Mathematics 30-2

Released Items

2013 Released Diploma Examination Items

Alberta Government

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The Alberta Education website is found at education.alberta.ca.

Contents

Introduction

The questions in this booklet are from the January 2013 Mathematics 30–2 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*. This material, along with the *Program of Studies*, *Information Bulletin*, *Assessment Standards and Exemplars*, and the *Assessment Highlights*, can provide insights that assist you with decisions about instructional planning.

These questions are released in both English and French by the Assessment Sector.

Additional Documents

The Assessment Sector supports the instruction of Mathematics 30–2 with the following documents available online at www.education.alberta.ca.

- *Mathematics 30–2 Information Bulletin and Mathematics 30–2 Assessment Standards and Exemplars*
  Available at education.alberta.ca.
  From the home page, follow this path:
  Teachers > *(Additional Programs and Services) Diploma Exams* > *Information Bulletins.*
  Contains information about the diploma examinations for the upcoming school year, and sample questions.

- *Mathematics 30–2 Practice Questions*
  Some practice questions have been released for Mathematics 30–2. Available at https://questaplus.alberta.ca.

- *School Reports and Instructional Group Reports*
  Available at https://phoenix.edc.gov.ab.ca/login.
  Detailed statistical information on provincial, group, and individual student performance on the entire examination.

Mathematics 30-2 Diploma Examination January 2013 – Blueprint Summary

The following table gives results for the machine-scored questions released from the examination and shows the percentage of students that answered each question correctly. For each question, the table also gives the correct response, the topic, the outcome, the standard, and the cognitive levels.

Topics

LR Logical Reasoning
PR Probability
RF Relations and Functions

Standards

AC Acceptable
SE Excellence

Cognitive Level

C Conceptual
P Procedural
PS Problem Solving

Question	Diff.*	Key	Topic	Outcome	Cognitive Level	Standard
MC1	53.0%	A	RF	2	Procedural	Acceptable
MC2	60.3%	B	RF	2	Procedural	Excellence
NR1	22.5%	425	RF	2	Procedural	Acceptable
MC3	41.5%	D	RF	1	Procedural	Acceptable
MC4	71.2%	C	RF	3	Procedural	Acceptable
NR2	28.6%	83.3	RF	3	Procedural	Acceptable
MC5	63.4%	D	RF	4	Procedural	Acceptable
NR3	62.7%	24	RF	4	Procedural	Acceptable
MC6	64.0%	D	RF	4	Procedural	Excellence
NR4	62.8%	21	RF	6	Problem Solving	Acceptable
MC7	59.9%	B	RF	5	Conceptual	Acceptable
MC8	59.6%	D	RF	6	Problem Solving	Acceptable
NR5	65.0%	126	RF	5	Procedural	Acceptable
MC9	64.8%	A	RF	6	Conceptual	Acceptable
MC10	56.7%	D	LR	2	Conceptual	Excellence
NR6	95.1%	13, 31, 14, 41, 34, or 43	LR	2	Problem Solving	Excellence

Question	Diff.*	Key	Topic	Outcome	Cognitive Level	Standard
MC11	74.8%	C	LR	2	Conceptual	Excellence
MC12	68.3%	A	LR	2	Problem Solving	Acceptable
MC13	53.3%	C	LR	2	Conceptual	Acceptable
MC14	69.3%	A	LR	1	Problem Solving	Acceptable
MC15	21.6%	A	LR	1	Problem Solving	Acceptable
MC16	65.6%	D	PR	1	Conceptual	Acceptable
MC17	37.1%	C	PR	1	Problem Solving	Acceptable
MC18	47.1%	B	PR	2	Conceptual	Acceptable
NR7	59.0%	0.34	PR	2	Problem Solving	Acceptable
MC19	89.0%	B	PR	3	Conceptual	Acceptable
NR8	31.8%	0.04	PR	3	Problem Solving	Acceptable
MC20	66.9%	C	PR	5	Conceptual	Acceptable
NR9	57.0%	3	PR	4	Problem Solving	Acceptable
MC21	70.4%	A	PR	4	Problem Solving	Excellence
NR10	66.5%	4960	PR	4	Problem Solving	Acceptable
MC22	51.4%	C	PR	6	Problem Solving	Excellence
MC23	43.2%	B	PR	6	Procedural	Acceptable
NR11	37.3%	15	PR	6	Conceptual	Acceptable
MC24	78.5%	B	RF	7	Conceptual	Acceptable
MC25	39.6%	C	RF	7	Conceptual	Acceptable
NR12	35.4%	7	RF	7	Problem Solving	Acceptable
MC26	45.8%	D	RF	8	Conceptual	Acceptable
MC27	60.9%	B	RF	8	Problem Solving	Acceptable
MC28	44.8%	C	RF	8	Conceptual	Acceptable

