Released Items Mathematics 30–2

August 2021 Diploma Exam

Diploma Examinations Program

Alberta

This document was primarily written for:		
Students	✓	
Teachers	✓	of Mathematics 30–2
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Parents		
General Audiences		
Others		

2025–2026 Mathematics 30–2 Released Item

Distribution: This document is posted on the Alberta Education and Childcare website.

Contents

Please note that if you cannot access one of the direct website links referred to in this document, you can find diploma examination-related materials on the Alberta Education and Childcare website.

Introduction

The questions in this document are from the *Mathematics 30–2 August 2021 Diploma Examination*. Teachers may wish to use these questions in a variety of ways to help students develop and demonstrate an understanding of the concepts described in the Mathematics 30–2 Program of Studies. The content in this document, along with the program of studies, the *Mathematics 30-2 Information Bulletin*, and the *Mathematics 30-2 Assessment Standards and Exemplars*, can provide insights that assist you with decisions about instructional planning.

For further information, contact

Jenny Kim, Mathematics 30–2 Diploma Exam Lead
Email: Jenny.Kim@gov.ab.ca

Terri Lynn Mundorf, Director
Diploma Programs
780-422-0206
Email: Terri-Lynn.Mundorf@gov.ab.ca

To call toll-free from outside Edmonton, dial 310-0000.

Documents

The Provincial Assessment Sector supports the instruction of Mathematics 30–2 with the following documents available online on the Writing diploma exams web page.

- *Mathematics 30-2 Information Bulletin*
- *Mathematics 30-2 Assessment Standards and Exemplars*
- *Mathematics 30-2 Released Items*
- *Mathematics 30-2 Written-Response Information*

Mathematics 30–2 Diploma Examination
August 2021 — Item Information

The following tables give the results for the machine-scored and written-response questions released from the examination. For each question, the table also gives the correct response, the topic, the outcome, the cognitive level, and the assessment standard.

Topics		Cognitive Levels		Standards
LR	Logical Reasoning	C	Conceptual	Acceptable
PR	Probability	P	Procedural	Excellence
RF	Relations and Functions	PS	Problem Solving	

Question	Diff.*	Key	Topic	Outcome	Cognitive Level	Standard
NR1	86.0%	8342	LR	1	PS	Acceptable
1	73.6%	C	LR	1	PS	Acceptable
2	52.7%	B	LR	2	PS	Excellence
3	62.0%	D	LR	2	C	Acceptable
4	80.2%	C	PR	1	C	Acceptable
5	69.4%	A	PR	1	PS	Acceptable
NR2	62.0%	0.55	PR	2	C	Acceptable
6	31.0%	D	PR	2	C	Excellence
7	70.5%	B	PR	3	P	Acceptable
8	65.9%	A	PR	5	PS	Acceptable
9	45.7%	B	PR	4, 5	C	Excellence
10	50.4%	D	PR	3	C	Excellence
NR3	55.4%	40	PR	4	PS	Acceptable
11	50.4%	A	PR	5	PS	Acceptable
12	58.9%	D	PR	6	P	Acceptable
NR4	54.3%	125 (any order)	PR	6	C	Acceptable
13	61.6%	C	RF	1	C	Acceptable

Question	Diff.*	Key	Topic	Outcome	Cognitive Level	Standard
14	55.0%	C	RF	1	C	Acceptable
15	28.7%	D	RF	2	P	Excellence
16	69.8%	B	RF	3	P	Acceptable
17	67.4%	A	RF	4	C	Acceptable
NR5	53.5%	17.5	RF	4	C	Acceptable
18	70.2%	A	RF	4	P	Excellence
19	70.9%	B	RF	5	C	Acceptable
NR6	44.2%	7.7	RF	5	P	Acceptable
20	58.9%	D	RF	5	PS	Acceptable
NR7	66.3%	0.79	RF	6	P	Acceptable
21	72.9%	B	RF	6	PS	Acceptable
22	37.2%	C	RF	6	PS	Acceptable
23	72.1%	A	RF	7	PS	Excellence
NR8	53.1%	3.41	RF	7	C	Acceptable
24	79.1%	D	RF	7	PS	Acceptable

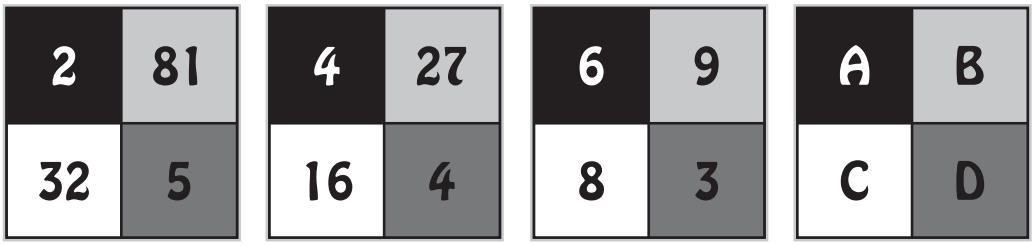
*Difficulty—percentage of students answering the question correctly

Question	Average Raw Score	Key	Topic	Outcome	Cognitive Level	Standard
WR1	3.06/7	See Sample Solution	RF, PR, LR	8, 1, 2	P, PS, C	Acceptable, Excellence
WR2	3.82/7	See Sample Solution	RF, LR	1, 2, 3	P, PS	Acceptable, Excellence

Mathematics 30–2 Diploma Examination
August 2021 — Released Items

Use the following information to answer numerical-response question 1.

