

Grade 12
Applied Mathematics
Achievement Test

Marking Guide

January 2017

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

Websites are subject to change without notice.

Disponible en français.

While the department is committed to making its publications as accessible as possible, some parts of this document are not fully accessible at this time.

Available in alternate formats upon request.

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General Marking Instructions

Please ensure that

- the student booklet number matches the number on the *Scoring Sheet*
- **only a pencil is used to complete the *Scoring Sheet***
- the final test mark is recorded on the *Scoring Sheet*
- the *Scoring Sheet* is complete and a copy has been made for school records

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

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

Marking

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

To receive full marks for a question, a student's response must be complete and correct. Partial marks may be awarded for an "appropriate strategy" with execution errors. **An appropriate strategy is defined as one that is consistent with the learning outcomes and mathematical processes associated with the question and, if properly executed, would lead to the correct answer.**

Some questions require a form of explanation or justification from students. Explanation or justification can be given through a labelled diagram, in words, by showing mathematical operations for answer verification, or by providing output from a technological tool. For this reason, appropriate flexibility is required when marking student responses.

Errors

Marks are deducted if conceptual or communication errors are committed.

Conceptual Errors

As a guiding principle, students should only be penalized once for each error committed in the context of a test question. For example, students may choose an inappropriate strategy for a question, but carry it through correctly and arrive at an incorrect answer. In such cases, students should be penalized for having selected an inappropriate strategy for the task at hand, but should be given credit for having arrived at an answer consistent with their choice of strategy.

Communication Errors

Communication errors are errors that are not related to the concepts and are tracked on the *Scoring Sheet* in a separate section. There will be a 0.5 mark deduction for each type of communication error committed, regardless of the number of errors committed for that type (see example on next page).

Ⓔ1 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

Ⓔ2 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

Ⓔ3 Transcription/Transposition

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

Ⓔ4 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

Ⓔ5 Rounding

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

Ⓔ6 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)

When a given response includes multiple types of communication errors, deductions are indicated in the order in which the errors occur in the response. No communication errors are recorded for work that has not been awarded marks. The total deduction may not exceed the marks awarded.

Scoring

The marks allocated to questions are based on the concepts associated with the learning outcomes in the curriculum. For each question, shade in the circle on the *Scoring Sheet* that represents the mark awarded based on the concepts. A total of these marks will provide the preliminary mark.

The student's final mark is determined by subtracting the communication errors from the preliminary mark.

Example:

A student has a preliminary mark of 46. The student committed one E1 error (0.5 mark deduction) and three E4 errors (0.5 mark deduction).

Ⓔ1	Ⓔ2	Ⓔ3	Ⓔ4	Ⓔ5	Ⓔ6
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 Training at the earliest opportunity to advise us of the situation and seek assistance if necessary.

You must contact the Assessment Consultant responsible for this project before making any modifications to the marking keys.

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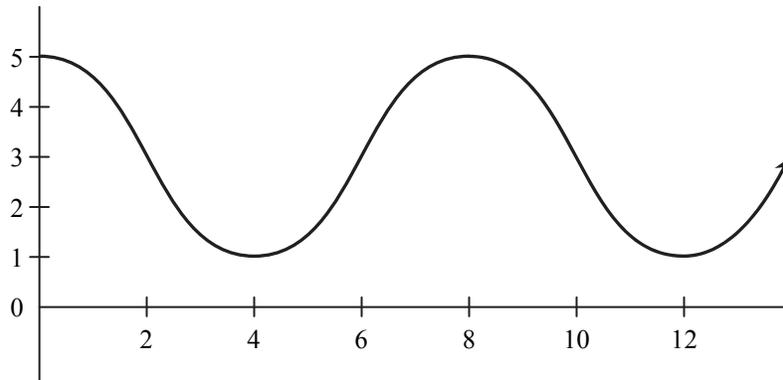
Marking Keys

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

RELATIONS AND FUNCTIONS

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

Use the graph below to answer the following question and select the best answer.



The median of the graph is

- A. 2
- B. 3**
- C. 5
- D. 8

Student Error A: amplitude C: maximum D: period

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

Yang kicks a soccer ball off the ground. The height of the ball is tracked over time. The ball reaches a maximum height of 20 m at 2.1 seconds.

State the domain and range of the quadratic function that models the height of the soccer ball from when it is kicked until it hits the ground.

Domain: _____ $\{0 \leq x \leq 4.2\}$ _____

OR

_____ $[0, 4.2]$ _____

OR

_____ Time x is greater than or equal to 0
but less than or equal to 4.2 seconds. _____

Range: _____ $\{0 \leq y \leq 20\}$ _____

OR

_____ $[0, 20]$ _____

OR

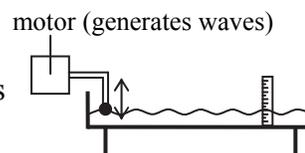
_____ Height y is greater than or equal to 0
but less than or equal to 20 m. _____

Other variables may be used.

Marking Key	
1	<i>1 mark for correct domain</i>
2	<i>1 mark for correct range</i>

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

Stephanie experiments with the frequency of waves in a ripple tank during her Physics class. At the beginning of the experiment, she places a ruler into the tank and measures the median height of the water to be 10 cm. The water then rises to a maximum height of 13 cm at 1 second.



- a) Determine the sinusoidal regression equation that models the relationship between the height of the water and time. Show your work.

(2 marks)

Time (s)	Height (cm)
0	10
1	13
2	10
3	7
4	10

$$y = 3 \sin(1.57x) + 10$$

- b) Determine the height of the water at 15 seconds.

(1 mark)

$$\boxed{\text{CALC}}$$
 1: value $x = 15, y = 7$

The height is at 7 cm.

- c) Stephanie changes the settings of the motor to generate waves more quickly. Write an equation that can model this change if all other conditions remain the same.

(1 mark)

$$y = 3 \sin(2x) + 10$$

Other answers are possible.

Marker Note(s):

→ An equation with a b value > 1.57 is appropriate, provided that a , c , and d values are constant.

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 consistent answer in (b)</i>
4	<i>1 mark for appropriate equation in (c)</i>

Question 4**Total: 2 marks****Learning Outcome: 12A.R.2****Question Type: Constructed Response**

The average price of an electronic device is based on its memory capacity. The following equation models this relationship:

$$P = -24.22 + 15.15 \ln c$$

where P represents the average price in dollars
and c represents the memory capacity in gigabytes (GB).

- a) What is the average price of a 256 GB device?

(1 mark)

CALC 1: value $x = 256, y = 59.79$

The average price of a 256 GB device is \$59.79.

OR _____

$$\begin{aligned} P &= -24.22 + 15.15 \ln(256) \\ &= 59.79 \end{aligned}$$

The average price of a 256 GB device is \$59.79.

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

(1 mark)

Storage capacity is finite.

OR _____

The price of a device cannot be negative.

OR _____

The equation will only model the price of electronic devices
at a given time, as the price of technology changes frequently.

Other answers are possible.

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

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Question 5**Total: 6 marks****Learning Outcome: 12A.R.2****Question Type: Constructed Response**

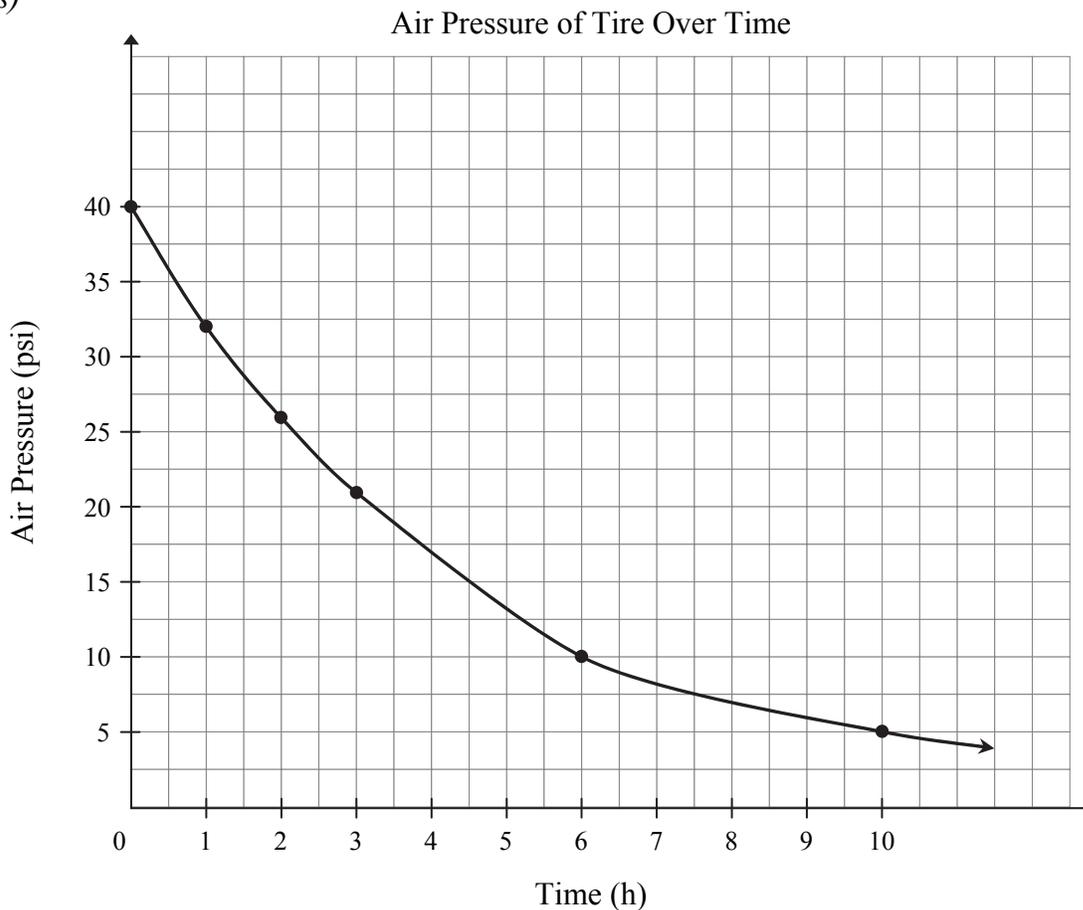
Pam drives her car over a nail. As a result, one of the tires on her car starts to lose air pressure. Her tire pressure sensor provides the following data:

t (h)	0	1	2	3	6	10
P (psi)	40	32	26	21	10	5

where P represents the air pressure (in psi)
and t represents the time (in hours).

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

(3 marks)



- b) Determine the regression equation that best models the data in this situation.

(1 mark)

$$P = 39.26(0.81)^t$$

Question 5 continued

- c) The car becomes unsafe to drive when the tire pressure is 14 psi or under. How many hours can Pam safely drive her car after driving over the nail?

Express your final answer to the nearest hundredth (two decimal places). Show your work.

(2 marks)

$$\boxed{\text{CALC}} \quad 5: \text{intersect} \quad (4.876\dots, 14)$$
$$t = 4.88$$

Pam can drive safely for 4.88 hours.

Marker Note(s):

→ Award mark **3** with an **E3** communication error for a correct graph with one incorrect data point.

→ Award mark **6** for 4.89 hours; answer reflects the use of rounded values in (b).

Marking Key	
1	1 mark for communicating the context of the graph with appropriate title and/or labels in (a)
2	1 mark for using an appropriate domain and range (i.e., window settings/grid range) for the context of the question in (a)
3	1 mark for correctly plotting the data in (a)
4	1 mark for correct equation in (b)
5	1 mark for appropriate work in (c)
6	1 mark for consistent answer in (c)

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PROBABILITY

Question 6**Total: 1 mark****Learning Outcome: 12A.P.4****Question Type: Selected Response**

Select the best answer.

