

Grade 12
Applied Mathematics
Achievement Test

Exemplars

Use in conjunction with *Marking Guide*

June 2024

Grade 12 applied mathematics achievement test.
Exemplars. June 2024

This resource is available in print and electronic formats.

ISBN: 978-0-7711-6608-2 (print)

ISBN: 978-0-7711-6610-5 (pdf)

Copyright © 2024, the Government of Manitoba, represented by the Minister of Education and Early Childhood Learning.

Manitoba Education and Early Childhood Learning
Winnipeg, Manitoba, Canada

All exemplars and images found in this resource are copyright protected and should not be extracted, accessed, or reproduced for any purpose other than for their intended educational use in this resource. Sincere thanks to the students who allowed their original material to be used.

Permission is hereby given to reproduce this resource for non-profit educational purposes provided the source is cited.

This resource will be available on the Manitoba Education and Early Childhood Learning 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.

Preamble

This document is one of a series of two documents.

- ***Grade 12 Applied Mathematics Achievement Test: Exemplars***
- *Grade 12 Applied Mathematics Achievement Test: Marking Guide*

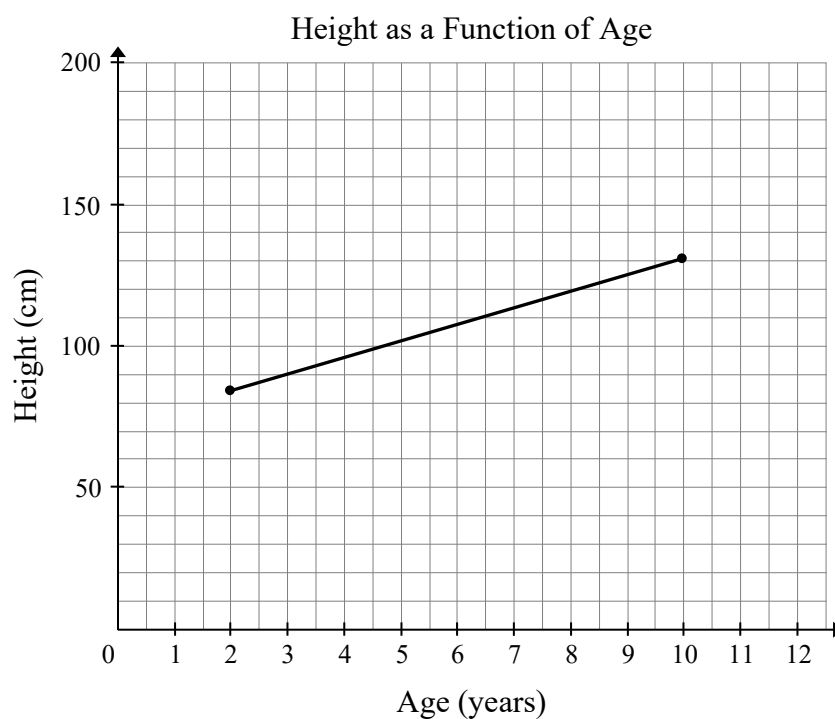
The exemplars contained in this document are intended to improve marking accuracy and consistency. The marking exemplars include marks assigned by the test development committee, together with rationales for the marks. Conversely, the training exemplars do not include marks and can be used for practice purposes. Markers may use these exemplars to practice marking on their own. They can then compare their work with the answers provided in the *Training Exemplar Answers* section at the end of this document.

Marking Exemplar 1

Question 3

Total: 1 mark

Given the following graph, state the domain.



Domain: _____

$(2, 10)$

0.5 mark:

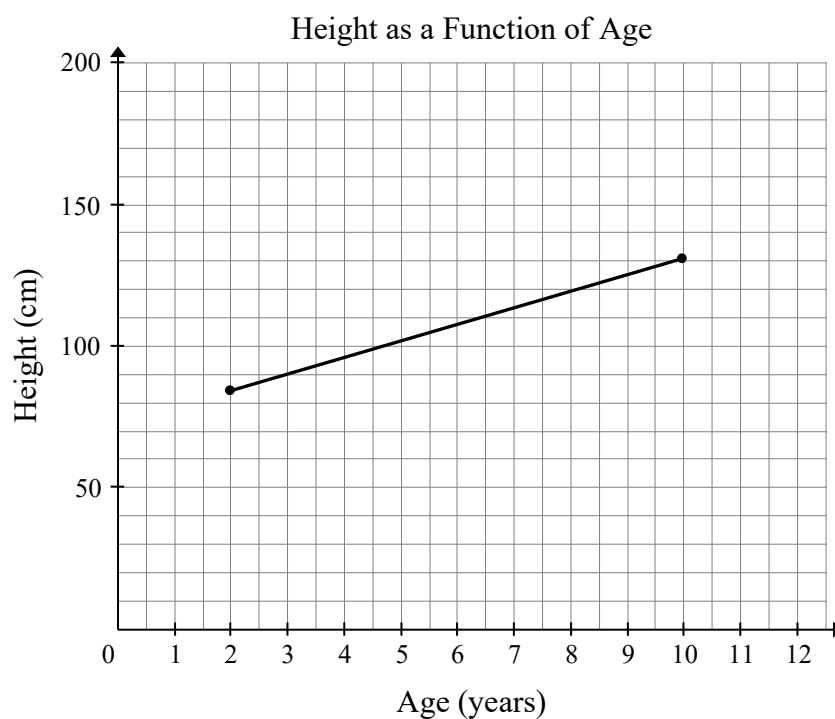
① → 0.5 mark for upper and lower bounds of the domain

Marking Exemplar 2

Question 3

Total: 1 mark

Given the following graph, state the domain.



Domain: $[1.5, 10]$

0.5 mark:

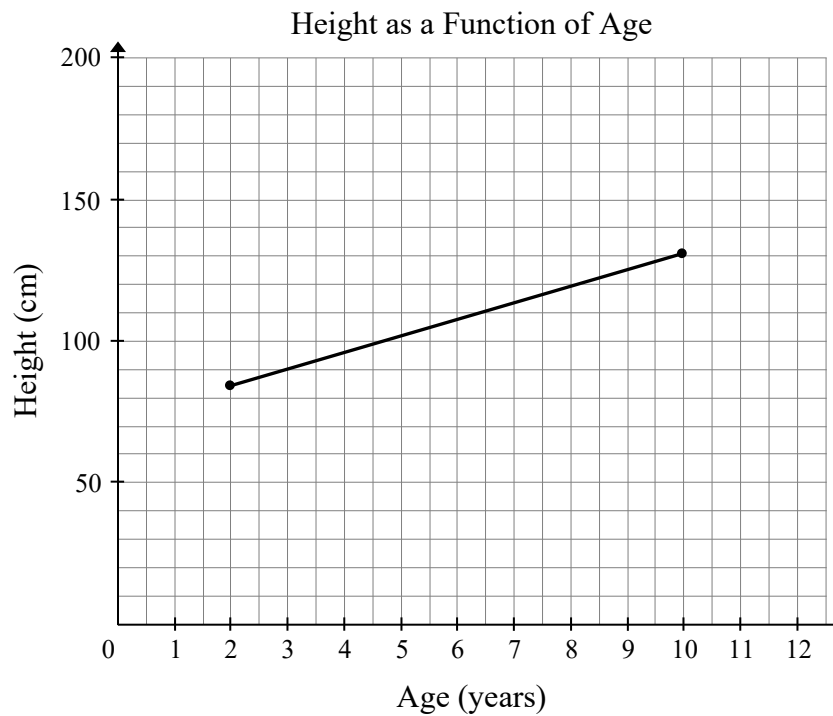
② → 0.5 mark for inclusivity of both upper and lower bounds

Training Exemplar 1

Question 3

Total: 1 mark

Given the following graph, state the domain.



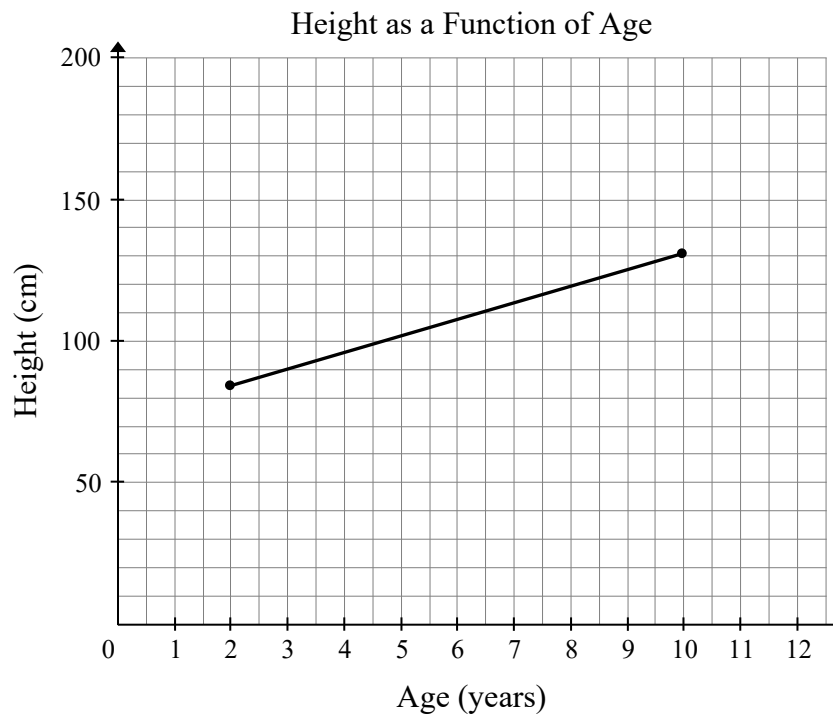
Domain: $\{x | x \in \mathbb{R} | 2 < x < 10\}$

Training Exemplar 2

Question 3

Total: 1 mark

Given the following graph, state the domain.



Domain: $x \in \mathbb{R}$ where $2 \leq x \leq 10$

Marking Exemplar 1

Question 4

Total: 1 mark

The number of students enrolled in a business program at a Canadian university can be modelled by the following equation:

$$y = 7.05x^3 - 77.36x^2 + 1069.99x + 7208.23$$

where x represents the time in years
and y represents the number of students enrolled.

The university would like to achieve an enrolment of 19 000 students in this program. State how long it will take for the enrolment to reach 19 000 students. Round to the nearest whole year.

calc intersect $y = 19000$
 $x = 10.99$

10.99 years
↑
EG

1 mark:

① → 1 mark for answer

EG → rounds incorrectly

Marking Exemplar 2

Question 4

Total: 1 mark

The number of students enrolled in a business program at a Canadian university can be modelled by the following equation:

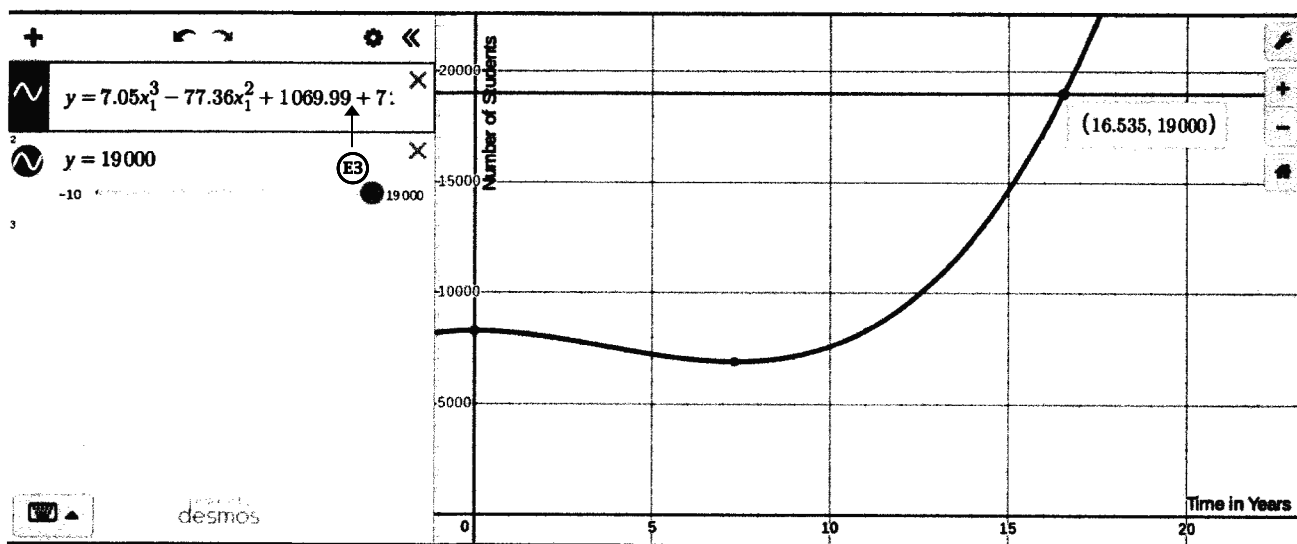
$$y = 7.05x^3 - 77.36x^2 + 1069.99x + 7208.23$$

where x represents the time in years
and y represents the number of students enrolled.

The university would like to achieve an enrolment of 19 000 students in this program. State how long it will take for the enrolment to reach 19 000 students. Round to the nearest whole year.

It would take them 16.54 years
to reach 19 000 students.

*see print out *



1 mark:

① → 1 mark for answer

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

Ⓔ → rounds incorrectly

Training Exemplar 1

Question 4**Total: 1 mark**

The number of students enrolled in a business program at a Canadian university can be modelled by the following equation:

$$y = 7.05x^3 - 77.36x^2 + 1069.99x + 7208.23$$

where x represents the time in years
and y represents the number of students enrolled.

The university would like to achieve an enrolment of 19 000 students in this program. State how long it will take for the enrolment to reach 19 000 students. Round to the nearest whole year.

$$y^2 = 19\,000 \text{ intersect } x = \underline{10.01 \text{ years}}$$

Training Exemplar 2

Question 4

Total: 1 mark

The number of students enrolled in a business program at a Canadian university can be modelled by the following equation:

$$y = 7.05x^3 - 77.36x^2 + 1069.99x + 7208.23$$

where x represents the time in years
and y represents the number of students enrolled.

The university would like to achieve an enrolment of 19 000 students in this program. State how long it will take for the enrolment to reach 19 000 students. Round to the nearest whole year.

it would take 16 years 6 months for the enrolment to reach 19 000

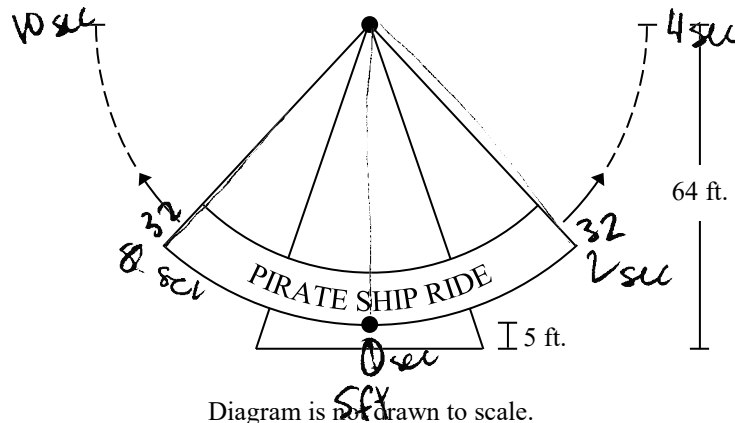
Marking Exemplar 1

Question 5

Total: 3 marks

Vern and Joanne are at an amusement park. They go on The Pirate Ship, a ride which acts like a giant pendulum swing.

