Mathematics 30–1 | Released Items

2016 Released Diploma Examination Items

Alberta Government

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The Alberta Education website is found here.

Contents

Introduction

The questions in this booklet are from the April 2016 Mathematics 30-1 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 30-1 Program of Studies*. This material, along with the *Program of Studies*, *Information Bulletin*, and *Assessment Standards and Exemplars*, can provide insights that assist with decisions about instructional planning.

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

Additional Documents

The Provincial Assessment Sector supports the instruction of Mathematics 30–1 with the following documents available online.

- *Mathematics 30–1 Information Bulletin* and *Mathematics 30–1 Assessment Standards and Exemplars*

- *Mathematics 30–1 Practice Questions*
  Some practice questions have been released for Mathematics 30–1.

- *School Reports and Instructional Group Reports*
  Detailed statistical information on provincial, group, and individual student performance on the entire examination.

Mathematics 30-1 Diploma Examination
April 2016 – 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		**Standards**	**Cognitive Level**
RF	Relations and Functions	Acceptable	Conceptual
TRIG	Trigonometry	Excellence	Procedural
PCBT	Permutations, Combinations, and Binomial Theorem		Problem Solving

Question	Diff.*	Key	Topic	Outcome	Cognitive Level	Standard
MC1	79.6%	C	RF	2	Procedural	Acceptable
MC2	84.0%	B	RF	4	Conceptual	Acceptable
MC3	72.5%	B	RF	3,5	Conceptual	Acceptable
NR1	43.4%	3547	RF	3	Conceptual	Acceptable
MC4	64.9%	C	RF	5	Procedural	Acceptable
NR2	35.5%	531	RF	5	Conceptual	Acceptable
MC5	50.4%	B	RF	6	Conceptual	Acceptable
MC6	33.1%	C	RF	10	Problem Solving	Acceptable
NR3	74.8%	3.33	RF	7	Problem Solving	Acceptable
MC7	77.9%	D	RF	8	Problem Solving	Excellence
NR4	62.9%	0.42	RF	8	Procedural	Acceptable
MC8	66.7%	A	RF	9	Conceptual	Acceptable
MC9	32.8%	C	RF	10	Problem Solving	Excellence
MC10	76.4%	B	RF	11	Procedural	Acceptable
NR5	47.0%	2.5	RF	11,12	Problem Solving	Acceptable
MC11	42.2%	B	RF	12	Problem Solving	Acceptable
MC12	55.7%	C	RF	13	Problem Solving	Acceptable
NR6	29.0%	410	RF	13	Conceptual	Acceptable
MC13	69.3%	D	RF	14	Procedural	Excellence
MC14	74.2%	D	RF	14	Conceptual	Acceptable
MC15	61.2%	C	RF	1	Conceptual	Acceptable

Question	Diff.*	Key	Topic	Outcome	Cognitive Level	Standard
NR7	53.8%	2.44	RF	1	Procedural	Acceptable
MC16	72.1%	B	TRIG	1	Procedural	Acceptable
NR8	47.7%	4.2	TRIG	1	Problem Solving	Acceptable
MC17	78.2%	A	TRIG	2,3	Procedural	Acceptable
NR9	47.5%	3494	TRIG	2	Procedural	Acceptable
MC18	28.3%	A	TRIG	3	Conceptual	Excellence
MC19	68.5%	C	TRIG	3	Conceptual	Acceptable
NR10	77.6%	80	TRIG	3,5	Problem Solving	Acceptable
MC20	39.2%	A	TRIG	4	Problem Solving	Acceptable
MC21	55.5%	D	TRIG	4	Problem Solving	Acceptable
MC22	27.8%	D	TRIG	5	Problem Solving	Excellence
MC23	45.6%	A	TRIG	6	Procedural	Excellence
MC24	78.5%	D	TRIG	6	Procedural	Acceptable
MC25	69.4%	A	PCBT	1	Conceptual	Acceptable
NR11	61.1%	23	PCBT	1	Conceptual	Excellence
NR12	70.5%	1080	PCBT	2	Problem Solving	Acceptable
MC26	51.0%	D	PCBT	3	Problem Solving	Excellence
MC27	48.4%	B	PCBT	4	Procedural	Excellence
MC28	68.9%	A	PCBT	4	Conceptual	Acceptable

