Grade 12
Applied Mathematics
Achievement Test

Marking Guide

January 2016

Manitoba 🐃

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

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

Websites are subject to change without notice.

Disponible en français.

Available in alternate formats upon request.

Contents

General Marking Instructions

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

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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. 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)

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

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

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

Irregularities in Provincial Tests

During the administration of provincial tests, supervising teachers may encounter irregularities. Markers may also encounter irregularities during local marking sessions. Appendix B provides examples of such irregularities as well as procedures to follow to report irregularities.

If a *Scoring Sheet* is marked with "0" and/or "NR" only (e.g., student was present but did not attempt any questions) please document this on the *Irregular Test Booklet Report*.

Assistance

If any issue arises that cannot be resolved locally during marking, please call Manitoba Education and Advanced Learning at the earliest opportunity to advise us of the situation and seek assistance if necessary.

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

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Assessment Consultant
Grade 12 Applied Mathematics
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Toll-Free: 1-800-282-8069, ext. 4035
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Marking Keys

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

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

Use the graph below to answer the following question and select the best answer.
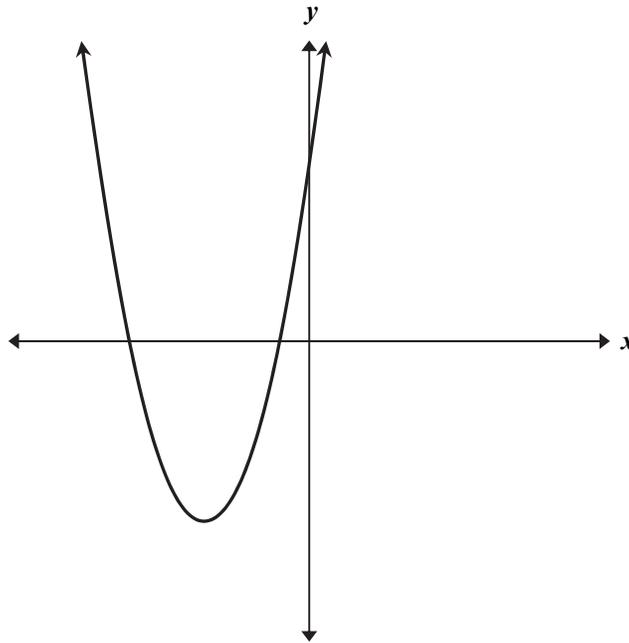
Which equation does the graph represent?

A. $y = 2x^2 + 7x - 3$

B. $y = -2x^2 + 7x + 3$

C. $y = 2x^2 + 7x + 3$

D. $y = -2x^2 + 7x - 3$

Question 2

Total: 1 mark

Select the best answer.

Which of the following functions has an unrestricted range, $\{y \mid y \in R\}$?

A.　exponential

Ⓑ　logarithmic

C.　quadratic

D.　sinusoidal

Question 3
Total: 2 marks

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

In a diving competition, Tracy's first dive can be modelled by the equation:

$$h = -4.90t^2 + 2.72t + 10$$

**where *t* represents the dive time (in seconds)
and *h* represents the diver's height (in metres) above the water.**

How much time does it take for Tracy to reach the water? Show your work.

$\boxed{\text{CALC}}$ 2: zero

$x = 1.73$

OR ————————————————————
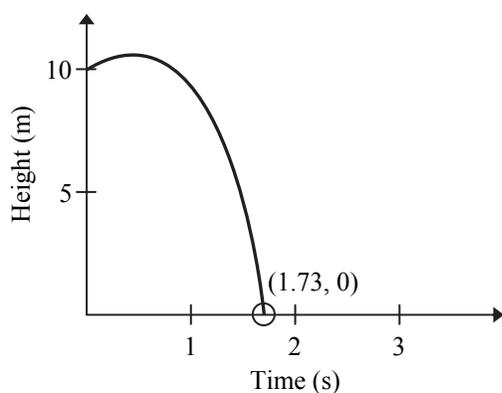
$\boxed{\text{CALC}}$ 5: intersect   Y₂ = 0

$x = 1.73$

She reaches the water after 1.73 s.

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

Question 4 — Total: 3 marks

A garden was treated to control pests. Every hour after treatment, there were half as many pests as there were the previous hour. After six (6) hours, 65 pests remained.

a) How many pests were there before treatment? Show your work.

(2 marks)

$$65 = N(0.5)^6$$
$$65 = N(0.015\ 625)$$
$$N = 4160$$

There were 4160 pests before treatment.

b) *Select the best answer.*

Which function best represents this situation?

(1 mark)

    A. linear

    B. quadratic

    C. cubic

    D. **exponential**

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

Question 5 — Total: 3 marks

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

The illuminated area of the moon varies sinusoidally with time. A lunar cycle begins and ends with a new moon. A *new moon*, which is 0% illuminated, occurs on the 1st and the 29th day of the cycle. Midway through the cycle (15th day), a *full moon*, which is 100% illuminated, occurs.

a) Determine the sinusoidal equation that models the relationship between the illuminated area of the moon and the lunar cycle. Show your work.

(2 marks)

Day of Cycle	Illumination (%)
1	0
8	50
15	100
22	50
29	0

$$y = 50 \sin(0.22x - 1.80) + 50$$

OR
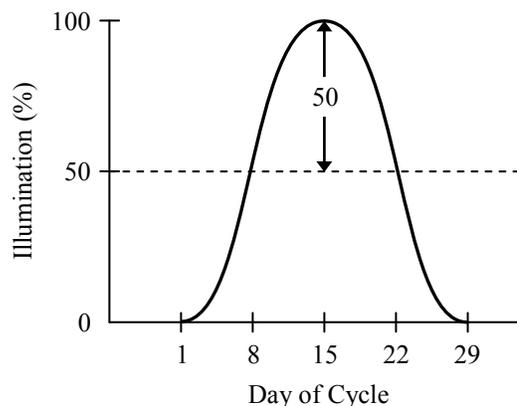
$$a = 50$$

$$b = \frac{2\pi}{29}$$

$$c = 8$$

$$d = 50$$

$$y = 50 \sin\left(\frac{2\pi}{29}[x - 8]\right) + 50$$

b) According to your equation in (a), what percentage of the moon is illuminated on the 18th day of the cycle?

(1 mark)

$$\boxed{\text{TRACE}} \; x = 18$$

$$y = 89.09$$

The moon is 89.09% illuminated.

Marker Note(s):
→ *Award mark* ❶ *if two of the four parameters are correct.*
→ *Award mark* ❸ *for 91.57%; answer reflects the use of rounded values in (a).*

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

Question 6
Total: 6 marks

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

Bailey launched his remote control plane. He recorded the height of the plane at different times during the flight.

Time (s)	Height (ft.)
0	0
1	9
2	7
3	3
4	7
5	26

a)   **Determine the cubic regression equation that models this data.**

(1 mark)

$$y = 1.48x^3 - 9.79x^2 + 17.12x + 0.06$$

b)   **Create a clearly labelled graph of the equation in (a).**

(3 marks)

Height of Plane Over Time
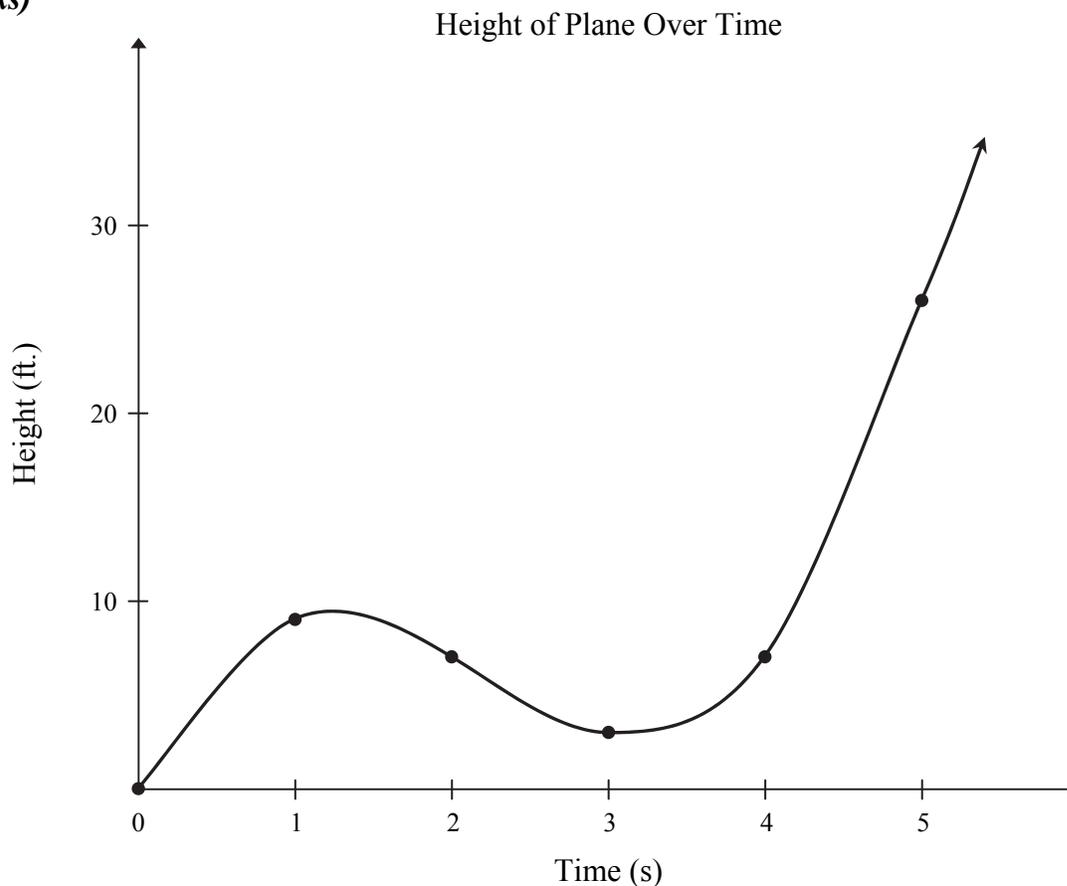
c) **Using your equation in (a), determine how long it will take for the plane to reach a height of 100 ft.**

(1 mark)

$$x = 100 \text{ ft.}$$
$$y = 6.44 \text{ s}$$

The plane will take 6.44 s to reach a height of 100 ft.

d) **Provide one limitation of the domain.**

(1 mark)

Time cannot be negative.

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

The plane cannot fly forever.

Other answers are possible.

