

Grade 12
Applied Mathematics
Achievement Test

Marking Guide

June 2015

Manitoba Education and Advanced Learning Cataloguing in Publication Data

Grade 12 applied mathematics achievement test. Marking guide. June 2015 [electronic resource]

ISBN: 978-0-7711-5820-9

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

Manitoba Education and Advanced Learning
School Programs Division
Winnipeg, Manitoba, Canada

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Websites are subject to change without notice.

Disponible en français.

Available in alternate formats upon request.

Contents

| | |
|--|----|
| General Marking Instructions | 1 |
| Marking Keys..... | 5 |
| Exemplars | 33 |
| Appendices..... | 85 |
| Appendix A: Table of Questions by Unit and Learning Outcome..... | 87 |
| Appendix B: Irregularities in Provincial Tests..... | 89 |
| <i>Irregular Test Booklet Report</i> | 91 |

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 |

| | | | | | |
|----------------------|---|-------------------------------|---|------------|--|
| Communication Errors | | | | | |
| Preliminary Mark | – | (Number of error types × 0.5) | = | Final Mark | |
| 46 | – | (2 × 0.5) | = | 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.

King Luu
Assessment Consultant
Grade 12 Applied Mathematics
Telephone: 204-945-4035
Toll-Free: 1-800-282-8069, ext. 4035
Email: king.luu@gov.mb.ca

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 Outcomes: 12A.R.1, 12A.R.2

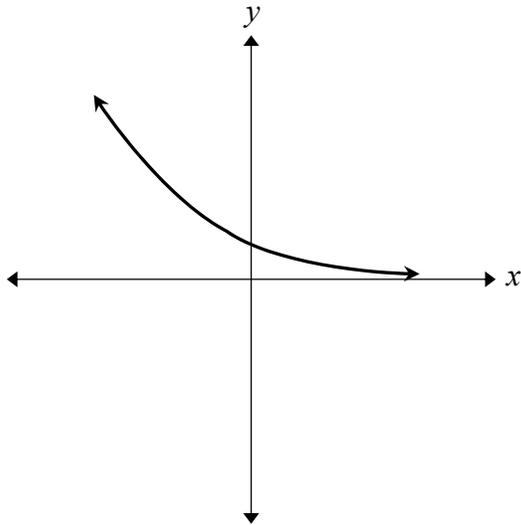
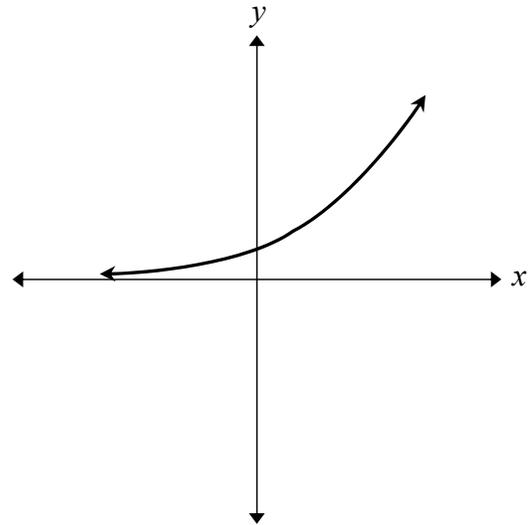
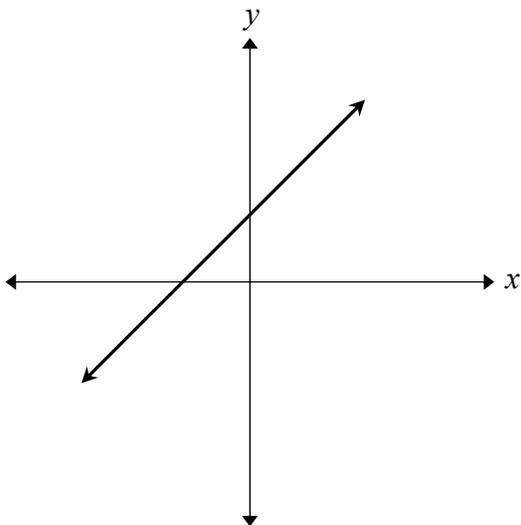
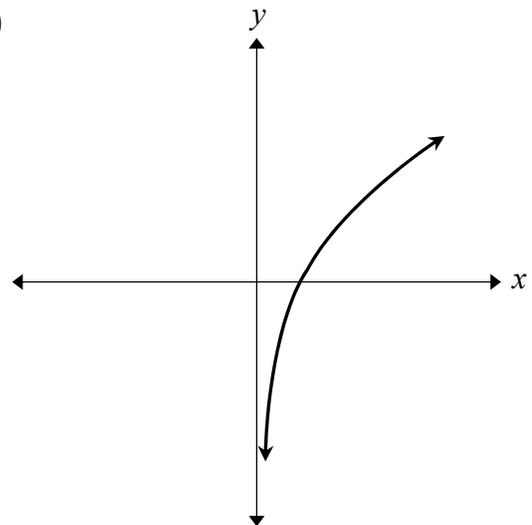
Question Type: Selected Response

Select the best answer.

Which of the following functions has an unrestricted domain and an unrestricted range?

- A.** cubic
- B.** exponential
- C.** logarithmic
- D.** quadratic

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

*Select the best answer.***Which graph below represents a logarithmic function?****A.****C.****B.****(D.)****Student Error**

A: exponential decay

B: linear

C: exponential growth

Question 3**Total: 2 marks**

Learning Outcome: 12A.R.1

Question Type: Constructed Response

Sam is studying the characteristics of quadratic functions.

She states the following:

Statement 1: A quadratic function always has a degree of 2.

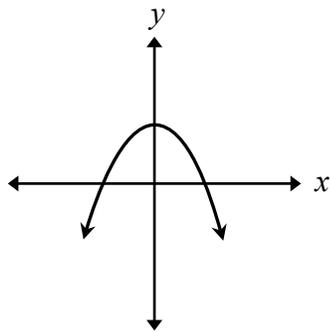
Statement 2: The graph of a quadratic function always extends from quadrant II to quadrant I.

Statement 3: The graph of a quadratic function always has one turning point.

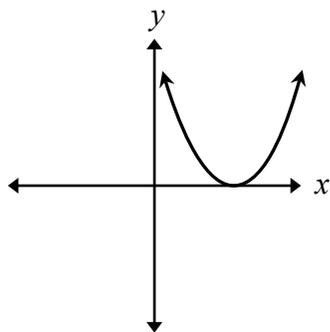
Statement 4: A quadratic function always has two x -intercepts.

Two of these statements are incorrect. Identify which statements are incorrect and provide a counterexample for each.

Statement 2:



Statement 4:



Other answers are possible.

| Marking Key | |
|--------------------|---|
| ❶ | 1 mark for correct counterexample for Statement 2 |
| ❷ | 1 mark for correct counterexample for Statement 4 |

Question 4**Total: 3 marks**

Learning Outcome: 12A.R.1

Question Type: Constructed Response

The table below shows the electricity consumption in gigawatt-hours (GWh) of a large city since 1960.

| Years (since 1960) | Consumption (GWh) |
|-----------------------|----------------------|
| 0 | 11 967 |
| 10 | 21 139 |
| 20 | 19 877 |
| 30 | 19 173 |
| 40 | 23 333 |
| 50 | 24 087 |

- a) Determine the equation for the cubic regression that models the data.

(1 mark)

$$y = 0.44x^3 - 37.02x^2 + 981.72x + 12\,631.56$$

- b) Using your equation in (a), estimate the electricity consumption in 2015. Show your work and round your answer to the nearest whole value.

(2 marks)

$$\boxed{\text{TRACE}} \quad x = 55$$

$$y = 28\,684.19 \text{ GWh}$$

It is estimated that 28 684 GWh will be consumed in 2015.

OR

When $x = 55$,

$$\begin{aligned} y &= 0.44(55)^3 - 37.02(55)^2 + 981.72(55) + 12\,631.56 \\ &= 27\,845.66 \text{ GWh} \end{aligned}$$

It is estimated that 27 846 GWh will be consumed in 2015.

Marking Key

- | | |
|---|-------------------------------------|
| ① | 1 mark for correct equation in (a) |
| ② | 1 mark for appropriate work in (b) |
| ③ | 1 mark for consistent answer in (b) |

Question 5**Total: 3 marks****Learning Outcome: 12A.R.2****Question Type: Constructed Response**

George is diabetic and the amount of sugar in his blood (concentration) gradually decreases over time according to the function:

$$c = 9(0.995)^t$$

where c represents the concentration and t represents the time (in minutes).

His initial blood sugar concentration is 9.

a) State the range in this situation.

(1 mark)

$$\{c | 0 < c \leq 9\}$$

OR

$$\{0 < c \leq 9\}$$

OR

$$(0, 9]$$

OR

Concentration (c) is greater than zero (0) but less than or equal to nine (9).

b) George forgets to eat his morning snack. He experiences dizziness once his blood sugar concentration drops below 3. After how many minutes will this happen? Show your work.

(2 marks)

$$\boxed{2\text{nd}} \boxed{\text{TRACE}} \text{ 5: Intersect } c = 3$$

$$t = 219.17\dots$$

He will feel dizzy after 219 minutes.

| Marking Key | |
|-------------|-------------------------------------|
| ① | 1 mark for correct range in (a) |
| ② | 1 mark for appropriate work in (b) |
| ③ | 1 mark for consistent answer in (b) |

Question 6**Total: 6 marks**

Learning Outcome: 12A.R.3

Question Type: Constructed Response

The top of a flagpole moves back and forth on a windy day. It sways 15 cm to the left (–15 cm) and 15 cm to the right (+15 cm) from its resting position (0 cm). It moves back and forth every two (2) seconds. At $t = 0$, the pole was at its resting position before swaying to the left.

a) Determine a sinusoidal equation that models this situation. Show your work.

(2 marks)

| Time (s) | Position (cm) |
|----------|---------------|
| 0 | 0 |
| 0.50 | –15 |
| 1.00 | 0 |
| 1.50 | 15 |
| 2.00 | 0 |

Using the SinReg function:

$$y = 15 \sin(3.14x - 3.14)$$

OR

$$a = 15$$

$$b = \frac{2\pi}{2} = \pi$$

$$c = -\pi$$

$$d = 0$$

$$y = 15 \sin(\pi x - \pi)$$

OR

$$a = -15$$

$$b = \frac{2\pi}{2} = \pi$$

$$c = 0$$

$$d = 0$$

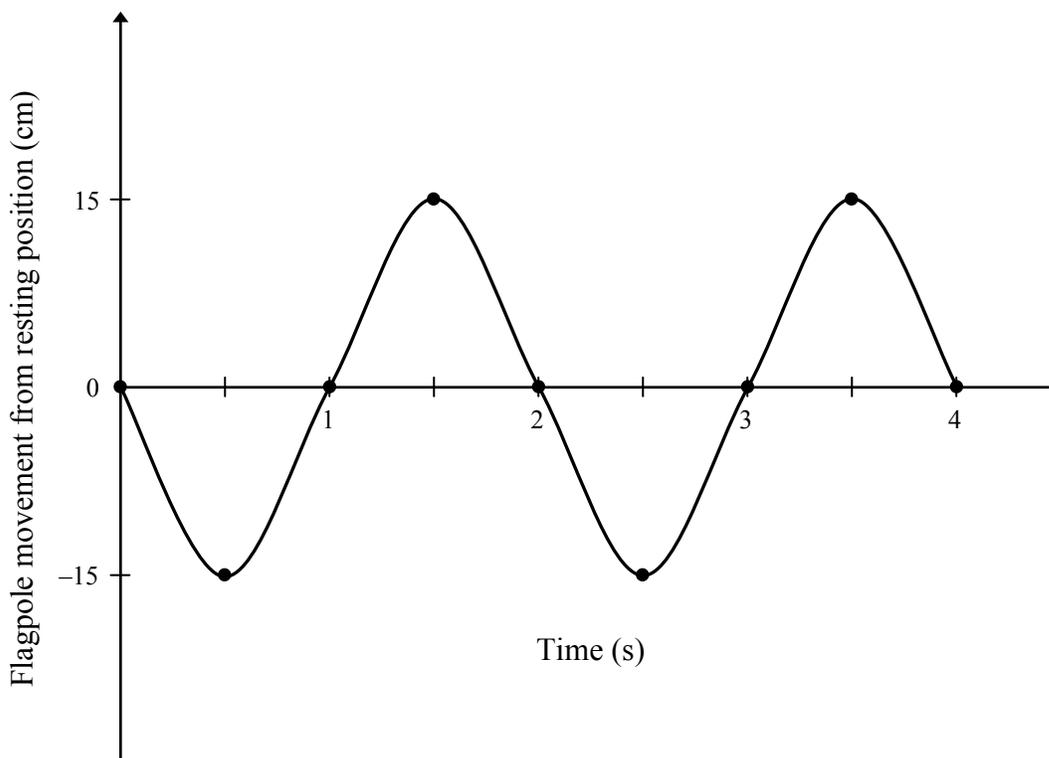
$$y = -15 \sin(\pi x)$$

Other answers are possible.