*Difficulty—proportion of students answering the question correctly

Mathematics 30–1 Diploma Examination
April 2016 – Released Items

1. If the graph of $f(x) = (x - 2)^2 + 1$ is transformed into the graph of $g(x) = f(x - 4) + 3$, then the coordinates of the vertex on the graph of $y = g(x)$ will be

A. (2, 4)

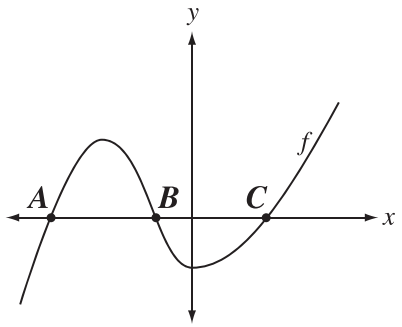
B. (–2, 4)

C. (6, 4)

D. (–6, 4)

Use the following information to answer question 2.

The partial graph of the function $y = f(x)$ is shown below.



2. Which of the following transformations will **always** create invariant points at *A*, *B*, and *C*?

A. $y = f(bx)$

B. $y = af(x)$

C. $y = f(x) + k$

D. $y = f(x - h)$

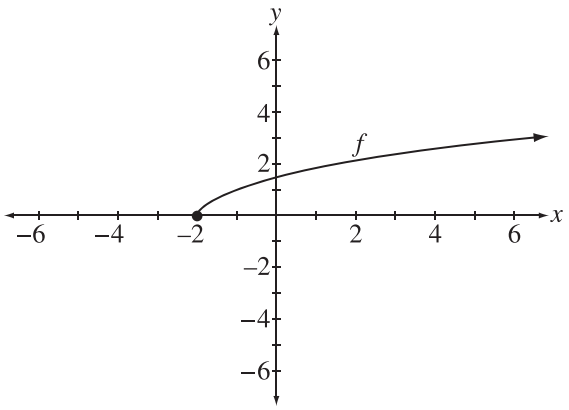
3. *When compared to the graph of* $y = f(x)$, *the graph of* $8y = f(-x)$ *has been reflected in the* ___***i***___ *and vertically stretched about the x-axis by a factor of* ___***ii***___ .

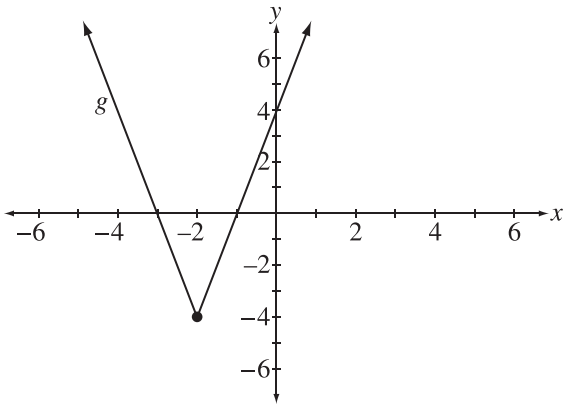
The statement above is completed by the information in row

Row	***i***	***ii***
A.	y-axis	8
B.	y-axis	$\frac{1}{8}$
C.	x-axis	8
D.	x-axis	$\frac{1}{8}$

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

The graphs of the functions $y = f(x)$ and $y = g(x)$ are shown below. Each function is then horizontally stretched by a factor of 2 about the y-axis, resulting in the new functions $y = p(x)$ and $y = q(x)$ respectively. The domain and the range of each of the new functions are found in the table below.





Reference Number	Possible Domain
1	$x \geq -1$
2	$x \geq -2$
3	$x \geq -4$
4	$x \in R$

Reference Number	Possible Range
5	$y \geq 0$
6	$y \geq -2$
7	$y \geq -4$
8	$y \geq -8$
9	$y \in R$

Numerical Response

1. Complete the statements below.

The domain and range of the new function $y = p(x)$ are numbered, respectively, _____ (Record in the **first** column) and _____ (Record in the **second** column).

The domain and range of the new function $y = q(x)$ are numbered, respectively, _____ (Record in the **third** column) and _____ (Record in the **fourth** column).

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

4. The graph of $f(x) = 4x^2 + 3x - 5$ is transformed into the graph of $g(x) = -f(-x)$. The equation representing $g(x)$ is

A. $g(x) = 4x^2 + 3x + 5$

B. $g(x) = 4x^2 + 3x - 5$

C. $g(x) = -4x^2 + 3x + 5$

D. $g(x) = -4x^2 - 3x - 5$

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

The point $A(3, -5)$ lies on the graph of the function $y = f(x)$. The ordered pairs below represent possible coordinates of the new point corresponding to Point A after $f(x)$ undergoes a single transformation.

