0 \rightarrow 1 \text{ mark for appropriate work in (b)} \\ \hline 0 \rightarrow 1 \text{ mark for appropriate work in (b)} \\ \hline 0 \rightarrow 1 \text{ mark for consistent answer in (b)} \end{array}$$





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Question 6

Total: 6 marks

An Australian farmer records the rabbit population on his farm over the course of one year. The table below represents his data.

×	Time (months)	1	4	7	9	11
Y	Number of rabbits	25	50	100	150	240

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

(3 marks)





Exemplar 1 (continued)

c) Using your equation in (b), determine how long it will take for the rabbit population to reach 400.
 Using Desmos

d) At a different farm, there are 300 rabbits at the beginning of the following year. This rabbit population increases, but less quickly than on the first farm. Write an exponential equation that models this situation.

(1 mark)

Using Desmos
$$y = a(b)^{x}$$

 $y = 20.2674(1.25169)^{x}$

5 marks:				
$0 \rightarrow$	1 mark for communicating the context of the graph with			
	appropriate title and/or labels in (a)			
0 →	1 mark for using an appropriate domain and range (i.e., window			
	settings/grid range) for the context of the question in (a)			
6 →	1 mark for correctly plotting the data in (a)			
$4 \rightarrow$	1 mark for correct equation in (b)			
6 →	1 mark for consistent answer in (c)			

(1 mark)

Question 6

Total: 6 marks

An Australian farmer records the rabbit population on his farm over the course of one year. The table below represents his data.

Time (months)	1	4	7	9	11
Number of rabbits	25	50	100	150	240

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



b) Determine the exponential regression equation that best models the data in this situation. *(1 mark)*

$$\gamma = 2.19 x^2 + (-5.56) x + 31.07$$

Exemplar 2 (continued)

c) Using your equation in (b), determine how long it will take for the rabbit population to reach 400.

(1 mark)



d) At a different farm, there are 300 rabbits at the beginning of the following year. This rabbit population increases, but less quickly than on the first farm. Write an exponential equation that models this situation.

(1 mark)



Corbin wants to create an image of himself on his cellphone. There are 7 choices for hair colour, 3 choices for hair length, and 9 choices for a hat.

Using these options, how many different images in total can he create with or without a hat? Show your work.



1.5 marks:				
$ 0 \rightarrow$	1 mark for correct case with a hat			
0 →	0.5 mark for correct case without a hat			
$0 \rightarrow 0$	0.5 mark for consistent sum of cases			
$\stackrel{\text{AE}}{\longrightarrow}$	0.5 mark deduction for arithmetic error			

Corbin wants to create an image of himself on his cellphone. There are 7 choices for hair colour, 3 choices for hair length, and 9 choices for a hat.

Using these options, how many different images in total can he create with or without a hat? Show your work.

With Hat $\frac{7}{4}$ x $\frac{3}{3}$ x $\frac{9}{4}$ = 189 image hair length hat Without hat 7 x 3 = 21 image He can create 189 image with hat or create 21 image without hat

1.5 marks:

 $\mathbf{0} \rightarrow 1$ mark for correct case with a hat

 $\mathbf{2} \rightarrow 0.5$ mark for correct case without a hat

Question 9 Total: 2 marks

There are 21 students in an applied math class. On a test, 10 students used an app, 14 students used a graphing calculator, and 4 students used both.

What is the probability that a randomly selected student used only an app on the test? Show your work.



2 marks:
$0 \rightarrow 1$ mark for appropriate work
$\Theta \rightarrow 1$ mark for consistent answer
\textcircled{D} \rightarrow does not include a box when using a Venn diagram

There are 21 students in an applied math class. On a test, 10 students used an app, 14 students used a graphing calculator, and 4 students used both.

What is the probability that a randomly selected student used only an app on the test? Show your work.



 2 marks: ● → 1 mark for appropriate work ● → 1 mark for consistent answer
$\textcircled{E2} \rightarrow \text{does not include a box when using a Venn diagram}$

Question 10	Total: 2 marks
~	

Pedro is walking from the train station to the convention centre and must withdraw money at the bank on his way. He can only walk south and east. How many different ways can he get to the convention centre? Show your work.





