Grade 12
Applied Mathematics
Achievement Test

Marking Guide

January 2015

Manitoba

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After the administration of this test, print copies of this resource will be available for purchase from the Manitoba Text Book Bureau. Order online at <www.mtbb.mb.ca>.

This resource will also be available on the Manitoba Education and Advanced Learning website at <www.edu.gov.mb.ca/k12/assess/archives/index.html>.

Websites are subject to change without notice.

Disponible en français.

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

Do not make any marks in the student booklets. Booklets may be selected by Manitoba Education and Advanced Learning for sample marking.

Once marking is completed, please forward the *Scoring Sheets* to Manitoba Education and Advanced Learning 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. Depending on the student's learning style, the explanation or justification can be given through a labelled diagram, in words, by showing mathematical operations for answer verification, or by referring to a software or calculator program. 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).

(E1) 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

(E2) 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

(E3) Transcription/Transposition

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

(E4) Final Answer

- does not express monetary values to two decimal places
- does not include a percent sign
- does not identify the answer (e.g., TVM solver, Venn diagram)
- does not use a contextual variable when stating the domain or the range in set notation
- incorrectly states the final answer

(E5) Rounding

- rounds incorrectly
- rounds too soon
- does not express the answer to the appropriate number of decimal places

(E6) 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)

The total mark deduction for communication errors for any student response is not to exceed the marks awarded for that response. For example, a student awarded one mark on a question is limited to two communication error deductions for that question.

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 E4 errors (0.5 mark deduction).

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

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

$$46 - \left(2 \times 0.5\right) = 45$$

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 Advanced Learning 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–83 Plus graphing calculator.

RELATIONS AND FUNCTIONS

Question 1 — Total: 1 mark

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

Select the best answer.

If the end behaviour of the graph of a function extends from Quadrant III to Quadrant I, then the function is a

A. constant

B. quadratic

C. **cubic**

D. sinusoidal

Question 2 — Total: 1 mark

Learning Outcomes: 12A.R.1, 12A.R.2 — **Question Type: Selected Response**

Select the best answer.

Which of the following statements is false?

A. A linear function has only one y-intercept.

B. **A quadratic function must have two x-intercepts.**

C. An exponential function has exactly one asymptote.

D. A logarithmic function has a range that extends from negative infinity to positive infinity.

Question 3 — Total: 5 marks

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

Joshua builds canoes. He has discovered that he can sell 120 canoes per year if the price is $450.00 per canoe. For every $100.00 increase in price, he sells 20 fewer canoes per year.

a) Complete the table below.

(1 mark)

Canoes	Selling Price ($)	Revenue from Canoe Sales ($)
120	450.00	54 000.00
100	550.00	55 000.00
80	650.00	52 000.00
60	750.00	45 000.00
40	850.00	34 000.00

b) Using the information in (a), determine the quadratic regression equation that models the relationship between the selling price and the revenue from canoe sales.

(1 mark)

$$y = -0.2x^2 + 210x$$

c) According to your equation in (b), what is Joshua's maximum revenue?

(1 mark)

$(525, 55\ 125)$

Joshua's maximum revenue is $55 125.00.

d) According to your equation in (b), what is the highest selling price Joshua can charge for a canoe that results in an annual revenue of $30 000.00? Show your work.

(2 marks)

2nd TRACE 5: Intersect $(879.44, 30\ 000)$

Joshua can charge up to $879.44 per canoe.

Marker Note(s):

→ *Regression equations may vary depending on software used.*

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

Question 4 — Total: 4 marks

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

Tania has invested $10 000.00 in a savings account. The approximate growth of her investment is modelled by the equation:

$$t = -288.007\ 35 + 31.27 \ln A$$

where A represents the future value of the investment (in dollars) and t represents the time (in years).

a) State the domain and the range in this situation.

(2 marks)

Domain: $[10\ 000, \infty)$

OR

$\{A \mid A \geq 10\ 000\}$

OR

(Future value) A is greater or equal to 10 000.

Range: $[0, \infty)$

OR

$\{t \mid t \geq 0\}$

OR

(Time in years) t is greater or equal to zero.

b) How long will it take Tania's investment to triple?

(1 mark)

$t = -288.007\ 35 + 31.27 \ln (30\ 000) = 34.35$ years

Her investment would take 34.35 years to triple.

c) How much will her investment be worth after 10 years?

(1 mark)

Represent graphically: $t = -288.007\ 35 + 31.27 \ln A$

$t = 10$

2nd TRACE 5: Intersect (13 768.46, 10)

Her investment would be worth $13 768.46 after 10 years.

Marker Note(s):
→ *Award mark ❸ if answer is given as 35 years in (b).*

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

Question 5 — Total: 4 marks

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

A car is driving down the street and a pebble gets caught in one of its tire treads.

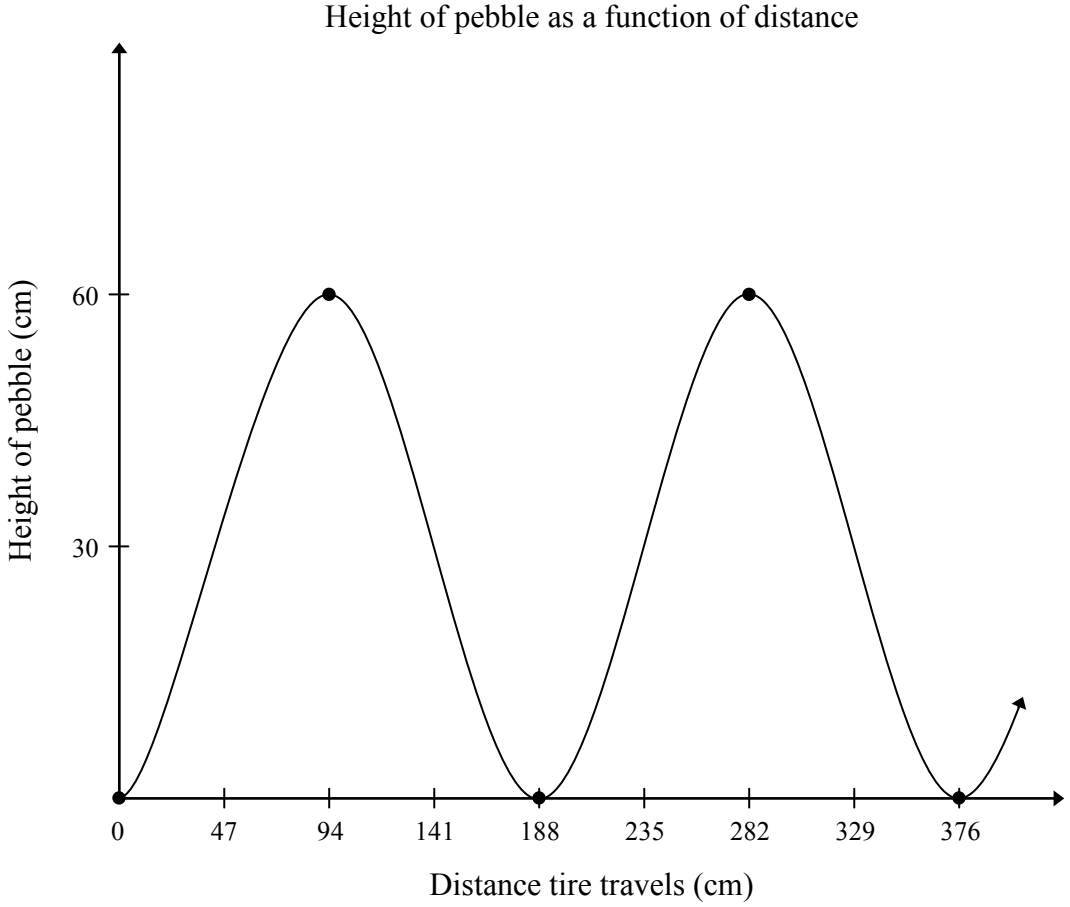
The tire rotates and the height of the pebble varies sinusoidally with the horizontal distance. This situation is modelled by the equation:

$$h = 30 \sin\left(0.0334d - 1.57\right) + 30$$

where d represents the distance the tire travels (in centimetres) and h represents the height of the pebble (in centimetres).

a) Create a clearly labelled graph of the equation for two revolutions of the tire starting from the time the pebble is caught in the tire tread.

(3 marks)



Question 5 continued

b) Determine the circumference of the tire.

(1 mark)

$$C = \frac{2\pi}{b}$$
$$= 188.12 \text{ cm}$$

The circumference of the tire is 188.12 cm.

OR

$$C = 2\pi(30)$$
$$= 60\pi$$
$$= 188.50 \text{ cm}$$

The circumference of the tire is 188.50 cm.

OR

2nd TRACE 3: Minimum

$C = 188.10$ cm

The circumference of the tire is 188.10 cm.

Marker Note(s):

→ *A deduction of* (E2) *in (a) may only be applied if mark* ❶ *has been awarded.*

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 an appropriate shape that illustrates key characteristics of the function (e.g., maximum, minimum, asymptotes, intercepts) in (a)*
❹	*1 mark for correct circumference in (b)*

PROBABILITY

Question 6 — Total: 1 mark

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

Select the best answer.

A card is drawn from a set of cards numbered from 1 to 10. Which situation below shows an event and its complement?

A. Drawing a 3 and drawing a 6.

B. Drawing an even number and drawing a 2.

C. **Drawing an odd number and drawing an even number.**

D. Drawing an odd number and drawing a 6.

Question 7 — Total: 1 mark

Learning Outcome: 12A.P.1 — **Question Type: Selected Response**

Select the best answer.

Ashton has some coins in his pocket. He reaches into his pocket and pulls out a coin at random. If the odds in favour of the chosen coin being a quarter are $4:7$, what is the probability of the coin not being a quarter?

A. $\frac{7}{4}$

B. $\frac{3}{7}$

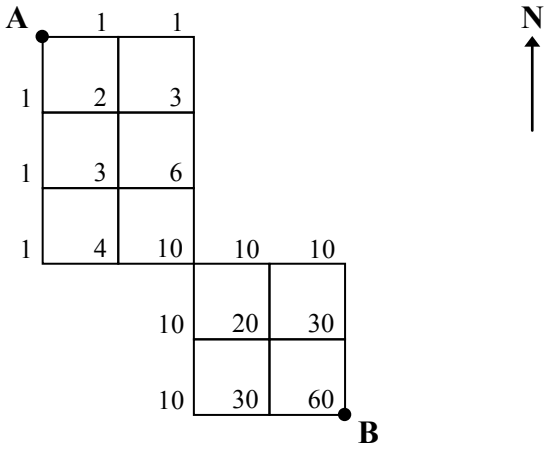
C. $\frac{4}{11}$

D. $\mathbf{\frac{7}{11}}$

Question 8 — Total: 2 marks

Learning Outcome: 12A.P.5 — **Question Type: Constructed Response**

How many different routes are there from point A to point B, if you only go east and south? Show your work.



There are 60 different routes.

OR

Permutations of the letters representing directions EESSS then EESS:

$$\frac{5!}{3!2!} \times \frac{4!}{2!2!} = 60$$

There are 60 different routes.

Marker Note(s):
→ *Allow one addition error without any mark deduction.*

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

Question 9 — Total: 1 mark

Learning Outcome: 12A.P.5 — **Question Type: Constructed Response**

Evaluate:

$$\frac{\mathbf{100!}}{\mathbf{98!}}$$

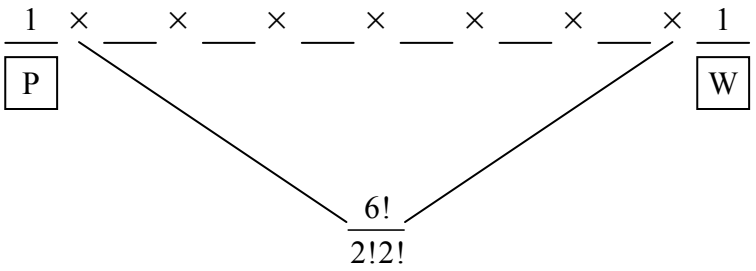
$$\frac{100 \times 99 \times \cancel{98!}}{\cancel{98!}} = 100 \times 99 = 9900$$

Marking Key	
❶	*1 mark for correct answer*

Question 10 — Total: 2 marks

Learning Outcome: 12A.P.5 — **Question Type: Constructed Response**

How many different arrangements can be made using all the letters of the word "WINNIPEG", if the first letter must be P and the last letter W? Show your work.



$$\frac{6!}{2!2!} = \frac{720}{4} = 180$$

There are 180 different arrangements.

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

Question 11 — Total: 2 marks

Learning Outcome: 12A.P.6 — **Question Type: Constructed Response**

The social justice committee at a high school is made up of 8 boys and 7 girls. From the committee, 4 students will be randomly chosen to attend a conference. What is the probability that all 4 students will be girls? Show your work.

$$P = \frac{{}_8C_0 \times {}_7C_4}{{}_{15}C_4} = \frac{35}{1365} \text{ or } 0.03 \text{ or } 2.56\%$$

The probability is 0.03 or 2.56%.