- The starting position is 5 feet above the ground.
- The ride reaches a maximum height of 64 feet.
- The ride takes 4 seconds to go from the starting position to the maximum height.



- a) Determine a sinusoidal regression equation that models this situation. Show your work. You may use the table below.

(2 marks)

Time (s)	Height (ft.)
0	5
2	32
4	64
6	32
8	5

Stat Calc → SinReg (Enter) =
 $29.68 \sin(0.83x - 1.73) + 34.32$
 (Unrounded Version:
 $29.68115942 \sin(0.8245005094x - 1.727205711) + 34.31884058$)

- b) State how many times Vern and Joanne reach the maximum height during the first 65 seconds.

(1 mark)

2nd Trace value → $x = 65, y = 63.987478$
 Answer: 9 times.
 I counted 9 peaks on the graph

2 marks:

- ② → 0.5 mark for two consistent values in the equation in (a)
- ③ → 0.5 mark for remaining two consistent values in the equation in (a)
- ④ → 1 mark for consistent answer in (b)

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

Marking Exemplar 2

Question 5

Total: 3 marks

Vern and Joanne are at an amusement park. They go on The Pirate Ship, a ride which acts like a giant pendulum swing.

- The starting position is 5 feet above the ground.
- The ride reaches a maximum height of 64 feet.
- The ride takes 4 seconds to go from the starting position to the maximum height.

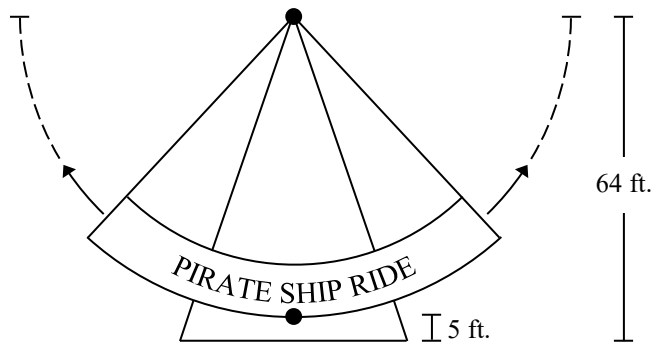


Diagram is not drawn to scale.

- a) Determine a sinusoidal regression equation that models this situation. Show your work. You may use the table below.

(2 marks)

Time (s)	Height (ft.)
0	5
2	32
4	59
6	32
8	5

L1 L2 Stat Calc SinReg

$$y = 27 \sin(.79x - 1.57) + 32$$

- b) State how many times Vern and Joanne reach the maximum height during the first 65 seconds.

$$x = 65$$

(1 mark)

8 times

2 marks:

- ② → 0.5 mark for two consistent values in the equation in (a)
- ③ → 0.5 mark for remaining two consistent values in the equation in (a)
- ④ → 1 mark for consistent answer in (b)

Training Exemplar 1

Question 5

Total: 3 marks

Vern and Joanne are at an amusement park. They go on The Pirate Ship, a ride which acts like a giant pendulum swing.

- The starting position is 5 feet above the ground.
- The ride reaches a maximum height of 64 feet.
- The ride takes 4 seconds to go from the starting position to the maximum height.

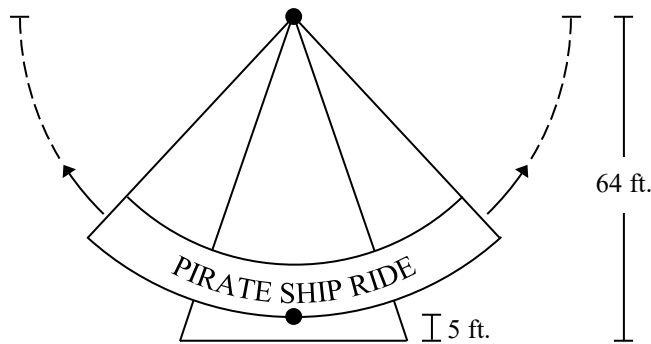


Diagram is not drawn to scale.

- a) Determine a sinusoidal regression equation that models this situation. Show your work. You may use the table below.

(2 marks)

Time (s)	Height (ft.)
0	5
4	64
8	5
12	64
16	5

- b) State how many times Vern and Joanne reach the maximum height during the first 65 seconds.

(1 mark)

8

Training Exemplar 2

Question 5

Total: 3 marks

Vern and Joanne are at an amusement park. They go on The Pirate Ship, a ride which acts like a giant pendulum swing.

- The starting position is 5 feet above the ground.
- The ride reaches a maximum height of 64 feet.
- The ride takes 4 seconds to go from the starting position to the maximum height.

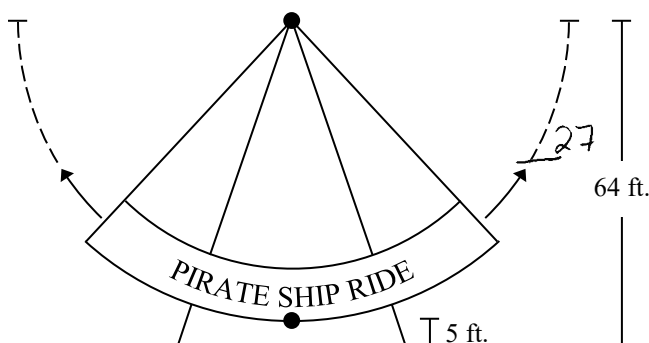


Diagram is not drawn to scale.

- a) Determine a sinusoidal regression equation that models this situation. Show your work. You may use the table below.

(2 marks)

Time (s)	Height (ft.)
0	5
2	27
4	64
6	27
8	5

starting
median
max

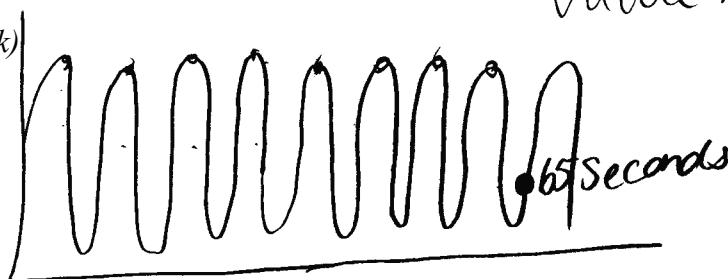
$$\frac{64}{2} = 32$$

$$32 - 5 = 27$$

$$y = 30.76 \cdot \sin(0.89x - 1.98) + 33.24$$

- b) State how many times Vern and Joanne reach the maximum height during the first 65 seconds.

(1 mark)



8 times vern and Joanne reach the maximum height

Marking Exemplar 1

Question 6

Total: 3 marks

Google gives some pages on the web a score which is a rough measure of the importance of a website. The table below demonstrates how Google creates its scoring system.

Page Visits (per day)	100	1000	1 000 000	10 000 000
Google Score	1	2	4	5

- a) State a logarithmic regression equation that models this situation.

(1 mark)

$$y = -1503059.69 + 4612061.46 \ln(x)$$

- b) A certain website averages 870 visits per day. A shoe company is willing to advertise on this website if it can reach a Google score of 2.4 or greater. Determine how many more visits the website needs to get per day. Show your work.

(2 marks)

CALC value

$$x = 2.4 \quad y = 2534655.9$$

$$2534655.9 - 870 = 2533785.9 \text{ visits per day}$$

Ⓔ4
↓

2 marks:

- Ⓔ → 1 mark for consistent x -value in (b)
- Ⓔ → 1 mark for consistent difference in (b)

- Ⓔ4 → does not use whole units in contextual questions involving discrete data in (b)

Marking Exemplar 2

Question 6

Total: 3 marks

Google gives some pages on the web a score which is a rough measure of the importance of a website. The table below demonstrates how Google creates its scoring system.

Page Visits (per day)	100	1000	1 000 000	10 000 000
Google Score	1	2	4	5

- a) State a logarithmic regression equation that models this situation.

(1 mark)

$$Y = -0.44 + 0.33 \ln x$$

- b) A certain website averages 870 visits per day. A shoe company is willing to advertise on this website if it can reach a Google score of 2.4 or greater. Determine how many more visits the website needs to get per day. Show your work.

(2 marks)

They will need to get at least
5192 visits each day to obtain a
Google Score of 2.4

2 marks:

- ① → 1 mark for answer in (a)
② → 1 mark for consistent x -value in (b)

Training Exemplar 1

Question 6

Total: 3 marks

Google gives some pages on the web a score which is a rough measure of the importance of a website. The table below demonstrates how Google creates its scoring system.

Page Visits (per day)	100	1000	1 000 000	10 000 000
Google Score	1	2	4	5

- a) State a logarithmic regression equation that models this situation.

(1 mark)

$$y = a + b \log(x)$$

$$y = 0.12 + 0.53 \log(x)$$

- b) A certain website averages 870 visits per day. A shoe company is willing to advertise on this website if it can reach a Google score of 2.4 or greater. Determine how many more visits the website needs to get per day. Show your work.

(2 marks)

$$y = 2.4$$

$$x = 20\,470$$

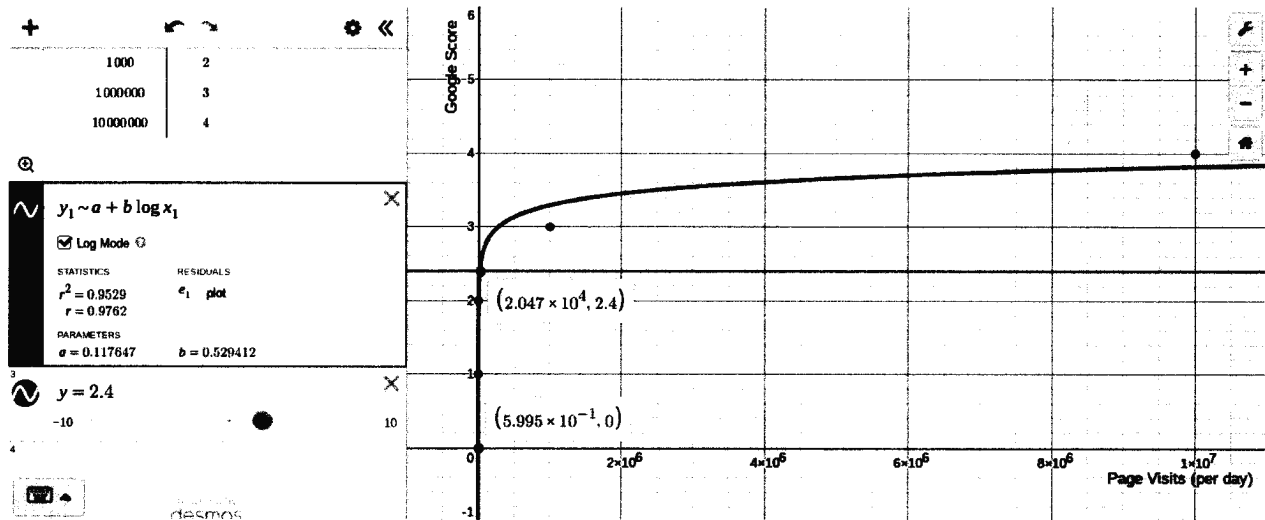
$$870 - 20\,470$$

$$= 19\,600 \text{ more visits a day}$$

* SEE PRINT OUT *

Desmos

Training Exemplar 1 (continued)



Marking Exemplar 1

Question 7

Total: 6 marks

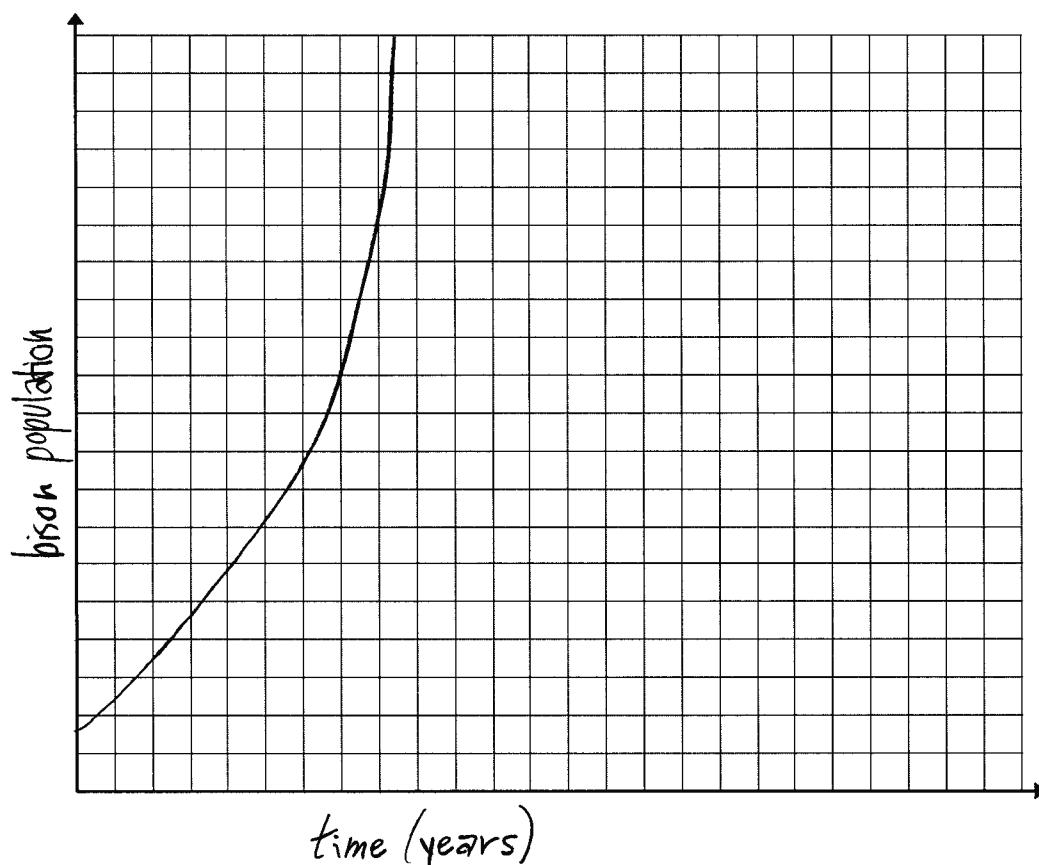
A farmer starts a bison farm where the population can be predicted by the following exponential equation:

$$P = 25(1.047)^t$$

where P represents the bison population
and t represents the time (in years).

- a) Create a clearly labelled graph of the predicted bison population over the next 40 years.

(3 marks)



- b) State the predicted bison population at 30 years.

