Grade 12
Applied Mathematics
Achievement Test

Marking Guide

January 2018

Manitoba

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

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

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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.

Errors

Marks are deducted if conceptual or communication errors are committed.

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 will be a 0.5 mark deduction for each type of communication error committed, regardless of the number of errors committed for that type (see example on next page).

Ⓔ₁ 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

Ⓔ₂ 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

Ⓔ₃ Transcription/Transposition

- makes a transcription error (inaccurate transferring of information)
- makes a transposition error (changing order of digits)

Ⓔ₄ 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)

Ⓔ₅ 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., cm^2 instead of cm^3, or vice versa)
- does not include units with labels on a graph

Ⓔ₆ 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).

(E1)	(E2)	(E3)	(E4)	(E5)	(E6)
Final Answer	Notation	Transcription/ Transposition	Whole Units	Units	Rounding

Communication Errors				
Preliminary Mark	$-$	$\left(\text{Number of error types} \times 0.5\right)$	$=$	Final Mark
46	$-$	$\left(2 \times 0.5\right)$	$=$	45

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" and/or "NR" 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.

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Grade 12 Applied Mathematics
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Marking Keys

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

RELATIONS AND FUNCTIONS

Question 1	Total: 3 marks
Learning Outcome: 12A.R.3	**Question Type: Constructed/Selected Response**

The temperature in an office is controlled by an electronic thermostat. The temperature varies according to the sinusoidal function:

$$y = 3 \sin(0.26x - 2.88) + 19$$

where y represents the temperature in degrees Celsius
and x represents the time in hours past midnight.

a) Determine the temperature in the office at 9 a.m.

(1 mark)   **OR**

$\boxed{\text{CALC}}$ 1: value $x = 9$, $y = 17.46$ $\qquad y = 3 \sin(0.26(9) - 2.88) + 19$

$\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad = 17.46$

The temperature is 17.46°C.

b) Determine the maximum temperature in the office.

(1 mark)   **OR**

$\boxed{\text{CALC}}$ 4: maximum $(17.118..., 22)$ $\qquad$ Maximum $= 19 + 3$

$y = 22$ $= 22$

The maximum temperature is 22°C.

c) An employee increased the average temperature of the electronic thermostat by 3°C. Which of the following equations represents the new function?

Select the best answer.

Student Error
A: a value ÷ 3
B: d value − 3
D: c value differs by 3

(1 mark)

A) $y = \sin(0.26x - 2.88) + 19$ **C) $y = 3 \sin(0.26x - 2.88) + 22$**

B) $y = 3 \sin(0.26x - 2.88) + 16$ D) $y = 3 \sin(0.26x - 5.88) + 19$

Marker Note(s):
→ *Answers of −1.14°C in (a) and 3°C in (b) are a result of not closing the parentheses when entering the equation. In this case, award mark ❷.*

Marking Key
❶ *1 mark for correct answer in (a)*
❷ *1 mark for consistent answer in (b)*
❸ *1 mark for correct answer in (c)*

Question 2
Total: 1 mark

Learning Outcome: 12A.R.2   **Question Type: Constructed Response**

Given the equation $y = 400(0.9)^x$, describe what "400" could represent in a real-life situation.

The initial population of a city.

OR——

The initial amount of bacteria in an experiment.

OR——

The initial amount of money in an account.

Other answers are possible.

Marking Key
❶   *1 mark for correct answer*

Question 3   Total: 3 marks

Learning Outcome: 12A.R.1   **Question Type: Constructed Response**

Josemaría is standing directly under the centre of a parabolic satellite dish.

- The bottom of the dish is 28 metres above the ground from where she is standing.
- The highest points of the dish are 50 m above the ground.
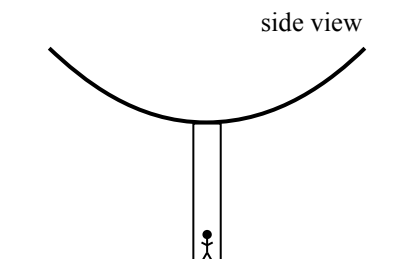- The width of the dish is 64 m.

side view

Diagram is not drawn to scale.

a) Determine a quadratic equation that models the shape of the dish. Show your work. You may use the table below.

(2 marks)   **OR**

Horizontal Distance (m)	Height of the Dish (m)
–32	50
0	28
32	50

Horizontal Distance (m)	Height of the Dish (m)
0	50
32	28
64	50

$$y = 0.02x^2 + 28$$ $$y = 0.02x^2 - 1.38x + 50$$

Other equations are possible.

b) Josemaría walks 20 metres to the right. She notices that a bird has made a nest on the dish directly above where she stands. Using your equation in (a), determine the height of the bird's nest from the ground.

(1 mark)   **OR**

$\boxed{\text{CALC}}$ 1: value $x = 20, y = 36.59$ $\boxed{\text{CALC}}$ 1: value $x = 52, y = 36.59$

The height of the bird's nest is 36.59 metres.

Marker Note(s):
→ *Regression equations may vary depending on the software used.*
→ *Award mark ❸ for a height of 36 m if using the first equation with rounded values and for 32.32 m if using the second equation with rounded values.*

| **Marking Key** |
|---|
| ❶   *1 mark for appropriate work in (a)* |
| ❷   *1 mark for consistent equation in (a)* |
| ❸   *1 mark for consistent answer in (b)* |

Question 4   Total: 6 marks

Learning Outcome: 12A.R.2   **Question Type: Constructed Response**

Corinne counts the number of large apples on her apple tree. The number of large apples increases over time as shown in the table below.

Time (days)	1	40	60	80	100	120
Number of large apples	0	66	76	82	87	92

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

(3 marks)

Number of Large Apples Over Time
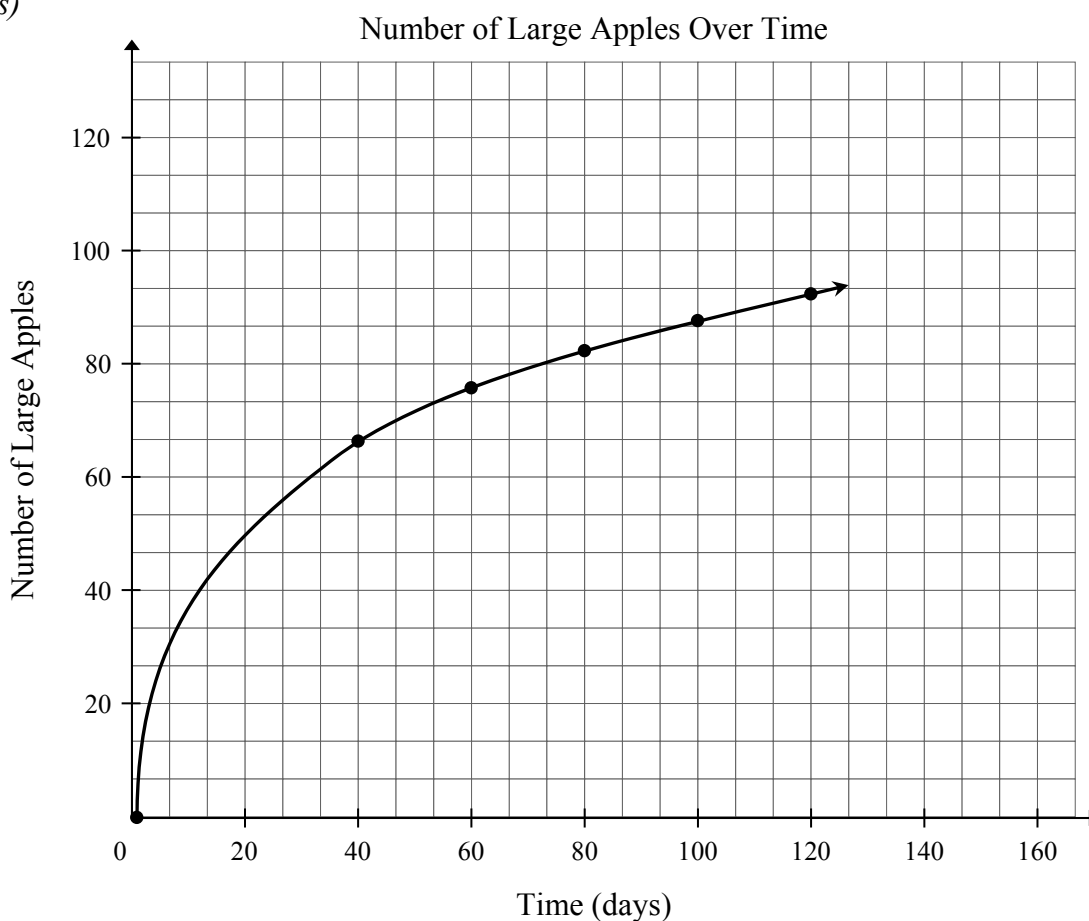
b) Determine the logarithmic regression equation that models this data.

(1 mark)

$$y = -0.76 + 18.90 \ln x$$

c) Corinne needs 84 large apples to make pies. How much time will it take for her to have enough apples? Show your work.

(2 marks)

$$Y_2 = 84$$

$$\boxed{\text{CALC}} \text{ 5: intersect} \quad (88.536..., 84)$$

$$x = 88.54$$

It will take 88.54 days for Corinne to have enough apples.

Marker Note(s):
→ *Regression equations may vary depending on the software used.*
→ *Award mark ❸ with an Ⓔ③ communication error for a correct graph with one incorrect data point.*
→ *Award mark ❸ with an Ⓔ① communication error if points are plotted but curve of best fit is not drawn.*
→ *Award mark ❻ for an answer of 89 days.*

Marking Key
❶ *1 mark for communicating the context of the graph with appropriate title and/or labels in (a)*
❷ *1 mark for using an appropriate domain and range (i.e., window settings/grid range) for the context of the question in (a)*
❸ *1 mark for correctly plotting the data in (a)*
❹ *1 mark for correct equation in (b)*
❺ *1 mark for appropriate work in (c)*
❻ *1 mark for consistent answer in (c)*

Question 5   Total: 3 marks

Learning Outcome: 12A.R.2   **Question Type: Constructed Response**

A scientific experiment is conducted on a beverage containing aspartame.

- The initial amount of aspartame is 160 mg.
- The amount of aspartame decreases by 50% every 3 days.

a) Determine an exponential equation that models the remaining amount of aspartame as a function of time (in days). Show your work.

(2 marks)

Time (days)	Remaining Amount (mg)
0	160
3	80
6	40
9	20

$$y = 160(0.79)^x$$

OR——

$$y = 160\left(\frac{1}{2}\right)^{\frac{x}{3}}$$

b) State the range for this experiment.

(1 mark)

$$\{0 < y \leq 160\}$$

OR——

$$(0, \, 160]$$

OR——

The remaining amount of aspartame is
greater than 0 but less than or equal to 160 mg.

Marker Note(s):
→ *Regression equations may vary depending on the software used.*

Marking Key
❶   *1 mark for correct initial value in equation in (a)*
❷   *1 mark for correct rate of change in equation in (a)*
❸   *1 mark for consistent range in (b)*

PROBABILITY

Question 6   **Total: 1 mark**

Learning Outcome: 12A.P.2   **Question Type: Selected Response**

Select the best answer.