A Pattern



Stage 1 **Stage 2** **Stage 3** **Stage 4**

Numerical Response

1. When Stage 4 of the pattern is completed, the value of

A is _____ (Record in the **first** column)

B is _____ (Record in the **second** column)

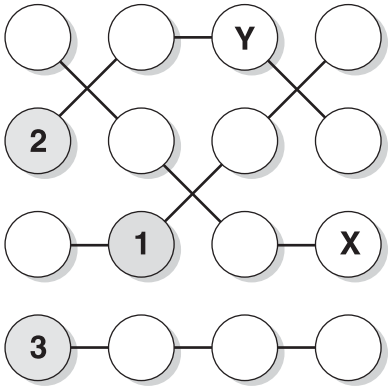
C is _____ (Record in the **third** column)

D is _____ (Record in the **fourth** column)

(Record your answer in the numerical-response section on the answer sheet.)

Use the following information to answer question 1.

In the puzzle shown below, the numbers 1 through 4 are placed so that no digit is repeated in each row, column, or set of connected circles.



1. *When the puzzle is completed correctly, the digit that will be placed in the circle marked* **X** *is* ___***i***___ *and the digit that will be placed in the circle marked* **Y** *is* ___***ii***___ .

The statement above is completed by the information in row

Row	***i***	***ii***
A.	4	4
B.	4	3
C.	3	4
D.	3	3

Use the following information to answer question 2.

A movie theatre surveyed 40 customers on whether they had seen three particular movies in the past year: "The Hungry Contest," "Jimmy Carpenter," "The Revengers." Below are the results of the survey.

5 customers had seen all three movies.

12 customers had seen "Jimmy Carpenter" and "The Revengers."

8 customers had seen "The Hungry Contest" and "The Revengers."

7 customers had seen "The Hungry Contest" and "Jimmy Carpenter."

8 customers had seen "The Revengers" only.

20 customers had seen "The Hungry Contest."

1 customer had not seen any of the movies.

2. The total number of customers in the survey who had seen the movie "Jimmy Carpenter" is

A. 11

B. 18

C. 19

D. 24

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3. If sets P and Q both contain elements, then which of the following statements about these two sets is true?

A. If $Q \subset P$, then $P \cap Q = \varnothing$.

B. If $Q \subset P$, then $P \cup Q = \varnothing$.

C. If sets P and Q are disjoint sets, then $P \subset Q$.

D. If sets P and Q are disjoint sets, then $P \cap Q = \varnothing$.

Use the following information to answer question 4.

In the first half of the 2014 season, Canadian baseball player Justin Morneau hit 92 times while batting 293 times.

4. Based on these results, the odds against Justin getting a hit the next time he is at bat are

A. 92 : 201

B. 92 : 293

C. 201 : 92

D. 201 : 293

Use the following information to answer question 5.

Sasha and Lucas are playing a game in which two six-sided dice are rolled, and the sum of the numbers on the upturned faces is calculated. The faces of the first die are labelled with the numbers 1, 1, 1, 2, 3, 4. The faces of the second die are labelled with the numbers 1, 2, 2, 3, 4, 5.

A chart of all possible sums for this game is shown below.

Die 2 \ Die 1	1	1	1	2	3	4
1	2	2	2	3	4	5
2	3	3	3	4	5	6
2	3	3	3	4	5	6
3	4	4	4	5	6	7
4	5	5	5	6	7	8
5	6	6	6	7	8	9

The rules state that if the sum is 5 or less, Sasha wins the game. If the sum is 6 or more, Lucas wins the game. Using these rules, the two players do **not** have an equal probability of winning.

5. Which of the following modifications would make the probability of winning the game equal for both players?

A. Sasha wins if the sum is even, and Lucas wins if the sum is odd.

B. Sasha wins if the sum is 4 or lower, and Lucas wins if the sum is 6 or greater.

C. Sasha wins if at least one die shows a 2, and Lucas wins if neither die shows a 2.

D. Sasha wins if at least one die shows an even number, and Lucas wins if neither die shows an even number.

Numerical Response

2. The probability that a particular high school football team will win its next game is 0.20, and the probability that the team will tie the game is 0.25. The probability that the football team will lose the next game, to the nearest hundredth, is _____.

(Record your answer in the numerical-response section on the answer sheet.)

Use the following information to answer question 6.

A particular experiment involves 15 game pieces that are identical in size. Each game piece has the image of a shape: a circle, a triangle, or a square. Each shape appears on five game pieces, each piece in a different colour – white, red, blue, yellow, or green. The 15 game pieces are placed in a bag, and a single game piece is selected at random.

6. Which of the following calculations could be used to determine the probability of selecting a game piece that either has a square or is white?

A. $\frac{5}{15} \cdot \frac{3}{15}$

B. $\frac{5}{15} + \frac{3}{15}$

C. $\frac{5}{15} \cdot \frac{3}{15} - \frac{1}{15}$

D. $\frac{5}{15} + \frac{3}{15} - \frac{1}{15}$

Use the following information to answer question 7.

A box contains 6 white marbles, 3 yellow marbles, and 4 red marbles. Two marbles are randomly selected from the box, one after the other, without replacement.

7. The probability of randomly selecting a white marble followed by a red marble, to the nearest hundredth, is

A. 0.14

B. 0.15

C. 0.77

D. 0.79

Use the following information to answer question 8.

The security code for Hwa's smartphone consists of 4 digits selected from 0 through 9, inclusive. The digits cannot be repeated.

