Grade 12
Applied Mathematics
Achievement Test

Marking Guide

Use in conjunction with *Exemplars*

January 2024

Manitoba

Contents

General Marking Instructions

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

> **Do not make any marks in the student booklets.** Booklets may be selected by Manitoba Education and Early Childhood Learning for sample marking.

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

Marking

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

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

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

Students are expected to round all final answers to two decimal places unless otherwise indicated in the question, or if the answer terminates to a whole number or one decimal place. More than two decimal places are acceptable if rounded correctly, except for monetary values or when the context of the question implies whole units be used (e.g., people, cans of paint).

Errors

Marks are deducted if conceptual or communication errors are committed. A 0.5 mark deduction will also apply each time a student makes one of the following errors:
- an arithmetic error
- a procedural error (not a conceptual error)
- a lack of clarity in the explanation, the description, or the justification

Conceptual Errors

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

Communication Errors

Communication errors are errors that are not related to the concepts and are tracked on the *Scoring Sheet* in a separate section. There is a 0.5 mark deduction for each type of communication error committed, with a maximum deduction of 3 marks from the total test mark. Each communication error can only be deducted once per test and committing a second error of the same type does not further affect a student's mark.

E1   Final Answer

- does not include a percent sign
- does not identify the answer (e.g., TVM solver, Venn diagram)
- does not use the given contextual variables
- incorrectly states the final answer

E2   Notation

- does not include braces when using set notation
- does not include a box when using a Venn diagram
- does not include one of the following in the equation: "$y =$", "sin", "ln", or "x", or writes parameters separately from the equation
- does not change "$y \sim$" to "$y =$" when writing an equation

E3   Transcription/Transposition

- makes a transcription error (inaccurate transferring of information)
- makes a transposition error (changing order of digits)
- inaccurately plots one point on a scatter plot

E4   Whole Units

- does not use whole units for materials purchased in design and measurement questions
- does not use whole units in contextual questions involving discrete data (e.g., people)

E5   Units

- does not include the dollar sign for monetary values
- uses incorrect units of measure
- does not include the units in the final answer
- confuses square and cubic units (e.g., cm^2 instead of cm^3, or vice versa)
- does not include units with labels on a graph

E6   Rounding

- rounds incorrectly
- rounds too soon
- does not express the answer to the appropriate number of decimal places, including monetary values to two decimal places

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

Scoring

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

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

Example:

A student has a preliminary mark of 46. The student committed one E1 error (0.5 mark deduction) and three E6 errors (0.5 mark deduction).

E1	**E2**	**E3**	**E4**	**E5**	**E6**
Final Answer	Notation	Transcription/ Transposition	Whole Units	Units	Rounding

Communication Errors
Preliminary Mark $-$ (Number of error types $\times\ 0.5$) $=$ Final Mark
46 $\qquad-\qquad$ (2×0.5) $\qquad=\qquad$ 45

Irregularities in Provincial Tests

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

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

Assistance

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

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

> Provincial Assessment Program Unit
> Telephone: 204-945-5011
> Toll-Free: 1-800-282-8069, ext. 5011 (8:30 a.m. to 4:30 p.m.)
> Email: assesseval@gov.mb.ca

Marking Keys

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

RELATIONS AND FUNCTIONS

Question 1	Total: 1 mark
Learning Outcomes: 12.A.R.1, 12.A.R.2, 12.A.R.3	**Question Type: Selected Response**

Select the pair of functions that might not have *x*-intercepts.

A) **exponential and quadratic**

B) quadratic and logarithmic

C) logarithmic and sinusoidal

D) sinusoidal and cubic

Question 2   **Total: 3 marks**

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

A pilot determined a function that shows the relation between height and atmospheric pressure:

$$H = 45.786 - 6.902 \ln p$$

where H represents the height of the plane above the ground (in km)
and p represents the atmospheric pressure (in mm of mercury).

a) Determine the atmospheric pressure at ground level in mm of mercury.

(1 mark)

The atmospheric pressure is 760.31 mm of mercury.

b) A plane is flying at a height of 11 km and the air pressure inside is 561 mm of mercury. Determine the difference between the air pressure inside the plane and the atmospheric pressure outside the plane in mm of mercury. Show your work.

(2 marks)   **OR**

Graphing Calculator:	Desmos:
$\boxed{\text{CALC}}$ 5: intersect	$y = 11$ $(154.468, 11)$
$Y_2 = 11$	
$x = 154.468\ 22$	$561 - 154.468$
	$= 406.532$
$561 - 154.468\ 22$	
$= 406.531\ 78$	

The difference in pressure is 406.53 mm of mercury.

Marking Key	
❶	*1 mark for answer in (a)*
❷	*1 mark for x-value in (b)*
❸	*1 mark for consistent answer in (b)*

Question 3   **Total: 4 marks**

For a math project, a student visits an amusement park. While riding the roller coaster, they use their smartphone to record their height above the ground as a function of time for a portion of the ride.