Question 10	Total: 2 marks
-	

Pedro is walking from the train station to the convention centre and must withdraw money at the bank on his way. He can only walk south and east. How many different ways can he get to the convention centre? Show your work.



Question 11Total: 4 marks

There are 5 biology books, 4 math books, and 7 history books randomly placed on a shelf.

a) Luis selects 2 books, one after the other. Determine the probability that both books are on the same subject. Show your work.

(3 marks)

Biology

$$\frac{5}{16} \times \frac{4}{16} = .078 \rightarrow 7.8 \%$$

Math
 $\frac{4}{16} \times \frac{3}{16} = 4.69\%$
History
 $\frac{7}{16} \times \frac{6}{16} = 16.41\%$
 $\frac{16}{16} \times \frac{6}{16} = 16.41\%$

b) Are the events in (a) independent or dependent? Explain.

(1 mark)

1.5 marks: 2 → 1 mark for correctly multiplying the number of same-subject books in (a) 4 → 1 mark for correct explanation in (b) C → 0.5 mark deduction for lack of clarity

Question 11Total: 4 marks

There are 5 biology books, 4 math books, and 7 history books randomly placed on a shelf.

a) Luis selects 2 books, one after the other. Determine the probability that both books are on the same subject. Show your work.

(3 marks)

(1 mark)



b) Are the events in (a) independent or dependent? Explain.

They are dependent become the
Second pick depends on the first
book being taken out,

$$4 \text{ marks:}$$

 $\bullet \rightarrow 1 \text{ mark for correctly considering dependency in (a)}$
 $\bullet \rightarrow 1 \text{ mark for correctly multiplying the number of same-subject books in (a)}$
 $\bullet \rightarrow 1 \text{ mark for consistent sum in (a)}$
 $\bullet \rightarrow 1 \text{ mark for correct explanation in (b)}$
 $\hline \bullet \rightarrow 1 \text{ mark for correct explanation in (b)}$

Construction work has slowed travel near Dauphin, Manitoba. Harry must drive through the construction zone to get to work. The probability that he will be delayed because of the construction is 45%. If he is delayed, the probability he will get to work on time is 70%. If he is not delayed, the probability he will get to work on time is 85%.

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

(1 mark)



b) Determine the probability that Harry will get to work on time. Show your work.

(2 marks)

2 marks:
$0 \rightarrow 1$ mark for appropriate graphic organizer in (a)
$2 \rightarrow 0.5$ mark for <i>P</i> (delayed, on time) in (b)
$\Theta \rightarrow 0.5$ mark for <i>P</i> (not delayed, on time) in (b)

Construction work has slowed travel near Dauphin, Manitoba. Harry must drive through the construction zone to get to work. The probability that he will be delayed because of the construction is 45%. If he is delayed, the probability he will get to work on time is 70%. If he is not delayed, the probability he will get to work on time is 85%.

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

(1 mark)



b) Determine the probability that Harry will get to work on time. Show your work. *(2 marks)*

$$(0.55 \times 0.15) + (0.45 \times 0.70)$$

= 0.3975 × 100
= 39.75%.

2.5 marks:

- $\mathbf{0} \rightarrow 1$ mark for appropriate graphic organizer in (a)
- $\Theta \rightarrow 0.5$ mark for *P*(delayed, on time) in (b)
- $\bullet \rightarrow 1$ mark for consistent sum in (b)

Question 13Total: 2 marks

A group of friends is ordering a meal of 3 pizzas and 2 salads from a restaurant. The restaurant offers 6 types of pizzas and 4 types of salads.

If all pizzas and salads chosen must be different from one another, how many meal options do the friends have? Show your work.



1 mark:

 \rightarrow 1 mark for using permutations instead of combinations as per marker note

Total: 2 marks

A group of friends is ordering a meal of 3 pizzas and 2 salads from a restaurant. The restaurant offers 6 types of pizzas and 4 types of salads.