Which of the following expressions represents the number of ways to create a 4-digit passcode for your phone using the digits 0 to 9, if repetition is allowed?

A. $10 \times 9 \times 8 \times 7$

B. 10^4

C. ${}_{10}C_4$

D. ${}_{10}P_4$

Student Error

A: no repetition

C: order matters, no repetition

D: no repetition

Question 7**Total: 1 mark****Learning Outcome: 12A.P.6****Question Type: Selected Response**

Select the best answer.

Scott can choose from 8 toppings to make a pizza. How many pizzas can be made with 3 different toppings?

A. 6

B. 56

C. 336

D. 6720

Student ErrorA: $3!$ C: ${}_8P_3$ D: $\frac{8!}{3!}$

Question 8**Total: 3 marks****Learning Outcome: 12A.P.3****Question Type: Constructed Response**

Joseph has 20 cards; 4 cards of each of the following colours: red, blue, yellow, green, and purple.

- a) What is the probability of randomly drawing 2 red cards in a row if the first card is replaced before drawing the second card?

(1 mark)

Independent:

$$\begin{aligned}P(A \text{ and } B) &= P(A) \times P(B) \\P(\text{red and red}) &= P(\text{red}) \times P(\text{red}) \\&= \frac{4}{20} \times \frac{4}{20} \\&= \frac{1}{5} \times \frac{1}{5} \\&= \frac{1}{25}\end{aligned}$$

The probability is $\frac{1}{25}$, 0.04, or 4%.

- b) What is the probability of randomly drawing 2 red cards in a row if the first card is not replaced before drawing the second card?

(1 mark)

Dependent:

$$\begin{aligned}P(A \text{ and } B) &= P(A) \times P(B|A) \\P(\text{red and red}) &= P(\text{red}) \times P(\text{red}|\text{first card red}) \\&= \frac{4}{20} \times \frac{3}{19} \\&= \frac{3}{95}\end{aligned}$$

The probability is $\frac{3}{95}$, 0.03, or 3.16%.

Question 8 continued

- c) Explain which part, (a) or (b), is an example of dependent events.

(1 mark)

Part (b) is an example of dependent events because there are fewer cards to choose from when the first card is not replaced.

Other answers are possible.

Marking Key	
❶	<i>1 mark for correct answer in (a)</i>
❷	<i>1 mark for consistent answer in (b)</i>
❸	<i>1 mark for appropriate explanation in (c)</i>

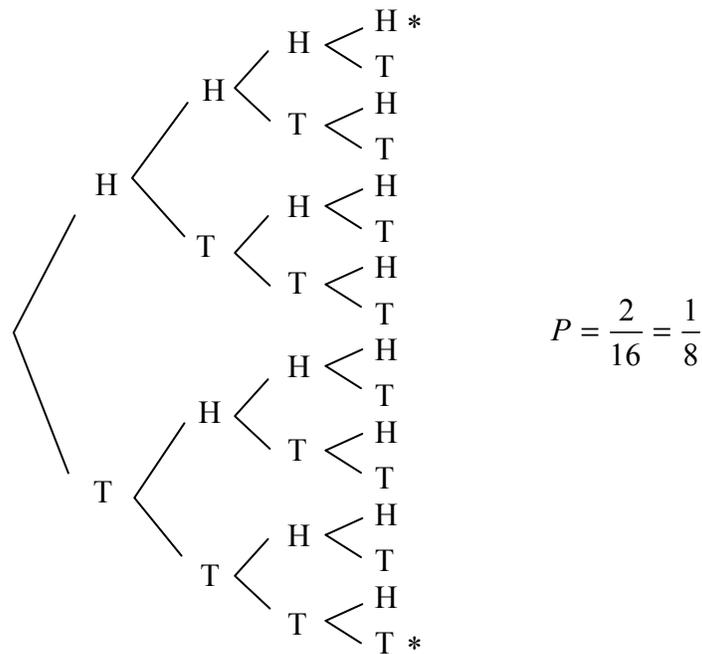
Question 9**Total: 2 marks****Learning Outcome: 12A.P.1****Question Type: Constructed Response**

If 4 coins are tossed at the same time, what is the probability that they will land as either all heads or as all tails? Show your work.

$$P = \left(\frac{1}{2} \times \frac{1}{2} \times \frac{1}{2} \times \frac{1}{2} \right) \times 2$$

$$= \frac{1}{8}$$

The probability is $\frac{1}{8}$, 0.13, or 12.50%.

OR

The probability is $\frac{1}{8}$, 0.13, or 12.50%.

Marking Key

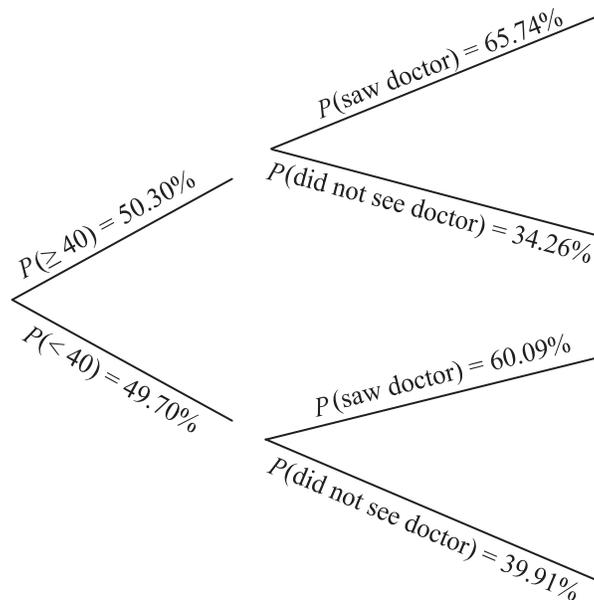
- | | |
|----------|-------------------------------------|
| 1 | <i>1 mark for appropriate work</i> |
| 2 | <i>1 mark for consistent answer</i> |

Question 10**Total: 3 marks****Learning Outcome: 12A.P.3****Question Type: Constructed Response**

Last year, it was reported that 50.30% of Mathematica's population was 40 years of age or older.

That same year, 65.74% of people 40 years of age or older saw a doctor and 34.26% of people younger than 40 years of age saw a doctor.

If Mathematica's population last year was 1 265 400, determine how many people in Mathematica did not see a doctor. Show your work.



$$P(\text{did not see doctor}) = (0.5030)(0.3426) + (0.4970)(0.3991) \\ = 0.3706805$$

$$0.3706805 \times 1\,265\,400 = 469\,059.1047$$

Last year, 469 059 people did not see a doctor.

Marker Note(s):

→ Answer may vary depending on rounding but the probability must be expressed to a minimum of 2 decimal places (e.g., 0.37 or more precise).

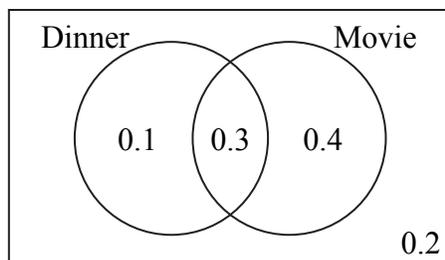
Marking Key	
1	<i>1 mark for appropriate work</i>
2	<i>1 mark for correct probability</i>
3	<i>1 mark for consistent total</i>

Question 11**Total: 2 marks****Learning Outcome: 12A.P.3****Question Type: Constructed Response**

The probability that Louise will go out for dinner tonight is 0.4. The probability that she will watch a movie is 0.7. The probability she will do neither is 0.2.

- a) Draw a Venn diagram to represent this situation.

(1 mark)



- b) Determine the probability that Louise does only one of these activities.

(1 mark)

$$0.1 + 0.4 = 0.5$$

The probability that she does only one of these activities is 0.5.

Marking Key

- | | |
|---|--|
| ① | 1 mark for correct Venn diagram in (a) |
| ② | 1 mark for consistent answer in (b) |

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

A coach randomly selects 5 players from a team of 18 to line up for a shot on goal.

- a) How many different 5-player arrangements are possible?

(1 mark)

$${}_{18}P_5 = 1\,028\,160$$

There are 1 028 160 possible arrangements.

- b) If Dustin and Andrew are 2 of the 18 players, what is the probability that Dustin will shoot first and Andrew will shoot second? Show your work. Express your answer as a fraction or round to the nearest thousandth (three decimal places).

(2 marks)

$$\frac{1}{\text{Dustin}} \quad \frac{1}{\text{Andrew}} \quad \frac{16}{\quad} \quad \frac{15}{\quad} \quad \frac{14}{\quad}$$

$$\frac{16 \times 15 \times 14}{1\,028\,160} = 0.003$$

OR

$$\frac{1}{18} \times \frac{1}{17} = \frac{1}{306}$$

The probability is $\frac{1}{306}$, 0.003, or 0.327%.

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

FINANCIAL MATHEMATICS

Question 13

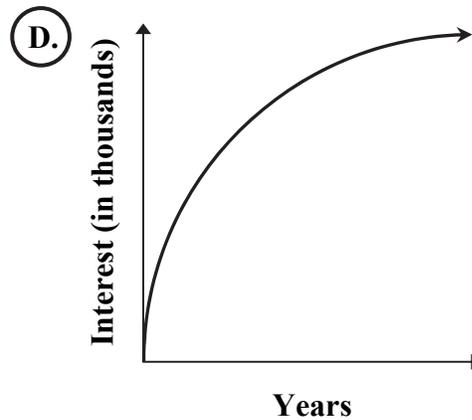
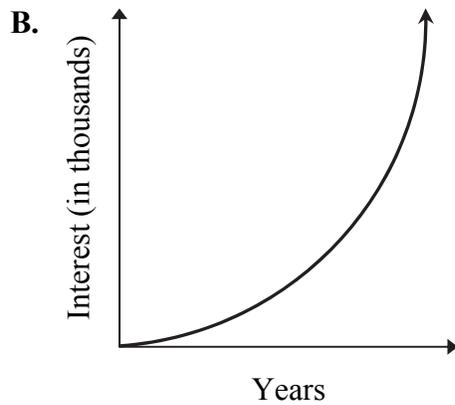
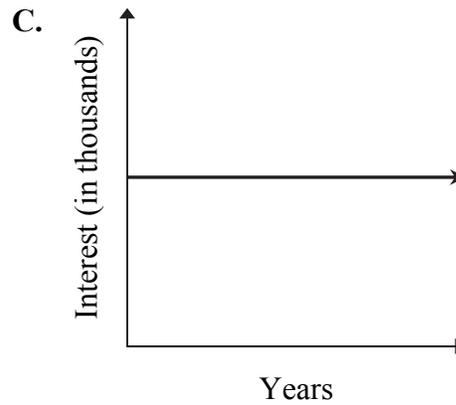
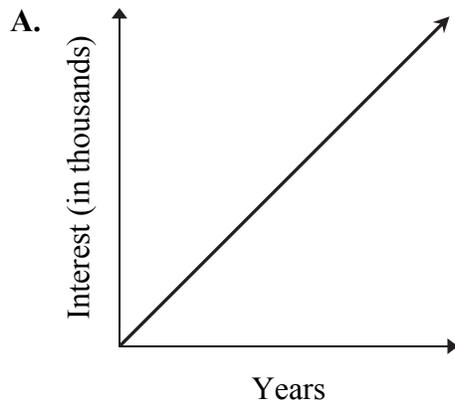
Total: 1 mark

Learning Outcome: 12A.FM.1

Question Type: Selected Response

Select the best answer.