Marker Note(s):
→ *Award mark ❺ for 6.45 s; answer reflects the use of rounded values in (a).*

Marking Key
❶ *1 mark for correct equation in (a)*
❷ *1 mark for communicating the context of the graph with appropriate title and/or labels in (b)*
❸ *1 mark for using an appropriate domain and range (i.e., window settings/grid range) for the context of the question in (b)*
❹ *1 mark for an appropriate shape that illustrates key characteristics of the function (e.g., maximum, minimum, intercepts) in (b)*
❺ *1 mark for consistent answer in (c)*
❻ *1 mark for a correct limitation of the domain in (d)*

PROBABILITY

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

Select the best answer.

Which of the following values cannot describe the probability of an event?

A. 100%

B. $\dfrac{3}{4}$

C. 0

(D.) **1.2**

Question 8	Total: 1 mark
Learning Outcome: 12A.P.2	Question Type: Selected Response

Select the best answer.

You have a stack of ten cards numbered 11 to 20. What is the probability that a randomly drawn card is an odd number or a multiple of three?

A. 0.3

B. 0.5

(C.) **0.7**

D. 0.8

> **Student Error**
> A: multiples of 3 only
> B: odd numbers only
> D: multiples of 3 plus odd numbers

Question 9

Total: 3 marks

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

Lena runs every day. If it is sunny, the probability she will run outside is 75%. If it is not sunny, the probability that she will run outside is 20%. A 45% probability of sunshine has been announced for tomorrow.

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

(1 mark)

Tree diagram:
- $P(\text{sunny}) = 0.45$
  - $P(\text{run outside}) = 0.75$
  - $P(\text{not run outside}) = 0.25$
- $P(\text{not sunny}) = 0.55$
  - $P(\text{run outside}) = 0.20$
  - $P(\text{not run outside}) = 0.80$
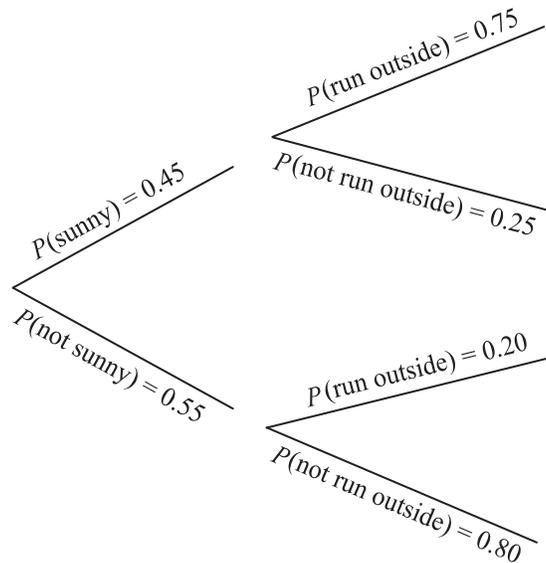
b) **Determine the probability that Lena runs outside tomorrow. Show your work.**

(2 marks)

$$P(\text{run outside}) = (0.45)(0.75) + (0.55)(0.20)$$
$$= 0.447\ 5 \text{ or } 44.75\%$$

The probability that she will run outside is 0.45 or 44.75%.

Marker Note(s):
→ *Award mark* ❷ *if correct probabilities were provided in (a).*

Marking Key
❶ *1 mark for correct graphic organizer (probabilities not required) in (a)*
❷ *1 mark for appropriate work in (b)*
❸ *1 mark for consistent answer in (b)*

Question 10

Total: 3 marks

a) Determine the number of different ways the letters of the word "CINCINNATI" can be arranged. Show your work.

(2 marks)

$$\frac{10!}{2!\ 3!\ 3!} = 50\ 400$$

$$\downarrow\ \downarrow\ \downarrow$$

$$\text{C}\quad \text{I}\quad \text{N}$$

There are 50 400 ways.

b) How many ways can the letters of the word "CINCINNATI" be arranged if the first letter must be T?

(1 mark)

The numerator becomes

$$1 \times 9! = 1 \times 9 \times 8 \times 7 \times 6 \times 5 \times 4 \times 3 \times 2 \times 1$$

$$\frac{9!}{2!3!3!} = 5040$$

There are 5040 ways.

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

Question 11   Total: 3 marks

Learning Outcomes: 12A.P.4, 12A.P.6   **Question Type: Constructed Response**

Alec walks eight blocks from home to school every morning.

a) **If he only travels south and east, what is the total number of routes from home to school?**

(1 mark)

OR
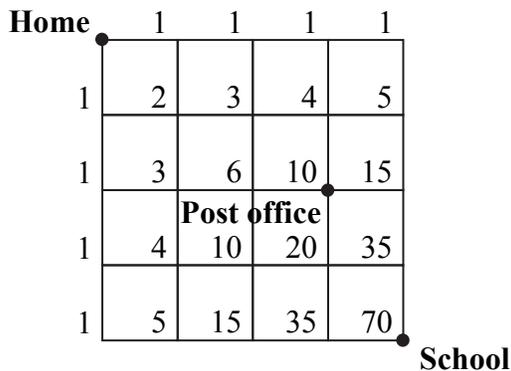
EEEESSSS

$$\frac{8!}{4!4!} = \frac{40\ 320}{576} = 70$$

There are 70 possible routes from home to school.

b) **What is the probability that his route from home to school passes by the post office? Show your work.**

(2 marks)

OR
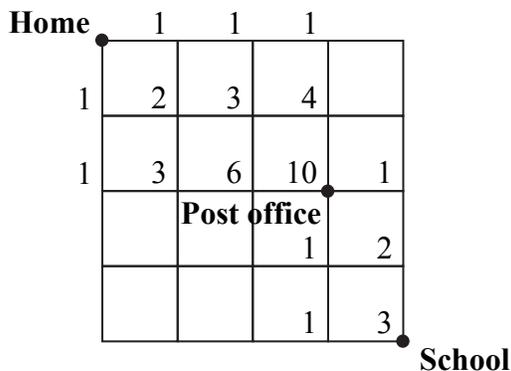
EEESS   ESS

$$\frac{5!}{3!2!} \quad \times \quad \frac{3!}{2!}$$

10   ×   3

Routes that pass by the post office:
$10 \times 3 = 30$ ways

$$P = \frac{30}{70}$$
$$= 0.428\ 6 \text{ or } 42.86\%$$

The probability is $\frac{3}{7}$ or 0.43 or 42.86%.

Marking Key
❶ *1 mark for correct total routes from home to school in (a)*
❷ *1 mark for correct number of routes from home to school passing by the post office in (b)*
❸ *1 mark for probability consistent with work in (b)*

Question 12

Total: 4 marks

Learning Outcome: 12A.P.6

Question Type: Constructed Response

There are 18 girls and 12 boys trying out for a debate team.

a) How many different teams of 4 members can be formed if there are no restrictions?

(1 mark)

$$_{30}C_4 = 27\ 405$$

There are 27 405 teams.

b) How many different teams of 4 members can be formed if <u>exactly</u> two members must be girls?

(1 mark)

2 girls, 2 boys: $_{18}C_2 \times {}_{12}C_2$
$$= 10\ 098$$

There are 10 098 teams.

c) How many different teams of 4 members can be formed if <u>at least</u> two members must be girls? Show your work.

(2 marks)

2 girls, 2 boys: $_{18}C_2 \times {}_{12}C_2$
$$= 10\ 098$$

3 girls, 1 boy: $_{18}C_3 \times {}_{12}C_1$
$$= 9792$$

4 girls, no boys: $_{18}C_4 \times {}_{12}C_0$
$$= 3060$$

$$10\ 098 + 9792 + 3060 = 22\ 950$$

There are 22 950 teams.

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

FINANCIAL MATHEMATICS

Question 13

Total: 1 mark

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

Select the best answer.

Which of the following is an advantage of buying a house?

A. no maintenance costs

B. no property taxes

C. no down payment required

D. **no restrictions on renovations**

Question 14

Total: 1 mark

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

Select the best answer.

Approximately how many years will it take a $1000.00 investment to double its value at an interest rate of 3.60%, compounded annually?

A. 5

B. 7.2

C. **20**

D. 50

Student Error
A: $\dfrac{3.60}{0.72}$
B: 2×3.60
D: $1000 \times \dfrac{3.60}{72}$

Question 15
Total: 2 marks

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

Bruce is 24 years old. He graduated from college when he was 20 and since then he has worked full-time. He has also made some investments.

His financial advisor sends him an update on his investment portfolio.

Investment	Initial Investment	Gain/Loss
low-risk mutual fund	$2000	+ $100
guaranteed investment certificate	$6000	+ $220
bonds	$4000	+ $180

a) What is the overall rate of return on Bruce's investments?

(1 mark)

$$\text{Rate of return} = \frac{\$100 + \$220 + \$180}{\$12\ 000} \times 100 = 4.17\%$$

His overall rate of return is 4.17%.

b) Do you think that Bruce's investment portfolio is appropriate for him at this stage of his life? Justify your answer, stating your assumptions.

(1 mark)

Bruce's portfolio is very conservative.
Assuming that he is a low risk-taker, this portfolio is appropriate for him.

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

Assuming Bruce may want to buy a house in the near future,
he should consider more liquid investments.

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

The rate of return is low over a 4-year period.
Bruce should consider some higher yield investments such as stocks
since he is young and has many years until retirement.

Other answers are possible.

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

Question 16   Total: 2 marks

Pedro has a tax-free savings account (TFSA) with a balance of $5000.00. Interest is earned at a rate of 4.00%, compounded monthly.

If Pedro contributes $400.00 to the TFSA at the end of every month, how long will it take him to save $20 000.00? Show your work.

```
■N=34.05523851
 I%=4
 PV=-5000
 PMT=-400
 FV=20000
 P/Y=12
 C/Y=12
 PMT:END BEGIN
```

It will take Pedro 34.06 months to save $20 000.00.

Marker Note(s):
→ _Accept 34.06 or 35 as correct answers._

Marking Key
❶   _1 mark for appropriate work_
❷   _1 mark for consistent answer_

Question 17
Total: 3 marks

Kira purchases a sofa for $1015.87 (taxes included). The department store offers her a promotion of 0% interest with no payments for one year. If Kira does not pay the amount in full within one year, interest will be charged from the date of purchase at an annual rate of 28.80%, compounded monthly.

a) If Kira does not make any payments, what will the department store bill her one year after the date of purchase? Show your work.