If all pizzas and salads chosen must be different from one another, how many meal options do the friends have? Show your work.



$0 \rightarrow 1 \text{ mark for appropriate work}$
(a) \rightarrow makes a transposition error (changing order of digits)

Question 14

A dealership has 6 cars, 2 vans, and 4 trucks for sale.

a) An employee is asked to park all of these vehicles in a row. How many different ways can this be done if all of the cars must be together, all of the vans must be together, and all of the trucks must be together? Show your work.

(2 marks)

$$12C0 \cdot 12C2 \cdot 12C4$$

= 924 · 66 · 495
= 30187080

b) Diane visits the dealership and decides to buy one of the trucks. The price of this truck is \$36 500.00, taxes included. She has \$4000.00 for a down payment. The balance will be financed at an interest rate of 2.99%, compounded monthly, for 7 years. Calculate her monthly payment. Show your work.

(2 marks)

Monthly payment would be \$428.22

STMV sheet

Exemplar 1 (continued)

c) What is the total amount Diane will pay to buy the truck?



A dealership has 6 cars, 2 vans, and 4 trucks for sale.

a) An employee is asked to park all of these vehicles in a row. How many different ways can this be done if all of the cars must be together, all of the vans must be together, and all of the trucks must be together? Show your work.

(2 marks)



b) Diane visits the dealership and decides to buy one of the trucks. The price of this truck is \$36 500.00, taxes included. She has \$4000.00 for a down payment. The balance will be financed at an interest rate of 2.99%, compounded monthly, for 7 years. Calculate her monthly payment. Show your work.

(2 marks)

$$N = 84
18 = 2.99
PV = +36500.00
MPMT - 482.12096...
FV = 0
Ply = 12
 $CNy = 12$
Her monthly payment would be
$482,12$$
Exemplar 2 (continued)

c) What is the total amount Diane will pay to buy the truck? *(1 mark)*

3 marks:

- $\mathbf{0} \rightarrow 0.5 \text{ mark for } 6!2!4! \text{ in (a)}$
- $\mathbf{2} \rightarrow 0.5 \text{ mark for 3! in (a)}$
- $\mathbf{\Theta} \rightarrow 1$ mark for consistent answer in (b)
- $\Theta \rightarrow 0.5$ mark for consistent total monthly payments in (c)
- $\Theta \rightarrow 0.5$ mark for consistent total amount in (c)

Question 16Total: 2 marks

Mr. Chen is moving to Manitoba and is looking for a place to live.

State two reasons why Mr. Chen would prefer renting a house instead of buying a similar house.

Reason 1:



0.5 mark:

 $\mathbf{0} \rightarrow 1$ mark for one appropriate reason (Reason 1)

 $\square \rightarrow 0.5$ mark deduction for lack of clarity

Mr. Chen is moving to Manitoba and is looking for a place to live.

State two reasons why Mr. Chen would prefer renting a house instead of buying a similar house.

Reason 1:

Wont need to pay land owner ship taxes

Reason 2:

cheaper then buyins a house

1 mark: 1 mark for one appropriate reason (Reason 1)

Question 17Total: 3 marks

Nadia hopes to save enough money over a 6-year period to go on a trip estimated to cost \$11 600.00. To start saving, she deposits \$1250.00 into an account that earns an interest rate of 4.21%, compounded monthly.

a) If she makes monthly payments of \$110.00 into this account, how much money will she have at the end of the 6-year period? Show your work.



b) What is the minimum number of additional monthly payments Nadia needs to make in order to save enough money for the trip?

1 mark: $\mathbf{2} \rightarrow 1$ mark for consistent answer in (a)

Question 17	Total: 3 marks
-	

Nadia hopes to save enough money over a 6-year period to go on a trip estimated to cost \$11 600.00. To start saving, she deposits \$1250.00 into an account that earns an interest rate of 4.21%, compounded monthly.

- a) If she makes monthly payments of \$110.00 into this account, how much money will she have at the end of the 6-year period? Show your work.
- (2 marks)

b) What is the minimum number of additional monthly payments Nadia needs to make in order to save enough money for the trip?