Which of the following graphs shows the total amount of interest paid over the course of a 25-year mortgage?



Question 14**Total: 1 mark****Learning Outcome: 12A.FM.3****Question Type: Selected Response**

Select the best answer.

According to the Rule of 72, a reasonable estimate for the time it would take to double an investment of \$24 000.00 at an interest rate of 6.00%, compounded monthly is

- A. 3 years
- B. 4 years
- C. 12 years
- D. 18 years

Question 15**Total: 4 marks****Learning Outcome: 12A.FM.1****Question Type: Constructed Response**

Imani is going to buy a car. She can afford monthly payments of \$600.00. The dealer offers two financing options:

Option 1: financing over 60 months at a rate of 0.90% compounded monthly

Option 2: financing over 60 months at a rate of 2.90% compounded monthly with an instant rebate of \$3000.00 at the time of purchase

Which option allows Imani to purchase a more expensive car? Show your work.

Option 1

```
N=60
I%=.9
PMT=-600
FV=0
P/Y=12
C/Y=12
PMT: [ ] BEGIN
```

\$35 189.11

Option 2

```
N=60
I%=2.9
PMT=-600
FV=0
P/Y=12
C/Y=12
PMT: [ ] BEGIN
```

\$33 474.14 + \$3000.00
= \$36 474.14

Option 2 allows Imani to purchase a more expensive car.

Marking Key

- | | |
|----------|--|
| 1 | <i>1 mark for appropriate work</i> |
| 2 | <i>1 mark for consistent loan amount for Option 1</i> |
| 3 | <i>1 mark for consistent loan amount for Option 2</i> |
| 4 | <i>1 mark for correct choice of option, including \$3000.00 rebate</i> |

Question 16**Total: 2 marks****Learning Outcome: 12A.FM.3****Question Type: Constructed Response**

Your friend has \$10 000.00 and is considering an investment in stocks, a guaranteed investment certificate (GIC), or rare collectibles.

Choose one of the three investments mentioned above and indicate one advantage and one disadvantage for your choice.

Stocks:

Advantage: There is the potential for a higher rate of return in a shorter period of time.

Disadvantage: Stocks are volatile, so there is a risk of principal loss.

OR_____

GIC:

Advantage: It is a safe investment.

Disadvantage: The interest rate is low.

OR_____

Rare Collectibles:

Advantage: Objects are tangible and can be enjoyed.

Disadvantage: It may be difficult to find a buyer willing to pay the perceived value of the object.

Other answers are possible.

Marking Key	
①	<i>1 mark for appropriate advantage of investment choice</i>
②	<i>1 mark for appropriate disadvantage of investment choice</i>

Question 17**Total: 4 marks****Learning Outcome: 12A.FM.1****Question Type: Constructed Response**

When she turned 25, Alexa began investing \$400.00 monthly into a mutual fund account producing average returns of 6.00%, compounded monthly. Alexa will stop contributing when she retires at age 55.

- a) How much money will her investment be worth at retirement? Show your work.

(2 marks)

```

N=360
I%=6
PV=0
PMT=-400
FV=401806.017
P/Y=12
C/Y=12
PMT: [ ] BEGIN
  
```

Her investment will be worth \$401 806.02 at retirement.

- b) Alexa will withdraw \$2500.00 per month from her account after retiring. If the average return rate stays the same, how old will she be when the account balance is zero? Show your work.

(2 marks)

```

N=326.3457928
I%=6
PV=401806.02
PMT=-2500
FV=0
P/Y=12
C/Y=12
PMT: [ ] BEGIN
  
```

$$\frac{326.35}{12} = 27.20$$

$$55 + 27.20 = 82.20$$

She will be 82 years old when the account balance is zero.

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 appropriate work in (b)</i>
4	<i>1 mark for consistent answer in (b)</i>

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Question 18**Total: 5 marks****Learning Outcomes: 12A.FM.1, 12A.FM.2****Question Type: Constructed Response**

Shirley and Cameron have just moved to Brandon and are considering the two following housing options:

Option 1: House for purchase

- purchase price of \$249 000.00
- down payment of \$50 000.00 required
- 25-year mortgage at an interest rate of 3.00%, compounded semi-annually

Option 2: Apartment for rent

- monthly payments of \$1300.00
- monthly parking fees of \$60.00

- a) What would be Shirley and Cameron's monthly mortgage payment with Option 1?
Show your work.

(2 marks)

```
N=300  
I%=3  
PV=199000  
PMT=-941.75854...  
FV=0  
P/Y=12  
C/Y=2  
PMT:  END  BEGIN
```

Shirley and Cameron's monthly mortgage payment would be \$941.76.

Question 18 continued

b) What will be the total amount paid for each option at the end of 10 years?

(2 marks)

Total amount paid for Option 1:

$$(\$941.76 \times 10 \times 12) + \$50\,000.00 = \$163\,011.20$$

Total amount paid for Option 2:

$$(\$1300.00 + \$60.00) \times 10 \times 12 = \$163\,200.00$$

c) State one advantage of renting the apartment.

(1 mark)

They should rent because a down payment is not required.

OR

They should rent because it provides more freedom to move.

Other answers are possible.

Marking Key	
①	1 mark for appropriate work in (a)
②	1 mark for consistent monthly mortgage payment in (a)
③	1 mark for consistent total amount paid for Option 1 in (b)
④	1 mark for consistent total amount paid for Option 2 in (b)
⑤	1 mark for appropriate advantage in (c)

DESIGN AND MEASUREMENT

Question 19**Total: 2 marks****Learning Outcome: 12A.D.1****Question Type: Constructed Response**

Eleni is placing cups onto a 7 in. by 10 in. tray. Each cup has a circumference of 10 in.

Determine the maximum number of cups she can place on the tray. Show your work.

$$2\pi r = 10 \text{ in.}$$

$$r = \frac{10}{2\pi} = 1.59 \text{ in.}$$

$$\text{Diameter of one cup} = 2 \times 1.59 = 3.18 \text{ in.}$$

$$\text{Number of cups that can be placed length wise} = \frac{10}{3.18} \doteq 3$$

$$\text{Number of cups that can be placed width wise} = \frac{7}{3.18} \doteq 2$$

$$\text{Total number of cups that can be placed on the tray} = 3 \times 2 = 6 \text{ cups}$$

Marker Note(s):

→ *If student finds the area of the tray and divides by the area of the cup, award a maximum of 1 mark.*

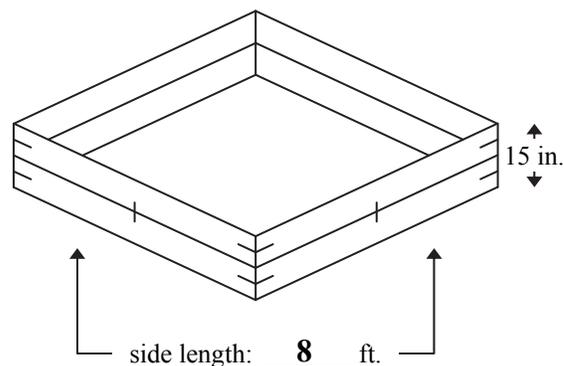
Marking Key	
①	<i>1 mark for correct diameter of one cup</i>
②	<i>1 mark for consistent total number of cups</i>

Question 20**Total: 4 marks****Learning Outcome: 12A.D.1****Question Type: Constructed Response**

You want to build a garden.

- The garden is square.
- The side length is between 8 ft. and 10 ft.
- The garden is enclosed using boards stacked two boards high.
- There are 12 metal supports used to connect the structure.
- The garden is filled with soil to a depth of 15 in.

(Diagram is not drawn to scale.)



Below is the price list for materials:

Item	Cost (plus GST and PST)
metal supports	\$2.00 each
boards	\$2.50/linear foot
soil	\$12.00/yd ³

Determine the total cost of building your garden. All items must be purchased in whole units. Show your work. (Note: GST = 5%, PST = 8%)

Boards:

$$P = 8 \text{ ft.} \times 4 = 32 \text{ ft.}$$

$$\therefore 32 \times 2 = 64 \text{ linear ft. needed}$$

Soil:

$$V = 8 \text{ ft.} \times 8 \text{ ft.} \times 1.25 \text{ ft.} = 80 \text{ ft}^3$$

$$\therefore 80 \text{ ft}^3 \div 27 \text{ yd}^3/\text{ft}^3 = 2.96 \text{ yd}^3 \doteq 3 \text{ yd}^3$$

Cost:

	8 ft.	OR	9 ft.	OR	10 ft.
Supports: 12 supports \times \$2.00/support	= \$24.00		\$24.00		\$24.00
Boards: ___ linear ft. \times \$2.50/linear ft.	= \$160.00		\$180.00		\$200.00
Soil: ___ yd ³ \times \$12.00/yd ³	= \$36.00		\$48.00		\$60.00
Subtotal	= \$220.00		\$252.00		\$284.00
GST	= \$11.00		\$12.60		\$14.20
PST	= \$17.60		\$20.16		\$22.72
Total	= \$248.60		\$284.76		\$320.92

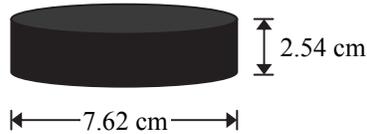
Other answers are possible.

Marking Key	
①	1 mark for correct number of linear feet needed
②	1 mark for correct volume of garden
③	1 mark for consistent conversion to cubic yards
④	1 mark for consistent total cost, including taxes

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

- a) What is the volume of a rubber hockey puck? (Diagram is not drawn to scale.)

(1 mark)



$$\begin{aligned}V &= \pi r^2 h \\&= \pi(3.81 \text{ cm})^2 (2.54 \text{ cm}) \\&= 115.83 \text{ cm}^3\end{aligned}$$

- b) How many pucks can be produced for \$1000.00 if it costs \$0.24 to print a logo on each puck and rubber costs \$0.003 6 per cm^3 ?

(2 marks)

Cost of one puck:

$$(115.83 \text{ cm}^3 \times \$0.0036 \text{ per cm}^3) + \$0.24 = \$0.6570$$

Total number:

$$\frac{\$1000.00}{\$0.6570} = 1522.07$$

A total of 1522 pucks can be produced.

Marker Note(s):

→ Award marks ② and ③ if the student rounds the unit price of the puck to \$0.66 and obtains 1515 pucks as a final answer.

Marking Key	
①	1 mark for correct answer in (a)
②	1 mark for correct unit cost of puck in (b)
③	1 mark for consistent answer in (b)

LOGICAL REASONING

Question 22

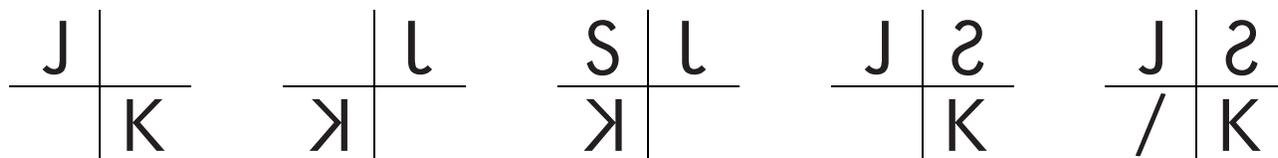
Total: 1 mark

Learning Outcome: 12A.L.1

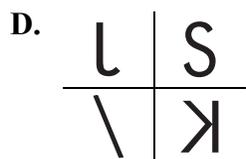
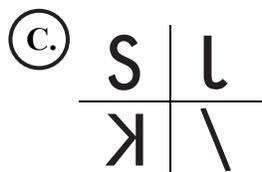
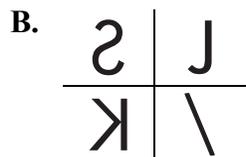
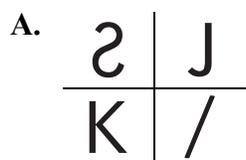
Question Type: Selected Response

Select the best answer.