Question 6 continued

b) Graph the equation for two (2) full cycles.

(3 marks)



c) On an even windier day, the flagpole moves back and forth every second. Explain how your equation will change.

(1 mark)

The “ b ” value changes to 2π or 6.28.

OR

The period is shorter, which increases the “ b ” value.

Marker Note(s):

→ A deduction of ② in (b) may only be applied if mark ③ has been awarded.

→ Award mark ① if two parameters in the equation are correct.

| Marking Key | |
|-------------|---|
| ① | <i>1 mark for appropriate work in (a)</i> |
| ② | <i>1 mark for correct equation in (a)</i> |
| ③ | <i>1 mark for communicating the context of the graph with appropriate title and/or labels in (b)</i> |
| ④ | <i>1 mark for using an appropriate domain and range (i.e., window settings/grid range) for the context of the question in (b)</i> |
| ⑤ | <i>1 mark for an appropriate shape that illustrates key characteristics of the function (e.g., maximum, minimum, intercepts) in (b)</i> |
| ⑥ | <i>1 mark for correct explanation in (c)</i> |

PROBABILITY

Question 7**Total: 1 mark****Learning Outcome: 12A.P.2****Question Type: Selected Response**

Select the best answer.

A game involves drawing one card from a set of cards numbered from 1 to 20. The desired outcomes in the game are to draw an even number or a multiple of 5.

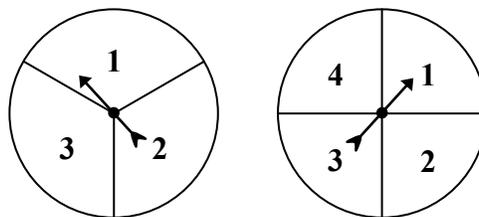
The outcomes in this game can best be described as:

- A. non-mutually exclusive
- B. mutually exclusive
- C. independent
- D. dependent

Question 8**Total: 1 mark****Learning Outcome: 12A.P.3****Question Type: Selected Response**

Select the best answer.

A student is given two spinners: one divided into three equal sections and the other divided into four equal sections, as shown below.



If both spinners are spun, what is the probability that the sum of the two spinners is 3?

- A. $\frac{1}{12}$
- B. $\frac{1}{6}$
- C. $\frac{1}{4}$
- D. $\frac{2}{7}$

Student Error

A: considers only one sum of 3
C: considers only one spinner
D: counts two sections of 3

Question 9**Total: 1 mark****Learning Outcome: 12A.P.1****Question Type: Constructed Response**

The probability of rain is 60%. What are the odds against rain?

40 : 60

2 : 3

The odds against rain would be 40 : 60 or 2 : 3.

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

Question 10**Total: 1 mark****Learning Outcome: 12A.P.4****Question Type: Constructed Response**

A pizza place offers the following choices:

- 3 types of crust
- 2 types of sauce
- 5 types of cheese
- 6 meat toppings
- 8 vegetable toppings

Charles would like to create a pizza by choosing one item from each category. Determine how many different pizzas can be made.

$$\begin{aligned} & 3 \times 2 \times 5 \times 6 \times 8 \\ & = 1440 \end{aligned}$$

There are 1440 different pizzas that can be made.

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

Question 11**Total: 1 mark****Learning Outcome: 12A.P.6****Question Type: Constructed Response**

Create a scenario where the calculation ${}_8C_5 \times {}_9C_2$ would be appropriate.

How many ways can a committee of 5 men and 2 women be made if there are 8 men and 9 women to choose from?

Other answers are possible.

| Marking Key | |
|--------------------|--|
| 1 | <i>1 mark for appropriate scenario</i> |

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

A contractor has five workers he can assign to a task. How many ways can the contractor assign at least one worker to the task?

$$\begin{aligned}\text{Total number} &= {}_5C_1 + {}_5C_2 + {}_5C_3 + {}_5C_4 + {}_5C_5 \\ &= 5 + 10 + 10 + 5 + 1 \\ &= 31\end{aligned}$$

There are 31 ways.

OR

$$\begin{aligned}\text{Total number of subsets} &= 2^n \\ &= 2^5 \\ &= 32\end{aligned}$$

The empty set is omitted $32 - 1 = 31$

There are 31 ways.

| Marking Key | |
|--------------------|-------------------------------------|
| ① | <i>1 mark for appropriate work</i> |
| ② | <i>1 mark for consistent answer</i> |

Question 13**Total: 3 marks**

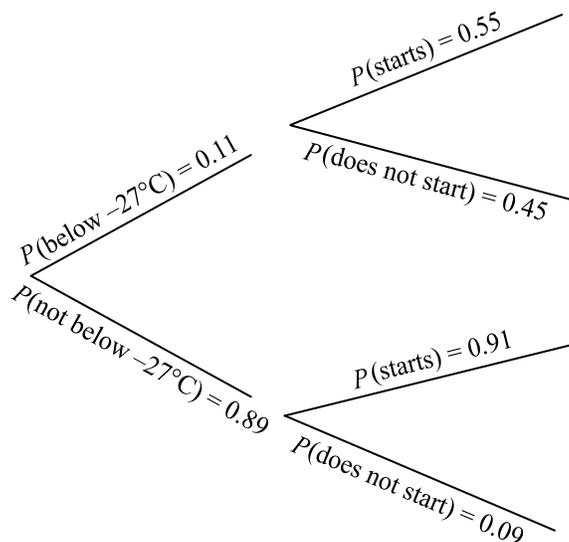
Learning Outcome: 12A.P.3

Question Type: Constructed Response

On January 21, the probability of the overnight low temperature being below -27°C is 11%. If the temperature is below -27°C , the probability of Cara's car starting is 55%. If it is not below -27°C , the probability of Cara's car starting is 91%.

a) Create a graphic organizer to represent all possibilities for this situation.

(1 mark)



b) What is the probability that Cara's car will not start on January 21? Show your work.

(2 marks)

$$\begin{aligned} P(\text{not starting}) &= (0.11)(0.45) + (0.89)(0.09) \\ &= 0.0495 + 0.0801 \\ &= 0.13 \text{ or } 12.96\% \end{aligned}$$

The probability of Cara's car not starting is 0.13 or 12.96%.

Marking Key

- | | |
|---|-------------------------------------|
| ① | 1 mark for graphic organizer in (a) |
| ② | 1 mark for appropriate work in (b) |
| ③ | 1 mark for consistent answer in (b) |

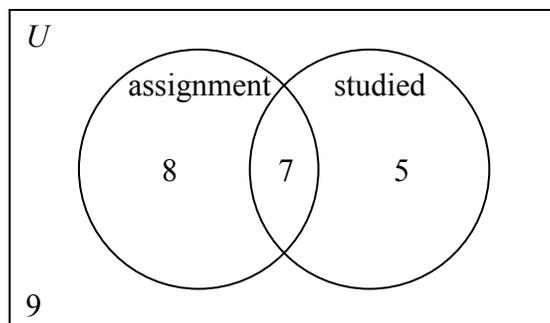
Question 14**Total: 3 marks**

Learning Outcomes: 12A.P.2, 12A.P.3

Question Type: Constructed Response

A teacher surveys her class of 29 students and finds out that in the past week, 15 students worked on an assignment, 12 students studied for a test, and 7 students did both.

a) How many students did not work on an assignment nor study for a test?

(1 mark)

Nine (9) students did neither.

OR

$$15 + 12 - 7 = 20$$

$$29 - 20 = 9$$

Nine (9) students did neither.

b) The teacher decides to randomly put students in groups of three for a class project. What is the probability that all three members of a group will not have worked on an assignment nor studied for a test?

(2 marks)

$$\left(\frac{9}{29}\right)\left(\frac{8}{28}\right)\left(\frac{7}{27}\right) = \frac{504}{21\,924} = \frac{2}{87}$$

The probability is $\frac{2}{87}$, 0.02, or 2.30%.

OR

$$\frac{{}_9C_3}{{}_{29}C_3} = \frac{84}{3654} = \frac{2}{87}$$

The probability is $\frac{2}{87}$, 0.02, or 2.30%.

Marking Key

- | | |
|---|-------------------------------------|
| ① | 1 mark for correct answer in (a) |
| ② | 1 mark for appropriate work in (b) |
| ③ | 1 mark for consistent answer in (b) |

Question 15**Total: 2 marks****Learning Outcomes: 12A.P.5, 12A.P.6****Question Type: Constructed Response**

There are 50 high school students in a small town. The school's cross-country coach wants to randomly select 9 students to form a team.

a) How many different teams can be created?

(1 mark)

$${}_{50}C_9 = 2\,505\,433\,700$$

There are 2 505 433 700 possible teams.

b) The coach rents a van and drives his team to the race. Calculate the number of ways the students can be seated, if there are 9 passenger seats.

(1 mark)

$${}_9P_9 = 9! = 9 \times 8 \times 7 \times 6 \times 5 \times 4 \times 3 \times 2 \times 1 = 362\,880$$

There are 362 880 ways this can be done.

| Marking Key | |
|-------------|---|
| ① | <i>1 mark for correct answer in (a)</i> |
| ② | <i>1 mark for correct answer in (b)</i> |

FINANCIAL MATHEMATICS

Question 16**Total: 1 mark**

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

Select the best answer.

The value of a house appreciates 4.10% per year. If the house was purchased for \$180 000 in June 2010, what is the approximate value of the house in June 2015?

- A. \$184 000
- B. \$220 000
- C. \$937 000
- D. \$1 003 000

Question 17**Total: 4 marks****Learning Outcome: 12A.FM.3****Question Type: Constructed Response**

Deema is saving for a home renovation. She deposits \$50.00 every month into a new high-interest savings account that earns 4.60%, compounded monthly.

a) What will be the value in Deema's account after 4 years? Show your work.

(2 marks)

| |
|--|
| N=48 I%=4.6 PV=0 PMT=-50 FV=2629.474784 P/Y=12 C/Y=12 PMT: <input type="checkbox"/> END <input checked="" type="checkbox"/> BEGIN |
|--|

The value will be \$2629.47.

b) How much interest will she have earned after 4 years? Show your work.

(2 marks)

Amount deposited:

$$\$50.00 \times 48 = \$2400.00$$

Interest earned:

$$\$2629.47 - \$2400.00 = \$229.47$$

She will have earned \$229.47 in interest.