Point 1 (3, 5)

Point 2 (–3, 5)

Point 3 (–3, –5)

Point 4 (–5, –3)

Point 5 (–5, 3)

Point 6 (5, –3)

Numerical Response

2. The corresponding point when the graph of $y = f(x)$ is reflected about the line

$y = x$ is Point _____ (Record in the **first** column)

$x = 0$ is Point _____ (Record in the **second** column)

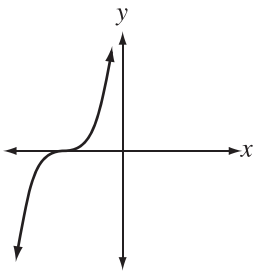
$y = 0$ is Point _____ (Record in the **third** column)

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

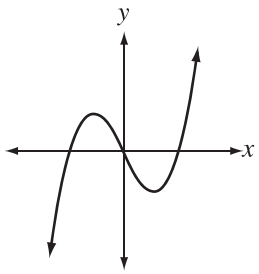
Use the following information to answer question 5.

A student is asked to draw the inverse of each of the following graphs.

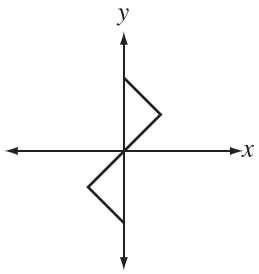
Graph 1



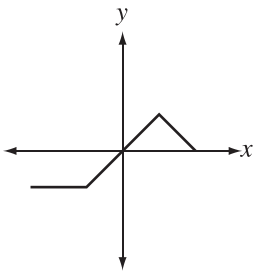
Graph 2



Graph 3



Graph 4



5. If no additional restrictions are given, which two graphs above will have an inverse that is a function?

A. Graph 1 and Graph 2

B. Graph 1 and Graph 3

C. Graph 2 and Graph 3

D. Graph 2 and Graph 4

Use the following information to answer question 6.

A student is asked to solve the equation $\frac{125^{x(x+1)}}{5^{(3x-4)}} = 25^{(x-5)}$ using an algebraic process.

She is able to simplify the equation to the form $3x^2 + bx + c = 0$.

6. The value of $\boldsymbol{c}$ is

A. 6

B. 9

C. 14

D. 40

Numerical Response

3. If $\log_a 8 = 3$ and $\log_4 b = \frac{3}{2}$, then the value of $\log_a b + \log_b a$, to the nearest hundredth, is _____.

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

7. An expression that is equivalent to $\log\left(\frac{2\sin x}{\sin(2x)}\right)$, where $0° < x < 90°$, is

A. $\log 1$

B. $\log(\cos x)$

C. $-\log(\sin x)$

D. $-\log(\cos x)$

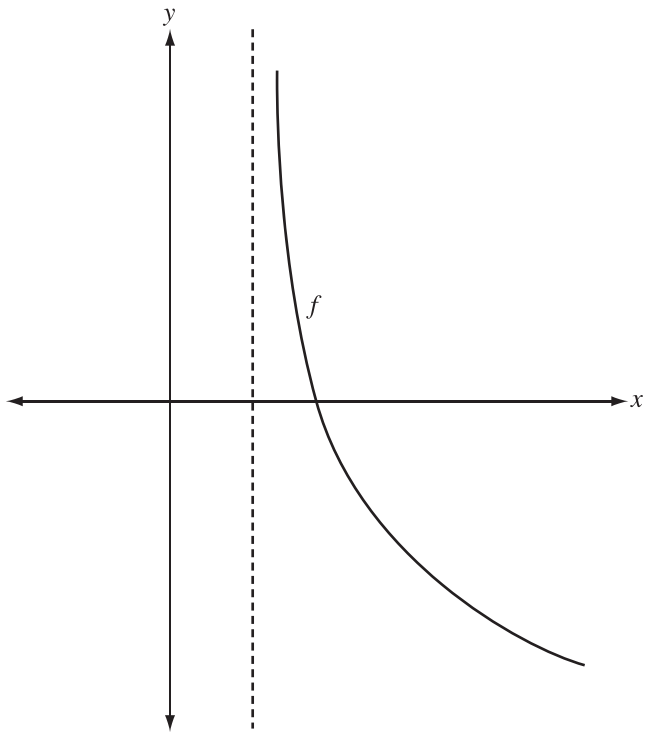
Numerical Response

4. If $\log_a b = 1.26$, where $a, b > 0$, $a \neq 1$, then the value of $\log_a\left(\sqrt[3]{b}\right)$, to the nearest hundredth, is _____.