Given the following pattern:



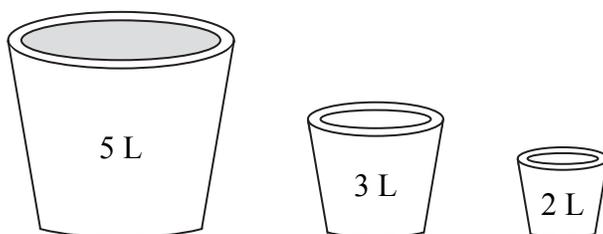
Which of the following continues this pattern?



Question 23**Total: 2 marks****Learning Outcome: 12A.L.1****Question Type: Constructed Response**

You have 3 pails with volumes of 2 L, 3 L, and 5 L.

The 5 L pail is filled with water. The other pails are empty.



Using only these pails, explain how to measure out exactly 4 L of water into the 5 L pail.

Fill the 3 L pail with water from the 5 L pail, leaving 2 L in the 5 L pail.
Fill the 2 L pail with water from the 3 L pail, leaving 1 L in the 3 L pail.
Pour 2 L of water from the 2 L pail into the 5 L pail to get 4 L of water.

Other answers are possible.

Marking Key

- | | |
|----------|--|
| ① | <i>1 mark for appropriate strategy</i> |
| ② | <i>1 mark for correct answer</i> |

Question 24**Total: 2 marks****Learning Outcome: 12A.L.3****Question Type: Constructed Response**

Consider the original statement:

“If students are in Grade 12, then they will graduate this June.”

- a) Write the converse of the statement.

(1 mark)

“If students graduate this June, then they are in Grade 12.”

- b) Determine if a biconditional statement is possible. If yes, write the biconditional statement. If not, provide a counterexample.

(1 mark)

No, a biconditional statement is not possible.

“Grade 12 students may not have enough credits to graduate.”

Other answers are possible.

Marking Key	
❶	<i>1 mark for correct answer in (a)</i>
❷	<i>1 mark for correct counterexample in (b)</i>

Exemplars

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

Exemplar 2

Question 2**Total: 2 marks**

Yang kicks a soccer ball off the ground. The height of the ball is tracked over time. The ball reaches a maximum height of 20 m at 2.1 seconds.

State the domain and range of the quadratic function that models the height of the soccer ball from when it is kicked until it hits the ground.

Domain: _____ $(0, 2.1)$ _____

Range: _____ $(0, 20)$ _____

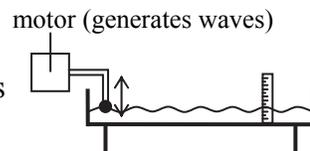
0 marks:
→ no criteria met

Exemplar 1

Question 3

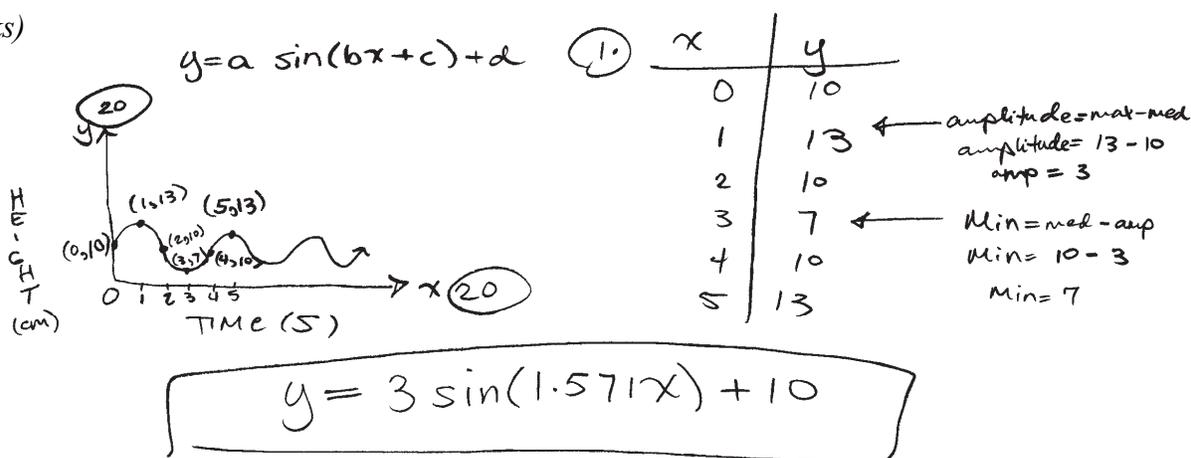
Total: 4 marks

Stephanie experiments with the frequency of waves in a ripple tank during her Physics class. At the beginning of the experiment, she places a ruler into the tank and measures the median height of the water to be 10 cm. The water then rises to a maximum height of 13 cm at 1 second.



- a) Determine the sinusoidal regression equation that models the relationship between the height of the water and time. Show your work.

(2 marks)



- b) Determine the height of the water at 15 seconds.

(1 mark)

$$y = 3 \sin(1.571(15)) + 10$$

$$y = 11.20 \text{ cm}$$

2nd Trace

1

when $x = 15$

$y = 11.20 \text{ cm}$

- c) Stephanie changes the settings of the motor to generate waves more quickly. Write an equation that can model this change if all other conditions remain the same.

(1 mark)

$$y = a \sin(\overset{\uparrow}{6}x + c) + d$$

stretch/compress graph horizontally \therefore
make the "b" value bigger

$$y = 3 \sin(3x) + 10$$

3 marks:

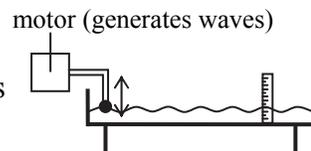
- ① → 1 mark for appropriate work in (a)
- ② → 1 mark for consistent answer in (a)
- ④ → 1 mark for appropriate equation in (c)

Exemplar 2

Question 3

Total: 4 marks

Stephanie experiments with the frequency of waves in a ripple tank during her Physics class. At the beginning of the experiment, she places a ruler into the tank and measures the median height of the water to be 10 cm. The water then rises to a maximum height of 13 cm at 1 second.



- a) Determine the sinusoidal regression equation that models the relationship between the height of the water and time. Show your work.

(2 marks)

$$y = 3 \sin(1x - 5) + 10$$

- b) Determine the height of the water at 15 seconds.

(1 mark)

$$y = \text{height cm}$$

15 sec. height will be 8.37cm

- c) Stephanie changes the settings of the motor to generate waves more quickly. Write an equation that can model this change if all other conditions remain the same.

(1 mark)

$$y = 3 \sin(2x - 5) + 10$$

2 marks:

- ③ → 1 mark for consistent answer in (b)
④ → 1 mark for appropriate equation in (c)

Exemplar 1

Question 4

Total: 2 marks

The average price of an electronic device is based on its memory capacity. The following equation models this relationship:

$$P = -24.22 + 15.15 \ln c$$

where P represents the average price in dollars
and c represents the memory capacity in gigabytes (GB).

- a) What is the average price of a 256 GB device?

(1 mark)

2nd TRACE | : value

$$c = 256$$

$$P = \$59.79$$

The average price of a 256 GB device will be \$59.79

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

(1 mark)

That the memory capacity in gigabytes
cannot be less than 0.

2 marks:

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

Exemplar 2

Question 4

Total: 2 marks

The average price of an electronic device is based on its memory capacity. The following equation models this relationship:

$$P = -24.22 + 15.15 \ln c$$

where P represents the average price in dollars
and c represents the memory capacity in gigabytes (GB).

- a) What is the average price of a 256 GB device?

(1 mark)

2nd \Rightarrow Trace \Rightarrow Intersect

$$x = \$26.80$$

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

(1 mark)

X cannot equal below 0
 \uparrow
E4

1 mark:

② \rightarrow 1 mark for appropriate limitation in (b)

.....
E4 \rightarrow does not use a contextual variable when
stating the domain or the range in set notation

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Exemplar 1

Question 5

Total: 6 marks

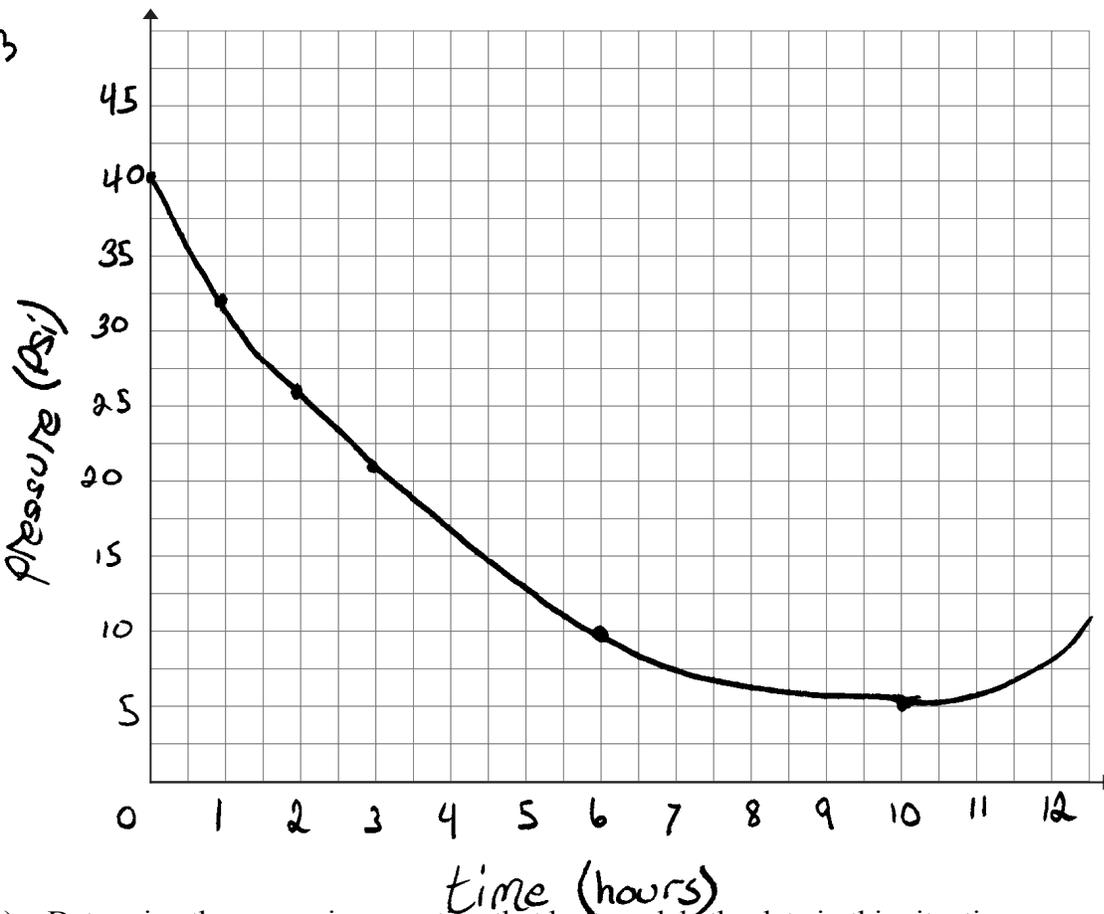
Pam drives her car over a nail. As a result, one of the tires on her car starts to lose air pressure. Her tire pressure sensor provides the following data:

t (h)	0	1	2	3	6	10
P (psi)	40	32	26	21	10	5

where P represents the air pressure (in psi)
and t represents the time (in hours).