A coin is flipped twice.

What is the probability of the coin landing on heads exactly two times?

A) 1

B) 0.75

C) 0.50

D) 0.25

Question 7
Total: 1 mark

Question Type: Constructed Response

The odds in favour of Danny's team winning the tournament are $3 : 7$.

Determine the probability that Danny's team does not win the tournament.

$$\frac{7}{10}$$

The probability is $\dfrac{7}{10}$, 0.7, or 70%.

Marking Key	
❶	*1 mark for correct answer*

Question 8

Total: 2 marks

Learning Outcomes: 12A.P.4, 12A.P.5   **Question Type: Constructed Response**

Using the digits 0 through 9, determine the number of 4-digit codes divisible by 5 that can be created if none of the digits repeat. Assume codes can start with zero. Show your work.

$$\underline{9} \times \underline{8} \times \underline{7} \times \underline{2} = 1008$$
$$\uparrow$$
$$0 \text{ or } 5$$

A total of 1008 codes can be created.

Marking Key	
❶	*1 mark for appropriate work*
❷	*1 mark for consistent answer*

Question 9

Total: 2 marks

Martha is entering the Hudson Bay Quest sled dog race. She owns 12 dogs and wants to enter a team of 10 dogs.

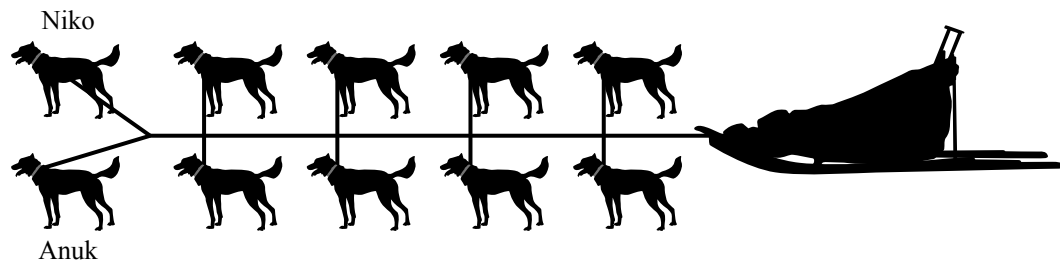a) Determine the number of ways she can randomly choose 10 of her dogs to make up a team.

(1 mark)

$$_{12}C_{10} = 66$$

There are 66 ways.

b) Martha must now put the 10 chosen dogs in their starting positions. She begins by attaching her lead dogs, Niko and Anuk. Determine the number of ways she can randomly attach the remaining dogs.

(1 mark)

Niko

Anuk

$$8! = 40\ 320$$

There are 40 320 ways.

Marking Key
❶   *1 mark for correct answer in (a)*
❷   *1 mark for correct answer in (b)*

Question 10

Total: 2 marks

Question Type: Constructed Response

At recess, students randomly pick one marble from a bag to determine teams for a game. Initially, there are 10 orange marbles and 10 blue marbles in the bag.

Maria and Leah hope to be on the blue team. Maria picks her marble first and puts it in her pocket. Leah picks her marble second. What is the probability that they will both pick a blue marble? Show your work.

$$P(\text{blue, blue}) = \frac{10}{20} \times \frac{9}{19}$$
$$= \frac{90}{380}$$
$$= 0.236\ 8$$
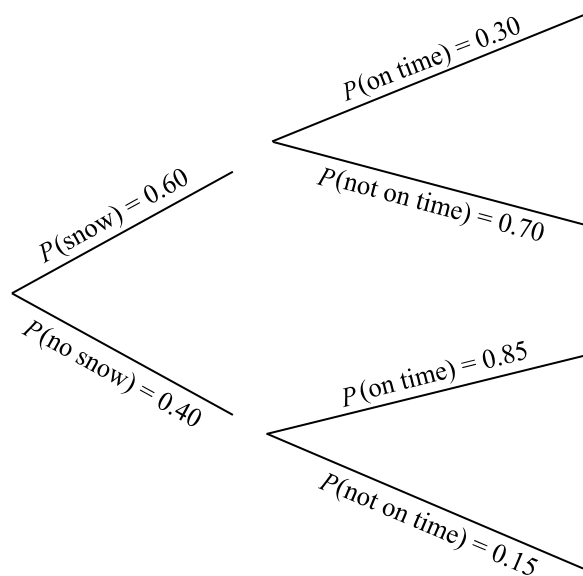
The probability is $\frac{9}{38}$, 0.24, or 23.68%.

Marking Key		
❶	*1 mark for appropriate work*	
❷	*1 mark for consistent answer*	

Question 11

Total: 3 marks

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

The weather report calls for a 60% probability of snow in northern Manitoba on Tuesday. The flight from Thompson to Flin Flon has a 30% probability of being on time when it is snowing. There is an 85% probability of the flight being on time when it is not snowing.

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

(1 mark)   **OR**

	snow (S)	no snow (NS)
on time (T)	ST	NST
not on time (NT)	SNT	NSNT

P(snow) = 0.60
P(on time) = 0.30
P(not on time) = 0.70
P(no snow) = 0.40
P(on time) = 0.85
P(not on time) = 0.15

Other graphic organizers are possible.

b) Determine the probability that the flight on Tuesday will not be on time. Show your work.

(2 marks)

$$P(\text{not on time}) = 0.60 \times 0.70 + 0.40 \times 0.15$$
$$= 0.42 + 0.06$$
$$= 0.48$$

The probability is $\dfrac{12}{25}$, 0.48, or 48%.

Marker Note(s):
→ *Award mark* ❶ *for a list of all possible outcomes without probability values.*

Marking Key
❶ *1 mark for appropriate graphic organizer in (a)*
❷ *1 mark for appropriate work in (b)*
❸ *1 mark for consistent answer in (b)*

Question 12
Total: 4 marks

There are 5 jazz dancers and 7 ballet dancers from which 4 dancers are randomly chosen to form a group.

a)   Determine the number of ways 4 dancers can be chosen.

(1 mark)
$$_{12}C_4 = 495$$

There are 495 ways.

b)   Determine the probability that 4 jazz dancers will be chosen. Show your work.

(2 marks)
$$\frac{_5C_4 \times {_7}C_0}{_{12}C_4} = \frac{5}{495}$$
$$= 0.010\ 1$$

The probability is $\frac{1}{99}$, 0.01, or 1.01%.

c)   Determine the probability that at least 1 ballet dancer will be chosen.

(1 mark)   **OR**

$P(\text{at least 1 ballet dancer}) = 1 - P(\text{no ballet dancers})$
$$= 1 - 0.010\ 1$$
$$= 0.989\ 9$$

The probability is $\frac{98}{99}$, 0.99, or 98.99%.

1 ballet, 3 jazz: $\dfrac{_7C_1 \times {_5}C_3}{_{12}C_4} = \dfrac{70}{495}$

2 ballet, 2 jazz: $\dfrac{_7C_2 \times {_5}C_2}{_{12}C_4} = \dfrac{210}{495}$

3 ballet, 1 jazz: $\dfrac{_7C_3 \times {_5}C_1}{_{12}C_4} = \dfrac{175}{495}$

4 ballet, 0 jazz: $\dfrac{_7C_4 \times {_5}C_0}{_{12}C_4} = \dfrac{35}{495}$

$$\frac{70 + 210 + 175 + 35}{495} = \frac{490}{495}$$

The probability is $\frac{98}{99}$, 0.99, or 98.99%.

Marker Note(s):
→ *Award a maximum of 3 marks if student consistently uses permutations instead of combinations.*

Marking Key
❶ *1 mark for correct answer in (a)*
❷ *1 mark for appropriate work in (b)*
❸ *1 mark for consistent answer in (b)*
❹ *1 mark for consistent answer in (c)*

Question 13	**Total: 1 mark**
Learning Outcome: 12A.D.1	**Question Type: Selected Response**

Select the best answer.

The Mathletica company manufactures inflatable exercise balls. If the cost of plastic for the balls is \$0.002/cm^2, which equation could be used to estimate the plastic cost, C, of one exercise ball with radius, r?

(A) $C = 0.002 \times 4\pi r^2$

B) $C = 0.002 \times \dfrac{4}{3}\pi r^3$

C) $C = \dfrac{4\pi r^2}{0.002}$

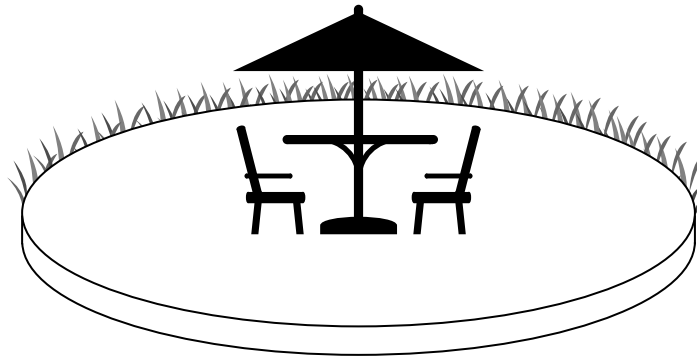D) $C = \dfrac{4\pi r^3}{3(0.002)}$

> **Student Error**
> B: volume formula
> C: divided by unit cost
> D: volume formula, divided by unit cost

Question 14
Total: 3 marks

Question Type: Constructed Response

Kami would like to build a circular cement patio with a diameter of 15 feet as shown below. (Diagram is not drawn to scale.)

a) Cement costs $200.00 per cubic yard, taxes included. Kami has a budget of $600.00 for the patio. Determine how many cubic feet of cement she can buy.

(1 mark)
$$\frac{\$600.00}{\$200.00} = 3$$

$$3 \text{ yd}^3 \times 27 = 81 \text{ ft}^3$$

Kami can buy 81 ft^3 of cement.

b) What is the maximum height of the patio, in inches, that keeps her within budget? Show your work.

(2 marks)
$$V = \pi r^2 h$$

$$h = \frac{V}{\pi r^2}$$

$$= \frac{81 \text{ ft}^3}{\pi (7.5 \text{ ft.})^2}$$

$$= 0.458\ 37 \text{ ft.}$$

$$0.458\ 37 \times 12 = 5.500\ 4 \text{ in.}$$

The maximum height of the patio is 5.50 in.

Marker Note(s):
→ *Use communication error* Ⓔ5 *if final answer in (a) is given in cubic inches or final answer in (b) is given in feet.*

| **Marking Key** |
|---|
| ❶ *1 mark for correct cement amount, in cubic feet, in (a)* |
| ❷ *1 mark for appropriate work in (b)* |
| ❸ *1 mark for consistent answer, in inches, in (b)* |

Question 15

Total: 6 marks

Learning Outcomes: 12A.D.1, 12A.FM.1   **Question Type: Constructed Response**

Thierry wants to build a baseball field by his home. He is going to place gravel, to a depth of 4 inches, in the infield and grass seed on top of the existing soil in the outfield. (Diagram is not drawn to scale.)