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

Use the following information to answer question 8.

The partial graph of the logarithmic function $f(x) = a\log_b(x - h)$, where $b > 1$, is shown below.



8. To produce the graph of $y = f(x)$ above, the values of ***a*** and ***h*** in the function must satisfy

A. $a < 0$ and $h > 0$

B. $a < 0$ and $h < 0$

C. $a > 0$ and $h > 0$

D. $a > 0$ and $h < 0$

Use the following information to answer question 9.

The loudness of a sound is related to the logarithm of the ratio of the measured intensity, I, to a reference intensity, I_0. The loudness, L, of a sound is measured in decibels, dB, and can be determined using the following formula.

$$L = 10\log_{10}\left(\frac{I}{I_0}\right)$$

During an international soccer tournament in 2010, a noisemaker called the vuvuzela had a measured loudness of 127 dB at full volume.

9. If the intensity of the sound of the vuvuzela is 5 000 times greater than the intensity of the sound of a lawn mower, then the measured loudness of the lawn mower, to the nearest decibel, is

A. 3 dB

B. 37 dB

C. 90 dB

D. 123 dB

Use the following information to answer question 10.

In the process of factoring the polynomial $P(x) = x^4 + 3x^3 + x - 42$, a student rewrites $P(x)$ as the product of two factors, where one factor is $x - 2$.

10. What is the remaining factor?

A. $x^3 + 5x^2 + 11x - 20$

B. $x^3 + 5x^2 + 10x + 21$

C. $x^3 + x^2 - x - 40$

D. $x^3 + x^2 - 2x + 5$

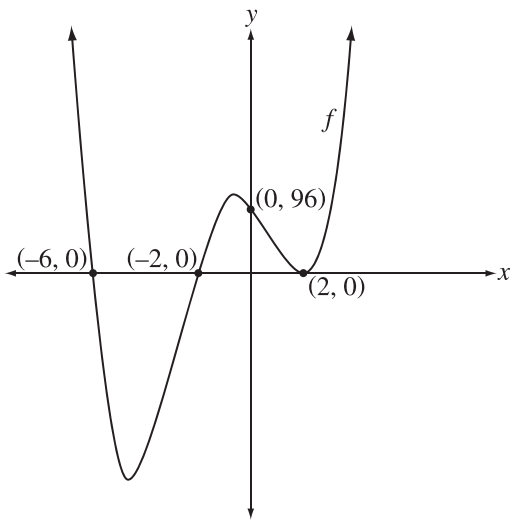
Numerical Response

5. For the polynomial function $P(x) = 2x^5 + 3x^4 - 10x^3 - 21x^2 + kx$, two of the zeros are –1 and –2. It can be determined that the largest zero of this function, to the nearest tenth, is _____.

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

Use the following information to answer question 11.

The graph of a particular function is shown below.



11. If the equation of the function graphed above is written in the form $f(x) = ax^4 + bx^3 + cx^2 + dx + e$, then the value of $\boldsymbol{a}$ is

A. 1

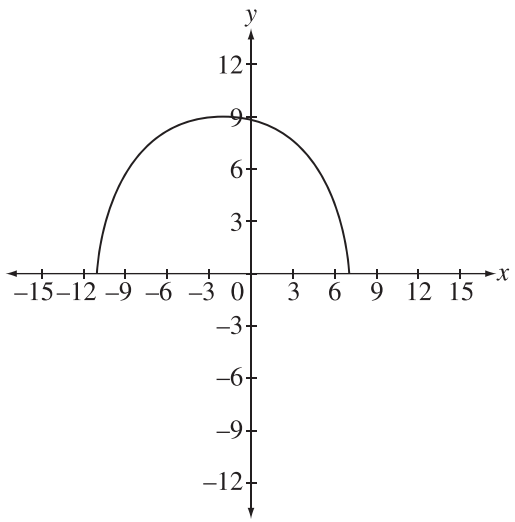
B. 2

C. 4

D. 96

Use the following information to answer question 12.