OR

$$\Sigma \text{Int}(1, 48) = \$229.47$$

She will have earned \$229.47 in interest.

| Marking Key | |
|-------------|-------------------------------------|
| ① | 1 mark for appropriate work in (a) |
| ② | 1 mark for consistent answer in (a) |
| ③ | 1 mark for appropriate work in (b) |
| ④ | 1 mark for consistent answer in (b) |

Question 18**Total: 2 marks****Learning Outcome: 12A.FM.3****Question Type: Constructed Response**

Lisette is 50 years old and would like to retire at age 55. Her assets include \$60 000.00 in a guaranteed investment certificate (GIC), \$78 000.00 in a chequing account, and \$192 000.00 in stocks.

Make two recommendations to help Lisette strengthen her investment portfolio. Justify your recommendations.

1. Reduce the amount in the chequing account. The chequing account has a low interest rate paid on the balance.
2. Reduce the amount held in stocks. They are a high-risk investment with a high potential to lose value.

Other answers are possible.

| Marking Key | |
|--------------------|--|
| ❶ | <i>1 mark for justification of first recommendation</i> |
| ❷ | <i>1 mark for justification of second recommendation</i> |

Question 19**Total: 2 marks****Learning Outcome: 12A.FM.3****Question Type: Constructed Response**

Serge invests \$12 000.00 on his 30th birthday. If his investment earns 6.00% interest, compounded annually, apply the Rule of 72 to estimate how much money he will have when he retires on his 66th birthday.

$$t = \frac{72}{6} = 12 \text{ years}$$

| | |
|------------------|-------------|
| Age 30 | \$12 000.00 |
| Age 30 + 12 = 42 | \$24 000.00 |
| Age 54 | \$48 000.00 |
| Age 66 | \$96 000.00 |

He will have approximately \$96 000.00 when he retires.

Marking Key

- | | |
|---|---|
| ① | <i>1 mark for correct doubling time</i> |
| ② | <i>1 mark for correct answer</i> |

Question 20**Total: 3 marks****Learning Outcomes: 12A.FM.1, 12A.FM.3****Question Type: Constructed Response**

Harsimran invested \$20 000.00 in a simple interest savings bond. After 12 years, the future value of the bond was \$26 768.00.

a) Determine the annual interest rate.

(2 marks)

$$I = \$26\,768.00 - \$20\,000.00 = \$6768.00$$

$$I = Prt$$

$$I = \$20\,000.00(r)(12) = \$6768.00$$

$$r = 0.0282 \text{ or } 2.82\%$$

The annual interest rate is 2.82%.

b) Determine the rate of return.

(1 mark)

$$\begin{aligned} \text{rate of return} &= \frac{\$6768.00}{\$20\,000.00} \times 100 \\ &= 33.84\% \end{aligned}$$

The rate of return is 33.84%.

OR_____

$$\begin{aligned} \text{rate of return} &= 2.82\% \times 12 \\ &= 33.84\% \end{aligned}$$

The rate of return is 33.84%.

| Marking Key | |
|--------------------|--|
| ① | <i>1 mark for appropriate work in (a)</i> |
| ② | <i>1 mark for consistent answer in (a)</i> |
| ③ | <i>1 mark for correct answer in (b)</i> |

Question 21**Total: 5 marks**

Learning Outcome: 12A.FM.2

Question Type: Constructed Response

Maurice needs a truck for his new job that will last four years. He has the following two options:

Option 1: He can purchase the truck for \$45 194.35 (taxes included) with no down payment, at an interest rate of 4.00%, compounded monthly, for four years.

Option 2: He can lease the same truck for four years with a down payment of \$5000.00 and monthly payments of \$850.00 (taxes included). He would be allowed 20 000 km per year and there is a \$0.18 per km (taxes included) charge above this limit.

- a) What would be Maurice's total cost in Option 1 if he makes monthly payments? Show your work.

(2 marks)

| |
|---|
| N=48 I%=4 PV=45194.35 PMT=-1020.4456... FV=0 P/Y=12 C/Y=12 PMT: <input type="checkbox"/> END <input checked="" type="checkbox"/> BEGIN |
|---|

$$\text{Total cost} = \$1020.45/\text{month} \times 48 \text{ months} = \$48\,981.60$$

- b) If Maurice drives 25 000 km annually, what would be his total cost in Option 2? Show your work.

(2 marks)

$$\text{Down payment} = \$5000.00$$

$$\text{Total lease payments} = \$850.00/\text{month} \times 48 \text{ months} = \$40\,800.00$$

$$\text{Extra kilometrage cost} = 5000 \text{ km/year} \times 4 \text{ years} \times \$0.18/\text{km} = \$3600.00$$

$$\text{Total cost} = \$49\,400.00$$

- c) Which option would you suggest to Maurice and why?

(1 mark)

Option 1: It has a lower cost overall. **OR** He would own the truck after 4 years.

OR

Option 2: The monthly payment is lower.

Other answers are possible.

| Marking Key | |
|-------------|--|
| ① | 1 mark for appropriate work in (a) |
| ② | 1 mark for consistent total cost in (a) |
| ③ | 1 mark for appropriate work in (b) |
| ④ | 1 mark for consistent total cost in (b) |
| ⑤ | 1 mark for appropriate suggestion in (c) |

DESIGN AND MEASUREMENT

Question 22**Total: 1 mark**

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

Select the best answer.

How many cubic yards are in 54 cubic feet?

- A. 2
- B. 3
- C. 6
- D. 18

Question 23**Total: 1 mark**

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

One can of paint can cover an area of 200 ft².

How many cans need to be purchased to paint a 60 ft. by 8 ft. wall?

$$60 \text{ ft.} \times 8 \text{ ft.} = 480 \text{ ft}^2$$

$$\frac{480 \text{ ft}^2}{200 \text{ ft}^2} = 2.4$$

$$\Rightarrow 3 \text{ cans}$$

Three (3) cans of paint are needed.

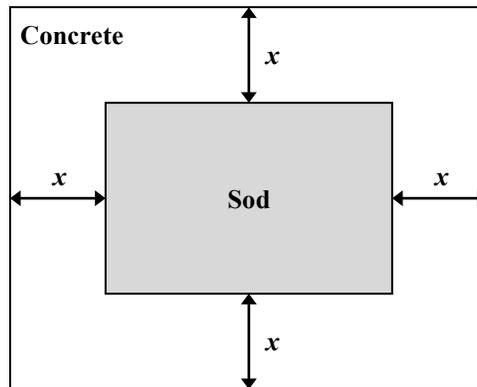
| Marking Key | |
|-------------|----------------------------------|
| 1 | <i>1 mark for correct answer</i> |

Question 24**Total: 5 marks**

Learning Outcome: 12A.D.1

Question Type: Constructed Response

James is landscaping his 50 ft. by 40 ft. yard. He will construct a concrete walkway with a uniform width of x around the centre of the yard which is to be covered in sod, as illustrated below. (Diagram is not drawn to scale.)



Consider the following:

- The walkway must be at least 3.5 feet wide.
 - The concrete must be poured 6 inches deep.
 - The concrete costs \$3.00 per cubic foot, plus GST and PST.
 - The sod costs \$0.40 per square foot, plus GST and PST.
 - The budget for this project is \$2150.00.
- a) Design a walkway that fits within the budget. Indicate the width of the walkway and the dimensions of the sod below.

(1 mark)

Width of the walkway (x): 4 ft.

Dimensions of the sod: 42 ft. by 32 ft.

Other answers are possible.

Question 24 continued

b) Calculate the total cost of your design. (Note: GST = 5%, PST = 8%)

(4 marks)

$$\begin{aligned} \text{Area of sod} &= 42 \text{ ft.} \times 32 \text{ ft.} \\ &= 1344 \text{ ft}^2 \end{aligned}$$

$$\begin{aligned} \text{Cost of sod} &= 1344 \text{ ft}^2 \times \$0.40 \\ &= \$537.60 \end{aligned}$$

$$\begin{aligned} \text{Cost} &= \$984.00 + \$537.60 \\ &= \$1521.60 \end{aligned}$$

$$\begin{aligned} \text{Area of walkway} &= (50 \text{ ft.} \times 40 \text{ ft.}) - 1344 \text{ ft}^2 \\ &= 656 \text{ ft}^2 \end{aligned}$$

$$\begin{aligned} \text{Volume of concrete} &= 0.5 \text{ ft.} \times 656 \text{ ft}^2 \\ &= 328 \text{ ft}^3 \end{aligned}$$

$$\begin{aligned} \text{Cost of concrete} &= 328 \text{ ft}^3 \times \$3.00 \\ &= \$984.00 \end{aligned}$$

$$\text{GST} = \$1521.60 \times 0.05 = \$76.08$$

$$\text{PST} = \$1521.60 \times 0.08 = \$121.73$$

$$\begin{aligned} \text{Total cost} &= \$1521.60 + \$76.08 + \$121.73 \\ &= \$1719.41 \end{aligned}$$

OR

| | | OR | OR |
|---------------------------------------|----------------|----------------|----------------|
| Width of walkway (ft.) | 3.5 | 5 | 6 |
| Dimensions of sod (ft.) | 43 × 33 | 40 × 30 | 38 × 28 |
| Area of sod (ft ²) | 1419 | 1200 | 1064 |
| Cost of sod (\$) | 567.60 | 480.00 | 425.60 |
| Area of walkway (ft ²) | 581 | 800 | 936 |
| Volume of concrete (ft ³) | 290.5 | 400 | 468 |
| Cost of concrete (\$) | 871.50 | 1200.00 | 1404.00 |
| GST + PST (\$) | 71.96 + 115.13 | 84.00 + 134.40 | 91.48 + 146.37 |
| Total cost (\$) | 1626.19 | 1898.40 | 2067.45 |

Other answers are possible.

Marker Note(s):

→ In order to fit within the parameters of the budget the width of the walkway must be between 3.50 ft. and 6.50 ft.

| Marking Key | |
|--------------------|---|
| 1 | 1 mark for appropriate dimensions of sod based on chosen width in (a) |
| 2 | 1 mark for correct area of sod in (b) |
| 3 | 1 mark for correct volume of concrete in (b) |
| 4 | 1 mark for consistent cost of sod and concrete in (b) |
| 5 | 1 mark for consistent total cost, including taxes, within budget in (b) |

LOGICAL REASONING

Question 25

Total: 1 mark

Learning Outcome: 12A.L.3

Question Type: Selected Response

Select the best answer.

What values of m and n correctly complete the following truth table?

| p | q | $p \rightarrow q$ |
|-------|-------|-------------------|
| True | True | True |
| True | False | m |
| False | True | n |
| False | False | True |

- A. $m = \text{True}$ $n = \text{True}$
- B. $m = \text{True}$ $n = \text{False}$
- C. $m = \text{False}$ $n = \text{True}$
- D. $m = \text{False}$ $n = \text{False}$

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

Consider this conditional statement:

“If x has a positive value, then $x^2 \geq x$.”

Provide a counterexample to the statement above.

$$\begin{aligned} \text{If } x &= \frac{1}{2} \\ \left(\frac{1}{2}\right)^2 &= \frac{1}{4} \\ \frac{1}{4} &< \frac{1}{2} \end{aligned}$$

Other answers are possible.