(1 mark)

$$1600-7383.78 = 4216.22$$
 -1351.35 per month
 12 for a year
 $0R$ She pays
 168.56 every
month for 6 years
 1.5 marks:
 $0 \rightarrow 1$ mark for appropriate work in (a)
 $2 \rightarrow 1$ mark for consistent answer in (a)
 $2 \rightarrow 0.5$ mark deduction for procedural error

Marshall and Kim are renting a house that they hope to purchase. They pay \$1800.00 in annual heating costs and know that the annual property taxes are \$2500.00. Their combined gross income is \$5200.00 per month.

a) Based on the gross debt service ratio (GDSR), what is the maximum monthly mortgage payment they can afford? Show your work.

(2 marks)

$$5109_{732} = \underline{MMP+208.33+150}_{5200}$$
 The maximum Monthly
mortgage payment they
Can afford is \$1605.67
 $208.33+150$
 $1664 = MMP+208.33+150\times100$
 $1665 = 1664 = 1665 \cdot 67$
Monthly Mortgage Payment=1605.67
 $BEPMAS$

- b) If they have saved \$30 000.00 for a down payment, what is the maximum house price they can afford based on a 25-year amortization period at an interest rate of 4.64%, compounded semi-annually? Show your work.
- (3 marks)

Exemplar 1 (continued)

Tran	saction	Туре	warre y borya T		1. j.		
() Inv	Investment ORetirement Plan			OLoa	n	(?)	
Payn	nent Fro	equen	cy (per	year)			
01	02	04	12	024	026	O 365	(?)
Com	pound	Frequ	ency (p	oer yea	ar)	e na statistica de la cara da	
01	•2	04	012	O 24	026	O 365	(?)
Final	ncial De	etails		•·····Na •·• • ·			1981-1000-100 1
	Present Value: 28(07),63] 🔴		
		F	uture Va	lue:		0.00	0
	Monthly Deposit:			160	5.67] 0	
Interest Rate (%):			4.67]0			
# Years:			ars:		25]0	
Make Deposit at: OStart or End of Period					eriod		
Financial Summary							
		Pr	incipal F	Paid:	286	171.63]
Interest Earned: 195629.37]				
Total Future Value: 481701.00							

3.5 marks:

- $\mathbf{0} \rightarrow 0.5$ mark for correctly converting annual costs to monthly costs in (a)
- $\mathbf{2} \rightarrow 0.5$ mark for correct substitution into formula in (a)
- $\Theta \rightarrow 1$ mark for consistent answer in (a)
- $\bullet \rightarrow 1$ mark for appropriate work in (b)
- $\mathbf{\Theta} \rightarrow 1$ mark for consistent value of mortgage in (b)
- $\Phi \rightarrow 0.5$ mark deduction for arithmetic error

Question 18Total: 5 marks

Marshall and Kim are renting a house that they hope to purchase. They pay \$1800.00 in annual heating costs and know that the annual property taxes are \$2500.00. Their combined gross income is \$5200.00 per month.

1

a) Based on the gross debt service ratio (GDSR), what is the maximum monthly mortgage payment they can afford? Show your work.

(2 marks)

b) If they have saved \$30 000.00 for a down payment, what is the maximum house price they can afford based on a 25-year amortization period at an interest rate of 4.64%, compounded semi-annually? Show your work.

$$N = 25(2) = 50$$

$$I = 4.64$$

$$PV = -30\ 000$$

$$PMT = 0$$

$$FV = 0 \longrightarrow 194\ 438.23$$

$$P/Y = 2$$

$$CIY = 2$$

$$I mark:$$

 $\mathbf{0} \rightarrow 0.5$ mark for correctly converting annual costs to monthly costs in (a) $\mathbf{2} \rightarrow 0.5$ mark for correct substitution into formula in (a)

(3 marks)

Amor and Angélique each want to retire at age 65. They start investing in tax-free savings accounts (TFSA) at different ages in their lives.