The costs are as follows:

- $1.50 per cubic foot of gravel
- $16.00 per bag of grass seed, covering 6500 square feet

All items must be purchased in whole units and all prices are taxes included.

320 ft.

Outfield (grass seed)

Infield (gravel)

← 145 ft. →
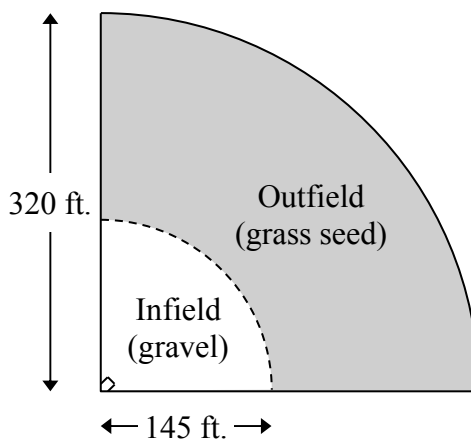
a) Determine the total cost to build the baseball field. Assume the field is in the shape of a quarter-circle.

(4 marks)

Cost of gravel:

$$\frac{\pi r^2 h}{4} = \frac{\pi (145)^2 \left(\frac{4}{12}\right)}{4} = \frac{22\ 017.328\ 5}{4} = 5504.33\ \text{ft}^3$$

$5505\ \text{ft}^3 \times \$1.50/\text{ft}^3 = \$8257.50$

Cost of grass seed:

$$\frac{\pi r_1^2 - \pi r_2^2}{4} = \frac{\pi (320)^2 - \pi (145)^2}{4} = 63\ 911.78\ \text{ft}^2$$

$$\frac{63\ 911.78\ \text{ft}^2}{6500} = 9.83\ \text{bags}$$

$10\ \text{bags} \times \$16.00/\text{bag} = \$160.00$

Total cost:

$\$8257.50 + \$160.00 = \$8417.50$

The total cost is $8417.50.

FINANCIAL MATHEMATICS

b) Thierry obtains a loan from the bank to build the field described in (a). If he makes monthly payments of $400.00, how many months will it take to repay the loan at an interest rate of 6.25%, compounded monthly? Show your work.

(2 marks)

```
∎N=22.34683127
 I%=6.25
 PV=8417.50
 PMT=-400
 FV=0
 P/Y=12
 C/Y=12
 PMT:END BEGIN
```

It will take 23 months to repay the loan.

Marker Note(s):
→ *Award a maximum of 1 mark in (b) for one incorrect input value; award no marks for two incorrect input values.*
→ *Award mark ❻ for an answer of 22.35 months.*

Marking Key
❶ *1 mark for correct volume of gravel in cubic feet in (a)*
❷ *1 mark for correct surface area in (a)*
❸ *1 mark for consistent number of bags of grass seed in (a)*
❹ *1 mark for consistent total cost in (a)*
❺ *1 mark for appropriate work in (b)*
❻ *1 mark for consistent number of months in (b)*

Question 16

Total: 2 marks

Question Type: Constructed Response

Samira's financial planner sent her an annual report of the investments in her portfolio. It stated that her $2000.00 stock investment increased in value by 6.00% while her $3000.00 mutual fund investment decreased in value by 8.00%.

Type of Investment	Principal ($)	Return ($)	Current Value ($)
Stocks	2000.00	**+120.00**	**2120.00**
Mutual Funds	3000.00	**−240.00**	**2760.00**
Total	5000.00	**−120.00**	**4880.00**

Calculate the average rate of return of her portfolio. Show your work.

$$\text{Rate of return} = \frac{\$4880.00 - \$5000.00}{\$5000.00} \times 100$$

$$= \frac{-\$120.00}{\$5000.00} \times 100$$

$$= -2.4\%$$

The rate of return is –2.4%.

Marking Key	
❶	1 mark for correct total return or correct total current value
❷	1 mark for consistent rate of return

Question 17

Total: 2 marks

Learning Outcome: 12A.FM.3 **Question Type: Constructed Response**

Your grandmother has some money that she would like to invest on your behalf. She would like to know whether you prefer a long-term or a short-term investment.

Explain one advantage for each type of investment.

A long-term investment may have a higher rate of return.

A short-term investment gives access to the capital sooner.

Other answers are possible.

Marking Key	
❶	*1 mark for appropriate long-term investment advantage*
❷	*1 mark for appropriate short-term investment advantage*

Question 18   Total: 2 marks

Salwa bought a new computer system for $6000.00. She anticipates the value of the system to depreciate at a rate of 15% per year.

What will the computer system be worth at the end of 3 years? Show your work.

$$y = \$6000.00(0.85)^3$$
$$y = \$3684.75$$

The computer system will be worth $3684.75.

OR——

$6000.00 × 0.15 = $900.00 $6000.00 − $900.00 = $5100.00
$5100.00 × 0.15 = $765.00 $5100.00 − $765.00 = $4335.00
$4335.00 × 0.15 = $650.25 $4335.00 − $650.25 = $3684.75

The computer system will be worth $3684.75.

Marking Key	
❶	*1 mark for appropriate use of depreciation rate*
❷	*1 mark for consistent value at the end of 3 years*

Question 19 **Total: 4 marks**

Learning Outcome: 12A.FM.2 **Question Type: Constructed Response**

Diego plans to move to Portage la Prairie. He has two housing options:

Option 1:

- Buy a house with a monthly mortgage payment of $1063.65.
- Property taxes are $3070.00 per year.

Option 2:

- Rent a house for $1250.00 per month.

a) What will be the total cost of Option 1 at the end of 25 years? Show your work.

(2 marks)

$$\text{Total cost} = \text{mortgage payments} + \text{property taxes}$$
$$= (\$1063.65 \times 12 \times 25) + (\$3070.00 \times 25)$$
$$= \$319\ 095.00 + \$76\ 750.00$$
$$= \$395\ 845.00$$

The total cost will be $395 845.00.

b) How many years will it take for the total cost of renting to equal the total cost of buying the house?

(1 mark)

$$\text{Number of years} = \frac{\$395\ 845.00}{\$1250.00 \times 12}$$
$$= 26.39$$

It will take 26.39 years.

c) Explain why Diego might choose to buy the house.

(1 mark)   He will own the house after 25 years.

OR——

He could sell the house.

OR——

He will build home equity.

Other answers are possible.

Marker Note(s):
→ *Award mark* ❸ *for an answer of 27 years.*

Marking Key
❶ *1 mark for appropriate work in (a)*
❷ *1 mark for consistent answer in (a)*
❸ *1 mark for consistent answer in (b)*
❹ *1 mark for appropriate explanation in (c)*

Question 20 — Total: 5 marks

Donald and Alex have a combined gross monthly income of $5500.00. They want to buy a house in a neighbourhood where the average monthly heating cost is $200.00 and monthly property taxes are $325.00.

a) Calculate the maximum monthly mortgage payment they can afford, based on the gross debt service ratio. Show your work.

(2 marks)

$$\text{GDSR} = \frac{\left(\begin{array}{ccc}\text{Monthly} & \text{Monthly} & \text{Monthly}\\ \text{mortgage} + \text{property} + \text{heating}\\ \text{payment} & \text{taxes} & \text{costs}\end{array}\right)}{\text{Gross monthly income}} \times 100$$

$$32\% = \frac{\text{Monthly mortgage payment} + \$325.00 + \$200.00}{\$5500.00} \times 100$$

They can afford a maximum monthly mortgage payment of $1235.00.

b) Based on the maximum monthly mortgage payment in (a), their bank has offered them a 25-year mortgage at an interest rate of 3.50%, compounded semi-annually. If they have saved $20 000.00 for a down payment, what would be the maximum house price they can afford? Show your work.

(3 marks)

```
N=300
I%=3.5
▪PV=247360.9826
PMT=-1235
FV=0
P/Y=12
C/Y=2
PMT:END BEGIN
```

$$\text{Maximum house price} = \$247\,360.98 + \$20\,000.00$$
$$= \$267\,360.98$$

They can afford a house with a price of $267 360.98.

Marker Note(s):
→ *Award a maximum of 2 marks in (b) for one incorrect input value; award a maximum of 1 mark for two or more incorrect input values.*

Marking Key	
❶	*1 mark for appropriate work in (a)*
❷	*1 mark for consistent answer in (a)*
❸	*1 mark for appropriate work in (b)*
❹	*1 mark for consistent maximum mortgage in (b)*
❺	*1 mark for consistent maximum house price in (b)*

LOGICAL REASONING
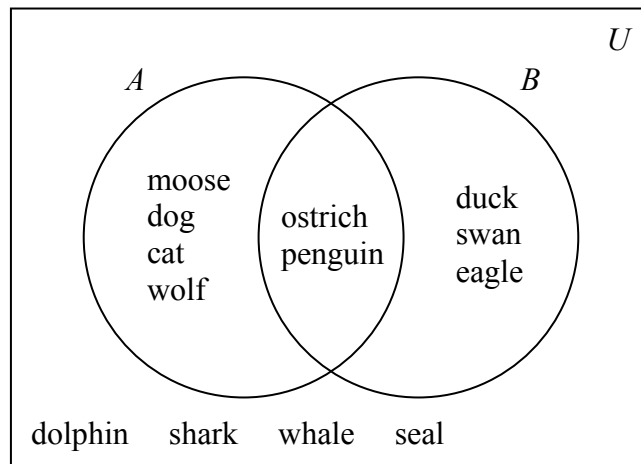
Question 21
Total: 1 mark

Question Type: Selected Response

Use the following information to answer the question and select the best answer.

Which of the following statements is true?

A) $n(A \cup B) = 2$

B) $n(A' \cup B') = 4$

C) $n(A' \cap B') = 4$

D) $n(A \cap B) = 9$

Student Error
A: $n(A \cup B) = 9$
B: $n(A' \cup B') = 11$
D: $n(A \cap B) = 2$

Question 22   Total: 1 mark

Learning Outcome: 12A.L.1   **Question Type: Constructed Response**

You are given the following four inequality statements.

I.   ☆ < △

II.   ◯ ≠ ☆

III.   ☆ > ☐

IV.   ◯ < ☐

Draw the four symbols in order from smallest value to largest value.

◯☐☆△

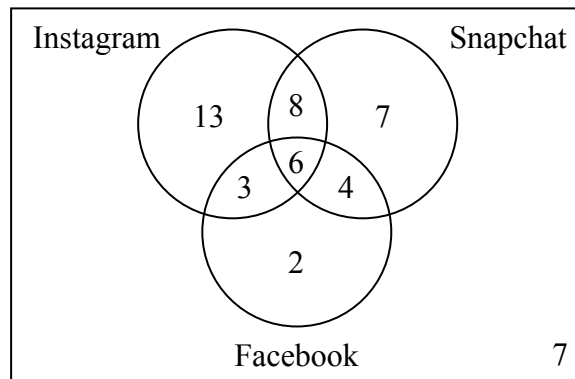| Marking Key |
|---|
| ❶   *1 mark for correct answer* |

Question 23
Total: 4 marks

Learning Outcome: 12A.L.2 **Question Type: Constructed Response**

A technology survey of 50 students found that:

- 30 students use Instagram
- 25 students use Snapchat
- 15 students use Facebook
- 8 students use only Instagram and Snapchat
- 3 students use only Facebook and Instagram
- 4 students use only Facebook and Snapchat
- 6 students use all three apps

a) Draw a Venn diagram to represent this situation.