Marker Note(s):

→ Any decimal or fraction greater than zero and less than one will work (i.e., $0 < x < 1$).

| Marking Key | |
|-------------|---------------------------------------|
| 1 | 1 mark for appropriate counterexample |

Question 27**Total: 3 marks**

Learning Outcome: 12A.L.2

Question Type: Constructed Response

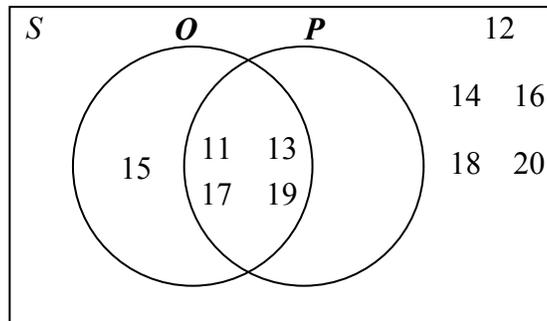
A universal set is defined as:

$$S = \{11, 12, 13, 14, 15, 16, 17, 18, 19, 20\}$$

Two subsets are given below:

$$O = \{\text{odd whole numbers of } S\}$$

$$P = \{\text{prime numbers of } S\}$$

a) Draw a Venn diagram to represent S , O , and P .*(1 mark)*b) Determine $O \cup P$.*(1 mark)*

$$O \cup P = \{11, 13, 15, 17, 19\}$$

c) Determine $n(O \cap P')$.*(1 mark)*

$$O \cap P' = \{15\}$$

$$n(O \cap P') = 1$$

Marking Key

- | | |
|---|--|
| ❶ | 1 mark for correct Venn diagram in (a) |
| ❷ | 1 mark for correct answer in (b) |
| ❸ | 1 mark for correct answer in (c) |

Exemplars

Exemplar 1

Question 3

Total: 2 marks

Sam is studying the characteristics of quadratic functions.

She states the following:

Statement 1: A quadratic function always has a degree of 2.

Statement 2: The graph of a quadratic function always extends from quadrant II to quadrant I.

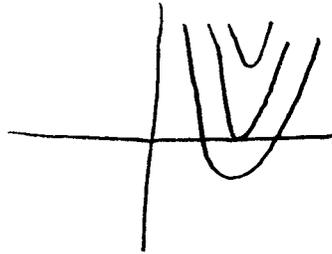
Statement 3: The graph of a quadratic function always has one turning point.

Statement 4: A quadratic function always has two x -intercepts.

Two of these statements are incorrect. Identify which statements are incorrect and provide a counterexample for each.

Statement 2

Statement 4



1 mark:

② → 1 mark for correct counterexample for Statement 4

Exemplar 2

Question 3

Total: 2 marks

Sam is studying the characteristics of quadratic functions.

She states the following:

Statement 1: A quadratic function always has a degree of 2.

Statement 2: The graph of a quadratic function always extends from quadrant II to quadrant I.

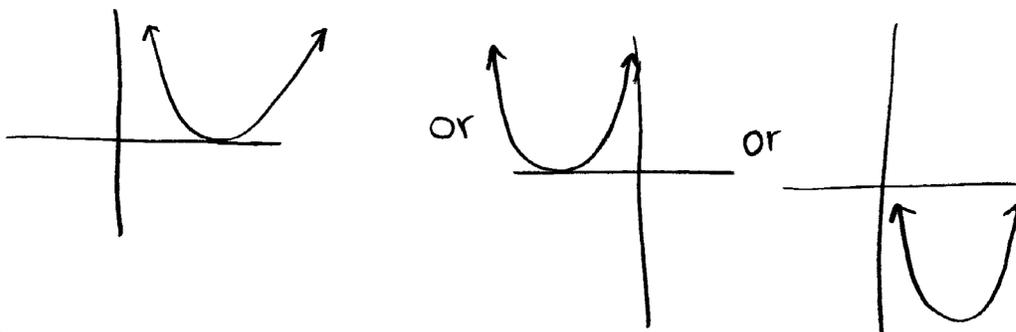
Statement 3: The graph of a quadratic function always has one turning point.

Statement 4: A quadratic function always has two x -intercepts.

Two of these statements are incorrect. Identify which statements are incorrect and provide a counterexample for each.

statement 2 : The graph of a quadratic function does not always extend from quadrant II to quadrant I

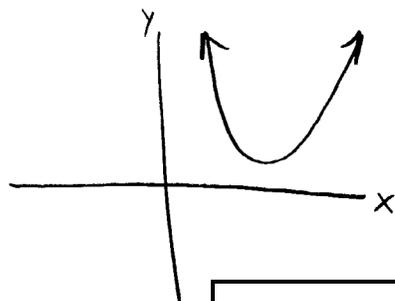
ex:



statement 4:

A quadratic function sometimes doesn't have an x -intercept

ex



1 mark:

② → 1 mark for correct counterexample for Statement 4

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Exemplar 1

Question 4

Total: 3 marks

The table below shows the electricity consumption in gigawatt-hours (GWh) of a large city since 1960.

| Years (since 1960) | Consumption (GWh) |
|-----------------------|----------------------|
| 0 | 11 967 |
| 10 | 21 139 |
| 20 | 19 877 |
| 30 | 19 173 |
| 40 | 23 333 |
| 50 | 24 087 |

- a) Determine the equation for the cubic regression that models the data.

(1 mark)

$$y = 0.448x^3 - 37.0058x^2 + 991.5142x + 12632.0689$$

↑
E3

- b) Using your equation in (a), estimate the electricity consumption in 2015.
Show your work and round your answer to the nearest whole value.

(2 marks)

in 2015 the electricity consumption will be 28676

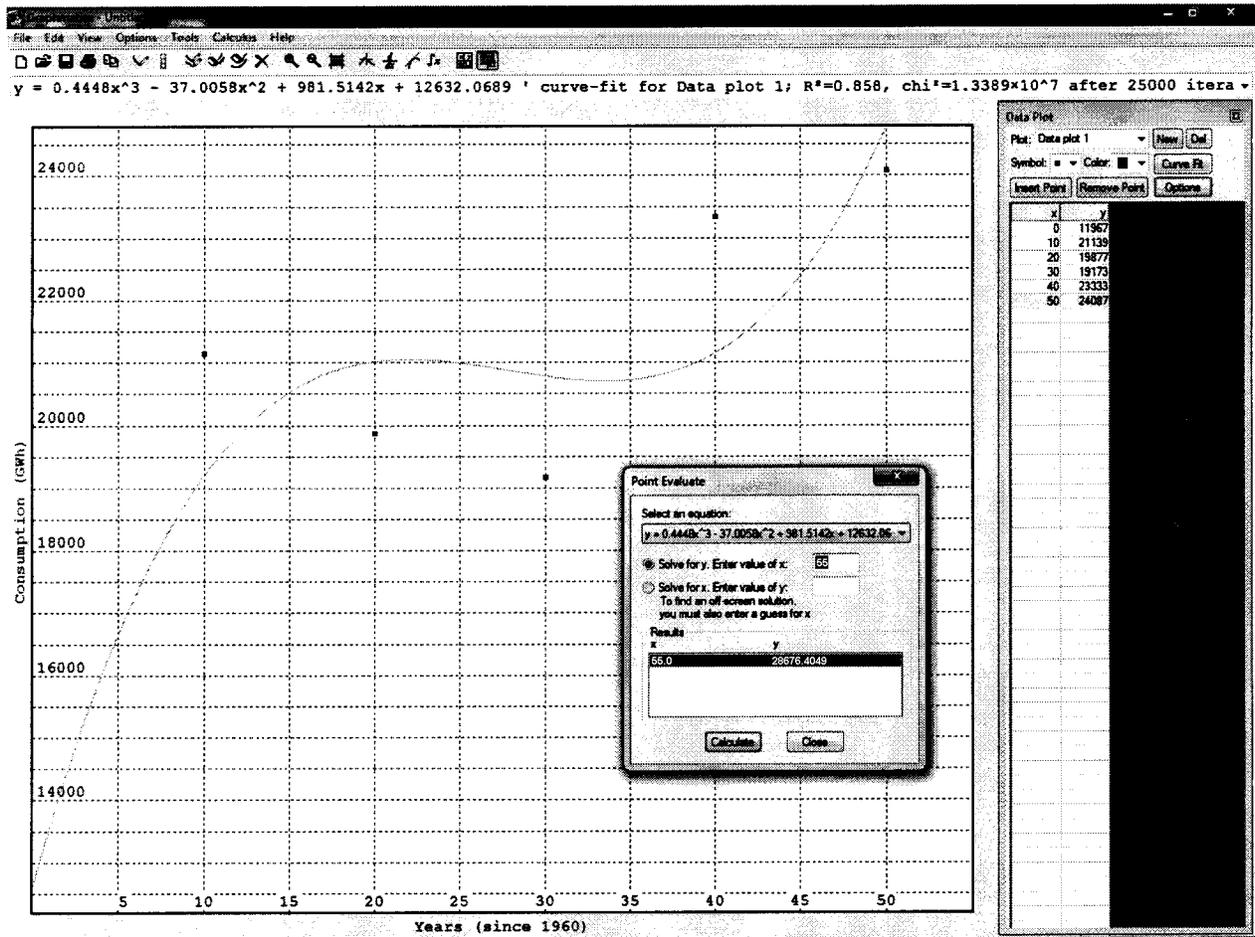
↑
E2

3 marks:

- ① → 1 mark for correct equation in (a)
- ② → 1 mark for appropriate work in (b)
- ③ → 1 mark for consistent answer in (b)

-
- E2 → does not include the units in the final answer
 - E3 → makes a transcription error (inaccurate transferring of information)

Exemplar 1 (continued)



Exemplar 1

Question 5

Total: 3 marks

George is diabetic and the amount of sugar in his blood (concentration) gradually decreases over time according to the function:

$$c = 9(0.995)^t$$

where c represents the concentration and t represents the time (in minutes).

His initial blood sugar concentration is 9.

- a) State the range in this situation.

(1 mark)

$0 < y \leq 9$

- b) George forgets to eat his morning snack. He experiences dizziness once his blood sugar concentration drops below 3. After how many minutes will this happen? Show your work.

(2 marks)

in 218 minutes his sugar concentration will drop below 3

1 mark:

① → 1 mark for correct range in (a)

Ⓔ1 → does not include braces when using set notation

Ⓔ4 → does not use a contextual variable when stating the domain or the range in set notation

Exemplar 2

Question 5

Total: 3 marks

George is diabetic and the amount of sugar in his blood (concentration) gradually decreases over time according to the function:

$$c = 9(0.995)^t$$

where c represents the concentration and t represents the time (in minutes).

His initial blood sugar concentration is 9.

- a) State the range in this situation.

(1 mark)

$$(-\infty, \infty)$$

- b) George forgets to eat his morning snack. He experiences dizziness once his blood sugar concentration drops below 3. After how many minutes will this happen? Show your work.

(2 marks)

$$x = 219.17$$

$$y = 3$$

↑
E4

↓
set $y=3$ on my
calculator and
got that answer

2 marks:

② → 1 mark for appropriate work in (b)

③ → 1 mark for consistent answer in (b)

.....
E4 → does not identify the answer
(e.g., TVM solver, Venn diagram)

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Exemplar 1

Question 6

Total: 6 marks

The top of a flagpole moves back and forth on a windy day. It sways 15 cm to the left (-15 cm) and 15 cm to the right (+15 cm) from its resting position (0 cm). It moves back and forth every two (2) seconds. At $t = 0$, the pole was at its resting position before swaying to the left.

a) Determine a sinusoidal equation that models this situation. Show your work.