- At age 28, Amor starts investing \$240.00 per month into a TFSA that earns an interest • rate of 2.95%, compounded monthly.
- At age 42, Angélique makes an initial deposit of \$5000.00 and starts investing • \$350.00 per month into a TFSA that earns an interest rate of 3.50%, compounded monthly.
- What is the value of each of their TFSAs at age 65? Show your work. a)



b) Explain why a small long-term investment may be worth more than a large short-term investment.



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- At age 42, Angélique makes an initial deposit of \$5000.00 and starts investing \$350.00 per month into a TFSA that earns an interest rate of 3.50%, compounded monthly.
- a) What is the value of each of their TFSAs at age 65? Show your work.

(4 marks)

AmorAngeliaue
$$N = 37(1\lambda)=444$$
 $N = \lambda 3(1\lambda)=\lambda 76$ $I = \lambda.95$ $I = 3.5$ $PV = 0$ $PV = 0$ $PN = -\lambda 40$ $Pmt = -350$ $Fv = Solve= 19\lambda,789.31$ $Fv = Solve= 148,089.38$ $Ply=1\lambda$ E_{S} $C/y=1\lambda$ $C/y=1\lambda$

b) Explain why a small long-term investment may be worth more than a large short-term investment.

(1 mark)

because the small term allows you to carry more free cash to spend during the long term investment

3 marks:
$0 \rightarrow 1$ mark for appropriate work for Amor in (a)
$\Theta \rightarrow 1$ mark for consistent value of Amor's TFSA in (a)
$\bullet \rightarrow 1$ mark for consistent value of Angélique's TFSA in (a)
$(15) \rightarrow \text{does not include the dollar sign for monetary values}$

. .

a)

You are in charge of purchasing enough sports drink for the participants of a 5-kilometre race. There are 300 participants and you assume they will each drink the equivalent of 2 cups of sports drink. The cups are cone shaped with the following dimensions:



$$V = 117.2861257 \text{ cm}^3$$

Each container of sports drink costs \$5.00 and contains 8 L (1 L = 1000 cm^3) of drink. b) How much will you spend on sports drink, before taxes?



You are in charge of purchasing enough sports drink for the participants of a 5-kilometre race. There are 300 participants and you assume they will each drink the equivalent of 2 cups of sports drink. The cups are cone shaped with the following dimensions:



What volume of sports drink must you purchase? Show your work. a)





You are in charge of purchasing enough sports drink for the participants of a 5-kilometre race. There are 300 participants and you assume they will each drink the equivalent of 2 cups of sports drink. The cups are cone shaped with the following dimensions:



a) What volume of sports drink must you purchase? Show your work.

(2 marks)

$$\frac{1}{3} \text{ tr } r^{2} h = V$$

$$\frac{469.11}{469.11} \text{ J}$$

$$\frac{1}{100} = 2001000 \text{ J}$$

$$\frac{1}{100} \text{ J}$$

$$\frac{1}{100} \text{ J}$$

$$\frac{1}{291484 \text{ cm}^{3}}$$

b) Each container of sports drink costs 5.00 and contains 8 L (1 L = 1000 cm³) of drink. How much will you spend on sports drink, before taxes?

(1 mark)
$$291494'_{6x1000} = 35_{51}85'_{5} = $175.93$$

 $\stackrel{(1 mark)}{\underset{(1 mark)}{2}} = 35_{51}85'_{5} = 175.93
 $\stackrel{(2 marks)}{\underset{(2 mark)}{2}} = 35_{51}85'_{5} = 175.93
 $\stackrel{(2 mark)}{\underset{(2 mark)}{2}} = 175.93
 $\stackrel{(2 mark)}{3}} = 175.93
 $\stackrel{(2 mark)}{3} = 175.93
 $\stackrel{(2 mark)$

Question 22

You are to design a bedroom. The bedroom design must satisfy the following conditions:

- The bedroom must be rectangular.
- The bedroom must include one dresser, one desk, and one bed chosen from the furniture options below.