Marking Key	
❶	*1 mark for correct number of possible ways to choose all girls*
❷	*1 mark for consistent answer*

Question 12 — Total: 3 marks

Learning Outcomes: 12A.P.3, 12A.P.6 — **Question Type: Constructed Response**

A hockey team has practice jerseys in three colours. The team bag has 5 black, 4 white, and 6 red jerseys. The coach reaches into the bag and randomly selects a jersey for Peter and a jersey for Paul. What is the probability that both jerseys are the same colour? Show your work.

$$P = \left(\frac{5}{15}\right)\left(\frac{4}{14}\right) + \left(\frac{4}{15}\right)\left(\frac{3}{14}\right) + \left(\frac{6}{15}\right)\left(\frac{5}{14}\right)$$

black white red

$$P = \frac{20}{210} + \frac{12}{210} + \frac{30}{210}$$

$$P = \frac{62}{210} \text{ or } \frac{31}{105} \text{ or } 0.30 \text{ or } 29.52\%$$

The probability is 0.30 or 29.52%.

OR

$$P = \frac{{}_5C_2 + {}_4C_2 + {}_6C_2}{{}_{15}C_2} = \frac{31}{105} \text{ or } 0.30 \text{ or } 29.52\%$$

The probability is 0.30 or 29.52%.

Marking Key	
❶	*1 mark for considering 3 cases*
❷	*1 mark for correctly considering dependency*
❸	*1 mark for consistent answer*

Question 13 — Total: 3 marks

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

Cindy has an MP3 player that can play songs in a random order.

a) How many different ways can a 12-song playlist be arranged, if each song is played only once?

(1 mark)

$$12! = 479\ 001\ 600$$

There are 479 001 600 different ways.

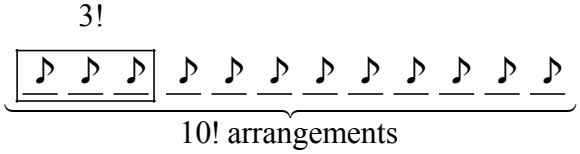
OR

$${}_{12}P_{12} = 479\ 001\ 600$$

There are 479 001 600 different ways.

b) What is the probability that Cindy's 3 favourite songs will be played together when she plays the 12-song playlist? Show your work.

(2 marks)



$$\frac{3! \times 10!}{12!} = \frac{21\ 772\ 800}{479\ 001\ 600} \text{ or } \frac{1}{22} \text{ or } 0.05 \text{ or } 4.55\%$$

The probability is 0.05 or 4.55%.

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)*

FINANCIAL MATHEMATICS

Question 14 — Total: 1 mark

Learning Outcome: 12A.FM.1 — **Question Type: Selected Response**

Select the best answer.

Kayla has an investment of $2000.00 at 3.00% simple interest for 4 years. Which of the following statements is false?

A. The interest earned doubles if the time period doubles.

B. The interest earned halves if the interest rate halves.

C. **The interest earned doubles if the interest rate doubles and the time period doubles.**

D. The interest earned remains the same if the investment halves and the interest rate doubles.

Question 15 — Total: 3 marks

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

Mr. and Mrs. Belair want to purchase a house.

Mr. Belair is a biologist and his annual salary is $81 000.00. Mrs. Belair is a pharmacist and her annual salary is $85 250.00.

The monthly mortgage payment for the house they want to purchase is $2750.00, annual property taxes are $3600.00, and the monthly heating costs are $240.00.

a) Find the gross debt service ratio (GDSR) for the Belairs.

(2 marks)

$$\text{Gross monthly income} = \frac{\$81\,000.00 + \$85\,250.00}{12}$$
$$= \$13\,854.17$$

$$\text{GDSR} = \frac{\$2750.00 + \$300.00 + \$240.00}{\$13\,854.17} \times 100$$
$$= 23.75\%$$

b) Using your answer in (a), explain if they can afford to buy the house.

(1 mark)

The Belairs can afford to buy the house since their GDSR is under 32%.

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

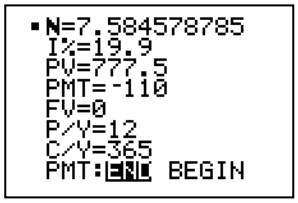
Question 16 — Total: 3 marks

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

Sara used her credit card to pay for a group hot air balloon ride. The cost was $997.50, taxes included. Her credit card has a promotional offer of 0% interest for 2 months. After this period, the annual interest rate is 19.90% on any outstanding balance, compounded daily.

Sara decides to make payments of $110.00 at the end of every month, even during the promotional period. How long will it take Sara to pay off the balance? Show your work.

$$\begin{aligned} \text{Amount borrowed} &= \$997.50 \\ \text{Amount paid in 2 months} &= \$220.00 \\ \text{Balance} &= \$997.50 - \$220.00 \\ &= \$777.50 \end{aligned}$$



$7.58 + 2 = 9.58$

It will take Sara 10 months to pay off the balance.

Marker Note(s):
→ *Accept 9.58, 9.59, or 10 months as correct answers.*

Marking Key	
❶	*1 mark for correct outstanding balance after promotional period*
❷	*1 mark for appropriate work*
❸	*1 mark for consistent answer*

Question 17 — Total: 4 marks

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

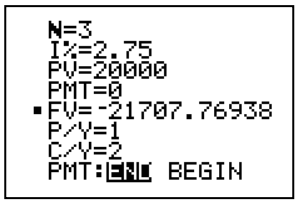
Sheena receives $20 000.00 from an insurance settlement. She wants to invest her money for three years in either a guaranteed investment certificate (GIC) or in real estate.

Option 1: The GIC has an annual interest rate of 2.75%, compounded semi-annually.

Option 2: The real estate investment generates annual returns of 5.90%, compounded annually.

a) Determine the value of the GIC after 3 years. Show your work.

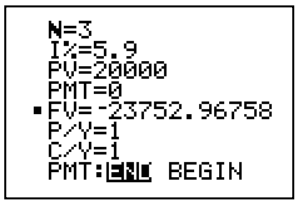
(2 marks)



The value of Option 1 is $21 707.77.

b) Determine the value of the real estate investment after 3 years.

(1 mark)



The value of Option 2 is $23 752.97.

c) Which would be the better investment for Sheena? Justify your answer.

(1 mark)

Option 1 would be the better option because it has a lower risk.

OR

Option 2 would be the better option because it will be worth more after 3 years.

Other answers are possible.

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

Question 18 — Total: 4 marks

Learning Outcomes: 12A.FM.1, 12A.FM.3 — **Question Type: Constructed Response**

At the age of 18, Justine invests $1000.00 at an interest rate of 7.20%, compounded annually.

a) Using the Rule of 72, estimate how old Justine will be when her investment equals $8000.00. Show your work.

(2 marks)

$$\frac{72}{7.2} = 10 \text{ years}$$

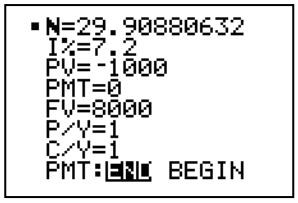
According to the Rule of 72, it takes 10 years to double her investment.

Age	Value
18	$1000.00
28	$2000.00
38	$4000.00
48	$8000.00

Therefore, Justine would be 48 years old.

b) Using a technology tool, determine the number of years it will take to reach $8000.00. Show your work and indicate your answer to two decimal places.

(2 marks)



It will take 29.91 years.

Marking Key	
❶	*1 mark for correct calculation of years needed to double her investment in (a)*
❷	*1 mark for consistent answer in (a)*
❸	*1 mark for appropriate work in (b)*
❹	*1 mark for consistent answer in (b)*

Question 19 — Total: 2 marks

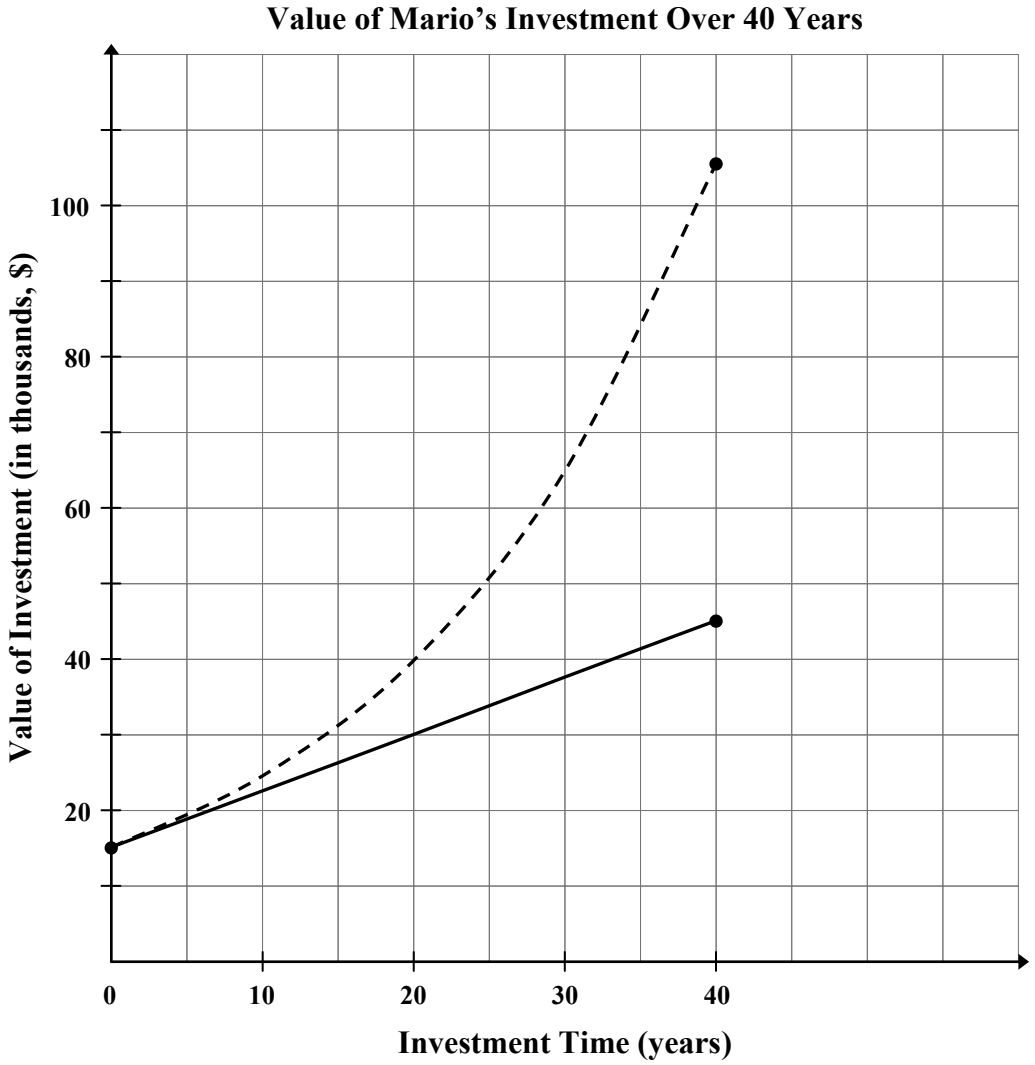
Learning Outcome: 12A.FM.3 — **Question Type: Constructed Response**

Use the information below to answer the questions on the next page.

Mario has decided to make an investment for a period of 40 years. He has two options:

Option 1: a fund that earns simple interest at 5.00% annually

Option 2: a savings account that earns 5.00% interest, compounded annually



Question 19 continued

a) Given the graphs of Option 1 and Option 2, estimate the value of the initial investment for each option.

(1 mark)

The initial investment is approximately $15 000.00 for each option.

b) Which graph represents Option 1? Explain your answer.

(1 mark)

Option 1 is the solid line because
simple interest increases at a constant rate rather than exponentially.

OR

Option 1 is the solid line because it earns less money over time.

Other answers are possible.

