Grade 12
Applied Mathematics
Achievement Test

Exemplars

Use in conjunction with *Marking Guide*

June 2026

Manitoba

Grade 12 Applied Mathematics Achievement Test:
Exemplars (June 2026)

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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. These exemplars include marks assigned by the test development committee, together with rationales for the marks.

Exemplar 1

Question 3 — Total: 3 marks

A football player kicks a ball. The height of the ball before it hits the ground is modelled by the following equation:

$$h = -32.15t^2 + 72.18t + 3.5$$

where h represents the height of the ball (in feet)
and t represents the time (in seconds).

a) State the initial height of the football.

(*0.5 mark*)

44.01ft

b) Determine the change in the height of the ball in the first 0.8 seconds.

(*1.5 marks*)

0.8 seconds = 40.668ft high

44.01 − 40.668 = 3.342

E5

c) State the range of the equation in this situation.

(*1 mark*)

$\{3.50 \leq y \leq 44.01\}$

E1

Mark(s): 2/3

- 2 1 mark for consistent second *y*-value in (b)
- 3 0.5 mark for consistent difference in (b)
- 5 0.5 mark for inclusivity of both upper and lower bounds in (c)
- E5 does not include the units in the final answer in (b)
- E1 does not use the given contextual variables in (c)

Exemplar 2

Question 3 — Total: 3 marks

A football player kicks a ball. The height of the ball before it hits the ground is modelled by the following equation:

$$h = -32.15t^2 + 72.18t + 3.5$$

where h represents the height of the ball (in feet)
and t represents the time (in seconds).

a) State the initial height of the football.

(*0.5 mark*)

Initial starting at (0, 3.5)

E1

b) Determine the change in the height of the ball in the first 0.8 seconds.

(*1.5 marks*)

So when $x = (0.8)$
the football height $(y) = (40.668)$

$(40.668)(0.8)$
$y \quad x$

c) State the range of the equation in this situation.

(*1 mark*)

$0 \leq h \leq 44.01$

E2

Mark(s): 2.5/3

1. 0.5 mark for answer in (a)
2. 1 mark for consistent second *y*-value in (b)
4. 0.5 mark for consistent upper and lower bounds of the range in (c)
5. 0.5 mark for inclusivity of both upper and lower bounds in (c)

E1 incorrectly states the final answer in (a)

E2 does not include braces when using set notation in (c)

Exemplar 1

Question 4 — Total: 3 marks

To treat an infection, Laertes takes medication. One pill contains 500 mg of medication. Once taken, the body filters out 60% of the medication every 5 hours.

a) State the exponential regression equation that models the remaining quantity in Laertes' body as a function of time, in hours.

You may use the table below.

Time (h)	0	5	10	15
Remaining Quantity (mg)	0 mg	500 mg	300 mg	180 mg

500 × 0.6 300 × 0.6

(*1 mark*)

Regression equation: $y = 212.70239 \cdot 1.01866^x$

b) State the quantity of medication remaining in Laertes' body 6 hours after taking the pill.

(*1 mark*)

t = 6 hrs → x = 6

(6, 237.65953)

there is 237.66 mg of medication remaing in Laertes' body after 6 hours

c) Determine the time when only 25 mg of medication remain in Laertes' body.

(*1 mark*)

mg = 25 → y = 25

(0, 25), (6, 25), (10, 25)

10 + 6 = 16

at 16 hours there is only 25 mg left in their body

Mark(s): 1.5/3

3. 1 mark for consistent answer in (b)
4. 0.5 mark for appropriate work in (c)

Exemplar 2

Question 4 — Total: 3 marks

To treat an infection, Laertes takes medication. One pill contains 500 mg of medication. Once taken, the body filters out 60% of the medication every 5 hours.

a) State the exponential regression equation that models the remaining quantity in Laertes' body as a function of time, in hours.

You may use the table below.

Time (h)	1	2	3	4
Remaining Quantity (mg)	200	80	32	12.8

(*1 mark*)

Regression equation: $y = 500 \cdot 0.4^x$

b) State the quantity of medication remaining in Laertes' body 6 hours after taking the pill.

(*1 mark*)

$x = 6$ hours

$y = 2.048$ mg

c) Determine the time when only 25 mg of medication remain in Laertes' body.

(*1 mark*)

$x = 3.27$ hours

Mark(s): 2/3

1. 0.5 mark for initial value in (a)
3. 1 mark for consistent answer in (b)
5. 0.5 mark for consistent answer in (c)

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Exemplar 1

Question 5 — Total: 3 marks

Erin invests $5000.00. She buys an investment where interest is compounded continuously at a rate of 7%. The approximate growth of her investment is modelled by the following equation:

$$t = \frac{\ln\left(\frac{A}{5000}\right)}{0.07}$$

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

a) Explain why the domain in this situation is D: $[5000, \infty)$.

(*1 mark*)

She only has $5,000 to begin with, and they are unsure of how much money she will end up with after a certain amount of time ← LC

b) State when this investment is worth $120 000.00.

(*1 mark*)

$$t = \frac{\ln\left(\frac{120000}{5000}\right)}{0.07}$$

$$t = 45.40$$ ← E6

In 45 years

c) Determine the value of the investment after 24 years.

(*1 mark*)

$$24 = \frac{\ln\left(\frac{A}{5000}\right)}{0.07}$$

$$1.68 = \ln\left(\frac{A}{5000}\right)$$

$$\ln(1.68) = 5000 \ln(A)$$

$$A = \$8400$$

Mark(s): 2/3

1. 1 mark for explanation in (a)
2. LC 0.5 mark deduction for lack of clarity in (a)
3. 1 mark for consistent answer in (b)
4. 0.5 mark for appropriate work in (c)
5. E6 rounds inappropriately in (b)

Exemplar 2

Question 5 — Total: 3 marks

Erin invests $5000.00. She buys an investment where interest is compounded continuously at a rate of 7%. The approximate growth of her investment is modelled by the following equation:

$$t = \frac{\ln\left(\frac{A}{5000}\right)}{0.07}$$

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

a) Explain why the domain in this situation is D: $[5000, \infty)$.

(*1 mark*)

Because the intial investment (5000) continues to grow.

b) State when this investment is worth $120 000.00.

(*1 mark*)

$$t = \frac{72}{0.07}$$

c) Determine the value of the investment after 24 years.

(*1 mark*)

$$A = 5000\left(1 + \frac{0.07}{365}\right)^{365(24)}$$

$$A = 26823.46$$

E5

Mark(s): 1.5/3

1. 1 mark for explanation in (a)
4. 0.5 mark for consistent answer in (c)
E5. does not include the dollar sign for monetary values in (c)

Exemplar 3

Question 5 — Total: 3 marks

Erin invests $5000.00. She buys an investment where interest is compounded continuously at a rate of 7%. The approximate growth of her investment is modelled by the following equation:

$$t = \frac{\ln\left(\frac{A}{5000}\right)}{0.07}$$

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

a) Explain why the domain in this situation is D: $[5000, \infty)$.

(*1 mark*)

She isn't going to be losing money, so the only other way is up, or in other terms, she can only get money. ← LC

b) State when this investment is worth $120 000.00.

(*1 mark*)

$t = \frac{\ln\left(\frac{A}{5000}\right)}{0.07} \rightarrow t = \frac{\ln\left(\frac{120000}{5000}\right)}{0.07} \rightarrow t = \frac{\ln(24)}{0.07}$

$t = 45.4$ years ← E6 ← $t = 45.406209$

c) Determine the value of the investment after 24 years.

(*1 mark*)

$26827.78

Mark(s): 2/3

- 1 1 mark for explanation in (a)
- LC 0.5 mark deduction for lack of clarity in (a)
- 2 1 mark for consistent answer in (b)
- 4 0.5 mark for consistent answer in (c)
- E6 does not express the answer to the appropriate number of decimal places in (b)

Exemplar 1

Question 6 — Total: 4 marks

Kulraj visits an amusement park and goes on a swing ride. Their height is recorded during the ride, as shown in the following table.

Time (s)	0	2	4	6	8
Height (m)	7	5	3	5	7

a) State the sinusoidal regression equation that models this situation.