(2 marks)

```
N=12
I%=28.8
PV=1015.87
PMT=0
▪FV=-1350.322844
P/Y=12
C/Y=12
PMT:END BEGIN
```

The department store will bill her $1350.32 one year after the date of purchase.

b) State a different compounding period such that the overall cost of the sofa is lower than if the annual interest rate were compounded monthly.

(1 mark)

Any compounding period longer than monthly, for example
- semi-annually
- annually

Other answers are possible.

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

Question 18
Total: 5 marks

Learning Outcomes: 12A.FM.1, 12A.FM.2   **Question Type: Constructed Response**

Bill and Celine purchase a new home. They obtain a $375 000.00 mortgage amortized over 25 years with their credit union. The initial 5-year term of the mortgage requires monthly payments. Interest is calculated at a rate of 3.25%, compounded semi-annually.

a) **Calculate Bill and Celine's mortgage payment. Show your work.**

(2 marks)

```
N=300
I%=3.25
PV=375000
■PMT=-1823.1223...
FV=0
P/Y=12
C/Y=2
PMT:END BEGIN
```

Their monthly payment is $1823.12.

b) **How much will Bill and Celine owe at the end of their 5-year term?**

(1 mark)

```
bal(60)
       322054.567
```

OR

```
N=60
I%=3.25
PV=375000
PMT=-1823.1223...
■FV=-322054.567
P/Y=12
C/Y=2
PMT:END BEGIN
```

They will owe $322 054.57 after 5 years.

c) **Bill and Celine make an additional $10 000.00 payment on the principal at the end of the 5-year term. How much sooner will they pay off their mortgage if they keep the same payments and interest rate over the life of the mortgage? Show your work.**

(2 marks)

```
■N=229.6782198
I%=3.25
PV=312054.567
PMT=-1823.1223...
FV=0
P/Y=12
C/Y=2
PMT:END BEGIN
```

$$300 - 60 - 229.68 = 10.32$$

They will pay off their mortgage 10.32 months sooner.

Marker Note(s):
→ *Accept 10 or 10.32 months as correct answers in (c).*

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

DESIGN AND MEASUREMENT

Question 19	Total: 1 mark
Learning Outcome: 12A.D.1	Question Type: Selected Response

Select the best answer.

The volume of a freezer is 0.46 m^3. This volume can also be expressed as:

A. 46 cm^3

B. 460 cm^3

C. 4600 cm^3

D. **460 000 cm^3**

Question 20

Total: 2 marks

    Question Type: Constructed Response

Sophie wants to install carpet in her bedroom. The 12 ft. by 9 ft. carpet she wants to install costs \$32.50/yd^2, plus GST and PST.

Calculate the total cost of the carpet. Show your work.
(Note: GST = 5%, PST = 8%)

$$1 \text{ yd}^2 = 9 \text{ ft}^2$$

$$108 \text{ ft}^2 \times \frac{1 \text{ yd}^2}{9 \text{ ft}^2} = 12 \text{ yd}^2$$

$$12 \text{ yd}^2 \times \$32.50/\text{yd}^2 = \$390.00$$

$$
\begin{array}{r}
\$19.50 \ (\text{GST}) \\
+ \quad \$31.20 \ (\text{PST}) \\
\hline
\$440.70
\end{array}
$$

The total cost is \$440.70.

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

Question 21
Total: 6 marks

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

The Menard family has a grain farm. They own 5 bins for grain storage.

Each bin
- **is composed of a cone and a cylinder**
- **is 30 feet tall (from the top of the cone to the bottom of the cylinder)**
- **has a diameter of 20 feet**
- **has a cylinder 22 feet tall**

(Diagram is not drawn to scale.)
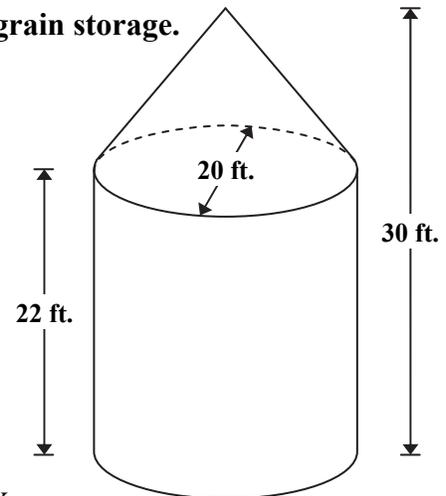
a) **Calculate the volume of one grain bin. Show your work.**

(2 marks)

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

$$= \pi \frac{(10 \text{ ft.})^2 (8 \text{ ft.})}{3}$$

$$= 837.76 \text{ ft}^3$$

$$V_{\text{cylinder}} = \pi r^2 h$$

$$= \pi (10 \text{ ft.})^2 (22 \text{ ft.})$$

$$= 6911.50 \text{ ft}^3$$

$$\text{Total} = 837.76 \text{ ft}^3 + 6911.50 \text{ ft}^3$$

$$= 7749.26 \text{ ft}^3$$

The volume of one grain bin is 7749.26 ft³.

Question 21 continued

b) **Mr. Menard decides to paint the exterior (sides and top) of the bins.**

- **Each bin needs 2 coats of paint.**
- **One can of paint covers 400 ft².**
- **Each can of paint costs $67.99, plus GST and PST.**

Calculate the total cost of the paint for the 5 bins. Show your work.
(Note: GST = 5%, PST = 8%)

(4 marks)

$$SA_{cone} = \pi rs \qquad\qquad s = \sqrt{\left(8^2 + 10^2\right)} \qquad\qquad SA_{cylinder} = 2\pi rh$$

$$= \pi(10 \text{ ft.})(12.81 \text{ ft.}) \qquad s = \sqrt{164} \text{ ft.} \qquad\qquad = 2\pi(10 \text{ ft.})(22 \text{ ft.})$$

$$= 402.32 \text{ ft}^2 \qquad\qquad s = 12.81 \text{ ft.} \qquad\qquad\qquad = 1382.30 \text{ ft}^2$$

$$\text{Total} = 402.32 \text{ ft}^2 + 1382.30 \text{ ft}^2$$

$$= 1784.621 \text{ ft}^2$$

$$\text{Area to paint} = 1784.62 \text{ ft}^2/\text{bin} \times 2 \text{ coats} \times 5 \text{ bins}$$

$$= 17\ 846.21 \text{ ft}^2$$

$$\text{Cans of paint needed} = \frac{17\ 846.21 \text{ ft}^2}{400 \text{ ft}^2}$$

$$= 44.61 \text{ cans}$$

$$= 45 \text{ cans}$$

$$\text{Total cost: } 45 \times \$67.99 = \$3059.55$$

$$\$152.98 \quad (\text{GST})$$

$$+ \quad \$244.76 \quad (\text{PST})$$

$$\overline{\$3457.29}$$

The total cost will be $3457.29.

Marking Key	
❶	*1 mark for appropriate work in (a)*
❷	*1 mark for consistent answer in (a)*
❸	*1 mark for appropriate work in calculating surface area in (b)*
❹	*1 mark for surface area of one bin in (b)*
❺	*1 mark for correct number of cans of paint in (b)*
❻	*1 mark for total cost in (b)*

LOGICAL REASONING

Question 22	Total: 1 mark
Learning Outcome: 12A.L.2	Question Type: Selected Response

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

Students were surveyed about the technology they own.

A = **owns a notebook computer**
B = **owns a tablet computer**
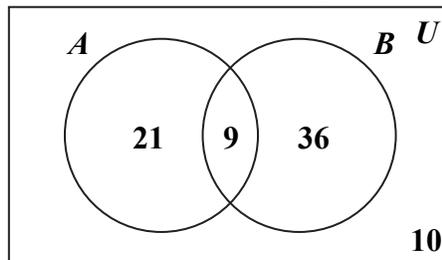
Which of the following statements is true?

A. $n(A) = 21$

B. $n(B') = 36$

C. $n(A \cap B) = 9$

D. $n(A \cup B) = 76$

Question 23
Total: 2 marks

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

A class of 28 students was surveyed to discover the type of music to which they listen.

- **12 students said they listen to country**
- **18 students said they listen to pop**
- **2 students said they listen to neither country nor pop**

Determine the number of students who listen only to pop. Show your work.
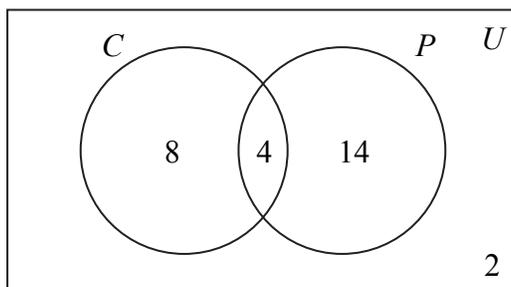
There are 14 students who listen only to pop.

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

$$P = \text{class} - C - C \bigcap P - N$$
$$= 28 - 8 - 4 - 2$$
$$= 14$$

There are 14 students who listen only to pop.

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

Question 24

Total: 2 marks

Question Type: Constructed Response

Consider the original statement:

"If the end behaviour of a function extends from quadrant II to quadrant I, then the function is quadratic."

a) Is the original statement true? If not, provide a counterexample.

(1 mark)

No, the original statement is not true.

Counterexample: ***OR***

$y = 5$ $y = 2^x$
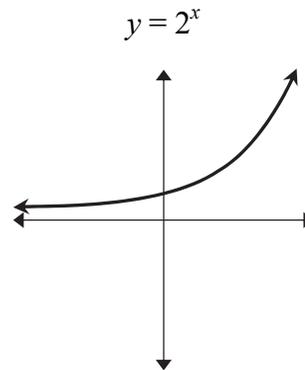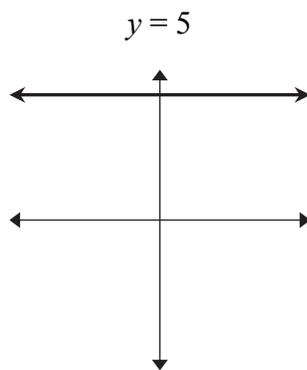
Other answers are possible.

b) Write the contrapositive of the original statement.

(1 mark)

If a function is not quadratic,
then its end behaviour does not extend from quadrant II to quadrant I.

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

Question 25   Total: 3 marks

Given the following sets:

$$U = \{1, 3, 5, 7, 9, 13, 17, 21\}$$
$$A = \{1, 9, 13, 21\}$$
$$B = \{1, 7, 9, 17, 21\}$$

a) Illustrate these sets using a Venn diagram.

(1 mark)

b) Determine $A' \cup B$.