(3 marks)

b) How many students use Snapchat or Instagram?

(1 mark)

$$50 - 2 - 7 = 41$$

There are 41 students.

OR————————————————————————————————————

$$7 + 4 + 6 + 8 + 3 + 13 = 41$$

There are 41 students.

Marking Key
❶ *1 mark for correctly placing the number of students using 2 or more apps in (a)*
❷ *1 mark for consistent number of students using exactly 1 app in (a)*
❸ *1 mark for consistent number of students using no app in (a)*
❹ *1 mark for consistent answer in (b)*

Question 24   Total: 1 mark

Learning Outcome: 12A.L.1   **Question Type: Constructed Response**

Use the following pattern to draw the 4th picture.
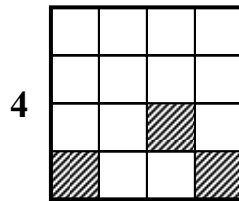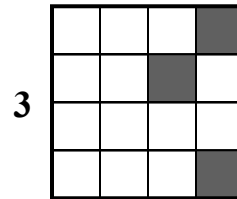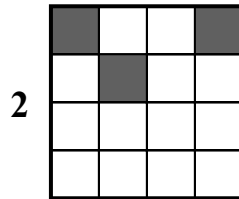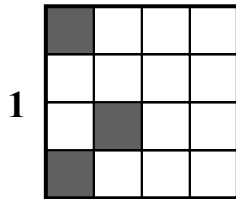
	Marking Key
❶	*1 mark for correct pattern*

Exemplars

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

Exemplar 1

Question 1   **Total: 3 marks**

The temperature in an office is controlled by an electronic thermostat. The temperature varies according to the sinusoidal function:

$$y = 3\sin(0.26x - 2.88) + 19$$

where y represents the temperature in degrees Celsius
and x represents the <u>time in hours past midnight</u>.

a) Determine the temperature in the office at 9 a.m.

(1 mark)

$$y = 3\sin(0.26(9) - 2.88) + 19$$
$$y = \boxed{18.97^\circ C}$$

b) Determine the maximum temperature in the office.

(1 mark)

Max $19 + 3 = 22$

$$\boxed{\begin{array}{c}\text{Max}\\22_\uparrow\end{array}}$$
(ES)

	1 mark:
❷ →	1 mark for consistent answer in (b)
(ES) →	does not include the units in the final answer

Exemplar 2

Question 1   Total: 3 marks

The temperature in an office is controlled by an electronic thermostat. The temperature varies according to the sinusoidal function:

$$y = 3\sin(0.26x - 2.88) + 19$$

where y represents the <u>temperature</u> in degrees Celsius
and x represents the time in hours past midnight.

a)   Determine the temperature in the office at 9 a.m.

(1 mark)

$X = 9 \quad Y = -1.14$

y temperature

$x = -7.63 \quad Y=3$

(a)

$x = time$
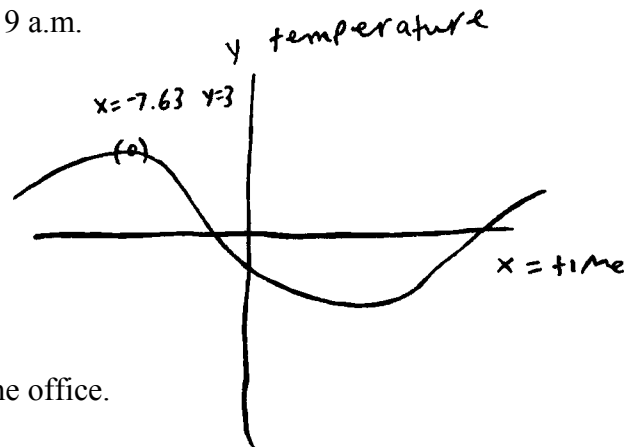
b)   Determine the maximum temperature in the office.

(1 mark)

Maximum

$x = -7.63 \cdot 3$

Ⓔ1 Ⓔ5

---

1 mark:
❷ → 1 mark for consistent answer in (b)

....

Ⓔ1 → does not identify the answer
Ⓔ5 → does not include the units in the final answer

Exemplar 1

Question 2   **Total: 1 mark**

Given the equation $y = 400(0.9)^x$, describe what "400" could represent in a real-life situation.

The "400" Could be an amount of animals in the Present.

> **1 mark:**
> ❶ → 1 mark for correct answer

Exemplar 2

Given the equation $y = 400(0.9)^x$, describe what "400" could represent in a real-life situation.

a decrease
in population

0 marks:
→ no criteria met

Exemplar 1

Question 3	Total: 3 marks

Josemaría is standing directly under the centre of a parabolic satellite dish.

- The bottom of the dish is 28 metres above the ground from where she is standing.
- The highest points of the dish are 50 m above the ground.
- The width of the dish is 64 m.

64 side view

50 *28*

Diagram is not drawn to scale.

a) Determine a quadratic equation that models the shape of the dish. Show your work. You may use the table below.

(2 marks)

Horizontal Distance (m)	Height of the Dish (m)

stat - calc - Quad Reg

$$y = .021x^2 - 1.375x + 50$$

b) Josemaría walks 20 metres to the right. She notices that a bird has made a nest on the dish directly above where she stands. Using your equation in (a), determine the height of the bird's nest from the ground.

(1 mark)

$32 + 20 = 52$

Trace 52

$y = 35.3 M$ (E6)

---

3 marks:

❶ → 1 mark for appropriate work in (a)

❷ → 1 mark for consistent equation in (a)

❸ → 1 mark for consistent answer in (b)

⌷⌷⌷⌷⌷⌷⌷⌷⌷⌷⌷⌷⌷⌷⌷⌷⌷⌷⌷⌷⌷⌷⌷⌷⌷⌷⌷⌷⌷⌷⌷⌷⌷⌷

(E6) → does not express the answer to the appropriate number of decimal places

Exemplar 2

Question 3	Total: 3 marks

Josemaría is standing directly under the centre of a parabolic satellite dish.

side view

- The bottom of the dish is 28 metres above the ground from where she is standing.
- The highest points of the dish are 50 m above the ground.
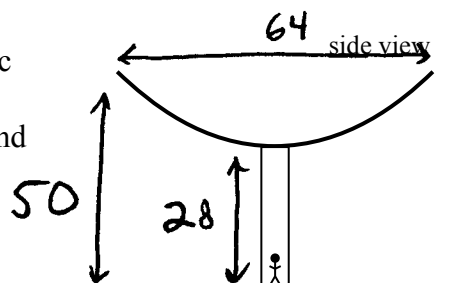- The width of the dish is 64 m.
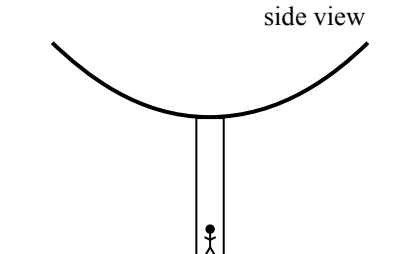
Diagram is not drawn to scale.

a) Determine a quadratic equation that models the shape of the dish. Show your work. You may use the table below.

(2 marks)

Horizontal Distance (m)	Height of the Dish (m)
-32	50
-16	39
0	28
16	39
32	50

Min → 28 metres from the ground (0, 28)

(32, 50)

(-32, 50)

[Quad Reg]

$y = 0.02 x^2 + 31.77$

b) Josemaría walks 20 metres to the right. She notices that a bird has made a nest on the dish directly above where she stands. Using your equation in (a), determine the height of the bird's nest from the ground.

(1 mark)

[Calc]

$x = 20$

$y = 39.1375$

39.14 m

2 marks:
❷ → 1 mark for consistent equation in (a)
❸ → 1 mark for consistent answer in (b)

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Exemplar 1

Question 4   **Total: 6 marks**

Corinne counts the number of large apples on her apple tree. The number of large apples increases over time as shown in the table below.

Time (days)	1	40	60	80	100	120
Number of large apples	0	66	76	82	87	92

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

(3 marks)

Apples compared to days

(# of apple)

Time (days)
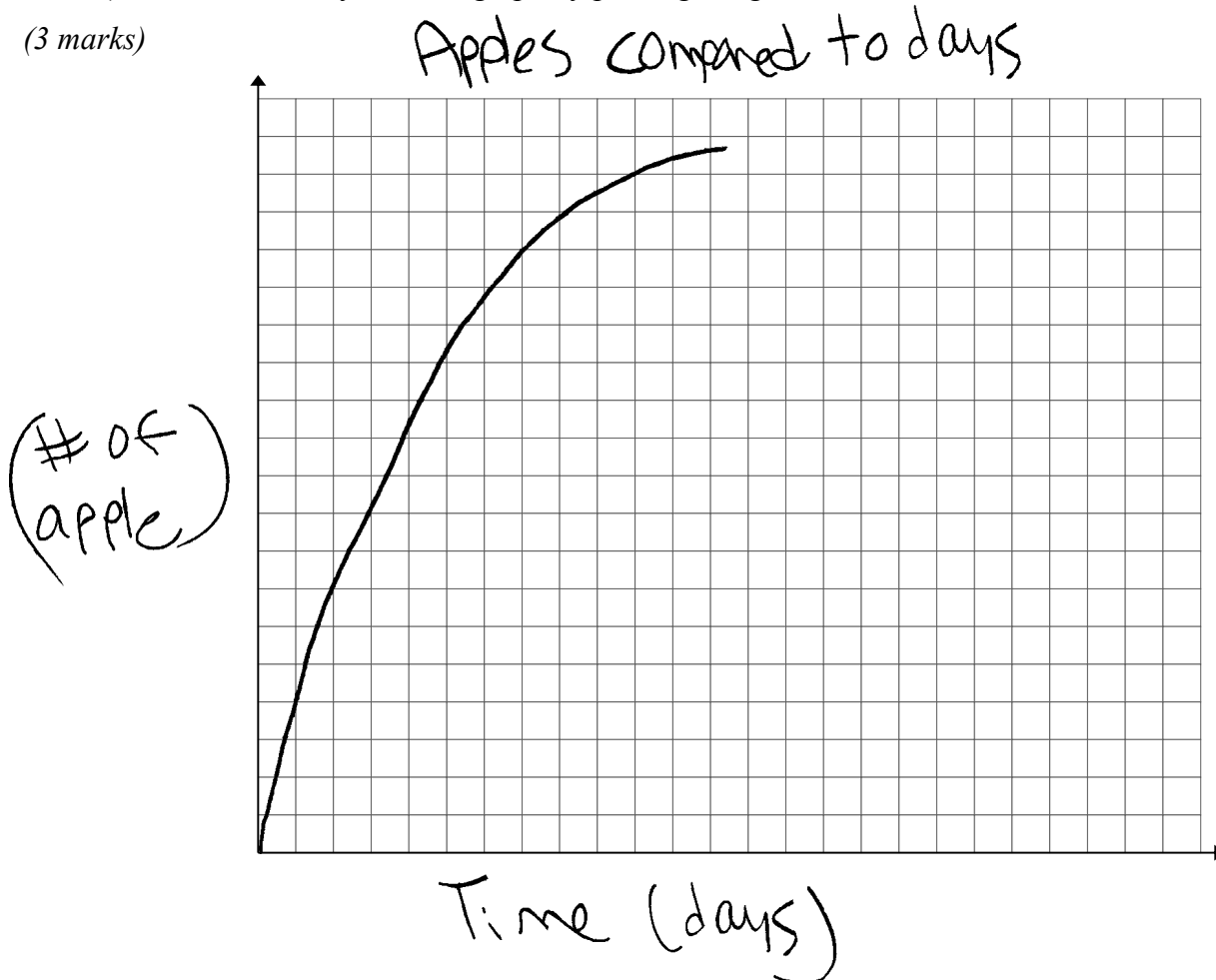
b) Determine the logarithmic regression equation that models this data.