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

(3 marks)
-3.38x
34.73



- b) Determine the regression equation that best models the data in this situation.

(1 mark)

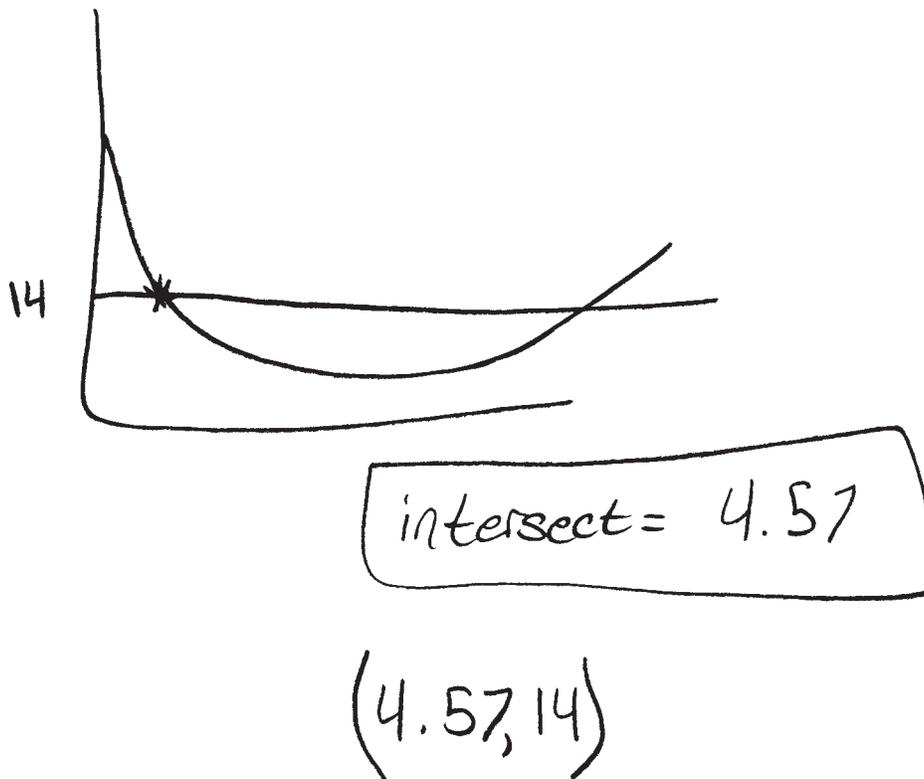
$$0.38x^2 + (-7.3x) + 39.42$$

Exemplar 1 (continued)

- c) The car becomes unsafe to drive when the tire pressure is 14 psi or under. How many hours can Pam safely drive her car after driving over the nail?

Express your final answer to the nearest hundredth (two decimal places). Show your work.

(2 marks)



5 marks:

- ① → 1 mark for communicating the context of the graph with appropriate title and/or labels in (a)
- ② → 1 mark for using an appropriate domain and range (i.e., window settings/grid range) for the context of the question in (a)
- ③ → 1 mark for correctly plotting the data in (a)
- ⑤ → 1 mark for appropriate work in (c)
- ⑥ → 1 mark for consistent answer in (c)

Exemplar 2

Question 5

Total: 6 marks

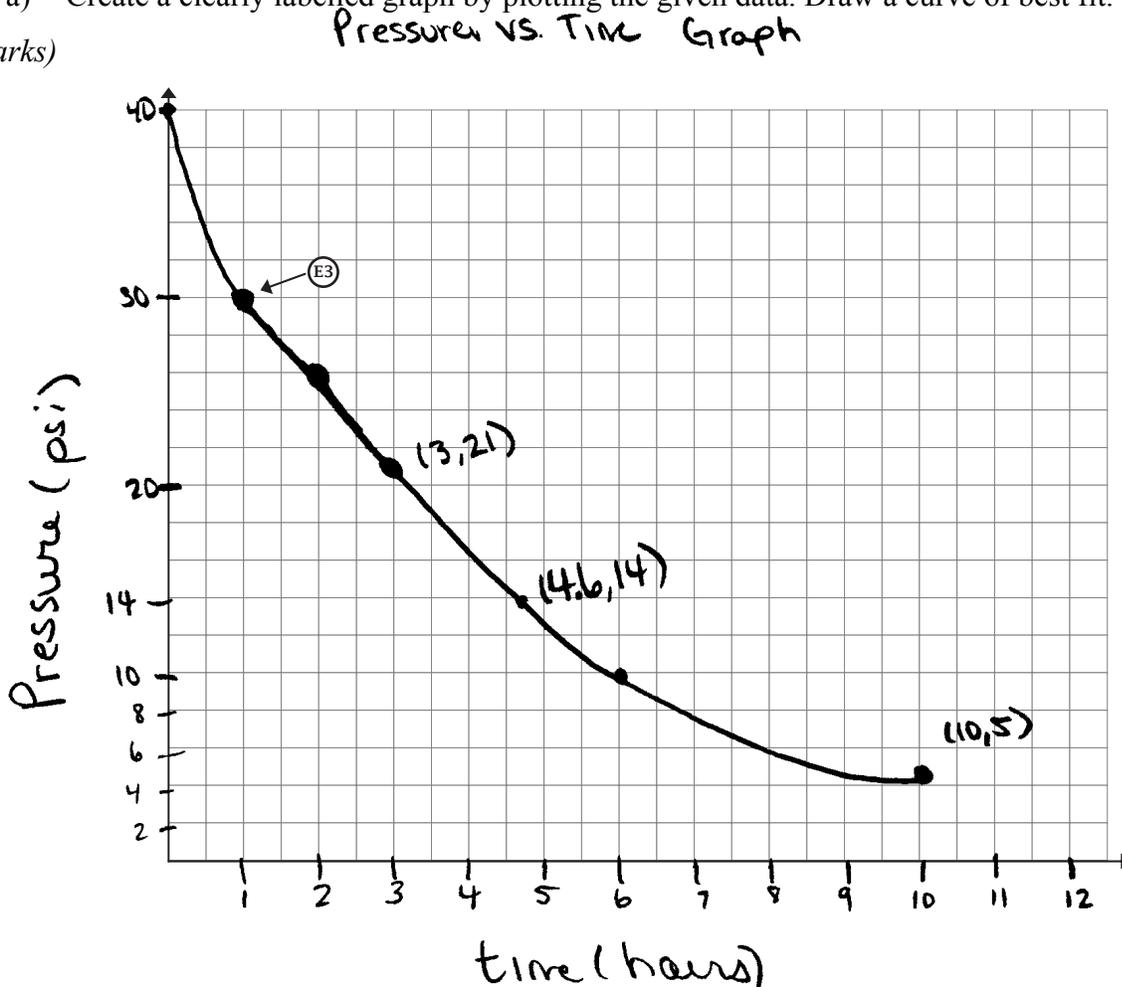
Pam drives her car over a nail. As a result, one of the tires on her car starts to lose air pressure. Her tire pressure sensor provides the following data:

t (h)	0	1	2	3	6	10
P (psi)	40	32	26	21	10	5

where P represents the air pressure (in psi)
and t represents the time (in hours).

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

(3 marks)



- b) Determine the regression equation that best models the data in this situation.

(1 mark)

$$y = -0.015x^3 + 0.604x^2 + (-8.044)x + 40$$

Exemplar 2 (continued)

- c) The car becomes unsafe to drive when the tire pressure is 14 psi or under. How many hours can Pam safely drive her car after driving over the nail?

Express your final answer to the nearest hundredth (two decimal places). Show your work.

(2 marks)

$$\text{When } y = 14 \quad x = 4.69 \text{ hours}$$

Pam can safely drive her vehicle for 4.69 hrs

5 marks:

- ① → 1 mark for communicating the context of the graph with appropriate title and/or labels in (a)
- ② → 1 mark for using an appropriate domain and range (i.e., window settings/grid range) for the context of the question in (a)
- ③ → 1 mark for correctly plotting the data in (a)
- ⑤ → 1 mark for appropriate work in (c)
- ⑥ → 1 mark for consistent answer in (c)

Ⓔ → makes a transcription error (inaccurate transferring of information)

Exemplar 3

Question 5

Total: 6 marks

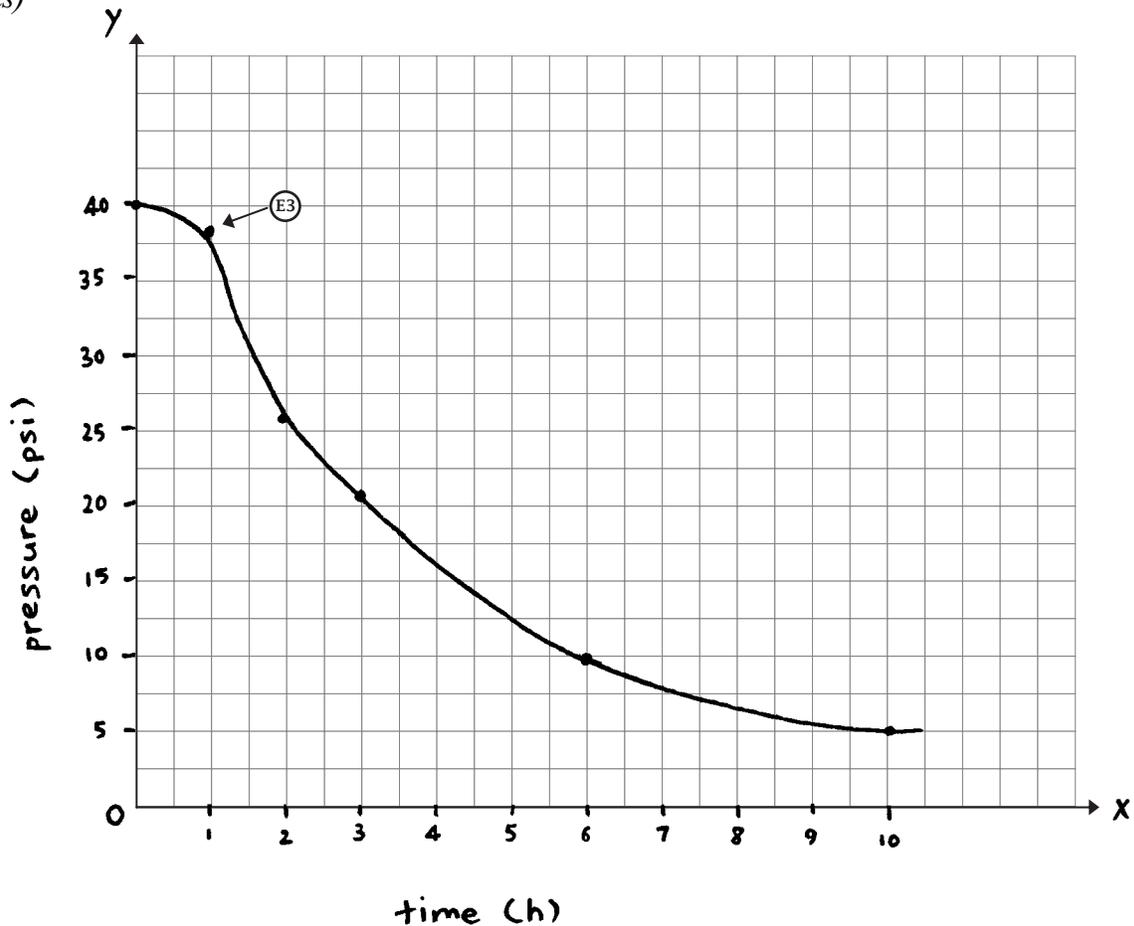
Pam drives her car over a nail. As a result, one of the tires on her car starts to lose air pressure. Her tire pressure sensor provides the following data:

t (h)	0	1	2	3	6	10
P (psi)	40	32	26	21	10	5

where P represents the air pressure (in psi)
and t represents the time (in hours).