(1 mark)

$$\{1, 3, 5, 7, 9, 17, 21\}$$

c) Create a set C with 3 elements, where $C \subset B$.

(1 mark)

$$\{1, 7, 9\}$$

Other answers are possible.

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)*

Question 26   **Total: 3 marks**

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

a) **Use the numbers 1, 2, 3, 4, 5, 6 only once to complete the chart.**

(2 marks)

$$7 + 6 + 9 = 22$$
$$+ \quad\quad + \quad\quad +$$
$$1 + 4 + 2 = 7$$
$$+ \quad\quad + \quad\quad +$$
$$5 + 8 + 3 = 16$$
$$\| \quad\quad \| \quad\quad \|$$
$$13 \quad\quad 18 \quad\quad 14$$

b) **What were the first two numbers you obtained?**   6 **and** 4

     Explain the strategy you used to obtain these numbers.

(1 mark)

Complete the top row as only one number is needed (6).
Complete the middle column as only one number is needed (4).

Other answers are possible.

Marking Key
❶   *1 mark for correct top row and middle column in (a)*
❷   *1 mark for correct completion of puzzle in (a)*
❸   *1 mark for appropriate strategy in (b)*

Exemplars

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

Exemplar 1

Question 3   Total: 2 marks

In a diving competition, Tracy's first dive can be modelled by the equation:

$$h = -4.90t^2 + 2.72t + 10$$

where *t* represents the dive time (in seconds)
and *h* represents the diver's height (in metres) above the water.

How much time does it take for Tracy to reach the water? Show your work.
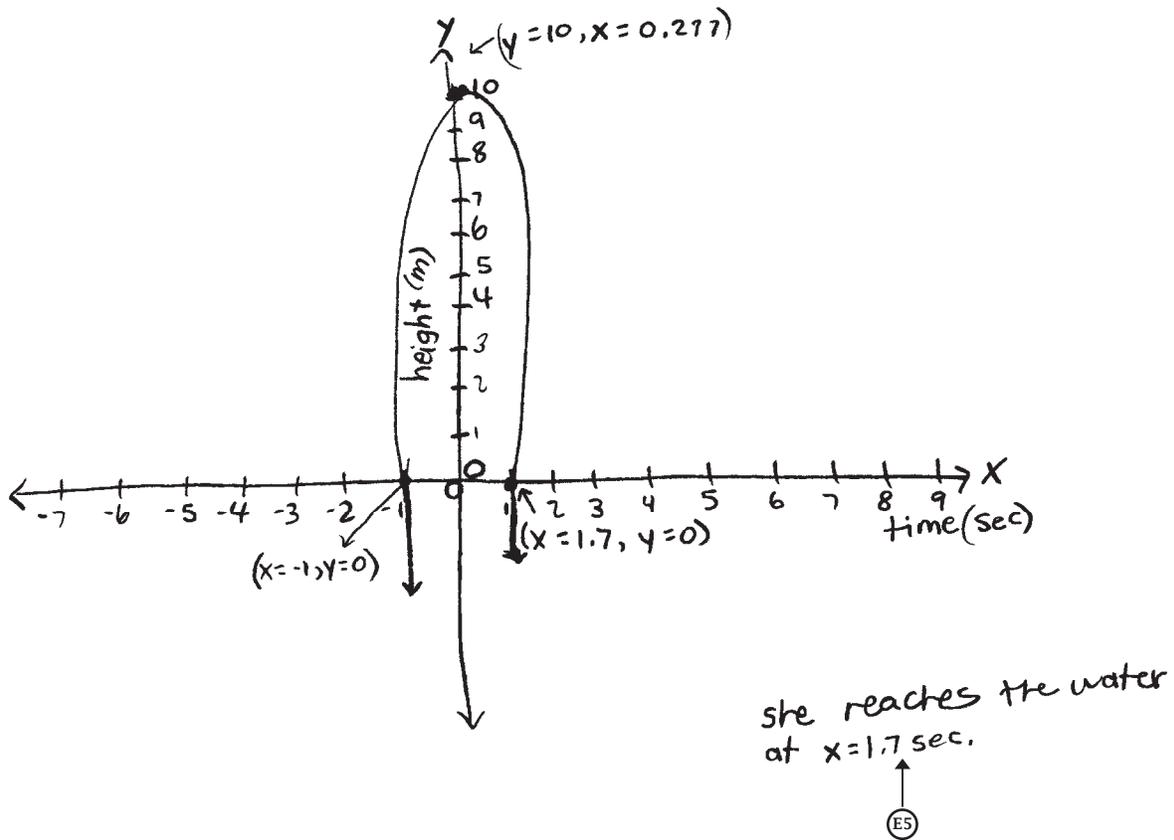
2 marks:
❶ → 1 mark for appropriate work
❷ → 1 mark for consistent answer
- -
Ⓔ⑤ → does not express the answer to the
       appropriate number of decimal places

Exemplar 2

In a diving competition, Tracy's first dive can be modelled by the equation:

$$h = -4.90t^2 + 2.72t + 10$$

where t represents the dive time (in seconds)
and h represents the diver's height (in metres) above the water.

How much time does it take for Tracy to reach the water? Show your work.

$$x = 1.73, \quad y = 0$$

(E2)

I put in y= graph intersect

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

⋯⋯⋯⋯⋯⋯⋯⋯⋯⋯⋯⋯⋯⋯⋯⋯⋯⋯⋯⋯⋯⋯⋯⋯⋯⋯⋯⋯⋯⋯⋯⋯

Ⓔ2 → does not include the units in the final answer

Exemplar 1

Question 4	Total: 3 marks

A garden was treated to control pests. Every hour after treatment, there were half as many pests as there were the previous hour. After six (6) hours, 65 pests remained.

a) How many pests were there before treatment? Show your work.

(2 marks)

6 h   65 pests

5 h   130

4 h   260

3 h   520

2 h   1040

1 h   2080

0 h   4160
(no treatment)

before
treatment
there was
4160 pests

---

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

Exemplar 2

Question 4   **Total: 3 marks**

A garden was treated to control pests. Every hour after treatment, there were half as many pests as there were the previous hour. After six (6) hours, 65 pests remained.

a)   How many pests were there before treatment? Show your work.

(2 marks)

$$\underset{6h}{65} \times \underset{5h}{2} \times \underset{4h}{2} \times \underset{3h}{2} \times \underset{2h}{2} \times \underset{1h}{2} = 2080 \text{ pests}$$

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

Exemplar 1

Question 5   Total: 3 marks

The illuminated area of the moon varies sinusoidally with time. A lunar cycle begins and ends with a new moon. A *new moon*, which is 0% illuminated, occurs on the 1st and the 29th day of the cycle. Midway through the cycle (15th day), a *full moon*, which is 100% illuminated, occurs.

a) Determine the sinusoidal equation that models the relationship between the illuminated area of the moon and the lunar cycle. Show your work.

(2 marks)

day (L_1)	% illumination (L_2)
1	0
8	50
15	100
22	50
29	0

SinReg

$a = 50$
$b = 0.224$
$c = -1.795$
$d = 50$

The equation that models this relationship is

$$y = 50 \sin (0.22x - 1.80) + 50$$

b) According to your equation in (a), what percentage of the moon is illuminated on the 18th day of the cycle?

(1 mark)

$\boxed{Y=}$ $Y_1 = (a)$

2nd $\boxed{\text{TRACE}}$ (CALC) → 1: value → $x = 18$ $y = 91.568$

On the 18th day of the cycle, the moon is 91.57% illuminated

---

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

Exemplar 2

The illuminated area of the moon varies sinusoidally with time. A lunar cycle begins and ends with a new moon. A *new moon*, which is 0% illuminated, occurs on the 1st and the 29th day of the cycle. Midway through the cycle (15th day), a *full moon*, which is 100% illuminated, occurs.

a)   Determine the sinusoidal equation that models the relationship between the illuminated area of the moon and the lunar cycle. Show your work.

(2 marks)

$$L_1 \quad L_2$$

x	y
1	0 %
7.5	50%
15	100%
22.5	50 %
29	0%

$$y = 50.7\sin(0.21x + 1.54) + 49.31$$

b)   According to your equation in (a), what percentage of the moon is illuminated on the 18th day of the cycle?

(1 mark)

2nd calc value $x = 18$

$y = ?$ → $\boxed{90.48 \%}$

---

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

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Exemplar 1

Question 6	Total: 6 marks

Bailey launched his remote control plane. He recorded the height of the plane at different times during the flight.

Time (s)	Height (ft.)
0	0
1	9
2	7
3	3
4	7
5	26

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

(1 mark)

$$y = 1.48x^3 - 9.79x^2 + 17.12x + 0.06$$

b) Create a clearly labelled graph of the equation in (a).

(3 marks)

Height of plane relative to time
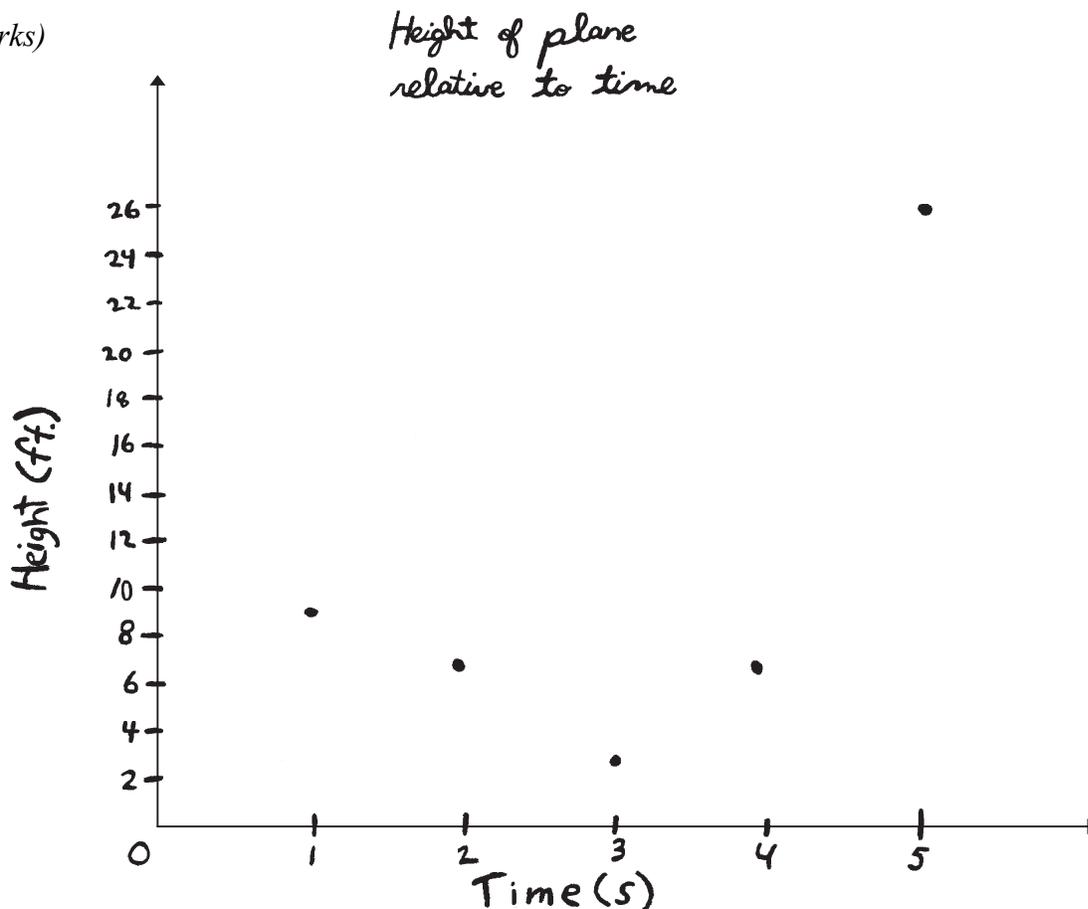
Exemplar 1 (continued)

c) Using your equation in (a), determine how long it will take for the plane to reach a height of 100 ft.