(1 mark)

$$-.76 + 18.9(x)$$

E2   E6   E2

Exemplar 1 (continued)

c)   Corinne needs 84 large apples to make pies. How much time will it take for her to have
     enough apples? Show your work.

(2 marks)

$y^2 = 84$

2nd trace intersect

$y = 84$ $x = 88.5$ days

84th day

---

4 marks:
❶ → 1 mark for communicating the context of the graph with appropriate title
      and/or labels in (a)
❹ → 1 mark for correct equation in (b)
❺ → 1 mark for appropriate work in (c)
❻ → 1 mark for consistent answer in (c)

- -

Ⓔ2 →   does not include one of the following in the equation: "$y =$", "sin", "ln",
        or "x", or writes parameters separately from the equation
Ⓔ6 →   does not express the answer to the appropriate number of decimal places

Exemplar 2

**Question 4**   **Total: 6 marks**

Corinne counts the number of large apples on her apple tree. The number of large apples increases over time as shown in the table below.

Time (days)	1	40	60	80	100	120
Number of large apples	0	66	76	82	87	92

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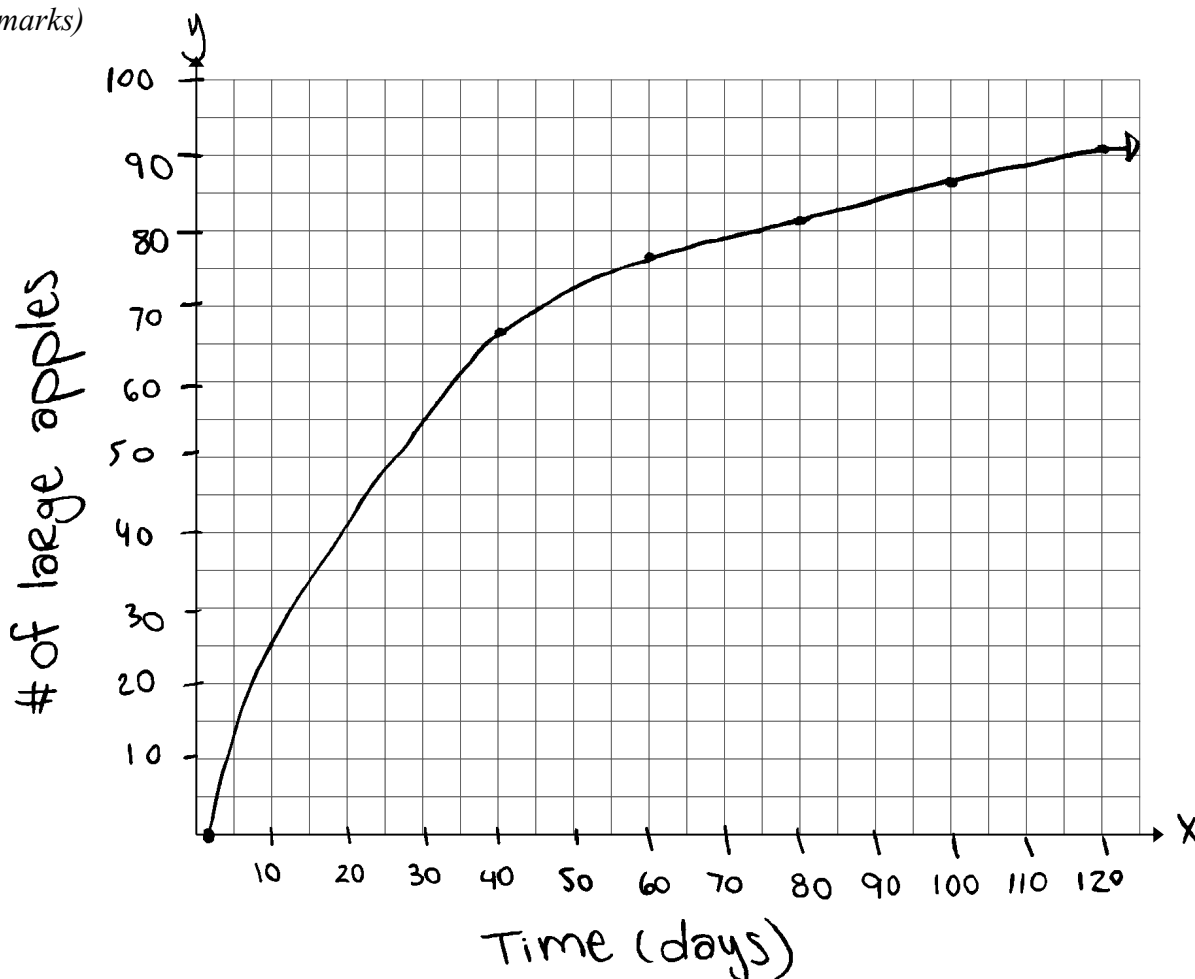
(3 marks)

b) Determine the logarithmic regression equation that models this data.

(1 mark)

stat, edit, L_1, L_2
stat, calc, linReg.

$y = 0.714x + 19.471$

Exemplar 2 (continued)

c) Corinne needs 84 large apples to make pies. How much time will it take for her to have enough apples? Show your work.

(2 marks)

$$y_2 = 84$$

* 2nd trace, intersect *

$$x = 90.4$$

$$\boxed{= 91 \text{ day}}$$

---

5 marks:
❶ → 1 mark for communicating the context of the graph with appropriate title and/or labels in (a)
❷ → 1 mark for using an appropriate domain and range (i.e., window settings/grid range) for the context of the question in (a)
❸ → 1 mark for correctly plotting the data in (a)
❺ → 1 mark for appropriate work in (c)
❻ → 1 mark for consistent answer in (c)

Exemplar 1

Question 5	Total: 3 marks

A scientific experiment is conducted on a beverage containing aspartame.

- The initial amount of aspartame is 160 mg.
- The amount of aspartame decreases by 50% every 3 days.

a) Determine an exponential equation that models the remaining amount of aspartame as a function of time (in days). Show your work.

(2 marks)

L_1 (days)	L_2 (mg)
1	160
2	120
3	80

$$Y = 230.76(0.707)^x$$

b) State the range for this experiment.

(1 mark)

$$(0, 230.76]$$

1 mark:
❸ → 1 mark for consistent range in (b)

Exemplar 2

Question 5	**Total: 3 marks**

A scientific experiment is conducted on a beverage containing aspartame.

- The initial amount of aspartame is 160 mg.
- The amount of aspartame decreases by 50% every 3 days.

a) Determine an exponential equation that models the remaining amount of aspartame as a function of time (in days). Show your work.

(2 marks)

$$50\% = 0.50$$

$$y = ab^x$$

$$y = 160(0.50)^x$$

$$a = 160$$

$$b = 0.50$$

Calculations 10-14

b) State the range for this experiment.

(1 mark)

$$[0, 160]$$

> **1 mark:**
> ❶ → 1 mark for correct initial value in equation in (a)

Exemplar 1

The odds in favour of Danny's team winning the tournament are $3:7$.

Determine the probability that Danny's team does not win the tournament.

$$3:7 \qquad\qquad \frac{7}{7+3} = \frac{7}{10}^{(\text{to win})}$$

$$\frac{3}{10} = 0.3 \times 100 = 30\%$$

Danny's team has a
30% chance of losing.

0 marks:
→ no criteria met

Exemplar 2

The odds in favour of Danny's team winning the tournament are $3 : 7$.

Determine the probability that Danny's team does not win the tournament.

$\cancel{OR}$

$\frac{4}{7}$ 0.57 or 57%

$\frac{7}{10} = 0.7$ or 70%   (E1)

| **1 mark:** |
| ❶ → 1 mark for correct answer |
| E1 → does not identify the answer |

Exemplar 1

Using the digits 0 through 9, determine the number of 4-digit codes divisible by 5 that can be created if none of the digits repeat. Assume codes can start with zero. Show your work.

$$\underline{8} \cdot \underline{7} \cdot \underline{6} \cdot \underline{\frac{2}{0,5}}$$

✳ 4 digit codes divisible by 5 must have the last digit to be either a 0 or 5

$$= 672$$

There are 672 different kinds of codes that are divisible by 5 and have no repeating digits.

```
┌─────────────────────────────────────────┐
│                1 mark:                    │
│   ❷ →  1 mark for consistent answer       │
└─────────────────────────────────────────┘
```

Exemplar 2

Question 8   **Total: 2 marks**

Using the digits 0 through 9, determine the number of 4-digit codes divisible by 5 that can be created if none of the digits repeat. Assume codes can start with zero. Show your work.

$$10 \cdot 9 \cdot 8 \cdot 7 = \frac{10!}{6!} = \boxed{5040 \text{ codes}}$$

| **1 mark:** |
| ❷ → 1 mark for consistent answer |

Exemplar 1

Question 9	Total: 2 marks

Martha is entering the Hudson Bay Quest sled dog race. She owns 12 dogs and wants to enter a team of 10 dogs.

a) Determine the number of ways she can randomly choose 10 of her dogs to make up a team.

(1 mark)

$$12C_{10} = 66$$

b) Martha must now put the 10 chosen dogs in their starting positions. She begins by attaching her lead dogs, Niko and Anuk. Determine the number of ways she can randomly attach the remaining dogs.

(1 mark)

Niko

Anuk

$$8P_8 \cdot 2P_2 = 80640$$

> **1 mark:**
> ❶ → 1 mark for correct answer in (a)

Exemplar 2

Question 9   **Total: 2 marks**

Martha is entering the Hudson Bay Quest sled dog race. She owns 12 dogs and wants to enter a team of 10 dogs.
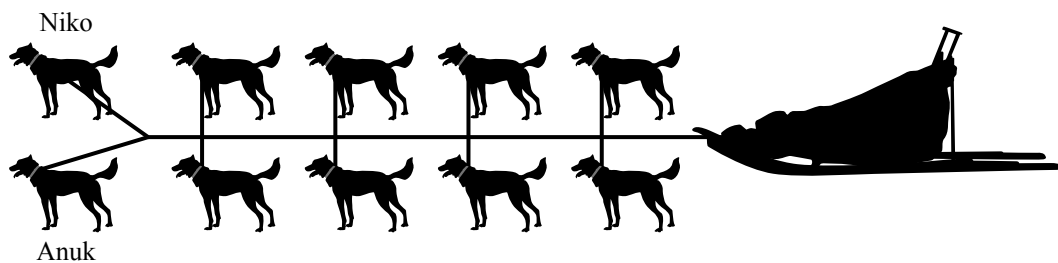
a)   Determine the number of ways she can randomly choose 10 of her dogs to make up a team.