*Difficulty—proportion of students answering the question correctly

Mathematics 30–2 Diploma Examination
January 2013 – Released Items

1. When $\frac{x}{3x+12}+\frac{x-1}{6x+24}$, $x \neq -4$, is simplified, the numerator is $3x - 1$ and the denominator is

A. $6(x + 4)$
B. $6(x + 4)^2$
C. $18(x + 4)$
D. $18(x + 4)^2$

2. The non-permissible values of x for the expression $\frac{x+3}{x-4} \div \frac{x}{x-3}$ are

A. –3, 0, 3, and 4
B. 0, 3, and 4
C. 0 and 4
D. 3 and 4

Use the following information to answer the next question.

The simplified product of $\frac{2n^4p}{3m} \cdot \frac{6m^6}{3n^2p^2}$, $m \neq 0, n \neq 0, p \neq 0$, can be represented by

$$\frac{\boxed{A}n^{\boxed{B}}m^{\boxed{C}}}{3p}$$

where ***A***, ***B***, and ***C*** represent single-digit numbers.

Numerical Response

1. In the simplified product $\frac{\boxed{A}n^{\boxed{B}}m^{\boxed{C}}}{3p}$, the value of

A is _____ (Record in the **first** column)
B is _____ (Record in the **second** column)
C is _____ (Record in the **third** column)

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

Use the following information to answer the next question.

Ken made an error in the simplification of the rational expression $\frac{2x+10}{2x^2-50}$, $x \neq -5, 5$. His simplification of the expression is shown below.

Step 1 $\frac{{}^{1}\cancel{2}(x+5)}{{}^{1}\cancel{2}(x^2-25)}$

Step 2 $\frac{1(x+5)}{1(x+5)(x-5)}$

Step 3 $\frac{1\cancel{(x+5)}}{1\cancel{(x+5)}(x-5)}$

Step 4 $(x-5),\ x \neq -5, 5$

3. The step in which Ken made his error is

A. Step 1
B. Step 2
C. Step 3
D. Step 4

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4. The solution for x in the equation $\frac{-2}{3} - \frac{4}{x} = 6,\ x \neq 0,$ is

A. –15

B. –9

C. $\frac{-3}{5}$

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

Use the following information to answer the next question.

Over a distance of 800 km, the average speed of a small airplane is 6 times faster than the average speed of a train. This information is shown in the table below.

	Distance (km)	Speed (km/h)	Time (h)
Train	800	x	$\frac{800}{x}$
Airplane	800	$6x$	$\frac{800}{6x}$

To travel 800 km, the train requires 8 h more than the airplane. The equation shown below represents this relationship.

$$\frac{800}{x} - \frac{800}{6x} = 8$$

Numerical Response

2. The average speed of the train, to the nearest tenth of a kilometre per hour, is _____ km/h.

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

5. Which of the following equations is equivalent to $4^{(x+2)} = 16$?

A. $\log_{(x+2)} 4 = 16$

B. $\log_{(x+2)} 16 = 4$

C. $\log_4 (x + 2) = 16$

D. $\log_4 16 = x + 2$

Numerical Response

3. When the expression $\log_8 6 + \log_8 4$ is simplified to the form $\log_8 a$, the value of a is _____.

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

6. An expression that is equivalent to $3 \log a - 3 \log b$ is

A. $\log(a - b)^3$

B. $3 \log(a - b)$

C. $\log\left(\frac{a^3}{b}\right)$

D. $\log\left(\frac{a}{b}\right)^3$

Use the following information to answer the next question.

The table below shows the average height of a particular stand of trees for their first 6 years.

Age (yrs)	Average Height (ft)
1	6
2	10
3	13
4	15
5	16
6	17

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

$$h = a + b \ln t$$

where h is the average height of the stand of trees after t years.

Numerical Response

4. According to this regression function, the average height of this stand of trees when they are 11 years old, to the nearest foot, will be _____ ft.