They collect the following data:

Time (s)	1	3	15	20	25	30
Height (m)	10	25	28	20	13	20

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

(1 mark)

$$y = 0.01x^3 - 0.60x^2 + 8.07x + 3.91$$

b)   Determine the *y*-intercept using your equation in (a).

(1 mark)

The *y*-intercept is 3.91.

c)   Explain what the *y*-intercept represents in this situation.

(1 mark)

The *y*-intercept represents the height of the roller coaster
above the ground when the student starts recording.

Other explanations are possible.

d)   Using your equation in (a), determine the maximum height of the roller coaster in the first 20 seconds.

(1 mark)

The maximum height is 36.62 m.

Marker Note(s):
→ *Award mark* ❹ *for a maximum height of 35.30 m; answer reflects using rounded values from (a).*

Marking Key
❶	1 mark for answer in (a)
❷	1 mark for consistent answer in (b)
❸	1 mark for appropriate explanation in (c)
❹	1 mark for consistent answer in (d)

Question 4
Total: 3 marks

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

Hummingbirds beat their wings with a period of approximately 0.006 seconds. A transmitter is placed at the tip of a hummingbird's wing to measure the height above the ground.

a) Select the sinusoidal function that could model the relationship between the height, h (in feet) and the time, t (in seconds).
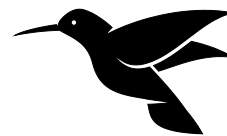
(1 mark)

     A) $h = 0.15\sin(t) + 6$

     B) $h = 0.15\sin(10t) + 6$

     C) $h = 0.15\sin(100t) + 6$

     D) $\mathbf{h = 0.15\sin(1000t) + 6}$

b) Using your chosen function in (a), determine the height of the wing at the 17th second.

(1 mark)

The wing is 5.89 feet above the ground at the 17th second.

If the student selects A), B), or C) in (a), the consistent answers are as follows:

     A)   h = 5.86 ft.

     B)   h = 6.05 ft.

     C)   h = 5.94 ft.

c) Determine the range of the function you chose in (a).

(1 mark)

$$\{5.85 \le h \le 6.15\}$$
$$[5.85, 6.15]$$

Marking Key	
❶	*1 mark for answer in (a)*
❷	*1 mark for consistent answer in (b)*
❸	*0.5 mark for upper and lower bounds of the range in (c)*
❹	*0.5 mark for inclusivity of both upper and lower bounds in (c)*

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## Question 5   Total: 6 marks

Learning Outcomes: 12.A.R.2, 12.A.FM.3   **Question Type: Constructed Response**

When Jennika was 22 years old, she received $7500.00 from her grandmother. She invested the money and the following data was collected throughout the term (rounded to the nearest dollar).

Time (years)	0	1	3	5	10	15
Account Value ($)	7500	7827	8523	9281	11 486	14 215

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

(3 marks)

Account Value as a Function of Time
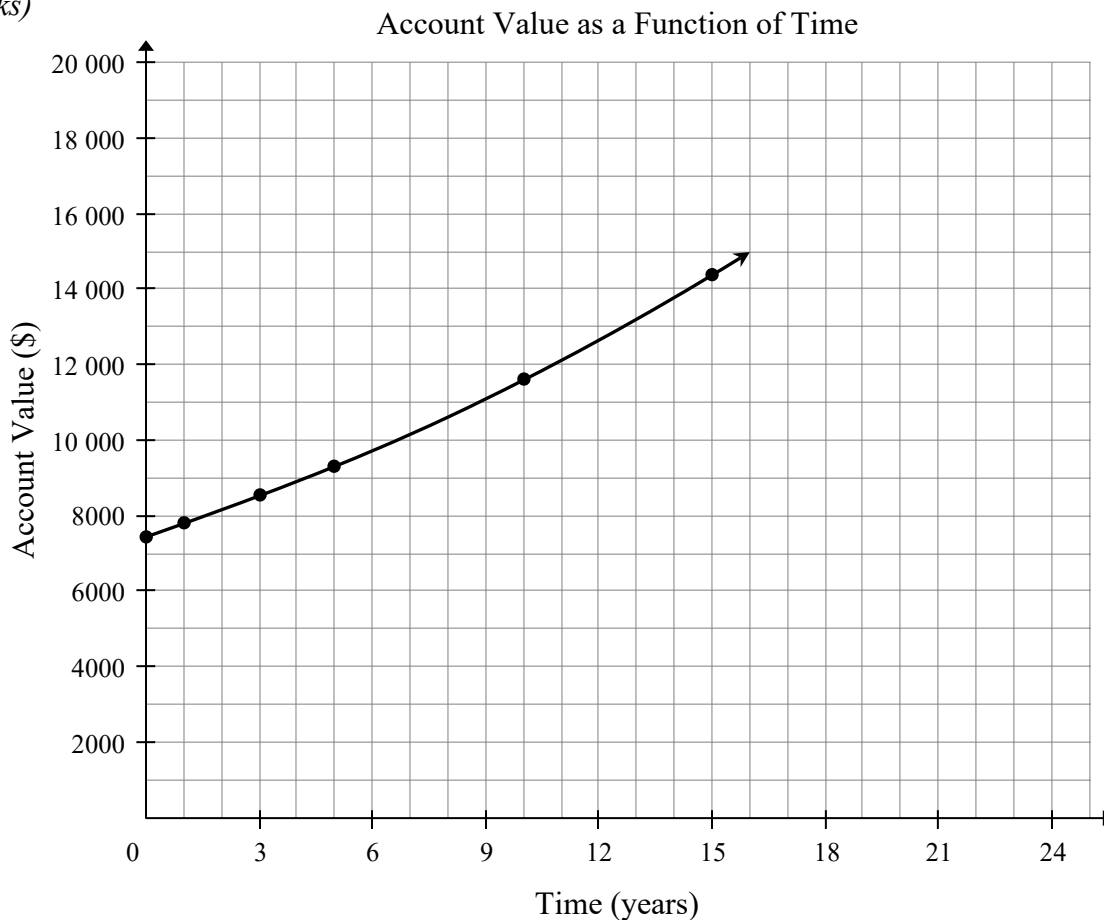
b)   Determine the exponential equation that best models the data in this situation.