(1 mark)

$$\underline{12}\ \underline{11}\ \underline{10}\ \underline{9}\ \underline{8}\ \underline{7}\ \underline{6}\ \underline{5}\ \underline{4}\ \underline{3}$$

$$\frac{12!}{2!} = 239500800$$

$$\therefore 239\ 500\ 800\ \text{ways}$$
she can make
a team.

b)   Martha must now put the 10 chosen dogs in their starting positions. She begins by attaching her lead dogs, Niko and Anuk. Determine the number of ways she can randomly attach the remaining dogs.
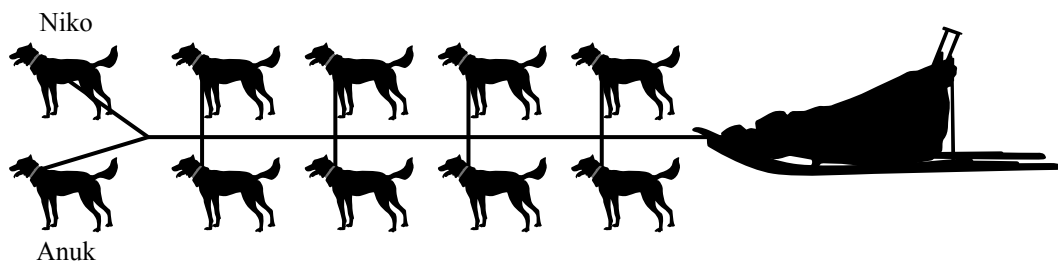
(1 mark)

Niko

Anuk

$$\underline{1}\ \underline{1}\ \underline{10}\ \underline{9}\ \underline{8}\ \underline{7}\ \underline{6}\ \underline{5}\ \underline{4}\ \underline{3}$$

$$\frac{10!}{2!} = 1814400$$

$$\therefore 1\ 814\ 400$$
ways to
rearrange.

| 0 marks: |
| → no criteria met |

Exemplar 1

Question 10   **Total: 2 marks**

At recess, students randomly pick one marble from a bag to determine teams for a game. Initially, there are 10 orange marbles and 10 blue marbles in the bag.

Maria and Leah hope to be on the blue team. Maria picks her marble first and puts it in her pocket. Leah picks her marble second. What is the probability that they will both pick a blue marble? Show your work.

Exemplar 2
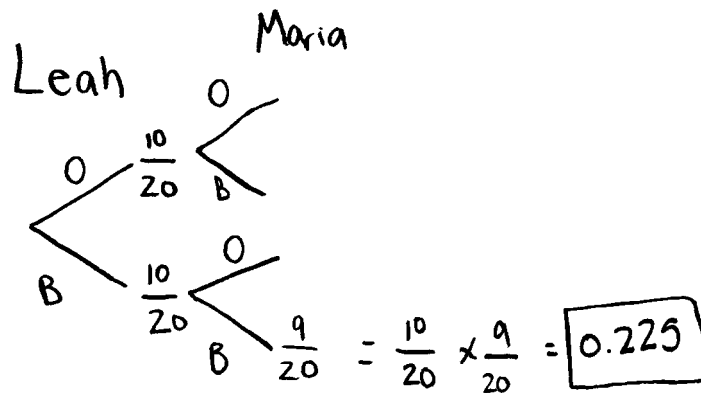

Question 10   **Total: 2 marks**

At recess, students randomly pick one marble from a bag to determine teams for a game. Initially, there are 10 orange marbles and 10 blue marbles in the bag.

Maria and Leah hope to be on the blue team. Maria picks her marble first and puts it in her pocket. Leah picks her marble second. What is the probability that they will both pick a blue marble? Show your work.

Maria $\dfrac{10}{20}$ Leah $\dfrac{9}{19}$

$$\dfrac{10}{20} \times \dfrac{9}{19} = \dfrac{90}{380} = 0.24 \text{ or } 24\%. \underset{\text{E6}}{\uparrow}$$

2 marks:
❶ → 1 mark for appropriate work
❷ → 1 mark for consistent answer
⋯⋯⋯⋯⋯⋯⋯⋯⋯⋯⋯⋯⋯⋯⋯⋯⋯⋯⋯⋯⋯⋯⋯⋯⋯⋯⋯
(E6) → does not express the answer to the appropriate number of decimal places

Exemplar 1

The weather report calls for a 60% probability of snow in northern Manitoba on Tuesday. The flight from Thompson to Flin Flon has a 30% probability of being on time when it is snowing. There is an 85% probability of the flight being on time when it is not snowing.

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

(1 mark)

b) Determine the probability that the flight on Tuesday will not be on time. Show your work.

(2 marks)

if snows = .6 × .7 = .42 or 42%

not snow = .4 × .15 = .06 or 6%

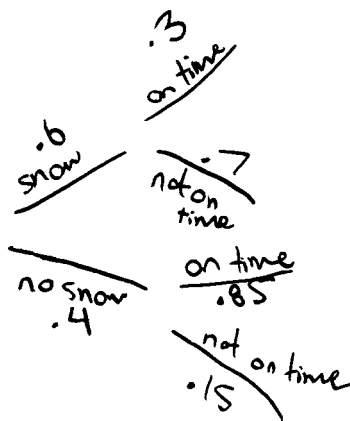| **2 marks:** |
| ❶ → 1 mark for appropriate graphic organizer in (a) |
| ❷ → 1 mark for appropriate work in (b) |

Exemplar 2

Question 11	Total: 3 marks

The weather report calls for a 60% probability of snow in northern Manitoba on Tuesday. The flight from Thompson to Flin Flon has a 30% probability of being on time when it is snowing. There is an 85% probability of the flight being on time when it is not snowing.

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

(1 mark)

snow (0.60)
late (0.30)
on time (0.70)

no snow (0.40)
late (0.15)
on time (0.85)
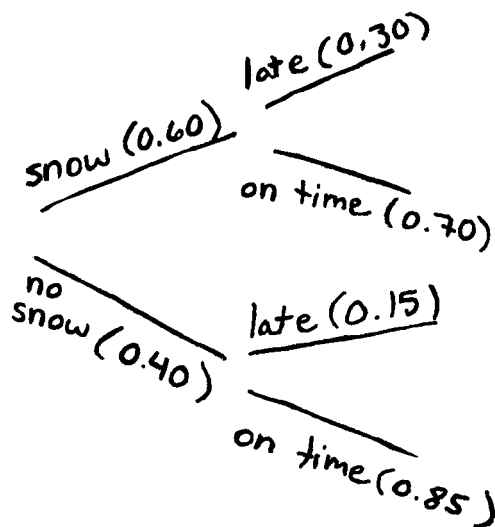
b) Determine the probability that the flight on Tuesday will not be on time. Show your work.

(2 marks)

$$0.40 \cdot 0.15 = 0.06$$

$$0.60 \cdot 0.30 = 0.18$$

$$0.18 + 0.06 = 0.24$$

The probability of being late is 0.24

> **2 marks:**
> ❶ → 1 mark for appropriate graphic organizer in (a)
> ❸ → 1 mark for consistent answer in (b)

Exemplar 1

Question 12   **Total: 4 marks**

There are 5 jazz dancers and 7 ballet dancers from which 4 dancers are randomly chosen to form a group.

a) Determine the number of ways 4 dancers can be chosen.

(1 mark)

$$5 + 7$$

$$12 \, P4 = \boxed{11880 \text{ way}}$$

b) Determine the probability that 4 jazz dancers will be chosen. Show your work.

(2 marks)

$$5P4 = 120$$

$$\frac{120}{11880} = \boxed{1.01 \text{ .}^\circ \text{ chance}}$$

c) Determine the probability that at least 1 ballet dancer will be chosen.

(1 mark)

$$6P4 \quad 360 \; +$$
$$7P4 \quad 840 \; +$$
$$8P4 \quad 1680$$
$$9P4 \quad 3024 \; +$$
$$\cancel{10P4}$$
$$12 \, P4$$

$$\frac{5904}{11880} \qquad \boxed{49.70 \text{ .}^\circ}$$

| **2 marks:** |
| ❷ → 1 mark for appropriate work in (b) |
| ❸ → 1 mark for consistent answer in (b) |

Exemplar 2

Question 12   **Total: 4 marks**

There are 5 jazz dancers and 7 ballet dancers from which 4 dancers are randomly chosen to form a group.

a) Determine the number of ways 4 dancers can be chosen.

(1 mark)

$$_{12}C_4 = 495$$

b) Determine the probability that 4 jazz dancers will be chosen. Show your work.

(2 marks)

$$_5C_4 \cdot {_7}C_0 = 5$$

$$\frac{5}{495} = 1.01\%$$

c) Determine the probability that at least 1 ballet dancer will be chosen.

(1 mark)

$$_5C_1 \cdot {_7}C_3 = 175$$

$$_5C_2 \cdot {_7}C_2 = 210$$

$$_5C_3 \cdot {_7}C_1 = 70$$

$$_5C_4 \cdot {_7}C_0 = 5$$

> **3 marks:**
> ❶ → 1 mark for correct answer in (a)
> ❷ → 1 mark for appropriate work in (b)
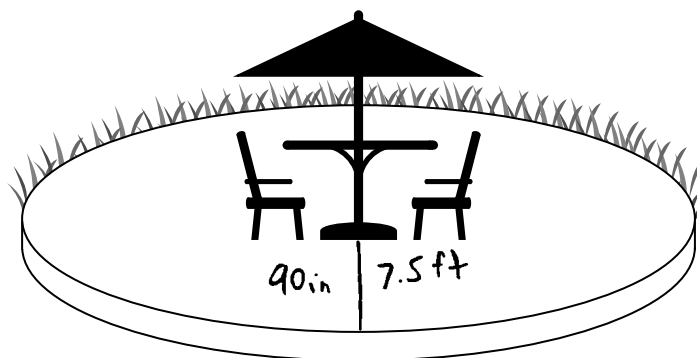> ❸ → 1 mark for consistent answer in (b)

$$175 + 210 + 70 + 5 = \frac{460}{495} = \boxed{92.93\%}$$

Exemplar 1

Kami would like to build a circular cement patio with a diameter of 15 feet as shown below. (Diagram is not drawn to scale.)

a) Cement costs $200.00 per cubic yard, taxes included. Kami has a budget of $600.00 for the patio. Determine how many cubic feet of cement she can buy.

(1 mark)

$$1 \text{ yd}^3 = 46656 \text{ in}^3$$

$200 per 46656 in³

$600 for 139968 in³   ⓔ5

b) What is the maximum height of the patio, in inches, that keeps her within budget? Show your work.