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

7. Which of the following equations could be used to algebraically solve the exponential equation $3^{(x-1)} = 9^{(x-3)}$?

A. $3^{(x-1)} = 3^{(2x-3)}$
B. $3^{(x-1)} = 3^{(2x-6)}$
C. $9^{(2x-1)} = 9^{(x-3)}$
D. $9^{(2x-2)} = 9^{(x-3)}$

Use the following information to answer the next question.

From 1997 to 2008, the population of a particular town grew at an average rate of 5.4%/a. During this 11-year period, its population, P, can be modelled by the exponential function

$$P = x(1 + r)^n$$

where x is the population in 1997, r is the average annual growth rate, and n is the number of years since 1997. In 2008, the population was 14 030.

8. According to the model, the population of this town in 1997 was approximately

A. 121
B. 828
C. 1 210
D. 7 867

Use the following information to answer the next question.

The 2010 earthquake in Haiti measured 7.0 on the Richter scale. In 2004, an earthquake off Indonesia measuring 9.1 on the same scale caused a tsunami. In order to compare the relative intensities, I, of these two earthquakes, the following formula may be used:

$$I = \frac{10^m}{10^n}$$

where m and n are the Richter scale values of each earthquake.

Numerical Response

5. Compared to the earthquake in Haiti, the earthquake off Indonesia, to the nearest whole number, was _____ times stronger.

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

Use the following information to answer the next question.

Ahmed invested $1 000 for four years into an account that pays 3%/a, compounded annually.

9. Which of the following functions models the value, V, of Ahmed's investment in four years' time?

A. $V = 1\ 000(1.03)^4$

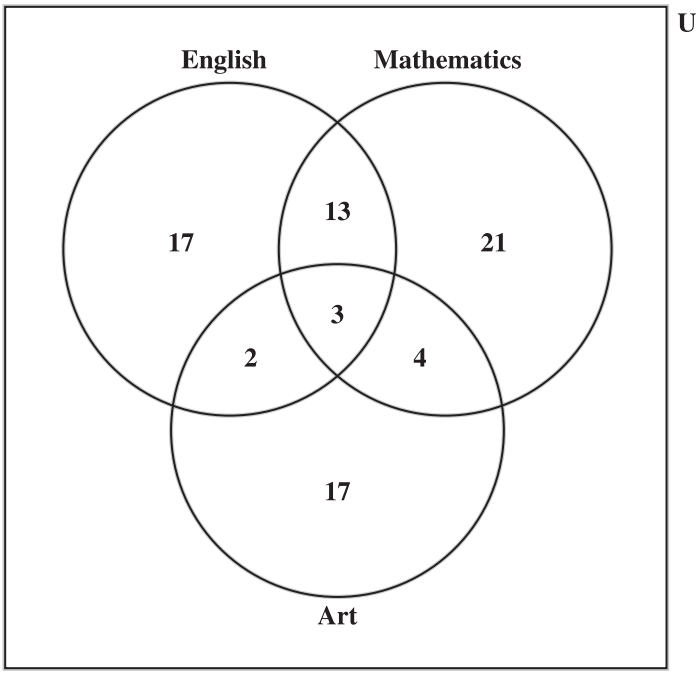
B. $V = 1\ 000(0.03)^4$

C. $V = 1\ 000(1.03)(4)$

D. $V = 1\ 000(0.03)(4)$

Use the following information to answer the next question.

The Venn diagram below represents the number of students taking English, mathematics, and art at a particular school.



10. The number of students taking mathematics or English is

A. 13

B. 16

C. 51

D. 60

Use the following information to answer the next question.

Four Sets

Set	Set Description
1	{2, 3, 8, 9, 15, 16}
2	{2, 3, 5, 7, 11, 13, 17, 19}
3	{multiples of 3 between 0 and 20}
4	{odd numbers between 0 and 20}