(2 marks)

| time | height |
|------|--------|
| 0 | 0 |
| .5 | -15 |
| 1 | 0 |
| 1.5 | 15 |
| 2 | 0 |
| 2.5 | -15 |
| 3 | 0 |
| 3.5 | 15 |
| 4 | 0 |

$$\frac{30}{60} = .5$$

Equation

$$y = 15 \sin(3.14x + 3.14) - 3.97$$

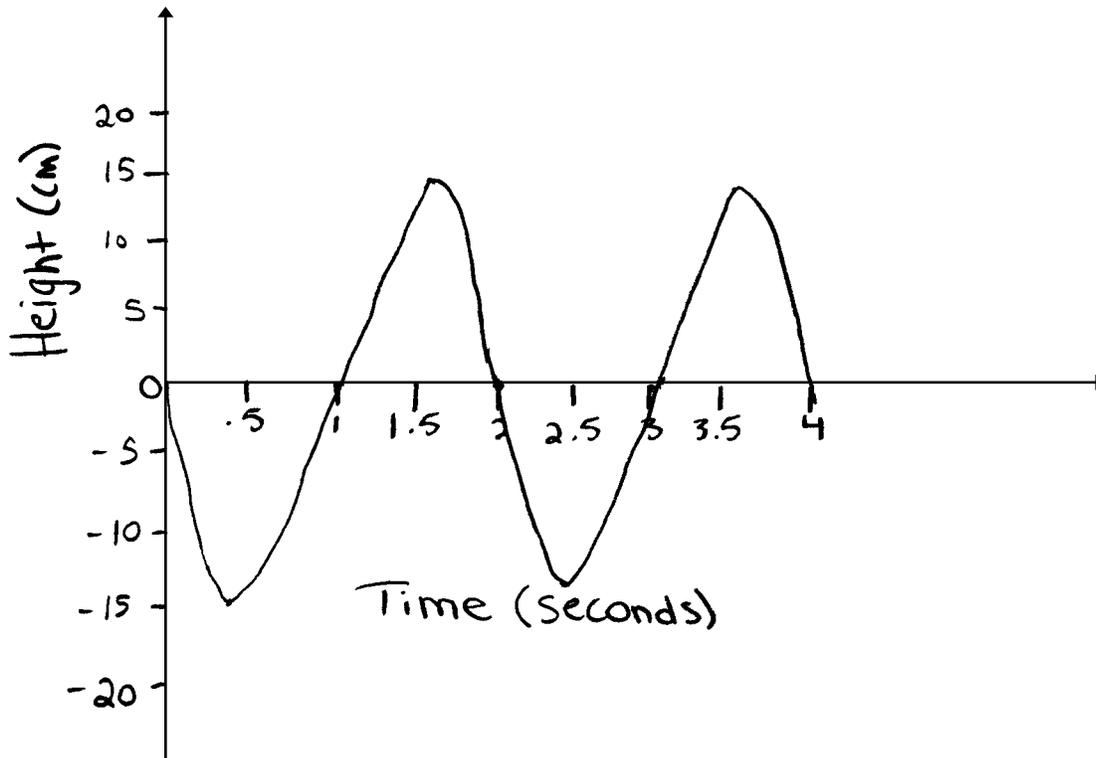
4 marks:

- ① → 1 mark for appropriate work in (a)
- ③ → 1 mark for communicating the context of the graph with appropriate title and/or labels in (b)
- ④ → 1 mark for using an appropriate domain and range (i.e., window settings/grid range) for the context of the question in (b)
- ⑤ → 1 mark for an appropriate shape that illustrates key characteristics of the function (e.g., maximum, minimum, intercepts) in (b)

Exemplar 1 (continued)

b) Graph the equation for two (2) full cycles.

(3 marks)



c) On an even windier day, the flagpole moves back and forth every second. Explain how your equation will change.

(1 mark)

$$\frac{60}{60} = 1$$

The equation will change because we will now be moving at 1 second every 60 times per minute instead of .5 seconds.

Exemplar 2

Question 6

Total: 6 marks

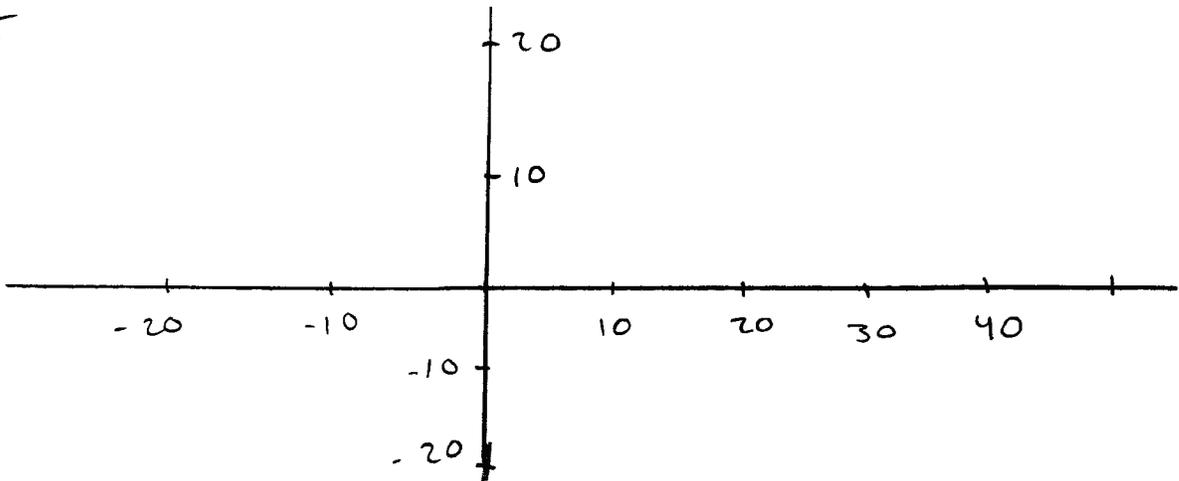
The top of a flagpole moves back and forth on a windy day. It sways 15 cm to the left (-15 cm) and 15 cm to the right (+15 cm) from its resting position (0 cm). It moves back and forth every two (2) seconds. At $t = 0$, the pole was at its resting position before swaying to the left.

a) Determine a sinusoidal equation that models this situation. Show your work.

(2 marks)

$$y = a \cdot \sin[b(x-c)] + d \quad b = \frac{2\pi}{30} = \frac{\pi}{15}$$

$$\begin{aligned} a &= 15 \\ b &= \frac{\pi}{15} \\ c &= 5 \\ d &= 0 \end{aligned}$$



$$y = 15 \cdot \sin\left[\frac{\pi}{15}(x-5)\right]$$

3 marks:

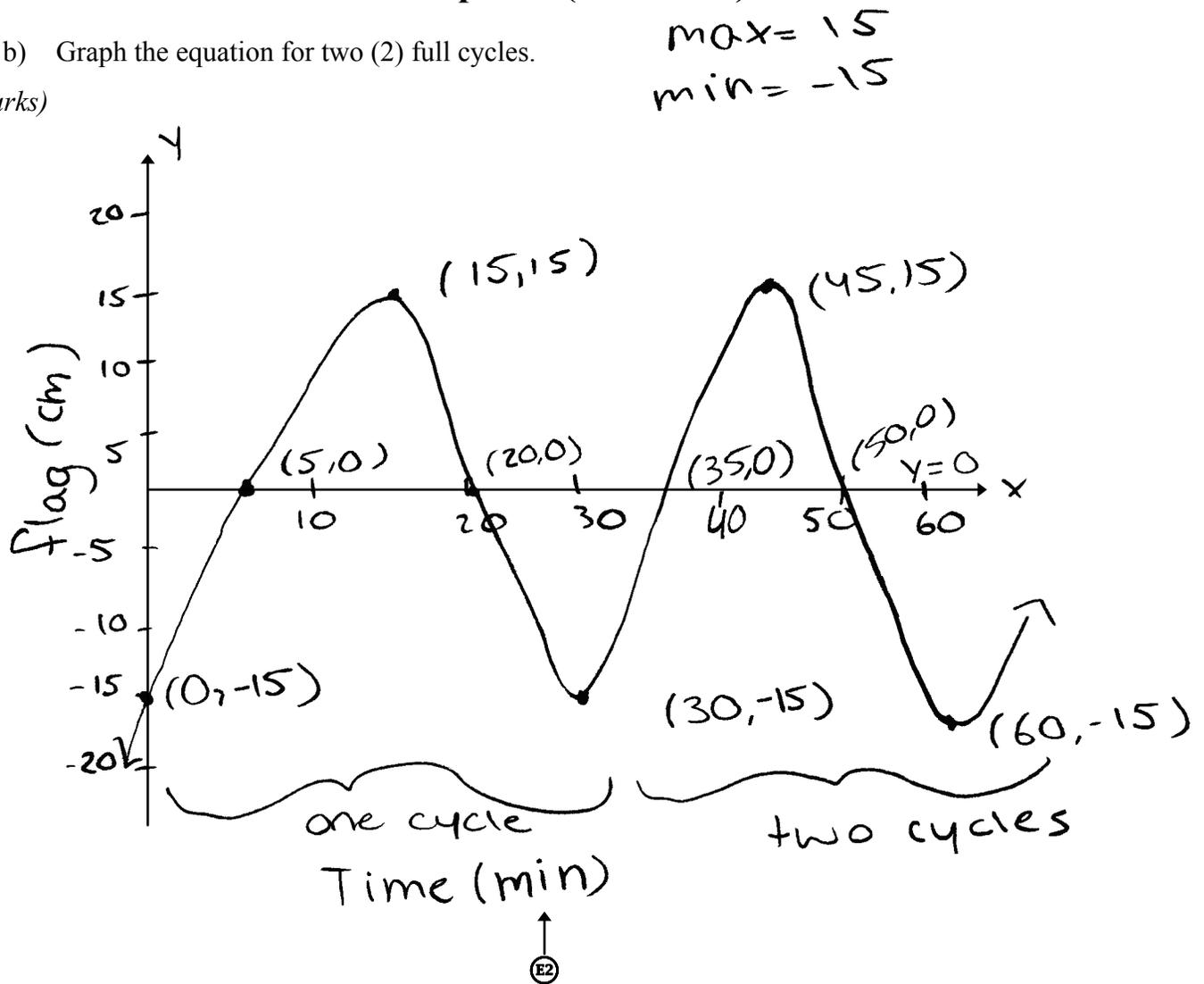
- ① → 1 mark for appropriate work in (a)
- ③ → 1 mark for communicating the context of the graph with appropriate title and/or labels in (b)
- ④ → 1 mark for using an appropriate domain and range (i.e., window settings/grid range) for the context of the question in (b)

ⓔ → uses incorrect units of measure

Exemplar 2 (continued)

b) Graph the equation for two (2) full cycles.

(3 marks)



c) On an even windier day, the flagpole moves back and forth every second. Explain how your equation will change.

(1 mark)

your b value will change

$$\frac{2\pi}{60} \rightarrow \frac{\pi}{30}$$

This will create double as many rises and falls in a period.

Exemplar 3

Question 6

Total: 6 marks

The top of a flagpole moves back and forth on a windy day. It sways 15 cm to the left (−15 cm) and 15 cm to the right (+15 cm) from its resting position (0 cm). It moves back and forth every two (2) seconds. At $t = 0$, the pole was at its resting position before swaying to the left.

a) Determine a sinusoidal equation that models this situation. Show your work.