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

(3 marks)



- b) Determine the regression equation that best models the data in this situation.

(1 mark)

$y = 39.26 (0.81)^x$
STAT Calc 0: ExpReg

Exemplar 3 (continued)

- c) The car becomes unsafe to drive when the tire pressure is 14 psi or under. How many hours can Pam safely drive her car after driving over the nail?

Express your final answer to the nearest hundredth (two decimal places). Show your work.

(2 marks)

$$y_1 = 39.26 (0.81)^x \quad \boxed{2^{\text{nd}}} \boxed{\text{Trace}} \quad 5: \text{Intersect}$$
$$y_2 = 14 \quad x = 4.88 \quad \leftarrow$$

Pam can safely drive
for $\boxed{4.88}$ hours.

6 marks:

- ① → 1 mark for communicating the context of the graph with appropriate title and/or labels in (a)
- ② → 1 mark for using an appropriate domain and range (i.e., window settings/grid range) for the context of the question in (a)
- ③ → 1 mark for correctly plotting the data in (a)
- ④ → 1 mark for correct equation in (b)
- ⑤ → 1 mark for appropriate work in (c)
- ⑥ → 1 mark for consistent answer in (c)

Ⓔ → makes a transcription error (inaccurate transferring of information)

Exemplar 1

Question 8**Total: 3 marks**

Joseph has 20 cards; 4 cards of each of the following colours: red, blue, yellow, green, and purple.

- a) What is the probability of randomly drawing 2 red cards in a row if the first card is replaced before drawing the second card?

(1 mark)

$$\frac{4}{20} \cdot \frac{3}{19} = \frac{12}{380} = \frac{6}{190} = \frac{3}{95}$$

- b) What is the probability of randomly drawing 2 red cards in a row if the first card is not replaced before drawing the second card?

(1 mark)

$$\frac{4}{20} \cdot \frac{4}{20} = \frac{16}{400} = \frac{1}{25}$$

Exemplar 1 (continued)

- c) Explain which part, (a) or (b), is an example of dependent events.

(1 mark)

Part (a) is an example of dependent events because what card is picked next depends on what was chosen before.

2 marks:

- ② → 1 mark for consistent answer in (b)
- ③ → 1 mark for appropriate explanation in (c)

Exemplar 2

Question 8

Total: 3 marks

Joseph has 20 cards; 4 cards of each of the following colours: red, blue, yellow, green, and purple.

- a) What is the probability of randomly drawing 2 red cards in a row if the first card is replaced before drawing the second card? *mutually exclusive*

(1 mark)

$$\frac{4^C_1}{20^C_1} \times 2 = [0.4]$$

- b) What is the probability of randomly drawing 2 red cards in a row if the first card is not replaced before drawing the second card? *dependant*

(1 mark)

$$\frac{4^C_1}{20^C_1} \cdot \frac{3^C_1}{19^C_1} = [0.03]$$

Exemplar 2 (continued)

- c) Explain which part, (a) or (b), is an example of dependent events.

(1 mark)

Part (b) is an example of a dependant event because once the first card is taken out of the deck of cards it changes the probability of selecting a red card the next time you draw a card.

2 marks:

- ② → 1 mark for consistent answer in (b)
- ③ → 1 mark for appropriate explanation in (c)

Exemplar 1

Question 9**Total: 2 marks**

If 4 coins are tossed at the same time, what is the probability that they will land as either all heads or as all tails? Show your work.

$$\begin{aligned}\text{Prob} &= \frac{1}{2} \times \frac{1}{2} \times \frac{1}{2} \times \frac{1}{2} \\ &= \frac{1}{16} = 0.0625\end{aligned}$$

1 mark:**②** → 1 mark for consistent answer

Exemplar 2

Question 9

Total: 2 marks

If 4 coins are tossed at the same time, what is the probability that they will land as either all heads or as all tails? Show your work.

Case 1
All
Heads $\frac{1}{2} \cdot \frac{1}{2} \cdot \frac{1}{2} \cdot \frac{1}{2} = \frac{1}{16}$

$$\frac{1}{16} + \frac{1}{16} = \boxed{\frac{2}{16}}$$

Case 2
All
Tails $\frac{1}{2} \cdot \frac{1}{2} \cdot \frac{1}{2} \cdot \frac{1}{2} = \frac{1}{16}$

2 marks:

- ① → 1 mark for appropriate work
- ② → 1 mark for consistent answer

Exemplar 1

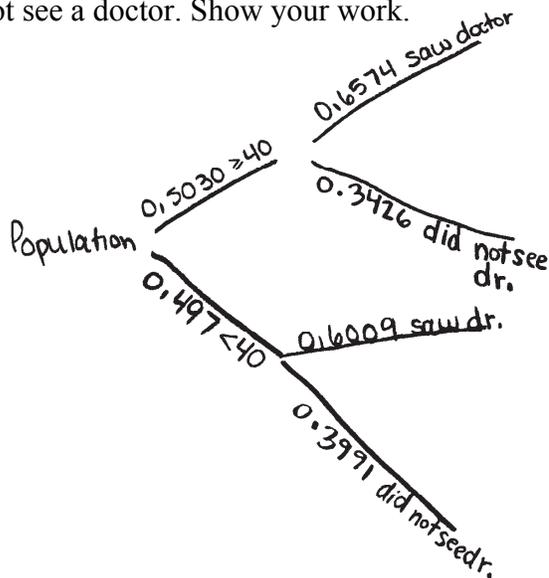
Question 10

Total: 3 marks

Last year, it was reported that 50.30% of Mathematica's population was 40 years of age or older.

That same year, 65.74% of people 40 years of age or older saw a doctor and 60.09% of people younger than 40 years of age saw a doctor.

If Mathematica's population last year was 1 265 400, determine how many people in Mathematica did not see a doctor. Show your work.



$$\begin{aligned} &\underline{\geq 40} \\ 1\,265\,400 \times 0.5030 &= 636\,496.2 \geq 40 \\ 636\,496.2 \times 0.6574 &= 418\,432.60\dots \doteq 418\,433 \geq 40 \text{ saw a dr.} \end{aligned}$$

$$\begin{aligned} &\underline{< 40} \\ 1\,265\,400 \times 0.497 &= 628\,903.8 < 40 \\ 628\,903.8 \times 0.6009 &= 377\,908.29\dots \doteq 377\,909 < 40 \text{ saw dr.} \end{aligned}$$

Total # of people who did not see dr.

$$1\,265\,400 - 418\,433 - 377\,909 = 469\,058 \text{ people did not see a doctor.}$$

3 marks:

- ① → 1 mark for appropriate work
- ② → 1 mark for correct probability
- ③ → 1 mark for consistent total

Exemplar 2

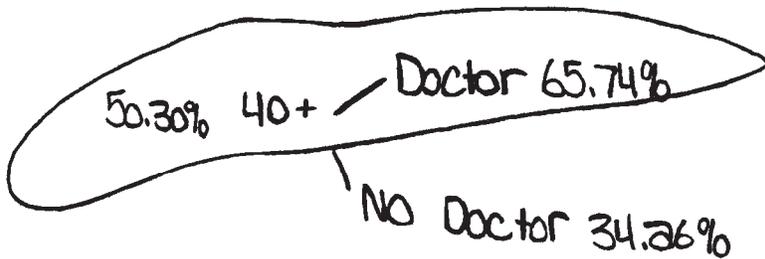
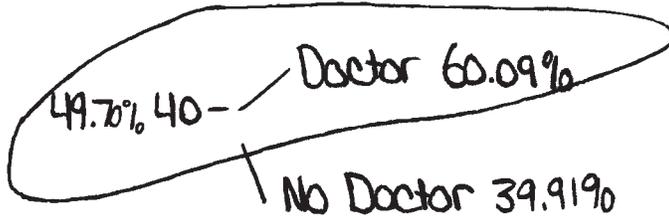
Question 10

Total: 3 marks

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That same year, 65.74% of people 40 years of age or older saw a doctor and 60.09% of people younger than 40 years of age saw a doctor.

If Mathematica's population last year was 1 265 400, determine how many people in Mathematica did not see a doctor. Show your work.



$$0.497(0.6009) = 0.2986$$

$$0.503(0.6574) = 0.3307$$

$$0.2986 + 0.3307 = 0.6293 \times 100 = 62.93\% \text{ saw a doctor}$$

$$100 - 62.93 = 37.07\% \text{ saw no doctors}$$

$$1\,265\,400(0.3707) = 469\,084$$

469 084 did not see a doctor

3 marks:

- ① → 1 mark for appropriate work
- ② → 1 mark for correct probability
- ③ → 1 mark for consistent total

Exemplar 1

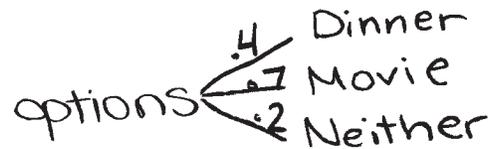
Question 11

Total: 2 marks

The probability that Louise will go out for dinner tonight is 0.4. The probability that she will watch a movie is 0.7. The probability she will do neither is 0.2.

- a) Draw a Venn diagram to represent this situation.

(1 mark)



- b) Determine the probability that Louise does only one of these activities.

(1 mark)

$$.4 + .7 = 1.1 \text{ chance}$$

0 marks:
→ no criteria met

Exemplar 2

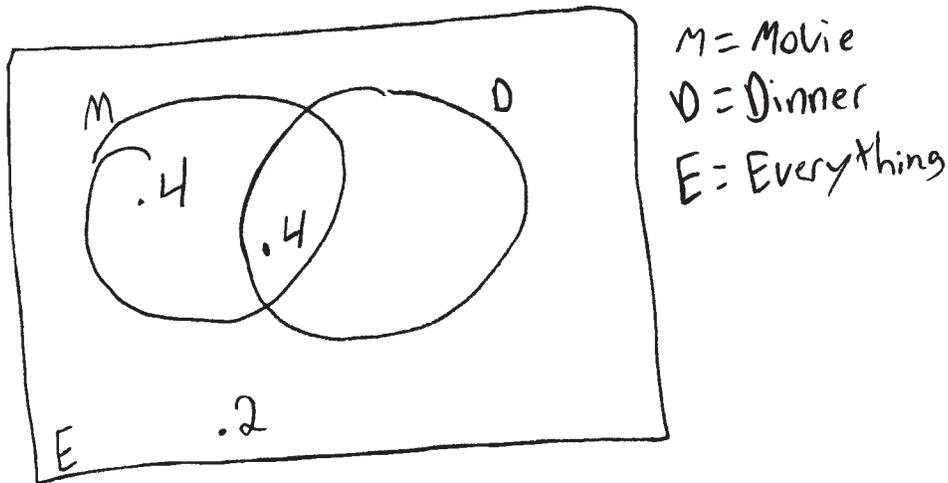
Question 11

Total: 2 marks

The probability that Louise will go out for dinner tonight is 0.4. The probability that she will watch a movie is 0.7. The probability she will do neither is 0.2.