Hwa knows that the first digit of her security code is 7, but she has forgotten the last 3 digits.

8. On her first try, the probability that Hwa will randomly guess the correct security code with 7 as the first digit is

A. $\frac{1}{504}$

B. $\frac{1}{720}$

C. $\frac{1}{3\,024}$

D. $\frac{1}{5\,040}$

Use the following information to answer question 9.

In a high school, there are 9 lockers available between Mr. Bissell's classroom and Mrs. Lim's classroom, as shown in the diagram below. The 9 players on the volleyball team, which includes 2 team captains, are assigned to these lockers.

9. Which of the following calculations could be used to determine the number of different locker assignments possible if one team captain is assigned the locker next to Mr. Bissell's classroom and the other team captain is assigned the locker next to Mrs. Lim's classroom?

A. $2! \cdot 9!$

B. $2! \cdot 7!$

C. $\frac{9!}{2!}$

D. $7!$

Use the following information to answer question 10.

Leah and Betty are practising basketball shots from the free-throw line. When Leah takes her shot, the probability that she will score is 0.4. When Betty takes her shot, the probability that she will score is 0.3.

10. If Leah and Betty each take 1 shot from the free-throw line, the probability that one person will score and the other person will **not** score can be determined by calculating

A. $0.4 \cdot 0.7$

B. $0.4 + 0.3$

C. $(0.4 + 0.3) \cdot (0.6 + 0.7)$

D. $(0.4 \cdot 0.7) + (0.6 \cdot 0.3)$

Use the following information to answer numerical-response question 3.

A particular corporation developed the following list of words that can be used to form impressive-sounding three-word phrases.

Column I	Column II	Column III
integrated	organizational	options
total	reciprocal	capability
parallel	digital	mobility
functional	incremental	projection
synchronized		contingency
balanced		

Each three-word phrase must use one word from each column in order from left to right. For example, one three-word phrase could be "integrated digital mobility."

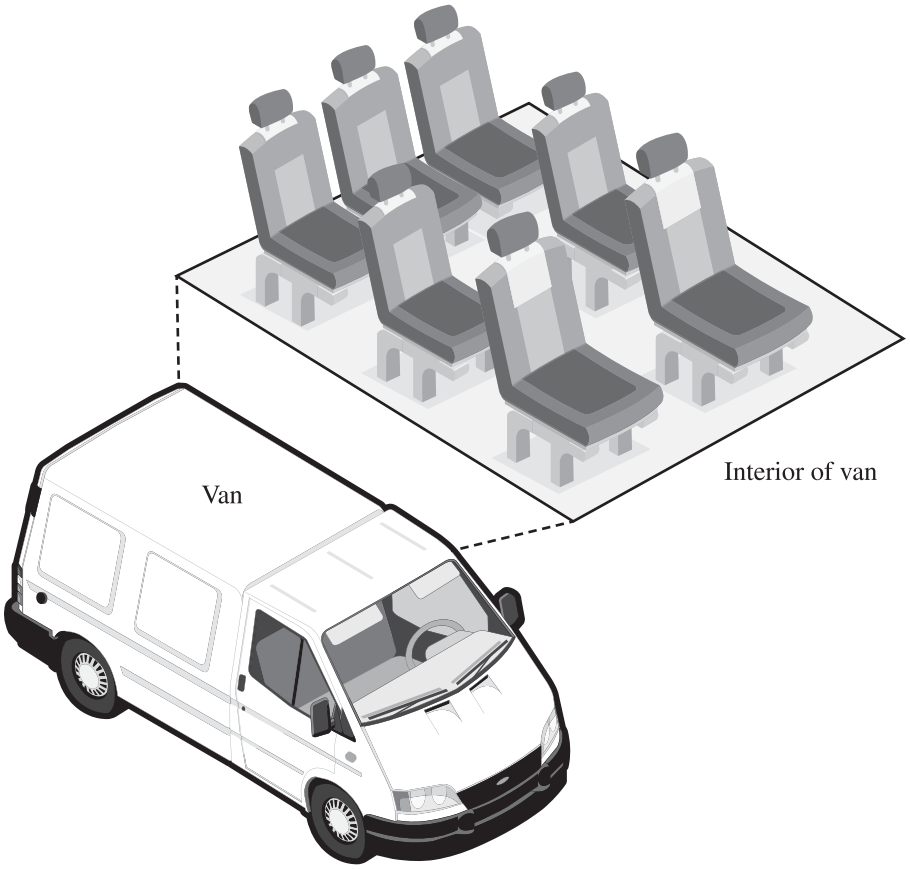
Numerical Response

3. Using only the list above, the number of different three-word phrases beginning with parallel or balanced is _____.

(Record your answer in the numerical-response section on the answer sheet.)

Use the following information to answer question 11.

A particular van has seats for 7 adults, including the driver, as shown in the diagram below.



For a trip, Maria and 4 other adults will be travelling in this van.

11. If Maria must drive, then the number of possible seating arrangements is

A. 360
B. 840
C. 2 520
D. 5 040

Use the following information to answer question 12.

A committee of 4 people is selected from a group of 11 teachers and 12 students.

12. The number of different 4-person committees that contain **exactly** 3 students is

A. 165
B. 220
C. 1 980
D. 2 420

Use the following information to answer numerical-response question 4.