(2 marks) $139968 = \pi(90)^2(h)$

$\dfrac{139968}{\pi(90)^2} = 5.5 \text{ in}$

∴ The max height of the patio she can afford is 5.5 in.   ⓔ6

---

3 marks:
- ❶ → 1 mark for correct cement amount, in cubic feet, in (a)
- ❷ → 1 mark for appropriate work in (b)
- ❸ → 1 mark for consistent answer, in inches, in (b)

....

- Ⓔ5 → uses incorrect units of measure
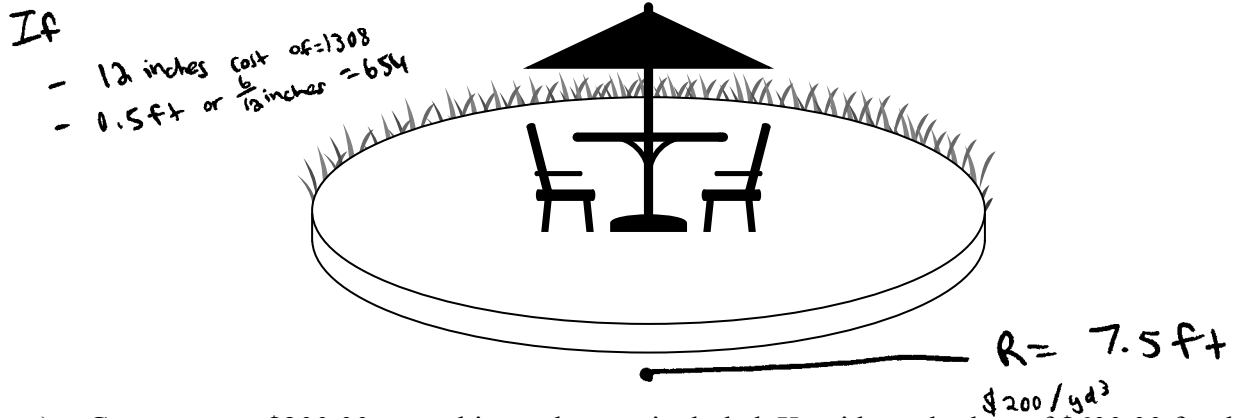- Ⓔ6 → does not express the answer to the appropriate number of decimal places

Exemplar 2

Kami would like to build a circular cement patio with a diameter of 15 feet as shown below. (Diagram is not drawn to scale.)

If
- 12 inches cost of=1308
- 0.5ft or $\frac{6}{12}$inches =654

R= 7.5ft

$200/yd^3

a) Cement costs $200.00 per cubic yard, taxes included. Kami has a budget of $600.00 for the patio. Determine how many cubic feet of cement she can buy.

(1 mark)

$81 ft^3$

b) What is the maximum height of the patio, in inches, that keeps her within budget? Show your work.

(2 marks)

If h= 0.46 ft $\pi (7.5)^2 \cdot 0.46 = 81.29 ft^3 \div 3^3 = 3.01 yd^3 \times 200/yd^3$
                                                                  $= 602

If h= 0.45ft $\pi (7.5)^2 \cdot 0.45 = 79.52 \div 3^3 = 2.95 yd^3 \times 200/yd^3$
0.45ft × 12 = 5.40 inches   =$590

Therfore, if Kami wants to stay in budget her maximum patio height would be 5.40 inches   at a cost of $590

---

2 marks:
❶ → 1 mark for correct cement amount, in cubic feet, in (a)
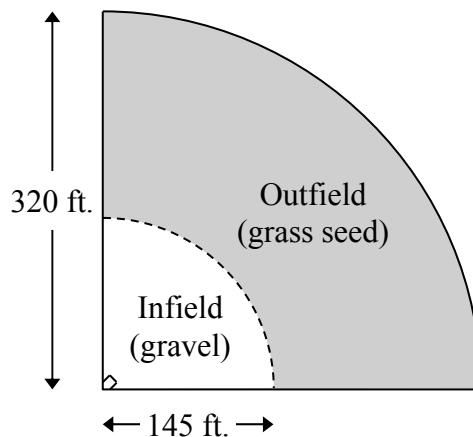❸ → 1 mark for consistent answer, in inches, in (b)

Exemplar 1

Question 15 — Total: 6 marks

Thierry wants to build a baseball field by his home. He is going to place gravel, to a depth of 4 inches, in the infield and grass seed on top of the existing soil in the outfield. (Diagram is not drawn to scale.)

The costs are as follows:

- $1.50 per cubic foot of gravel
- $16.00 per bag of grass seed, covering 6500 square feet

All items must be purchased in whole units and all prices are taxes included.

320 ft.

Outfield (grass seed)

Infield (gravel)

← 145 ft. →

a) Determine the total cost to build the baseball field. Assume the field is in the shape of a quarter-circle.

(4 marks)

$$SA = 2\pi \times 320^2$$
$$= 643,398.1755 \text{ ft}^2$$

$$SA(\text{inner}) = 2\pi \times 145^2$$
$$= 132,103.9711 \times \tfrac{1}{4}$$
$$= 33,025.992 \text{ ft}^2$$

$$SA(\text{outer}) = SA - SA(\text{inner})$$
$$= 511,294.2044 \times \tfrac{1}{4}$$
$$= 127,823.551\ldots \text{ ft}^2$$

$$V(\text{inner}) = \pi \times 145^2 \times 4 \times \tfrac{1}{4}$$
$$= 66,051.985\ldots \text{ ft}^3$$

grass seed bags needed = SA (outer) ÷ 6500
$$= 19.665\ldots$$
∴ 20 bags needed

Cost

infield = $V_{ft}^3 \times 1.50$ (E4)
$$= 66,051.985\ldots \times 1.50$$
$$= 99,077.98$$

$ 99,077.98

outfield = 20 × 16
$$= 320$$

$320 for outfield

Total cost is $99,397.98

99,077.98 + 320

$ 99,397.98

Exemplar 1 (continued)

b)   Thierry obtains a loan from the bank to build the field described in (a). If he makes monthly
     payments of $400.00, how many months will it take to repay the loan at an interest rate
     of 6.25%, compounded monthly? Show your work.

(2 marks)

$$99,397.98 \div (400 \times 12)$$

$$= 20.70...$$

It will take thiery to repay the loan 20.70 years

---

2 marks:
❸ → 1 mark for consistent number of bags of grass seed in (a)
❹ → 1 mark for consistent total cost in (a)

··

Ⓔ④ → does not use whole units for materials purchased in
        design and measurement questions


Exemplar 2

| **Question 15** | **Total: 6 marks** |

Thierry wants to build a baseball field by his home. He is going to place gravel, to a depth of 4 inches, in the infield and grass seed on top of the existing soil in the outfield. *0.33 ft* (Diagram is not drawn to scale.)

The costs are as follows:

- $1.50 per cubic foot of gravel ft^3
- $16.00 per bag of grass seed, covering 6500 square feet ft^2

All items must be purchased in whole units and all prices are taxes included.
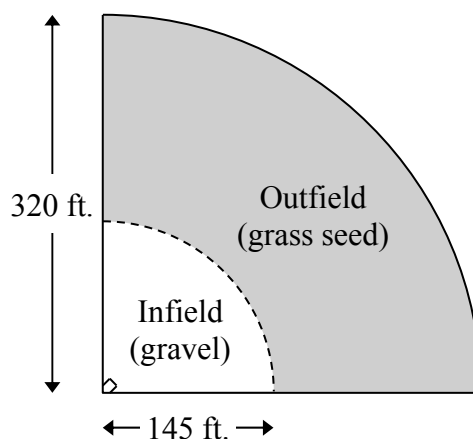
320 ft.

Outfield (grass seed)

Infield (gravel)

← 145 ft. →

a) Determine the total cost to build the baseball field. Assume the field is in the shape of a quarter-circle.

(4 marks)

$4 in \rightarrow ft$
$0.33 ft$

(E6)

$320 - 145 =$
$175 ft$
$= radius$
$of outfield$

Infield (gravel) $= \dfrac{\pi r^2 h}{4}$

$= \dfrac{\pi (145)^2 (0.33)}{4}$

$= 5449.29 \, ft^3$

outfield (grass seed) : $\dfrac{\pi r^2}{4} = \dfrac{\pi (175)^2}{4} = 24052.82 \, ft^2$

cost: $\$16/6500 ft^2$ $\dfrac{24052.82}{6500} = 3.70 = 4$ $\$16 \times 4 = \$64$ of grass seed

(E6)

$\$1.50/ft^3$ $5449.29^3 \times 1.50 = \$8173.93$

(E4)

$+ \$64$
$\overline{\$8237.93}$

Exemplar 2 (continued)

b) Thierry obtains a loan from the bank to build the field described in (a). If he makes monthly payments of $400.00, how many months will it take to repay the loan at an interest rate of 6.25%, compounded monthly? Show your work.

(2 marks)

$N = 0$

$I = 6.25$

$PV = 8237.93$

$PMT = -400$

$FV = 0$

$P/y = 12$

$C/y = 12$

END

$N = 21.84$

Take him about 22 months to repay the loan

---

5 marks:
❶ → 1 mark for correct volume of gravel in cubic feet in (a)
❸ → 1 mark for consistent number of bags of grass seed in (a)
❹ → 1 mark for consistent total cost in (a)
❺ → 1 mark for appropriate work in (b)
❻ → 1 mark for consistent number of months in (b)

....

Ⓔ4 → does not use whole units for materials purchased in design and measurement questions
Ⓔ6 → rounds too soon/rounds incorrectly

Exemplar 1

Question 16   Total: 2 marks

Samira's financial planner sent her an annual report of the investments in her portfolio. It stated that her $2000.00 stock investment increased in value by 6.00% while her $3000.00 mutual fund investment decreased in value by 8.00%.

Type of Investment	Principal ($)	Return ($)	Current Value ($)
Stocks	2000.00	6%	3200.00
Mutual Funds	3000.00	−8%	2760.00
Total	5000.00	−2%	5960.00

Calculate the average rate of return of her portfolio. Show your work.

$5960.00 - 5000$

$$\frac{960.00}{5000} = 19.2\%$$

1 mark:
❷ → 1 mark for consistent rate of return

Exemplar 2

Question 16	Total: 2 marks

Samira's financial planner sent her an annual report of the investments in her portfolio. It stated that her $2000.00 stock investment increased in value by 6.00% while her $3000.00 mutual fund investment decreased in value by 8.00%.

Type of Investment	Principal ($)	Return ($)	Current Value ($)
Stocks	2000.00	$120	$2,120.00
Mutual Funds	3000.00	$240	$3,240.00
Total	5000.00	$360	$5,360.00

Calculate the average rate of return of her portfolio. Show your work.

$$\text{Rate of return} = \frac{360}{5000} \times 100 = 7.2\%$$

1 mark:
❷ → 1 mark for consistent rate of return

Question 17	**Total: 2 marks**

Your grandmother has some money that she would like to invest on your behalf. She would like to know whether you prefer a long-term or a short-term investment.

Explain one advantage for each type of investment.

long-term investments are usually low-risk
meaning that you will get your money back, but
the rate of return won't be as high as
short term investments which are risky, but
one advantage would be that you will
get a lot of money back.