(2 marks)

$a = 15$



$$a \sin bx + c + d$$

Remembering

- Ⓐ = amp
- Ⓑ = number of cycles
- c = shift
- d = midline

Period = $\frac{d}{360}$ $\frac{d}{2\pi}$

\uparrow

Ⓔ1

$15 \sin(30x)$

3 marks:

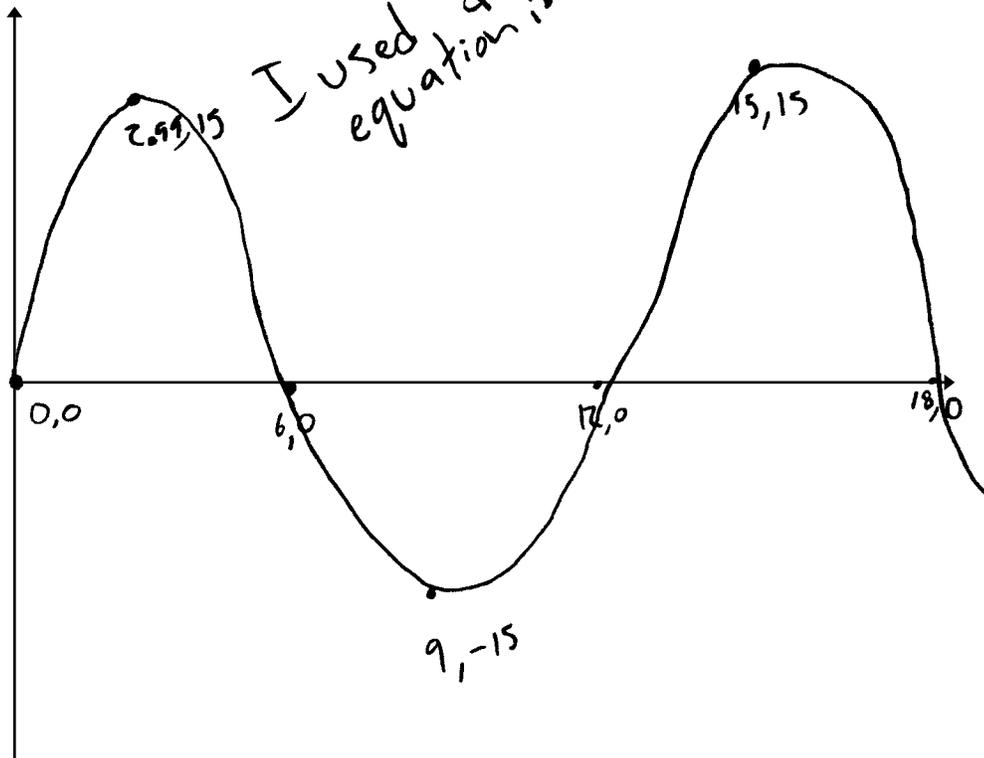
- Ⓐ → 1 mark for appropriate work in (a)
- Ⓑ → 1 mark for an appropriate shape that illustrates key characteristics of the function (e.g., maximum, minimum, intercepts) in (b)
- Ⓒ → 1 mark for correct explanation in (c)

- Ⓔ1 → does not include one of the following in the equation: “y =”, “sin”, “ln”, or “x”, or writes parameters separately from the equation

Exemplar 3 (continued)

b) Graph the equation for two (2) full cycles.

(3 marks)



c) On an even windier day, the flagpole moves back and forth every second. Explain how your equation will change.

(1 mark)

the b value will double.

$$15 \sin(90x)$$

vs

$$15 \sin(60x)$$

Exemplar 1

Question 9

Total: 1 mark

The probability of rain is 60%. What are the odds against rain?

40% : 60%

1 mark:

① → 1 mark for correct answer

Exemplar 2

Question 9

Total: 1 mark

The probability of rain is 60%. What are the odds against rain?

.40

0 marks:
→ no criteria met

Exemplar 1

Question 10**Total: 1 mark**

A pizza place offers the following choices:

- 3 types of crust
- 2 types of sauce
- 5 types of cheese
- 6 meat toppings
- 8 vegetable toppings

Charles would like to create a pizza by choosing one item from each category. Determine how many different pizzas can be made.

$$3! \times 2! \times 5! \times 6! \times 8! = 4,18e10$$

0 marks:
→ no criteria met

Exemplar 2

Question 10

Total: 1 mark

A pizza place offers the following choices:

- 3 types of crust
- 2 types of sauce
- 5 types of cheese
- 6 meat toppings
- 8 vegetable toppings

Charles would like to create a pizza by choosing one item from each category. Determine how many different pizzas can be made.

$$\frac{3}{\text{crust}} \times \frac{2}{\text{sauce}} \times \frac{5}{\text{cheese}} \times \frac{6}{\text{meat}} \times \frac{8}{\text{veggie}} = 1440$$

1140 different pizzas can be made.

ⓔ3

1 mark:

① → 1 mark for correct answer

ⓔ3 → makes a transcription error (inaccurate transferring of information)

Exemplar 1

Question 11**Total: 1 mark**

Create a scenario where the calculation ${}_8C_5 \times {}_9C_2$ would be appropriate.

having a party and having to choose
5 of 8 friends and also having to
choose 2 out of 9 flavours of icecream

1 mark:

① → 1 mark for appropriate scenario

Exemplar 2

Question 11

Total: 1 mark

Create a scenario where the calculation ${}_8C_5 \times {}_9C_2$ would be appropriate.

having a group of 17 people and making two smaller groups, choosing 5 people for the first one and 2 people for the second one

0 marks:
→ no criteria met

Exemplar 1

Question 12

Total: 2 marks

A contractor has five workers he can assign to a task. How many ways can the contractor assign at least one worker to the task?

*5 P 5 = 120 ways he can
Assign workers.*

OR
 $5 \cdot 4 \cdot 3 \cdot 2 \cdot 1 = 5!$ which equals 120 ways.

0 marks:
→ no criteria met

Exemplar 2

Question 12

Total: 2 marks

A contractor has five workers he can assign to a task. How many ways can the contractor assign at least one worker to the task?

$$\begin{aligned}5_n P_r 5 &= 120 \text{ ways} \\5_n P_r 4 &= 120 \text{ ways} \\5_n P_r 3 &= 60 \text{ ways} \\5_n P_r 2 &= 20 \text{ ways} \\5_n P_r 1 &= 5 \text{ ways}\end{aligned}$$

$$120 + 120 + 60 + 20 + 5 = 325 \text{ ways}$$

1 mark:

② → 1 mark for consistent answer

Exemplar 1

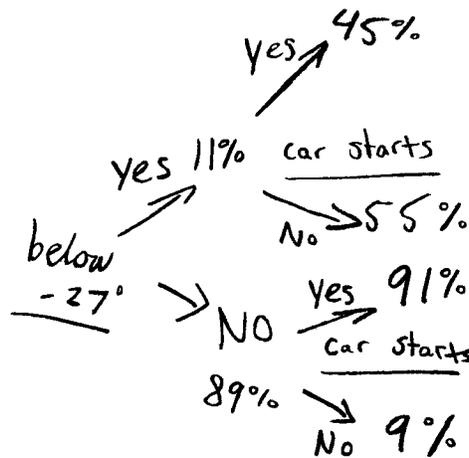
Question 13

Total: 3 marks

On January 21, the probability of the overnight low temperature being below -27°C is 11%. If the temperature is below -27°C , the probability of Cara's car starting is 55%. If it is not below -27°C , the probability of Cara's car starting is 91%.

- a) Create a graphic organizer to represent all possibilities for this situation.

(1 mark)



- b) What is the probability that Cara's car will not start on January 21? Show your work.

(2 marks)

$$\begin{aligned} .11 \times .55 &= .06 \\ .89 \times .09 &= .08 \end{aligned} \quad \begin{array}{l} \diagdown \\ \diagup \end{array} = 1.4$$

the chances of her car
not starting are 1.4%

1 mark:

① → 1 mark for graphic organizer in (a)

Exemplar 2

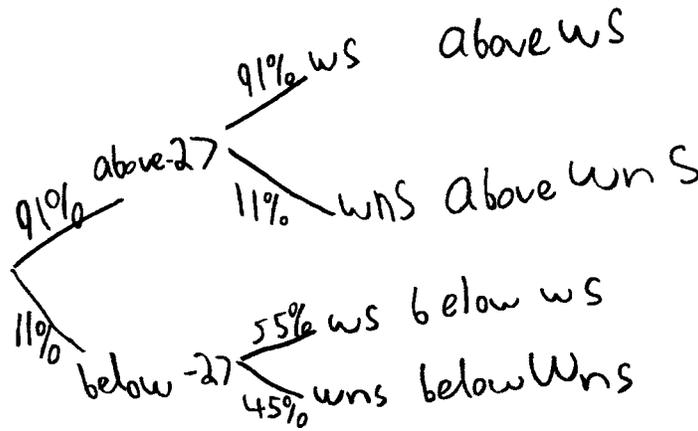
Question 13

Total: 3 marks

On January 21, the probability of the overnight low temperature being below -27°C is 11%. If the temperature is below -27°C , the probability of Cara's car starting is 55%. If it is not below -27°C , the probability of Cara's car starting is 91%.

- a) Create a graphic organizer to represent all possibilities for this situation.

(1 mark)



- b) What is the probability that Cara's car will not start on January 21? Show your work.

(2 marks)

$$\begin{array}{l}
 .91 \times .11 = .1 \\
 .11 \times .45 = .05
 \end{array}
 \left. \vphantom{\begin{array}{l} .91 \times .11 = .1 \\ .11 \times .45 = .05 \end{array}} \right\}
 \begin{array}{l}
 .1 + .05 = .15 \\
 \text{15\%}
 \end{array}$$

(ES)

2 marks:

- ① → 1 mark for graphic organizer in (a)
- ② → 1 mark for consistent answer in (b)

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

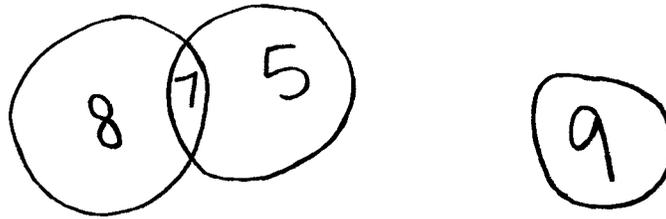
Exemplar 1

Question 14**Total: 3 marks**

A teacher surveys her class of 29 students and finds out that in the past week, 15 students worked on an assignment, 12 students studied for a test, and 7 students did both.

- a) How many students did not work on an assignment nor study for a test?

(1 mark)



- b) The teacher decides to randomly put students in groups of three for a class project. What is the probability that all three members of a group will not have worked on an assignment nor studied for a test?

(2 marks)

9/20

1 mark:

① → 1 mark for correct answer in (a)

Exemplar 2

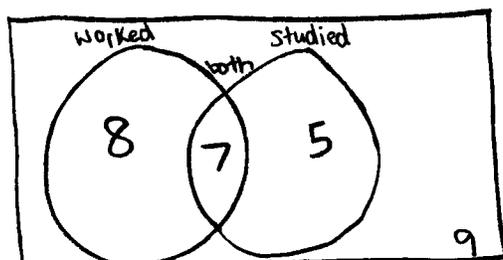
Question 14

Total: 3 marks

A teacher surveys her class of 29 students and finds out that in the past week, 15 students worked on an assignment, 12 students studied for a test, and 7 students did both.

- a) How many students did not work on an assignment nor study for a test?

(1 mark)



$$15 - 7 = 8$$
$$12 - 7 = 5$$

did neither

$$29 - 7 - 8 - 5 = 9$$

- b) The teacher decides to randomly put students in groups of three for a class project. What is the probability that all three members of a group will not have worked on an assignment nor studied for a test?

(2 marks)

$$P(\text{not working or studying}) = \frac{20}{29} - \frac{9}{29} = \frac{11}{29}$$

1 mark:

① → 1 mark for correct answer in (a)

Exemplar 1

Question 15

Total: 2 marks

There are 50 high school students in a small town. The school's cross-country coach wants to randomly select 9 students to form a team.

- a) How many different teams can be created?

(1 mark)

$$\underline{50} \cdot \underline{49} \cdot \underline{48} \cdot \underline{47} \cdot \underline{46} \cdot \underline{45} \cdot \underline{44} \cdot \underline{43} \cdot \underline{42} =$$

9.09E14 ways a team could be created.