Five Scenarios

1 Selecting vegetable toppings for a pizza that can have 1, 2, or 3 vegetable toppings
2 Choosing 4 students from 15 to take a trip to Saskatoon
3 Creating a performance schedule for a school talent show that consists of 6 acts
4 Arranging all the letters of the word TOOTH
5 Purchasing 5 books from a list of 13 available books

Numerical Response

4. The three scenarios above that can be classified as combinations are numbered _____, _____, and _____.

(Record all **three digits** of your answer **in any order** in the numerical-response section on the answer sheet.)

13. Which of the following expressions is equivalent to $\frac{6x^2 + 2x}{2x}$, $x \neq 0$?

A. $3x$

B. $6x^2$

C. $3x + 1$

D. $6x^2 + 1$

14. Which of the following rational expressions has **exactly** 3 non-permissible values?

A. $\frac{7(x + 5)}{x(x^2 - 25)(x + 1)}$

B. $\frac{7}{3(x - 2)(x + 1)}$

C. $\frac{x + 5}{(x^2 - 25)(x + 1)}$

D. $\frac{(x + 2)(x - 3)}{x + 1}$

15. When the rational expression $\frac{x + 3}{x - 4} - \frac{x - 2}{x + 3}$, $x \neq -3, 4$, is simplified, the numerator is

A. 1

B. -2

C. $x - 2$

D. $12x + 1$

16. The solution to the equation $\frac{x+1}{2x} = \frac{4}{3}$ is

A. -3

B. $\frac{3}{5}$

C. $\frac{3}{4}$

D. 1

17. Which of the following equations is equivalent to $2 = 3^{(5x+1)}$?

A. $\log_3 2 = 5x + 1$

B. $\log_2 3 = 5x + 1$

C. $\log_3(5x + 1) = 2$

D. $\log_2(5x + 1) = 3$

Numerical Response

5. When the expression $\log_b 259 + \log_b 15 - \log_b 222$, where $b > 1$, is simplified to a single logarithm of the form $\log_b M$, the value of M, to the nearest tenth, is _____.

(Record your answer in the numerical-response section on the answer sheet.)

18. When written as a single logarithm, the expression $\frac{1}{3}\log_2 x - \log_2 10,\ x > 0,$ is equivalent to

A. $\log_2\left(\frac{x^{\frac{1}{3}}}{10}\right)$

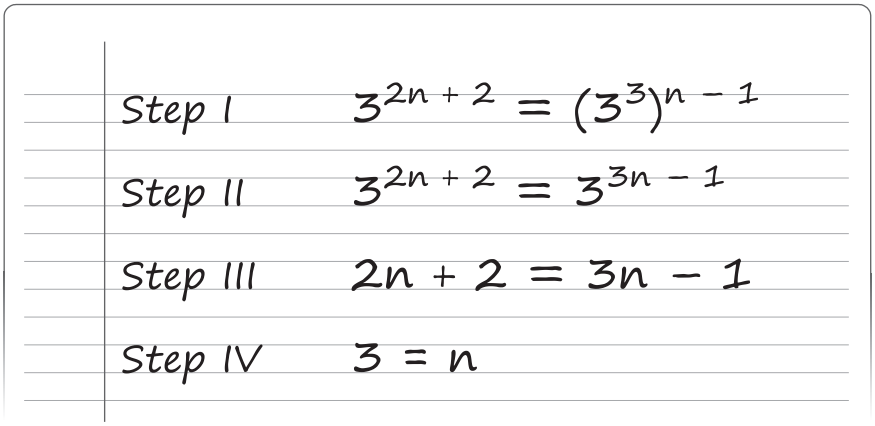
B. $\log_2\left(\frac{10}{x^{\frac{1}{3}}}\right)$

C. $\log_2\left(10x\right)^{\frac{1}{3}}$

D. $\log_2\left(10x^{\frac{1}{3}}\right)$

Use the following information to answer question 19.

Clinton made an error when solving the equation $3^{2n+2} = 27^{n-1}$. His work is shown below.



19. In which step did Clinton record his **first** error?

A. Step I

B. Step II

C. Step III

D. Step IV

Numerical Response

6. To the nearest tenth, the solution to the equation $5 = 10^{(x-7)}$ is _____ .

(Record your answer in the numerical-response section on the answer sheet.)

Use the following information to answer question 20.

The half-life of plutonium-238 is 88 years, and as it decays, the mass remaining, M, can be modelled by the exponential function

$$M = M_0(0.5)^{\frac{t}{88}}$$

where M_0 is the original mass of plutonium, and t is the number of years.

20. If 10 g of plutonium remains after 292 years, what was the original mass, to the nearest gram?

A. 8 g

B. 12 g

C. 33 g

D. 100 g

Use the following information to answer numerical-response question 7.

When radiation enters a substance, the amount of radiation that is absorbed depends on the substance. The results of an experiment related to this context are shown in the table below.

Ratio of Incident to Transmitted Radiation	Absorbance Rating of Substance
1.00	0.00
1.27	0.10
1.79	0.25
3.15	0.50
5.56	0.75
7.70	0.90

These data can be modelled by a logarithmic regression function of the form

$$y = a + b \cdot \ln x$$

where x is the ratio of incident to transmitted radiation and y is the absorbance rating of the substance.

Numerical Response

7. To the nearest hundredth, a substance with a ratio of incident to transmitted radiation of 6.04 will have an absorbance rating of _____.

(Record your answer in the numerical-response section on the answer sheet.)

Use the following information to answer question 21.

The number of bacteria in a particular culture, P, can be modelled by the function

$$P = 1\,000(4)^{\frac{t}{24}}$$

where t is the time, in hours, after the initial count.