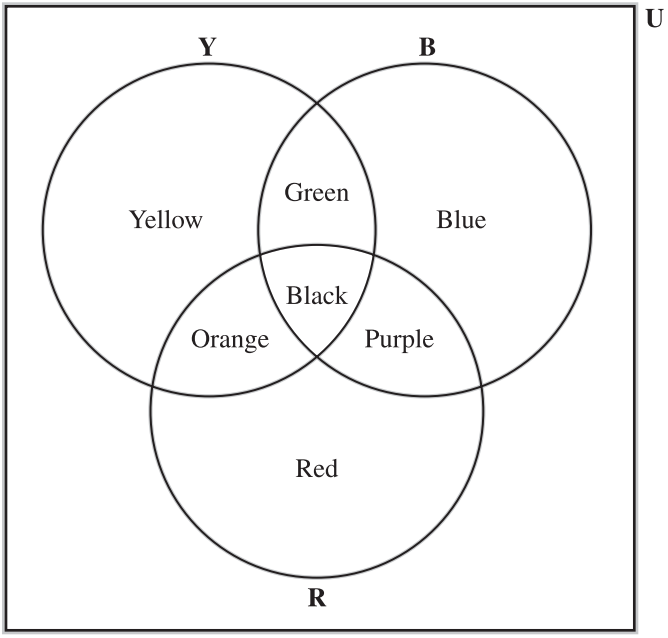
Numerical Response

6. Two of the sets that can produce the intersection {3, 9, 15} are _____ and _____. (There is more than one correct answer.)

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

Use the following information to answer the next question.

The universal set of the primary and secondary colours in art contains the colours yellow, blue, red, orange, green, purple, and black, as shown below.



11. If R is the set of colours that contains red, then all of the colours in the complement of R, R', are

A. yellow and blue

B. orange and purple

C. yellow, green, and blue

D. orange, black, and purple

Use the following information to answer the next question.

There are 35 students in John's homeroom class. There are 5 students who take English and biology, and 7 students who take neither of these subjects. There are 3 more students taking only English than there are students taking only biology.

12. The number of students in John's homeroom who take biology only is

A. 10

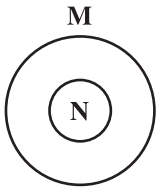
B. 13

C. 15

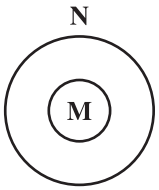
D. 20

13. Which of the following Venn diagrams illustrates $M \cap N = \varnothing$?

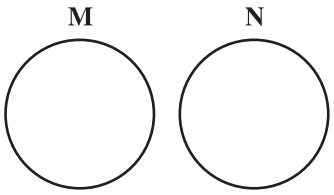
A.



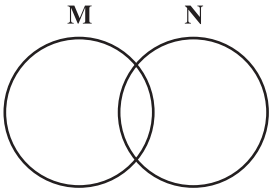
B.



C.

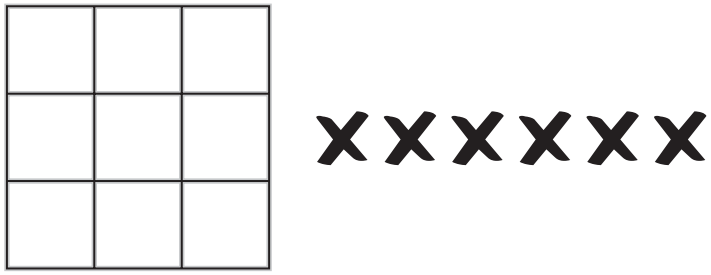


D.



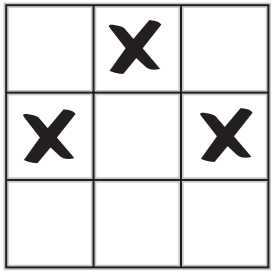
Use the following information to answer the next question.

To solve a particular logic puzzle, an X must be placed in six of the squares in the grid shown below so that no three Xs lie in a vertical, horizontal, or diagonal line.

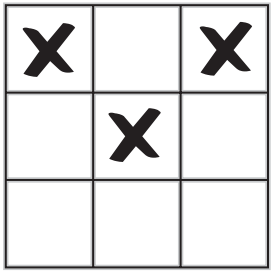


14. Which of the following opening placements for the first three Xs could lead to a successful solution for this logic puzzle?

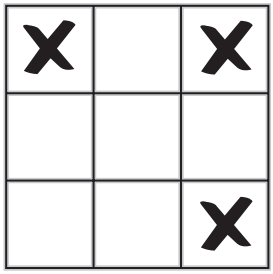
A.



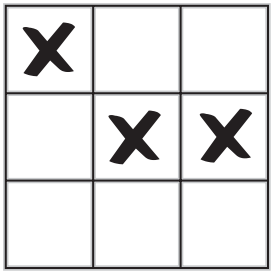
B.