0 marks:
→ no criteria met

Exemplar 2

Question 17   **Total: 2 marks**

Your grandmother has some money that she would like to invest on your behalf. She would like to know whether you prefer a long-term or a short-term investment.

Explain one advantage for each type of investment.

- Long-term: Likely higher interest rates, accumulate
             more money over time.

- Short-term: Access to your money sooner.

> **2 marks:**
> ❶ → 1 mark for appropriate long-term investment advantage
> ❷ → 1 mark for appropriate short-term investment advantage

Exemplar 1

Question 18   **Total: 2 marks**

Salwa bought a new computer system for $6000.00. She anticipates the value of the system to depreciate at a rate of 15% per year.

What will the computer system be worth at the end of 3 years? Show your work.

$$
\begin{array}{c|l}
Y & \$ \\
\hline
1 & 6000 \;\}\times 0.85 \\
2 & 5100 \;\}\times 0.85 \quad = \quad \$4335 \\
3 & 4335
\end{array}
$$

1 mark:
❶ → 1 mark for appropriate use of depreciation rate

Exemplar 2

Salwa bought a new computer system for $6000.00. She anticipates the value of the system to depreciate at a rate of 15% per year.

What will the computer system be worth at the end of 3 years? Show your work.

$$N = 3$$

$$I = -15$$

$$PV = 6000$$

$$PMT = 0$$

$$\text{*} \; FV = \overset{\text{E5}}{\cancel{\;}} 3684.75$$

$$P/y = 1$$

$$C/y = 1$$

<div style="border:1px solid;">

2 marks:
❶ → 1 mark for appropriate use of depreciation rate
❷ → 1 mark for consistent value at the end of 3 years

···

Ⓔ⑤ → does not include the dollar sign for monetary values

</div>

Exemplar 1

Diego plans to move to Portage la Prairie. He has two housing options:

Option 1:

- Buy a house with a monthly mortgage payment of $1063.65.
- Property taxes are $3070.00 per year.

Option 2:

- Rent a house for $1250.00 per month.

a) What will be the total cost of Option 1 at the end of 25 years? Show your work.

(2 marks)

1063.65 X 300 = $319095, $395845

3070,00 X 25 = $76750   After 25yrs

b) How many years will it take for the total cost of renting to equal the total cost of buying the house? (E6)

(1 mark)

1250x12 = 15000

15000 X 27 = 405000

15000 X 26 = 390000

So After 26.5 yrs Would Equal as much as he can buy it for

c) Explain why Diego might choose to buy the house.

(1 mark)

B/c At the End of the 25 yrs the house is his to do whatever he wants to it.

> **3 marks:**
> ❶ → 1 mark for appropriate work in (a)
> ❷ → 1 mark for consistent answer in (a)
> ❸ → 1 mark for consistent answer in (b)
> ···
> E6 → rounds incorrectly

Exemplar 2

Question 19	**Total: 4 marks**

Diego plans to move to Portage la Prairie. He has two housing options:

Option 1:

- Buy a house with a monthly mortgage payment of $1063.65.
- Property taxes are $3070.00 per year.

Option 2:

- Rent a house for $1250.00 per month.

a) What will be the total cost of Option 1 at the end of 25 years? Show your work.

(2 marks)

$$25 \times 3070.00 = \$76750$$
$$300 \times 1063.65 = \$319095$$
$$= \$395,845.00$$

b) How many years will it take for the total cost of renting to equal the total cost of buying the house?

(1 mark)

$$395\,845 \div 1250 = 317 \text{ months} \div 12 = 26.41$$
$$27 \text{ years}$$

c) Explain why Diego might choose to buy the house.

(1 mark)

It takes less time

> **3 marks:**
> ❶ → 1 mark for appropriate work in (a)
> ❷ → 1 mark for consistent answer in (a)
> ❸ → 1 mark for consistent answer in (b)

Exemplar 1

Question 20   **Total: 5 marks**

Donald and Alex have a combined gross monthly income of $5500.00. They want to buy a house in a neighbourhood where the average monthly heating cost is $200.00 and monthly property taxes are $325.00.

a) Calculate the maximum monthly mortgage payment they can afford, based on the gross debt service ratio. Show your work.

(2 marks)

$$GDSR = \frac{\text{monthly mortgage pay} + \text{monthly taxes} + \text{monthly heating costs}}{\text{Gross monthly income}}$$

$$\frac{\$1230 + \$325.00 + \$200.00}{\$5500} = 31.91\%$$

need
• 32% or lower   lower than 32 ✓

b) Based on the maximum monthly mortgage payment in (a), their bank has offered them a 25-year mortgage at an interest rate of 3.50%, compounded semi-annually. If they have saved $20 000.00 for a down payment, what would be the maximum house price they can afford? Show your work.

(3 marks)

$N = 25 \cdot 12$

$I\% = 3.50$

$PV = 20,000$

$PMT = -1230$

$FV = \boxed{9343446.93}$ can afford.

$C/Y = 2$

$P/Y = 12$

> **1 mark:**
> ❷ → 1 mark for consistent answer in (a)

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Exemplar 2

Question 20	Total: 5 marks

Donald and Alex have a combined gross monthly income of $5500.00. They want to buy a house in a neighbourhood where the average monthly heating cost is $200.00 and monthly property taxes are $325.00.

a) Calculate the maximum monthly mortgage payment they can afford, based on the gross debt service ratio. Show your work.

(2 marks)

$$\$5500 - \$200 - \$325 = \$4975$$

They can pay up to $4975 a month in mortgage on a house.

b) Based on the maximum monthly mortgage payment in (a), their bank has offered them a 25-year mortgage at an interest rate of 3.50%, compounded semi-annually. If they have saved $20 000.00 for a down payment, what would be the maximum house price they can afford? Show your work.

(3 marks)

Apps : 1 : Finance : 1 : TVM Solver

N - 25×12
I - 3.5   Alpha : Solve
PV - 0 → 996454.16
PMT - -4975
FV - 0
P/Y - 12
C/Y - 2

The maximum house price they can afford would be $996454.16.

2 marks:
❸ → 1 mark for appropriate work in (b)
❹ → 1 mark for consistent maximum mortgage in (b)

Exemplar 1

Question 22	Total: 1 mark

You are given the following four inequality statements.
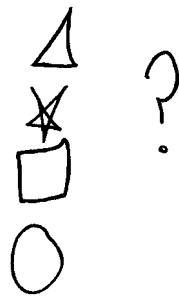
I. ☆ < △

II. ○ ≠ ☆

III. ☆ > ▢

IV. ○ < ▢

Draw the four symbols in order from smallest value to largest value.

0 marks:
→ no criteria met

Exemplar 2

Question 22	**Total: 1 mark**

You are given the following four inequality statements.

I.   ☆ < △

II.   ○ ≠ ☆

III.   ☆ > □

IV.   ○ < □

Draw the four symbols in order from smallest value to largest value.

△ , ☆ , □ , ○

> **0 marks:**
> → no criteria met

Exemplar 1

Question 23	Total: 4 marks

A technology survey of 50 students found that:

- 30 students use Instagram
- 25 students use Snapchat
- 15 students use Facebook
- 8 students use only Instagram and Snapchat
- 3 students use only Facebook and Instagram
- 4 students use only Facebook and Snapchat
- 6 students use all three apps

a) Draw a Venn diagram to represent this situation.

(3 marks)

I 30   S 25

13   8   7

3 6 4

2

(E2)

F 15

b) How many students use Snapchat or Instagram?

(1 mark)

13 + 8 + 6 + 7

34 student

2 marks:
❶ → 1 mark for correctly placing the number of students using 2 or more apps in (a)
❷ → 1 mark for consistent number of students using exactly 1 app in (a)
(E2) → does not include a box when using a Venn diagram

Exemplar 2

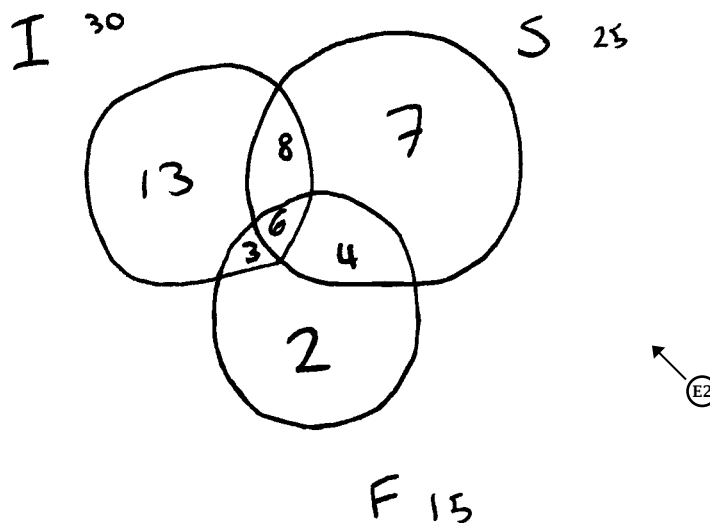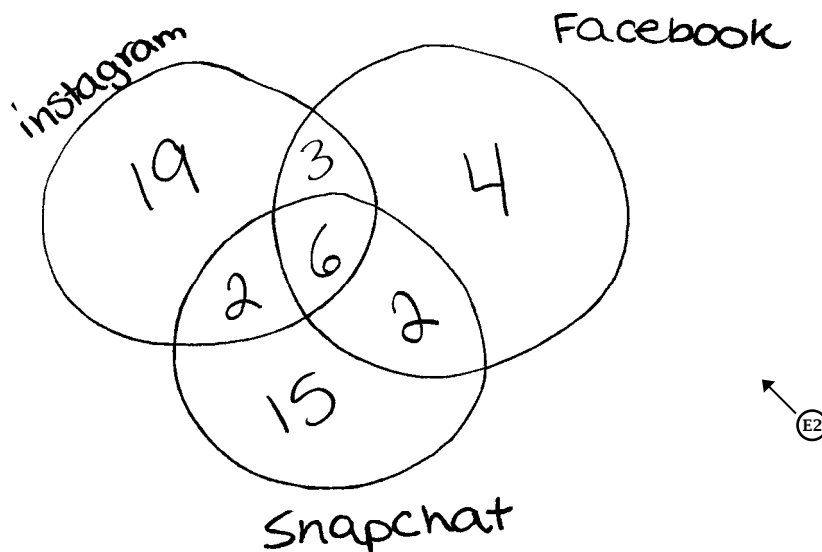**Question 23**   **Total: 4 marks**

A technology survey of 50 students found that:

- 30 students use Instagram
- 25 students use Snapchat
- 15 students use Facebook
- 8 students use only Instagram and Snapchat
- 3 students use only Facebook and Instagram
- 4 students use only Facebook and Snapchat
- 6 students use all three apps

a)   Draw a Venn diagram to represent this situation.

(3 marks)

b)   How many students use Snapchat or Instagram?

(1 mark)

47

2 marks:
❷ → 1 mark for consistent number of students using exactly 1 app in (a)
❹ → 1 mark for consistent answer in (b)
⒠ → does not include a box when using a Venn diagram

Appendices

Appendix A:
Table of Questions by Unit and Learning Outcome

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

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 (all "NR") 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: _____