21. The time that it takes for the number of bacteria to double, to the nearest hour, is

A. 8 h

B. 12 h

C. 24 h

D. 48 h

Use the following information to answer question 22.

The magnitude of an earthquake, M, is measured on the Richter scale. The intensity of an earthquake, I, can be calculated using the formula

$$I = I_0(10)^M$$

where I_0 represents the intensity of an earthquake that has a magnitude of 0.

On November 2, 2004, Vancouver Island experienced an earthquake with a magnitude of 6.7 on the Richter scale. On June 23, 1946, the same area experienced an earthquake with a magnitude of 7.3.

22. To the nearest tenth, how many times more intense was the 1946 earthquake compared to the 2004 earthquake?

A. 0.6 times

B. 1.1 times

C. 4.0 times

D. 12.3 times

Use the following information to answer question 23.

A particular rectangular prism has a width of x cm. Its length is 3 times its width, and its height is 6 times its width.

The formula for the volume of a rectangular prism is $V = l \cdot w \cdot h$.

23. If the volume of the prism is 21 654 cm^3, then the width of the prism, x, to the nearest tenth of a centimetre, is

A. 10.6 cm

B. 13.4 cm

C. 15.3 cm

D. 27.9 cm

Use the following information to answer numerical-response question 8.

In 2012, Rafael Ortiz kayaked over the highest waterfall ever kayaked, Palouse Falls. The height of the kayak above the bottom of the falls, h, in metres, during the descent can be modelled by the function

$$h(t) = -4.9t^2 + 57$$

where t is the time, in seconds, since the descent began.

Numerical Response

8. The time that it took the kayak to reach the bottom of Palouse Falls, to the nearest hundredth of a second, was _____ s.

(Record your answer in the numerical-response section on the answer sheet.)

Use the following information to answer question 24.

A team is trying to maximize its profit from ticket sales by adjusting the ticket price. The estimated profits per game at different ticket prices are shown in the table below.

Ticket Price ($)	5	8	9	13	15
Estimated Profit per Game ($)	1 925	2 600	2 725	2 725	2 425

These data can be modelled by a quadratic regression function of the form

$$y = ax^2 + bx + c$$

where x is the ticket price and y is the estimated profit per game.

24. *According to the quadratic regression function, the price per ticket that produces the maximum profit is $ ____**i**____ , and the maximum profit that can be made is $ ____**ii**____ .*

The statement above is completed by the information in row

Row	***i***	***ii***
A.	12	2 725
B.	11	2 725
C.	12	2 825
D.	11	2 825

Written-response question 1 begins on the next page.

Use the following information to answer written-response question 1.

Hopewell Cape, located on the coast of the Bay of Fundy, has some of the highest tides in the world. The height of the tide at Hopewell Cape on one particular day can be modelled by the sinusoidal function

$$h = 4.6 \sin(0.5t + 1.5) + 7.0$$

where h is the height of the tide, in metres, and t is the time, in hours after midnight.

Written Response—7 Marks

1. **a.** State the minimum height of the tide, to the nearest tenth of a metre, at Hopewell Cape on this particular day.

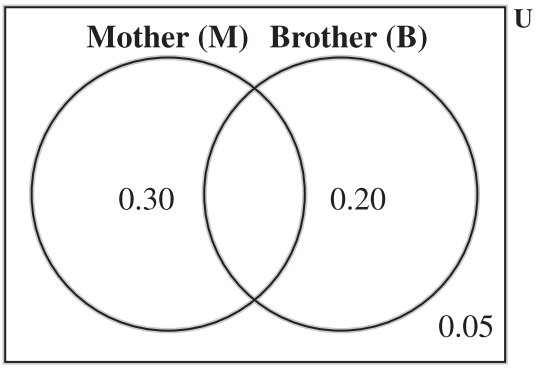
Use the following additional information to answer the next part of the question.

It is recommended that tourists visiting Hopewell Cape stay for both low tide and high tide so they can see the drastic change in landscape.

b. **Determine** the minimum amount of time, to the nearest tenth of an hour, that a tourist would have to wait at Hopewell Cape in order to experience both low tide and high tide.

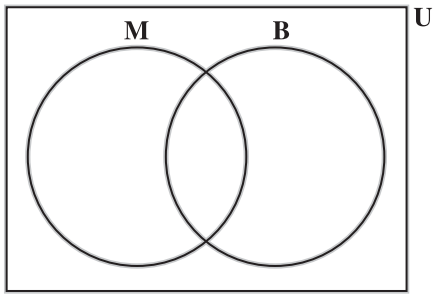
Use the following information to answer the next two parts of the question.

Janelle's family plans to take a vacation to visit Hopewell Cape. Her mother and brother both submit requests to get time off work. The probabilities of each of them receiving approval for the time off can be represented by a Venn diagram. The partially completed Venn diagram is shown below.



c. Complete the Venn diagram above and calculate the odds in favour of Janelle's brother being approved for the time off.

d. Shade the region of the Venn diagram below that represents $P(M \cup B)$, and **describe** what $P(M \cup B)$ represents in this context.



Written-response question 2 begins on the next page.

Use the following information to answer written-response question 2.

A duathlon is a race that consists of two activities—running and cycling. To prepare for a duathlon, Min started daily training sessions. During one training session, Min's average cycling speed, in kilometres per hour, can be represented by the expression $\frac{8x^2 + 32x}{4x}$ and the time spent cycling, in hours, can be represented by the expression $\frac{7x - 28}{x^2 - 16}$.