(1 mark)

value
 $x=30$ $y=99.16$ 99 bison at 30 years

Marking Exemplar 1 (continued)

- c) The farmer operates the farm for 30 years and then retires.
- She sells the bison for \$2000.00 each.
 - She invests the money in an account with an interest rate of 4.00%, compounded monthly.
 - She withdraws an equal amount monthly for 10 years until there is no money left.

Determine the amount of money that she withdraws monthly. Show your work.

(2 marks)

$$99 \times 2000 = \$198\,000$$

$$\begin{aligned} N &= 10 \times 12 \\ I &= 4 \\ PV &= 198\,000 \\ PMT &= ? \\ FV &= 0 \\ P/Y &= 12 \\ C/Y &= 12 \end{aligned}$$

$$PMT = \$-2004.65$$

She withdraws \$2004.65
monthly for 10 years

4 marks:

- ❶ → 1 mark for communicating the context of the graph with appropriate title and/or labels in (a)
- ❷ → 1 mark for bison population in (b)
- ❸ → 1 mark for appropriate work in (c)
- ❹ → 1 mark for consistent answer in (c)

Marking Exemplar 2

Question 7

Total: 6 marks

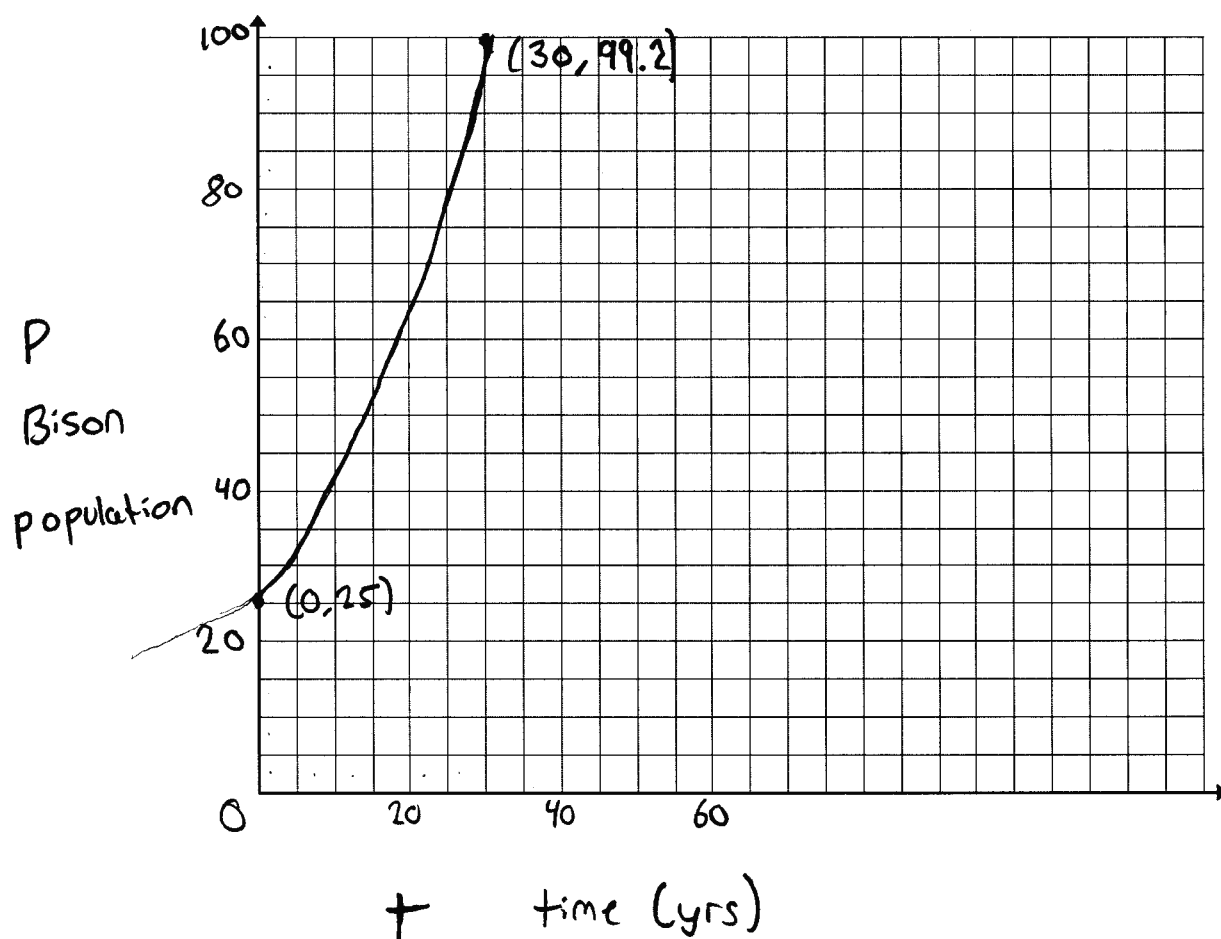
A farmer starts a bison farm where the population can be predicted by the following exponential equation:

$$P = 25(1.047)^t$$

where P represents the bison population
and t represents the time (in years).

- a) Create a clearly labelled graph of the predicted bison population over the next 40 years.

(3 marks)



- b) State the predicted bison population at 30 years.

(1 mark)

$(30, 99.2)$

Population will be 99

Marking Exemplar 2 (continued)

- c) The farmer operates the farm for 30 years and then retires.
- She sells the bison for \$2000.00 each.
 - She invests the money in an account with an interest rate of 4.00%, compounded monthly.
 - She withdraws an equal amount monthly for 10 years until there is no money left.

Determine the amount of money that she withdraws monthly. Show your work.

(2 marks)

$$2000 \times 99 = \$198000$$

$$N = 10$$

$$I = 4$$

$$PV = 198000$$

$$PMT = \$-20164.81 \text{ withdraw}$$

$$FV = 0$$

$$P/Y = 12$$

$$C/Y = 12$$

4 marks:

- ① → 1 mark for communicating the context of the graph with appropriate title and/or labels in (a)
- ③ → 1 mark for an appropriate shape that illustrates key characteristics of the function (e.g., maximum, minimum, asymptotes, intercepts) in (a)
- ④ → 1 mark for bison population in (b)
- ⑥ → 1 mark for consistent answer in (c)

Training Exemplar 1

Question 7

Total: 6 marks

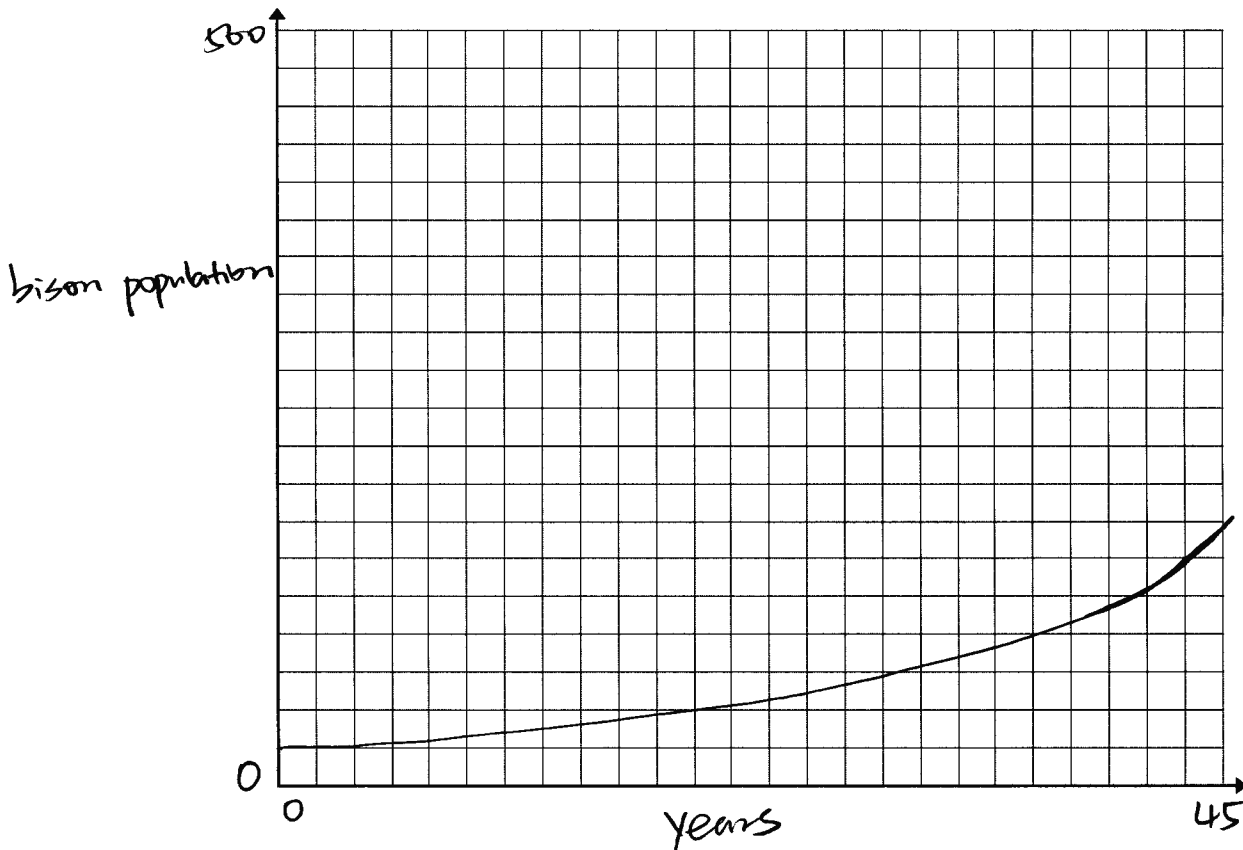
A farmer starts a bison farm where the population can be predicted by the following exponential equation:

$$P = 25(1.047)^t$$

where P represents the bison population
and t represents the time (in years).

- a) Create a clearly labelled graph of the predicted bison population over the next 40 years.

(3 marks)



- b) State the predicted bison population at 30 years.

(1 mark)

$$t = \text{value} \quad x = 30$$

99 bison.

Training Exemplar 1 (continued)

- c) The farmer operates the farm for 30 years and then retires.
- She sells the bison for \$2000.00 each.
 - She invests the money in an account with an interest rate of 4.00%, compounded monthly.
 - She withdraws an equal amount monthly for 10 years until there is no money left.

Determine the amount of money that she withdraws monthly. Show your work.

(2 marks)

$$\begin{aligned}N &= 10 \times 12 \\i\% &= 4.00 \\PV &= 99 \times 2000 \\PMT &= \\FV &= 0 \\PIY &= 12 \\CIY &= 12\end{aligned}$$

\$ 2004.65 /month

Training Exemplar 2

Question 7

Total: 6 marks

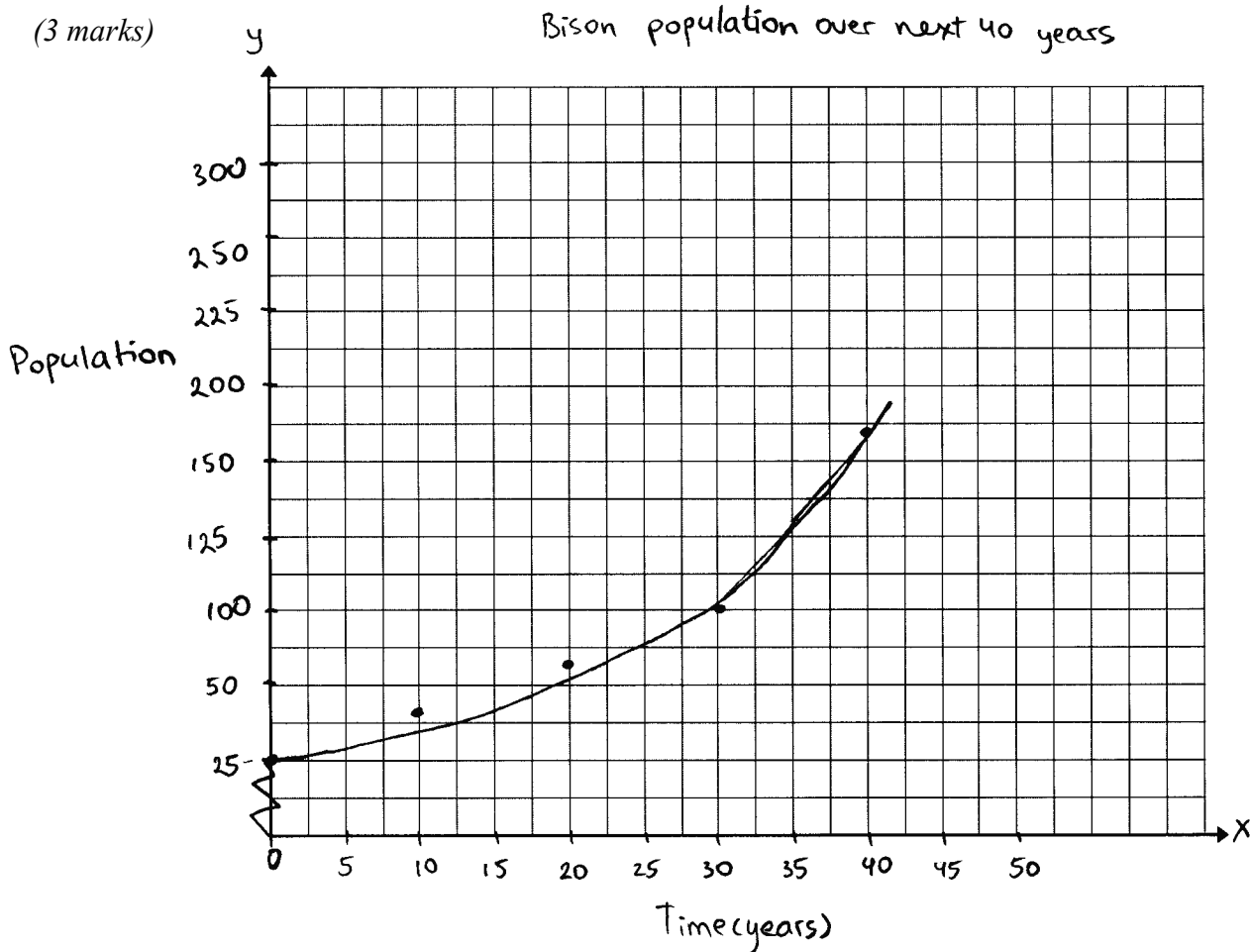
A farmer starts a bison farm where the population can be predicted by the following exponential equation:

$$P = 25(1.047)^t$$

where P represents the bison population
and t represents the time (in years).

- a) Create a clearly labelled graph of the predicted bison population over the next 40 years.

(3 marks)



- b) State the predicted bison population at 30 years.

(1 mark)

2nd Trace Value

when $x = 30$, $y = 99$

Training Exemplar 2 (continued)

- c) The farmer operates the farm for 30 years and then retires.
- She sells the bison for \$2000.00 each.
 - She invests the money in an account with an interest rate of 4.00%, compounded monthly.
 - She withdraws an equal amount monthly for 10 years until there is no money left.