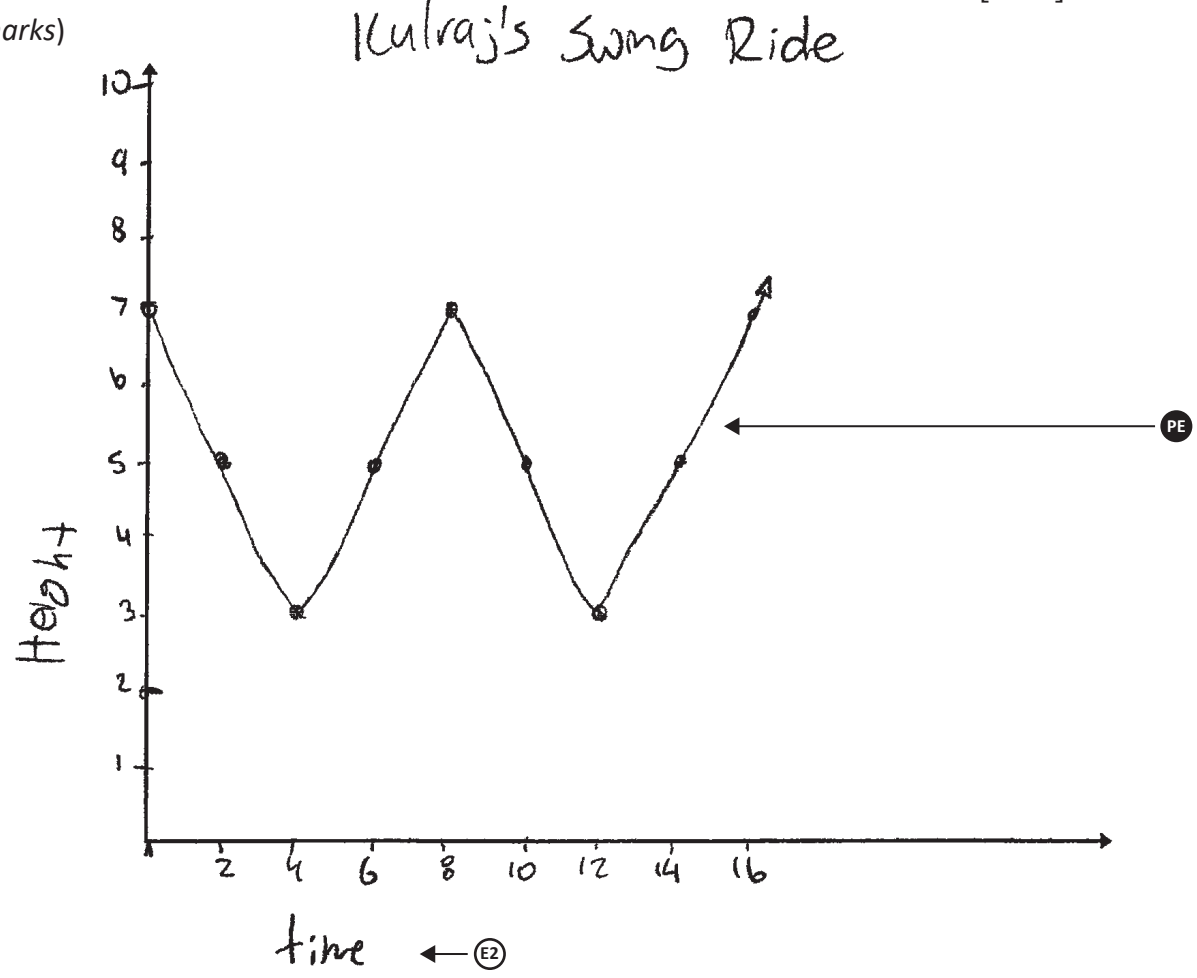
(*1 mark*)

$2\sin(0.79x+1.57)+5.00$

E2

b) Create a clearly labelled graph of the equation in (a) over the domain $[0, 16]$.

(*2 marks*)



c) State the height of Kulraj at 14.5 seconds.

(*1 mark*)

Mark(s): 2/4

- 1 0.5 mark for two values in (a)
- 2 0.5 mark for remaining two values in (a)
- 5 1 mark for plotting the data and appropriate shape of the sinusoidal curve in (b)
- PE 0.5 mark deduction for procedural error in (b)
- 6 1 mark for consistent answer in (c)
- PE 0.5 mark deduction for procedural error in (c)
- E2 does not include one of the following in the equation: "$y =$", "sin", "ln", or "x", or writes parameters separately from the equation in (a)
- E2 does not include titles and/or labels, with units, on a graph in (b)

Exemplar 2

Question 6 — Total: 4 marks

Kulraj visits an amusement park and goes on a swing ride. Their height is recorded during the ride, as shown in the following table.

Time (s)	0	2	4	6	8
Height (m)	7	5	3	5	7

a) State the sinusoidal regression equation that models this situation.

(*1 mark*)

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

$b = \frac{2\pi}{8}$ or 4

$b =$

$y = a\sin(bx + c) + d$

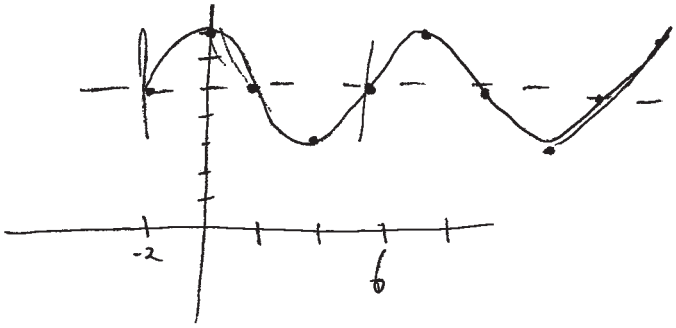
$d = 5$

$a = 2$

$b = \frac{\pi}{4}$

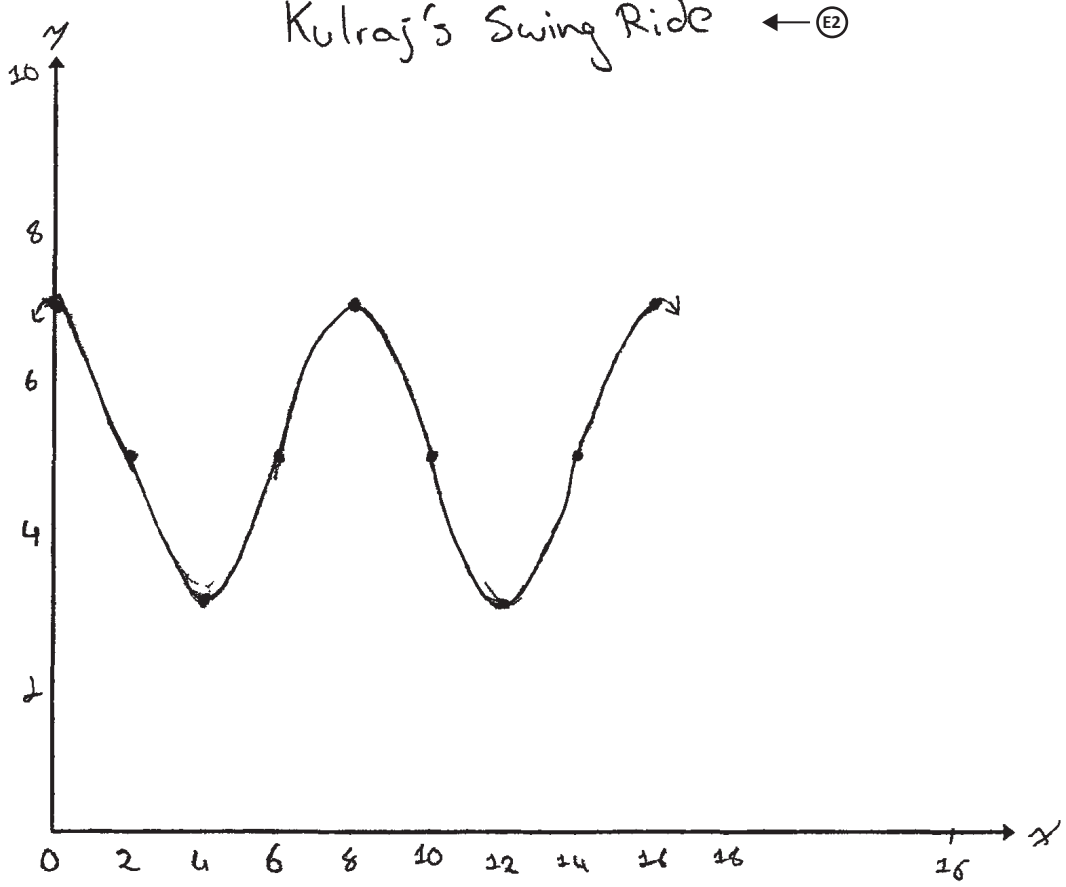
$c = 6$

$y = 2\sin\left(\frac{\pi}{4}x + 6\right) + 5$



b) Create a clearly labelled graph of the equation in (a) over the domain $[0, 16]$.