C.



D.



Use the following information to answer the next question.

Sasha has 6 white socks, 4 black socks, and 10 brown socks in the clothes dryer. Without looking, he randomly selects one sock at a time until he gets 2 socks that are the same colour.

15. The number of socks that Sasha must randomly select from the clothes dryer to guarantee that he gets 2 socks that are the same colour but **not** white is

A. 9

B. 8

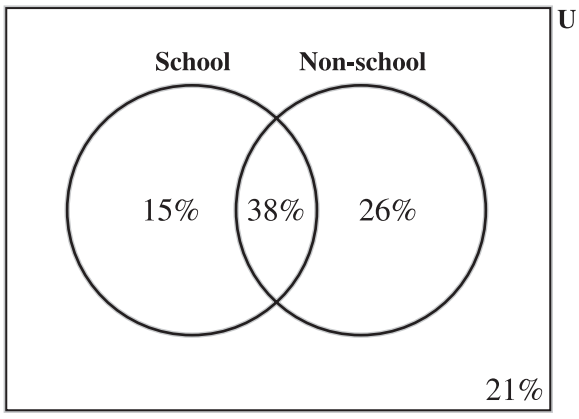
C. 4

D. 3

Use the following information to answer the next question.

A survey of Alberta students was used to estimate the percentage of students who participate in school and non-school athletics, as well as the percentage who do not participate in any athletics. The results of the survey are shown in the Venn diagram below.