(1 mark)

$$y = 7500.00(1.04)^x$$

OR───

$$y = 7500(1.04)^x$$

FINANCIAL MATHEMATICS

c) Determine the rate of return of Jennika's investment when she is 36 years old. Show your work.

(2 marks)

$$\text{Time} = 36 - 22$$
$$= 14 \text{ years}$$

$$\boxed{\text{2nd}} \; \boxed{\text{CALC}} \; 1: \text{value} \quad (14, 13\,621.44)$$
$$y = \$13\,621.44$$

$$\text{Rate of return (\%)} = \frac{\left(\begin{array}{cc}\text{Current value} & \text{Previous value} \\ \text{of portfolio} & \text{of portfolio}\end{array}\right)}{\text{Previous value of portfolio}} \times 100$$

$$= \frac{\left(\$13\,621.44 - \$7500.00\right)}{\$7500.00} \times 100$$
$$= 81.619\,2$$

The rate of return is 81.62%.

Marker Note(s):
→ *Award marks ❺, ❻, and ❼ for a rate of return of 73.17%; answer reflects using rounded values from (b).*
→ *In Desmos, if ☐ Log Mode is unchecked, a = 7499.92.*

Marking Key
❶ *1 mark for communicating the context of the graph with appropriate title and/or labels in (a)*
❷ *1 mark for using an appropriate domain and range (i.e., window settings/grid range) for the context of the question in (a)*
❸ *1 mark for plotting the data in (a)*
❹ *1 mark for equation in (b)*
❺ *0.5 mark for number of years in (c)*
❻ *0.5 mark for consistent value of investment in (c)*
❼ *1 mark for consistent rate of return in (c)*

Question 6   **Total: 5 marks**

Georgio has two options when investing $15 000.00.

    Option 1: He can invest the money at an interest rate of 6.50%, compounded monthly for 5 years.

    Option 2: He can invest the money in an account that earns simple interest for 5 years.

a) Determine the value of the investment if he chooses Option 1. Show your work.

(2 marks)

```
N=5
I%=6.5
PV=-15000
PMT=0
■FV=20742.25986
P/Y=1
C/Y=12
PMT:END BEGIN
```

The value of the investment is $20 742.26.

b) Georgio wants to earn the same amount of interest as he did in (a). Determine the simple interest rate, as a percent, that he would need if he chooses Option 2. Show your work.

(2 marks)

$$\text{Interest} = \$20\ 742.26 - \$15\ 000.00$$
$$= \$5742.26$$

$$I = Prt$$
$$\$5742.26 = \$15\ 000.00 \times r \times 5$$
$$0.076\ 563... = r$$

He would need a simple interest rate of 7.66%.

c) Explain why the simple interest rate in (b) is higher than 6.50%.

(1 mark)

To earn the same amount of interest, the rate must be higher
because interest is only earned on the principal.

    Other explanations are possible.

Marking Key
❶ *1 mark for appropriate work in (a)*
❷ *1 mark for consistent value of investment in (a)*
❸ *1 mark for consistent amount of interest in (b)*
❹ *1 mark for consistent simple interest rate in (b)*
❺ *1 mark for appropriate explanation in (c)*

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Question 7

Total: 5 marks

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

Luke and Autumn want to buy a house. The bank offers them a mortgage with the following terms:

- an interest rate of 2.85%, compounded semi-annually
- an amortization period of 20 years

a) Luke and Autumn want to make

- a down payment of $18 000.00
- monthly payments of $1450.00

Given the terms above, determine the maximum house price they can afford.
Show your work.

(2.5 marks)

```
N=240
I%=2.85
▪PV=265428.7112
PMT=-1450
FV=0
P/Y=12
C/Y=2
PMT:END BEGIN
```

$265 428.71 + $18 000.00 = $283 428.71

The maximum house price they can afford is $283 428.71.

b) Luke and Autumn find a house they want to buy that is valued at $343 000.00. The bank offers the same mortgage terms. They have $18 000.00 saved for a down payment. Determine the monthly mortgage payment.