(1 mark)

$$y = 100$$

$$x = 6.44$$

$$6.44 \text{ seconds}$$

d) Provide one limitation of the domain.

(1 mark)

$$x \geq 0$$

(E1)

---

5 marks:

❶ → 1 mark for correct equation in (a)

❷ → 1 mark for communicating the context of the graph with appropriate title and/or labels in (b)

❸ → 1 mark for using an appropriate domain and range (i.e., window settings/grid range) for the context of the question in (b)

❺ → 1 mark for consistent answer in (c)

❻ → 1 mark for a correct limitation of the domain in (d)

....

(E1) → does not include braces when using set notation

Exemplar 2

Question 6	Total: 6 marks

Bailey launched his remote control plane. He recorded the height of the plane at different times during the flight.

Time (s)	Height (ft.)
0	0
1	9
2	7
3	3
4	7
5	26

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

(1 mark)

$$Y = 1.48x^3 - 9.79x^2 + 17.12x + 0.06$$

b) Create a clearly labelled graph of the equation in (a).

(3 marks)

c) Using your equation in (a), determine how long it will take for the plane to reach a height of 100 ft.

(1 mark)

6.44 seconds

d) Provide one limitation of the domain.

(1 mark)

The plane must be above ground.

3 marks:
❶ → 1 mark for correct equation in (a)
❹ → 1 mark for an appropriate shape that illustrates key characteristics of the function (e.g., maximum, minimum, intercepts) in (b)
❺ → 1 mark for consistent answer in (c)

Exemplar 1

Question 9   **Total: 3 marks**

Lena runs every day. If it is sunny, the probability she will run outside is 75%. If it is not sunny, the probability that she will run outside is 20%. A 45% probability of sunshine has been announced for tomorrow.

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

(1 mark)
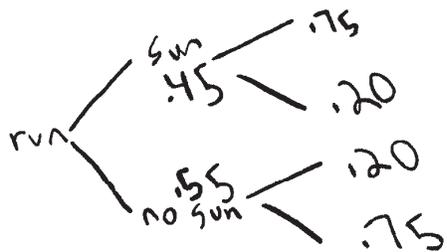
Sun & run = .45 × .75 = .3375 = 34%

sun & no run = .45 × .20 = .09 = 9%

no sun & run = .55 × .75 = .41 = 41%

no sun & no run = .55 × .20 = .11 = 11%

b)   Determine the probability that Lena runs outside tomorrow. Show your work.

(2 marks)

$$\frac{no\ sun}{.55} \times \frac{run}{.75}$$

$$= .41$$

$$= 41\% \text{ she will run tmrw}$$

---

1 mark:
❶ → 1 mark for correct graphic organizer (probabilities not required) in (a)

Exemplar 2

Question 9   **Total: 3 marks**

Lena runs every day. If it is sunny, the probability she will run outside is 75%. If it is not sunny, the probability that she will run outside is 20%. A 45% probability of sunshine has been announced for tomorrow.

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

(1 mark)

$$S_{.45} \left< \begin{array}{l} R \ .75 \ (Sunny, \ run) \\ R' \ .25 \ (Sunny, \ not \ run) \end{array} \right.$$

$$S'_{.55} \left< \begin{array}{l} R \ .2 \ (not \ sunny, \ run) \\ R' \ .8 \ (not \ sunny, \ not \ run) \end{array} \right.$$
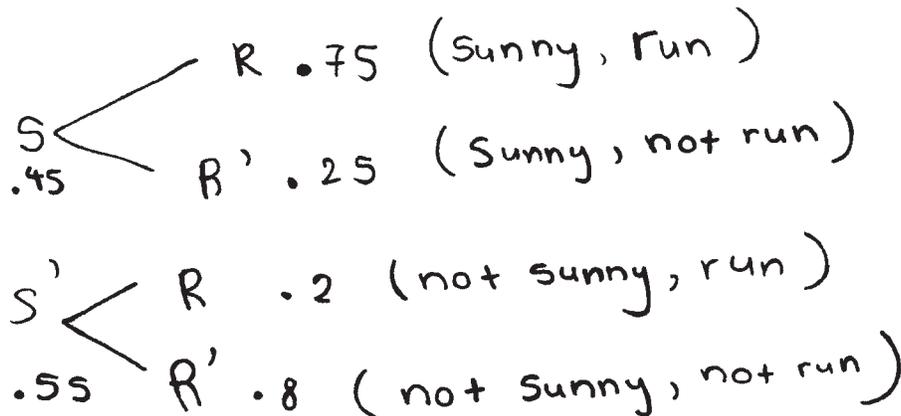
b)   Determine the probability that Lena runs outside tomorrow. Show your work.

(2 marks)

Sunny , run   +   not sunny, run

.45 x .75   .55 x .2

.3375   +   .11

.4475 = 44.75%

The probability that Lena runs outside tomorrow is
44.75%

---

3 marks:
❶ → 1 mark for correct graphic organizer (probabilities not required) in (a)
❷ → 1 mark for appropriate work in (b)
❸ → 1 mark for consistent answer in (b)

Exemplar 1

Question 10   Total: 3 marks

a) Determine the number of different ways the letters of the word "~~CINCINNATI~~" can be arranged. Show your work.

(2 marks)

$$\frac{10\,P\,10}{3!\,3!\,2!} = 7257600 \text{ ways}$$

$$C = 2$$
$$i = 3$$
$$N = 3$$

b) How many ways can the letters of the word "CINCINNATI" be arranged if the first letter must be T?

(1 mark)

$$1 \times 9 \times 8 \times 7 \times 6 \times 5 \times 4 \times 3 \times 2 \times 1 = 362880 \text{ ways}$$

1 mark:
❶ → 1 mark for appropriate work in (a)

Exemplar 2

Question 10   Total: 3 marks

a)   Determine the number of different ways the letters of the word "CINCINNATI" can be arranged. Show your work.

(2 marks)

$$\frac{10!}{2!3!2!} \quad = \frac{3628800}{24} \quad = 151200$$

$$\boxed{151200 \text{ ways}}$$

b)   How many ways can the letters of the word "CINCINNATI" be arranged if the first letter must be T?

(1 mark)

$$\frac{1 \quad 9 \quad 8 \quad 7 \quad 6 \quad 5 \quad 4 \quad 3 \quad 2 \quad 1}{2!3! \, 2!} \qquad = \frac{362880}{24}$$

$$= 15120$$

$$\boxed{15120 \text{ ways}}$$

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

Exemplar 1

Question 11   Total: 3 marks
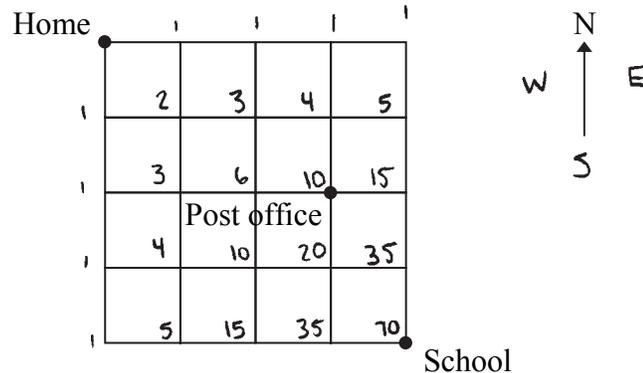
Alec walks eight blocks from home to school every morning.

a)   If he only travels south and east, what is the total number of routes from home to school?

(1 mark)

$$70$$

b)   What is the probability that his route from home to school passes by the post office?
     Show your work.

(2 marks)

$$\frac{10}{70} = .143 \times 100 = 14.29\%$$

There is a 14.29% probability the route passes by the post office.

2 marks:
❶ → 1 mark for correct total routes from home to school in (a)
❸ → 1 mark for probability consistent with work in (b)

Exemplar 2

Question 11   **Total: 3 marks**
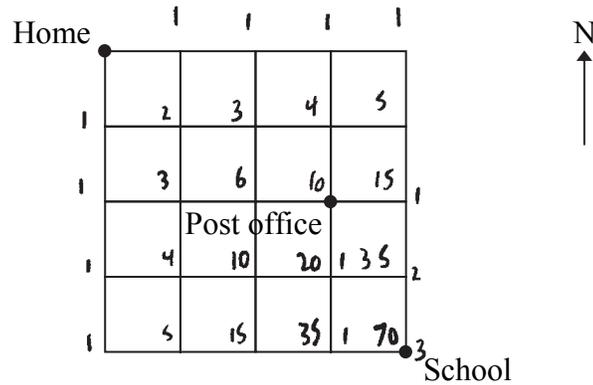
Alec walks eight blocks from home to school every morning.

a) If he only travels south and east, what is the total number of routes from home to school?

(1 mark)

$$70$$

b) What is the probability that his route from home to school passes by the post office?
Show your work.

(2 marks)

$$\frac{10+3}{70} = \frac{13}{70}$$

---

2 marks:
❶ → 1 mark for correct total routes from home to school in (a)
❸ → 1 mark for probability consistent with work in (b)

Question 12   **Total: 4 marks**

There are 18 girls and 12 boys trying out for a debate team.

a) How many different teams of 4 members can be formed if there are no restrictions?