- a) Draw a Venn diagram to represent this situation.

(1 mark)



- b) Determine the probability that Louise does only one of these activities.

(1 mark)

$$P(M \cap \bar{D}) = \frac{2}{5}$$

1 mark:

② → 1 mark for consistent answer in (b)

Exemplar 1

Question 12

Total: 3 marks

A coach randomly selects 5 players from a team of 18 to line up for a shot on goal.

- a) How many different 5-player arrangements are possible?

(1 mark)

$${}_{18}P_5 = 1028160$$

- b) If Dustin and Andrew are 2 of the 18 players, what is the probability that Dustin will shoot first and Andrew will shoot second? Show your work. Express your answer as a fraction or round to the nearest thousandth (three decimal places).

(2 marks)

$$\frac{1}{18} \times \frac{1}{17} = .0032 = .32\%$$

↑
(E5)

3 marks:

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

(E5) → rounds incorrectly

Exemplar 2

Question 12**Total: 3 marks**

A coach randomly selects 5 players from a team of 18 to line up for a shot on goal.

- a) How many different 5-player arrangements are possible?

(1 mark)

$$18C_5 = 8568$$

- b) If Dustin and Andrew are 2 of the 18 players, what is the probability that Dustin will shoot first and Andrew will shoot second? Show your work. Express your answer as a fraction or round to the nearest thousandth (three decimal places).

(2 marks)

$$2C_2 = 1$$

$$16C_3 = 560$$

$$1 \times 560 = 560$$

$$\frac{560}{8568} = 0.0654$$

2 marks:

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

Exemplar 1

Question 15

Total: 4 marks

Imani is going to buy a car. She can afford monthly payments of \$600.00. The dealer offers two financing options:

Option 1: financing over 60 months at a rate of 0.90% compounded monthly

Option 2: financing over 60 months at a rate of 2.90% compounded monthly with an instant rebate of \$3000.00 at the time of purchase

Which option allows Imani to purchase a more expensive car? Show your work.

Option 1:

$$N = 5 \times 12$$
$$I = 0.90$$
$$PV = 0$$
$$PMT = 600$$
$$DFV = \$36808.17$$
$$Ply = 12$$
$$Cly = 12$$

option 2:

$$N = 5 \times 12$$
$$I = 2.90$$
$$PV = 0$$
$$PMT = 600$$
$$DFV = 38690.66 + 3000$$
$$Ply = 12$$
$$Cly = 12$$

3 marks:

- ② → 1 mark for consistent loan amount for Option 1
- ③ → 1 mark for consistent loan amount for Option 2
- ④ → 1 mark for correct choice of option, including \$3000.00 rebate

Option 2 will give you expensive car,

Exemplar 2

Question 15

Total: 4 marks

Imani is going to buy a car. She can afford monthly payments of \$600.00. The dealer offers two financing options:

Option 1: financing over 60 months at a rate of 0.90% compounded monthly

Option 2: financing over 60 months at a rate of 2.90% compounded monthly with an instant rebate of \$3000.00 at the time of purchase

Which option allows Imani to purchase a more expensive car? Show your work.

$$\begin{aligned} 1: N &= 60 \\ I &= .9 \\ PV &= 35189 \\ Pmt &= -600 \text{ (E4)} \\ FV &= 0 \\ P/Y &= 12 \\ C/Y &= 12 \end{aligned}$$

$$\begin{aligned} 2: N &= 60 \\ I &= 2.9 \\ PV &= 33474 \\ Pmt &= -600 \text{ (E4)} \\ FV &= 0 \\ P/Y &= 12 \\ C/Y &= 12 \end{aligned}$$

Option 1 lets him purchase a more expensive car

3 marks:

- ① → 1 mark for appropriate work
- ② → 1 mark for consistent loan amount for Option 1
- ③ → 1 mark for consistent loan amount for Option 2

(E4) → does not express monetary values to two decimal places

Exemplar 1

Question 16**Total: 2 marks**

Your friend has \$10 000.00 and is considering an investment in stocks, a guaranteed investment certificate (GIC), or rare collectibles.

Choose one of the three investments mentioned above and indicate one advantage and one disadvantage for your choice.

If they choose stocks, it is a great way to make a lot of money. But to own a stock it takes up a lot of time and you can lose money very easily if your stocks aren't doing well

1 mark:

② → 1 mark for appropriate disadvantage of investment choice

Exemplar 2

Question 16

Total: 2 marks

Your friend has \$10 000.00 and is considering an investment in stocks, a guaranteed investment certificate (GIC), or rare collectibles.

Choose one of the three investments mentioned above and indicate one advantage and one disadvantage for your choice.

I would choose a GIC because it is a secure investment however, interest rates can be quite expensive

1 mark:

① → 1 mark for appropriate advantage of investment choice

Exemplar 1

Question 17

Total: 4 marks

When she turned 25, Alexa began investing \$400.00 monthly into a mutual fund account producing average returns of 6.00%, compounded monthly. Alexa will stop contributing when she retires at age 55.

a) How much money will her investment be worth at retirement? Show your work.

(2 marks)

$$\begin{aligned} N &= 372 && 31 \text{ years} \\ I &= 6 \\ PV &= 0 \\ PMT &= -400 \\ FV &= 433680.37 \\ P/Y &= 12 \\ C/Y &= 12 \\ PMT &: \text{BEGIN} \end{aligned}$$

Her investment will be worth \$433680.37

b) Alexa will withdraw \$2500.00 per month from her account after retiring. If the average return rate stays the same, how old will she be when the account balance is zero? Show your work.

(2 marks)

$$\begin{aligned} N &= 124.75 && 10.40 \text{ years} \\ I &= 6 \\ PV &= 0 \\ PMT &= -2500 \\ FV &= 433680.37 \\ P/Y &= 12 \\ C/Y &= 12 \\ PMT &: \text{BEGIN} \end{aligned}$$

she will be 65 years old

2 marks:

② → 1 mark for consistent answer in (a)

④ → 1 mark for consistent answer in (b)

Exemplar 2

Question 17

Total: 4 marks

When she turned 25, Alexa began investing \$400.00 monthly into a mutual fund account producing average returns of 6.00%, compounded monthly. Alexa will stop contributing when she retires at age 55.

a) How much money will her investment be worth at retirement? Show your work.

(2 marks)

$$\begin{aligned}
 N &= 360 \\
 I\% &= 6 \\
 PV &= 0 \\
 PMT &= 400 \\
 FV &= -401806.017 \\
 P/Y &= 12 \\
 C/Y &= 12
 \end{aligned}$$

$\$ 401806.02$

b) Alexa will withdraw \$2500.00 per month from her account after retiring. If the average return rate stays the same, how old will she be when the account balance is zero? Show your work.

(2 marks)

$$\begin{aligned}
 N &= 118.2529 \div 12 = 9.85 \\
 I\% &= 6 \\
 PV &= 0 \\
 PMT &= -2500 \\
 FV &= 401806.02 \\
 P/Y &= 12 \\
 C/Y &= 12
 \end{aligned}$$

$$\begin{array}{r}
 +55 \\
 \hline
 64.85
 \end{array}$$

about
65 years

3 marks:

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

Exemplar 1

Question 18

Total: 5 marks

Shirley and Cameron have just moved to Brandon and are considering the two following housing options:

Option 1: House for purchase

- purchase price of \$249 000.00
- down payment of \$50 000.00 required
- 25-year mortgage at an interest rate of 3.00%, compounded semi-annually

Option 2: Apartment for rent

- monthly payments of \$1300.00
- monthly parking fees of \$60.00

- a) What would be Shirley and Cameron's monthly mortgage payment with Option 1?
Show your work.

(2 marks)

They will have monthly payments of
\$ 941.76

TVM

Exemplar 1 (continued)

b) What will be the total amount paid for each option at the end of 10 years?

(2 marks)

$$199\,000 - 136\,518.21 = \cancel{62\,481.79} \text{ for option 1}$$

$$\text{Option 2: } (1300 \times 12 \times 10) + (60 \times 12 \times 10) \\ 156\,000 + 7200 = \$163\,200.00 \text{ After 10 years}$$

c) State one advantage of renting the apartment.

(1 mark)

for the apartment you don't have to pay interest.

2 marks:

- ② → 1 mark for consistent monthly mortgage payment in (a)
- ④ → 1 mark for consistent total amount paid for Option 2 in (b)

Exemplar 2

Question 18

Total: 5 marks

Shirley and Cameron have just moved to Brandon and are considering the two following housing options:

Option 1: House for purchase

- purchase price of \$249 000.00
- down payment of \$50 000.00 required
- 25-year mortgage at an interest rate of 3.00%, compounded semi-annually

Option 2: Apartment for rent

- monthly payments of \$1300.00
- monthly parking fees of \$60.00

- a) What would be Shirley and Cameron's monthly mortgage payment with Option 1?
Show your work.

(2 marks)

$$\begin{aligned} N &= 25 \\ I &= 3 \\ PV &= 50\,000 \\ \boxed{PMT = -3618.61} \\ FV &= 249\,000 \\ P/Y &= 12 \\ C/Y &= 2 \end{aligned}$$

\therefore monthly mortgage
Payments will be
\$7601.00

Exemplar 2 (continued)

b) What will be the total amount paid for each option at the end of 10 years?

(2 marks)

$$\text{Option 1} = 3618.51 \times 50 = 180925.5 + 50000 = 230925.5$$

↑ (E2)

↑ (E4)

$$\text{Option 2} = 120 \times 1300 = 156000 + 60 \times 120 = 163200$$

↑ (E2)

c) State one advantage of renting the apartment.

(1 mark)

You do not have to pay mortgage
making it cheaper.

1 mark:

④ → 1 mark for consistent total amount paid for Option 2 in (b)

(E2) → does not include the dollar sign for monetary values

(E4) → does not express monetary values to two decimal places

Exemplar 1

Question 19

Total: 2 marks

Eleni is placing cups onto a 7 in. by 10 in. tray. Each cup has a circumference of 10 in.

Determine the maximum number of cups she can place on the tray. Show your work.



$$C = 2\pi r$$
$$10 = 2\pi r$$
$$r = 1.59'$$

$$A = \pi r^2$$
$$A = \pi (1.59)^2$$
$$A = 7.94 \text{ in}^2$$

$$L \cdot w = 10 \times 7$$
$$= 70$$

$$\frac{70}{7.94} = 8.82$$

So 8 cups

1 mark:

② → 1 mark for consistent total number of cups

Exemplar 2

Question 19

Total: 2 marks

Eleni is placing cups onto a 7 in. by 10 in. tray. Each cup has a circumference of 10 in.

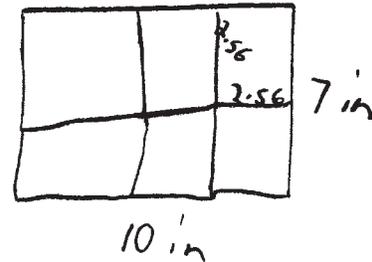
Determine the maximum number of cups she can place on the tray. Show your work.

$$C = 2\pi r$$

$$10 = 2\pi r$$
$$\frac{10}{2\pi} = \frac{2\pi r}{2\pi}$$

$$r = 1.6$$

$$d = 2.56 \text{ in}$$



$$3 \times 2 = 6 \text{ cups}$$

you can fit 6 cups on the tray.