Determine the amount of money that she withdraws monthly. Show your work.

(2 marks)

$$\begin{aligned}N &= 120 \\I &= 4.00 \\PV &= 198000 \\PMT &= 0 * FV &= \rightarrow \$23867781.26 \\P/Y &= 1 \\C/Y &= 12 \\PMT &= END\end{aligned}$$

$$\begin{aligned}N &= 120 \\I &= 4 \\PV &= 198000 * PMT &= \rightarrow \$16268.61 / \text{month} \\FV &= 23867781.26 \\P/Y &= 1 \\C/Y &= 12 \\PMT &= END\end{aligned}$$

Marking Exemplar 1

Question 10

Total: 2 marks

Jin has a portfolio that contains three investments which were valued in 2019 and 2024.

Type of Investment	2019	2024	Gain/Loss
GIC	\$5000.00	\$5500.00	+ \$500.00
TFSA	\$30 000.00	\$38 000.00	+ \$8000.00
Stocks	\$80 000.00	\$75 000.00	- \$5000.00
Total	\$115000	\$118500	\$13500

Calculate the rate of return. Show your work. You may use the table above.

$$\text{Rate of Return} = \frac{\text{current value} - \text{previous value}}{\text{previous value}} \times 100$$

$$= \frac{118500 - 115000}{115000} \times 100$$

$$= \frac{3500}{115000}$$

$$= 0.030434782 \times 100$$

$$= 3.04\%$$

2 marks:

- ❶ → 1 mark for appropriate work
- ❷ → 1 mark for consistent answer

Marking Exemplar 2

Question 10

Total: 2 marks

Jin has a portfolio that contains three investments which were valued in 2019 and 2024.

	Type of Investment	2019	2024	Gain/Loss
1	GIC	\$5000.00	\$5500.00	gain \$10
2	TFSA	\$30 000.00	\$38 000.00	Gain \$26.67
3	Stocks	\$80 000.00	\$75 000.00	loss \$-6.25
T	Total	\$115 000.00	\$118 500.00	203.05

Calculate the rate of return. Show your work. You may use the table above.

$$1) \frac{5500.00 - 5000.00}{5000.00} \times 100 = 10$$

$$2) \frac{38\,000.00 - 30\,000.00}{30\,000.00} \times 100 = 26.\bar{6}$$

$$3) \frac{75\,000.00 - 80\,000.00}{80\,000.00} \times 100 = -6.25$$

$$T) \frac{118\,500.00 - 115\,000.00}{115\,000.00} \times 100 = 203.05$$

⬆ PE
⬆ E1

1.5 marks:

- ① → 1 mark for appropriate work
- ② → 1 mark for consistent answer
- PE → 0.5 mark deduction for procedural error

ⓔ1 → does not include a percent sign

Training Exemplar 1

Question 10

Total: 2 marks

Jin has a portfolio that contains three investments which were valued in 2019 and 2024.

Type of Investment	2019	2024	Gain/Loss
GIC	\$5000.00	\$5500.00	\$5000 gain
TFSA	\$30 000.00	\$38 000.00	\$8000 gain
Stocks	\$80 000.00	\$75 000.00	\$5000 loss
Total	\$115 000	\$118 500	\$8000

Calculate the rate of return. Show your work. You may use the table above.

$$\begin{aligned}
 \text{ROR} &= \frac{\text{FV portfolio} - \text{amt invested}}{\text{amt invested}} \\
 &= \frac{118\,500 - 115\,000}{115\,000} \\
 &= \frac{3500}{115\,000} \\
 &= 0.030 \times 100 \\
 &= 3\%
 \end{aligned}$$

Training Exemplar 2

Question 10

Total: 2 marks

Jin has a portfolio that contains three investments which were valued in 2019 and 2024.

Type of Investment	2019	2024	Gain/Loss
GIC	\$5000.00	\$5500.00	= \$500 gain
TFSA	\$30 000.00	\$38 000.00	= \$8 000 gain
Stocks	\$80 000.00	\$75 000.00	= \$5 000 loss
Total	\$115 000	\$118 500	= \$3 500 gain

Calculate the rate of return. Show your work. You may use the table above.

$$R\&R = \frac{(118500 - 115000)}{115000} \times 100$$

$$R\&R = 3.04\%$$

Marking Exemplar 1

Question 11

Total: 4 marks

Raphael needs a car. He is deciding between buying or leasing a car that costs \$23 500.00 (taxes included), and has the following options:

Option 1: Bank financing at an interest rate of 5.00%, compounded monthly, over 5 years.

Option 2: Leasing at \$316.00 per month over 60 months then buying the car for \$8000.00 at the end of the lease.

a) Determine the monthly payment if Raphael chooses Option 1. Show your work.

(2 marks)

$$\begin{aligned} N &: 5 \\ I &: 5 \\ PV &: 23\,500 \\ PMT &: ? \\ FV &: 0 \\ P/Y &: 1 \\ C/Y &: 12 \end{aligned}$$

he should make payments
of \$5445.35 per month

b) Determine the total cost of each option.

(1.5 marks)

buying	leasing
23500.00 + 3726.77 = \$27226.77	18960 + 8000 = 26960 ⬆ E5

$$\begin{aligned} 316.00 (60) &= 18\,960 \\ &+ 8\,000 \end{aligned}$$

c) Explain which option Raphael should choose.

(0.5 mark)

he should lease because he would
save \$266.77

3 marks:

- ② → 1 mark for consistent answer in (a)
- ③ → 0.5 mark for consistent cost of Option 1 in (b)
- ④ → 0.5 mark for adding \$8000.00 to Option 2 in (b)
- ⑤ → 0.5 mark for consistent cost of Option 2 in (b)
- ⑥ → 0.5 mark for appropriate explanation in (c)

E5 → does not include the dollar sign for monetary values in (b)

Marking Exemplar 2

Question 11

Total: 4 marks

Raphael needs a car. He is deciding between buying or leasing a car that costs \$23 500.00 (taxes included), and has the following options:

Option 1: Bank financing at an interest rate of 5.00%, compounded monthly, over 5 years.

Option 2: Leasing at \$316.00 per month over 60 months then buying the car for \$8000.00 at the end of the lease.

a) Determine the monthly payment if Raphael chooses Option 1. Show your work.

(2 marks)

$$\begin{aligned}N &= 60 \\i &= 5 \\PV &= -23,500 && \$ 443.47 \\PMT &= \\FV &= \\P/Y &= 12 \\C/Y &= 12\end{aligned}$$

b) Determine the total cost of each option.

(1.5 marks)

$$\begin{aligned}\text{Option 1} &= \$ 30,158.93 \\ \text{Option 2} &= \$ 26,960\end{aligned}$$

c) Explain which option Raphael should choose.

(0.5 mark)

leasing, it costs less

3.5 marks:

- ① → 1 mark for appropriate work in (a)
- ② → 1 mark for consistent answer in (a)
- ④ → 0.5 mark for adding \$8000.00 to Option 2 in (b)
- ⑤ → 0.5 mark for consistent cost of Option 2 in (b)
- ⑥ → 0.5 mark for appropriate explanation in (c)

Training Exemplar 1

Question 11

Total: 4 marks

Raphael needs a car. He is deciding between buying or leasing a car that costs \$23 500.00 (taxes included), and has the following options:

Option 1: Bank financing at an interest rate of 5.00%, compounded monthly, over 5 years.

Option 2: Leasing at \$316.00 per month over 60 months then buying the car for \$8000.00 at the end of the lease.

a) Determine the monthly payment if Raphael chooses Option 1. Show your work.

(2 marks)

$$\begin{aligned} N &= 5 \text{ years} \\ I\% &= 5\% \\ PV &= \$23\,500 \\ FV &= 0 \\ C/Y &= 12 \\ P/Y &= 12 \end{aligned}$$

$$PMT = -\$443.47$$

b) Determine the total cost of each option.

(1.5 marks)

$$\begin{array}{r} \text{Option 1} \\ \$23\,500 \\ + \$3\,108.44 \\ \hline \underline{\underline{\$26\,608.44}} \end{array}$$

$$\begin{array}{r} \text{Option 2} \\ (\$316)(60) = \$18\,960 \\ \$18\,960 \\ + 8\,000 \\ \hline \underline{\underline{\$26\,960}} \end{array}$$

c) Explain which option Raphael should choose.

(0.5 mark)

Raphael should choose option because he will make smaller payments per month over the same period of time.

THIS PAGE WAS INTENTIONALLY LEFT BLANK.

Training Exemplar 2

Question 11

Total: 4 marks

Raphael needs a car. He is deciding between buying or leasing a car that costs \$23 500.00 (taxes included), and has the following options:

Option 1: Bank financing at an interest rate of 5.00%, compounded monthly, over 5 years.

Option 2: Leasing at \$316.00 per month over 60 months then buying the car for \$8000.00 at the end of the lease.

72 months
(6 years)

a) Determine the monthly payment if Raphael chooses Option 1. Show your work.

(2 marks)

The monthly payment would be \$378.47

(see TUM).

b) Determine the total cost of each option.

(1.5 marks)

Total loan payment for option 1: \$27249.55

Leasing →

$$316.00 \times 72 = \underline{\underline{\$22752}}$$

Then buying →

$$22752 + 8000.00 = \underline{\underline{\$30752.00}}$$

c) Explain which option Raphael should choose.

(0.5 mark)

Well, I'd recommend option 1, because, it's \$3502.45 cheaper.
Also if you're wanting to save money, but have to use more km to get work, then you have to pay for that extra km,

Training Exemplar 2 (continued)

Time and Value of Money	
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:	23500.00 ☐
Final Loan Balance:	0 ☐
Monthly Payment:	378.47 ☒
Interest Rate (%):	5.00 ☐
= Years:	6 ☐
Make Payment at: ☐ Start or ☒ End of Period	
Financial Summary	
Loan Principal Paid:	23500.00
Interest Charged:	3749.55
Total Loan Payment:	27249.55

Marking Exemplar 1

Question 12

Total: 4 marks

Paul wants to purchase a new house valued at \$265 000.00. He has \$35 000.00 to use as a down payment. He gets approval for:

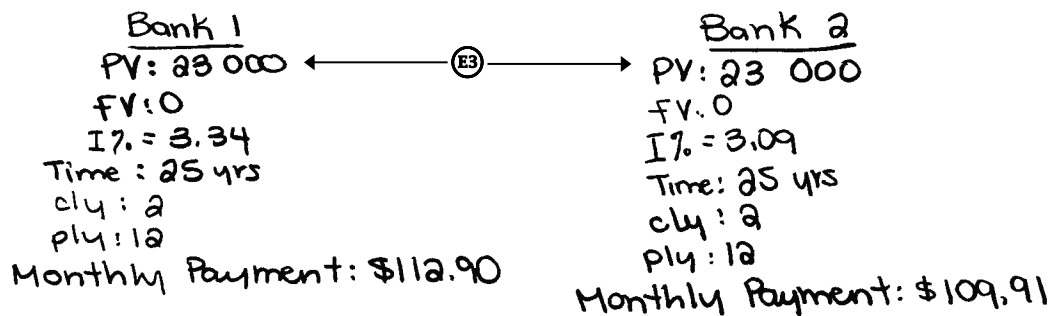
- monthly payments
- an interest rate, compounded semi-annually
- a 25-year amortization period

Bank 1: offers an interest rate of 3.34%

Bank 2: offers an interest rate of 3.09%

- a) Determine the monthly mortgage payment at each bank. Show your work.

(3 marks)



- b) Determine the difference between the total amounts paid to the banks after 25 years of payments.

(1 mark)

$$\begin{aligned} \text{Bank 1 total} &: 33\,869.51 \\ \text{Bank 2 total} &: 32\,973.41 \\ 33\,869.51 - 32\,973.41 &= 896.10 \text{ difference} \end{aligned}$$

4 marks:

- ① → 1 mark for appropriate work for Bank 1 in (a)
- ② → 1 mark for consistent answer for Bank 1 in (a)
- ③ → 1 mark for consistent answer for Bank 2 in (a)
- ④ → 0.5 mark for consistent total amounts in (b)
- ⑤ → 0.5 mark for consistent difference in (b)

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

Marking Exemplar 2

Question 12

Total: 4 marks

Paul wants to purchase a new house valued at \$265 000.00. He has \$35 000.00 to use as a down payment. He gets approval for:

- monthly payments
- an interest rate, compounded semi-annually
- a 25-year amortization period

Bank 1: offers an interest rate of 3.34%

Bank 2: offers an interest rate of 3.09%

- a) Determine the monthly mortgage payment at each bank. Show your work.

(3 marks)

Bank 1	Bank 2
N 25×2	N 25×2
I 3.34	I 3.09
PV $230\ 000$	PV $230\ 000$
<u>PMT</u> -6820.89	<u>PMT</u> -6637.01
FV 0	FV 0
PY 2	PY 2
CY 2	CY 2

Ⓔ1
Ⓔ5

- b) Determine the difference between the total amounts paid to the banks after 25 years of payments.

(1 mark)

$$\begin{array}{r}
 6820.89 \\
 - 6637.01 \\
 \hline
 \$183.88
 \end{array}$$

2.5 marks:

- ② → 1 mark for consistent answer for Bank 1 in (a)
- ③ → 1 mark for consistent answer for Bank 2 in (a)
- ⑤ → 0.5 mark for consistent difference in (b)

- Ⓔ1 → incorrectly states the final answer in (a)
- Ⓔ5 → does not include the dollar sign for monetary values in (a)

Training Exemplar 1

Question 12

Total: 4 marks

Paul wants to purchase a new house valued at \$265 000.00. He has \$35 000.00 to use as a down payment. He gets approval for:

- monthly payments
- an interest rate, compounded semi-annually
- a 25-year amortization period

Bank 1: offers an interest rate of 3.34%

Bank 2: offers an interest rate of 3.09%

- a) Determine the monthly mortgage payment at each bank. Show your work.

(3 marks)

Bank 1
 $N = 300$
 $I = 3.34$
 $PV = 230\,000$
 $* PMT = \text{alpha enter} \rightarrow \1128.98
 $FV = 0$
 $P/Y = 12$
 $C/Y = 2$

Bank 2 $N = 300$
 $I = 3.09$
 $PV = 230\,000$
 $* PMT = \text{alpha enter} \rightarrow \1099.11
 $FV = 0$
 $P/Y = 12$
 $C/Y = 2$

- b) Determine the difference between the total amounts paid to the banks after 25 years of payments.

(1 mark)

Bank 1 $FV = \$526\,464.41$ Bank 2 $FV = \$495\,056.80$
 $\$526\,464.41 - \$495\,056.80$
 $= \$31\,407.61$

Training Exemplar 2

Question 12

Total: 4 marks

Paul wants to purchase a new house valued at \$265 000.00. He has \$35 000.00 to use as a down payment. He gets approval for:

- monthly payments
- an interest rate, compounded semi-annually
- a 25-year amortization period

Bank 1: offers an interest rate of 3.34%

Bank 2: offers an interest rate of 3.09%

a) Determine the monthly mortgage payment at each bank. Show your work.