The graph of $y = \sqrt{f(x)}$ has a range of $[0, 9]$ as shown below.



12. If $f(x)$ is a quadratic function, then a point which **cannot** be on the graph of $y = f(x)$ is

A. (–14, –63)

B. (–7, 56)

C. (4, 90)

D. (9, –40)

Use the following information to answer numerical-response question 6.

The graphs of the functions $y = f(x)$, $y = g(x)$, and $y = h(x)$ are shown below. Each function is transformed into $y = \sqrt{f(x)}$, $y = \sqrt{g(x)}$, and $y = \sqrt{h(x)}$, respectively.

Diagram 1

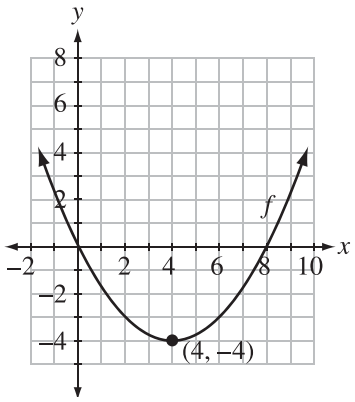


Diagram 2

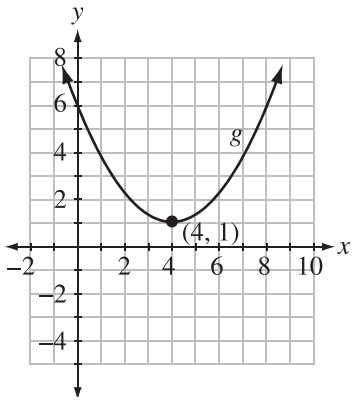
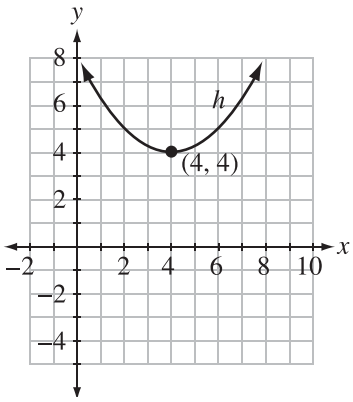


Diagram 3



Numerical Response

6. The number of invariant points on the original graph and its transformed graph for

Diagram **1** is _____ (Record in the **first** column)

Diagram **2** is _____ (Record in the **second** column)

Diagram **3** is _____ (Record in the **third** column)

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

Use the following information to answer question 13.

The graph of the function $f(x) = \dfrac{3x^2 - 11x - 4}{(x - 4)(x + 4)}$ has a point of discontinuity at (m, n).

13. The value of ***n*** is

A. –11

B. 0

C. $\dfrac{11}{8}$

D. $\dfrac{13}{8}$

Use the following information to answer question 14.

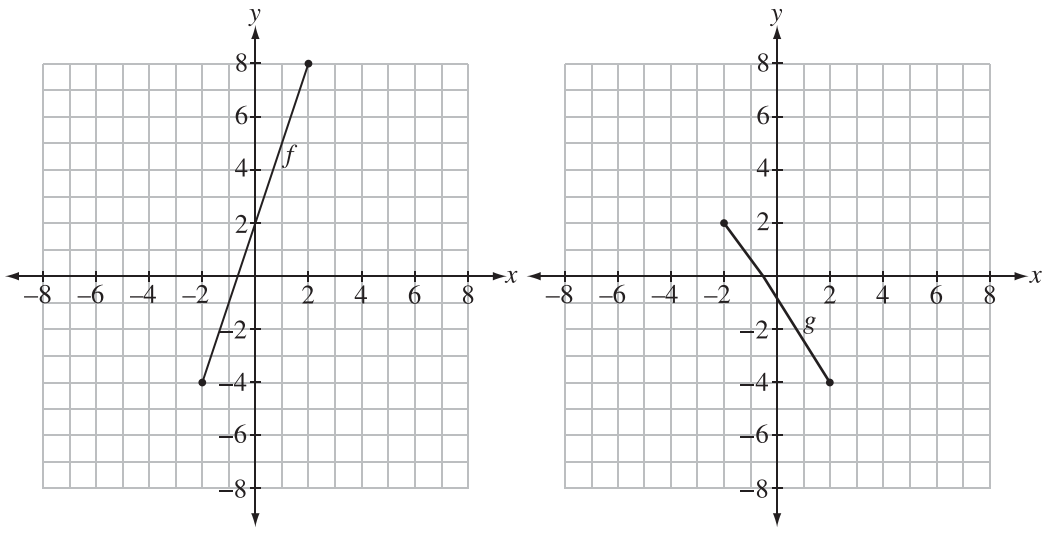
$$f(x) = \frac{(3x - 2)(2x + 3)}{(-x + 1)(3x - 2)}$$