(1 mark)

$343 000.00 – $18 000.00 = $325 000.00

```
N=240
I%=2.85
PV=325000
▪PMT=-1775.4296…
FV=0
P/Y=12
C/Y=2
PMT:END BEGIN
```

The monthly mortgage payment will be $1775.43.

c) The house in (b) is in a neighbourhood where

- the average monthly property taxes are $280.00
- the monthly heating costs are $345.00

Luke and Autumn have an annual gross income of $83 000.00. Based on their gross debt service ratio (GDSR), would the bank lend them money? Explain.

(1.5 marks)

$$\text{Gross monthly income} = \frac{\$83\ 000.00}{12} = \$6916.67$$

$$\begin{array}{l} \text{Gross debt} \\ \text{service} \\ \text{ratio (\%)} \end{array} = \frac{\left(\begin{array}{ccc} \text{Monthly} & \text{Monthly} & \text{Monthly} \\ \text{mortgage} + \text{property} + \text{heating} \\ \text{payment} & \text{taxes} & \text{costs} \end{array}\right)}{\text{Gross monthly income}} \times 100$$

$$= \frac{\left(\$1775.43 + \$280.00 + \$345.00\right)}{\$6916.67} \times 100$$

$$= 34.70\%$$

The bank will not lend them money because their GDSR is over 32%.

Marker Note(s):
→ *Do not award mark ❶ if treated as an investment.*

Marking Key	
❶	*1 mark for appropriate work in (a)*
❷	*1 mark for consistent mortgage value in (a)*
❸	*0.5 mark for consistent maximum house price in (a)*
❹	*1 mark for consistent answer in (b)*
❺	*0.5 mark for substitution in (c)*
❻	*0.5 mark for consistent GDSR in (c)*
❼	*0.5 mark for appropriate explanation in (c)*

Question 8	**Total: 6 marks**
Learning Outcome: 12.A.FM.3	**Question Type: Constructed Response**

It is Joelyn's 18th birthday and she is planning for retirement.

- Her grandparents gave her $10 000.00.
- She will retire when her investment reaches $500 000.00.

Option 1: She invests $10 000.00 initially and will make regular monthly deposits at 5% interest, compounded monthly.

Option 2: She invests $1500.00 initially and makes regular monthly deposits of $200.00. She receives a 5% interest rate, compounded monthly.

a) If she selects Option 1, determine how much she will have to invest monthly to retire at age 60. Show your work.

(2 marks)

```
N=504
I%=5
PV=-10000
▪PMT=-244.65721…
FV=500000
P/Y=12
C/Y=12
PMT:END BEGIN
```

She will have to invest $244.66 monthly to retire at age 60.

b) If she selects Option 2, determine how old she will be when she retires. Show your work.

(3 marks)

```
▪N=578.2339464
I%=5
PV=-1500
PMT=-200
FV=500000
P/Y=12
C/Y=12
PMT:END BEGIN
```

$$\frac{578.23}{12} = 48.19 \text{ years}$$

Age = 18 + 48.19

= 66.19 years old

She will be 66 years old when she retires.

c) Explain which option you would recommend.

(1 mark)

Option 1:
- the monthly payment is not much more than the one in Option 2
- can retire 6 years earlier

Option 2:
- can use $8500.00 for other purposes
- more money available each month

Other explanations are possible.

<u>*Marker Note(s):*</u>
→ *Award mark* ❹ *if age is expressed in decimal form.*

Marking Key	
❶	*1 mark for appropriate work in (a)*
❷	*1 mark for consistent answer in (a)*
❸	*1 mark for appropriate work in (b)*
❹	*1 mark for consistent number of payments in (b)*
❺	*0.5 mark for consistent number of years in (b)*
❻	*0.5 mark for consistent age in (b)*
❼	*1 mark for appropriate explanation in (c)*

PROBABILITY

Question 9   Total: 1 mark

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

Describe a situation with two events where the probability of the second event is dependent on the first event.

There are 4 blue marbles and 4 red marbles in a bag.

Event 1: Choosing a marble from the bag.
Event 2: Choosing another marble from the bag without replacing the first marble.

Other answers are possible.

Marking Key	
❶	*1 mark for answer*

Question 10

Total: 1 mark

Learning Outcome: 12.A.P.2

Question Type: Constructed Response

There were 12 students at a camp. Over the course of the weekend

- 4 students went swimming
- 9 students went biking

Is participation in these events over the course of the weekend mutually exclusive? Justify your answer.

> No. Participation in these events over the course of the weekend is not mutually exclusive because the total number of students who participated in the two events is greater than the number of students at camp.
>
> $4 + 9 = 13$ which is larger than 12

Other answers are possible.

Marking Key
❶ *1 mark for appropriate justification*

Question 11

Total: 2 marks

A food inspector has 5 cafeterias and 4 restaurants to inspect.

Determine how many ways he can choose 3 places to inspect today if he must go to at least one restaurant. Show your work.