(*2 marks*)



c) State the height of Kulraj at 14.5 seconds.

(*1 mark*)

$y = 2\sin\left(\frac{\pi}{4}(14.5) + 6\right) + 5$

$= 2\sin(27.388) + 5$

$y = 5.597$ ← PE

The height of Kulraj at 14.5 seconds is 5.6 m. ← E6

Mark(s): 2.5/4

- 1 0.5 mark for two values in (a)
- 4 0.5 mark for using an appropriate range for the context of the question in (b)
- 5 1 mark for plotting the data and appropriate shape of the sinusoidal curve in (b)
- 6 1 mark for consistent answer in (c)
- PE 0.5 mark deduction for procedural error in (c)
- E2 does not include titles and/or labels, with units, on a graph in (b)
- E6 does not express the answer to the appropriate number of decimal places in (c)

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Exemplar 1

Question 7 — Total: 2 marks

There are 9 apples and 6 oranges in a fruit bowl.

a) Phoebe selects two fruits to eat from the bowl.

Determine the probability that both fruits are the same.

(*2 marks*)

Apple $^{9}/_{15} \cdot {}^{8}/_{15} = 0.32$

$= 32\%$.

Orange $^{6}/_{15} \cdot {}^{5}/_{15} = 0.13$

$= 13\%$. ← E6

Mark(s): 1/2

1 0.5 mark for considering dependency in the numerator in (a)

3 0.5 mark for multiplying the number of same fruit in (a)

E6 does not express the answer to the appropriate number of decimal places in (a)

Exemplar 2

Question 7 — Total: 2 marks

There are 9 apples and 6 oranges in a fruit bowl.

a) Phoebe selects two fruits to eat from the bowl.

Determine the probability that both fruits are the same.

(*2 marks*)

$\frac{m}{n+m}$ $\frac{9}{15} + \frac{8}{14} = \frac{17}{29} = 0.59$

Mark(s): 1/2

1. 0.5 mark for considering dependency in the numerator in (a)
2. 0.5 mark for considering dependency in the denominator in (a)

Exemplar 3

Question 7 — Total: 2 marks

There are 9 apples and 6 oranges in a fruit bowl.

a) Phoebe selects two fruits to eat from the bowl.

Determine the probability that both fruits are the same.

(*2 marks*)

$9 + 6 = 15$ in total

$\frac{9}{15} + \frac{6}{14} = 1.02857$ or 102.86% ← PE

Mark(s): 0.5/2

2 0.5 mark for considering dependency in the denominator in (a)

4 0.5 mark for consistent sum in (a)

PE 0.5 mark deduction for procedural error in (a)

Exemplar 1

Question 8 — Total: 3 marks

Monica is arranging a row of picture frames over her fireplace. She has 4 different rectangular frames and 3 different circular frames.

a) Determine the number of ways the frames can be arranged if she wants a rectangular frame at both ends.

(*1.5 marks*)

$2P_2 \times 5P_5 = 240$

$2! \times 5! = 240$

b) Determine the number of ways the frames can be arranged if the rectangular frames must be grouped together and the circular frames must be grouped together.

(*1.5 marks*)

$4! \times 3! = 144$

Mark(s): 2/3

- 2 0.5 mark for remaining frames in the middle in (a)
- 3 0.5 mark for consistent product in (a)
- 4 0.5 mark for 3!4! in (b)
- 6 0.5 mark for multiplying factorials in (b)

Exemplar 2

Question 8 — Total: 3 marks

Monica is arranging a row of picture frames over her fireplace. She has 4 different rectangular frames and 3 different circular frames. 7 total

a) Determine the number of ways the frames can be arranged if she wants a rectangular frame at both ends.

(*1.5 marks*)

4 rectangle _ 3 _ 2 _ 1 _ 2 _ 1 _ 3 rectangle

= 144 arrangements

b) Determine the number of ways the frames can be arranged if the rectangular frames must be grouped together and the circular frames must be grouped together.

(*1.5 marks*)

1 2

(4 3 2 1) (3 2 1)

$\frac{4! \cdot 3!}{2!}$

= 72 ways

Mark(s): 2/3

1. 0.5 mark for rectangular frames at both ends in (a)
3. 0.5 mark for consistent product in (a)
4. 0.5 mark for 3!4! in (b)
5. 0.5 mark for 2! in (b)

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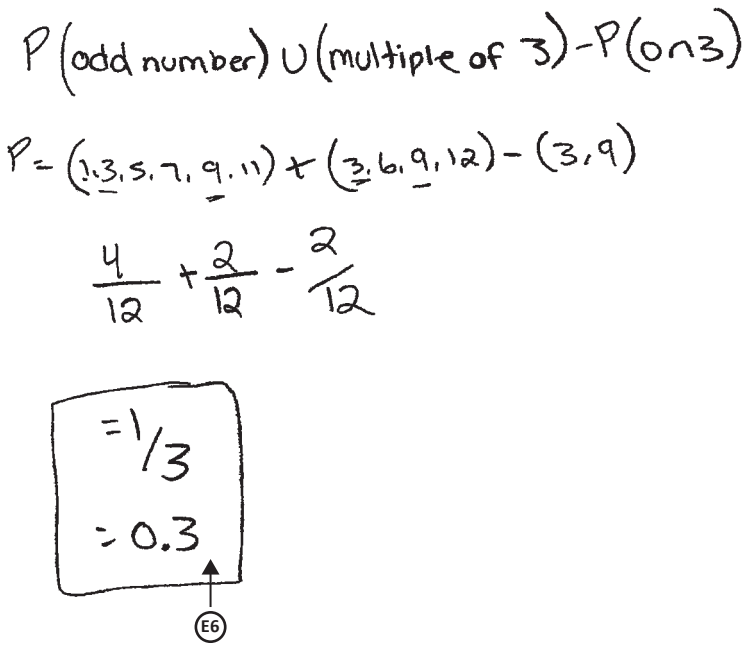
Exemplar 1

Question 9 **Total: 2 marks**

Janice rolls a 12-sided die.

Determine the probability that she rolls an odd number or a multiple of three.



Mark(s): 1/2

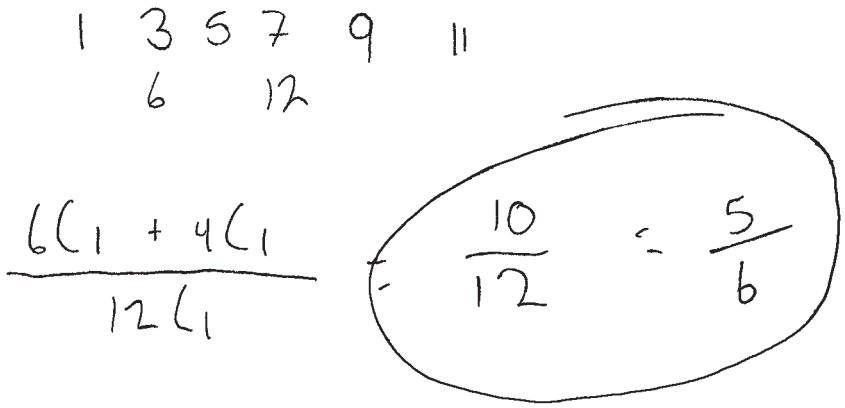
- ❸ 0.5 mark for $P(\text{both})$
- ❹ 0.5 mark for consistent answer
- Ⓔ6 does not express the answer to the appropriate number of decimal places

Exemplar 2

Question 9 **Total: 2 marks**

Janice rolls a 12-sided die.

Determine the probability that she rolls an odd number or a multiple of three.



Mark(s): 1.5/2

1. 0.5 mark for $P(\text{odd})$
2. 0.5 mark for $P(\text{multiple of three})$
4. 0.5 mark for consistent answer

Exemplar 3

Question 9 **Total: 2 marks**

Janice rolls a 12-sided die.