14. For the function above, the vertical asymptote and the horizontal asymptote are represented by the information in row

Row	Vertical Asymptote	Horizontal Asymptote
A.	$x = \frac{2}{3}$	$y = -2$
B.	$x = 1$	$y = -3$
C.	$x = \frac{2}{3}$	$y = -3$
D.	$x = 1$	$y = -2$

Use the following information to answer question 15.

The graphs of $y = f(x)$ and $y = g(x)$ are shown below.



15. The range of the graph of $h(x) = (f - g)(x)$ would be

A. $\{y \mid 0 \le y \le 6, y \in R\}$

B. $\{y \mid -6 \le y \le 0, y \in R\}$

C. $\{y \mid -6 \le y \le 12, y \in R\}$

D. $\{y \mid -12 \le y \le 6, y \in R\}$

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

$h(x) = g(x) + (f \circ g)(x)$, where $f(x) = x^2 + 6x$ and $g(x) = \dfrac{1}{x - 2}$

Numerical Response

7. The value of $h(5)$, to the nearest hundredth, is _____.

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

16. An angle that is co-terminal with an angle of $\frac{-11\pi}{4}$, in standard position, is

A. $\frac{7\pi}{4}$

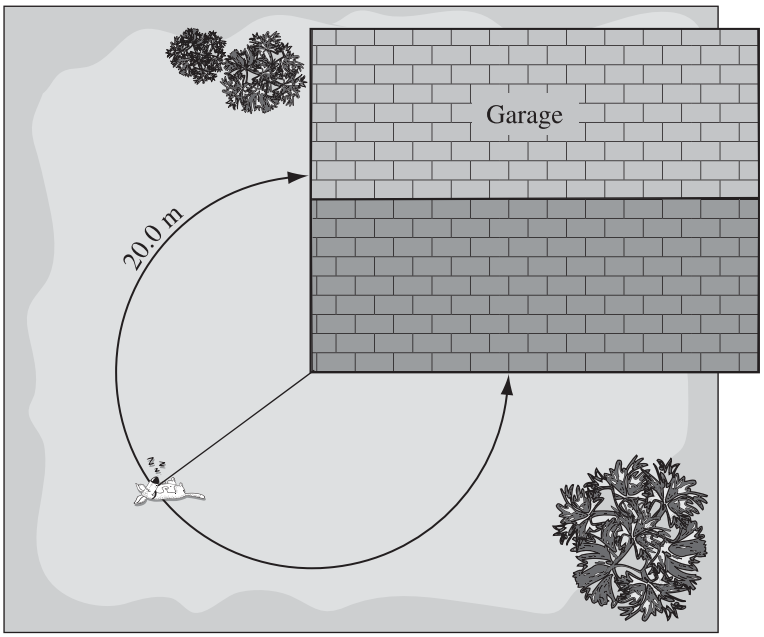
B. $\frac{5\pi}{4}$

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

D. $\frac{\pi}{4}$

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

A dog is tied to the corner of a rectangular garage. He is given enough leash to run along a 20.0 m circular path, completing $\frac{3}{4}$ of a circle, as shown in the diagram below.



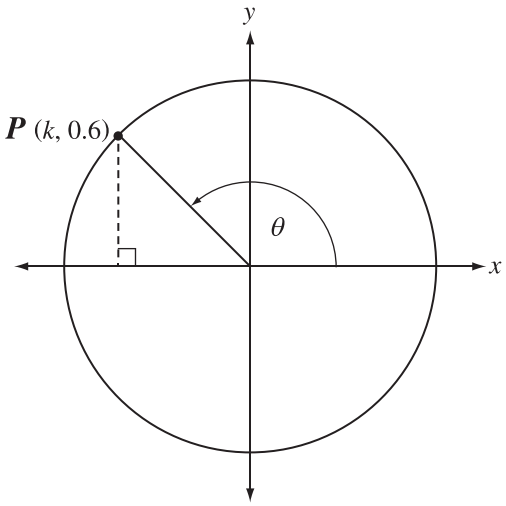
Numerical Response

8. The length of the dog's leash, to the nearest tenth of a metre, is _____ m.

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

Use the following information to answer question 17.