Participation in School and Non-School Athletics



16. The odds in favour of randomly selecting an Alberta student who participates in school athletics are

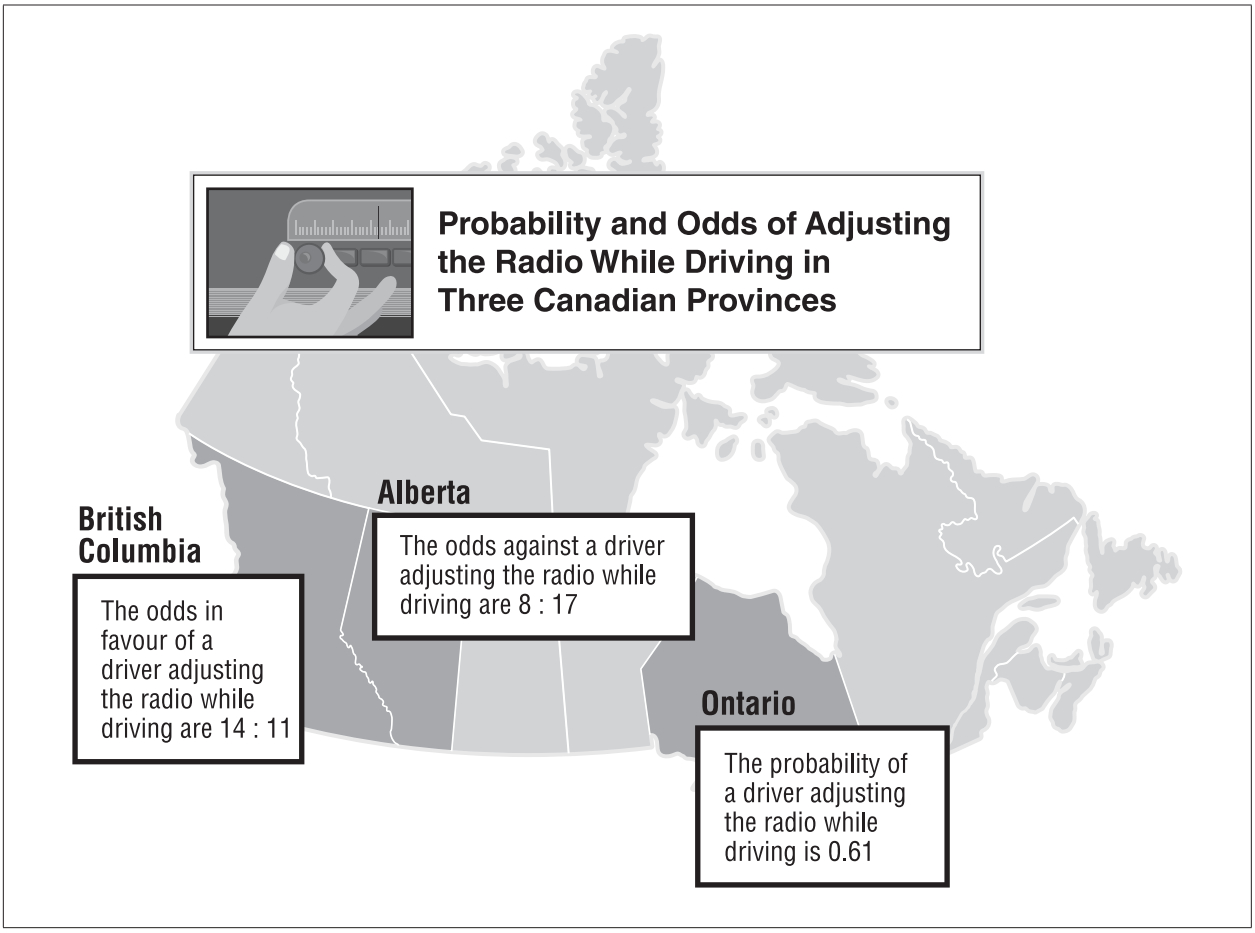
A. 15 : 64

B. 15 : 85

C. 53 : 26

D. 53 : 47

Use the following information to answer the next question.



17. If the provinces listed above are arranged in order from the **lowest** probability of a driver adjusting the radio to the **highest** probability of a driver adjusting the radio, the order will be

A. Alberta, British Columbia, Ontario

B. Alberta, Ontario, British Columbia

C. British Columbia, Ontario, Alberta

D. British Columbia, Alberta, Ontario

Use the following information to answer the next question.

Three Experiments and Related Events

I Experiment I involves rolling a fair die once. Event X is rolling a 2. Event Y is rolling a 6.

II Experiment II involves randomly selecting one number from 1 to 10 inclusive. Event X is selecting an odd number. Event Y is selecting a number that is prime.

III Experiment III involves randomly choosing one marble from a bag. Event X is choosing a red marble. Event Y is choosing a green marble.

18. The mutually exclusive events are described in experiments

A. I and II only
B. I and III only
C. II and III only
D. I, II, and III

Use the following information to answer the next question.

There are 10 black, 12 red, 14 yellow, 9 green, 8 orange, and 11 purple candies in a particular package of candy.

Numerical Response

7. If one candy is randomly selected, then the probability, to the nearest hundredth, that it is a red candy or a black candy is _____.

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

Use the following information to answer the next question.

A child has a box containing 8 toy cars and 6 toy trucks. He reaches in and randomly selects 2 toys, one after the other, without replacement.

19. Which of the following expressions could be used to determine the probability that the two toys selected are both toy cars?

A. $\frac{8}{14} \cdot \frac{7}{14}$

B. $\frac{8}{14} \cdot \frac{7}{13}$

C. $\frac{8}{14} \cdot \frac{8}{14}$

D. $\frac{8}{14} \cdot \frac{8}{13}$

Use the following information to answer the next question.

An automobile association collected data on the probability of an accident occurring at different time periods over the course of a day. It also collected separate data on the probability of an accident occurring in each month of the year. These data are shown in the two tables below.

Accident Occurrence by Time of Day

24-h Clock Time Period	Probability of An Accident Occurring
23:00 – 02:59	0.074
03:00 – 06:59	0.061
07:00 – 10:59	0.180
11:00 – 14:59	0.241
15:00 – 18:59	0.286
19:00 – 22:59	0.158
Total	**1.000**

Accident Occurrence by Month

Month	Probability of An Accident Occurring
January	0.105
February	0.094
March	0.072
April	0.075
May	0.066
June	0.073
July	0.073
August	0.068
September	0.072
October	0.079
November	0.089
December	0.134
Total	**1.000**

Numerical Response

8. Assuming that these are independent events, the probability, to the nearest hundredth, that a randomly selected accident will occur in the time period 15:00–18:59 in December is _____.

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

Use the following information to answer the next question.

Soren is arranging 6 coloured blocks in a row. There are 3 identical green blocks, 1 red block, 1 blue block, and 1 yellow block.

20. An expression that Soren could use to calculate the total number of different possible arrangements of the 6 blocks is

A. $6!$

B. $3!$

C. $\frac{6!}{3!}$

D. $\frac{6!}{4!}$

Use the following information to answer the next question.