Written Response—7 Marks

2. **a.** State the non-permissible values of the two expressions $\frac{8x^2 + 32x}{4x}$ and $\frac{7x - 28}{x^2 - 16}$.

b. The distance travelled, in kilometres, is the product of speed and time. **Determine** the distance Min cycled in this training session.

Use the following information to answer the next part of the question.

During another training session, Min ran a total distance of 9 km and cycled 35 km. Her average cycling speed was 16 km/h faster than her average running speed. It took Min a total of 2 h to complete this training session. An equation that models this relationship is

$$\frac{9}{x} + \frac{35}{x+16} = 2$$

where x represents Min's average running speed in kilometres per hour.

c. Algebraically determine Min's average running speed to the nearest kilometre per hour.

Written-response question 2 continues on the next page.

Use the following information to answer the next part of the question.

Quinn, Priya, and Min finished in the top three places of the duathlon for their age category. Each of these competitors was from a different country—Australia, Canada, or Ireland. Each received a different-sized jersey—small, medium, or large. The following clues provide information about these top three competitors.

- The competitor from Ireland had the slowest race time of the three.
- The fastest competitor wore a medium-sized race jersey.
- Priya did not come in 1st place and is from Australia.
- Quinn wore the large-sized jersey and is not from Canada.

d. For each of these top three competitors, identify the placing (1st, 2nd, or 3rd), country, and jersey size.

Written-response Question 1 Sample Solution

Use the following information to answer written-response question 1.

Hopewell Cape, located on the coast of the Bay of Fundy, has some of the highest tides in the world. The height of the tide at Hopewell Cape on one particular day can be modelled by the sinusoidal function

$$h = 4.6 \sin(0.5t = 1.5) + 7.0$$

where h is the height of the tide, in metres, and t is the time, in hours after midnight.

Written Response—7 Marks

1. **a.** State the minimum height of the tide, to the nearest tenth of a metre, at Hopewell Cape on this particular day.

A possible solution to WR 1 Part a

The minimum height of the tide at Hopewell Cape on this day is 2.4 m.

$$7.0 - 4.6 = 2.4 \text{ metres}$$

Use the following additional information to answer the next part of the question.

It is recommended that tourists visiting Hopewell Cape stay for both low tide and high tide so they can see the drastic change in landscape.

b. **Determine** the minimum amount of time, to the nearest tenth of an hour, that a tourist would have to wait at Hopewell Cape in order to experience both low tide and high tide.

A possible solution to WR 1 Part b

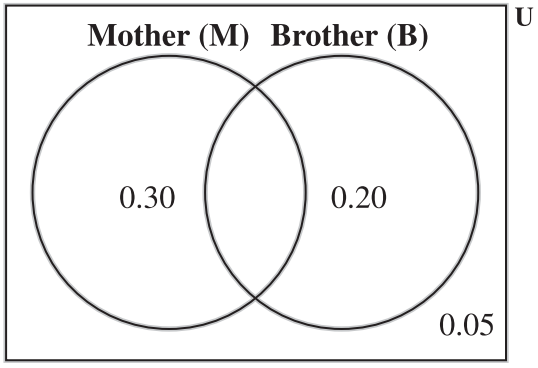
Period can be calculated by

$$\frac{2\pi}{0.5} = 12.6$$

Therefore, the amount of time a tourist would have to remain at Hopewell Cape to experience both low tide and high tide (half of the period) is 6.3 hours.

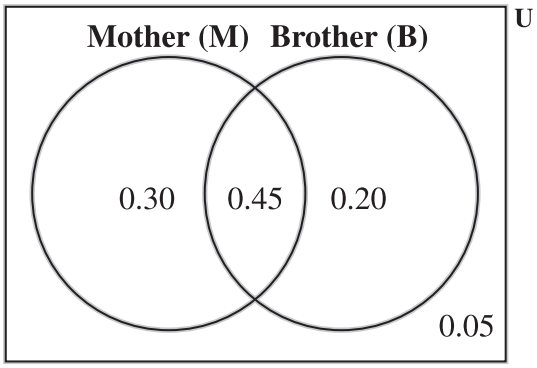
Use the following information to answer the next two parts of the question.

Janelle's family plans to take a vacation to visit Hopewell Cape. Her mother and brother both submit requests to get time off work. The probabilities of each of them receiving approval for the time off can be represented by a Venn diagram. The partially completed Venn diagram is shown below.



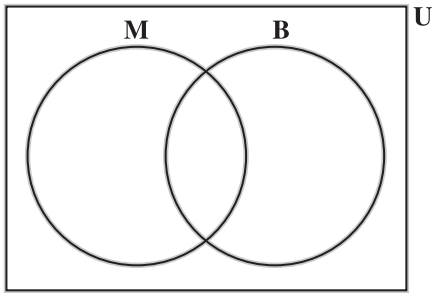
c. Complete the Venn diagram above and calculate the odds in favour of Janelle's brother being approved for the time off.

A possible solution to WR 1 Part c

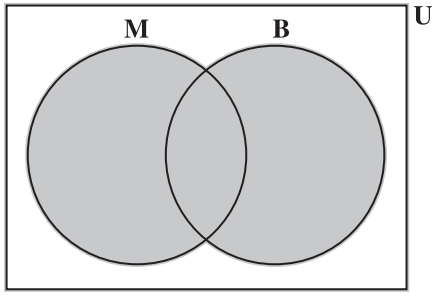


The odds in favour of Janelle's brother being approved for time off are $13 : 7$.

d. Shade the region of the Venn diagram below that represents $P(M \cup B)$, and describe what $P(M \cup B)$ represents in this context.