(3 marks)

bank 1: N: 50 (25 · 2) I/Y: 3.34 PV: -35 000 PMT: -\$5699.94 FV: 265 000 P/Y: 12 C/Y: 2 \$5699.94 per month	bank 2: N: 50 (25 · 2) I/Y: 3.09 PV: 265 000 - 35 000 PMT: -\$5721.61 FV: 265 000 P/Y: 12 C/Y: 2 \$5721.61 per month
--	--

b) Determine the difference between the total amounts paid to the banks after 25 years of payments.

(1 mark)

bank 1: 5699.94 (50) = \$284 997.00	bank 2: 5721.61 (50) = \$286 080.50
--	--

$286\ 080.50 - 284\ 997.00$
= \$1083.50

Bank 1 is \$1083.50 cheaper

Marking Exemplar 1

Question 13

Total: 1 mark

Abdul wants to buy a house. He has the option of making biweekly or monthly payments.

Explain one advantage of making biweekly payments.

If Abdul sucks at budgeting, taking a smaller sum from every check would be easier to manage than making sure he puts it aside for one large payment.

1 mark:

❶ → 1 mark for appropriate explanation

Marking Exemplar 2

Question 13**Total: 1 mark**

Abdul wants to buy a house. He has the option of making biweekly or monthly payments.

Explain one advantage of making biweekly payments.

The biweekly payments will be a smaller amount of money each payment compared to monthly payments.

1 mark:

① → 1 mark for appropriate explanation

Training Exemplar 1

Question 13**Total: 1 mark**

Abdul wants to buy a house. He has the option of making biweekly or monthly payments.

Explain one advantage of making biweekly payments.

Much cheaper and affordable.

Training Exemplar 2

Question 13**Total: 1 mark**

Abdul wants to buy a house. He has the option of making biweekly or monthly payments.

Explain one advantage of making biweekly payments.

The advantage of biweekly payments would be that it's smaller in the amount he has to pay

Marking Exemplar 1

Question 14

Total: 2 marks

Kamil bought a house for \$300 000.00. Before moving in, he built an addition which increased the value of the house by \$56 000.00.

If the house appreciates at an annual rate of 2.00%, determine the value of the house after 10 years. Show your work.

$$I = Prt$$

$$I = (356\,000)(0.02)(10)$$

$$= 71\,200$$

$$356\,000 + 71\,200 = \underline{\underline{427\,200}}$$

↑
(E5)

1 mark:

② → 1 mark for consistent answer

(E5) → does not include the dollar sign for monetary values

Marking Exemplar 2

Question 14

Total: 2 marks

Kamil bought a house for \$300 000.00. Before moving in, he built an addition which increased the value of the house by \$56 000.00.

If the house appreciates at an annual rate of 2.00%, determine the value of the house after 10 years. Show your work.

$$\begin{aligned} \$300000 + \$56000 &= \$356000 \\ \$356000 \times 1.002^{10} &= \$363184.423 \end{aligned}$$

1.5 marks:

- ❶ → 1 mark for appropriate work
- ❷ → 1 mark for consistent answer
- Ⓐ → 0.5 mark deduction for arithmetic error

- E6** → does not express the answer to the appropriate number of decimal places, including monetary values to two decimal places

Training Exemplar 1

Question 14

Total: 2 marks

Kamil bought a house for \$300 000.00. Before moving in, he built an addition which increased the value of the house by \$56 000.00.

If the house appreciates at an annual rate of 2.00%, determine the value of the house after 10 years. Show your work.

$$\text{App/Dep Val.} = (\text{asset value} \overset{\substack{\% \text{ decimal} \\ |}}{\text{app/dep rate}})^{\text{yrs}}$$

$$= (356\,000(0.02))^{\wedge} 10$$

$$= \$71\,200 \text{ house value after 10 years}$$

Training Exemplar 2

Question 14

Total: 2 marks

Kamil bought a house for \$300 000.00. Before moving in, he built an addition which increased the value of the house by \$56 000.00.

If the house appreciates at an annual rate of 2.00%, determine the value of the house after 10 years. Show your work.

$$\begin{aligned}N &= 10 \times 12 \\I\% &= 2 \\PV &= 356\ 000 \\PMT &= 0 \\FV &= \$434\ 387.65 \\P/Y &= 12 \\C/Y &= 2\end{aligned}$$

After 10 years, house
will be the value of
\$434 387.65.

Marking Exemplar 1

Question 17

Total: 1 mark

Draw a Venn diagram showing mutually exclusive events.



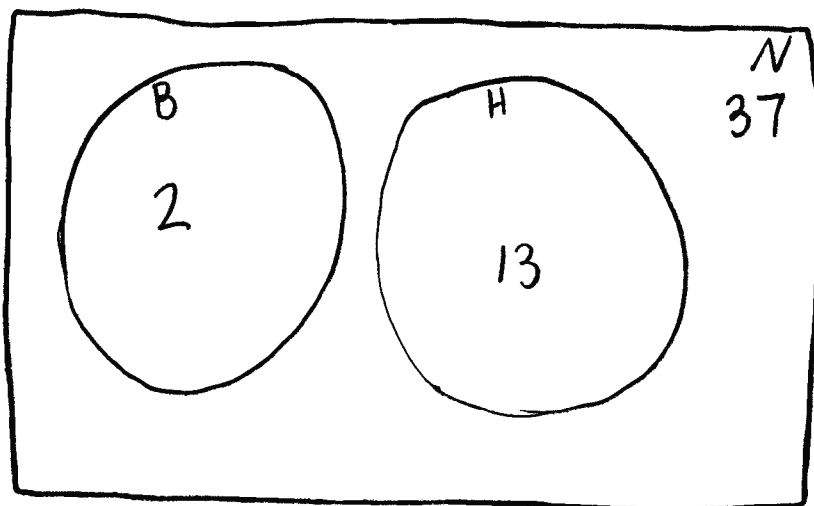
0 marks:
→ no criteria met

Marking Exemplar 2

Question 17

Total: 1 mark

Draw a Venn diagram showing mutually exclusive events.



cards that are Black ace
2/52

Cards that are hearts
13/52

Cards that are neither

$$\begin{array}{r} 52 \\ -15 \\ \hline 37 \end{array}$$

1 mark:

① → 1 mark for showing mutually exclusive events

Training Exemplar 1

Question 17

Total: 1 mark

Draw a Venn diagram showing mutually exclusive events.



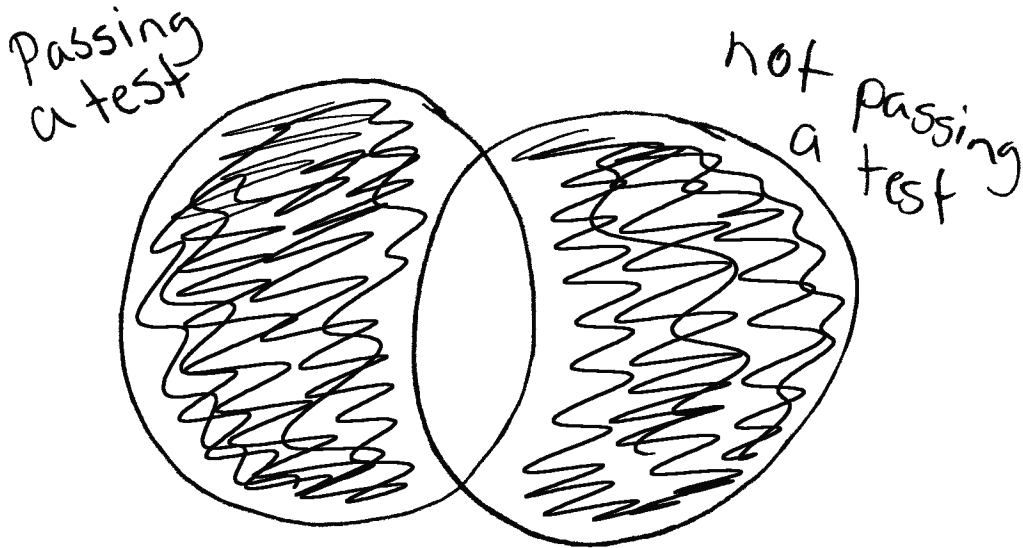
These events have no relation to each other

Training Exemplar 2

Question 17

Total: 1 mark

Draw a Venn diagram showing mutually exclusive events.



Marking Exemplar 1

Question 18

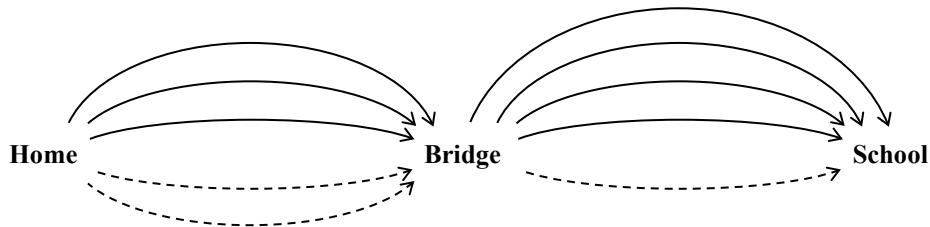
Total: 2 marks

Silas is biking from home to school and must cross a bridge. On one side of the bridge, there are 3 paved paths and 2 unpaved paths. On the other side of the bridge, there are 4 paved paths and 1 unpaved path that lead to Silas' school.

Legend:

———— paved path

----- unpaved path



- a) Determine the total number of routes Silas could take from home to school.

(1 mark)

$$3 + 2 + 4 + 1 = 10$$

10 routes

- b) Determine the probability that Silas takes only paved paths from home to school.

(1 mark)

$$\frac{7}{10} = 0.7 \text{ or } 70\%$$

1 mark:

- ② → 0.5 mark for number of routes on only paved paths in (b)
- ③ → 0.5 mark for consistent probability in (b)

Marking Exemplar 2

Question 18

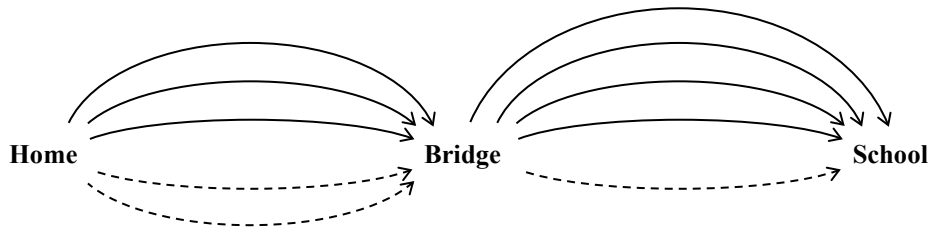
Total: 2 marks

Silas is biking from home to school and must cross a bridge. On one side of the bridge, there are 3 paved paths and 2 unpaved paths. On the other side of the bridge, there are 4 paved paths and 1 unpaved path that lead to Silas' school.

Legend:

———— paved path

----- unpaved path



- a) Determine the total number of routes Silas could take from home to school.

(1 mark)

$$\frac{5!}{3! \cdot 2!} = 10 \quad \frac{5!}{1! \cdot 4!} = 5$$

$$10(5) = 50 \text{ possible routes}$$

- b) Determine the probability that Silas takes only paved paths from home to school.

(1 mark)

~~3/5~~

$$\frac{3}{5} \cdot \frac{4}{5} = \boxed{\frac{12}{25}}$$

1 mark:

- ② → 0.5 mark for number of routes on only paved paths in (b)
- ③ → 0.5 mark for consistent probability in (b)

Training Exemplar 1

Question 18

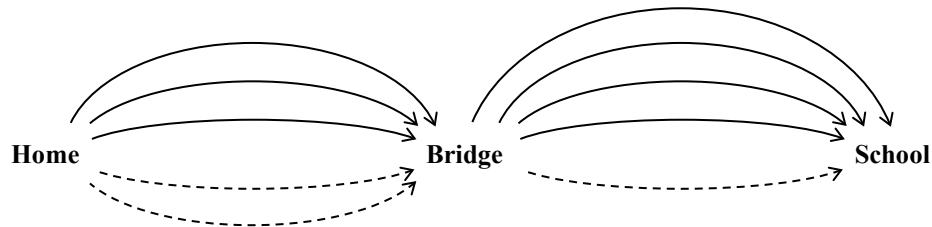
Total: 2 marks

Silas is biking from home to school and must cross a bridge. On one side of the bridge, there are 3 paved paths and 2 unpaved paths. On the other side of the bridge, there are 4 paved paths and 1 unpaved path that lead to Silas' school.

Legend:

———— paved path

----- unpaved path



- a) Determine the total number of routes Silas could take from home to school.

(1 mark)

$$5 \times 5 = 25 \text{ Routes}$$

- b) Determine the probability that Silas takes only paved paths from home to school.

(1 mark)

$$5 \times 4 = 20$$

$$\frac{20}{25}$$

$$\frac{4}{5}$$

$$80\%$$

Training Exemplar 2

Question 18

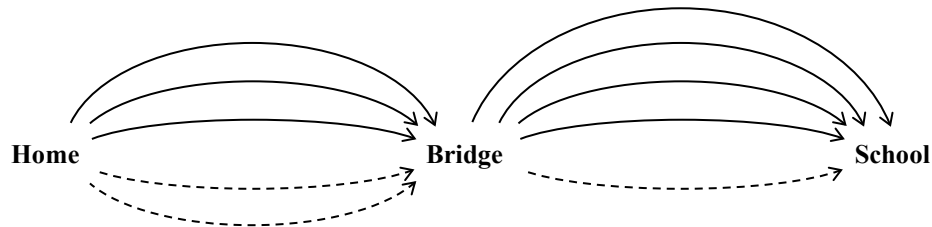
Total: 2 marks

Silas is biking from home to school and must cross a bridge. On one side of the bridge, there are 3 paved paths and 2 unpaved paths. On the other side of the bridge, there are 4 paved paths and 1 unpaved path that lead to Silas' school.

Legend:

———— paved path

----- unpaved path



- a) Determine the total number of routes Silas could take from home to school.

(1 mark)

25 different routes

- b) Determine the probability that Silas takes only paved paths from home to school.

(1 mark)

$$\frac{7}{10} = 70\% \text{ probability}$$

Marking Exemplar 1

Question 19

Total: 3 marks

Avra is knitting a blanket for her niece. She has 5 balls of yarn that are different shades of blue and 7 balls of yarn that are different shades of purple.

- a) State the number of ways Avra could randomly choose 6 balls of yarn for the blanket.

(1 mark)

$$\begin{array}{l} \frac{6}{12} \\ 12C_6 \\ = \underline{\underline{924}} \end{array}$$

- b) Determine the number of ways Avra could randomly choose 6 balls of yarn if she wants 2 shades of blue and 4 shades of purple. Show your work.

(2 marks)

$$\begin{array}{l} 12C_2 = 66 \\ + \\ 12C_4 = 495 \\ = \underline{\underline{561}} \end{array}$$

1 mark:

① → 1 mark for answer in (a)

Marking Exemplar 2

Question 19

Total: 3 marks

Avra is knitting a blanket for her niece. She has 5 balls of yarn that are different shades of blue and 7 balls of yarn that are different shades of purple.