(1 mark)

$18 + 12 = 30$ people

4 members

$_{30}C_4 = 27,405$

27,405 different teams

b) How many different teams of 4 members can be formed if <u>exactly</u> two members must be girls?

(1 mark)

$_{18}C_2 + _{12}C_2 = 219$

219 different teams

c) How many different teams of 4 members can be formed if <u>at least</u> two members must be girls? Show your work.

(2 marks)

$_{18}C_2 + _{18}C_3 + _{18}C_4 + _{12}C_1 + _{12}C_2 = 4,107$

18 girls   4,107 different teams if at least 2 must

12 boys   be girls

2 marks:
❶ → 1 mark for correct answer in (a)
❹ → 1 mark for consistent answer in (c)

Exemplar 2

Question 12   **Total: 4 marks**

There are 18 girls and 12 boys trying out for a debate team.

a) How many different teams of 4 members can be formed if there are no restrictions?

(1 mark)

$$18 + 12 = 30$$

$$_{30}C_4 = \boxed{27,405 \text{ teams}}$$

b) How many different teams of 4 members can be formed if <u>exactly</u> two members must be girls?

(1 mark)

$$2G \; 2B$$

$$_{18}C_2 * {}_{12}C_2 = \boxed{10,098 \text{ teams}}$$

c) How many different teams of 4 members can be formed if <u>at least</u> two members must be girls? Show your work.

(2 marks)

$$2G \; 2B \;\; + \;\; 3G \; 1B$$

$$_{18}C_2 * {}_{12}C_2 \;\; + \;\; {}_{18}C_3 * {}_{12}C_1$$

$$10,098 + 9,792$$

$$\boxed{19,890 \text{ teams}}$$

| **3 marks:** |
| ❶ → 1 mark for correct answer in (a) |
| ❷ → 1 mark for consistent answer in (b) |
| ❹ → 1 mark for consistent answer in (c) |

Exemplar 1

Question 15	**Total: 2 marks**

Bruce is 24 years old. He graduated from college when he was 20 and since then he has worked full-time. He has also made some investments.

His financial advisor sends him an update on his investment portfolio.

Investment	Initial Investment	Gain/Loss
low-risk mutual fund	$2000	+ $100
guaranteed investment certificate	$6000	+ $220
bonds	$4000	+ $180

a) What is the overall rate of return on Bruce's investments?

(1 mark)

$$ROR = \frac{Interest\ earned}{principle}$$

Mutual

$$ROR = \frac{100}{2000}$$

$$= 5\%$$

GIC

$$RoR = \frac{220}{6000}$$

$$= 3.67\%$$

Bonds

$$ROR = \frac{180}{4000}$$

$$= 4.5\%$$

b) Do you think that Bruce's investment portfolio is appropriate for him at this stage of his life? Justify your answer, stating your assumptions.

(1 mark)

I do think this is an appropriate portfolio at this stage in his life. He is only 20 and can live a young bachelor life before needing to make any serious purchases. By the time he may need it, it could have grown substantially. but he doesn't need it now.

0 marks:
→ no criteria met

Exemplar 2

Question 15	Total: 2 marks

Bruce is 24 years old. He graduated from college when he was 20 and since then he has worked full-time. He has also made some investments.

His financial advisor sends him an update on his investment portfolio.

Investment	Initial Investment	Gain/Loss
low-risk mutual fund	$2000	+ $100
guaranteed investment certificate	$6000	+ $220
bonds	$4000	+ $180

a) What is the overall rate of return on Bruce's investments?

(1 mark)

$$\text{rate of return} = \frac{\text{interest rate}}{\text{Principle}} \times 100$$

b) Do you think that Bruce's investment portfolio is appropriate for him at this stage of his life? Justify your answer, stating your assumptions.

(1 mark)

NO, because Bruce is putting a lot of money into these bonds that have only made him $500 over the course of 4 years. Seeing as he just got out of college he probably has student loans to pay off + he should put the money towards that.

```
1 mark:
❷ →  1 mark for appropriate justification in (b)
```

Exemplar 1

Question 16   **Total: 2 marks**

Pedro has a tax-free savings account (TFSA) with a balance of $5000.00. Interest is earned at a rate of 4.00%, compounded monthly.

If Pedro contributes $400.00 to the TFSA at the end of every month, how long will it take him to save $20 000.00? Show your work.

$$5000\$$$

$$n = ? \Rightarrow 34 \text{ months} \quad \text{(E5)}$$
$$I\% = 4\%$$
$$PV = -5000$$
$$PMT = -400$$
$$IV = 20,000$$
$$P/y = 12$$
$$C/y = 12$$

Exemplar 2

Question 16   Total: 2 marks

Pedro has a tax-free savings account (TFSA) with a balance of $5000.00. Interest is earned at a rate of 4.00%, compounded monthly.

If Pedro contributes $400.00 to the TFSA at the end of every month, how long will it take him to save $20 000.00? Show your work.

59 months it will take pedro to save $20,000

$$N = ? \rightarrow 59.11$$
$$I = 4$$
$$PV = 5000$$
$$PMT = -400$$
$$FV = 20000$$
$$P/y = 12$$
$$C/y = 12$$
$$PMT : END$$

1 mark:
❶ → 1 mark for appropriate work

Exemplar 1

Question 17	**Total: 3 marks**

Kira purchases a sofa for $1015.87 (taxes included). The department store offers her a promotion of 0% interest with no payments for one year. If Kira does not pay the amount in full within one year, interest will be charged from the date of purchase at an annual rate of 28.80%, compounded monthly.

a) If Kira does not make any payments, what will the department store bill her one year after the date of purchase? Show your work.

(2 marks)

$$N = (1)$$
$$I\% = 28.8$$
$$PV = 1015.87$$
$$PMT = 0$$
$$\rightarrow FV = -1308.44$$
$$P/Y = 1$$
$$C/Y = 1$$

The store will bill her $1308.44

b) State a different compounding period such that the overall cost of the sofa is lower than if the annual interest rate were compounded monthly.

(1 mark)

Use a compounding period C/Y = 5

┌───┐
| **2 marks:** |
| ❷ → 1 mark for consistent answer in (a) |
| ❸ → 1 mark for correct answer in (b) |
└───┘

Exemplar 2

Question 17   **Total: 3 marks**

Kira purchases a sofa for $1015.87 (taxes included). The department store offers her a promotion of 0% interest with no payments for one year. If Kira does not pay the amount in full within one year, interest will be charged from the date of purchase at an annual rate of 28.80%, compounded monthly.

a) If Kira does not make any payments, what will the department store bill her one year after the date of purchase? Show your work.

(2 marks)

$$A = 1015.87 \left(1 + \frac{0.2880}{12} \right)^{12}$$

$$\boxed{= \$1350.32}$$

b) State a different compounding period such that the overall cost of the sofa is lower than if the annual interest rate were compounded monthly.

(1 mark)

Pay it off before the year is up.

---

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

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Exemplar 1

Question 18   **Total: 5 marks**

Bill and Celine purchase a new home. They obtain a $375 000.00 mortgage amortized over 25 years with their credit union. The initial 5-year term of the mortgage requires monthly payments. Interest is calculated at a rate of 3.25%, compounded semi-annually.

a) Calculate Bill and Celine's mortgage payment. Show your work.

(2 marks)

N-25×12
I-3.25
PV-375000
Pmt-$1823.12
FV-0
P/y-12
C/y-2

Their monthly mortgage payment is $1823.12.

b) How much will Bill and Celine owe at the end of their 5-year term?

(1 mark)

1823.12 × 5 × 12 = $109,387.20

```
  375,000.00
- 1,09,387.20
 ─────────────
 $265,612.80
```

They'll owe $265,612.80

c) Bill and Celine make an additional $10 000.00 payment on the principal at the end of the 5-year term. How much sooner will they pay off their mortgage if they keep the same payments and interest rate over the life of the mortgage? Show your work.

(2 marks)

```
  265,612.80
-  10,000
 ─────────────
 $255,612.80
```

176.25 months
─────────────
     12
= 14.69 years

N- 176.25
I- 3.25
PV--255,612.80
Pmt-1823.12
FV-0
P/y-12
C/y-2

```
   25
- 14.69
 ───────
 10.31 years
```

Sooner if they pay $10,000

┌───┐
│   **3 marks:**   │
│ ❶ → 1 mark for appropriate work in (a)   │
│ ❷ → 1 mark for consistent answer in (a) │
│ ❹ → 1 mark for appropriate work in (c)   │
└───┘

Exemplar 2

Question 18	Total: 5 marks

Bill and Celine purchase a new home. They obtain a $375 000.00 mortgage amortized over 25 years with their credit union. The initial 5-year term of the mortgage requires monthly payments. Interest is calculated at a rate of 3.25%, compounded semi-annually.

a) Calculate Bill and Celine's mortgage payment. Show your work.

(2 marks)

please see print out

b) How much will Bill and Celine owe at the end of their 5-year term?

(1 mark)

please see print out

c) Bill and Celine make an additional $10 000.00 payment on the principal at the end of the 5-year term. How much sooner will they pay off their mortgage if they keep the same payments and interest rate over the life of the mortgage? Show your work.

(2 marks)

please see print out

5 marks:
❶ → 1 mark for appropriate work in (a)
❷ → 1 mark for consistent answer in (a)
❸ → 1 mark for answer in (b) consistent with work in (a)
❹ → 1 mark for appropriate work in (c)
❺ → 1 mark for consistent answer in (c)
Ⓔ③ → makes a transcription error (inaccurate transferring of information)

Exemplar 2 (continued)

a.)

Transaction Type
◯ Investment ◯ Retirement Plan ⦿ Loan (?)

Payment Frequency (per year)
◯ 1 ◯ 2 ◯ 4 ⦿ 12 ◯ 24 ◯ 26 ◯ 365 (?)

Compound Frequency (per year)
◯ 1 ⦿ 2 ◯ 4 ◯ 12 ◯ 24 ◯ 26 ◯ 365 (?)

Financial Details
Initial Loan Amount:	375000.00	◯
Final Loan Balance:	0.00	◯
Monthly Payment:	(1823.12)	⦿
Interest Rate (%):	3.25	◯
# Years:	25	◯
Make Payment at: ◯ Start or ⦿ End of Period		

Financial Summary
Loan Principal Paid:	375000.00
Interest Charged:	171936.71
Total Loan Payment:	546936.71

Bill and Celine's mortgage payment will be $1,823.13

b.)