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

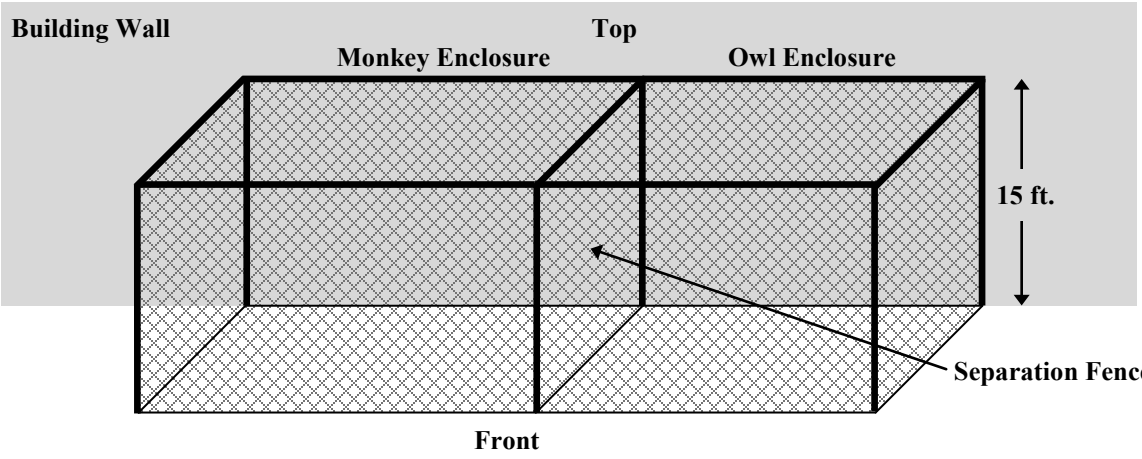
DESIGN AND MEASUREMENT

Question 20 — Total: 5 marks

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

The zoo has asked you to design a structure for its monkeys and owls using the following guidelines:

- **The structure will back against the wall of a building and will be fenced at the top, front, and sides. (No fence is needed on the ground or at the back.)**
- **The structure will be divided into two enclosures by a separation fence and have a height of 15 ft.**
- **The monkeys require an enclosure with a ground area between 600 ft^2 and 1000 ft^2.**
- **The owls require an enclosure with a ground area between 400 ft^2 and 800 ft^2.**
- **The entire structure will be created using chain-linked fence, which is sold in 50 ft. × 5 ft. (250 ft^2) segments. Each segment costs $160.00, plus GST and PST.**



a) Determine a possible set of dimensions for your design.

(1 mark)

Answer 1

Ground dimensions of monkey enclosure: 20 ft. × 50 ft.

Ground dimensions of owl enclosure: 20 ft. × 40 ft.

OR

Ground dimensions of monkey enclosure: 20 ft. × 30 ft.

Answer 2

Ground dimensions of owl enclosure: 20 ft. × 20 ft.

Other answers are possible.

Question 20 continued

b) Determine the minimum number of fence segments needed for your design. Show your work.

(3 marks)

Answer 1

$$\text{top: } 90 \text{ ft.} \times 4 \text{ widths} = 360 \text{ ft.} \qquad \therefore \frac{360 \text{ ft.}}{50 \text{ ft.}} = 7.2 \text{ segments}$$

$$\text{front: } 90 \text{ ft.} \times 3 \text{ widths} = 270 \text{ ft.} \qquad \therefore \frac{270 \text{ ft.}}{50 \text{ ft.}} = 5.4 \text{ segments}$$

$$\text{sides and separation fence: } (20 \text{ ft.} \times 3) \times 3 \text{ widths} = 180 \text{ ft.} \qquad \therefore \frac{180 \text{ ft.}}{50 \text{ ft.}} = 3.6 \text{ segments}$$

$$\text{Total} = 7.2 + 5.4 + 3.6 = 16.2 \text{ segments} \Rightarrow 17 \text{ segments}$$

OR

Answer 2

$$\text{area of top: } 20 \text{ ft.} \times 50 \text{ ft.} = 1000 \text{ ft}^2$$

$$\text{area of front: } 50 \text{ ft.} \times 15 \text{ ft.} = 750 \text{ ft}^2$$

$$\text{area of sides and separation fence: } 20 \text{ ft.} \times 15 \text{ ft.} = 300 \text{ ft}^2 \times 3 \text{ sides} = 900 \text{ ft}^2$$

$$\text{Total} = \frac{1000 \text{ ft}^2 + 750 \text{ ft}^2 + 900 \text{ ft}^2}{250 \text{ ft}^2} = 10.6 \text{ segments} \Rightarrow 11 \text{ segments}$$

Other answers are possible.

c) Calculate the total cost of the structure. (Note: GST = 5%, PST = 8%)

(1 mark)

Answer 1

$$17 \text{ segments} \times \$160.00/\text{segment} = \$2720.00$$

$$\text{GST} = \$2720.00 \times 0.05 = \$136.00$$

$$\text{PST} = \$2720.00 \times 0.08 = \$217.60$$

$$\text{Total} = \$2720.00 + \$136.00 + \$217.60$$

$$= \$3073.60$$

OR

Answer 2

$$11 \text{ segments} \times \$160.00/\text{segment} = \$1760.00$$

$$\text{GST} = \$1760.00 \times 0.05 = \$88.00$$

$$\text{PST} = \$1760.00 \times 0.08 = \$140.80$$

$$\text{Total} = \$1760.00 + \$88.00 + \$140.80$$

$$= \$1988.80$$

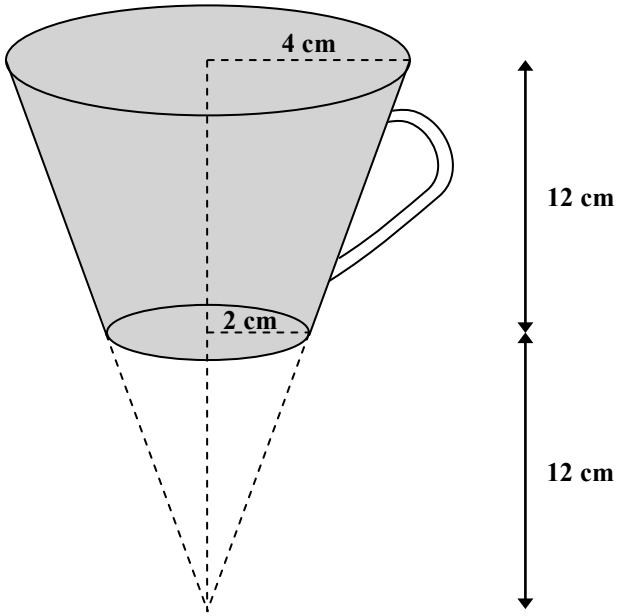
Other answers are possible.

Marking Key	
❶	*1 mark for appropriate dimensions for both enclosures in (a)*
❷	*1 mark for including top, front, sides, and separation fence in calculations in (b)*
❸	*1 mark for appropriate work in (b)*
❹	*1 mark for correct minimum number of total segments in (b)*
❺	*1 mark for correct total cost of the structure in (c)*

Question 21 — Total: 2 marks

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

The coffee mug shaded in the diagram below is based on a cone with the bottom portion removed. (Diagram is not drawn to scale.)



Determine the volume of the mug. Show your work.

Volume of large cone:

$$V = \frac{1}{3}\pi(4\text{ cm})^2(24\text{ cm})$$
$$= 402.124\text{ cm}^3$$

Volume of small cone:

$$V = \frac{1}{3}\pi(2\text{ cm})^2(12\text{ cm})$$
$$= 50.265\text{ cm}^3$$

Volume of mug:

$$V = 402.124\text{ cm}^3 - 50.265\text{ cm}^3$$
$$= 351.86\text{ cm}^3$$

The mug has a volume of 351.86 cm^3.

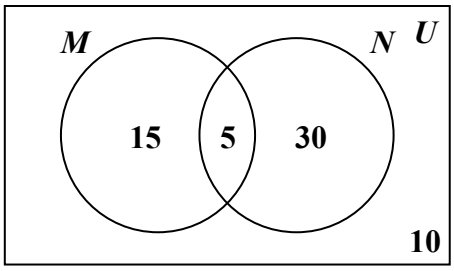
Marking Key	
❶	*1 mark for appropriate work*
❷	*1 mark for consistent answer*

LOGICAL REASONING

Question 22 — Total: 1 mark

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

Use the Venn diagram below to answer the following question and select the best answer.



What is $n(M \cup N)$?

A. 5

B. 10

C. **50**

D. 60

Student Error
A: $n(M \cap N)$
B: $n\left((M \cup N)'\right)$
D: $n(U)$

Question 23 — Total: 1 mark

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

Given the following universal set:

$$U = \{\textbf{Alain, Betty, Candace}\}$$

Write all the subsets of U that have exactly 2 elements.

$\{\text{Alain, Betty}\}, \{\text{Alain, Candace}\}, \{\text{Betty, Candace}\}$

Marking Key	
❶	*1 mark for correct answer*

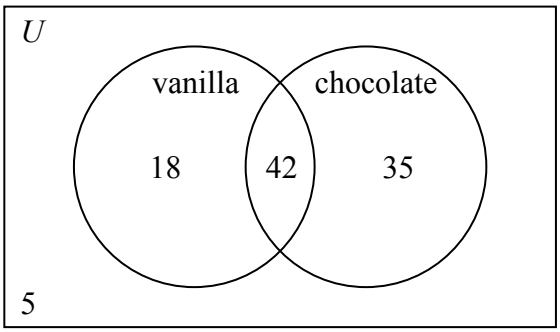
Question 24 — Total: 2 marks

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

A survey of 100 students was conducted to find the most popular ice cream flavour. The findings are displayed below.

- **60 students like vanilla**
- **77 students like chocolate**
- **42 students like both vanilla and chocolate**

Use a Venn diagram to represent this situation.



Marking Key	
❶	*1 mark for correctly calculating and placing the number of students who like only chocolate and like only vanilla (18 and 35)*
❷	*1 mark for correctly calculating and placing the number of students who like neither chocolate nor vanilla (5)*

Question 25 — Total: 2 marks

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

Consider the original statement:

"If a polygon is a triangle, then this polygon has exactly three sides."

a) Write the converse of the statement.

(1 mark)

"If a polygon has exactly three sides, then this polygon is a triangle."

b) Determine if a biconditional statement can be made using the original statement. If it is possible, write the biconditional statement. If not, provide a counterexample.

(1 mark)

"A polygon is a triangle if and only if it has exactly three sides."

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

Exemplars

Exemplar 1

Question 3 — Total: 5 marks

Joshua builds canoes. He has discovered that he can sell 120 canoes per year if the price is $450.00 per canoe. For every $100.00 increase in price, he sells 20 fewer canoes per year.

a) Complete the table below.

(1 mark)

Canoes	Selling Price ($)	Revenue from Canoe Sales ($)
120	$450.00	$54,000
100	$550.00	$55,000
80	$650.00	$52,000
60	$750.00	$45,000
40	$850.00	$34,000

b) Using the information in (a), determine the quadratic regression equation that models the relationship between the selling price and the revenue from canoe sales.

(1 mark)

$y = -0.2x^2 + 209.99x + 1.03$

c) According to your equation in (b), what is Joshua's maximum revenue?

(1 mark)

Joshuas maximum revenue is $55,000.

d) According to your equation in (b), what is the highest selling price Joshua can charge for a canoe that results in an annual revenue of $30 000.00? Show your work.

(2 marks)

the highest selling price would be $879.38

3 marks:
❶ → 1 mark for appropriate work in (a)
❷ → 1 mark for correct equation in (b)
❺ → 1 mark for consistent answer in (d)

Exemplar 2

Question 3 — Total: 5 marks

Joshua builds canoes. He has discovered that he can sell 120 canoes per year if the price is $450.00 per canoe. For every $100.00 increase in price, he sells 20 fewer canoes per year.

a) Complete the table below.

(1 mark)

Canoes	Selling Price ($)	Revenue from Canoe Sales ($)
120	450	54,000
100	550	55,000
80	650	52,000
60	750	45,000
40	850	34,000

b) Using the information in (a), determine the quadratic regression equation that models the relationship between the selling price and the revenue from canoe sales.

(1 mark)

$33 \times 10^{-5} x^3 + 0.0012 x^2 + 96.6433 x + 36527.2976$

c) According to your equation in (b), what is Joshua's maximum revenue?