Determine the probability that she rolls an odd number or a multiple of three.

odd = 1, 3, 5, 7, 9, 11

B = 3, 6, ~~8~~, 12

$\frac{8}{12}$ = 0.67

Mark(s): 2/2

1. 0.5 mark for $P(\text{odd})$
2. 0.5 mark for $P(\text{multiple of three})$
3. 0.5 mark for $P(\text{both})$
4. 0.5 mark for consistent answer

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Exemplar 1

Question 10 **Total: 1 mark**

Rachel has been asked to state the expression to represent the total number of ways the letters can be arranged in the word MANIFESTATION.

They incorrectly stated the solution as:

$13P13$

Explain to Rachel how their error can be corrected.

$$\frac{13!}{(2!)(2!)(2!)(2!)} = 389,188,800$$

Mark(s): 0/1

→ no criteria met

Exemplar 2

Question 10 **Total: 1 mark**

Rachel has been asked to state the expression to represent the total number of ways the letters can be arranged in the word MANIFESTATION.

They incorrectly stated the solution as:

$13^{P}13$

Explain to Rachel how their error can be corrected.

The word has many of the same letter making less unique ways to arrange the word Manifestation.

Mark(s): 0.5/1

1 1 mark for explanation

LC 0.5 mark deduction for lack of clarity

Exemplar 3

Question 10 — Total: 1 mark

Rachel has been asked to state the expression to represent the total number of ways the letters can be arranged in the word MANIFESTATION.

They incorrectly stated the solution as:

$13P13$

Explain to Rachel how their error can be corrected.

Didn't account for Repeating

$\frac{n!}{a!\,b!\,c!}$ ← correct formula

$= 389,188,800$

$\frac{13!}{2!\,2!\,2!\,2!}$

Mark(s): 1/1

1. 1 mark for explanation

Exemplar 1

Question 11 — Total: 4 marks

Ross is an animal trainer. He is choosing 5 animals to participate at the next animal show. He has 6 dogs and 3 cats to choose from.

a) Determine the number of ways the 5 animals can be chosen for the show.

(*1 mark*)

$_9C_5 = 126$

b) Determine the number of ways the 5 animals can be chosen if he wants to bring exactly 2 cats.

(*1.5 marks*)

$_3P_2 \cdot {}_6P_3 = 720$ ways

c) State the probability that Ross chooses exactly 2 cats.

(*0.5 mark*)

$\frac{2}{9}$

d) State the odds in favour of choosing exactly 2 cats.

(*1 mark*)

2:7

Mark(s): 2.5/4

1. 0.5 mark for appropriate work in (a)
2. 0.5 mark for consistent answer in (a)
5. 0.5 mark for consistent product in (b)
7. 1 mark for consistent odds in favour in (d)

Exemplar 2

Question 11 **Total: 4 marks**

Ross is an animal trainer. He is choosing 5 animals to participate at the next animal show. He has 6 dogs and 3 cats to choose from.

a) Determine the number of ways the 5 animals can be chosen for the show.

(*1 mark*)

$9C_5 = 126$ ways

b) Determine the number of ways the 5 animals can be chosen if he wants to bring exactly 2 cats.

(*1.5 marks*)

$3C_2 + 6C_3 = 23$ ways

c) State the probability that Ross chooses exactly 2 cats.

(*0.5 mark*)

$\frac{23}{126} = 0.1\%$

10.25%

d) State the odds in favour of choosing exactly 2 cats.

(*1 mark*)

$23:103$

Mark(s): 3.5/4

1. 0.5 mark for appropriate work in (a)
2. 0.5 mark for consistent answer in (a)
3. 0.5 mark for ${}_3C_2$ in (b)
4. 0.5 mark for ${}_6C_3$ in (b)
6. 0.5 mark for consistent probability in (c)
7. 1 mark for consistent odds in favour in (d)

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Exemplar 1

Question 12 **Total: 2 marks**

Joey has 13 different coloured water bottles.

a) Determine the number of ways Joey can arrange 3 water bottles on his kitchen counter if he has left 4 at school.

(*1 mark*)

13 - 4

$_9P_3$

504 ways

b) Joey's school is collecting water bottles. He would like to donate 5 of his water bottles.

Determine how many ways the water bottles can be chosen.

(*1 mark*)

$_{13}P_5$

154,440 ways

Mark(s): 1/2

1. 0.5 mark for appropriate work in (a)
2. 0.5 mark for consistent answer in (a)

Exemplar 2

Question 12 — Total: 2 marks

Joey has 13 different coloured water bottles.

a) Determine the number of ways Joey can arrange 3 water bottles on his kitchen counter if he has left 4 at school.

(*1 mark*)

$13 - 4 = 9$

$9C_3 = 84$

b) Joey's school is collecting water bottles. He would like to donate 5 of his water bottles.

Determine how many ways the water bottles can be chosen.

(*1 mark*)

$13P_5 = 154\,440$

Mark(s): 1/2

3. 0.5 mark for appropriate work in (b)
4. 0.5 mark for consistent answer in (b)

Exemplar 3

Question 12 — Total: 2 marks

Joey has 13 different coloured water bottles.

a) Determine the number of ways Joey can arrange 3 water bottles on his kitchen counter if he has left 4 at school.

(*1 mark*)

$_4P_3 = 24$ ways

b) Joey's school is collecting water bottles. He would like to donate 5 of his water bottles.

Determine how many ways the water bottles can be chosen.

(*1 mark*)

$_9C_5 = 126$ ways

Mark(s): 1/2

2. 0.5 mark for consistent answer in (a)
4. 0.5 mark for consistent answer in (b)

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Exemplar 1

Question 13 — Total: 2 marks

Chandler is playing in a badminton tournament. Based on his past performance, Chandler has determined that the probability of winning first place is $\frac{1}{3}$. The probability of finishing second place is $\frac{3}{8}$.

a) Determine the probability that Chandler does not place in the top two.

(*1 mark*)

$\frac{1}{3} + \frac{3}{8} = \frac{17}{24}$ or 70.83%

b) State the odds against finishing in second place.

(*1 mark*)

5: 3

Mark(s): 1.5/2

- ❷ 0.5 mark for consistent answer in (a)
- ❸ 1 mark for answer in (b)

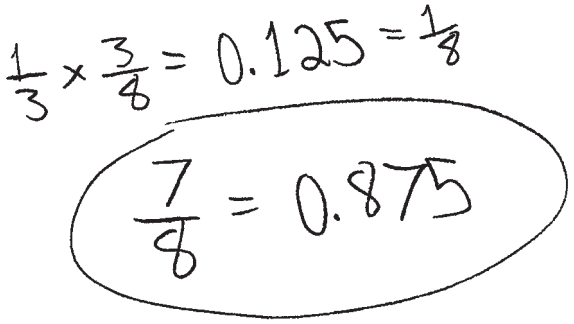
Exemplar 2

Question 13 — Total: 2 marks

Chandler is playing in a badminton tournament. Based on his past performance, Chandler has determined that the probability of winning first place is $\frac{1}{3}$. The probability of finishing second place is $\frac{3}{8}$.

a) Determine the probability that Chandler does not place in the top two.

(*1 mark*)



b) State the odds against finishing in second place.

(*1 mark*)

Mark(s): 1.5/2

❷ 0.5 mark for consistent answer in (a)

❸ 1 mark for answer in (b)

Exemplar 3

Question 13 — Total: 2 marks

Chandler is playing in a badminton tournament. Based on his past performance, Chandler has determined that the probability of winning first place is $\frac{1}{3}$. The probability of finishing second place is $\frac{3}{8}$.

a) Determine the probability that Chandler does not place in the top two.

(*1 mark*)

AE

$P(A \text{ or } B) = \frac{1}{3} + \frac{3}{8} = \frac{4}{11}$

$1 - \frac{4}{11} = \frac{7}{11}$

$\frac{7}{11} = 63.64\%$

b) State the odds against finishing in second place.

(*1 mark*)

5:3

Mark(s): 1.5/2

1. 0.5 mark for appropriate work in (a)
2. 0.5 mark for consistent answer in (a)
- AE 0.5 mark deduction for arithmetic error in (a)
3. 1 mark for answer in (b)

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Exemplar 1

Question 16 — Total: 4 marks

Gunthar is comparing two different payment options for the latest smartphone.

Option 1: Buy

- The cost of the phone is $1271.44, taxes included.
- There is a down payment of $350.00.
- The remaining balance is financed with monthly payments at an interest rate of 7.99% compounded monthly over 2 years.