- a) State the number of ways Avra could randomly choose 6 balls of yarn for the blanket.

(1 mark)

$${}_{12}P_6 = 665\,280 \text{ ways}$$

- b) Determine the number of ways Avra could randomly choose 6 balls of yarn if she wants 2 shades of blue and 4 shades of purple. Show your work.

(2 marks)

$${}_5P_2 \times {}_7P_4 = 20 \times 840$$
$$= 16\,800 \text{ ways}$$

2 marks:

- ② → 0.5 mark for ${}_5P_2$ in (b)
- ③ → 0.5 mark for ${}_7P_4$ in (b)
- ④ → 1 mark for consistent product in (b)

Training Exemplar 1

Question 19

Total: 3 marks

Avra is knitting a blanket for her niece. She has 5 balls of yarn that are different shades of blue and 7 balls of yarn that are different shades of purple.

- a) State the number of ways Avra could randomly choose 6 balls of yarn for the blanket.

(1 mark)

$${}^{12}P_6 = 665\,280$$

- b) Determine the number of ways Avra could randomly choose 6 balls of yarn if she wants 2 shades of blue and 4 shades of purple. Show your work.

(2 marks)

$${}^6P_2 \times {}^6P_4 = 10\,800 \text{ ways}$$

Training Exemplar 2

Question 19

Total: 3 marks

Avra is knitting a blanket for her niece. She has 5 balls of yarn that are different shades of blue and 7 balls of yarn that are different shades of purple.

- a) State the number of ways Avra could randomly choose 6 balls of yarn for the blanket.

(1 mark)

$$\underline{12} \cdot \underline{11} \cdot \underline{10} \cdot \underline{9} \cdot \underline{8} \cdot \underline{7} = \boxed{665280}$$

5+7

- b) Determine the number of ways Avra could randomly choose 6 balls of yarn if she wants 2 shades of blue and 4 shades of purple. Show your work.

(2 marks)

$$5C2 \cdot 7C4 = \boxed{350 \text{ ways}}$$

Marking Exemplar 1

Question 20

Total: 2 marks

Determine the number of ways the letters in the name ~~OPASKWAYAK~~ can be arranged.
Show your work.

$$\frac{10!}{3!} = 604800 \text{ ways}$$

1.5 marks:

- ❶ → 0.5 mark for 10!
- ❷ → 0.5 mark for 3!
- ❸ → 0.5 mark for consistent quotient

Marking Exemplar 2

Question 20

Total: 2 marks

Determine the number of ways the letters in the name OPASKWAYAK can be arranged.
Show your work.

$$\begin{array}{c}
 \text{PE} \\
 \swarrow \quad \searrow \\
 10! \quad 9! \quad 8! \quad 7! \quad 6! \quad 5! \quad 4! \quad 3! \\
 \hline
 2! \quad 3!
 \end{array}$$

$\uparrow$
 AE

$$\begin{array}{r}
 151200 \\
 \hline
 2 \\
 \hline
 = 75600
 \end{array}$$

1 mark:

- ① → 0.5 mark for 10!
- ② → 0.5 mark for 3!
- ③ → 0.5 mark for 2!
- ④ → 0.5 mark for consistent quotient
- PE → 0.5 mark deduction for procedural error
- AE → 0.5 mark deduction for arithmetic error

Training Exemplar 1

Question 20

Total: 2 marks

Determine the number of ways the letters in the name OPASKWAYAK can be arranged.
Show your work.

10 letters

$$\frac{1! 8! 1!}{2! 3!} = \frac{40320}{12} = 3360 \text{ number of ways the letters can be arranged}$$

Training Exemplar 2

Question 20

Total: 2 marks

Determine the number of ways the letters in the name OPASKWAYAK can be arranged.
Show your work.

$$\underline{2} \underline{8} \underline{7} \underline{6} \underline{5} \underline{4} \underline{3} \underline{2} \underline{1} \underline{1}$$

$$= 40320 \text{ different ways}$$

Marking Exemplar 1

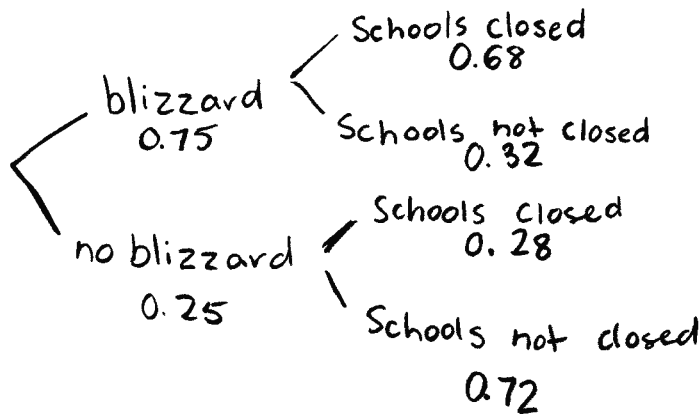
Question 21

Total: 3 marks

On January 30, there is a 75% probability of blizzard conditions. If there is a blizzard, there is a 68% probability that schools will be closed. If there is not a blizzard, there is still a 28% probability schools will be closed (due to the cold).

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

(1 mark) free diagram



$$\begin{aligned} BC & 0.68 \times 0.75 = 0.51 \\ BS & 0.75 \times 0.32 = 0.24 \\ NC & 0.25 \times 0.28 = 0.07 \\ NS & 0.25 \times 0.72 = 0.18 \end{aligned}$$

$$\frac{0.51}{0.70} = 0.7285$$

Blizzard = B School closed = C School not closed = S
no blizzard = N

b) Determine the probability that schools will be closed January 30. Show your work.

(2 marks)

$$\begin{aligned} BC &= 0.68 \times 0.75 = 0.51 \\ NC &= 0.25 \times 0.28 = 0.07 \\ \frac{0.51}{0.70} &= 0.7285 \end{aligned}$$

probability that school will be closed is 0.7285.

2 marks:

- ① → 1 mark for appropriate graphic organizer in (a)
 - ② → 0.5 mark for $P(\text{blizzard, schools closed})$ in (b)
 - ③ → 0.5 mark for $P(\text{no blizzard, schools closed})$ in (b)
-
- Ⓔ → makes a transposition error in (b)

Marking Exemplar 2

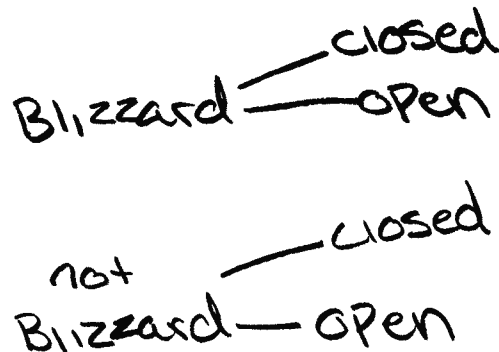
Question 21

Total: 3 marks

On January 30, there is a 75% probability of blizzard conditions. If there is a blizzard, there is a 68% probability that schools will be closed. If there is not a blizzard, there is still a 28% probability schools will be closed (due to the cold).

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

(1 mark)



- b) Determine the probability that schools will be closed January 30. Show your work.

(2 marks)

$$68 + 28 = 96$$

there is a 96% chance school
will be closed

1 mark:

① → 1 mark for appropriate graphic organizer in (a)

Training Exemplar 1

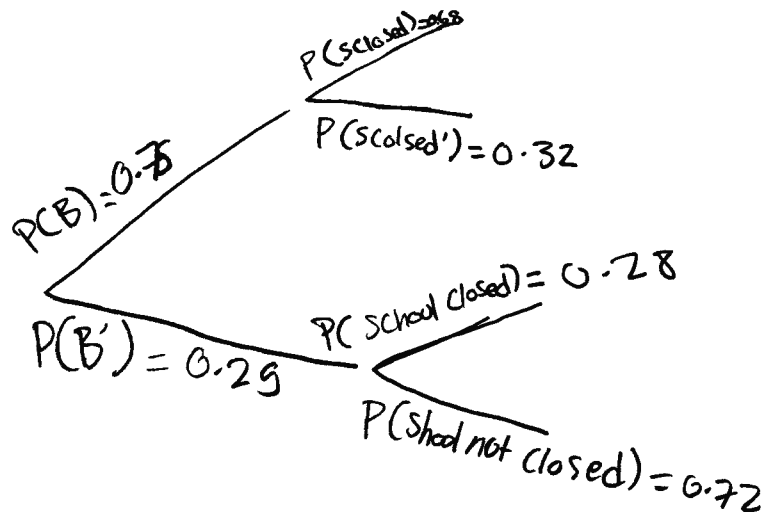
Question 21

Total: 3 marks

On January 30, there is a 75% probability of blizzard conditions. If there is a blizzard, there is a 68% probability that schools will be closed. If there is not a blizzard, there is still a 28% probability schools will be closed (due to the cold).

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

(1 mark)



- b) Determine the probability that schools will be closed January 30. Show your work.

(2 marks)

$$0.75 \cdot 0.68 = 0.51$$

$$0.75 \cdot 0.32 = 0.24$$

$$0.25 \cdot 0.28 = 0.07$$

$$= 0.82 \times 100$$

Probability of School Closed

$$= 82\%$$

Training Exemplar 2

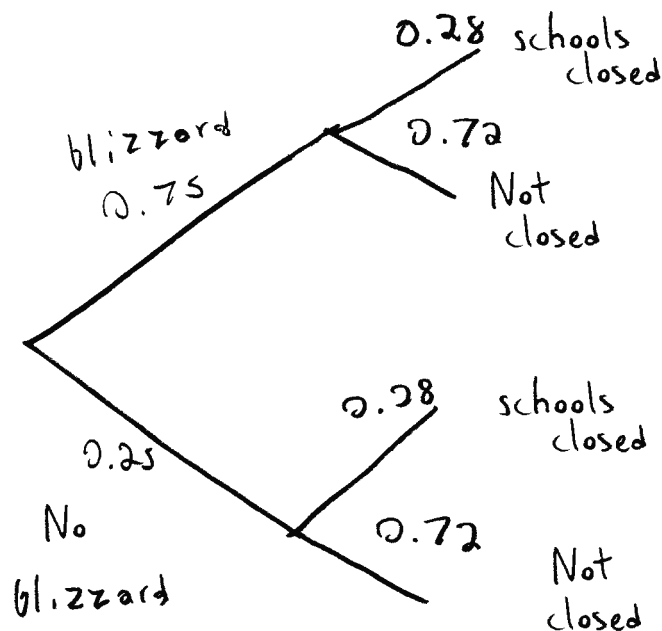
Question 21

Total: 3 marks

On January 30, there is a 75% probability of blizzard conditions. If there is a blizzard, there is a 68% probability that schools will be closed. If there is not a blizzard, there is still a 28% probability schools will be closed (due to the cold).

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

(1 mark)



- b) Determine the probability that schools will be closed January 30. Show your work.

(2 marks)

$$(0.75 \cdot 0.28) + (0.25 \cdot 0.28)$$

$$= 0.0147$$

$$0.0147 \cdot 100 = 1.47\%$$

Marking Exemplar 1

Question 22

Total: 3 marks

A pre-school class has 12 children. The children stand in a row for their class picture.

- a) State the number of different arrangements for the picture.

(1 mark)

$$12! = \underline{479001600}$$

- b) Determine the number of arrangements in which two children, Acakos and Písim, stand beside each other. Show your work.

(2 marks)

$$= 12! - (2! \cdot 11!) = 399168000$$

2 marks:

- ❶ → 1 mark for answer in (a)
- ❷ → 0.5 mark for $2!$ or ${}_2P_2$ in (b)
- ❸ → 0.5 mark for $11!$ or ${}_{11}P_{11}$ in (b)

Marking Exemplar 2

Question 22

Total: 3 marks

A pre-school class has 12 children. The children stand in a row for their class picture.

- a) State the number of different arrangements for the picture.

(1 mark)

$${}_{12}P_{12} = 479001600$$

There are 479001600 possible arrangements
for pictures

- b) Determine the number of arrangements in which two children, Acakos and Písim, stand beside each other. Show your work.

(2 marks)

$${}_{12}P_{10} = 239500800$$

There are 239500800 possible arrangements
for pictures that allow Acakos and
Písim to stand by each other

1 mark:

① → 1 mark for answer in (a)

Training Exemplar 1

Question 22

Total: 3 marks

A pre-school class has 12 children. The children stand in a row for their class picture.

- a) State the number of different arrangements for the picture.

(1 mark)

$$12!$$

$$= 479,001,600 \text{ different arrangements}$$

- b) Determine the number of arrangements in which two children, Acakos and Písim, stand beside each other. Show your work.

(2 marks)

$$(12 - 2 + 1)!(2)!$$

$$(11)!(2)!$$

$$= 79\,833\,600 \text{ arrangements}$$

Training Exemplar 2

Question 22

Total: 3 marks

A pre-school class has 12 children. The children stand in a row for their class picture.

- a) State the number of different arrangements for the picture.

(1 mark)

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

- b) Determine the number of arrangements in which two children, Acakos and Písim, stand beside each other. Show your work.

(2 marks)

$$\underline{1} \cdot \underline{1} \cdot \underline{10} \cdot \underline{9} \cdot \underline{8} \cdot \underline{7} \cdot \underline{6} \cdot \underline{5} \cdot \underline{4} \cdot \underline{3} \cdot \underline{2} \cdot \underline{1}$$

$$3\,628\,800$$

Marking Exemplar 1

Question 24**Total: 3 marks**

Arianna bought a new soccer ball. It is completely flat and she wants to inflate it.

- When the ball is inflated, it has a diameter of 22 cm.
- The pump she is using produces $0.000\ 3\ \text{m}^3$ of air per pump.

Determine the minimum number of pumps Arianna will need to inflate the ball to a diameter of 22 cm. Show your work.

$$1\ \text{m}^3 = 1000\ \text{cm}^3$$

$$V = \frac{4}{3} \pi r^3$$

$$V = 5\ 575.28\ \text{cm}^3$$

$$= 3\ \text{cm} \sqrt{\text{answer}}$$

$$= 1\ 858.43\ \text{times}$$

2 marks:

- ① → 1 mark for volume of soccer ball
- ② → 1 mark for consistent number of pumps

Marking Exemplar 2

Question 24

Total: 3 marks

Arianna bought a new soccer ball. It is completely flat and she wants to inflate it.

- When the ball is inflated, it has a diameter of 22 cm.
- The pump she is using produces $0.000\ 3\ \text{m}^3$ of air per pump.

Determine the minimum number of pumps Arianna will need to inflate the ball to a diameter of 22 cm. Show your work.

$$r = \frac{22}{2} = 11\text{ cm}$$

$$V = \frac{4}{3} \pi \cdot 11^3 = 5575.28\text{ cm}^3 = 0.005575\text{ m}^3$$

$$\frac{0.005575}{0.003} = 1.86\text{ pumps}$$

↑
Ⓔ3

3 marks:

- ① → 1 mark for volume of soccer ball
- ② → 1 mark for unit conversion
- ③ → 1 mark for consistent number of pumps

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

Training Exemplar 1

Question 24

Total: 3 marks

Arianna bought a new soccer ball. It is completely flat and she wants to inflate it.