(1 mark)

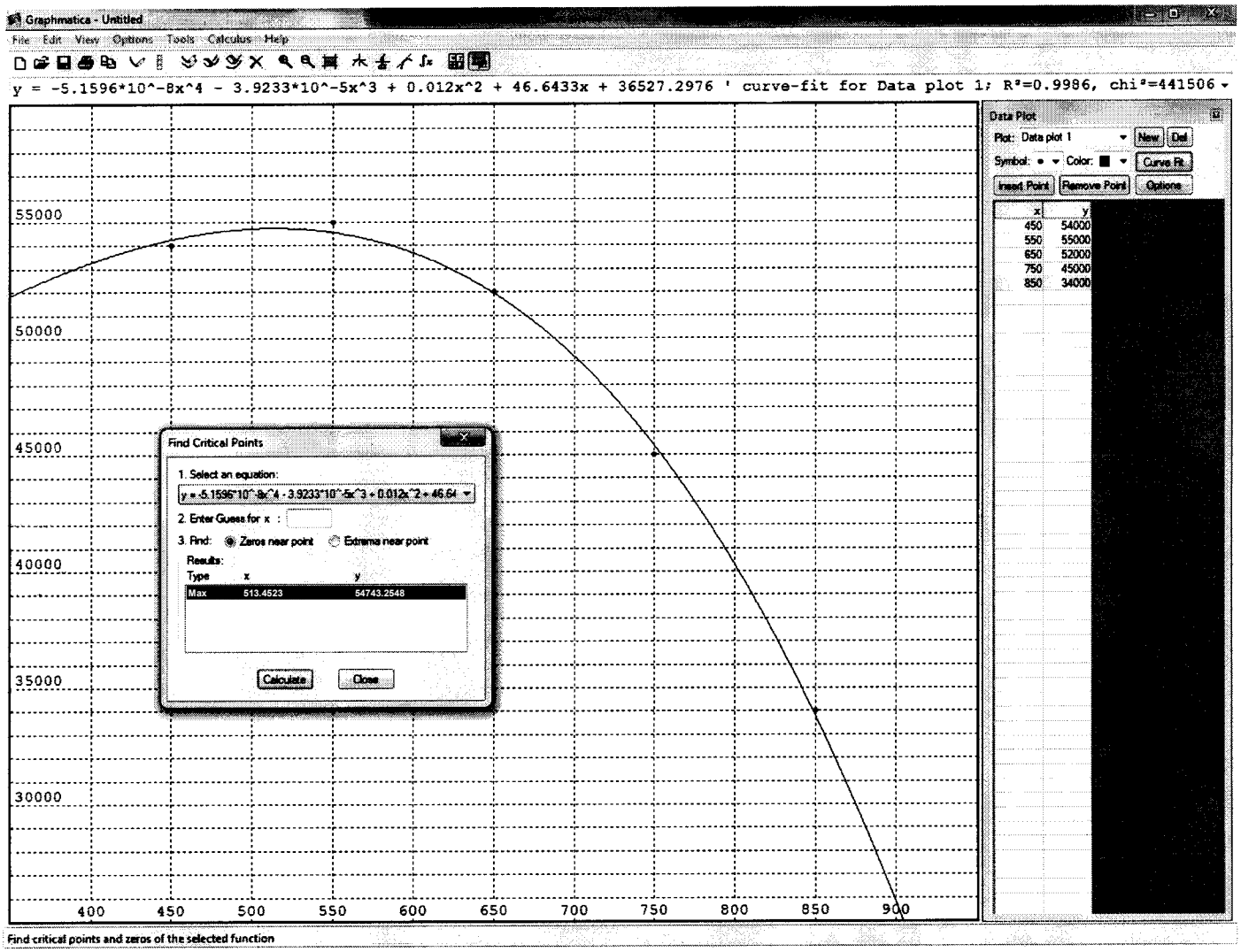
$59,743.25 / year

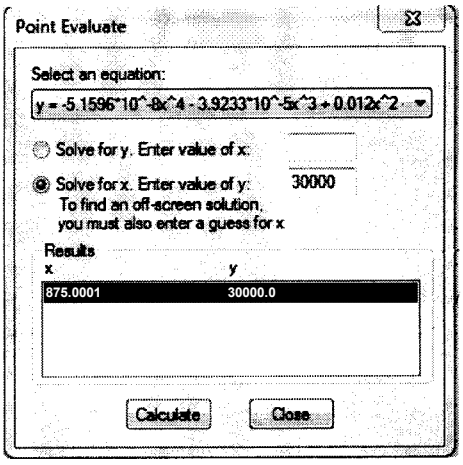
d) According to your equation in (b), what is the highest selling price Joshua can charge for a canoe that results in an annual revenue of $30 000.00? Show your work.

(2 marks)

$475

Exemplar 2 (continued)





4 marks:

❶ → 1 mark for appropriate work in (a)
❸ → 1 mark for correct maximum revenue in (c)
❹ → 1 mark for appropriate work in (d)
❺ → 1 mark for consistent answer in (d)

Exemplar 1

Question 4 **Total: 4 marks**

Tania has invested $10 000.00 in a savings account. The approximate growth of her investment is modelled by the equation:

$$t = -288.007\ 35 + 31.27 \ln A$$

where A represents the future value of the investment (in dollars)
and t represents the time (in years).

a) State the domain and the range in this situation.

(2 marks)

Domain: $x \in \mathbb{R}$

Range: $0 < y \leq 0$

b) How long will it take Tania's investment to triple?

(1 mark)

It will take 34.3536 years for her investment to triple.

c) How much will her investment be worth after 10 years?

(1 mark)

her investment after 10 years will be worth $13,768.462 (E4)

2 marks: ❸ → 1 mark for correct answer in (b) ❹ → 1 mark for correct answer in (c)
(E4) → does not express monetary values to two decimal places

Exemplar 2

Question 4 — Total: 4 marks

Tania has invested $10 000.00 in a savings account. The approximate growth of her investment is modelled by the equation:

$$t = -288.007\,35 + 31.27 \ln A$$

where A represents the future value of the investment (in dollars)
and t represents the time (in years).

a) State the domain and the range in this situation.

(2 marks)

Domain: $\{x \mid x \in \mathbb{R}\}$

Range: $\{y \mid y > 0, y \in \mathbb{R}\}$

b) How long will it take Tania's investment to triple?

(1 mark)

$t = -288.00735 + 31.27 \ln A$
$t = -288.00735 + 31.27 \ln 30\,000$
$t = -288.00735 + 322.360497$
$t = 34.3536$
$t = 34$ years

E5

c) How much will her investment be worth after 10 years?

(1 mark)

$10 = -288.00735 + 31.27 \ln A$
$+288.00735 \quad +288.00735$
$\frac{298.00735}{31.27} = \frac{31.27 \ln A}{31.27}$
$9.5301 = \ln A$

1 mark:
❸ → 1 mark for correct answer in (b)

E5 → does not express the answer to the appropriate number of decimal places

Exemplar 1

Question 5 — Total: 4 marks

A car is driving down the street and a pebble gets caught in one of its tire treads.

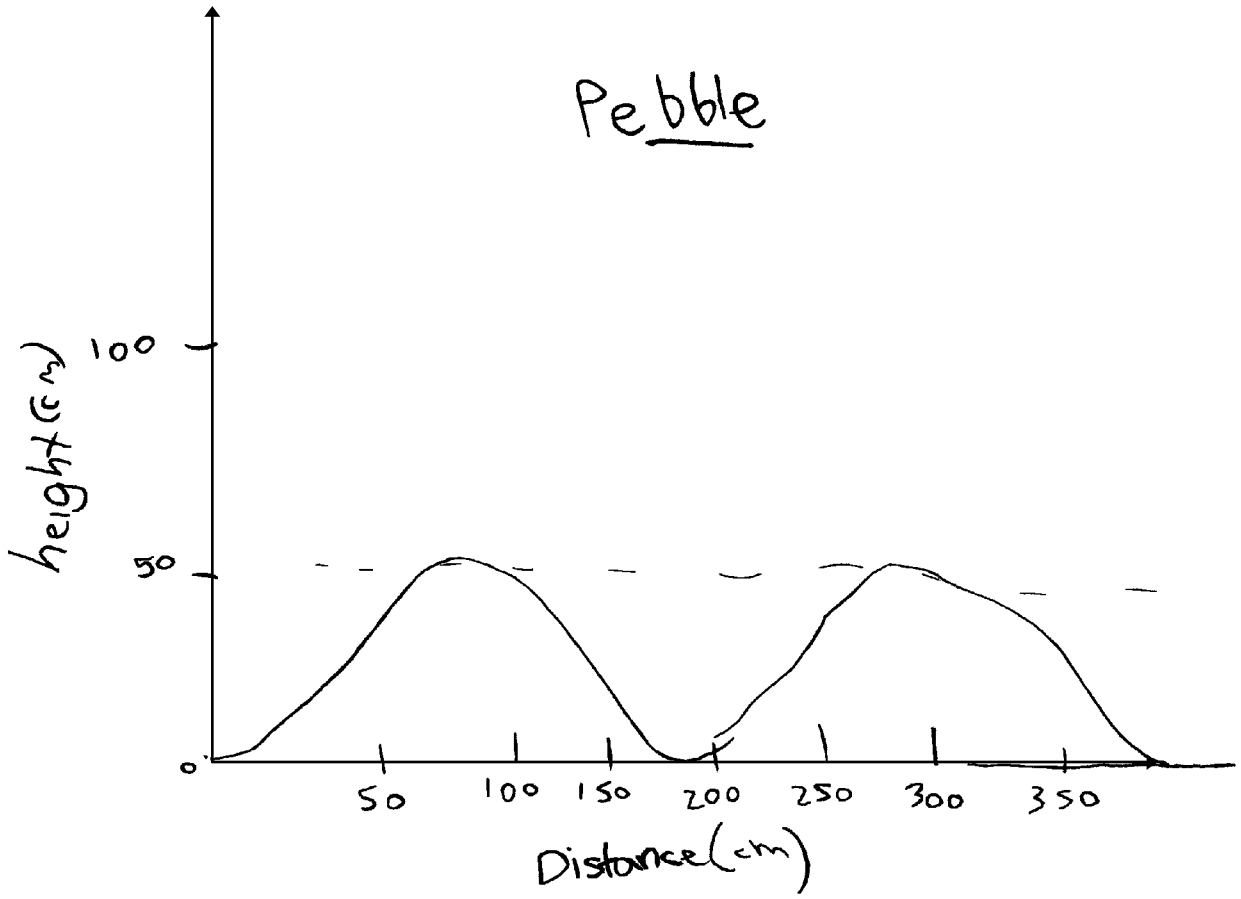
The tire rotates and the height of the pebble varies sinusoidally with the horizontal distance. This situation is modelled by the equation:

$$h = 30 \sin\left(0.0334d - 1.57\right) + 30$$

where d represents the distance the tire travels (in centimetres)
and h represents the height of the pebble (in centimetres).

a) Create a clearly labelled graph of the equation for two revolutions of the tire starting from the time the pebble is caught in the tire tread.

(3 marks)



Exemplar 1 (continued)

b) Determine the circumference of the tire.

(1 mark)

Diameter = 60
radius = 30

πr^2

$\pi 30^2$

$= 2827.433$

2 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)

Exemplar 2

Question 5 — Total: 4 marks

A car is driving down the street and a pebble gets caught in one of its tire treads.

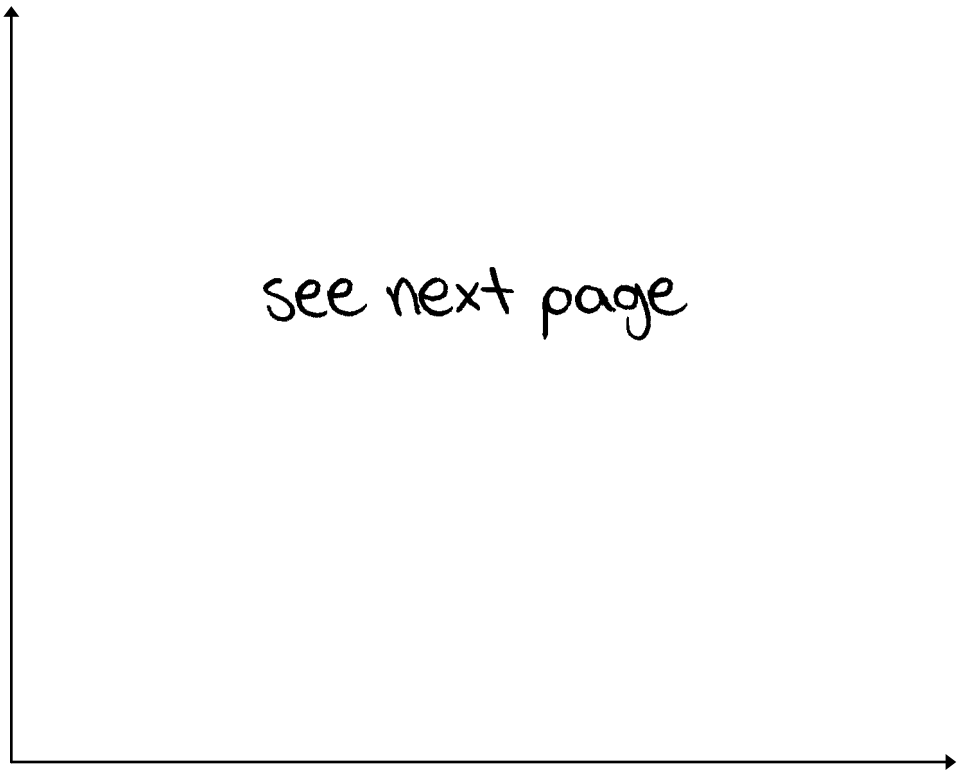
The tire rotates and the height of the pebble varies sinusoidally with the horizontal distance. This situation is modelled by the equation:

$$h = 30 \sin\left(0.0334d - 1.57\right) + 30$$

where d represents the distance the tire travels (in centimetres)
and h represents the height of the pebble (in centimetres).

a) Create a clearly labelled graph of the equation for two revolutions of the tire starting from the time the pebble is caught in the tire tread.