Option 2: Rent

- Make monthly payments of $51.05 for 2 years.

a) Determine the monthly payment for Option 1.

(*2 marks*)

DP: 1271.44 − 350 = $921.44

PV = −921.44
PMT = 41.55
FV = 0
I% = 7.99
N = 24
C/Y = 1

The monthly payment is $41.55

b) Determine the total cost for Option 1.

(*1 mark*)

(41.55)(24) + 350 = 1347.20

The total cost is $1347.20

c) Gunthar plans to get a new phone in 2 years.

Justify which option Gunthar should choose.

(*1 mark*)

I'd choose option 2 because overall it cost less for the 2 years.

Mark(s): 3/4

1. 0.5 mark for appropriate work in (a) (deducted 1 mark for two incorrect inputs)
2. 0.5 mark for consistent monthly payment in (a)
3. 0.5 mark for appropriate work in (b)
4. 0.5 mark for consistent answer in (b)
5. 1 mark for appropriate justification in (c)

Exemplar 2

Question 16 — Total: 4 marks

Gunthar is comparing two different payment options for the latest smartphone.

Option 1: Buy

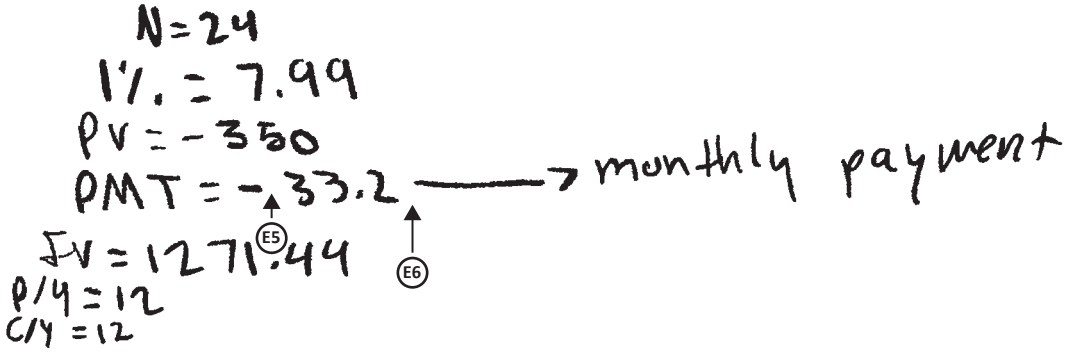
- The cost of the phone is $1271.44, taxes included.
- There is a down payment of $350.00.
- The remaining balance is financed with monthly payments at an interest rate of 7.99% compounded monthly over 2 years.

Option 2: Rent

- Make monthly payments of $51.05 for 2 years.

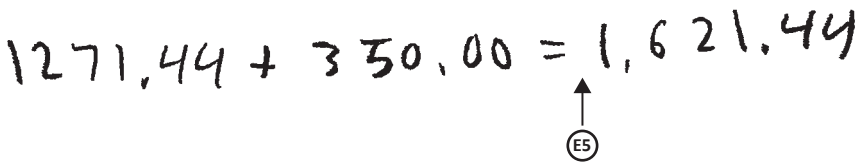
a) Determine the monthly payment for Option 1.

(*2 marks*)



b) Determine the total cost for Option 1.

(*1 mark*)



c) Gunthar plans to get a new phone in 2 years.

Justify which option Gunthar should choose.

(*1 mark*)

I would choose the Rent, as it is more financially safe and responsible decision to choose.

Mark(s): 1.5/4

1. 0.5 mark for appropriate work in (a) (deducted 1 mark for two incorrect inputs)
2. 0.5 mark for consistent monthly payment in (a)
4. 0.5 mark for consistent answer in (b)

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

E6 does not express the answer to the appropriate number of decimal places, including monetary values to two decimal places in (a)

Exemplar 3

Question 16 — Total: 4 marks

Gunthar is comparing two different payment options for the latest smartphone.

Option 1: Buy

- The cost of the phone is $1271.44, taxes included.
- There is a down payment of $350.00.
- The remaining balance is financed with monthly payments at an interest rate of 7.99% compounded monthly over 2 years.

1271.44
921.44

Option 2: Rent

- Make monthly payments of $51.05 for 2 years.

a) Determine the monthly payment for Option 1.

(*2 marks*)

N 2
I 7.99
PV -350.00
PMT -456.86
FV 1271.44
P/Y 12
C/Y 12

$456.86 per month

b) Determine the total cost for Option 1.

(*1 mark*)

$350 + (456.86 \cdot 12 \cdot 2)$ (E5)

total cost = 11 314.14 ← AE

c) Gunthar plans to get a new phone in 2 years.

Justify which option Gunthar should choose.

(*1 mark*)

Option 2 : $51.05 \cdot 12 \cdot 2$

$= 1225.2$

option 2 because it's a lot less money

Mark(s): 2/4

- 2 0.5 mark for consistent monthly payment in (a)
- 3 0.5 mark for appropriate work in (b)
- 4 0.5 mark for consistent answer in (b)
- AE 0.5 mark deduction for arithmetic error in (b)
- 5 1 mark for appropriate justification in (c)
- E5 does not include the dollar sign for monetary values in (b)

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Exemplar 1

Question 17 — Total: 5 marks

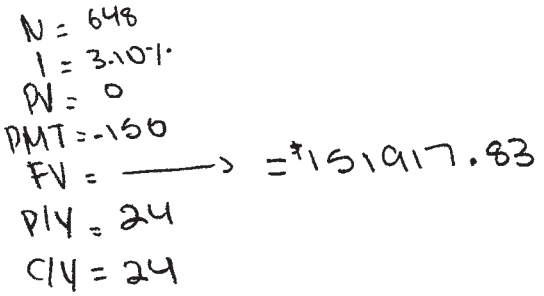
Dene and Malia both plan to retire in 27 years. They each invest in a registered retirement savings plan (RRSP) that earns 3.10% compounded annually.

Investment 1: Dene starts investing immediately, depositing $150.00 semi-monthly.

Investment 2: Malia starts investing 7 years before retirement, depositing $1500.00 monthly.

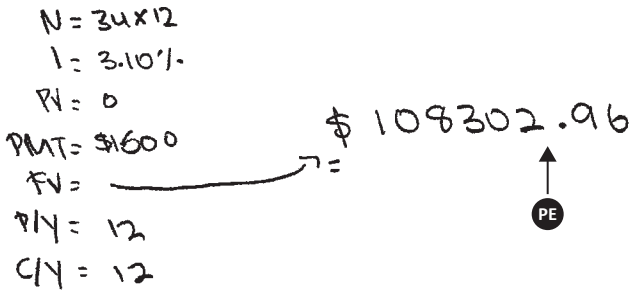
a) Determine the value of the RRSP when Dene retires.

(*2 marks*)



b) Determine the value of the RRSP when Malia retires.

(*2 marks*)



c) Explain a disadvantage for one of the investments.

(*1 mark*)

For option b the longer you take to invest, the less amount of money you will accumulate over time.

Mark(s): 2/5

1. 1 mark for appropriate work in (a) (deducted 0.5 mark for one incorrect input)
2. 0.5 mark for consistent answer in (a)
3. 0.5 mark for appropriate work in (b) (deducted 1 mark for two incorrect inputs)
4. 0.5 mark for consistent answer in (b)

PE 0.5 mark deduction for procedural error in (b)

Exemplar 2

Question 17 — Total: 5 marks

Dene and Malia both plan to retire in 27 years. They each invest in a registered retirement savings plan (RRSP) that earns 3.10% compounded annually.

Investment 1: Dene starts investing immediately, depositing $150.00 semi-monthly.

Investment 2: Malia starts investing 7 years before retirement, depositing $1500.00 monthly.

a) Determine the value of the RRSP when Dene retires.

(*2 marks*)

N = 6x27 = 162
I% = 3.16
PV = 0
PMT = -150
FV = ? = $37646.00
P/Y = 6
C/Y = 1

E6

b) Determine the value of the RRSP when Malia retires.

(*2 marks*)

N = 42
I% = 3.10
PV = 0
PMT = -1500
FV = ? = $66404.46
P/Y = 12
C/Y = 1

c) Explain a disadvantage for one of the investments.

(*1 mark*)

Fixtone.

Fewer Payments, less money in the future.