A possible solution to WR 1 Part d



$P(M \cup B)$ represents the probability of either Janelle's mother or Janelle's brother receiving approval for time off.

Written-response Question 2 Sample Solution

Use the following information to answer written-response question 2.

A duathlon is a race that consists of two activities—running and cycling. To prepare for a duathlon, Min started daily training sessions. During one training session, Min's average cycling speed, in kilometres per hour, can be represented by the expression $\frac{8x^2 + 32x}{4x}$ and the time spent cycling, in hours, can be represented by the expression $\frac{7x - 28}{x^2 - 16}$.

Written Response—7 Marks

2. **a.** State the non-permissible values of the two expressions $\frac{8x^2 + 32x}{4x}$ and $\frac{7x - 28}{x^2 - 16}$.

A possible solution to WR 2 Part a

The non-permissable values are –4, 0, and 4.

b. The distance travelled, in kilometres, is the product of speed and time. **Determine** the distance Min cycled in this training session.

A possible solution to WR 2 Part b

$$\begin{aligned} \text{Distance} &= \frac{8x^2 + 32x}{4x} \cdot \frac{7x - 28}{x^2 - 16} \\ &= \frac{8x(x + 4)}{4x} \cdot \frac{7(x - 4)}{(x - 4)(x + 4)} \\ &= 2 \cdot 7 \\ &= 14 \text{ km} \end{aligned}$$

Use the following information to answer the next part of the question.

During another training session, Min ran a total distance of 9 km and cycled 35 km. Her average cycling speed was 16 km/h faster than her average running speed. It took Min a total of 2 h to complete this training session. An equation that models this relationship is

$$\frac{9}{x} + \frac{35}{x+16} = 2$$

where x represents Min's average running speed in kilometres per hour.

c. Algebraically determine Min's average running speed to the nearest kilometre per hour.

A possible solution to WR 2 Part c

$$\frac{9}{x} + \frac{35}{x+16} = 2$$
$$9(x + 16) + 35x = 2x(x + 16)$$
$$9x + 144 + 35x = 2x^2 + 32x$$
$$2x^2 - 12x - 144 = 0$$
$$2(x^2 - 6x - 72) = 0$$
$$2(x - 12)(x + 6) = 0$$
$$x = 12 \quad \text{or} \quad x = -6$$

Since $x > 0$, the solution is $x = 12$. Min's average running speed is 12 km/h.

Use the following information to answer the next part of the question.

Quinn, Priya, and Min finished in the top three places of the duathlon for their age category. Each of these competitors was from a different country—Australia, Canada, or Ireland. Each received a different-sized jersey—small, medium, or large. The following clues provide information about these top three competitors.

- The competitor from Ireland had the slowest race time of the three.
- The fastest competitor wore a medium-sized race jersey.
- Priya did not come in 1st place and is from Australia.
- Quinn wore the large-sized jersey and is not from Canada.

d. For each of these top three competitors, identify the placing (1st, 2nd, or 3rd), country, and jersey size.

A possible solution to WR 2 Part d

	Race Jersey Size	Country of Origin	Place in Race
Quinn	L	Ireland	3rd
Priya	S	Australia	2nd
Min	M	Canada	1st

Scoring Guide for Written-response Question 1

WR 1 Part a

Score	General Description	Specific Description
NR	No response is provided.	
0	In the response, the student does not address the question or provides a solution that is invalid.	In the response, the student • states the t-coordinate of the minimum point OR • states the maximum height
0.5		For example, the student could • state the correct minimum height, but round the final answer incorrectly OR • state the coordinates of a correct minimum point
1	In the response, the student applies appropriate mathematical knowledge to find a complete and correct solution.	In the response, the student • states the correct minimum height

WR 1 Part b

Score	General Description	Specific Description
NR	No response is provided.	
0	In the response, the student does not address the question or provides a solution that is invalid.	In the response, the student • states the minimum value or the maximum value
0.5		For example, the student could • state the correct answer with no supporting work OR • state the correct time at a minimum point only or a maximum point only
1	In the response, the student demonstrates basic mathematical understanding of the problem by applying an appropriate strategy or relevant mathematical knowledge to find a partial solution.	In the response, the student • determines the correct period OR • correctly calculates an adjacent set of maximum and minimum points, expressed as an ordered pair or stating the time coordinates only OR • uses a graphical approach and misinterprets the first maximum is on the *y*-axis to calculate the minimum amount of time (i.e., solution is 6.4)
1.5		For example, the student could • correctly calculate the minimum amount of time with supporting work, but round the final answer incorrectly
2	In the response, the student demonstrates complete mathematical understanding of the problem by applying an appropriate strategy or relevant mathematical knowledge to find a complete and correct solution.	In the response, the student • correctly determines the minimum amount of time, rounded accurately
Note: Supporting work provided can be a graphical approach or an algebraic approach.		