Method A:

$$_5C_2 \times {}_4C_1 = (10)(4) = 40$$
$$_5C_1 \times {}_4C_2 = (5)(6) = 30$$
$$_5C_0 \times {}_4C_3 = (1)(4) = 4$$

$$40 + 30 + 4 = 74$$

There are 74 ways.

Marker Note(s):
→ *Award a maximum of 1 mark if student consistently uses permutations instead of combinations.*
→ *Award a maximum of 0.5 mark for correctly describing cases with no calculations.*

Marking Key	
❶	*0.5 mark for $_5C_2 \times {}_4C_1$*
❷	*0.5 mark for $_5C_1 \times {}_4C_2$*
❸	*0.5 mark for $_5C_0 \times {}_4C_3$*
❹	*0.5 mark for consistent sum*

OR

Method B:

$$_9C_3 - {}_5C_3 \times {}_4C_0 = 84 - 10$$
$$= 74$$

There are 74 ways.

Marker Note(s):
→ *Award a maximum of 1 mark if student consistently uses permutations instead of combinations.*
→ *Award a maximum of 0.5 mark for correctly describing cases with no calculations.*

Marking Key	
❶	*1 mark for total number of ways*
❷	*0.5 mark for the complement*
❸	*0.5 mark for total number of ways minus the complement*

Question 12   **Total: 2 marks**

Serena has a collection of 17 superhero books. Superman defeats Batman in 11 of these books.

a) If Serena randomly chooses a book from these 17 books, determine the odds in favour of choosing a book in which Superman defeats Batman.

(1 mark)

$$11:6$$

The odds in favour are $11:6$.

b) Serena buys 4 more books to add to her collection. Among these 4 books, Superman defeats Batman in 3 of them. Determine the odds against randomly choosing a book from her collection in which Superman defeats Batman.

(1 mark)

$$7:14 \text{ or } 1:2$$

The odds against are $7:14$ or $1:2$.

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

Question 13

Total: 1 mark

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

A teacher asks her students: "How many ways can the 11 letters of the word PROBABILITY be arranged?"

A student provides the following incorrect solution:

$$\frac{11!}{4!} = 1\ 663\ 200$$

There are 1 663 200 ways.

Correct the student's work.

> The student needs to consider the repeating letters "B" and "I" separately.
>
> $$\frac{11!}{2!2!} = 9\ 979\ 200$$
>
> There are 9 979 200 ways.

Marking Key	
❶	*1 mark for* $\dfrac{11!}{2!\,2!}$

Question 14   Total: 3 marks

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

Arjun has 5 extra concert tickets to give away. He has 9 friends who would like to go to the concert.

a) Determine how many ways he can choose to give away the tickets to his friends.

(1 mark)

$$_9C_5 = 126$$

There are 126 ways.

b) Paul is one of the 9 friends. If Arjun gives one of the tickets to Paul, determine how many ways Arjun can choose to give away the remaining tickets to his other friends.

(1 mark)

$$_8C_4 \times {}_1C_1 = 70$$

There are 70 ways.

c) Determine the probability that Arjun chooses to give Paul a ticket.

(1 mark)

The probability is $\dfrac{70}{126} = \dfrac{5}{9}$, 0.56, or 55.56%.

Marker Note(s):
→ *Award a maximum of 2 marks if student consistently uses permutations instead of combinations.*
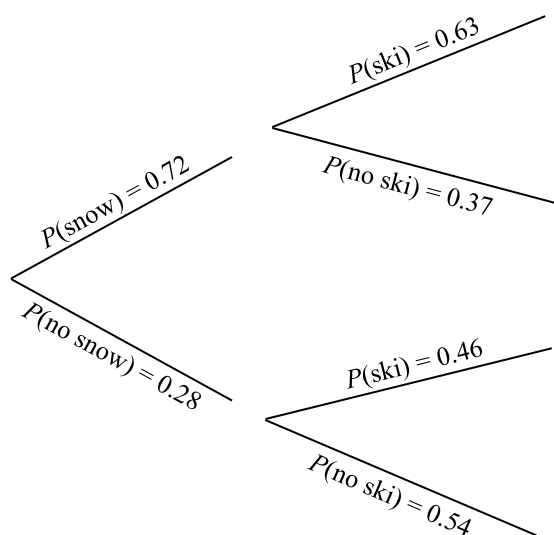
Marking Key
❶   *1 mark for answer in (a)*
❷   *1 mark for answer in (b)*
❸   *1 mark for consistent answer in (c)*

Question 15   **Total: 3 marks**

Learning Outcomes: 12.A.P.2, 12.A.P.3   **Question Type: Constructed Response**

The weather report calls for a 72% probability of snow tomorrow. If it snows, the probability that Juan will go skiing tomorrow is 63%. If it does not snow, the probability that Juan will go skiing tomorrow is 46%.