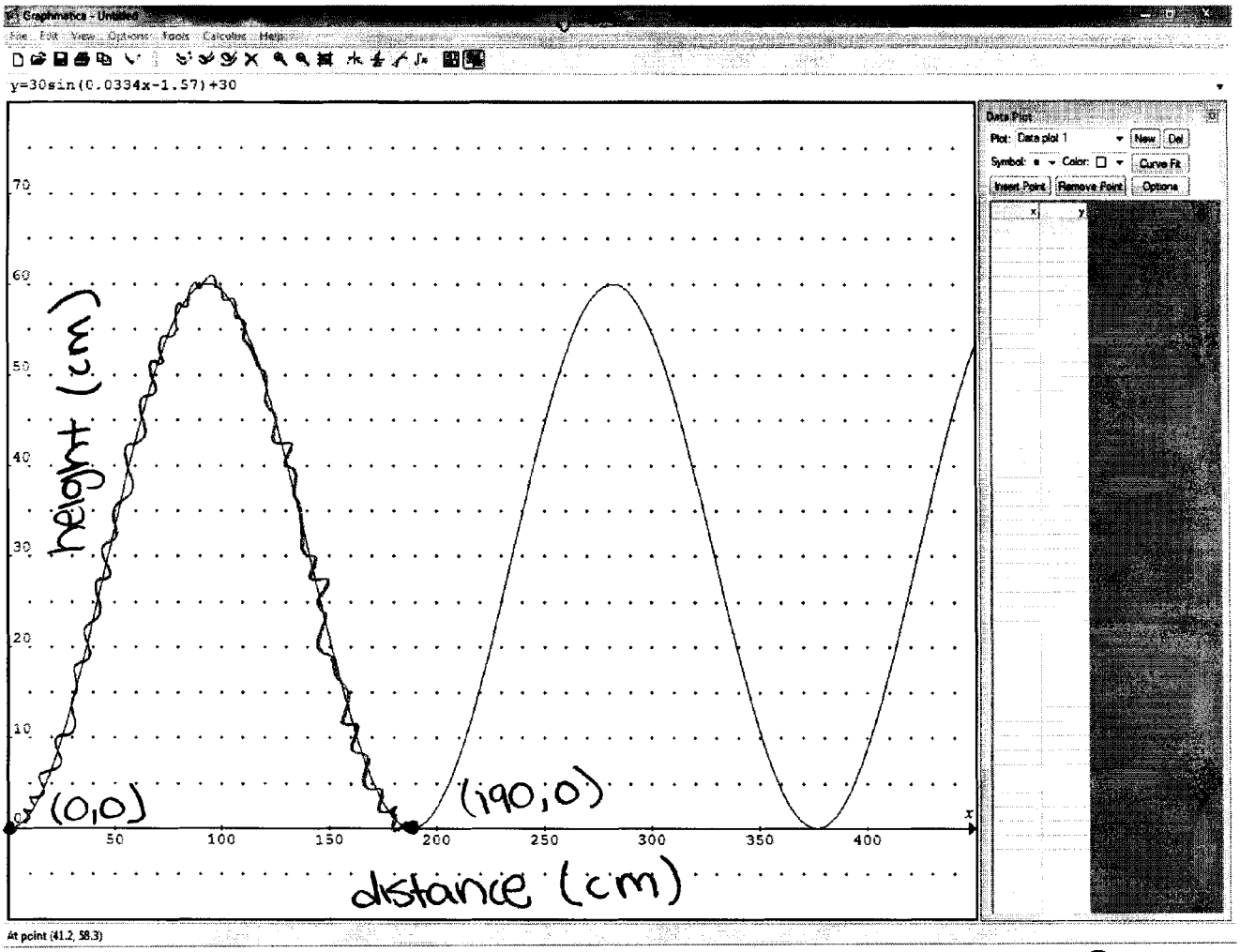
(3 marks)



Exemplar 2 (continued)

b) Determine the circumference of the tire.

(1 mark)



5. a. ↑ b) 190 − 0 = 190 E5

The circumference of the tire is 190cm.

4 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 an appropriate shape that illustrates key characteristics of the function (e.g., maximum, minimum, asymptotes, intercepts) in (a)

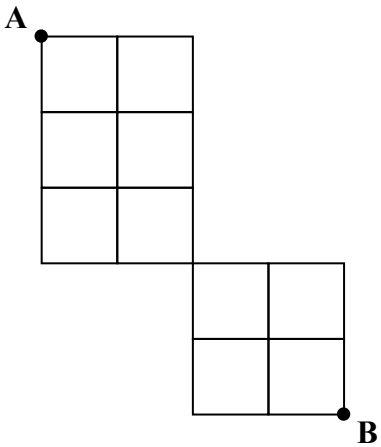
❹ → 1 mark for correct circumference in (b)

E5 → does not express the answer to the appropriate number of decimal places

Exemplar 1

Question 8 — Total: 2 marks

How many different routes are there from point A to point B, if you only go east and south? Show your work.



N

4 East
5 South

$$\frac{9!}{4!\,5!}$$

$$= \frac{362\,880}{(24)(120)}$$

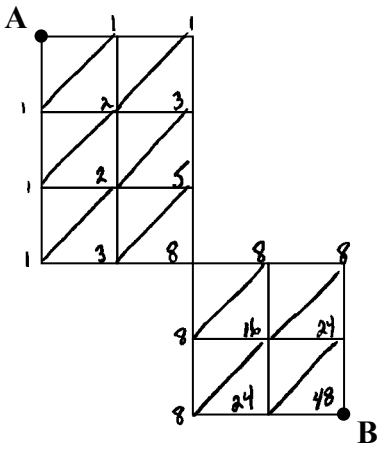
$$= 126 \text{ routes}$$

1 mark:
❷ → 1 mark for consistent answer

Exemplar 2

Question 8 — Total: 2 marks

How many different routes are there from point A to point B, if you only go east and south? Show your work.



48 routes.

2 marks:
❶ → 1 mark for appropriate work
❷ → 1 mark for consistent answer

Exemplar 1

Question 9 — Total: 1 mark

Evaluate:

$$\frac{100!}{98!} = (100!)(99!)$$

0 marks:
→ no criteria met

Exemplar 2

Question 9 **Total: 1 mark**

Evaluate:

$$\frac{100!}{98!}$$

$$\frac{50!}{49!}$$

0 marks:
→ no criteria met

Exemplar 1

Question 10 **Total: 2 marks**

How many different arrangements can be made using all the letters of the word "WINNIPEG", if the first letter must be P and the last letter W? Show your work.

Winnipeg = 8 letters
6 letters remain

P 6 5 4 3 2 1 W

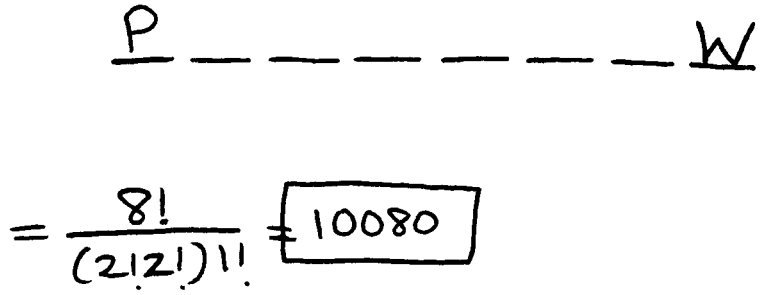
$6 \cdot 5 \cdot 4 \cdot 3 \cdot 2 \cdot 1 = 6! = 720$ arrangements

1 mark:
❷ → 1 mark for consistent answer

Exemplar 2

Question 10 **Total: 2 marks**

How many different arrangements can be made using all the letters of the word "WINNIPEG", if the first letter must be P and the last letter W? Show your work.



1 mark:
❷ → 1 mark for consistent answer

Exemplar 1

Question 11 **Total: 2 marks**

The social justice committee at a high school is made up of 8 boys and 7 girls. From the committee, 4 students will be randomly chosen to attend a conference. What is the probability that all 4 students will be girls? Show your work.

$_nP_r$

$_8P_4 = 1680$

$_7P_4 = 840$

$_{15}P_4 = 32760$

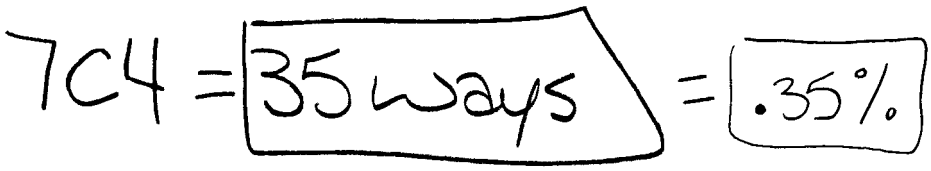
$\text{Prob all 4 girls} = \frac{840}{32760} \times 100 = \underline{\underline{2.56\%}}$

1 mark:
❷ → 1 mark for consistent answer

Exemplar 2

Question 11 **Total: 2 marks**

The social justice committee at a high school is made up of 8 boys and 7 girls. From the committee, 4 students will be randomly chosen to attend a conference. What is the probability that all 4 students will be girls? Show your work.



math -> PRB -> #3

1 mark:

❶ → 1 mark for correct number of possible ways to choose all girls

Exemplar 1

Question 12 **Total: 3 marks**

A hockey team has practice jerseys in three colours. The team bag has 5 black, 4 white, and 6 red jerseys. The coach reaches into the bag and randomly selects a jersey for Peter and a jersey for Paul. What is the probability that both jerseys are the same colour? Show your work.

Case 1: 2 black

$5C_1 \cdot 4C_1 = 20$

Case 2: 2 white

$4C_1 \cdot 3C_1 = 12$

Case 3: 2 red

$6C_1 \cdot 5C_1 = 30$

$62 \div {}_{15}C_2 = .59\,047\,619\,05$

There is a 59.05 percent chance they will get the same colour.

2 marks:
❶ → 1 mark for considering 3 cases
❷ → 1 mark for correctly considering dependency

Exemplar 2

Question 12 **Total: 3 marks**

A hockey team has practice jerseys in three colours. The team bag has 5 black, 4 white, and 6 red jerseys. The coach reaches into the bag and randomly selects a jersey for Peter and a jersey for Paul. What is the probability that both jerseys are the same colour? Show your work.

$$\frac{{}_5P_2 \; {}_4P_2 \; {}_6P_2}{{}_{15}P_{13}} = \frac{7200}{6.53837184 \in 11}$$

1 mark:
❶ → 1 mark for considering 3 cases

Exemplar 1

Question 13 **Total: 3 marks**

Cindy has an MP3 player that can play songs in a random order.

a) How many different ways can a 12-song playlist be arranged, if each song is played only once?

(1 mark)

$12! = 479\ 001\ 600$ different ways

b) What is the probability that Cindy's 3 favourite songs will be played together when she plays the 12-song playlist? Show your work.

(2 marks)

$\boxed{3 \times 2 \times 1} \times 9 \times 8 \times 7 \times 6 \times 5 \times 4 \times 3 \times 2 \times 1$

$\frac{3!9!}{3!} = 362\,880$

$\frac{362\,880}{479\,001\,600} = 0.08\%$ chance of happening

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

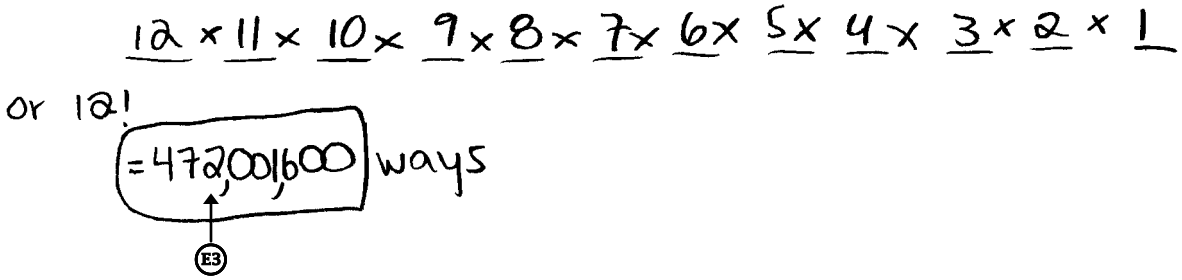
Exemplar 2

Question 13 **Total: 3 marks**

Cindy has an MP3 player that can play songs in a random order.

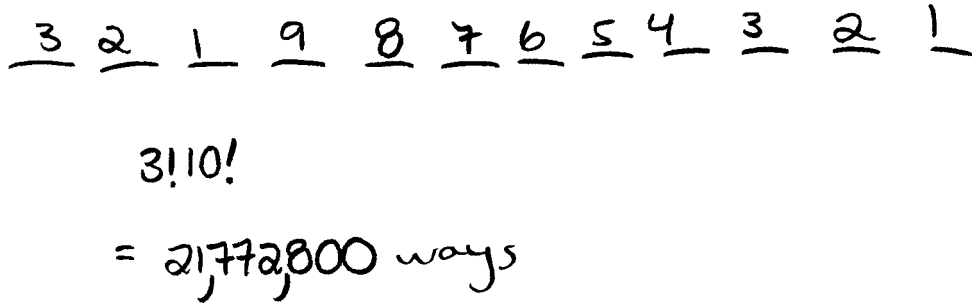
a) How many different ways can a 12-song playlist be arranged, if each song is played only once?

(1 mark)



b) What is the probability that Cindy's 3 favourite songs will be played together when she plays the 12-song playlist? Show your work.