Mark(s): 3/5

1. 1 mark for appropriate work in (a) (deducted 0.5 mark for one incorrect input)
2. 0.5 mark for consistent answer in (a)
3. 1 mark for appropriate work in (b) (deducted 0.5 mark for one incorrect input)
4. 0.5 mark for consistent answer in (b)

E6 rounds incorrectly in (a)

Exemplar 3

Question 17 — Total: 5 marks

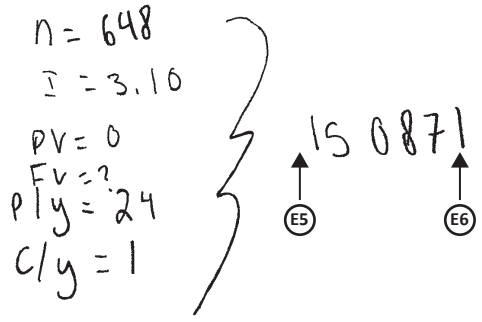
Dene and Malia both plan to retire in 27 years. They each invest in a registered retirement savings plan (RRSP) that earns 3.10% compounded annually.

Investment 1: Dene starts investing immediately, depositing $150.00 semi-monthly.

Investment 2: Malia starts investing 7 years before retirement, depositing $1500.00 monthly.

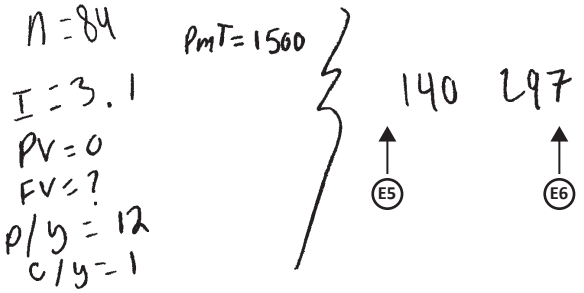
a) Determine the value of the RRSP when Dene retires.

(*2 marks*)



b) Determine the value of the RRSP when Malia retires.

(*2 marks*)



c) Explain a disadvantage for one of the investments.

(*1 mark*)

yes for b) you have to have lots of disposible income

Mark(s): 4.5/5

1. 1 mark for appropriate work in (a) (deducted 0.5 mark for one incorrect input)
2. 0.5 mark for consistent answer in (a)
3. 1.5 marks for appropriate work in (b)
4. 0.5 mark for consistent answer in (b)
5. 1 mark for appropriate disadvantage for Investment 1 or Investment 2 in (c)

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

E6 does not express the answer to the appropriate number of decimal places, including monetary values to two decimal places in (a) and (b)

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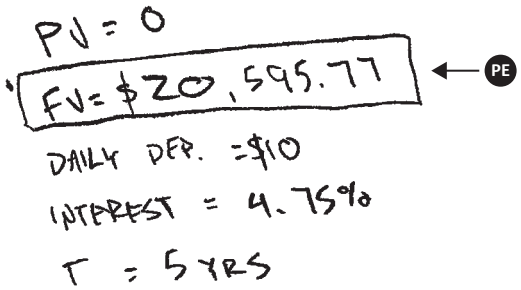
Exemplar 1

Question 18 — Total: 4 marks

After high school, Dakota invests $10.00 each day for 5 years in a tax-free savings account (TFSA), with an interest rate of 4.75% compounded monthly.

a) Determine the value of his investment after 5 years.

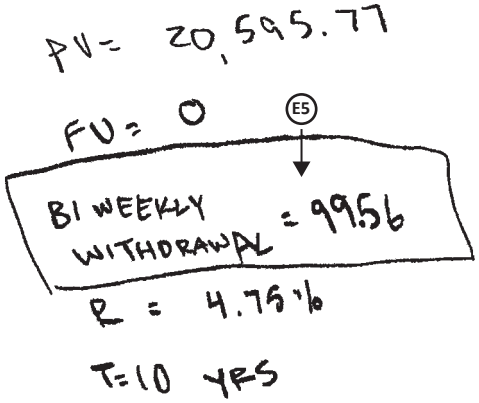
(*2 marks*)



b) He plans to withdraw the full amount over the next 10 years by making biweekly withdrawals.

Determine the amount of each withdrawal if the interest rate remains at 4.75% compounded monthly.

(*2 marks*)



Mark(s): 3/4

1. 1 mark for appropriate work in (a) (deducted 0.5 mark for one incorrect input)
2. 0.5 mark for consistent answer in (a)
PE. 0.5 mark deduction for procedural error in (a)
3. 1.5 marks for appropriate work in (b)
4. 0.5 mark for consistent answer in (b)
E5. does not include the dollar sign for monetary values in (b)

Exemplar 2

Question 18 **Total: 4 marks**

After high school, Dakota invests $10.00 each day for 5 years in a tax-free savings account (TFSA), with an interest rate of 4.75% compounded monthly.

a) Determine the value of his investment after 5 years.

(*2 marks*)

Inv
PP = 365
CF = 12
PV = 0
FV = ? → $ 20 593.09
PD = $ 10.00
IR = 4.75
t = 5 years
S/(€)

b) He plans to withdraw the full amount over the next 10 years by making biweekly withdrawals.

Determine the amount of each withdrawal if the interest rate remains at 4.75% compounded monthly.

(*2 marks*)

Inv
PF = 24
CF = 12
PV = 0
FV = $20593.09
PD = ? → $ 67.13
IR = 4.75
t = 10 years
S/(€)

Mark(s): 2.5/4

1. 1.5 marks for appropriate work in (a)
2. 0.5 mark for consistent answer in (a)
4. 0.5 mark for consistent answer in (b)

Exemplar 3

Question 18 **Total: 4 marks**

After high school, Dakota invests $10.00 each day for 5 years in a tax-free savings account (TFSA), with an interest rate of 4.75% compounded monthly.

a) Determine the value of his investment after 5 years.

(*2 marks*)

N=1825
I= 4.75
PV= 0
PMT= -10
FV=?
P/Y=365
C/Y=12

After 5 years, he would have $20 593 worth in his TFSA. (E6)

b) He plans to withdraw the full amount over the next 10 years by making biweekly withdrawals.

Determine the amount of each withdrawal if the interest rate remains at 4.75% compounded monthly.

(*2 marks*)

N= 3650
I = 4.75
PV = 20593
PMT = ?
FV = 0
P/Y = 48
C/Y = 12

PMT = $20.92/biweekly

Mark(s): 3/4

1. 1.5 marks for appropriate work in (a)
2. 0.5 mark for consistent answer in (a)
3. 0.5 mark for appropriate work in (b) (deducted 1 mark for two incorrect inputs)
4. 0.5 mark for consistent answer in (b)

E6 does not express the answer to the appropriate number of decimal places, including monetary values to two decimal places in (a)

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Exemplar 1

Question 19 **Total: 3 marks**

Mr. Beans has $3000.00 in a savings account, a car worth $37 000.00, some long-term investments worth $35 000.00, and a loan for $32 000.00.

He owns a house valued at $175 000.00. He has a mortgage of $160 000.00.

a) Calculate his net worth.

(*1 mark*)

assets

3000
37000
35000
= 75000

liabilities

175000
160000
32000
= 223 000

75000 − 223000 = −$148 000.00

b) Calculate his debt-to-equity ratio.

(*1 mark*)

$$\frac{223\,000 - 160\,000}{-148\,000} \times 100$$

= −42.57%

c) Mr. Beans wants to borrow more money to build a garage.

Explain if a bank would lend him the money.

(*1 mark*)

No because he is already in debt

Mark(s): 1.5/3

- ❷ 0.5 mark for consistent net worth in (a)
- ❸ 0.5 mark for appropriate work in (b)
- ❹ 0.5 mark for consistent debt-to-equity ratio in (b)

Exemplar 2

Question 19 **Total: 3 marks**

Mr. Beans has $3000.00 in a savings account, a car worth $37 000.00, some long-term investments worth $35 000.00, and a loan for $32 000.00.

He owns a house valued at $175 000.00. He has a mortgage of $160 000.00.

a) Calculate his net worth.

(*1 mark*)

3000 + 37 000 + 35 000 = 75000

32 000 + 160 000 = 192 000

Net Worth = -117 000.00 (E5)

b) Calculate his debt-to-equity ratio.

(*1 mark*)

$$= \frac{-32000 - 160000}{-117\,000} \times 100$$

= 164% (E6)

c) Mr. Beans wants to borrow more money to build a garage.