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

(1 mark)   ***OR***

$P(\text{snow}) = 0.72$

$P(\text{ski}) = 0.63$

$P(\text{no ski}) = 0.37$

$P(\text{no snow}) = 0.28$

$P(\text{ski}) = 0.46$

$P(\text{no ski}) = 0.54$

Possible Outcomes:
- snow, ski
- snow, no ski
- no snow, ski
- no snow, no ski

Other graphic organizers are possible.

b) Determine the probability that Juan goes skiing tomorrow. Show your work.

(2 marks)

$$P(\text{ski}) = P(\text{snow, ski}) + P(\text{no snow, ski})$$
$$= 0.72 \times 0.63 + 0.28 \times 0.46$$
$$= 0.453\ 6 + 0.128\ 8$$
$$= 0.582\ 4$$

The probability is $\dfrac{364}{625}$, 0.58, or 58.24%.

Marker Note(s):
→ *Award mark ❶ for a list of all possible outcomes without probability values.*

Marking Key	
❶	*1 mark for appropriate graphic organizer in (a)*
❷	*0.5 mark for P(snow, ski) in (b)*
❸	*0.5 mark for P(no snow, ski) in (b)*
❹	*1 mark for consistent sum in (b)*

Using the digits 0 through 9, Haaziq needs to create a 4-digit or 5-digit code for his new bank card. Determine the total number of codes possible if repetition is allowed. Show your work.

$$\underline{10} \times \underline{10} \times \underline{10} \times \underline{10} \quad \text{or} \quad \underline{10} \times \underline{10} \times \underline{10} \times \underline{10} \times \underline{10}$$
$$= 10^4 + 10^5$$
$$= 110\ 000$$

There are 110 000 codes possible.

Marker Note(s):
→ *Award a maximum of 1 mark if repetition is not considered correctly in both cases.*

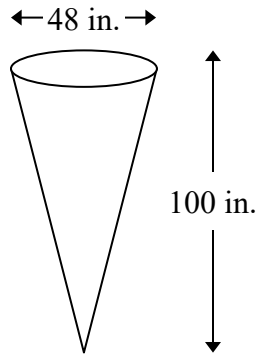| **Marking Key**	
❶	*0.5 mark for number of 4-digit codes*
❷	*0.5 mark for number of 5-digit codes*
❸	*1 mark for consistent sum*

Question 17	Total: 1 mark
Learning Outcome: 12.A.D.1	**Question Type: Selected Response**

Select the volume of the following cone, in cubic feet, given the measurements shown below in inches.

(**A**) **34.91 ft³**

B) 418.88 ft³

C) 5026.55 ft³

D) 60 318.58 ft³

Student Error
B: volume $\div 12^2$
C: volume $\div 12$
D: volume in in³

Question 18   Total: 3 marks

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

A food company sells soup in a cylindrical container with a radius of 3.3 cm and a height of 9.8 cm.

a) Calculate the surface area of the soup container.

(1 mark)

$$\text{Surface area} = 2\pi r^2 + 2\pi rh$$

$$= 2\pi(3.3)^2 + 2\pi(3.3)(9.8)$$

$$= 271.622\,100\,8 \text{ cm}^2$$

The surface area is 271.62 cm^2.

b) The aluminum used to make the containers costs \$0.10 per 1000 cm^2, taxes included. The company wants to make 4500 soup containers. Determine the total cost (ignore waste). Show your work.

(2 marks)

$$271.622\,100\,8 \times 4500 = 1\,222\,299.454 \text{ cm}^2$$

$$\frac{1\,222\,299.454}{1000} = 1222.299\,454$$

$$1222.299\,454 \times \$0.10 = \$122.23$$

The total cost would be \$122.23.

Marking Key	
❶	*1 mark for surface area in (a)*
❷	*0.5 mark for consistent total surface area in (b)*
❸	*0.5 mark for consistent amount of aluminum in (b)*
❹	*1 mark for consistent total cost in (b)*

Question 19
Total: 6 marks

Madelaine and Ryan both want to change the flooring in their bedrooms. They both have bedrooms that are 14 feet long and 8 feet wide.

a) Madelaine is using vinyl planks. The planks are sold in cases. Each case can cover 24 ft^2 and costs $47.50, taxes included. Calculate the cost of Madelaine's flooring. Show your work.

(2 marks)

$$\text{Area of Madelaine's bedroom} = 14 \times 8$$
$$= 112 \text{ ft}^2$$

$$\text{Number of cases} = \frac{\text{Area of bedroom}}{\text{Area of case}}$$
$$= \frac{112}{24}$$
$$= 4.66...$$

She needs 5 cases.

$$\text{Cost of flooring} = 5 \times \$47.50$$
$$= \$237.50$$

The cost of Madelaine's flooring is $237.50.

b) Ryan is using sheet vinyl. Rolls are 12 feet wide and can be cut to any length. Ryan wants to lay the vinyl as one single rectangular sheet. The vinyl costs $23.88 per linear foot, taxes included. Calculate the cost of Ryan's flooring. Show your work.