1 mark:

② → 1 mark for consistent total number of cups

Exemplar 1

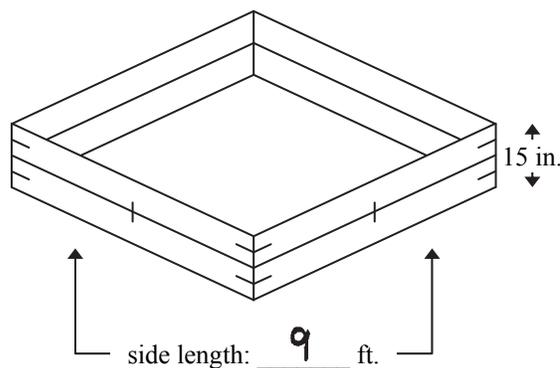
Question 20

Total: 4 marks

You want to build a garden.

- The garden is square.
- The side length is between 8 ft. and 10 ft.
- The garden is enclosed using boards stacked two boards high.
- There are 12 metal supports used to connect the structure.
- The garden is filled with soil to a depth of 15 in.

(Diagram is not drawn to scale.)



Below is the price list for materials:

Item	Cost (plus GST and PST)
metal supports	\$2.00 each
boards	\$2.50/linear foot
soil	\$12.00/yd ³

Determine the total cost of building your garden. All items must be purchased in whole units. Show your work. (Note: GST = 5%, PST = 8%)

TOTAL VOLUME: $L \times W \times H$

$$15 \text{ in} \times \frac{1 \text{ ft}}{12 \text{ in}} = 1.25 \text{ ft}$$

$$= 9 \text{ ft} \times 9 \text{ ft} \times 1.25 \text{ ft}$$

$$= 101.25 \text{ ft}^3 \quad \textcircled{\text{E3}}$$

$$1 \text{ ft}^3 = 0.036 \text{ yd}^3$$

$$101.25 \text{ ft}^3 \times \frac{0.036 \text{ yd}^3}{1 \text{ ft}^3} = 3.645 \text{ yd}^3 \approx 4 \text{ yd}^3$$

$$\text{SOIL: } 4 \text{ yd}^3 \times \$12.00 = \boxed{\$48.00}$$

$$\text{BOARDS: } 9 \text{ ft} \times 2.50 = 22.50 \times 3 = 67.50 \times 4$$

$$= \$270$$

$$= 1.25 \text{ ft} \times 2.50 = 3.125 \times 4 = \$12.5$$

$$= 270.00 + 12.5$$

$$= \boxed{\$282.50}$$

SUPPORTS:

$$12 \times 2.00 = \boxed{\$24.00}$$

$$\$48.00$$

$$+ \$282.50$$

$$\$24.00$$

$$\$354.50$$

$$\text{GST: } 354.50 \times 0.05 = \$17.725$$

$$\text{PST: } 354.50 \times 0.08 = \$28.36$$

$$\$354.50 + \$46.085$$

$$= \boxed{\$400.59}$$

TOTAL:

3 marks:

- ② → 1 mark for correct volume of garden
- ③ → 1 mark for consistent conversion to cubic yards
- ④ → 1 mark for consistent total cost, including taxes

ⓔ → makes a transcription error

Exemplar 2

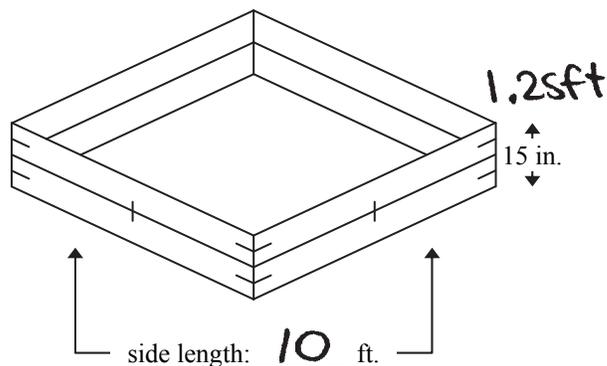
Question 20

Total: 4 marks

You want to build a garden.

- The garden is square.
- The side length is ~~between 8 ft. and 10 ft.~~
- The garden is enclosed using boards stacked two boards high.
- There are 12 metal supports used to connect the structure.
- The garden is filled with soil to a depth of 15 in.

(Diagram is not drawn to scale.)



Below is the price list for materials:

Item	Cost (plus GST and PST)
metal supports	\$2.00 each
boards	\$2.50/linear foot
soil	\$12.00/yd ³

Determine the total cost of building your garden. All items must be purchased in whole units. Show your work. (Note: GST = 5%, PST = 8%)

boards
 $4 \times 2 = 8 \times 10$
 $= 80 \text{ ft}$
 $\frac{80}{2.50} = \boxed{\$32}$

supports
 2×12
 $= \boxed{\$24}$

$32 + 24 + 24$
 $= \boxed{\$80}$

Soil
 $V = whl$
 $= (10)(10)(1.25)$
 $= 125 \text{ ft}^3$
 $\frac{125}{81}$
 $= 1.54 \text{ yd}^3$

$1 \text{ yd}^2 = 27 \text{ ft}^2$
 $1 \text{ yd}^3 = 81 \text{ ft}^3$

80×1.13
 $= \boxed{\$90.40}$

\therefore The cost of building your garden is $\boxed{\$90.40}$

12×2
 $= \boxed{\$24}$

2 marks:

- ① → 1 mark for correct number of linear feet needed
- ② → 1 mark for correct volume of garden

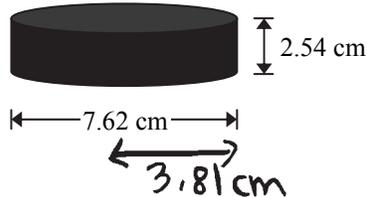
Exemplar 1

Question 21

Total: 3 marks

- a) What is the volume of a rubber hockey puck? (Diagram is not drawn to scale.)

(1 mark)



$$\begin{aligned}V &= \pi r^2 h \\V &= \pi (3.81)^2 (2.54) \\V &= 115.833. \\V &\doteq 115.83 \text{ cm}^3\end{aligned}$$

- b) How many pucks can be produced for \$1000.00 if it costs \$0.24 to print a logo on each puck and rubber costs \$0.0036 per cm^3 ?

(2 marks) Cost of 1 puck

$$\text{logo} = \$0.24$$

$$\text{rubber} : \$0.0036 (115.83) = \$0.416988$$

$$\doteq \$0.42$$

$$\$0.24 + \$0.42 = \$0.66 / \text{puck}$$

$$\frac{\$1000.00}{\$0.66} = 1515.15$$

\therefore 1515 pucks can be produced for \$1000.00

3 marks:

- ① → 1 mark for correct answer in (a)
- ② → 1 mark for correct unit cost of puck in (b)
- ③ → 1 mark for consistent answer in (b)

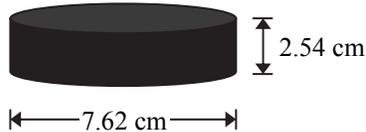
Exemplar 2

Question 21

Total: 3 marks

- a) What is the volume of a rubber hockey puck? (Diagram is not drawn to scale.)

(1 mark)



$$\frac{7.62}{2} = 3.81$$

$$\begin{aligned} \text{Volume} &= \pi r^2 h \\ &= \pi (3.81^2)(2.54) \\ &= 115.83 \text{ cm}^3 \end{aligned}$$

- b) How many pucks can be produced for \$1000.00 if it costs \$0.24 to print a logo on each puck and rubber costs \$0.0036 per cm^3 ?

(2 marks)

$$\frac{\$1000.00}{\$0.2436} = 4105.09$$

$$\begin{aligned} \$0.24 + 0.0036 &= 0.2436 \\ &= \$0.2436 \end{aligned}$$

4105.09 ^{EG} pucks can be made for \$1000.00

2 marks:

① → 1 mark for correct answer in (a)

② → 1 mark for consistent answer in (b)

EG → does not use whole units in contextual questions involving discrete data (e.g., people)

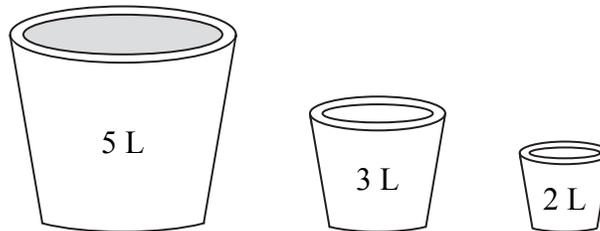
Exemplar 1

Question 23

Total: 2 marks

You have 3 pails with volumes of 2 L, 3 L, and 5 L.

The 5 L pail is filled with water. The other pails are empty.



Using only these pails, explain how to measure out exactly 4 L of water into the 5 L pail.

Take the 2L bucket and fill it up from the 5 L bucket, pour the 2L into the 3 L bucket. Then once again refill 2L bucket with water.

1 mark:

① → 1 mark for appropriate strategy

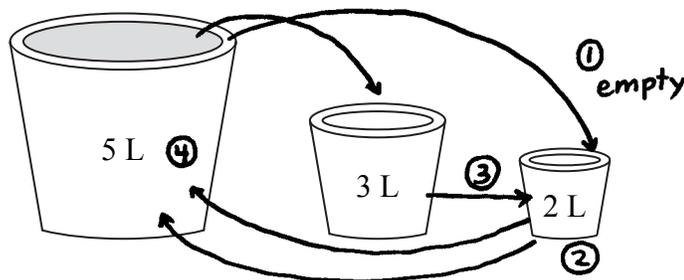
Exemplar 2

Question 23

Total: 2 marks

You have 3 pails with volumes of 2 L, 3 L, and 5 L.

The 5 L pail is filled with water. The other pails are empty.



Using only these pails, explain how to measure out exactly 4 L of water into the 5 L pail.

To measure out exactly 4 L of water into the 5 L pail, do these steps:

- 1) Empty the 5 L that is filled with water in the 3 L pail and the 2 L pail (together they can hold 5 L of water).
- 2) Now the 5 L pail is empty.
- 3) Take the water that is in the 2 L pail and put it in the 5 L pail.
- 4) Now the 2 L pail is empty.
- 5) Fill the 2 L again with water from the 3 L pail.
- 6) Take the water that is in the 2 L pail and empty it into the 5 L pail.
- 7) Now there is exactly 4 L of water in the 5 L pail, 1 L of water in the 3 L pail, and 0 L in the 2 L pail.

2 marks:

- ① → 1 mark for appropriate strategy
- ② → 1 mark for correct answer

Exemplar 1

Question 24**Total: 2 marks**

Consider the original statement:

“If students are in Grade 12, then they will graduate this June.”

- a) Write the converse of the statement.

(1 mark)

If they will graduate in June, they are Grade 12 Students

- b) Determine if a biconditional statement is possible. If yes, write the biconditional statement. If not, provide a counterexample.

(1 mark)

No
The grade 12 student could fail

1 mark:

② → 1 mark for correct counterexample in (b)

Exemplar 2

Question 24**Total: 2 marks**

Consider the original statement:

“If students are in Grade 12, then they will graduate this June.”

- a) Write the converse of the statement.

(1 mark)

If students graduate this June, they are in grade 12.

- b) Determine if a biconditional statement is possible. If yes, write the biconditional statement. If not, provide a counterexample.

(1 mark)

Students graduate this June if, and only if they are in grade 12.

0 marks: → no criteria met

Appendices

Appendix A: Table of Questions by Unit and Learning Outcome

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