	Furniture Options					
	Dresser Desk Bed				ed	
	Tall	Wide	Small	Large	Queen	King
Dimensions (ft.) (width × length)	1.5×4	1.5 × 6	2×4	2×6	4 × 6	5 × 6
Area (ft ²)	6	9	8	12	24	30
Cost (\$)	559.00	729.00	379.00	449.00	1669.00	1779.00

- a) Draw or describe the bedroom design, including dimensions, where
 - one of the dimensions of the bedroom floor must be at least 10 feet

 the area of the bedroom must be between double and triple the area occupied by the total of all the furniture





- b) You must also install flooring in the bedroom. Flooring must be purchased in whole units. You can buy carpet or hardwood.
 - You must include an additional 10% to the area for installation and waste.
 - The carpet costs \$14.40 per yd².
 - The hardwood costs \$19.80 per yd².

Calculate the cost of the flooring before taxes.

(2 marks)



c) Calculate the total cost of the furniture and the flooring, plus GST and PST. (Note: GST = 5%, PST = 8%)

$$559.1.13=631.67$$

 $379.1.13=428.27$
 $1669.1.13=1285.97$
 2945.91
floor
 $216.1.13=244.08$
 $244.08+2945.91$
 31899.999

4 marks: ● → 0.5 mark for including one dresser, one desk, and one bed in (a) ◎ → 0.5 mark for appropriate

- $\bullet \rightarrow 1$ mark for consistent cost of flooring before taxes in (b)
- $\bullet \rightarrow 0.5$ mark for correct cost of furniture before taxes in (c)
- Ø → 0.5 mark for consistent total cost of bedroom, including cost of flooring and taxes in (c)

\rightarrow rounds incorrectly

 $(6) \rightarrow \text{rounds too soon}$

Question 22

You are to design a bedroom. The bedroom design must satisfy the following conditions:

- The bedroom must be rectangular.
- The bedroom must include one dresser, one desk, and one bed chosen from the furniture options below.

		Furniture Options				
	Dre	Dresser Desk Bed				
	Tall	Wide	Small	Large	Queen	King
Dimensions (ft.) (width × length)	1.5×4	1.5×6	2×4	2×6	4×6	5×6
Area (ft ²)	6	9	8	12	24	30
Cost (\$)	559.00	729.00	379.00	449.00	1669.00	1779.00

- a) Draw or describe the bedroom design, including dimensions, where
 - one of the dimensions of the bedroom floor must be at least 10 feet
 - the area of the bedroom must be between double and triple the area occupied by the total of all the furniture

(2 marks)





Exemplar 2 (continued)

- b) You must also install flooring in the bedroom. Flooring must be purchased in whole units. You can buy carpet or hardwood.
 - You must include an additional 10% to the area for installation and waste.
- The carpet costs \$14.40 per yd^2 .
 - The hardwood costs \$19.80 per yd².

Calculate the cost of the flooring before taxes.

(2 marks)

$$20.10 = 200ft^{2} = 22.22yds^{2}$$

$$22.22 \cdot 1.10 = 24.44yds^{2}$$

$$24.44 \cdot 14.40 = $351.94$$

c) Calculate the total cost of the furniture and the flooring, plus GST and PST. (Note: GST = 5%, PST = 8%) (E3)

(1 mark) 5597379+1669=52601 5597379+1669=52601 = 9358.94+2.13 = 53343.60 4 marks: $\bullet \rightarrow 0.5 \text{ mark for including one dresser, one desk, and one bed in (a)}$ $\bullet \rightarrow 0.5 \text{ mark for appropriate dimensions of bedroom in (a)}$ $\bullet \rightarrow 1 \text{ mark for correct conversion to yd² in (b)}$ $\bullet \rightarrow 1 \text{ mark for correct cost of flooring before taxes in (b)}$ $\bullet \rightarrow 0.5 \text{ mark for correct cost of flooring before taxes in (c)}$

flooring and taxes in (c)
 (3) → makes a transcription error (inaccurate transferring of information)
 (4) → does not use whole units for materials purchased in design and measurement questions

Question 23

a) Create a true conditional statement using two of the statements given below.

- the number is positive
- the number is negative
- the number is less than zero
- the number is prime
- the number is odd
- the number is even
- the number is 5

(1 mark)

The number to nogation if the # 15 less than O

b) Write the inverse of the statement created in (a).