(2 marks)



2 marks:
❶ → 1 mark for correct answer in (a) ❷ → 1 mark for appropriate work in (b)
Ⓔ3 → makes a transcription error (inaccurate transferring of information)

Exemplar 1

Question 15 **Total: 3 marks**

Mr. and Mrs. Belair want to purchase a house.

Mr. Belair is a biologist and his annual salary is $81 000.00. Mrs. Belair is a pharmacist and her annual salary is $85 250.00.

The monthly mortgage payment for the house they want to purchase is $2750.00, annual property taxes are $3600.00, and the monthly heating costs are $240.00.

a) Find the gross debt service ratio (GDSR) for the Belairs.

(2 marks)

$$GDSR = \frac{(2750 + 3600 + 240)}{166\,250} \times 100$$

$$= \frac{6590}{166250} \times 100$$

$$= 3.96\%$$

b) Using your answer in (a), explain if they can afford to buy the house.

(1 mark)

They can afford it because the GDSR < 32%

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

Exemplar 2

Question 15 **Total: 3 marks**

Mr. and Mrs. Belair want to purchase a house.

Mr. Belair is a biologist and his annual salary is $81 000.00. Mrs. Belair is a pharmacist and her annual salary is $85 250.00.

The monthly mortgage payment for the house they want to purchase is $2750.00, annual property taxes are $3600.00, and the monthly heating costs are $240.00.

a) Find the gross debt service ratio (GDSR) for the Belairs.

(2 marks)

81 000 + 85 250 = 166250 annual total cost per year

mortgage 2750 x12 = $33000

property tax = $3600

heating 240 X12 = + $2880

total cost = $39480 per year

GDSR = 39480 / 166250 = 0.24

b) Using your answer in (a), explain if they can afford to buy the house.

(1 mark)

they can afford the house since Cost lower than annual salary.

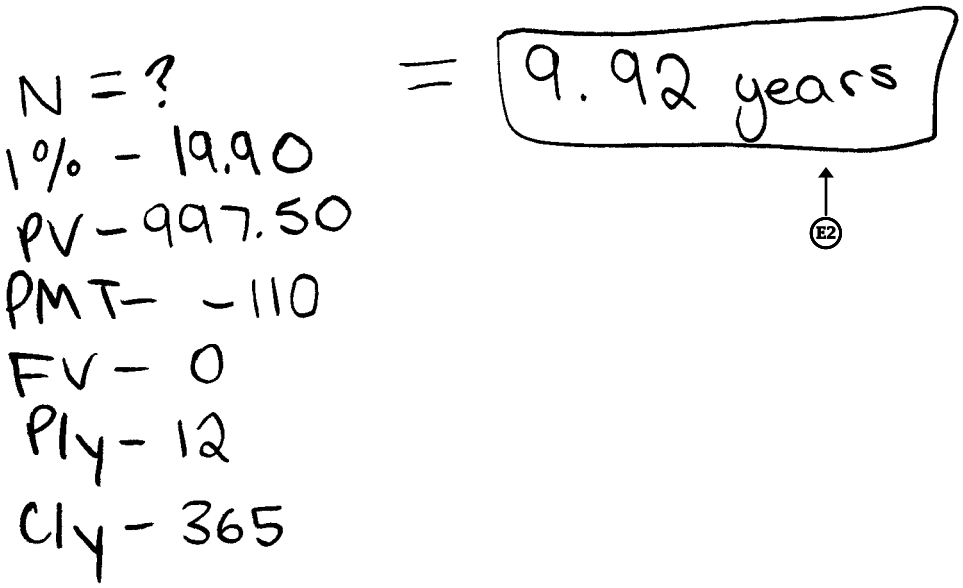
2 marks:
❶ → 1 mark for appropriate work in (a)
❷ → 1 mark for consistent answer in (a)

Exemplar 1

Question 16 **Total: 3 marks**

Sara used her credit card to pay for a group hot air balloon ride. The cost was $997.50, taxes included. Her credit card has a promotional offer of 0% interest for 2 months. After this period, the annual interest rate is 19.90% on any outstanding balance, compounded daily.

Sara decides to make payments of $110.00 at the end of every month, even during the promotional period. How long will it take Sara to pay off the balance? Show your work.



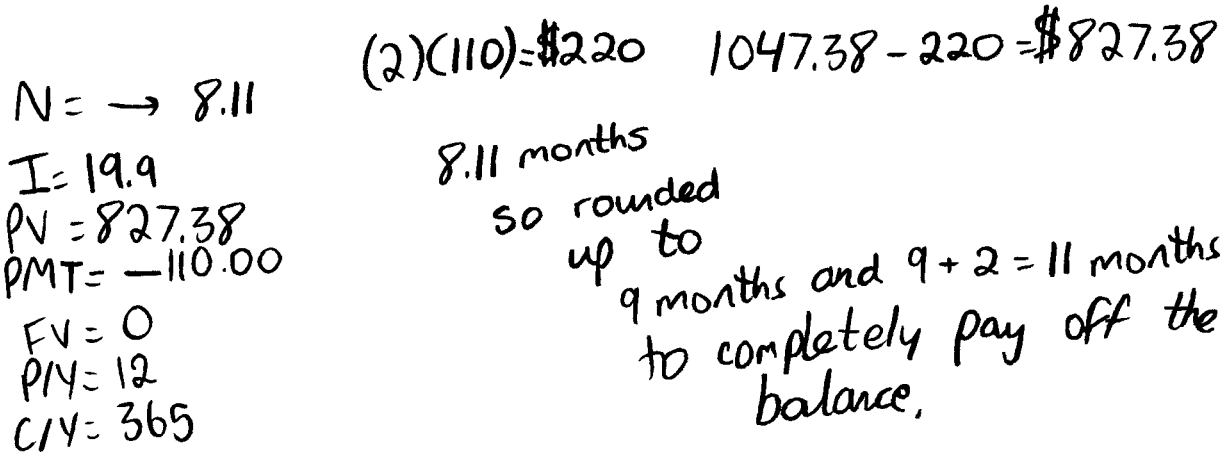
2 marks:
❷ → 1 mark for appropriate work
❸ → 1 mark for consistent answer
Ⓔ2 → uses incorrect units of measure

Exemplar 2

Question 16 **Total: 3 marks**

Sara used her credit card to pay for a group hot air balloon ride. The cost was $997.50, taxes included. Her credit card has a promotional offer of 0% interest for 2 months. After this period, the annual interest rate is 19.90% on any outstanding balance, compounded daily.

Sara decides to make payments of $110.00 at the end of every month, even during the promotional period. How long will it take Sara to pay off the balance? Show your work.



2 marks:
❷ → 1 mark for appropriate work
❸ → 1 mark for consistent answer

Exemplar 1

Question 17 — Total: 4 marks

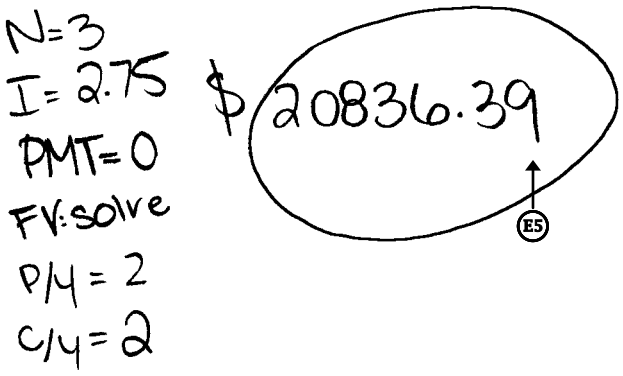
Sheena receives $20 000.00 from an insurance settlement. She wants to invest her money for three years in either a guaranteed investment certificate (GIC) or in real estate.

Option 1: The GIC has an annual interest rate of 2.75%, compounded semi-annually.

Option 2: The real estate investment generates annual returns of 5.90%, compounded annually.

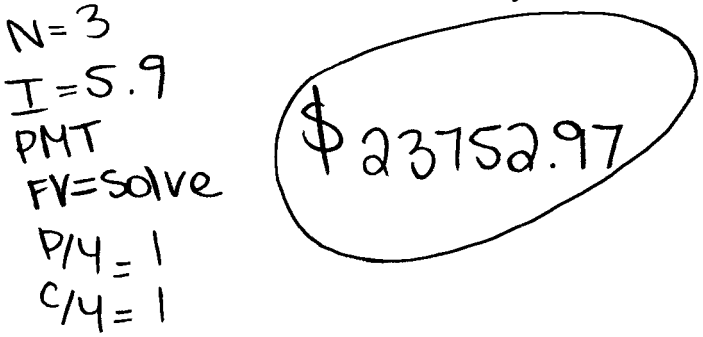
a) Determine the value of the GIC after 3 years. Show your work.

(2 marks)



b) Determine the value of the real estate investment after 3 years.

(1 mark)



c) Which would be the better investment for Sheena? Justify your answer.

(1 mark)

The Real estate investment, She would make more money by using the Real estate investment.

3 marks:
❷ → 1 mark for consistent answer in (a)
❸ → 1 mark for correct answer in (b)
❹ → 1 mark for correct justification in (c)

Ⓔ5 → rounds incorrectly

Exemplar 2

Question 17 **Total: 4 marks**

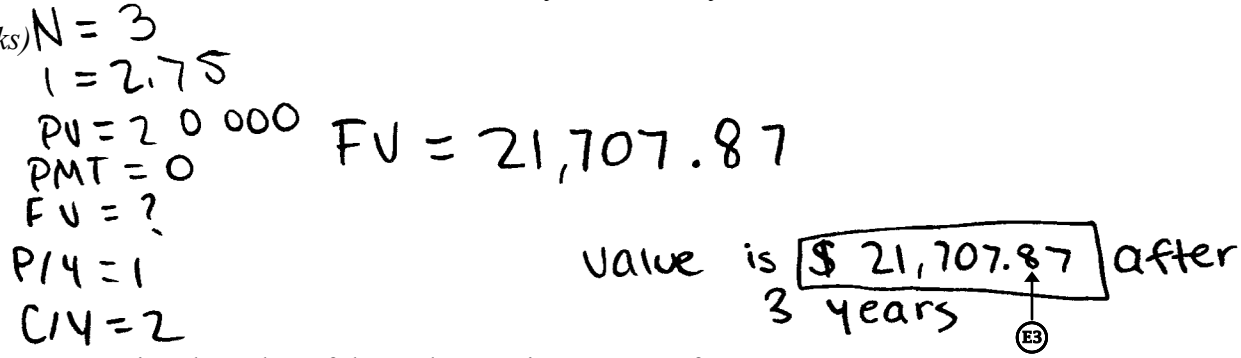
Sheena receives $20 000.00 from an insurance settlement. She wants to invest her money for three years in either a guaranteed investment certificate (GIC) or in real estate.

Option 1: The GIC has an annual interest rate of 2.75%, compounded semi-annually.

Option 2: The real estate investment generates annual returns of 5.90%, compounded annually.

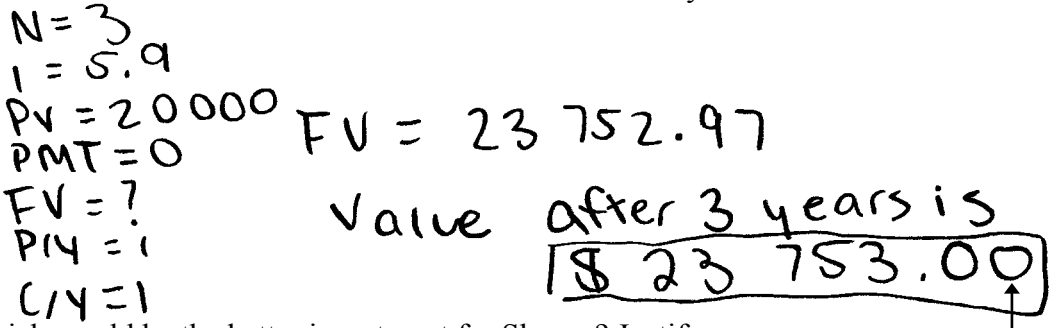
a) Determine the value of the GIC after 3 years. Show your work.

(2 marks)



b) Determine the value of the real estate investment after 3 years.

(1 mark)



c) Which would be the better investment for Sheena? Justify your answer.

(1 mark) The better investment for Sheena is the real estate investment because it makes her more money

4 marks:
❶ → 1 mark for appropriate work in (a)
❷ → 1 mark for consistent answer in (a)
❸ → 1 mark for correct answer in (b)
❹ → 1 mark for correct justification in (c)
Ⓔ3 → makes a transcription error (inaccurate transferring of information)
Ⓔ5 → rounds too soon

Exemplar 1

Question 18 **Total: 4 marks**

At the age of 18, Justine invests $1000.00 at an interest rate of 7.20%, compounded annually.

a) Using the Rule of 72, estimate how old Justine will be when her investment equals $8000.00. Show your work.

(2 marks)

$\frac{72}{i\%} = \frac{72}{7.2} = 10$ $10 + 18 = 28$

Justine will be 28 years old.

b) Using a technology tool, determine the number of years it will take to reach $8000.00. Show your work and indicate your answer to two decimal places.