Explain if a bank would lend him the money.

(*1 mark*)

No his debt equity ratio exceeds 50%.

Mark(s): 2/3

- (2) 0.5 mark for consistent net worth in (a)
- (4) 0.5 mark for consistent debt-to-equity ratio in (b)
- (5) 1 mark for appropriate explanation with reference to 50% in (c)
- (E5) does not include the dollar sign for monetary values in (a)
- (E6) does not express the answer to the appropriate number of decimal places in (b)

Exemplar 3

Question 19 **Total: 3 marks**

Mr. Beans has $3000.00 in a savings account, a car worth $37 000.00, some long-term investments worth $35 000.00, and a loan for $32 000.00.

He owns a house valued at $175 000.00. He has a mortgage of $160 000.00.

a) Calculate his net worth.

(*1 mark*)

Total assets: 3000 + 37000 + 35000 + 175000
= $250 000

Total liabilities: 32000 + 160000 = 192000

NET WORTH: $250 000 − 192000
= $58000.00

b) Calculate his debt-to-equity ratio.

(*1 mark*)

$$\text{Debt-to-equity ratio (\%)} = \frac{192000 - 160000}{250\,000} \times 100$$

$$= 12.8\% \approx 13\%$$

E6

c) Mr. Beans wants to borrow more money to build a garage.

Explain if a bank would lend him the money.

(*1 mark*)

13% < 35% so yes the bank would lend him the money.

Mark(s): 1.5/3

1 0.5 mark for total assets and liabilities in (a)

2 0.5 mark for consistent net worth in (a)

4 0.5 mark for consistent debt-to-equity ratio in (b)

E6 does not express the answer to the appropriate number of decimal places in (b)

Exemplar 1

Question 21 — Total: 1.5 marks

Tala is in Switzerland and is buying chocolates to bring home. The price of chocolate is 28 Swiss francs per kilogram. Tala buys 450 grams of chocolates.

Determine the cost, in Canadian dollars, if 1 Swiss franc is equal to 1.59 Canadian dollars.

$450 \div 100 = 4.5$

$4.5 \times 28 = 126$

$126 \times 1.59 = \$200.34$

Mark(s): 1/1.5

- 2 0.5 mark for consistent cost in Swiss francs
- 3 0.5 mark for consistent cost in Canadian dollars

Exemplar 2

Question 21 — Total: 1.5 marks

Tala is in Switzerland and is buying chocolates to bring home. The price of chocolate is 28 Swiss francs per kilogram. Tala buys 450 grams of chocolates.

Determine the cost, in Canadian dollars, if 1 Swiss franc is equal to 1.59 Canadian dollars.

$12.6 \times 1.59 = \$20.03$

Mark(s): 1.5/1.5

1. 0.5 mark for conversion of weight
2. 0.5 mark for consistent cost in Swiss francs
3. 0.5 mark for consistent cost in Canadian dollars

Exemplar 1

Question 22 — Total: 2 marks

Sujin is visiting Egypt. He goes to a pyramid-shaped visitor centre and he learns that the volume of the pyramid is 648 m^3 and the height of the pyramid is 13.5 m.

a) Determine the area of the base of the pyramid.

(*1 mark*)

$$648 = \frac{B(13.5)}{3}$$

$$\frac{648(3)}{13} = B$$

E3

$$149.538... = B$$

$$149.54 \text{ m}^3$$ E5

b) Calculate the total cost, plus GST and RST, to tile the base if the tiles cost \$50.00/m^2. (Note: GST = 5%, RST = 7%)

(*1 mark*)

E6 $150 \times 50 = \$7500.00$

$7500 \times 0.12 = \$900.00$

Mark(s): 1.5/2

1. 0.5 mark for appropriate work in (a)
2. 0.5 mark for consistent area of base in (a)
3. 0.5 mark for total cost of tiles before taxes in (b)

E3 makes a transcription error (inaccurate transferring of information) in (a)

E5 uses incorrect units of measure in (a)

E6 rounds inappropriately in (b)

Exemplar 2

Question 22 **Total: 2 marks**

Sujin is visiting Egypt. He goes to a pyramid-shaped visitor centre and he learns that the volume of the pyramid is 648 m^3 and the height of the pyramid is 13.5 m.

a) Determine the area of the base of the pyramid.

(*1 mark*)

$$V = \frac{lwh}{3}$$

$$648 = \frac{lw(13.5)}{3}$$

$$1944 = 13.5lw$$

$$144 = lw$$

$$\sqrt{144} = \boxed{12} \leftarrow \text{E5}$$

b) Calculate the total cost, plus GST and RST, to tile the base if the tiles cost \$50.00/m^2.
(Note: GST = 5%, RST = 7%)

(*1 mark*)

$$12 \times 50 = 600$$

$$600 \times 12\% = \boxed{\$7200.00}$$

Mark(s): 1/2

1 0.5 mark for appropriate work in (a)

3 0.5 mark for total cost of tiles before taxes in (b)

E5 does not include the units in the final answer in (a)

Exemplar 1

Question 23 **Total: 5 marks**

Lukas and Greta are building an inground fish pond in the shape of a cylinder.

- The radius of the pond is 0.75 m.
- The pond is 35 cm deep.

a) Determine the volume of dirt to be removed to build the pond.

(*1 mark*)

$4/3 \times \pi \times 0.75^3 = 1.77\ m^3$

b) A plastic liner is placed in the hole to hold the water.

Determine the amount of plastic liner needed, in square metres, if you add 15% to account for overlap.

(*1.5 marks*)

$4 \times \pi \times 0.75^2 = 7.07\ m^2$

$7.07 \times 1.15 = 8.13\ m^2$

c) Each goldfish needs 20 gallons of water to survive. The pond Lukas and Greta are building will hold 163 gallons.

State the maximum number of goldfish they can have.

(*0.5 mark*)

8,15

8

d) Consider the following:

- The plastic liner costs \$12.80/m^2, plus GST and RST.
- Each goldfish costs \$4.45, plus GST and RST.
- Water is free.
- The stone border for the pond costs \$284.00, plus GST and RST.

Calculate the total cost, plus GST and RST. (Note: GST = 5%, RST = 7%)

(*2 marks*)

Liner 12.80 x 8.13 = \$104.06 x 1.12 = \$116.55

fish 4.45 x 8 = \$35.6 x 1.12 = \$39.87

water 0

border \$284 x 1.12 = \$318.08

Total = \$474.50

Mark(s): 4/5

3. 0.5 mark for appropriate work calculating surface area in (b)
4. 0.5 mark for consistent surface area in (b)
5. 0.5 mark for consistent answer including overlap in (b)
6. 0.5 mark for answer in (c)
7. 0.5 mark for consistent cost of plastic liner in (d)
8. 0.5 mark for consistent cost of goldfish in (d)
9. 0.5 mark for consistent subtotal of cost in (d)
10. 0.5 mark for consistent total cost including taxes in (d)

Exemplar 2

Question 23 **Total: 5 marks**

Lukas and Greta are building an inground fish pond in the shape of a cylinder.

- The radius of the pond is 0.75 m. → 75cm
- The pond is 35 cm deep. 0.35m

a) Determine the volume of dirt to be removed to build the pond.

(*1 mark*)

$V = \pi r^2 h$

$V = \pi 0.75^2 (0.35)$

$V = 0.61850\ldots$

$\times 100$

$V = 61.85\text{cm}^3$

b) A plastic liner is placed in the hole to hold the water.

Determine the amount of plastic liner needed, in square metres, if you add 15% to account for overlap.

(*1.5 marks*)

$SA = \pi r^2 + 2\pi rh$

$= \pi 75^2 + 2\pi 75(35)$

$= 34164.82011\ldots$

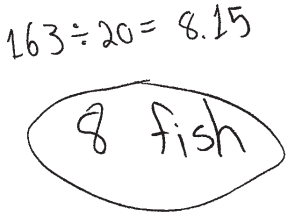
$\times 1.15\%$

$= 39289.54\text{cm}^2$

c) Each goldfish needs 20 gallons of water to survive. The pond Lukas and Greta are building will hold 163 gallons.

State the maximum number of goldfish they can have.