Transaction Type
◯ Investment ◯ Retirement Plan ⦿ Loan (?)

Payment Frequency (per year)
◯ 1 ◯ 2 ◯ 4 ⦿ 12 ◯ 24 ◯ 26 ◯ 365 (?)

Compound Frequency (per year)
◯ 1 ⦿ 2 ◯ 4 ◯ 12 ◯ 24 ◯ 26 ◯ 365 (?)

Financial Details
Initial Loan Amount:	375000.00	◯
Final Loan Balance:	(322054.72)	⦿
Monthly Payment:	1823.12	◯
Interest Rate (%):	3.25	◯
# Years:	5	◯
Make Payment at: ◯ Start or ⦿ End of Period		

Financial Summary
Loan Principal Paid:	52945.28
Interest Charged:	56441.92
Total Loan Payment:	109387.20

Bill and Celine owe $322,054.72 at the end of their 5-year term.

c)

Transaction Type
◯ Investment ◯ Retirement Plan ⦿ Loan (?)

Payment Frequency (per year)
◯ 1 ◯ 2 ◯ 4 ⦿ 12 ◯ 24 ◯ 26 ◯ 365 (?)

Compound Frequency (per year)
◯ 1 ⦿ 2 ◯ 4 ◯ 12 ◯ 24 ◯ 26 ◯ 365 (?)

Financial Details
Initial Loan Amount:	312054.72	◯
Final Loan Balance:	0.00	◯
Monthly Payment:	1823.12	◯
Interest Rate (%):	3.25	◯
# Years:	(19.14)	⦿
Make Payment at: ◯ Start or ⦿ End of Period		

Financial Summary
Loan Principal Paid:	312054.72
Interest Charged:	106677.27
Total Loan Payment:	418731.99

additional
- Make payment of $10,000 at end of 5-year term

$322,054.72
- 10,000
────────
$312,054.72

- After 5 yr-term 20 years left originally

20
-19.14
──────
0.86   or

Bill and Celine can pay off their mortgage 0.84 yr. sooner.

(E3)

Exemplar 1

Question 20   **Total: 2 marks**

Sophie wants to install carpet in her bedroom. The 12 ft. by 9 ft. carpet she wants to install costs $32.50/yd^2, plus GST and PST.

$$\times 1.13 = \$36.73$$

Calculate the total cost of the carpet. Show your work.
(Note: GST = 5%, PST = 8%)

$$A = 12 \times 9$$
$$= 108 \text{ ft}^2 \quad \frac{1 \text{ yd}^2}{9 \text{ ft}^2}$$

(E5)

$$= 12 \text{ yd}^2 \times 36.73$$

$$= \$440.76 \text{ to install the carpet}$$

| **2 marks:** |
| ❶ → 1 mark for appropriate work |
| ❷ → 1 mark for consistent answer |
| ⋯⋯⋯⋯⋯⋯⋯⋯⋯⋯⋯⋯⋯ |
| (E5) → rounds too soon |

Exemplar 2

Sophie wants to install carpet in her bedroom. The 12 ft. by 9 ft. carpet she wants to install costs $32.50/yd^2, plus GST and PST.

Calculate the total cost of the carpet. Show your work.
(Note: GST = 5%, PST = 8%)

$$12ft \times 9ft$$
$$= \frac{108ft^2}{3}$$
$$= 36yd^2$$

$$36yd^2 \times \$32.50$$
$$= \$1170.00$$
$$\times 0.13$$
$$= 152.10$$
$$+ 1170.00$$
$$= \$1322.10$$
total cost
of the
installation.

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

Exemplar 1

The Menard family has a grain farm. They own 5 bins for grain storage.

Each bin
- is composed of a cone and a cylinder
- is 30 feet tall (from the top of the cone to the bottom of the cylinder)
- has a diameter of 20 feet
- has a cylinder 22 feet tall

(Diagram is not drawn to scale.)

20 ft.

22 ft.

30 ft.
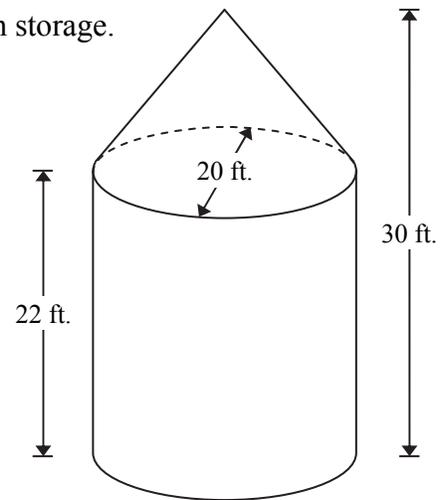
a) Calculate the volume of one grain bin. Show your work.

(2 marks)

Volume of a cone → $\dfrac{\pi r^2 h}{3}$

Volume of a cylinder → $\pi r^2 h$

Volume of the cone

height of the cone
30 − 22 = 8 ft

$\dfrac{\pi (20^2)(8)}{3} = 3351.03$

Volume of the cylinder

$\pi (20^2)(22) = 27\,646.02$

$3351.03 + 27\,646.02 = 30\,997.05$

The volume of the grain bin is $30\,997.05$ ft^3

Exemplar 1 (continued)

b) Mr. Menard decides to paint the exterior (sides and top) of the bins.

- Each bin needs 2 coats of paint.
- One can of paint covers 400 ft^2.
- Each can of paint costs $67.99, plus GST and PST.

Calculate the total cost of the paint for the 5 bins. Show your work.
(Note: GST = 5%, PST = 8%)

(4 marks)

$S \rightarrow$ Slant height

$a^2 + b^2 = c^2$

$8^2 + 10^2 = 164$

$\sqrt{164} = 12.81$

$S = 12.81$
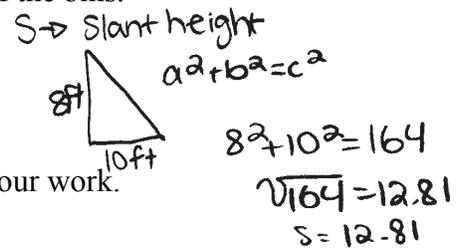
Surface area of a cylinder $\rightarrow 2\pi rh + 2\pi r^2$

Surface area of a cone $\rightarrow \pi r^2 + \pi rs$

Surface area of the cylinder $\qquad$ Surface area of the cone

$2\pi(10)(22) + 2\pi(10^2) \qquad \pi(10^2) + \pi(10)(12.81)$

$= 2010.62 \qquad\qquad = 716.60$

$= 2727.22 ft^2 / 1$ bin

$\dfrac{2767.22}{400ft} = 6.82$ cans/bin for 1 coat

$6.82 \times 2 = 13.64$ cans/2 coats

∴ 14 cans of paint is needed to do 2 coats on a bin

BUT. painting all 5 bins...

$13.64 \times 5 = 68.2$

∴ 69 cans of paint is needed to paint all 5 bins with 2 coats.

---

3 marks:
❶ → 1 mark for appropriate work in (a)
❹ → 1 mark for surface area of one bin in (b)
❺ → 1 mark for correct number of cans of paint in (b)

Exemplar 2

The Menard family has a grain farm. They own 5 bins for grain storage.

Each bin
- is composed of a cone and a cylinder
- is 30 feet tall (from the top of the cone to the bottom of the cylinder)
- has a diameter of 20 feet
- has a cylinder 22 feet tall

(Diagram is not drawn to scale.)

20 ft.

30 ft.

22 ft.
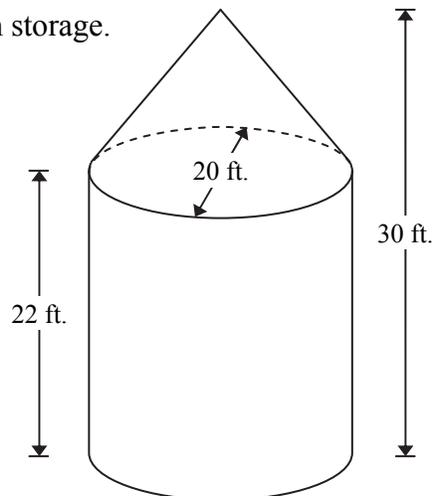
a) Calculate the volume of one grain bin. Show your work.

(2 marks)

$$\text{volume of cylinder} = \pi r^2 h$$
$$= \pi\, 10^2\, 22$$
$$= 6911.50\ ft^3$$

$$\text{Volume of cone} = \pi r^2 h$$
$$= \pi\, 10^2\, 8$$
$$= 2513.27\ ft^3$$

$$\begin{array}{r} 6911.50 \\ +\ 2513.27 \\ \hline 9424.77 \end{array}$$

Volume of one grain bin is $9424.77\ ft^3$

Exemplar 2 (continued)

b) Mr. Menard decides to paint the exterior (sides and top) of the bins.

- Each bin needs 2 coats of paint.
- One can of paint covers 400 ft^2.
- Each can of paint costs $67.99, plus GST and PST.

Calculate the total cost of the paint for the 5 bins. Show your work.
(Note: GST = 5%, PST = 8%)

(4 marks)

Surface area for cylinder $= 2\pi r h + 2\pi r^2$

$= 2\pi \cdot 10 \cdot 22 + 2\pi \cdot 10^2$

$= 2010.6193 \, ft^2$

Take away bottom and top $= \pi r^2 \times 2$

$= 628.3185$

$$\begin{array}{r} 2010.6193 \\ - \quad 628.3185 \\ \hline \end{array}$$

surface area of cylinder $1382.3008 \, ft^2$ ✱

surface area of Cone $= \pi r^2 + \pi r s$

$= \pi \cdot 10^2 + \pi \cdot 10 \cdot 8$

$= 565.48 \, ft^2$

minus bottom $= \pi r^2$

$= \pi \cdot 10^2$

$= 314.159$

$$\begin{array}{r} 565.48 \\ - 314.16 \\ \hline \end{array}$$

surface area of cone 251.32 ✱

$$\begin{array}{l} + \quad \begin{array}{l} \text{cylinder} \\ \text{cone} \end{array} = \begin{array}{r} 1382.30 \\ 251.32 \\ \hline 1633.62 \end{array} \times 5 \, bins = 8168.1 \, ft^2 \text{ to be painted} \end{array}$$

How many cans needed

$\dfrac{8168.1}{400} = 20.42$

$\therefore 21$ cans

(E5) $21 \times \$67.99 = \$1427.79$

$+ \, Tax \quad \underline{.13}$

$\$1613.40$

$$\boxed{\text{Total cost for paint is } \$1,613.40}$$

---

3 marks:

❶ → 1 mark for appropriate work in (a)

❹ → 1 mark for surface area of one bin in (b)

❻ → 1 mark for total cost in (b)

....