- b) The coach rents a van and drives his team to the race. Calculate the number of ways the students can be seated, if there are 9 passenger seats.

(1 mark)

$$\underline{9} \cdot \underline{8} \cdot \underline{7} \cdot \underline{6} \cdot \underline{5} \cdot \underline{4} \cdot \underline{3} \cdot \underline{2} \cdot \underline{1} = 362,880$$

ways the students can be seated.

1 mark:

② → 1 mark for correct answer in (b)

Exemplar 1

Question 17

Total: 4 marks

Deema is saving for a home renovation. She deposits \$50.00 every month into a new high-interest savings account that earns 4.60%, compounded monthly.

a) What will be the value in Deema's account after 4 years? Show your work.

(2 marks)

$$\begin{aligned} N &= 4 \times 12 = 48 \\ I &= 4.6 \\ PV &= 50 \\ PMT &= -50 \\ \hline FV &= 2569.395131 \\ \hline P/Y &= 12 \\ C/Y &= 12 \end{aligned}$$

\$2569.40 after 4 years

b) How much interest will she have earned after 4 years? Show your work.

(2 marks)

$$50 \times 12 = 600 \times 4 = 2400$$

$$\begin{array}{r} 2569.40 \\ 2400.00 \\ \hline \$169.40 \text{ in interest} \end{array}$$

3 marks:

- ① → 1 mark for appropriate work in (a)
- ③ → 1 mark for appropriate work in (b)
- ④ → 1 mark for consistent answer in (b)

Exemplar 2

Question 17

Total: 4 marks

Deema is saving for a home renovation. She deposits \$50.00 every month into a new high-interest savings account that earns 4.60%, compounded monthly.

a) What will be the value in Deema's account after 4 years? Show your work.

(2 marks)

$$\begin{aligned} N &= 4 \times 12 \\ I &= 4.6 \\ PV &= 0 \\ PMT &= -50 \\ FV &= ? \\ P/Y &= 12 \\ C/Y &= 12 \end{aligned} \rightarrow \boxed{\$ 2639.55}$$

b) How much interest will she have earned after 4 years? Show your work.

(2 marks)

$$\begin{aligned} &\Sigma \text{int}(1, 48) \\ &\boxed{\text{int} = \$ 229.47} \end{aligned}$$

4 marks:

- ① → 1 mark for appropriate work in (a)
- ② → 1 mark for consistent answer in (a)
- ③ → 1 mark for appropriate work in (b)
- ④ → 1 mark for consistent answer in (b)

Exemplar 1

Question 18

Total: 2 marks

Lisette is 50 years old and would like to retire at age 55. Her assets include \$60 000.00 in a guaranteed investment certificate (GIC), \$78 000.00 in a chequing account, and \$192 000.00 in stocks.

Make two recommendations to help Lisette strengthen her investment portfolio. Justify your recommendations.

I would suggest Lisette to invest more money in GIC instead of stocks because stocks aren't as safe as GIC investments & she is old so it's a greater risk as well.

As well as the money she has on her chequing account to put it into a saving account so she can receive interest on the money.

2 marks:

- ① → 1 mark for justification of first recommendation
- ② → 1 mark for justification of second recommendation

Exemplar 2

Question 18

Total: 2 marks

Lisette is 50 years old and would like to retire at age 55. Her assets include \$60 000.00 in a guaranteed investment certificate (GIC), \$78 000.00 in a chequing account, and \$192 000.00 in stocks.

Make two recommendations to help Lisette strengthen her investment portfolio. Justify your recommendations.

5 yrs

She should invest her \$192 000.00 that she has in stocks in a GIC, because investing in stocks can be risky because the market can drop and she can lose all of her money. But if she invest her money in GIC she will have her money back no matter what, because it's guaranteed.

She should invest some of her \$78 000 that she has in a chequing account, because she can spend it all, but if she invests in an account where you can only get your money back after the 5 years she will have her money, and plus it will have grow, so she will have more money.

2 marks:

- ① → 1 mark for justification of first recommendation
- ② → 1 mark for justification of second recommendation

Exemplar 1

Question 19

Total: 2 marks

Serge invests \$12 000.00 on his 30th birthday. If his investment earns 6.00% interest, compounded annually, apply the Rule of 72 to estimate how much money he will have when he retires on his 66th birthday.

TVM Solver:

$$N = 36$$

$$I = 6$$

$$PV = -1200$$

$$PMT = 0$$

$$FV = 2$$

$$P/Y = 1$$

$$C/Y = 1$$

$$\longrightarrow \boxed{=\$97767.02}$$

0 marks:

→ no criteria met

Exemplar 2

Question 19

Total: 2 marks

Serge invests \$12 000.00 on his 30th birthday. If his investment earns 6.00% interest, compounded annually, apply the Rule of 72 to estimate how much money he will have when he retires on his 66th birthday.

$$\begin{aligned} t &= \frac{72}{i} && \text{TVM-solver} \\ & && N = 36 \\ & && I = 6 \\ t &= \frac{72}{6} && PV = -12000 \\ & && PMT = 0 \\ & && FV = \underline{97767.02} \\ t &= 12 && P/Y = 1 \\ & && C/Y = 1 \end{aligned}$$

he will have \$97767.02
when he retires on his
66th birthday

1 mark:

① → 1 mark for correct doubling time

Exemplar 1

Question 20

Total: 3 marks

Harsimran invested \$20 000.00 in a simple interest savings bond. After 12 years, the future value of the bond was \$26 768.00.

a) Determine the annual interest rate.

(2 marks)

$$26768 = (20000)r(12)$$

$$r = \frac{26768}{240000} = 0.1115$$

Annual interest rate is 11.15%

b) Determine the rate of return.

(1 mark)

$$\text{rate of return} = \frac{(26768 - 20000)}{20000} \times 100 = 33.84\%$$

2 marks:

- ① → 1 mark for appropriate work in (a)
- ② → 1 mark for correct answer in (b)

Exemplar 2

Question 20

Total: 3 marks

Harsimran invested \$20 000.00 in a simple interest savings bond. After 12 years, the future value of the bond was \$26 768.00.

a) Determine the annual interest rate.

(2 marks)

$$I = Prt$$
$$\$ 6768 = 20\,000 \times r \times 12$$
$$\frac{6768}{24\,000} = \frac{240\,000r}{24\,000}$$
$$\boxed{0.03 = r}$$

⬆
E4

$$\begin{array}{r} 26\,768.00 \\ - 20\,000.00 \\ \hline \$ 6768.00 \end{array}$$

b) Determine the rate of return.

(1 mark)

$$\frac{\text{Current Value} - \text{previous value}}{\text{previous}} \times 100$$

$$\frac{26\,768.00 - 20\,000.00}{20\,000.00} \times 100 = 33.84$$

$$\text{Rate of return} = 33.84\%$$

3 marks:

- ① → 1 mark for appropriate work in (a)
- ② → 1 mark for consistent answer in (a)
- ③ → 1 mark for correct answer in (b)

E4 → incorrectly states the final answer

Exemplar 1

Question 21

Total: 5 marks

Maurice needs a truck for his new job that will last four years. He has the following two options:

Option 1: He can purchase the truck for \$45 194.35 (taxes included) with no down payment, at an interest rate of 4.00%, compounded monthly, for four years.

Option 2: He can lease the same truck for four years with a down payment of \$5000.00 and monthly payments of \$850.00 (taxes included). He would be allowed 20 000 km per year and there is a \$0.18 per km (taxes included) charge above this limit.

- a) What would be Maurice's total cost in Option 1 if he makes monthly payments? Show your work.

(2 marks)

$$\begin{aligned}
 N &= 48 \\
 I &= 4\% \\
 PV &= \$45,194.35 \\
 PMT &= 0 \\
 FV &= \$530,219.5 \\
 P/Y &= 12 \\
 C/Y &= 12
 \end{aligned}$$

\$530,219.5 total cost

- b) If Maurice drives 25 000 km annually, what would be his total cost in Option 2? Show your work.

(2 marks)

$$\begin{aligned}
 850(12 \cdot 4) &= \overset{\text{down}}{\$40800} + 5000 \\
 (25000 - 20000)(0.18)(4) &= \$3600
 \end{aligned}$$

$$\begin{array}{r}
 45800 \\
 + 3600 \\
 \hline
 \end{array}$$

\$49400 is the total cost

- c) Which option would you suggest to Maurice and why?

(1 mark)

Option 1 because it is his to own and he can sell or rent it out

3 marks:

- ③ → 1 mark for appropriate work in (b)
- ④ → 1 mark for consistent total cost in (b)
- ⑤ → 1 mark for appropriate suggestion in (c)

Exemplar 2

Question 21

Total: 5 marks

Maurice needs a truck for his new job that will last four years. He has the following two options:

Option 1: He can purchase the truck for \$45 194.35 (taxes included) with no down payment, at an interest rate of 4.00%, compounded monthly, for four years.

Option 2: He can lease the same truck for four years with a down payment of \$5000.00 and monthly payments of \$850.00 (taxes included). He would be allowed 20 000 km per year and there is a \$0.18 per km (taxes included) charge above this limit.

- a) What would be Maurice's total cost in Option 1 if he makes monthly payments? Show your work.

(2 marks)

| | |
|---------------------------------------|---|
| Transaction Type | |
| <input type="radio"/> Investment | <input type="radio"/> Retirement Plan |
| <input checked="" type="radio"/> Loan | <input type="radio"/> (?) |
| Payment Frequency (per year) | |
| <input type="radio"/> 1 | <input type="radio"/> 2 |
| <input type="radio"/> 4 | <input checked="" type="radio"/> 12 |
| <input type="radio"/> 24 | <input type="radio"/> 26 |
| <input type="radio"/> 365 | <input type="radio"/> (?) |
| Compound Frequency (per year) | |
| <input type="radio"/> 1 | <input type="radio"/> 2 |
| <input type="radio"/> 4 | <input checked="" type="radio"/> 12 |
| <input type="radio"/> 24 | <input type="radio"/> 26 |
| <input type="radio"/> 365 | <input type="radio"/> (?) |
| Financial Details | |
| Initial Loan Amount: | 45194.35 |
| Final Loan Balance: | 0.00 |
| Monthly Payment: | 1020.45 |
| Interest Rate (%): | 4.00 |
| # Years: | 4 |
| Make Payment at: | <input type="radio"/> Start or <input checked="" type="radio"/> End of Period |
| Financial Summary | |
| Loan Principal Paid: | 45194.35 |
| Interest Charged: | 3787.04 |
| Total Loan Payment: | 48981.39 |

He would have to pay \$1020.45 monthly

- b) If Maurice drives 25 000 km annually, what would be his total cost in Option 2? Show your work.

(2 marks)

$$3600 + 40800 + 5000 = \$49400$$

- c) Which option would you suggest to Maurice and why?

(1 mark)

Option 1 drive for as much as you want and it is cheaper but bigger monthly payments

4 marks:

- ① → 1 mark for appropriate work in (a)
- ③ → 1 mark for appropriate work in (b)
- ④ → 1 mark for consistent total cost in (b)
- ⑤ → 1 mark for appropriate suggestion in (c)

Exemplar 1

Question 23

Total: 1 mark

One can of paint can cover an area of 200 ft².

How many cans need to be purchased to paint a 60 ft. by 8 ft. wall?

$$60 \times 8 = 480$$

$$\frac{480}{200} = 2.4 \text{ cans need to be purchased}$$

↑
ⓔⓖ

1 mark:

① → 1 mark for correct answer

ⓔⓖ → does not use whole units for materials purchased in design and measurement questions

Exemplar 2

Question 23

Total: 1 mark

One can of paint can cover an area of 200 ft^2 .