(2 marks)

n = ?
i% = 7.20
pv = -1000
pmt = 0
fv = 8000
py = 1
cy = 1

APPS, finance, TVM solver

n = 29.9088

n = 29.91 years

3 marks:
- ❶ → 1 mark for correct calculation of years needed to double her investment in (a)
- ❸ → 1 mark for appropriate work in (b)
- ❹ → 1 mark for consistent answer in (b)

Exemplar 2

Question 18 **Total: 4 marks**

At the age of 18, Justine invests $1000.00 at an interest rate of 7.20%, compounded annually.

a) Using the Rule of 72, estimate how old Justine will be when her investment equals $8000.00. Show your work.

(2 marks)

$t = \frac{72}{7.20} = 10$

It will take about 10 years.

b) Using a technology tool, determine the number of years it will take to reach $8000.00. Show your work and indicate your answer to two decimal places.

(2 marks)

*N = 6.54
I = 7.20
PV = 0
PMT = -1000
FV = 8000
P/Y = 1
C/Y = 1

18 + 6.5 = 24.5

she will be about 25 years old when her investment reaches $8000

2 marks:
❶ → 1 mark for correct calculation of years needed to double her investment in (a)
❸ → 1 mark for appropriate work in (b)

Exemplar 1

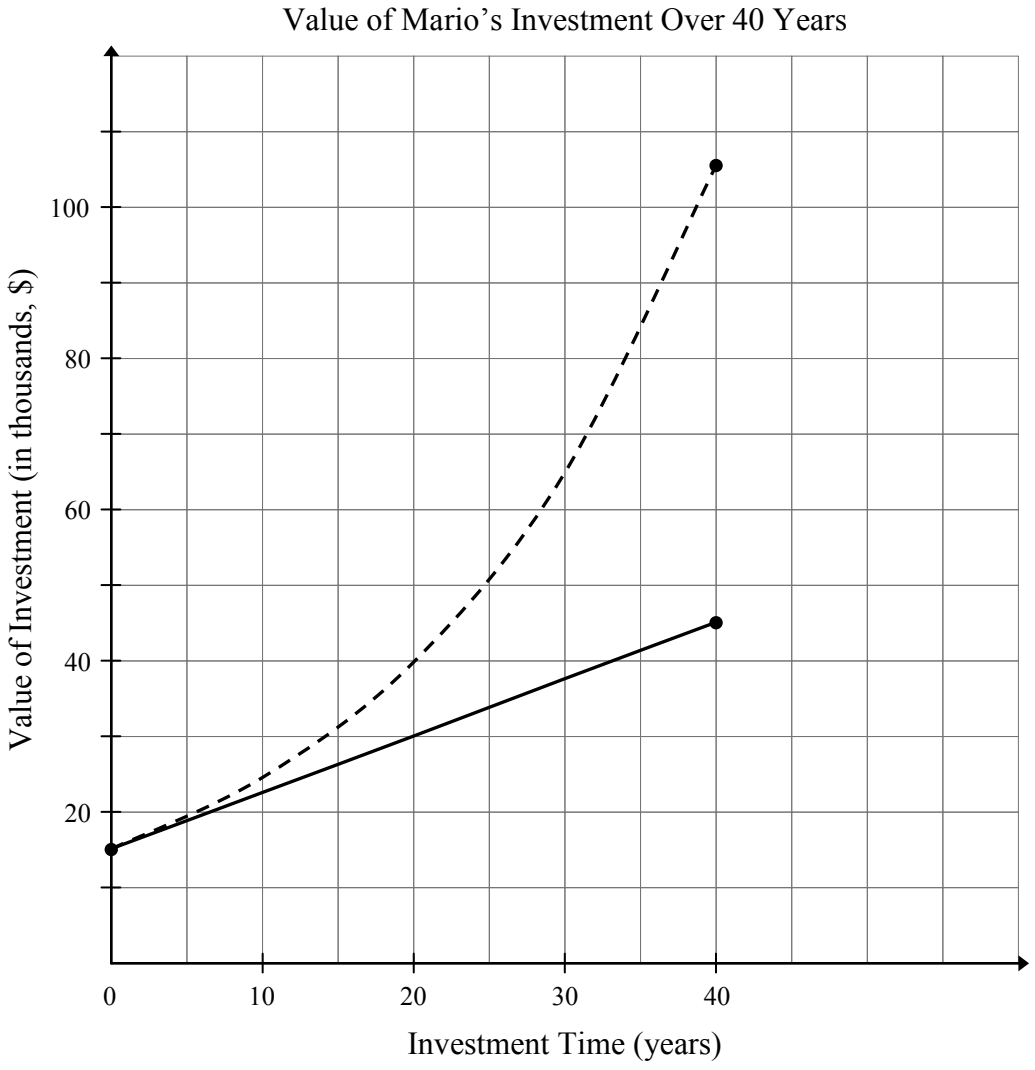
Question 19 — Total: 2 marks

Use the information below to answer the questions on the next page.

Mario has decided to make an investment for a period of 40 years. He has two options:

Option 1: a fund that earns simple interest at 5.00% annually

Option 2: a savings account that earns 5.00% interest, compounded annually



Exemplar 1 (continued)

a) Given the graphs of Option 1 and Option 2, estimate the value of the initial investment for each option.

(1 mark)

Option 1: N=480
I%=5
*PV=-14405.27
PMT=0
FV=106000
P/Y=12
C/Y=1
PMT: END BEGIN

∴ initial investment is $14405.27

Option 2: N=480
I%=5
*PV=-6392.05
PMT=0
FV=45000
P/Y=12
C/Y=1

∴ the initial investment is $6392.05

b) Which graph represents Option 1? Explain your answer.

(1 mark)

Option 1 is the smaller line because it earns less after the 40 years.

1 mark:
❷ → 1 mark for appropriate explanation in (b)

Exemplar 2

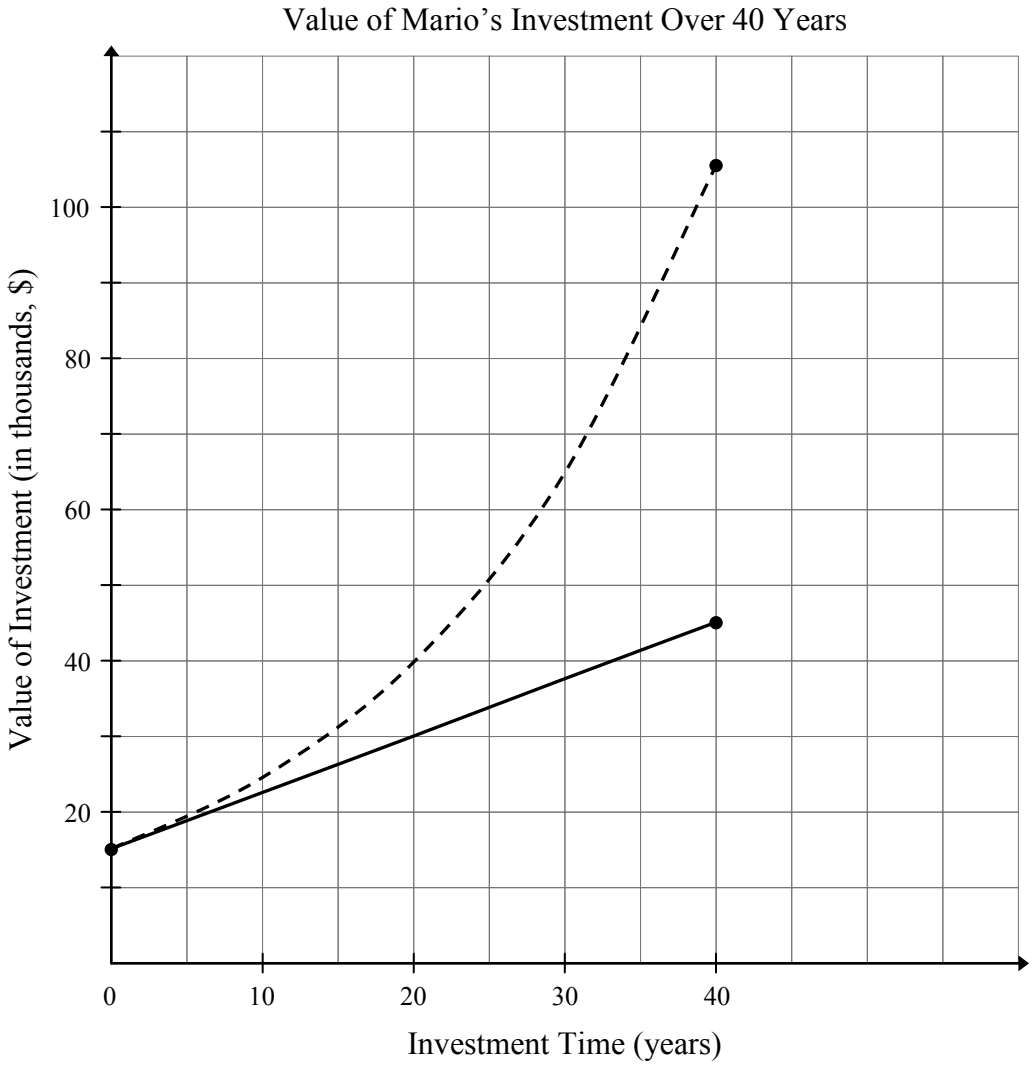
Question 19 — Total: 2 marks

Use the information below to answer the questions on the next page.

Mario has decided to make an investment for a period of 40 years. He has two options:

Option 1: a fund that earns simple interest at 5.00% annually

Option 2: a savings account that earns 5.00% interest, compounded annually



Exemplar 2 (continued)

a) Given the graphs of Option 1 and Option 2, estimate the value of the initial investment for each option.

(1 mark)

$ 15000

b) Which graph represents Option 1? Explain your answer.

(1 mark)

bottom one

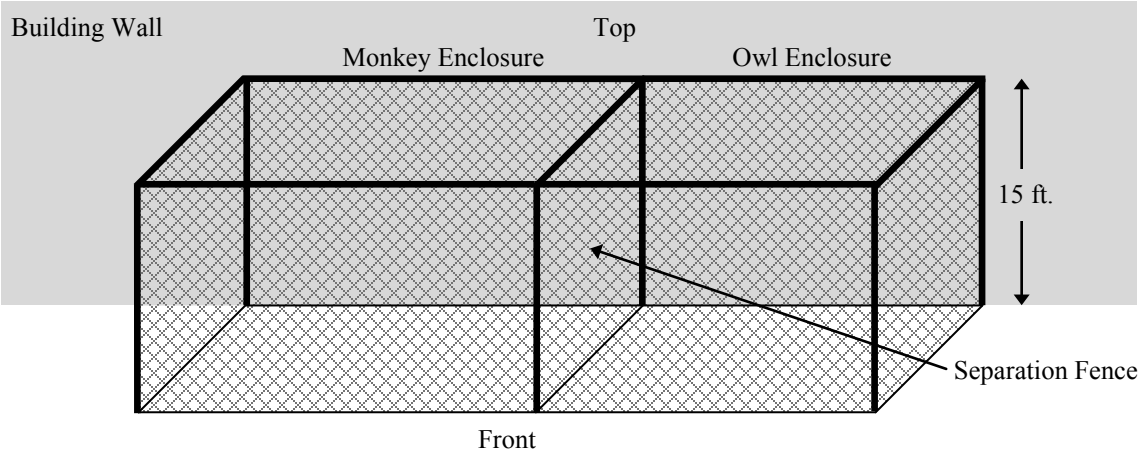
1 mark:
❶ → 1 mark for correct answer in (a)

Exemplar 1

Question 20 — Total: 5 marks

The zoo has asked you to design a structure for its monkeys and owls using the following guidelines:

- The structure will back against the wall of a building and will be fenced at the top, front, and sides. (No fence is needed on the ground or at the back.)
- The structure will be divided into two enclosures by a separation fence and have a height of 15 ft.
- The monkeys require an enclosure with a ground area between 600 ft^2 and 1000 ft^2.
- The owls require an enclosure with a ground area between 400 ft^2 and 800 ft^2.
- The entire structure will be created using chain-linked fence, which is sold in 50 ft. × 5 ft. (250 ft^2) segments. Each segment costs $160.00, plus GST and PST.



a) Determine a possible set of dimensions for your design.

(1 mark)

Ground dimensions of monkey enclosure: 10 ft. × 70 ft.

Ground dimensions of owl enclosure: 10 ft. × 50 ft.

Exemplar 1 (continued)

b) Determine the minimum number of fence segments needed for your design. Show your work.