(*0.5 mark*)



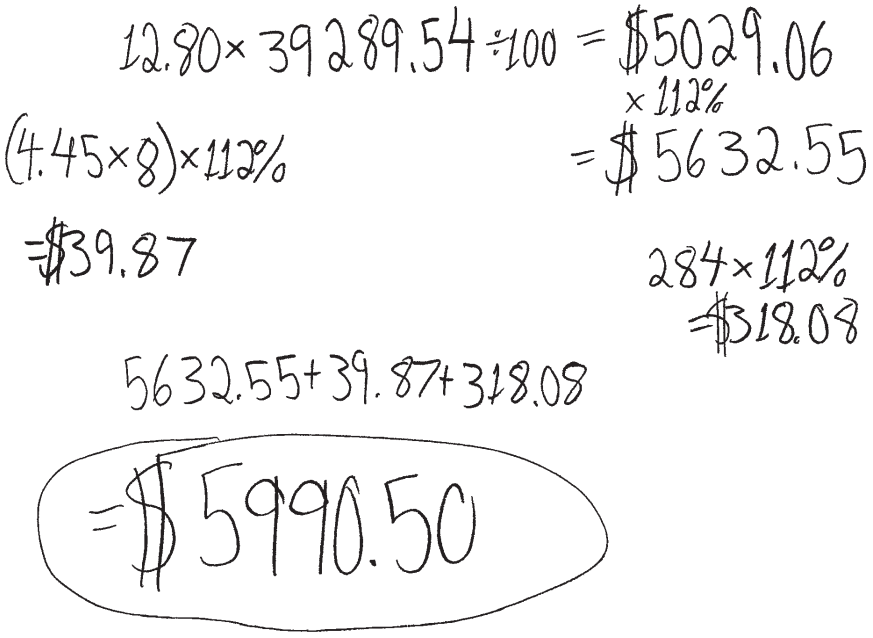
d) Consider the following:

>100 cm

- The plastic liner costs \$12.80/m^2, plus GST and RST.
- Each goldfish costs \$4.45, plus GST and RST.
- Water is free.
- The stone border for the pond costs \$284.00, plus GST and RST.

Calculate the total cost, plus GST and RST. (Note: GST = 5%, RST = 7%)

(*2 marks*)



Mark(s): 4/5

1. 0.5 mark for appropriate work in (a)
3. 0.5 mark for appropriate work calculating surface area in (b)
4. 0.5 mark for consistent surface area in (b)
5. 0.5 mark for consistent answer including overlap in (b)
6. 0.5 mark for answer in (c)
8. 0.5 mark for consistent cost of goldfish in (d)
9. 0.5 mark for consistent subtotal of cost in (d)
10. 0.5 mark for consistent total cost including taxes in (d)

Exemplar 1

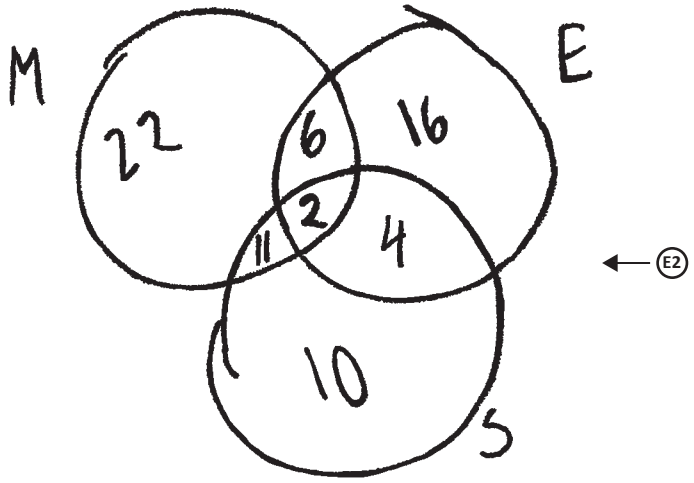
Question 25 — Total: 4.5 marks

There are 74 students in grade 12 at Mencar Collegiate. The list of the number of students enrolled in each course, in the first semester, is displayed below.

- 41 take Math (*M*)
- 28 take English (*E*)
- 27 take Science (*S*)
- 8 take Math and English
- 11 take only Math and Science
- 6 take English and Science
- 2 take all three courses

a) Create a Venn diagram to represent this situation.

(*3 marks*)



b) State the number of students who do not take any of the three courses.

(*0.5 mark*)

3

c) State the number of students who take Math or Science but not English.

(*1 mark*)

11

Mark(s): 3/4.5

1. 0.5 mark for $n\left(\left(M \cap E\right) \setminus S\right) = 6$ in (a)
2. 0.5 mark for $n\left(\left(S \cap E\right) \setminus M\right) = 4$ in (a)
3. 0.5 mark for consistent number of students who take Math in (a)
4. 0.5 mark for consistent number of students who take English in (a)
5. 0.5 mark for consistent number of students who take Science in (a)
7. 0.5 mark for consistent number of students who do not take any of the three courses in (b)

E2 does not include a box when using a Venn diagram in (a)

Exemplar 2

Question 25 **Total: 4.5 marks**

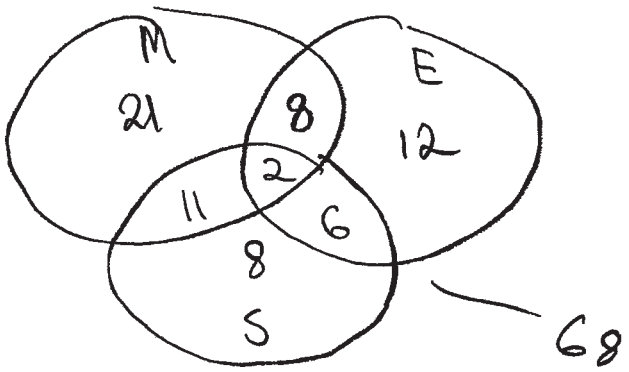
There are 74 students in grade 12 at Mencar Collegiate. The list of the number of students enrolled in each course, in the first semester, is displayed below.

- 41 take Math (*M*)
- 28 take English (*E*)
- 27 take Science (*S*)
- 8 take Math and English
- 11 take only Math and Science
- 6 take English and Science
- 2 take all three courses

a) Create a Venn diagram to represent this situation.

(*3 marks*)

E2 →



41 - 8 - 2 - 11 = 21
28 - 16
27 - 19 = 8

b) State the number of students who do not take any of the three courses.

(*0.5 mark*) 74 − 68 = 6 students do not take any of the 3

c) State the number of students who take Math or Science but not English.

(*1 mark*)

MUS

21 + 11 + 8 = 40

Mark(s): 2.5/4.5

4 0.5 mark for consistent number of students who take English in (a)

5 0.5 mark for consistent number of students who take Science in (a)

7 0.5 mark for consistent number of students who do not take any of the three courses in (b)

8 1 mark for consistent number of students who take Math or Science but not English in (c)

E2 does not include a box when using a Venn diagram in (a)

Exemplar 1

Question 26 — Total: 1.5 marks

Complete the truth table for the conditional statement $q \rightarrow \sim p$.

p	q	$p \rightarrow q$	$\sim p$	$q \rightarrow \sim p$
True	True	T	F	F
True	False	F	T	T
False	True	T	F	T
False	False	T	T	T

Mark(s): 0.5/1.5

1. 0.5 mark for filling out $p \rightarrow q$ column

Exemplar 2

Question 26 — Total: 1.5 marks

Complete the truth table for the conditional statement $q \rightarrow \sim p$.

p	q	$p \rightarrow q$	$\sim p$	$q \rightarrow \sim p$
True	True	T	F	T
True	False	F	F	T
False	True	T	T	T
False	False	T	T	F

Mark(s): 1/1.5

1. 0.5 mark for filling out $p \rightarrow q$ column
2. 0.5 mark for filling out $\sim p$ column

Exemplar 1

Question 27 — Total: 1.5 marks

There are four students: Adisson, Brendan, Carson, and Danica. Each student has a favourite activity. The activities are chess, dance, soccer, and video games.

Determine each student's favourite activity, using the clues below.

- Adisson's activity requires more than one person.
- Brendan and the soccer player watch the dance recital.
- The chess player is a good friend of Adisson and Brendan.
- Carson favours dance or soccer.

You may use the chart below.

	Chess	Dance	Soccer	Video Games
Adisson	✗	✓	✗	✗
Brendan	✗	✗	✗	✓
Carson	✗	✗	✓	✗
Danica	✓	✗	✗	✗

Mark(s): 1/1.5

1. 0.5 mark for one correct activity
2. 0.5 mark for a second correct activity