A magazine publisher is planning a photographic layout to show how 12 different outfits are possible by combining one shirt, one jacket, and a pair of pants.

Numerical Response

9. If 2 different jackets and 2 styles of pants are used for the photographic layout, then the minimum number of different shirts required to show the 12 different outfits is _____.

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

Use the following information to answer the next question.

A particular school generates student identification (ID) numbers using the following rules.

- The first two digits are the last two digits of the year the student started Grade 1 (2009 = 09, 2010 = 10, etc.).
- The third digit indicates the student's gender (1 for male and 2 for female).
- The remaining four digits are any whole number from 0 to 9 inclusive, without repetition.

21. The number of different ID numbers that are possible for students who started Grade 1 in 2002 can be determined by using the calculation

A. $1 \cdot 1 \cdot 2 \cdot 10 \cdot 9 \cdot 8 \cdot 7$

B. $1 \cdot 2 \cdot 2 \cdot 10 \cdot 9 \cdot 8 \cdot 7$

C. $1 \cdot 1 \cdot 2 \cdot 10 \cdot 10 \cdot 10 \cdot 10$

D. $1 \cdot 2 \cdot 2 \cdot 10 \cdot 10 \cdot 10 \cdot 10$

Use the following information to answer the next question.

The four-digit security code for Maureen's old bank card allowed the digits 0 through 9 inclusive, without repetition. Maureen's new bank card requires a four-digit security code that consists of the digits 0 through 9 inclusive, with repetition allowed.

Note: Both security codes can start with 0.

Numerical Response

10. Compared to the four-digit security code for Maureen's old bank card, there are _____ more four-digit security codes available for her new bank card.

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

Use the following information to answer the next question.

There are 14 students, 8 boys and 6 girls, who belong to a particular school's badminton club. The coach randomly selects 2 boys and 2 girls to practice together.

22. How many different practice teams can be selected?

A. 43
B. 86
C. 420
D. 1 001

Use the following information to answer the next question.

A local restaurant offers milkshakes in 20 different flavours. The owner has decided to offer customers the choice of blending two different flavours together to create more flavour options.

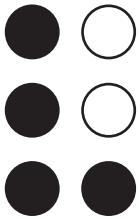
23. The total number of different possible two-flavour blended milkshakes is

A. 40
B. 190
C. 380
D. 400

Use the following information to answer the next question.

In the Braille system, each Braille character consists of 6 dot positions. Dots can be raised to represent letters, digits, symbols, or common letter combinations.

The Braille character for the letter "v" is shown below. Dots that are raised are represented by solid dots.



v

Numerical Response

11. The number of different Braille characters that have 4 of the 6 dots raised is _____.

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

Use the following information to answer the next question.

A ball is launched vertically upward from a height of 5 ft, with an initial velocity of 96 ft/s. The height of the ball above the ground for the first 5 seconds is shown in the table below.

Time (s)	Height (ft)
0	5
1	86
2	134
3	150
4	134
5	86

24. These data could **most appropriately** be modelled using

A. linear regression
B. quadratic regression
C. sinusoidal regression
D. exponential regression

Use the following information to answer the next question.

The following statements were made about the polynomial function $y = (x - 5)^2(x + 3)$.

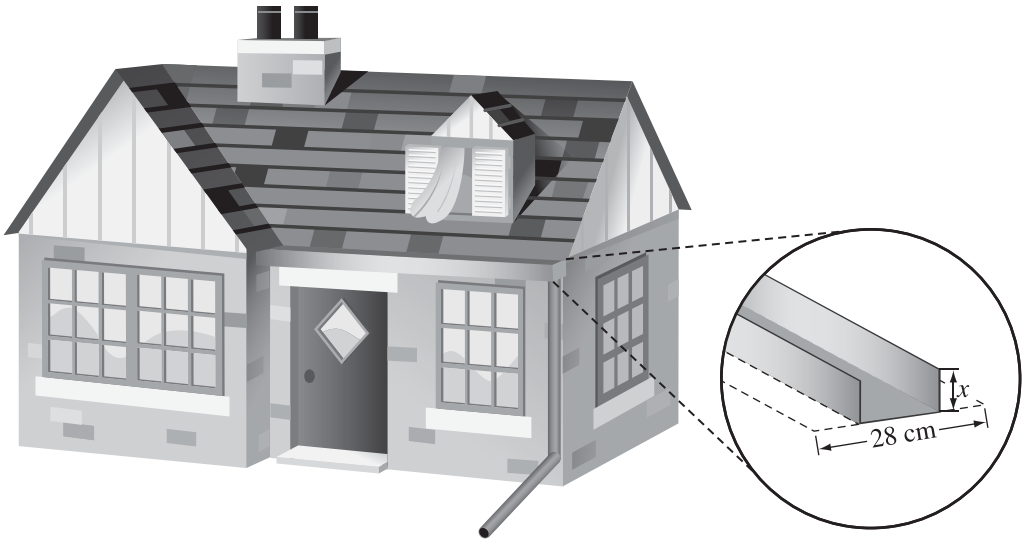
I The x-intercepts are -3 and 5.
II The function has a degree of 3.
III The domain is $-3 \leq x \leq 5$, $x \in R$.
IV The range is $y \in R$.