(1 mark)

Ryan needs 14 linear feet of flooring.

$$\text{Cost of flooring} = 14 \times \$23.88$$
$$= \$334.32$$

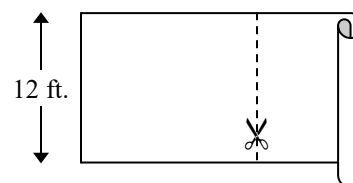The cost of Ryan's flooring is $334.32.

12 ft.

Diagram is not drawn to scale.

c) Calculate the amount of waste (unused material) in each bedroom, in square feet. Show your work.

(2 marks)

<u>Madelaine:</u>

Area of vinyl planks: $24 \times 5 = 120 \text{ ft}^2$

Waste: $120 - 112 = 8 \text{ ft}^2$

The waste in Madelaine's bedroom is 8 ft^2.

<u>Ryan:</u>

Area of sheet vinyl: $14 \times 12 = 168 \text{ ft}^2$

Waste: $168 - 112 = 56 \text{ ft}^2$

The waste in Ryan's bedroom is 56 ft^2.

d) Madelaine's flooring costs $1.98 per square foot and Ryan's flooring costs $1.99 per square foot. Explain why these unit costs are so close but the total flooring costs are so different.

(1 mark)

Since Ryan wants to lay the vinyl as a single rectangular sheet, he has to buy more sheet vinyl to cover the same area. As a result, he has more waste.

<u>Marker Note(s):</u>
→ Deduct a maximum of 0.5 mark if taxes are calculated in (a) and (b).

Marking Key	
❶	*0.5 mark for area of bedroom in (a)*
❷	*0.5 mark for consistent number of cases in (a)*
❸	*1 mark for consistent cost of flooring in (a)*
❹	*0.5 mark for length of flooring in (b)*
❺	*0.5 mark for consistent cost of flooring in (b)*
❻	*0.5 mark for area of the vinyl planks purchased by Madelaine in (c)*
❼	*0.5 mark for consistent waste in Madelaine's bedroom in (c)*
❽	*0.5 mark for area of the sheet vinyl purchased by Ryan in (c)*
❾	*0.5 mark for consistent waste in Ryan's bedroom in (c)*
❿	*1 mark for appropriate explanation in (d)*

LOGICAL REASONING

Question 20   **Total: 1 mark**

Learning Outcome: 12.A.L.2   **Question Type: Selected Response**
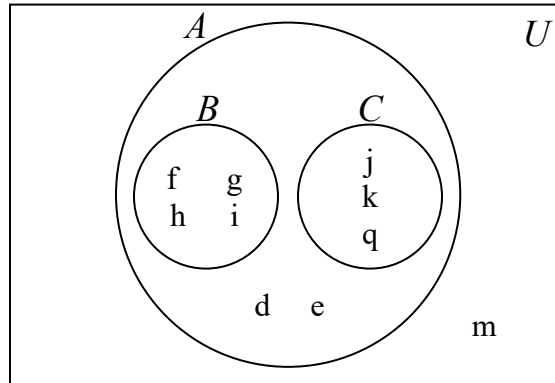
Given the following sets:

$U = \{d, e, f, g, h, i, j, k, m, q\}$

$A = \{d, e, f, g, h, i, j, k, q\}$

$B = \{f, g, h, i\}$

$C = \{j, k, q\}$

Select the correct statement from below.

A) $n(C' \cap B') = 5$

B) $\boldsymbol{n(C \cap B) = 0}$

C) $n(C \cup B) = 10$

D) $n(C' \cup B') = 2$

Student Error
A: $n(C' \cap B') = 3$
C: $n(U)$
D: $n(C' \cup B') = 10$

Question 21   **Total: 2 marks**

Learning Outcome: 12.A.L.2   **Question Type: Constructed Response**
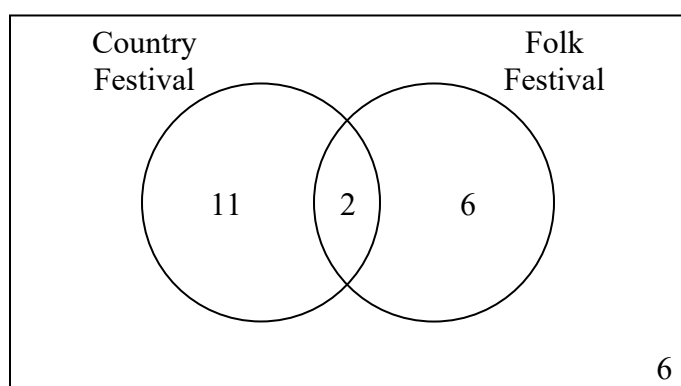
Given a group of 25 high school students, 13 students attend a country festival and 8 students attend a folk festival.

$$C = \{\text{students who attend the country festival}\}$$

$$F = \{\text{students who attend the folk festival}\}$$

a)   Given $n(C \cup F) = 19$, draw a Venn diagram to represent this situation.

(1.5 marks)

b)   Determine $n(C \cap F)'$.