The unit circle is shown below with an angle, θ, in standard position. Point $P(k, 0.6)$ is on the terminal arm.



17. *The value of k is* ____***i***____ *, and the* ***exact*** *value of* $\sec\theta$ *is* ____***ii***____ .

The statement above is completed by the information in row

Row	***i***	***ii***
A.	–0.8	$-\frac{5}{4}$
B.	–0.8	$-\frac{5}{3}$
C.	0.8	$-\frac{5}{4}$
D.	0.8	$-\frac{5}{3}$

Use the following information to answer numerical-response question 9.

The terminal arm of an angle of 70° in standard position intersects the unit circle at the point $P(x, y)$. The coordinates of Point $P(x, y)$, rounded to the nearest hundredth, are $\boldsymbol{x} = 0.ab$ and $\boldsymbol{y} = 0.cd$.

Numerical Response

9. The value of $\boldsymbol{x}$ is 0._____ (Record in the **first and second** columns.)

The value of $\boldsymbol{y}$ is 0._____ (Record in the **third and fourth** columns.)

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

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18. If $\sin\theta = -2\cos\theta$ and $\frac{\pi}{2} \leq \theta \leq \pi$, then the **exact** value of $\tan(2\theta)$ is

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

B. $\frac{4}{5}$

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

D. $-\frac{4}{5}$

19. *If* $\csc\theta = \frac{2}{\sqrt{3}}$, *where* $0 \le \theta < 2\pi$, *then* θ *lies in Quadrant* ___***i***___ , *and* $\cot\theta$ *is equal to* ___***ii***___ .

The statement above is completed by the information in row

Row	*i*	*ii*
A.	I or II	$\pm\sqrt{3}$
B.	I or IV	$\pm\sqrt{3}$
C.	I or II	$\pm\frac{1}{\sqrt{3}}$
D.	I or IV	$\pm\frac{1}{\sqrt{3}}$

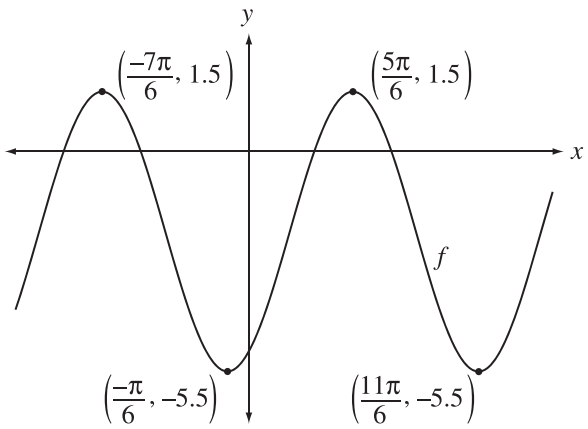
Numerical Response

10. If $\cos(x - 20°) = \frac{1}{2}$, where $0° < x < 90°$, then the value of x, to the nearest degree, is _____°.

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

Use the following information to answer question 20.

The partial graph of $f(x) = a\sin\left[b(x - c)\right] + d$, where $a > 0$ and x is in radians, is shown below. Two of its maximum points and two of its minimum points are labelled.



20. The minimum positive value of ***c***, to the nearest hundredth of a radian, is

A. 1.05

B. 1.57

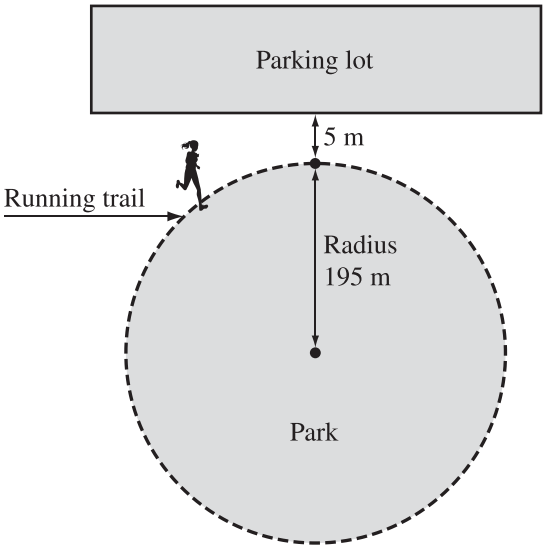
C. 2.09

D. 2.62

Use the following information to answer question 21.