(3 marks)

Front x side x 2 = area of top and front
120 x 10 x 2 = 2400 ft.
3 x 15 x 10 = 450 ft needed for sides
2400 + 450 = 2850 ft^2 needed

minimum of 12 segments needed

c) Calculate the total cost of the structure. (Note: GST = 5%, PST = 8%)

(1 mark)

160 x 1.05 x 1.08 = 217.28

3 marks:

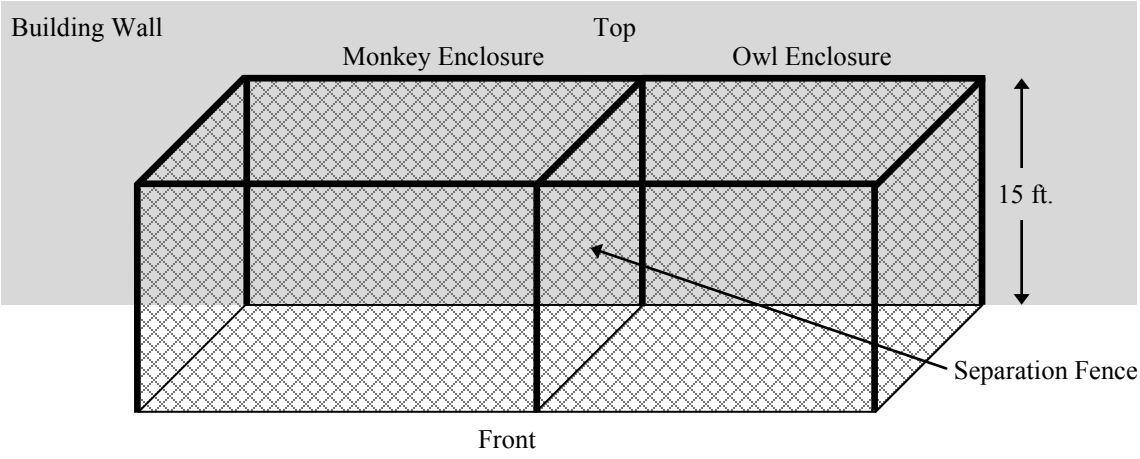
❶ → 1 mark for appropriate dimensions for both enclosures in (a)
❷ → 1 mark for including top, front, sides, and separation fence in calculations in (b)
❹ → 1 mark for correct minimum number of total segments in (b)

Exemplar 2

Question 20 — Total: 5 marks

The zoo has asked you to design a structure for its monkeys and owls using the following guidelines:

- The structure will back against the wall of a building and will be fenced at the top, front, and sides. (No fence is needed on the ground or at the back.)
- The structure will be divided into two enclosures by a separation fence and have a height of 15 ft.
- The monkeys require an enclosure with a ground area between 600 ft^2 and 1000 ft^2.
- The owls require an enclosure with a ground area between 400 ft^2 and 800 ft^2.
- The entire structure will be created using chain-linked fence, which is sold in 50 ft. × 5 ft. (250 ft^2) segments. Each segment costs $160.00, plus GST and PST.



132

a) Determine a possible set of dimensions for your design.

(1 mark)

Ground dimensions of monkey enclosure: 25 ft. × 25 ft.

Ground dimensions of owl enclosure: 25 ft. × 25 ft.

Exemplar 2 (continued)

b) Determine the minimum number of fence segments needed for your design. Show your work.

(3 marks)

Fence: $50ft \times 5ft = 250ft^2$

Monkey: Side 1
$25ft \times 15ft = 375ft^2$ +

Owl: Side 2
$25ft \times 15ft = 375ft^2$ +

Both: Top
$50ft \times 25ft = 1250ft^2$ +

Side 3
$50ft \times 15ft = 750ft^2$

$= 2750ft^2$

$2750 / 250$

$= 11$ segments

c) Calculate the total cost of the structure. (Note: GST = 5%, PST = 8%)

(1 mark)

11×180.8

$= \$1988.80$

$160 + TAX$
↳ 5%
↳ 8%

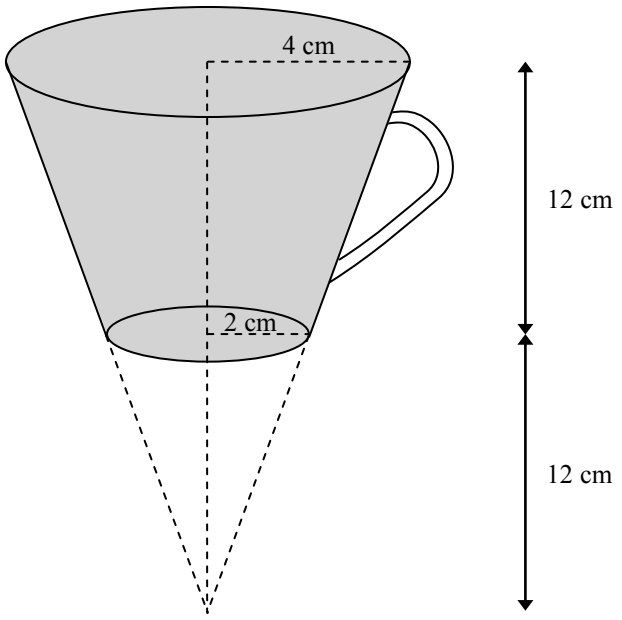
$= 20.80$
$+ 160$
$= 180.8$

4 marks:
- ❶ → 1 mark for appropriate dimensions for both enclosures in (a)
- ❸ → 1 mark for appropriate work in (b)
- ❹ → 1 mark for correct minimum number of total segments in (b)
- ❺ → 1 mark for correct total cost of the structure in (c)

Exemplar 1

Question 21 — Total: 2 marks

The coffee mug shaded in the diagram below is based on a cone with the bottom portion removed. (Diagram is not drawn to scale.)



Determine the volume of the mug. Show your work.

Volume of full cone

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

$V = \frac{\pi\, 4^2 (24)}{3}$

$V = 402.12 \text{ cm}^3$ (E5)

Volume of small cone

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

$V = \frac{\pi\, 2^2 (12)}{3}$

$V = 50.27 \text{ cm}^3$

$402.12 - 50.25 = 351.85 \text{ cm}^3$

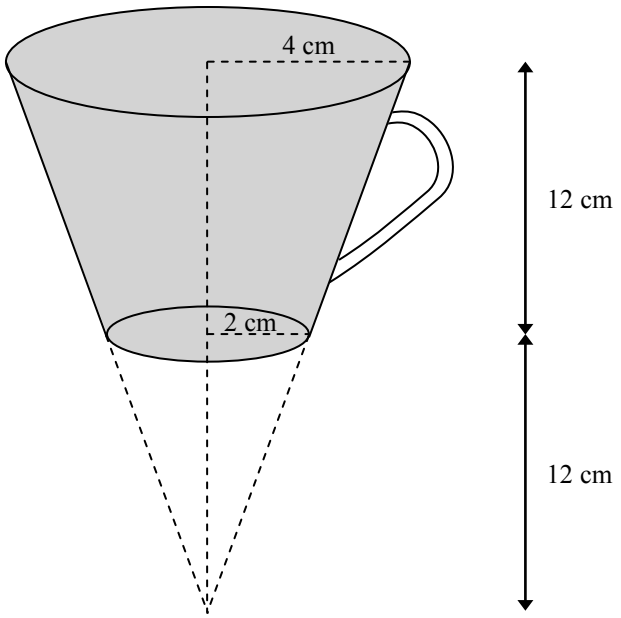
2 marks:
❶ → 1 mark for appropriate work
❷ → 1 mark for consistent answer

(E5) → rounds too soon

Exemplar 2

Question 21 — Total: 2 marks

The coffee mug shaded in the diagram below is based on a cone with the bottom portion removed. (Diagram is not drawn to scale.)



Determine the volume of the mug. Show your work.

top

$V = \frac{\pi r^2 h}{3}$ $\quad \frac{\pi 4^2 12}{3} = 201.06\ cm^3$

bottom

$\frac{\pi 2^2 12}{3} = 50.27$

$150.79\ cm^3$ (E5)

1 mark:
❶ → 1 mark for appropriate work
(E5) → rounds too soon

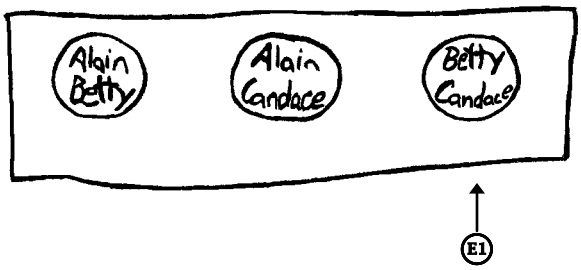
Exemplar 1

Question 23 — Total: 1 mark

Given the following universal set:

$$U = \{\text{Alain, Betty, Candace}\}$$

Write all the subsets of U that have exactly 2 elements.



3 subsets are possible.

1 mark:
❶ → 1 mark for correct answer
Ⓔ1 → does not include braces when using set notation

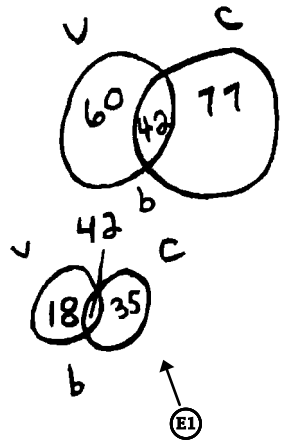
Exemplar 1

Question 24 — Total: 2 marks

A survey of 100 students was conducted to find the most popular ice cream flavour. The findings are displayed below.

- 60 students like vanilla
- 77 students like chocolate
- 42 students like both vanilla and chocolate

Use a Venn diagram to represent this situation.



1 mark:

❶ → 1 mark for correctly calculating and placing the number of students who like only chocolate and like only vanilla (18 and 35)

Ⓔ1 → does not include a box when using a Venn diagram

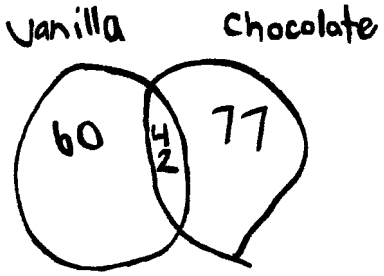
Exemplar 2

Question 24 — Total: 2 marks

A survey of 100 students was conducted to find the most popular ice cream flavour. The findings are displayed below.

- 60 students like vanilla
- 77 students like chocolate
- 42 students like both vanilla and chocolate

Use a Venn diagram to represent this situation.



0 marks:
→ no criteria met

Exemplar 1

Question 25 — Total: 2 marks

Consider the original statement:

"If a polygon is a triangle, then this polygon has exactly three sides."

a) Write the converse of the statement.

(1 mark)

If a polygon has 3 sides then this is a triangle

b) Determine if a biconditional statement can be made using the original statement. If it is possible, write the biconditional statement. If not, provide a counterexample.

(1 mark)

If a polygon is not a triangle, then this polygon does not have 3 sides

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

Exemplar 2

Question 25 **Total: 2 marks**

Consider the original statement:

"If a polygon is a triangle, then this polygon has exactly three sides."

a) Write the converse of the statement.

(1 mark)

"If a polygon has exactly three sides, then it is a triangle."

b) Determine if a biconditional statement can be made using the original statement. If it is possible, write the biconditional statement. If not, provide a counterexample.

(1 mark)

- A polygon can be triangle if and only if it has three sides
- A polygon can have three sides if and only if it is a triangle

2 marks:
❶ → 1 mark for correct answer in (a)
❷ → 1 mark for correct statement in (b)

Appendices

Appendix A:
Table of Questions by Unit and Learning Outcome

Unit	Question	Type	Learning Outcome	Mark
A	1	SR	12A.R.1	1
A	2	SR	12A.R.1, 12A.R.2	1
A	3	CR	12A.R.1	5
A	4	CR	12A.R.2	4
A	5	CR	12A.R.3	4
				Total = 15
B	6	SR	12A.P.2	1
B	7	SR	12A.P.1	1
B	8	CR	12A.P.5	2
B	9	CR	12A.P.5	1
B	10	CR	12A.P.5	2
B	11	CR	12A.P.6	2
B	12	CR	12A.P.3, 12A.P.6	3
B	13	CR	12A.P.4, 12A.P.5	3
				Total = 15
C	14	SR	12A.FM.1	1
C	15	CR	12A.FM.2, 12A.FM.3	3
C	16	CR	12A.FM.1	3
C	17	CR	12A.FM.3	4
C	18	CR	12A.FM.1, 12A.FM.3	4
C	19	CR	12A.FM.3	2
				Total = 17
D	20	CR	12A.D.1	5
D	21	CR	12A.D.1	2
				Total = 7
E	22	SR	12A.L.2	1
E	23	CR	12A.L.2	1
E	24	CR	12A.L.2	2
E	25	CR	12A.L.3	2
				Total = 6

Legend for Units:

A: Relations and Functions
B: Probability
C: Financial Mathematics
D: Design and Measurement
E: Logical Reasoning

Legend for Question Types:

SR: Selected Response
CR: Constructed Response

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: _____

_____

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Follow-up: _____

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_____

Decision: _____

_____

_____

_____

_____

_____

_____

Marker's Signature: _____

Principal's Signature: _____

For Department Use Only—After Marking Complete

Consultant: _____

Date: _____