WR 1 Part c

Score	General Description	Specific Description
NR	No response is provided.	
0	In the response, the student does not address the question or provides a solution that is invalid.	In the response, the student • incorrectly completes the Venn diagram only
0.5		For example, the student could • correctly complete the Venn diagram only OR • not complete or incorrectly complete the Venn diagram and state the odds in favour of only Janelle's brother being approved
1	In the response, the student demonstrates basic mathematical understanding of the problem by applying an appropriate strategy or relevant mathematical knowledge to find a partial solution.	In the response, the student • incorrectly completes the Venn diagram, but then continues with a correct process to determine the odds in favour OR • correctly completes the Venn diagram, but determines an incorrect odds in favour by not taking 0.05 into consideration (i.e., 65 : 30) OR • correctly completes the Venn diagram, but determines the probability only (i.e., 0.65)
1.5		For example, the student could • correctly complete the Venn diagram, but determine the odds in favour of only Janelle's brother being approved (i.e., 20 : 80)
2	In the response, the student demonstrates complete mathematical understanding of the problem by applying an appropriate strategy or relevant mathematical knowledge to find a complete and correct solution.	In the response, the student • correctly completes the Venn diagram and determines the correct odds in favour of Janelle's brother being approved for the time off
Note: Any equivalent odds ratio can receive full marks.		

WR 1 Part d

Score	General Description	Specific Description
NR	No response is provided.	
0	In the response, the student does not address the question or provides a solution that is invalid.	The response does not contain • shades in an incorrect region and provides an incorrect description
0.5		For example, the student could • provide a correct description with no reference to the context
1	In the response, the student demonstrates basic mathematical understanding of the problem by applying an appropriate strategy or relevant mathematical knowledge to find a partial solution.	In the response, the student • shades in the correct region, and either provides an incorrect description or does not provide a description OR • shades in an incorrect region, but provides a correct description of the notation within the context
1.5		For example, the student could • shade in the correct region, but provide a correct description that makes no reference to the context or lacks clarity
2	In the response, the student demonstrates complete mathematical understanding of the problem by applying an appropriate strategy or relevant mathematical knowledge to find a complete and correct solution.	In the response, the student • shades in the correct region and provides a correct description within the context

Scoring Guide for Written-response Question 2

WR 2 Part a

Score	General Description	Specific Description
NR	No response is provided.	
0	In the response, the student does not address the question or provides a solution that is invalid.	In the response, the student • states any incorrect non-permissible values
0.5		For example, the student could • state only two of the correct non-permissible values of x
1	In the response, the student applies appropriate mathematical knowledge to find a complete and correct solution.	In the response, the student • correctly states all three non-permissible values

WR 2 Part b

Score	General Description	Specific Description
NR	No response is provided.	
0	In the response, the student does not address the question or provides a solution that is invalid.	In the response, the student • writes the multiplication statement only OR • states the answer with no supporting work
0.5		For example, the student could • correctly factor two of the polynomials OR • multiply the expressions correctly with no factoring
1	In the response, the student demonstrates basic mathematical understanding of the problem by applying an appropriate strategy or relevant mathematical knowledge to find a partial solution.	In the response, the student • correctly factors two of the polynomials, and simplifies incompletely with common factors remaining OR • correctly factors all the polynomials and multiplies the expressions, but does not reduce OR • incorrectly writes an addition statement, but correctly factors all the polynomials, and continues with a correct process to find the simplified sum $\left(\text{i.e., } \frac{2x^2 + 16x + 39}{x + 4}\right)$
1.5		For example, the student could • correctly factor all the polynomials, but simplifies incompletely with common factors remaining OR • correctly factor all the polynomials and reduce, but makes a minor error in the simplified answer
2	In the response, the student demonstrates complete mathematical understanding of the problem by applying an appropriate strategy or relevant mathematical knowledge to find a complete and correct solution.	In the response, the student • correctly determines the distance travelled

Note: Students do not need to restate the non-permissible values in part b.

WR 2 Part c

Score	General Description	Specific Description
NR	No response is provided.	
0	In the response, the student does not address the question or provides a solution that is invalid.	In the response, the student • states the correct answer with no supporting work
0.5		For example, the student could • correctly apply a common denominator to the left side only, and continues to solve a linear equation for x OR • correctly identify a common denominator and attempt to eliminate the denominators
1	In the response, the student demonstrates basic mathematical understanding of the problem by applying an appropriate strategy or relevant mathematical knowledge to find a partial solution.	In the response, the student • eliminates all denominators correctly and obtains a quadratic equation
1.5		For example, the student could • obtain a correct quadratic equation in standard form, but makes an algebraic error in solving for x OR • correctly solve the equation algebraically, but does not reject the extraneous solution OR • provide a complete and correct solution to an incorrect quadratic equation
2	In the response, the student demonstrates complete mathematical understanding of the problem by applying an appropriate strategy or relevant mathematical knowledge to find a complete and correct solution.	In the response, the student • correctly determines the solution to the equation algebraically, and clearly rejects the extraneous solution

WR 2 Part d

Score	General Description	Specific Description
NR	No response is provided.	
0	In the response, the student does not address the question or provides a solution that is invalid.	The response does not contain • does not show progress toward the successful completion of the puzzle
0.5		For example, the student could • correctly identify the information for one of the competitors or one of the categories
1	In the response, the student demonstrates basic mathematical understanding of the problem by applying an appropriate strategy or relevant mathematical knowledge to find a partial solution.	In the response, the student • provides a partially correct solution to the puzzle with three errors or omissions
1.5		For example, the student could • provide a partially complete solution to the puzzle with one or two errors or omissions
2	In the response, the student demonstrates complete mathematical understanding of the problem by applying an appropriate strategy or relevant mathematical knowledge to find a complete and correct solution.	In the response, the student • correctly solves the puzzle and clearly identifies the solution