25. The statements that are true are

A. I and II only
B. III and IV only
C. I, II, and IV
D. I, III, and IV

Use the following information to answer the next question.

A rain gutter is made from sheets of aluminium that are 28 cm wide. The first step in forming the rain gutter is to turn the edges up to form right angles, as shown in the diagram below.



The cross-sectional area formed by the turned-up edges affects the water flow. This cross-sectional area, A, can be modelled by the function

$$A = x\,(28 - 2x)$$

where x is the height of the turned-up edges.

Numerical Response

12. To the nearest centimetre, the height of the turned-up edge, x, that will maximize the cross-sectional area is _____ cm.

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

Use the following information to answer the next question.

A family is going to take a ride on the London Eye, which is a Ferris wheel that constantly rotates. Once the family is in a capsule on the ride, the height of the capsule above the ground, y, in metres, can be modelled by the sinusoidal function

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

where x is the time, in seconds, after the family gets in the capsule.

26. In this context, the y-intercept represents the

A. length of time it takes for the family to reach the median height of the Ferris wheel

B. length of time it takes for the Ferris wheel to complete one revolution

C. height of the family at the highest point above the ground

D. height of the family at the moment they get in the capsule

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Use the following information to answer the next question.

The height of the tide, in metres, at a particular harbour can be modelled by the sinusoidal function

$$h = 4 \sin(0.51t + 1.57) + 6$$

where t represents the number of hours after midnight on a particular day.

27. To the nearest minute, the earliest time after midnight on that day that the height of the tide is at its minimum depth is

A. 09:14

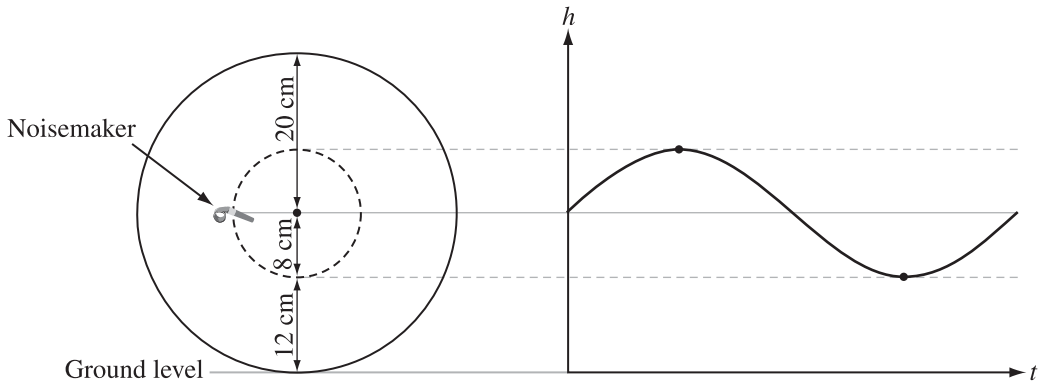
B. 06:10

C. 03:05

D. 00:09

Use the following information to answer the next question.

The radius of a child's bicycle wheel is approximately 20 cm. The child has placed a noisemaker on a spoke of the wheel 12 cm from the outside edge. As the wheel rotates, the height of the noisemaker above the ground follows a sinusoidal pattern, as shown below.



28. If ground level is the reference point, the amplitude and median of the sinusoidal function are, respectively,

A. 20 and 20

B. 20 and 8

C. 8 and 20

D. 8 and 8