- When the ball is inflated, it has a diameter of 22 cm. $0.11 \text{ m} \rightarrow \text{radius}$
- The pump she is using produces 0.0003 m^3 of air per pump.

Determine the minimum number of pumps Arianna will need to inflate the ball to a diameter of 22 cm. Show your work.

$$\begin{aligned}\text{sphere Volume} &= \frac{4}{3} \pi r^3 \\ &= \frac{4}{3} \pi (0.11)^3 \\ &= \boxed{0.0056 \text{ m}^3}\end{aligned}$$

$$0.0056 \div 0.0003 = 18.6 \text{ m}^3$$

the minimum number of
pumps is 18 pumps

Training Exemplar 2

Question 24

Total: 3 marks

Arianna bought a new soccer ball. It is completely flat and she wants to inflate it.

- When the ball is inflated, it has a diameter of 22 cm.
- The pump she is using produces 0.0003 m^3 of air per pump.

Determine the minimum number of pumps Arianna will need to inflate the ball to a diameter of 22 cm. Show your work.

$$\begin{aligned}\text{Ball's volume} &= \frac{4\pi r^3}{3} \\ &= \frac{4(3.14)(11)^3}{3} \\ &= \underline{5575.28 \text{ cm}^3} = 55.75 \text{ m}^3\end{aligned}$$

$$55.75 / 0.0003 = \underline{185842.66 \text{ pumps}}$$

Marking Exemplar 1

Question 25

Total: 3 marks

Mancole is a company that manufactures tents.
Fabric tents include four sides and a floor.
One particular tent has the following dimensions:

- a height of 8 ft.
- a slant height of 10 ft.
- a 12 ft. $\times$ 18 ft. floor

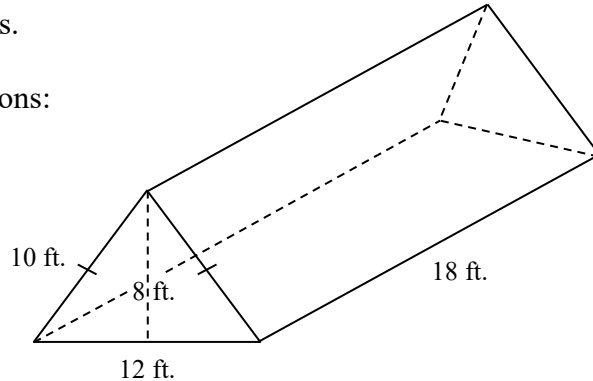


Diagram is not drawn to scale.

- a) Determine the amount of fabric required to make one tent if an extra 30 ft² of fabric is needed for sewing.

(1 mark)

$$\begin{aligned} \left(\frac{1}{2}bh\right)2 &= \left(\frac{1}{2}(12)(8)\right)2 = 96 \text{ ft}^2 \\ (lw)3 &= (18 \times 12)3 = 648 \text{ ft}^2 \\ &+ 30 \text{ ft}^2 \\ \hline &174 \text{ ft}^2 \end{aligned}$$

- b) Each tent requires 18 poles. Each pole costs \$24.00 and the fabric costs \$3.00/ft². Determine the total cost of the tent, plus GST and PST. Show your work.
(Note: GST = 5%, PST = 7%)

(2 marks)

$$\begin{aligned} 18 \times 24 &= 432 \times 1.12 = 483.84 \\ 3 \times 174 &= 522 \times 1.12 = 584.64 \\ \hline &1068.48 \end{aligned}$$

2.5 marks:

- ② → 0.5 mark for consistent surface area of tent with extra fabric in (a)
- ③ → 0.5 mark for cost of poles in (b)
- ④ → 0.5 mark for consistent cost of fabric in (b)
- ⑤ → 0.5 mark for consistent total cost before taxes in (b)
- ⑥ → 0.5 mark for consistent total cost after taxes in (b)

Marking Exemplar 2

Question 25

Total: 3 marks

Mancole is a company that manufactures tents.
Fabric tents include four sides and a floor.
One particular tent has the following dimensions:

- a height of 8 ft.
- a slant height of 10 ft.
- a 12 ft. $\times$ 18 ft. floor

SA

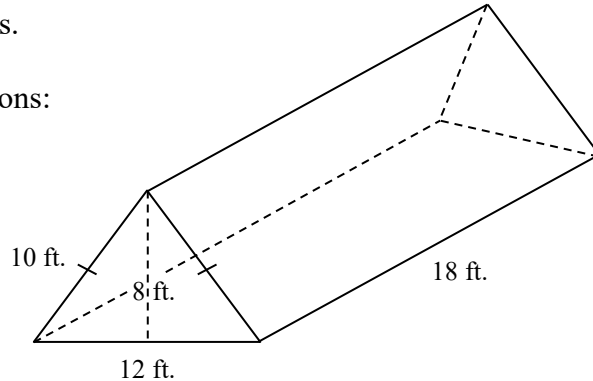


Diagram is not drawn to scale.

- a) Determine the amount of fabric required to make one tent if an extra 30 ft² of fabric is needed for sewing.

(1 mark)

$$2\left(\frac{12 \times 8}{2}\right) = 96 \text{ ft}^2$$

$$3(18 \times 10) = 540 \text{ ft}^2$$

$$\text{total} = 636 \text{ ft}^2$$

$$636 + 30 = 666 \text{ ft}^2$$

- b) Each tent requires 18 poles. Each pole costs \$24.00 and the fabric costs \$3.00/ft². Determine the total cost of the tent, plus GST and PST. Show your work.
(Note: GST = 5%, PST = 7%)

(2 marks)

$$18 \times 24 = \$432$$

$$3 \times 666 = \$1998$$

$$(432 + 1998) \times 1.13 = \$2745.90$$

2 marks:

- ② → 0.5 mark for consistent surface area of tent with extra fabric in (a)
- ③ → 0.5 mark for cost of poles in (b)
- ④ → 0.5 mark for consistent cost of fabric in (b)
- ⑤ → 0.5 mark for consistent total cost before taxes in (b)
- ⑥ → 0.5 mark for consistent total cost after taxes in (b)
- Ⓐ → 0.5 mark deduction for arithmetic error in (b)

Training Exemplar 1

Question 25

Total: 3 marks

Mancole is a company that manufactures tents.
Fabric tents include four sides and a floor.
One particular tent has the following dimensions:

- a height of 8 ft.
- a slant height of 10 ft.
- a 12 ft. $\times$ 18 ft. floor

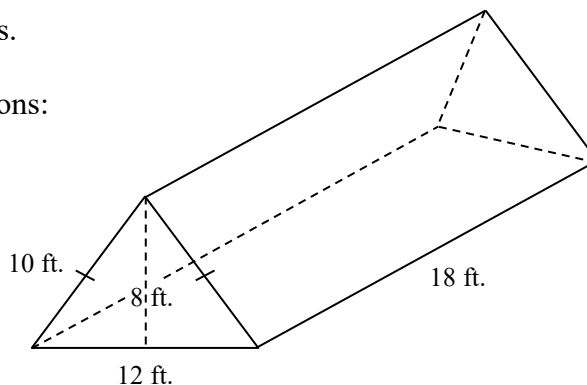


Diagram is not drawn to scale.

- a) Determine the amount of fabric required to make one tent if an extra 30 ft² of fabric is needed for sewing.

(1 mark)

$$\begin{aligned}
 10 \times 18 \times 2 &= 180 \text{ ft} \\
 12 \times 18 &= 216 \text{ ft} \\
 \frac{12 \times 8}{2} &= 48 \text{ ft}
 \end{aligned}$$

$$\begin{aligned}
 180 + 216 + 48 \\
 = 444 \text{ ft for sewing}
 \end{aligned}$$

- b) Each tent requires 18 poles. Each pole costs \$24.00 and the fabric costs \$3.00/ft². Determine the total cost of the tent, plus GST and PST. Show your work.
(Note: GST = 5%, PST = 7%)

(2 marks)

$$18 \times 24 = \$432$$

$$444 / 3 = \$148$$

$$\text{Total cost} = \$644.6$$

Training Exemplar 2

Question 25

Total: 3 marks

Mancole is a company that manufactures tents.
Fabric tents include four sides and a floor.
One particular tent has the following dimensions:

- a height of 8 ft.
- a slant height of 10 ft.
- a 12 ft. $\times$ 18 ft. floor

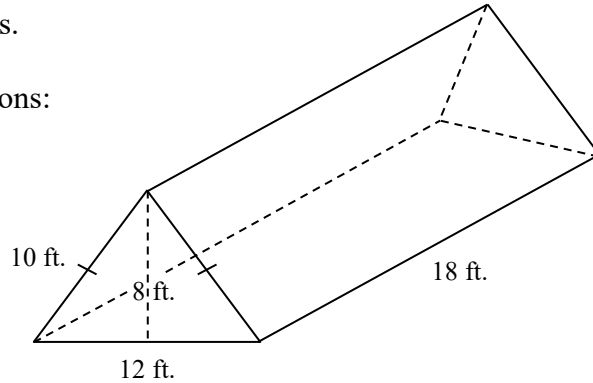


Diagram is not drawn to scale.

- a) Determine the amount of fabric required to make one tent if an extra 30 ft² of fabric is needed for sewing.

(1 mark)

$$10 \times 18 \times 2 = 360$$

$$\frac{12 \times 8}{2} = 48 \times 2 = 96 + 360 = 456 + 30 = \boxed{486 \text{ ft}^2}$$

- b) Each tent requires 18 poles. Each pole costs \$24.00 and the fabric costs \$3.00/ft². Determine the total cost of the tent, plus GST and PST. Show your work.
(Note: GST = 5%, PST = 7%)

(2 marks)

$$18 \times 24 = 432$$

$$432 \times 0.012 = \$437.18$$

$$486 \times 3 = 1458$$

$$1458 \times 0.012 = \$145.50$$

$$437.18 + 145.50 = \$192.68$$

Marking Exemplar 1

Question 28

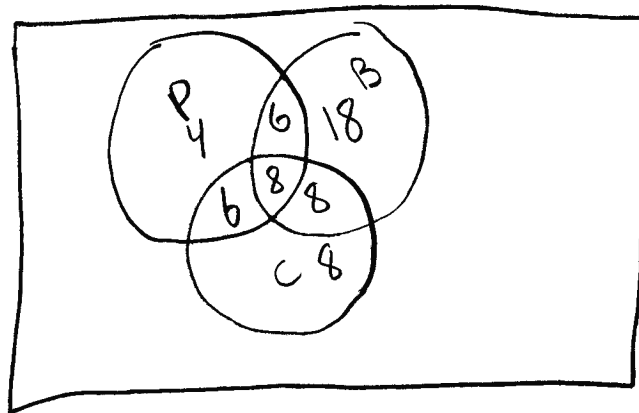
Total: 5 marks

There are 60 Grade 12 students at a high school.

- 40 students take biology (B)
- 30 students take chemistry (C)
- 24 students take physics (P)
- 8 students take only biology and chemistry
- 4 students take only biology and physics
- 6 students take only chemistry and physics
- 4 students take physics only

a) Draw a Venn diagram to represent this situation.

(3 marks)



60

b) State the number of students who take only one science course.

(1 mark)

$$4 + 8 + 8 = 30$$

c) Explain what $B \cap C \cap \overline{P}$ means in this situation.

(1 mark)

That they all have students in common

2 marks:

- ② → 1 mark for consistent number of students in only one science course in (a)
- ④ → 1 mark for consistent number of students in only one science course in (b)

Marking Exemplar 2

Question 28

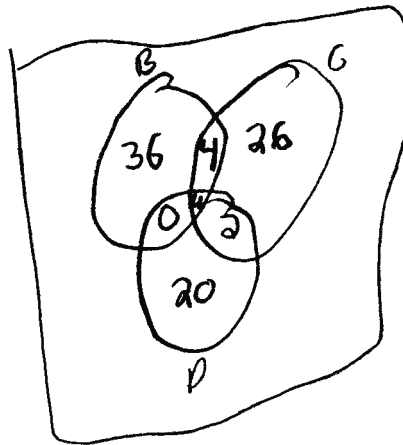
Total: 5 marks

There are 60 Grade 12 students at a high school.

- 40 students take biology (B)
- 30 students take chemistry (C)
- 24 students take physics (P)
- 8 students take only biology and chemistry
- 4 students take only biology and physics
- 6 students take only chemistry and physics
- 4 students take physics only

a) Draw a Venn diagram to represent this situation.

(3 marks)



b) State the number of students who take only one science course.

(1 mark)

82 people

c) Explain what $B \cap C \cap \bar{P}$ means in this situation.

(1 mark)

What students took Biology and chemistry but not physics.

2 marks:

- ④ → 1 mark for consistent number of students in only one science course in (b)
- ⑤ → 1 mark for appropriate explanation in (c)

Training Exemplar 1

Question 28

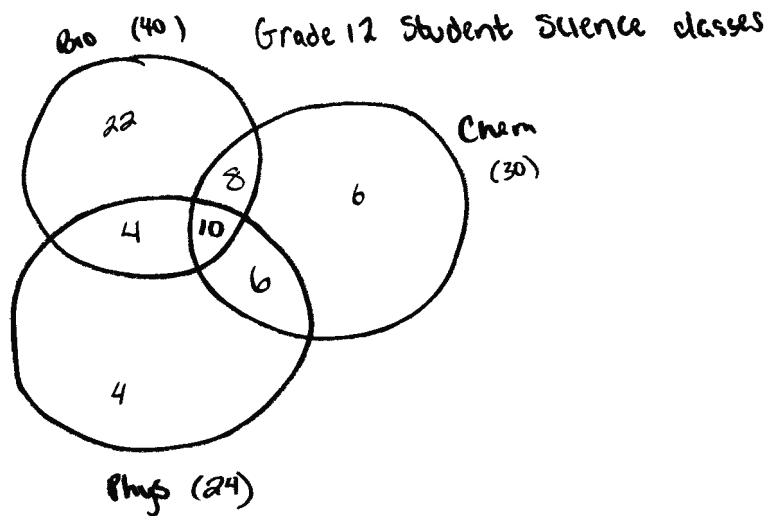
Total: 5 marks

There are 60 Grade 12 students at a high school.

- 40 students take biology (B)
- 30 students take chemistry (C)
- 24 students take physics (P)
- 8 students take only biology and chemistry
- 4 students take only biology and physics
- 6 students take only chemistry and physics
- 4 students take physics only

a) Draw a Venn diagram to represent this situation.

(3 marks)



b) State the number of students who take only one science course.

(1 mark)

32 students

c) Explain what $B \cap C \cap \bar{P}$ means in this situation.