(E5) → rounds too soon

Exemplar 1

A class of 28 students was surveyed to discover the type of music to which they listen.

- 12 students said they listen to country
- 18 students said they listen to pop
- 2 students said they listen to neither country nor pop

Determine the number of students who listen only to pop. Show your work.

$$12 + 18 = 30 \text{ students}$$
$$30 - 28 = 2 \text{ students like both}$$
$$18 - 2 = 16 \text{ students like pop}$$

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

Exemplar 2

## Question 23   Total: 2 marks

A class of 28 students was surveyed to discover the type of music to which they listen.

- 12 students said they listen to country
- 18 students said they listen to pop
- 2 students said they listen to neither country nor pop

Determine the number of students who listen only to pop. Show your work.

$$y + 4 = 12$$
$$y = 8$$
$$P + 4 = 18$$

$$y + x + p + 2 = 28$$

$$P = 14$$
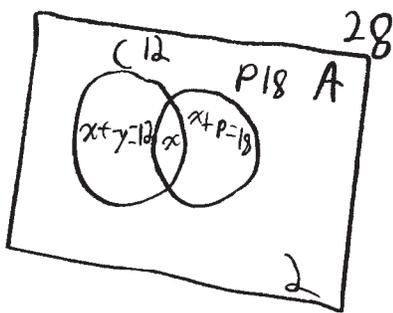
$$y + x + p = 26$$
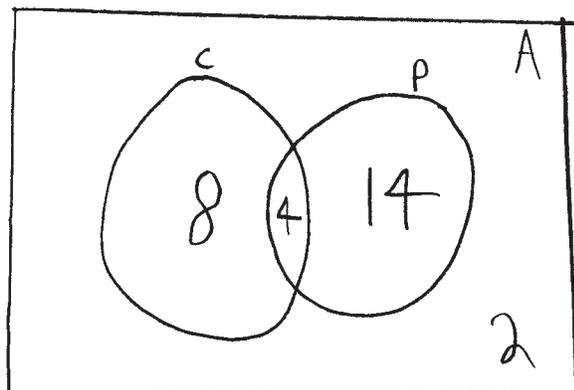
A = # of people who listen to music
C = " " " " " " country
P = " " " " " " pop

Exemplar 1

Question 24	**Total: 2 marks**

Consider the original statement:

"If the end behaviour of a function extends from quadrant II to quadrant I,
then the function is quadratic."

a) Is the original statement true? If not, provide a counterexample.

(1 mark)

NO, not always.

For example the quadratic function

$-0.38x^2 + 11.44x - 17.07$ extends
from quadrant III to quadrant IV.
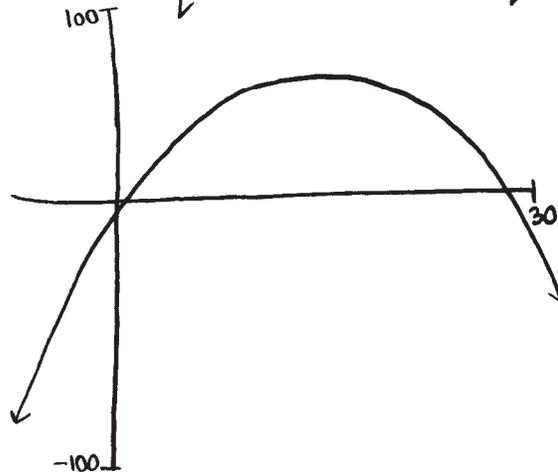
b) Write the contrapositive of the original statement.

(1 mark)

If it is not a quadratic function, then
it does not extend from quadrant
II to quadrant I.

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

Exemplar 2

Question 24   **Total: 2 marks**

Consider the original statement:

"If the end behaviour of a function extends from quadrant II to quadrant I,
then the function is quadratic."

a)   Is the original statement true? If not, provide a counterexample.

(1 mark)

no it could be an exponential
function extending from quadrant II to
quadrant I

b)   Write the contrapositive of the original statement.

(1 mark)

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

Exemplar 1

Question 25   **Total: 3 marks**

Given the following sets:

$$U = \{1, 3, 5, 7, 9, 13, 17, 21\}$$
$$A = \{1, 9, 13, 21\}$$
$$B = \{1, 7, 9, 17, 21\}$$

a) Illustrate these sets using a Venn diagram.
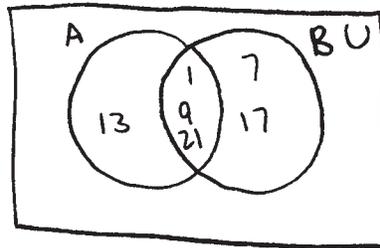
(1 mark)

b) Determine $A' \cup B$.

(1 mark)

$$(A' \cup B) = 7$$
$$A' \cup B = 5, 7, 17, 1, 9, 21, 3 \quad \text{E1}$$

c) Create a set C with 3 elements, where $C \subset B$.

(1 mark)

$$C = \{1, 9, 21\}$$

2 marks:
❷ → 1 mark for correct answer in (b)
❸ → 1 mark for correct answer in (c)
....
Ⓔ1 → does not include braces when using set notation

Exemplar 2

Question 25	**Total: 3 marks**

Given the following sets:

$$U = \{1, 3, 5, 7, 9, 13, 17, 21\}$$
$$A = \{1, 9, 13, 21\}$$
$$B = \{1, 7, 9, 17, 21\}$$

a)   Illustrate these sets using a Venn diagram.
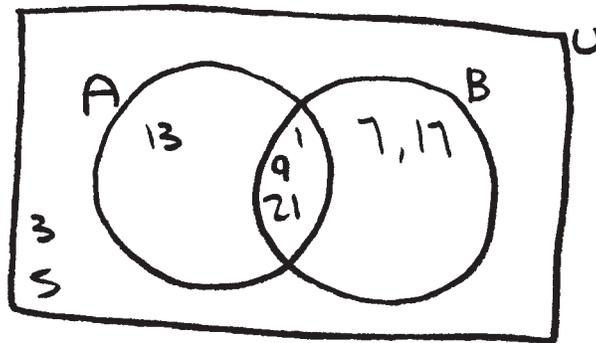
(1 mark)


b)   Determine $A' \cup B$.

(1 mark)

$$A' \cup B \{1, 7, 9, 17, 21\}$$

c)   Create a set C with 3 elements, where $C \subset B$.
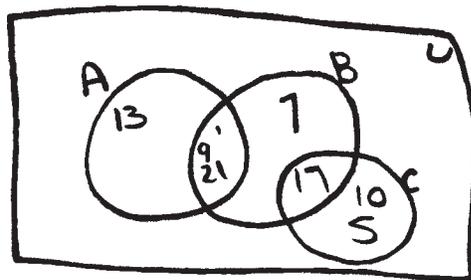
(1 mark)

$$C = \{5, 10, 17\}$$

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

Exemplar 1

a)   Use the numbers 1, 2, 3, 4, 5, 6 only once to complete the chart.

(2 marks)

$$
\begin{array}{ccccccc}
\boxed{7} & + & \boxed{6} & + & \boxed{9} & = & 22 \\
+ & & + & & + & & \\
\boxed{1} & + & \boxed{4} & + & \boxed{2} & = & 7 \\
+ & & + & & + & & \\
\boxed{5} & + & \boxed{8} & + & \boxed{3} & = & 16 \\
\| & & \| & & \| & & \\
13 & & 18 & & 14 & &
\end{array}
$$

b)   What were the first two numbers you obtained? $\boxed{22}$ and $\boxed{18}$

Explain the strategy you used to obtain these numbers.

(1 mark)

I obtain these 2 numbers first because they both only had one possible answer.

for ex . $\boxed{7}$ + $\boxed{}$ + $\boxed{9}$ = 22

only 6 would fit into this situation.

and once I got 6 to be in between 7 and 9, only 4 can go inbetween 6 and 8 to make 18.

---

3 marks:
❶ → 1 mark for correct top row and middle column in (a)
❷ → 1 mark for correct completion of puzzle in (a)
❸ → 1 mark for appropriate strategy in (b)

Exemplar 2

## Question 26   Total: 3 marks

a)   Use the numbers 1, 2, 3, 4, 5, 6 only once to complete the chart.

(2 marks)

$$
\begin{array}{ccccccc}
7 & + & 6 & + & 9 & = & 22 \\
+ & & + & & + & & \\
1 & + & 4 & + & 2 & = & 7 \\
+ & & + & & + & & \\
5 & + & 8 & + & 3 & = & 16 \\
\| & & \| & & \| & & \\
13 & & 18 & & 14 & &
\end{array}
$$

b)   What were the first two numbers you obtained?   6   and   4

Explain the strategy you used to obtain these numbers.

(1 mark)

Guess & check / process of elimination

---

2 marks:
❶ → 1 mark for correct top row and middle column in (a)
❷ → 1 mark for correct completion of puzzle in (a)

Appendices

Appendix A:
Table of Questions by Unit and Learning Outcome

Unit	Question	Type	Learning Outcome	Mark
A	1	SR	12A.R.1	1
A	2	SR	12A.R.1, 12A.R.2, 12A.R.3	1
A	3	CR	12A.R.1	2
A	4	CR, MC	12A.R.2	3
A	5	CR	12A.R.3	3
A	6	CR	12A.R.1	6
				Total = 16
B	7	SR	12A.P.1	1
B	8	SR	12A.P.2	1
B	9	CR	12A.P.3	3
B	10	CR	12A.P.5	3
B	11	CR	12A.P.4, 12A.P.6	3
B	12	CR	12A.P.6	4
				Total = 15
C	13	SR	12A.FM.2	1
C	14	SR	12A.FM.3	1
C	15	CR	12A.FM.3	2
C	16	CR	12A.FM.3	2
C	17	CR	12A.FM.1	3
C	18	CR	12A.FM.1, 12A.FM.2	5
				Total = 14
D	19	SR	12A.D.1	1
D	20	CR	12A.D.1	2
D	21	CR	12A.D.1	6
				Total = 9
E	22	SR	12A.L.2	1
E	23	CR	12A.L.2, 12A.P.2	2
E	24	CR	12A.L.3	2
E	25	CR	12A.L.2	3
E	26	CR	12A.L.1	3
				Total = 11

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: _____

For Department Use Only—After Marking Complete

Consultant: _____

Date: _____