How many cans need to be purchased to paint a 60 ft. by 8 ft. wall?

3

1 mark:

① → 1 mark for correct answer

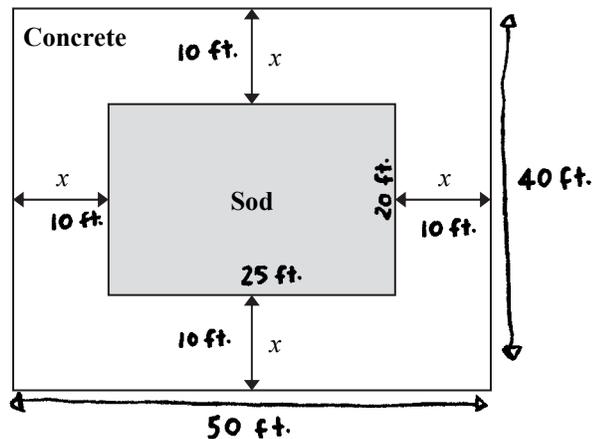
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Exemplar 1

Question 24

Total: 5 marks

James is landscaping his 50 ft. by 40 ft. yard. He will construct a concrete walkway with a uniform width of x around the centre of the yard which is to be covered in sod, as illustrated below. (Diagram is not drawn to scale.)



Consider the following:

- The walkway must be at least 3.5 feet wide.
- The concrete must be poured 6 inches deep.
- The concrete costs \$3.00 per cubic foot, plus GST and PST.
- The sod costs \$0.40 per square foot, plus GST and PST.
- The budget for this project is \$2150.00.

- a) Design a walkway that fits within the budget. Indicate the width of the walkway and the dimensions of the sod below.

(1 mark)

Width of the walkway (x): 10 ft.

Dimensions of the sod: 25 ft. by 20 ft.

Exemplar 1 (continued)

b) Calculate the total cost of your design. (Note: GST = 5%, PST = 8%)

(4 marks)

$$6 \text{ in.} \cdot \frac{1 \text{ ft.}}{12 \text{ in.}} = 0.5 \text{ ft.}$$

$$\text{Sod} = 25 \times 20 = 500 \text{ ft}^2$$

$$0.40 \times 500 = \$200.00$$

$$\text{GST} = 200 \times 0.05 = 10$$

$$\text{PST} = 200 \times 0.08 = 16$$

$$200 + 10 + 16 = \$226.00 \text{ for the Sod}$$

$$\text{Concrete} = 30 \times 20 = 600 \text{ ft}^2$$

$$3.00 \times 600 = \$1800.00$$

$$\text{GST} = 1800 \times 0.05 = 90$$

$$\text{PST} = 1800 \times 0.08 = 144$$

$$1800 + 90 + 144 = \$2034.00 \text{ for the concrete}$$

$$2034.00 + 226.00 = \boxed{\$2260.00} \text{ is the total cost}$$

for the project

2 marks:

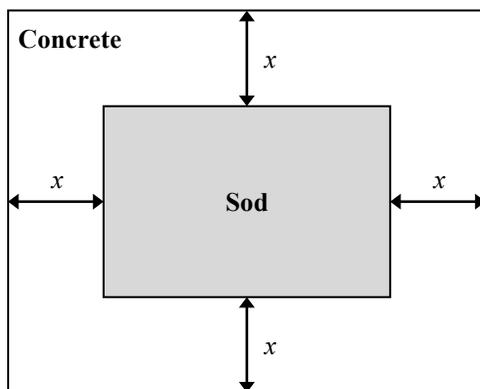
- ② → 1 mark for correct area of sod in (b)
- ④ → 1 mark for consistent cost of sod and concrete in (b)

Exemplar 2

Question 24

Total: 5 marks

James is landscaping his 50 ft. by 40 ft. yard. He will construct a concrete walkway with a uniform width of x around the centre of the yard which is to be covered in sod, as illustrated below. (Diagram is not drawn to scale.)



Consider the following:

- The walkway must be at least 3.5 feet wide.
- The concrete must be poured 6 inches deep.
- The concrete costs \$3.00 per cubic foot, plus GST and PST.
- The sod costs \$0.40 per square foot, plus GST and PST.
- The budget for this project is \$2150.00.

- a) Design a walkway that fits within the budget. Indicate the width of the walkway and the dimensions of the sod below.

(1 mark)

Width of the walkway (x): 4 ft.

Dimensions of the sod: 42 ft. by 32 ft.

Exemplar 2 (continued)

b) Calculate the total cost of your design. (Note: GST = 5%, PST = 8%)

(4 marks)

concrete

$$40 \times 4 \times 0.5 \times 2 = 160 \text{ft}^3 \quad 40'$$

$$4 \times 42 \times 0.5 \times 2 = 168 \text{ft}^3$$

$$\text{Total} = 328 \text{ft}^3$$

cost

$$328 \times 3 = \$984$$

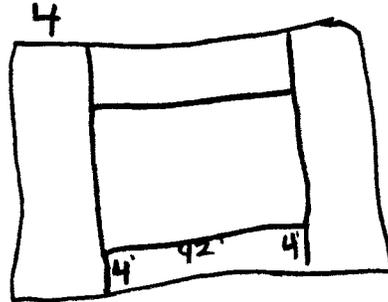
sod cost

$$42 \times 32 = 1344 \text{ft}^2$$

$$0.40 \times 1344 = \$537.60$$

Total cost

$$984 + 537.60 = \$1521.60$$



4 marks:

- ① → 1 mark for appropriate dimensions of sod based on chosen width in (a)
- ② → 1 mark for correct area of sod in (b)
- ③ → 1 mark for correct volume of concrete in (b)
- ④ → 1 mark for consistent cost of sod and concrete in (b)

Exemplar 1

Question 26

Total: 1 mark

Consider this conditional statement:

“If x has a positive value, then $x^2 \geq x$.”

Provide a counterexample to the statement above.

$$\begin{array}{l} \underline{x = 0.5} \\ 0.5^2 = 0.25 \\ 0.25 < 0.5 \end{array}$$

1 mark:

① → 1 mark for appropriate counterexample

Exemplar 2

Question 26

Total: 1 mark

Consider this conditional statement:

“If x has a positive value, then $x^2 \geq x$.”

Provide a counterexample to the statement above.

$0.5^2 = 0.25$ so if x is less than 1 then
the statement is false

1 mark:

① → 1 mark for appropriate counterexample

Exemplar 1

Question 27

Total: 3 marks

A universal set is defined as:

$$S = \{11, 12, 13, 14, 15, 16, 17, 18, 19, 20\}$$

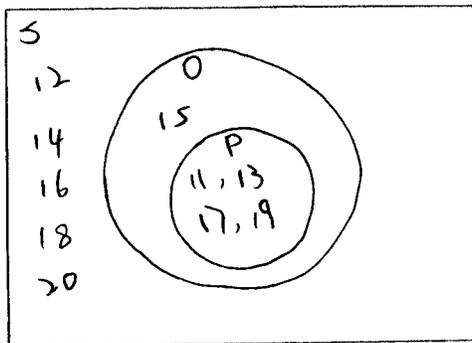
Two subsets are given below:

$$O = \{\text{odd whole numbers of } S\}$$

$$P = \{\text{prime numbers of } S\}$$

a) Draw a Venn diagram to represent S , O , and P .

(1 mark)



b) Determine $O \cup P$.

(1 mark)

$$O \cup P = 11, 13, 15, 17, 19$$

↑
E1

c) Determine $n(O \cap P')$.

(1 mark)

$$n(O \cap P) = 4$$

2 marks:

① → 1 mark for correct Venn diagram in (a)

② → 1 mark for correct answer in (b)

E1 → does not include braces when using set notation

Exemplar 2

Question 27

Total: 3 marks

A universal set is defined as:

$$S = \{11, 12, 13, 14, 15, 16, 17, 18, 19, 20\}$$

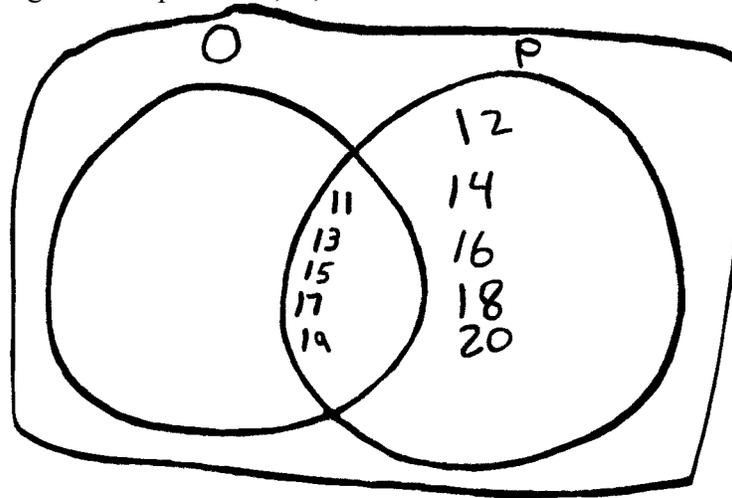
Two subsets are given below:

$$O = \{\text{odd whole numbers of } S\}$$

$$P = \{\text{prime numbers of } S\}$$

a) Draw a Venn diagram to represent S , O , and P .

(1 mark)



b) Determine $O \cup P$.

(1 mark)

$$(O \cup P) = \{11, 13, 15, 17, 19\}$$

c) Determine $n(O \cap P)$.

(1 mark)

$$n(O \cap P) = 5$$

1 mark:

② → 1 mark for correct answer 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, 12A.R.2 | 1 |
| A | 2 | SR | 12A.R.1 | 1 |
| A | 3 | CR | 12A.R.1 | 2 |
| A | 4 | CR | 12A.R.1 | 3 |
| A | 5 | CR | 12A.R.2 | 3 |
| A | 6 | CR | 12A.R.3 | 6 |
| Total = 16 | | | | |
| B | 7 | SR | 12A.P.2 | 1 |
| B | 8 | SR | 12A.P.3 | 1 |
| B | 9 | CR | 12A.P.1 | 1 |
| B | 10 | CR | 12A.P.4 | 1 |
| B | 11 | CR | 12A.P.6 | 1 |
| B | 12 | CR | 12A.P.6 | 2 |
| B | 13 | CR | 12A.P.3 | 3 |
| B | 14 | CR | 12A.P.2, 12A.P.3 | 3 |
| B | 15 | CR | 12A.P.5, 12A.P.6 | 2 |
| Total = 15 | | | | |
| C | 16 | SR | 12A.FM.1 | 1 |
| C | 17 | CR | 12A.FM.3 | 4 |
| C | 18 | CR | 12A.FM.3 | 2 |
| C | 19 | CR | 12A.FM.3 | 2 |
| C | 20 | CR | 12A.FM.1, 12A.FM.3 | 3 |
| C | 21 | CR | 12A.FM.2 | 5 |
| Total = 17 | | | | |
| D | 22 | SR | 12A.D.1 | 1 |
| D | 23 | CR | 12A.D.1 | 1 |
| D | 24 | CR | 12A.D.1 | 5 |
| Total = 7 | | | | |
| E | 25 | SR | 12A.L.3 | 1 |
| E | 26 | CR | 12A.L.3 | 1 |
| E | 27 | CR | 12A.L.2 | 3 |
| Total = 5 | | | | |

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: _____

Follow-up: _____

Decision: _____

Marker's Signature: _____

Principal's Signature: _____

| |
|--|
| <p>For Department Use Only—After Marking Complete</p> <p>Consultant: _____</p> <p>Date: _____</p> |
|--|