A local park with a radius of 195 m has a circular running trail surrounding it, as shown below. The shortest distance from the running trail to the parking lot is 5 m. At a constant speed, Ellie can complete 4 full laps around the park in 32 minutes. Ellie's distance from the parking lot as she runs, s, in metres, as a function time, t, in minutes, can be represented by the function

$$s(t) = a\cos\left[b(t - c)\right] + d.$$



21. The values of ***b*** and ***d*** in the function are, respectively,

A. $\frac{\pi}{16}$ and 195

B. $\frac{\pi}{16}$ and 200

C. $\frac{\pi}{4}$ and 195

D. $\frac{\pi}{4}$ and 200

Use the following information to answer question 22.

The steps shown below were used to determine the complete solution set to the equation $3\sin^2 x + \cos^2 x + 5\sin x - 4 = 0$, where $0 \le x < 2\pi$.

$$3\sin^2 x + \cos^2 x + 5\sin x - 4 = 0$$

Step 1 $2\sin^2 x + \sin^2 x + \cos^2 x + 5\sin x - 4 = 0$

Step 2 $2\sin^2 x + 1 + 5\sin x - 4 = 0$

Step 3 $2\sin^2 x + 5\sin x - 3 = 0$

Step 4 $(2\sin x - 1)(\sin x + 3) = 0$

Step 5 $\sin x = \frac{1}{2}$ or $\sin x = -3$

Step 6 $x = \left\{\frac{\pi}{6}\right\}$

22. The **first** recorded error is in Step

A. 1
B. 2
C. 4
D. 6

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23. The non-permissible values of θ for the identity $\frac{1 - \sin^2\theta}{1 - \cos^2\theta} = \frac{\cos^2\theta}{\sin^2\theta}$ are

A. $n\pi,\ n \in I$

B. $2n\pi,\ n \in I$

C. $\frac{\pi}{2} + n\pi,\ n \in I$

D. $\pi + 2n\pi,\ n \in I$

24. If the identity $\frac{\sin x}{1-\cos x} = \frac{1+\cos x}{\sin x}$ is verified using $x = \frac{2\pi}{3}$, then the **exact** value of each side is

A. $-\sqrt{3}$

B. $\sqrt{3}$

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

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

Use the following information to answer question 25.

A soccer team plays six games in one month. Each game results in a win, loss, or tie.

25. For this soccer team, how many different sets of results are possible for the six games?

A. 729

B. 720

C. 216

D. 64

Use the following information to answer numerical-response question 11.

Prior to 2010, standard licence plates in Alberta consisted of 3 letters followed by 3 digits, and standard Ontario licence plates consisted of 4 letters followed by 3 digits. Letters and digits can be repeated on licence plates. There are 23 letters in the alphabet that can be used, as the letters I, O, and Q are not allowed. All of the digits from 0 to 9 may be used. An example of each licence plate is shown below.

Numerical Response

11. In 2009, the number of standard licence plates possible in Ontario was ***r*** times greater than the number of standard licence plates possible in Alberta. The value of ***r*** as a whole number is _____ .

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

Numerical Response

12. The number of different 4-digit or 5-digit personal identification numbers (PINs) that can be formed using only the digits 2, 3, 4, 5, 6, and 7, with no repetitions within a single PIN, is _____ .

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

Use the following information to answer question 26.

In a local high school, from a group of 16 students comprised of 7 singers and 9 actors, a 6-person executive council is selected.

26. How many different executive councils are possible if the council must include **at least** 4 actors?

A. 336

B. 2 646

C. 3 528

D. 3 612

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27. In the expansion of $\left(x^3 + \frac{1}{2x^2}\right)^8$ written in descending powers of x, the sixth term is

A. $\frac{28}{x}$

B. $\frac{7}{4x}$

C. $\frac{1}{64x^6}$

D. $\frac{7}{16x^6}$

Use the following information to answer question 28.

There are 6 terms in the expansion of $(x + 4)^n$.

28. *The value of* ***n*** *is* ___***i***___ *, and the value of the constant term in the expansion is* ___***ii***___ .

The statement above is completed by the information in row

Row	***i***	***ii***
A.	5	1 024
B.	5	4 096
C.	6	1 024
D.	6	4 096