(1 mark)

Bio and Chem and everything not in Physics

30 students in Bio and Chem only

Training Exemplar 2

Question 28

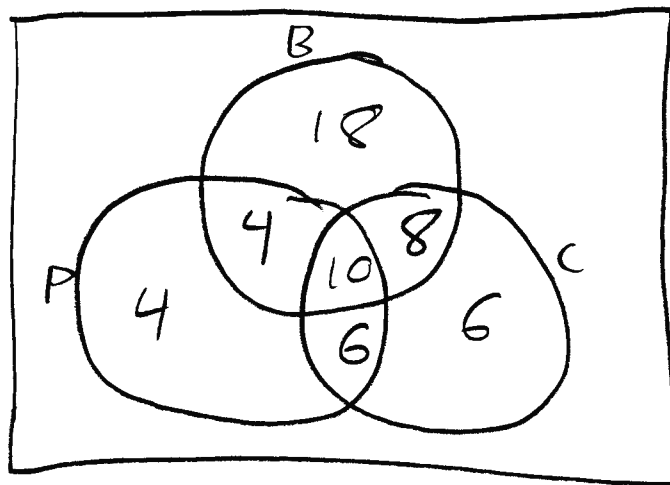
Total: 5 marks

There are 60 Grade 12 students at a high school.

- 40 students take biology (B)
- 30 students take chemistry (C)
- 24 students take physics (P)
- 8 students take only biology and chemistry
- 4 students take only biology and physics
- 6 students take only chemistry and physics
- 4 students take physics only

a) Draw a Venn diagram to represent this situation.

(3 marks)



b) State the number of students who take only one science course.

(1 mark)

28 students only take 1 science

c) Explain what $B \cap C \cap \bar{P}$ means in this situation.

(1 mark)

Biology and chemistry but not physics

Marking Exemplar 1

Question 29

Total: 1 mark

Given the following statement:

“If a number is odd, then the number is prime.”

State a counterexample to this statement.

2

0 marks:
→ no criteria met

Marking Exemplar 2

Question 29**Total: 1 mark**

Given the following statement:

“If a number is odd, then the number is prime.”

State a counterexample to this statement.

$$3 \cdot 5 = 15$$

$$1 \cdot 15 = 15$$

1 mark:

❶ → 1 mark for counterexample

Training Exemplar 1

Question 29

Total: 1 mark

Given the following statement:

prim

“If a number is odd, then the number is prime.”

State a counterexample to this statement.

prime # : 2, 3, 5, 7, 11, 13, 17

odd # : 1 3 5 7 9 11 13 15, 17, 19

Some odd numbers are not prime #.

Marking Exemplar 1

Question 30

Total: 1 mark

A 3×3 KenKen puzzle uses the digits 1, 2, and 3 in each row and column exactly once.

- Each bold rectangle in the puzzle is called a “cage”.
- In each cage, the number in the top-left corner is the result of the given operation.
- The numbers may be written in any order in the cage.

Example:

2 −	
1	3

Complete the KenKen puzzle below.

3	2 ÷ 1	2
6 × 1	2	3 × 3
3 + 2	3	1

0 marks:

→ no criteria met

Marking Exemplar 1

Question 31

Total: 3 marks

Consider the following statement:

“Someone who plays drums is a musician.”

- a) Write a conditional statement using the statement above.

(1 mark)

If someone plays drums, then they are a musician

- b) Write the converse of the conditional statement in (a).

(1 mark)

If someone is a musician, they play the drums

- c) Is the conditional statement in (a) biconditional? Explain.

(1 mark)

It is not biconditional because the converse and conditional aren't both true statements.

2.5 marks:

- ❶ → 0.5 mark for including “if” and “then” in (a)
- ❷ → 0.5 mark for conditional statement in (a)
- ❹ → 0.5 mark for consistent converse statement in (b)
- ❺ → 1 mark for consistent explanation in (c)

Marking Exemplar 2

Question 31

Total: 3 marks

Consider the following statement:

“Someone who plays drums is a musician.”

- a) Write a conditional statement using the statement above.

(1 mark)

If someone plays drums, then ^{the person} is a musician.

- b) Write the converse of the conditional statement in (a).

(1 mark)

If someone is a musician, then the person plays drums.

- c) Is the conditional statement in (a) biconditional? Explain.

(1 mark)

If someone is not a musician, the person doesn't play drums

No. Some people play drums although they are not musicians.

2.5 marks:

- ❶ → 0.5 mark for including “if” and “then” in (a)
- ❷ → 0.5 mark for conditional statement in (a)
- ❸ → 0.5 mark for including “if” and “then” in (b)
- ❹ → 0.5 mark for consistent converse statement in (b)
- ❺ → 1 mark for consistent explanation in (c)
- ❻ → 0.5 mark deduction for lack of clarity in (c)

Training Exemplar 1

Question 31**Total: 3 marks**

Consider the following statement:

“Someone who plays drums is a musician.”

- a) Write a conditional statement using the statement above.

(1 mark)

If someone plays the drums then they are a musician.

- b) Write the converse of the conditional statement in (a).

(1 mark)

a musician is someone who plays the drums.

- c) Is the conditional statement in (a) biconditional? Explain.

(1 mark)

no because it isn't "if and only if" in the statement.

Training Exemplar 2

Question 31

Total: 3 marks

Consider the following statement:

“Someone who plays drums is a musician.”

- a) Write a conditional statement using the statement above.

(1 mark)

If I play drums, then I am a musician

- b) Write the converse of the conditional statement in (a).

(1 mark)

If I'm not a musician, then I don't play drums

- c) Is the conditional statement in (a) biconditional? Explain.

(1 mark)

Yes, b/c if you play any instrument you are considered a musician

Training Exemplar Answers

Question 3

Total: 1 mark**Training Exemplar 1****Mark(s): 0.5/1**

- ❶ → 0.5 mark for upper and lower bounds of the domain

Training Exemplar 2**Mark(s): 0/1**

→ no criteria met

Question 4

Total: 1 mark**Training Exemplar 1****Mark(s): 1/1**

- ❶ → 1 mark for answer
ⒺⒺ → rounds incorrectly

Training Exemplar 2**Mark(s): 0/1**

→ no criteria met

Question 5

Total: 3 marks**Training Exemplar 1****Mark(s): 2/3**

- ❶ → 1 mark for appropriate work in (a)
❷ → 1 mark for consistent answer in (b)

Training Exemplar 2**Mark(s): 2/3**

- ❸ → 0.5 mark for two consistent values in the equation in (a)
❹ → 0.5 mark for remaining two consistent values in the equation in (a)
❺ → 1 mark for consistent answer in (b)
ⒺⒻ → makes a transcription error (inaccurate transferring of information) in (b)

Question 6**Total: 3 marks**

Training Exemplar 1**Mark(s): 3/3**

- ❶ → 1 mark for answer in (a)
- ❷ → 1 mark for consistent x -value in (b)
- ❸ → 1 mark for consistent difference in (b)
- Ⓔ → makes a transcription error (inaccurate transferring of information) in (a)

Question 7**Total: 6 marks**

Training Exemplar 1**Mark(s): 5/6**

- ❶ → 1 mark for communicating the context of the graph with appropriate title and/or labels in (a)
- ❸ → 1 mark for an appropriate shape that illustrates key characteristics of the function (e.g., maximum, minimum, asymptotes, intercepts) in (a)
- ❹ → 1 mark for bison population in (b)
- ❺ → 1 mark for appropriate work in (c)
- ❻ → 1 mark for consistent answer in (c)

Training Exemplar 2**Mark(s): 3/6**

- ❶ → 1 mark for communicating the context of the graph with appropriate title and/or labels in (a)
- ❸ → 1 mark for an appropriate shape that illustrates key characteristics of the function (e.g., maximum, minimum, asymptotes, intercepts) in (a)
- ❹ → 1 mark for bison population in (b)

Question 10**Total: 2 marks**

Training Exemplar 1**Mark(s): 2/2**

- ❶ → 1 mark for appropriate work
- ❷ → 1 mark for consistent answer
- ⓔⓖ → rounds too soon

Training Exemplar 2**Mark(s): 1.5/2**

- ❶ → 1 mark for appropriate work
- ❷ → 1 mark for consistent answer
- ⓔⓔ → 0.5 mark deduction for procedural error

Question 11**Total: 4 marks**

Training Exemplar 1**Mark(s): 3.5/4**

- ❶ → 1 mark for appropriate work in (a)
- ❷ → 1 mark for consistent answer in (a)
- ❸ → 0.5 mark for consistent cost of Option 1 in (b)
- ❹ → 0.5 mark for adding \$8000.00 to Option 2 in (b)
- ❺ → 0.5 mark for consistent cost of Option 2 in (b)

Training Exemplar 2**Mark(s): 3/4**

- ❷ → 1 mark for consistent answer in (a)
- ❸ → 0.5 mark for consistent cost of Option 1 in (b)
- ❹ → 0.5 mark for adding \$8000.00 to Option 2 in (b)
- ❺ → 0.5 mark for consistent cost of Option 2 in (b)
- ❻ → 0.5 mark for appropriate explanation in (c)

Question 12**Total: 4 marks**

Training Exemplar 1**Mark(s): 3.5/4**

- ❶ → 1 mark for appropriate work for Bank 1 in (a)
- ❷ → 1 mark for consistent answer for Bank 1 in (a)
- ❸ → 1 mark for consistent answer for Bank 2 in (a)
- ❺ → 0.5 mark for consistent difference in (b)

Training Exemplar 2**Mark(s): 1/4**

- ❹ → 0.5 mark for consistent total amounts in (b)
- ❺ → 0.5 mark for consistent difference in (b)

Question 13**Total: 1 mark**

Training Exemplar 1**Mark(s): 0/1**

→ no criteria met

Training Exemplar 2**Mark(s): 1/1**

- ❶ → 1 mark for appropriate explanation

Question 14**Total: 2 marks**

Training Exemplar 1**Mark(s): 0/2**

→ no criteria met

Training Exemplar 2**Mark(s): 1/2**

- ❷ → 1 mark for consistent answer

Question 17

Total: 1 mark**Training Exemplar 1****Mark(s): 0/1**

→ no criteria met

Training Exemplar 2**Mark(s): 1/1**

- ❶ → 1 mark for showing mutually exclusive events
- Ⓔ → does not include a box when using a Venn diagram

Question 18

Total: 2 marks**Training Exemplar 1****Mark(s): 1.5/2**

- ❶ → 1 mark for answer in (a)
- ❸ → 0.5 mark for consistent probability in (b)

Training Exemplar 2**Mark(s): 1/2**

- ❶ → 1 mark for answer in (a)

Question 19

Total: 3 marks**Training Exemplar 1****Mark(s): 1/3**

- ❹ → 1 mark for consistent product in (b)

Training Exemplar 2**Mark(s): 2/3**

- ❷ → 0.5 mark for ${}_5C_2$ in (b)
- ❸ → 0.5 mark for ${}_7C_4$ in (b)
- ❹ → 1 mark for consistent product in (b)

Question 20**Total: 2 marks**

Training Exemplar 1**Mark(s): 1.5/2**

- ❷ → 0.5 mark for 3!
- ❸ → 0.5 mark for 2!
- ❹ → 0.5 mark for consistent quotient

Training Exemplar 2**Mark(s): 0/2**

→ no criteria met

Question 21**Total: 3 marks**

Training Exemplar 1**Mark(s): 2.5/3**

- ❶ → 1 mark for appropriate graphic organizer in (a)
- ❸ → 0.5 mark for $P(\text{no blizzard, schools closed})$ in (b)
- ❹ → 1 mark for consistent sum in (b)

Training Exemplar 2**Mark(s): 1.5/3**

- ❶ → 1 mark for appropriate graphic organizer in (a)
- ❸ → 0.5 mark for $P(\text{no blizzard, schools closed})$ in (b)

Question 22**Total: 3 marks**

Training Exemplar 1**Mark(s): 3/3**

- ❶ → 1 mark for answer in (a)
- ❷ → 0.5 mark for $2!$ or ${}_2P_2$ in (b)
- ❸ → 0.5 mark for $11!$ or ${}_{11}P_{11}$ in (b)
- ❹ → 1 mark for consistent product in (b)

Training Exemplar 2**Mark(s): 2/3**

- ❶ → 1 mark for answer in (a)
- ❹ → 1 mark for consistent product in (b)

Question 24**Total: 3 marks**

Training Exemplar 1**Mark(s): 3/3**

- ① → 1 mark for volume of soccer ball
- ② → 1 mark for unit conversion
- ③ → 1 mark for consistent number of pumps
- Ⓔ⑤ → uses incorrect units of measure
- Ⓔ⑥ → rounds incorrectly
- Ⓔ⑥ → rounds too soon

Training Exemplar 2**Mark(s): 2/3**

- ① → 1 mark for volume of soccer ball
- ③ → 1 mark for consistent number of pumps

Question 25**Total: 3 marks**

Training Exemplar 1**Mark(s): 1.5/3**

- ③ → 0.5 mark for cost of poles in (b)
- ⑤ → 0.5 mark for consistent total cost before taxes in (b)
- ⑥ → 0.5 mark for consistent total cost after taxes in (b)
- Ⓔ⑥ → does not express the answer to the appropriate number of decimal places, including monetary values to two decimal places in (b)

Training Exemplar 2**Mark(s): 2/3**

- ② → 0.5 mark for consistent surface area of tent with extra fabric in (a)
- ③ → 0.5 mark for cost of poles in (b)
- ④ → 0.5 mark for consistent cost of fabric in (b)
- ⑤ → 0.5 mark for consistent total cost before taxes in (b)
- ⑥ → 0.5 mark for consistent total cost after taxes in (b)
- ⒶⒺ → 0.5 mark deduction for arithmetic error in (b)

Question 28**Total: 5 marks**

Training Exemplar 1**Mark(s): 4/5**

- ❶ → 1 mark for placing 10 students in all three science courses in (a)
- ❸ → 1 mark for consistent number of students in no science courses in (a)
- ❹ → 1 mark for consistent number of students in only one science course in (b)
- ❺ → 1 mark for appropriate explanation in (c)
- Ⓔ → does not include a box when using a Venn diagram in (a)

Training Exemplar 2**Mark(s): 4/5**

- ❶ → 1 mark for placing 10 students in all three science courses in (a)
- ❷ → 1 mark for consistent number of students in only one science course in (a)
- ❹ → 1 mark for consistent number of students in only one science course in (b)
- ❺ → 1 mark for appropriate explanation in (c)

Question 29**Total: 1 mark**

Training Exemplar 1**Mark(s): 1/1**

- ❶ → 1 mark for counterexample

Question 31**Total: 3 marks**

Training Exemplar 1**Mark(s): 1.5/3**

- ❶ → 0.5 mark for including “if” and “then” in (a)
- ❷ → 0.5 mark for conditional statement in (a)
- ❹ → 0.5 mark for consistent converse statement in (b)

Training Exemplar 2**Mark(s): 1.5/3**

- ❶ → 0.5 mark for including “if” and “then” in (a)
- ❷ → 0.5 mark for conditional statement in (a)
- ❸ → 0.5 mark for including “if” and “then” in (b)