(0.5 mark)

$$n(C \cap F)' = 25 - 2$$
$$= 23$$

Marking Key	
❶	*0.5 mark for number of students attending neither festival in (a)*
❷	*0.5 mark for consistent number of students attending the country festival only in (a)*
❸	*0.5 mark for consistent number of students attending the folk festival only in (a)*
❹	*0.5 mark for consistent answer for $n(C \cap F)'$ in (b)*

Question 22   **Total: 2 marks**

Let *p* represent "a rock is wet" and *q* represent "it is raining outside".

a)   Write a conditional statement based on the following symbolic form:

$$\neg p \Rightarrow \neg q$$

(1 mark)

"If a rock is not wet, then it is not raining outside."

b)   Provide a counterexample to the statement in (a).

(1 mark)

A rock is sheltered by a table while it rains.

Other examples are possible.

Marker Note(s):
→ *Award a maximum of 0.5 mark if "if" or "then" is missing from the conditional statement.*

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

Question 23

Total: 2 marks

Question Type: Constructed Response

Given the following statement:

> "If it takes about 8 years to double your investment,
> then you invest at an annual interest rate of 9%."

a)   Write the converse of this statement.

(1 mark)

> "If you invest at an annual interest rate of 9%,
> then it takes about 8 years to double your investment."

b)   Determine if the original conditional statement is true using the Rule of 72.

(1 mark)

The original conditional statement is true.

$$\frac{72}{9} = 8 \text{ years} \quad \text{or} \quad \frac{72}{8} = 9\%$$

Marker Note(s):
→ *Award a maximum of 0.5 mark if "if" or "then" is missing from the converse statement.*

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

Question 24

Total: 1 mark

Learning Outcome: 12.A.L.1

Question Type: Constructed Response

Complete the following square using the numbers 1 to 9 only once. Each row, column, and diagonal must add up to 15.

4	3	8
9	5	1
2	7	6

Marking Key	
❶	*1 mark for completing the square*

Appendices

Appendix A:
Table of Questions by Unit and Learning Outcome

RELATIONS AND FUNCTIONS		
Question	**Learning Outcome**	**Mark**
1	12.A.R.1, 12.A.R.2, 12.A.R.3	1
2	12.A.R.2	3
3	12.A.R.1	4
4	12.A.R.3	3
5 a)	12.A.R.2	3
5 b)	12.A.R.2	1
		Total = 15

FINANCIAL MATHEMATICS		
Question	**Learning Outcome**	**Mark**
5 c)	12.A.FM.3	2
6	12.A.FM.1	5
7	12.A.FM.1, 12.A.FM.3	5
8	12.A.FM.3	6
		Total = 18

PROBABILITY		
Question	**Learning Outcome**	**Mark**
9	12.A.P.3	1
10	12.A.P.2	1
11	12.A.P.6	2
12	12.A.P.1	2
13	12.A.P.5	1
14	12.A.P.6	3
15	12.A.P.2, 12.A.P.3	3
16	12.A.P.4, 12.A.P.5	2
		Total = 15

DESIGN AND MEASUREMENT		
Question	**Learning Outcome**	**Mark**
17	12.A.D.1	1
18	12.A.D.1	3
19	12.A.D.1	6
		Total = 10

LOGICAL REASONING		
Question	**Learning Outcome**	**Mark**
20	12.A.L.2	1
21	12.A.L.2	2
22	12.A.L.3	2
23	12.A.L.3, 12.A.FM.3	2
24	12.A.L.1	1
		Total = 8

Appendix B:
Irregularities in Provincial Tests

A Guide for Local Marking

During the marking of provincial tests, irregularities are occasionally encountered in test booklets. The following list provides examples of irregularities for which an *Irregular Test Booklet Report* should be completed and sent to the department:

- completely different penmanship in the same test booklet
- incoherent work with correct answers
- notes from a teacher indicating how he or she has assisted a student during test administration
- student offering that he or she received assistance on a question from a teacher
- student submitting work on unauthorized paper
- evidence of cheating or plagiarism
- disturbing or offensive content
- no responses provided by the student or only incorrect responses ("0")

Student comments or responses indicating that the student may be at personal risk of being harmed or of harming others are personal safety issues. This type of student response requires an immediate and appropriate follow-up at the school level. In this case, please ensure the department is made aware that follow-up has taken place by completing an *Irregular Test Booklet Report*.

Except in the case of cheating or plagiarism where the result is a provincial test mark of 0%, it is the responsibility of the division or the school to determine how they will proceed with irregularities. Once an irregularity has been confirmed, the marker prepares an *Irregular Test Booklet Report* documenting the situation, the people contacted, and the follow-up. The original copy of this report is to be retained by the local jurisdiction and a copy is to be sent to the department along with the test materials.

Irregular Test Booklet Report

Test: _____

Date marked: _____

Booklet number: _____

Problem(s) noted: _____

_____

_____

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_____

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Question(s) affected: _____

_____

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Action taken or rationale for assigning marks: _____

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Follow-up: _____

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Decision: _____

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_____

Marker's Signature: _____

Principal's Signature: _____

For Department Use Only—After Marking Complete

Consultant: _____

Date: _____