(1 mark)

If the number is lot negative the # is not less than O

 $0 \text{ marks:} \\ \rightarrow \text{ no criteria met}$

Question 23

- a) Create a true conditional statement using two of the statements given below.
 - the number is positive
 - the number is negative
 - the number is less than zero
 - the number is prime
 - the number is odd
 - the number is even
 - the number is 5

(1 mark)

If the number is odd, then the number is 5.

b) Write the inverse of the statement created in (a).

(1 mark)

1 mark: $\mathbf{2} \rightarrow 1$ mark for consistent inverse in (b)

Ouestion 24	Total: 2 marks

The universal set *B* represents the breakfast items in Pierre's backpack:

 $B = \{apple, yogurt, granola bar\}$

Pierre must choose at least one item to eat for breakfast.

Write all of Pierre's breakfast options as subsets.

2 marks:
$0 \rightarrow 0.5$ mark for correctly identifying 4 subsets
$2 \rightarrow 0.5$ mark for correctly identifying 5th subset
$\bullet \rightarrow 0.5$ mark for correctly identifying 6th subset
$\bullet \rightarrow 0.5$ mark for correctly identifying 7th subset
$\textcircled{E2} \rightarrow \text{does not include braces when using set notation}$

Total: 2 marks

The universal set *B* represents the breakfast items in Pierre's backpack:

 $B = \{ apple, yogurt, granola bar \}$

Pierre must choose at least one item to eat for breakfast.

Write all of Pierre's breakfast options as subsets.

1.5 marks:

- $\mathbf{0} \rightarrow 0.5$ mark for correctly identifying 4 subsets
- $\mathbf{2} \rightarrow 0.5$ mark for correctly identifying 5th subset $\mathbf{3} \rightarrow 0.5$ mark for correctly identifying 6th subset

Question 26

A magic square is an array that has the same sum in each row, column, and diagonal. This sum is called the magic number.

7	20	11	12	50
14	8	23	15	50
20	6	13	11	50
9	16	3	22	50
50	50	56	60	50

60

50

a) Determine the number in the array above that prevents it from being a magic square. *(1 mark)*

b) What number should replace the number found in (a) to make the array a magic square?

(1 mark)

c) What is the magic number of the resulting magic square?

(1 mark)

1 mark: $\Im \rightarrow 1$ mark for correct answer in (c)

Appendices

Appendix A: Table of Questions by Unit and Learning Outcome

RELATION AND FUNCTIONS				
Question	Learning Outcome	Mark		
1	12.A.R.1	1		
2	12.A.R.1	1		
3	12.A.R.1	2		
4	12.A.R.2	2		
5	12.A.R.3	4		
6	12.A.R.2	6		
		Total = 16		
	PROBABILITY			
Question	Learning Outcome	Mark		
7	12.A.P.1	1		
8	12.A.P.4	2		
9	12.A.P.2, 12.A.L.2	2		
10	12.A.P.4, 12.A.P.5	2		
11	12.A.P.3	4		
12	12.A.P.2, 12.A.P.3	3		
13	12.A.P.6	2		
14 a)	12.A.P.5	2		
		Total = 18		
	FINANCIAL MATHEMATICS			
Question	Learning Outcome	Mark		
14 b)	12.A.FM.1	2		
14 c)	12.A.FM.1	1		
15	12.A.FM.1	1		
16	12.A.FM.2	2		
17	12.A.FM.1, 12.A.FM.3	3		
18	12.A.FM.1	5		
19	12.A.FM.3	5		
		Total = 19		
	Design and Measurement			
Question	Learning Outcome	Mark		
20	12.A.D.1	1		
21	12.A.D.1	3		
22	12.A.D.1	5		
		Total = 9		
	LOGICAL REASONING			
Question	Learning Outcome	Mark		
23	12.A.L.3	2		
24	12.A.L.2	2		
25	12.A.L.2	1		
26	12.A.L.1	3		
		Total = 8		

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 No.:
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: