Released 2013 Achievement Test

Mathematics

Alberta Government

This document contains the test items from the 2013 Mathematics Achievement Test in Grade 9.

A test blueprint and an answer key are included in this document. These materials, along with the program of studies and subject bulletin, provide information that can be used to inform instructional practice.

Assessment Highlights reports for all achievement test subjects and grades will be posted on the Alberta Education website every year in the fall. *Assessment Highlights* provides information about the overall test, the test blueprints, and student performance on the 2013 Mathematics Achievement Test in Grade 9. Also provided is commentary on student performance at the acceptable standard and the standard of excellence on selected items from the 2013 Achievement test. This information is intended for teachers and is best used in conjunction with the multi-year and detailed school reports that are available to schools via the extranet.

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The Alberta Education website: education.alberta.ca.

Contents

2013 Grade 9 Mathematics Achievement Test Blueprint

Program of Study Strands	Reporting Category: Item Complexity			Number (Percentage) of items
	Low Complexity Items	Moderate Complexity Items	High Complexity Items	
Number	1, 14, 15, 36, NR3	4, 20, 25, 27, 28, 35, 37, NR5, NR7, NR8	NR4	16 (32%)
Patterns and Relations	5, 19, 22, 24, 31, 38, NR6, NR9	3, 9, 17, 21, 29, 30, 34, 39, NR1, NR10		18 (36%)
Shape and Space	6, 11, 32, NR2	2, 8, 13, 16, 18, 26	10, 33	12 (24%)
Statistics and Probability		40	7, 12, 23	4 (8%)
Number (Percentage) of Questions	17 (34%)	27 (54%)	6 (12%)	50 (100%)

Additional Information

The table below provides additional information about the items that appeared on the 2013 Grade 9 Mathematics Achievement Test.

Item	Key	Correct Response %	Item Complexity	Strand	Specific Outcome	Item Description
MC 1	C	79.8	L	N	6	Identify numbers from a set of numbers that have a square root that is between two given rational numbers (Gr.8, N.1; Gr.8, N.2).
MC 2	C	65.3	M	SS	5	Determine the order of rotational symmetry and angle of rotation of a given shape on the Cartesian Plane (Gr.8, SS.6; Gr.7, SS.5).
MC 3	B	63.0	M	PR	7	Identify the error(s) in given incorrect simplifications of polynomial expressions involving operations on monomials and polynomials.
MC 4	B	67.3	M	N	3	Determine the area and side length of a square shape that is within a given rectangle (Gr.7, N.2; Gr.6, N.6; Gr.6, N.8).
MC 5	B	55.5	L	PR	4	Interpret the number line graphs of two inequalities to determine the values that are solutions to both inequalities.
MC 6	C	54.0	L	SS	3	Determine which rectangle from a set of rectangles is proportional to a given rectangle.
MC 7	A	85.5	H	SP	4	Identify the reasoning used to make a decision given a context involving probability.
MC 8	C	42.8	M	SS	4	Use the properties of similar triangles to determine the missing length required for the calculation of the area of a circle (Gr.7, SS.2).
MC 9	A	42.5	M	PR	3	Model the solution of a given linear equation using a pictorial representation of the equation (Gr.8, PR.2).
MC 10	B	50.3	H	SS	1	Solve a given problem by applying a circle property involving a line that is tangent to a circle (Gr.8, SS.1; Gr.7, SS.1).
MC 11	B	55.9	L	SS	1	Determine the measure of an angle inscribed in a circle using one or more of the circle properties.
MC 12	A	71.8	H	SP	2	Identify a reason why a given example of a generalization made from data in a sample is not valid for the population of the survey.

Item	Key	Correct Response %	Item Complexity	Strand	Specific Outcome	Item Description
MC 13	C	42.6	M	SS	2	Determine the surface area of a composite 3-D object composed of identical cubes (Gr.8, SS.3, SS.4).
MC 14	C	82.0	L	N	2	Identify the expression that represents the sum of two given powers.
MC 15	D	73.9	L	N	5	Identify a rational number with a square root that is between two numbers on a number line (Gr.8, N.1).
MC 16	A	44.6	M	SS	1	Determine the distance between two locations in a circle diagram using one or more of the circle properties (Gr.8, SS.1).
MC 17	C	82.1	M	PR	3	Find the solution to a given problem involving money by creating and solving a single-variable linear equation (Gr.8, PR.2; Gr.7, PR.6; Gr.6, PR.4).
MC 18	D	35.4	M	SS	2	Determine the area of overlap in a given composite 3-D object (Gr.8, SS.3; Gr.8, SS.5; Gr.6, SS.3).
MC 19	B	56.0	L	PR	5	Identify the pair of expressions that are equivalent (Gr.8, PR.2).
MC 20	B	46.8	M	N	2	Simplify a given expression by applying the exponent laws.
MC 21	D	43.7	M	PR	1	Write a linear equation that represents the pattern described in a given context (Gr.8, PR.2; Gr.7, PR.7).
MC 22	D	58.8	L	PR	1	Identify a written context that could be represented using a given linear equation (Gr.8, PR.2; Gr.7, PR.7; Gr.6, PR.4).
MC 23	C	80.8	H	SP	1	Identify the source of potential bias in a given survey.
MC 24	A	49.5	L	PR	4	Match a given inequality that is represented symbolically to pictorial representations of the same inequality.
MC 25	A	50.0	M	N	1	Evaluate a given set of powers and arrange the powers in ascending order or magnitude.
MC 26	C	62.4	M	SS	1	Determine the measure of an unknown angle inscribed in a circle using one or more of the circle properties.
MC 27	B	71.2	M	N	4	Solve a given problem by applying the order of operations on positive rational numbers (Gr.6, N.9).
MC 28	C	56.0	M	N	4	Identify the error(s) in the simplification of two expressions involving powers.

Item	Key	Correct Response %	Item Complexity	Strand	Specific Outcome	Item Description
MC 29	A	41.0	M	PR	6	Use a model to determine the unknown addend in the addition of polynomials given one addend and the sum.
MC 30	C	60.7	M	PR	2	Plot a line that represents a given linear equation on a grid to determine where the line would intersect another line on the grid (Gr.8, PR.1; Gr.7, PR.2).
MC 31	B	80.6	L	PR	3	Solve a linear equation symbolically.
MC 32	B	68.1	L	SS	4	Determine the scale factor for a given diagram that has been drawn to scale.
MC 33	D	60.1	H	SS	5	Identify the location of the vertices of a 2-D shape after completing a combination of transformations on the Cartesian plane (Gr.7, SS.4; Gr.7, SS.5).
MC 34	D	75.5	M	PR	3	Identify the equation that represents the relationship between some of the objects presented in a diagram of a balanced mobile of 3-D objects (Gr.7, PR.3; Gr.6, PR.5).
MC 35	B	57.9	M	N	4	Evaluate an expression involving powers using the order of operations.
MC 36	D	62.3	L	N	3	Organize a given set of negative rational numbers in decimal form and fraction form in ascending order.
MC 37	D	87.8	M	N	3	Solve a given problem involving operations on rational numbers in decimal form (Gr.7, N.2; Gr.6, N.2; Gr.6, N.8).
MC 38	A	65.2	L	PR	2	Match the given graph of a linear relation with its corresponding linear equation (Gr.8, PR.1).
MC 39	D	34.3	M	PR	7	Determine the missing expression in the given model of the division of a polynomial by a monomial.
MC 40	A	70.5	M	SP	1	Identify a method for minimizing potential bias in the data collection for a survey (Gr.6, SP.2).
NR 1	75	59.2	M	PR	1	Solve a given problem using a linear equation that represents a pattern provided in a given table of values (Gr.8, PR.2; Gr.7, PR.1; Gr.6, PR.2).
NR 2	4	81.1	L	SS	5	Determine the number of lines of symmetry in a given 2-D image.
NR 3	12	64.0	L	N	2	Evaluate a given expression by applying the exponent laws.

Item	Key	Correct Response %	Item Complexity	Strand	Specific Outcome	Item Description
NR 4	1.5	31.4	H	N	3	Interpret a 2-D composite figure in order to solve a problem involving operations on rational numbers in fraction form (Gr.8, N.6; Gr.7, N.5).
NR 5	18	62.3	M	N	3	Solve a given problem involving operations on rational numbers in fraction form (Gr.8, N.6).
NR 6	125	70.6	L	PR	3	Solve a linear equation symbolically (Gr.8, PR.2).
NR 7	48	42.1	M	N	5	Solve a given problem that involves determining the square root of a given perfect number (Gr.8, N.1).
NR 8	5	37.5	M	N	3	Determine the number of rational numbers that are possible solutions to a linear inequality using substitution.
NR 9	3	46.3	L	PR	7	Determine the unknown value in the division of a polynomial expression by a monomial.
NR 10	16	74.1	M	PR	3	Find the solution to a given problem involving money by creating and solving a single-variable linear equation (Gr.8, PR.2; Gr.7, PR.6; Gr.6, PR.4).

Grade 9 Mathematics Achievement Test

2013

$$\sqrt{51} \quad \sqrt{55} \quad \sqrt{61} \quad \sqrt{66} \quad \sqrt{71} \quad \sqrt{77} \quad \sqrt{81} \quad \sqrt{88}$$

1. How many of the square roots shown above have a value that is between 7.8 and 8.8?

    A.   2

    B.   3

    C.   4

    D.   5

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

Members of a recreation centre pay a one-time registration fee in addition to a fixed monthly fee of $15. The following table shows the total amount paid to be a member of the centre for a certain number of months.

Number of Months	Total Amount Paid
4	$135
6	$165
12	$255

Numerical Response

1. According to the information above, what is the cost of the one-time registration fee?

Answer: _____ **dollars**

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

Use the following information to answer question 2.

The 2-D shape shown below is rotated about its centre.
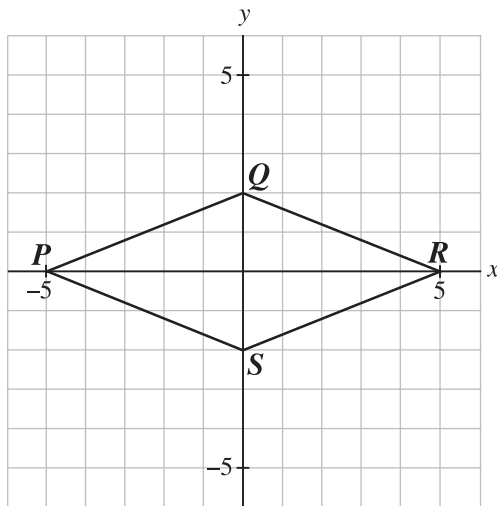
2. What are the order of rotational symmetry and the angle of rotation of the 2-D shape?

Row	Order of rotational symmetry	Angle of rotation
A.	1	180°
B.	1	360°
C.	2	180°
D.	2	360°

Two students, Robert and Jacob, simplify the expression $3(x^2 + 4x - 1) - (2x + 5)$, as shown below.

	Robert	Jacob
Step 1	$= 3x^2 + 12x - 3 - (2x + 5)$	$= 3x^2 + 12x - 1 - (2x + 5)$
Step 2	$= 3x^2 + 12x - 3 - 2x + 5$	$= 3x^2 + 12x - 1 - 2x - 5$
Step 3	$= 3x^2 + 10x + 2$	$= 3x^2 + 10x - 6$

3. The **first** error made in the simplification of the expression shown above was made by

    A. Robert in Step 1

    B. Jacob in Step 1

    C. Robert in Step 2

    D. Jacob in Step 2

A square carpet covers 37.5% of the floor area of a rectangular room, as shown below.
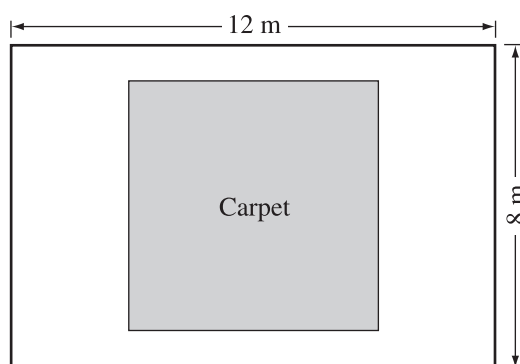
4. What is the side length of the carpet shown above?

    A. 7 m

    B. 6 m

    C. 5 m

    D. 4 m

Use the following information to answer question 5.

An inequality is shown on each number line below.
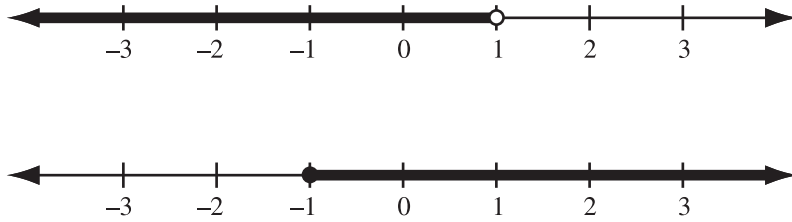
5. Which expression represents the values (*n*) that are part of both inequalities?

A. $-1 \le n \le 1$
B. $-1 \le n < 1$
C. $-1 < n \le 1$
D. $-1 < n < 1$

Use the following diagram to answer numerical-response question 2.
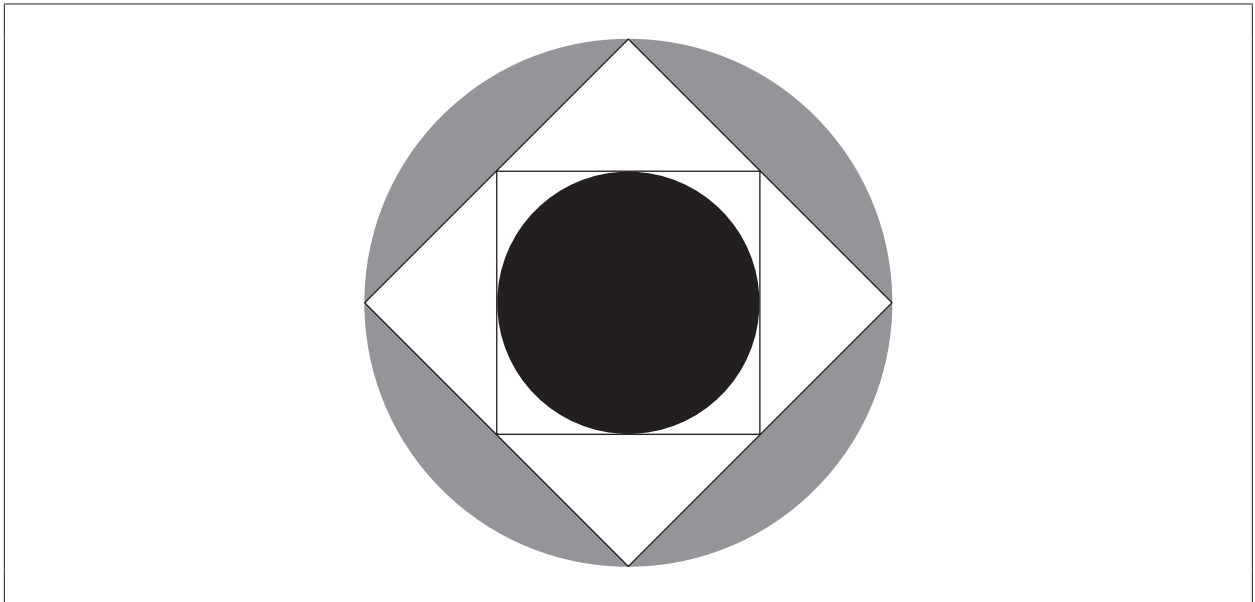
Numerical Response

2. How many lines of symmetry does the diagram shown above have?

Answer: _____ **lines**

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

10

Four-sided Polygons

6. Which of the polygons above is proportional to the shaded rectangle?

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

_____

A teacher placed a cafeteria coupon in only one of three differently coloured envelopes. A randomly selected student was asked to choose one of the three envelopes. The student chose the red envelope because red was his favourite colour.

7. The student's decision was based on

   A. subjective judgment
   B. theoretical probability
   C. experimental probability
   D. mathematical calculation

In the diagram below, x represents the approximate distance across a circular lake.

15.3 km

x

7.4 km

4.5 km

5.9 km
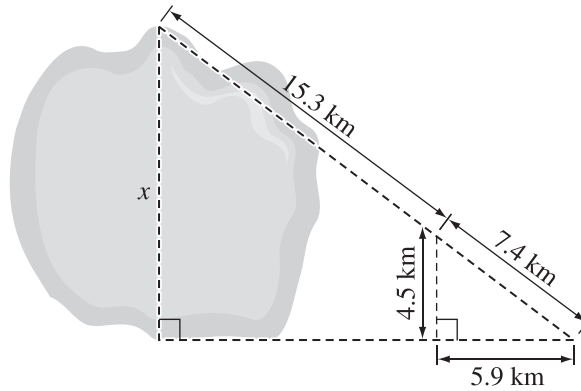
8. What is the approximate area of the lake, to the nearest square kilometre?

A. 599 km^2

B. 272 km^2

C. 150 km^2

D. 68 km^2

Numerical Response

3. If $(x^3)^2 \div x^4 = 144$, then what is the whole number value of x?

Answer: _____

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

Legend

$\blacksquare = 1$ $= x$ $= x^2$

$\square = -1$ $= -x$ $= -x^2$
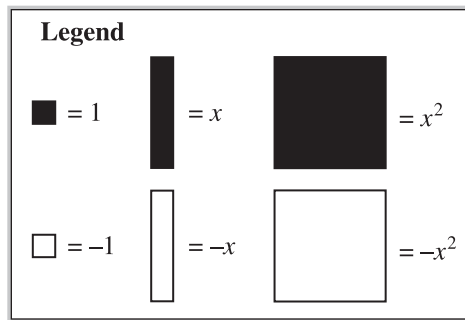
The left and right sides of an equation are represented below.

Left side	Right side
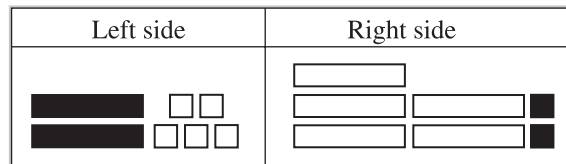
9. The solution to the equation above can be represented by

A. $\blacksquare\blacksquare\blacksquare = \blacksquare$

B. $\blacksquare\blacksquare\blacksquare = \blacksquare \ \blacksquare$

C. $\blacksquare\blacksquare\blacksquare = \square$

D. $\blacksquare\blacksquare\blacksquare = \square \ \square$

13

The diagram shown below is a square and has a perimeter of 8 cm.
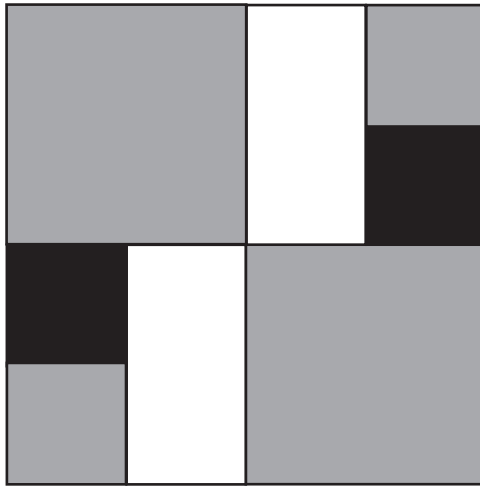
Numerical Response

4. What is the **total** area of the white rectangles and the black squares?

Answer: _____ **cm^2**

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

The gong shown below is 30 cm in diameter and hangs by a chain from a nail.
The total length of the chain is 18 cm. The lengths of chain on each side of the nail are equal to each other and form a tangent to the gong.

Note: The diagram shown above has **not** been drawn to scale.

10. How far above the top of the gong is the nail, to the nearest tenth of a centimetre?

    A.   2.3 cm

    B.   2.5 cm

    C.   12.0 cm

    D.   17.5 cm

The letter O in the diagram below represents the centre of the circle.
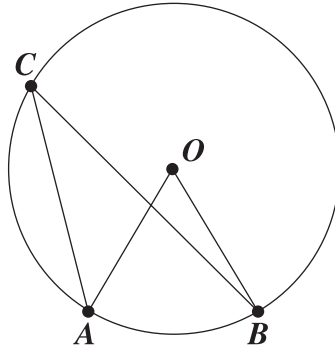
Note: The diagram shown above has **not** been drawn to scale.

11. If the sum of $\angle AOB$ and $\angle ACB$ is 75°, then $\angle ACB$ equals

    A. 30°
    B. 25°
    C. 20°
    D. 15°

Nina and Sarah observe that 6 of their 10 female classmates are shorter than 160 cm. Nina concludes that of the 410 students in their school, 246 are shorter than 160 cm. Sarah believes Nina's conclusion cannot be supported by her observation.

12. Which of the following statements **best** supports Sarah's belief?

    A. Nina's survey sample contains only female students.
    B. Nina's probability calculation is incorrect.
    C. Nina did not use a proper questionnaire.
    D. Nina completed her survey too quickly.

The following 3-D object is composed of identical cubes. The volume of the 3-D object is 56 cm^3.
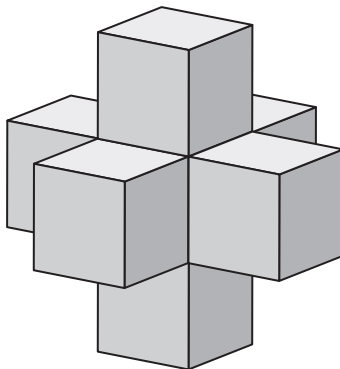
13. The surface area of the 3-D object above is

    A.   30 cm^2

    B.   60 cm^2

    C.   120 cm^2

    D.   144 cm^2

---

14. Which of the following expressions represents the addition of 7^2 and 7^3?

    A. $(7 + 7)^{2 + 3}$

    B. $(7 + 7)^{2 \times 3}$

    C. $(7 \times 7) + (7 \times 7 \times 7)$

    D. $(7 + 7) \times (7 + 7 + 7)$

The square roots of two rational numbers are represented on the number line shown below.

15. If Q is located between points P and R on the number line above, then which of the following square roots could **not** represent Q?

A. $\sqrt{\dfrac{324}{81}}$

B. $\sqrt{\dfrac{256}{9}}$

C. $\sqrt{\dfrac{225}{64}}$

D. $\sqrt{\dfrac{169}{4}}$

A scientific calculator has 40 buttons, of which $\dfrac{1}{4}$ are white, $\dfrac{1}{5}$ are grey, and 4 are orange. The rest of the buttons are black.

Numerical Response

5. How many black buttons does the calculator have?

Answer: _____

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

A diagram of a swimming pool is shown below. The dotted circle represents floating buoys. The pool has a diameter of 10 metres.
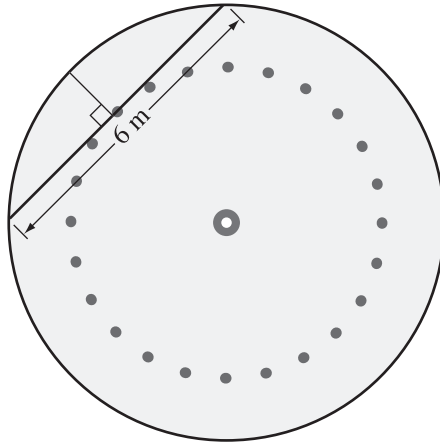
16. The shortest distance from the buoys to the edge of the pool is

    A. 1 m

    B. 2 m

    C. 3 m

    D. 4 m

Tara, Jennifer, and Mindy donated some money to a charity. Jennifer donated twice as much as Tara, and Mindy donated $10 less than Jennifer.

17. If the **total** amount donated to the charity is $50, then how much money did Tara donate?

    A. $6

    B. $8

    C. $12

    D. $24

A 3-D object made of 2 cm × 2 cm × 2 cm cubes is dipped in paint.
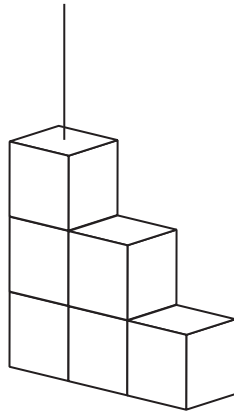
Unpainted Object   **Painted Object**
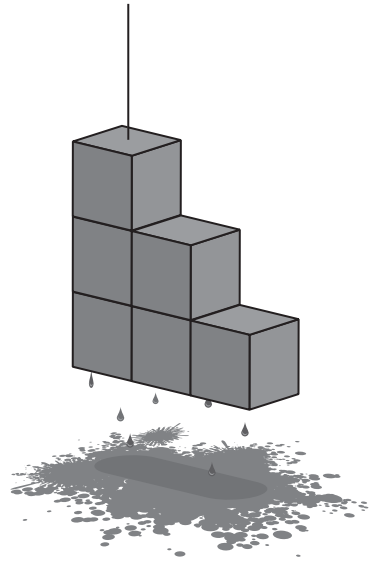
18. If the painted object is separated into individual cubes, then the total area of the **unpainted** surfaces will be

    A. 12 cm^2

    B. 24 cm^2

    C. 32 cm^2

    D. 48 cm^2

---

19. Which pair of expressions below are equivalent for all values of x?

    A. $-3x + 4x^2 + 2$ and $4x^2 - 2 + 3x$

    B. $-3x + 4x^2 + 2$ and $2 - 3x + 4x^2$

    C. $2 - 4x^2 + 3x$ and $-4x^2 + 3x - 2$

    D. $2 - 4x^2 + 3x$ and $-3x + 4x^2 + 2$

The expression $\left(\dfrac{(n^3)^4}{n^2}\right)(n^{10} \div n^5 \times n^2)$ can be simplified to the form n^p.

20. The value of p is

    A. 20
    B. 17
    C. 14
    D. 13

Use the following information to answer question 21.

Nathan completed a 5 km run on his first day of training for a cross-country race. He increased the length of his next training runs by 1.5 km each time.

21. Which of the following equations could be used to determine the distance (d) that Nathan ran on each training run (r)?

    A. $d = 1.5r$
    B. $d = 5r$
    C. $d = 1.5 + 3.5r$
    D. $d = 3.5 + 1.5r$

The relationship between two variables is given in the equation $35 + 15n = A$.

22. Which of the following situations could be represented using the equation above?

  A. The price of a caterer for a party is $35 for each dinner ordered and $15 for each dessert ordered.

  B. The bill for framing a painting is $35 for each square metre of glass required and $15 for the wooden frame.

  C. The fee for a computer consultant is $15 for an administration charge and $35 for each hour worked.

  D. The cost of silk screening a design on T-shirts is $15 for each shirt created and a $35 design fee.

_____

Numerical Response

6. The value of x in the equation $\frac{x}{5} + 1 = 26$ is _____.

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

The student council of a senior high school surveyed 120 out of 250 Grade 10 students to determine which of three animals should be the school's new mascot. The results of the survey are shown below.

Student Responses to Mascot Survey
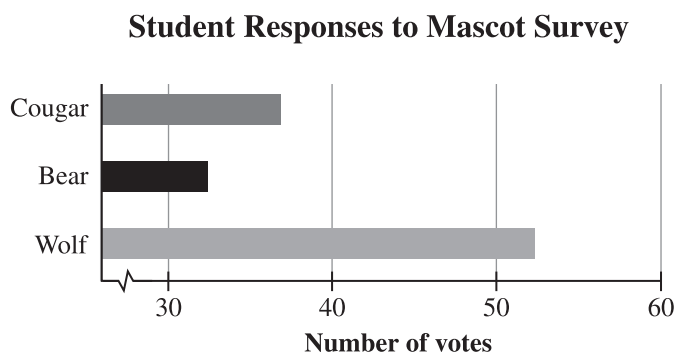
23. What potential bias exists in the data collection for this survey?

A. The survey question is confusing.

B. The survey took too long to complete.

C. The sample does not represent the population.

D. The participants' cultural beliefs were not considered.

The squares of the grid below are identical. The area of the shaded square on the grid is 9 units^2.
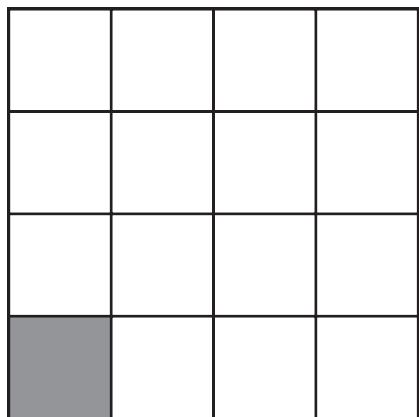
7. The perimeter of the grid shown above is _____ units.

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

I

III

II

IV
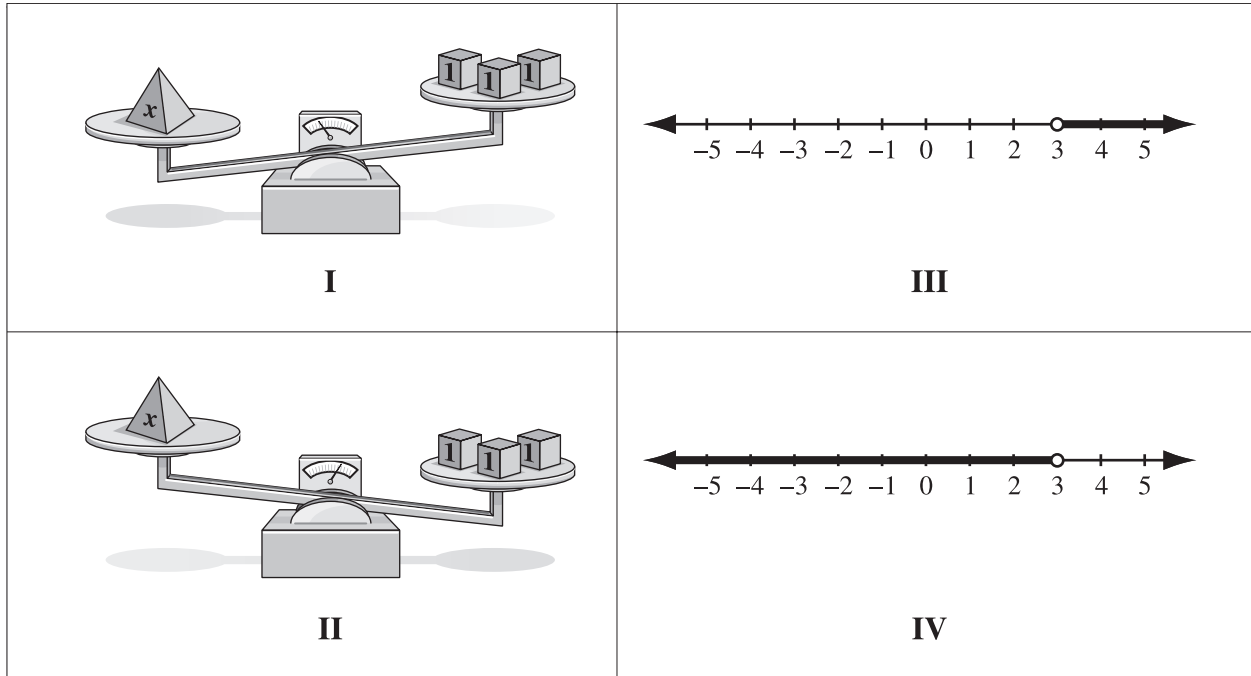
24. The two diagrams shown above that **both** represent the inequality $x > 3$ are numbered

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

_____

25. Which of the following sets of powers is arranged in order of increasing value from left to right?

   A. $-2^2,\ -1^2,\ (-1)^2,\ (-2)^2$
   B. $(-2)^2,\ (-1)^2,\ -1^2,\ -2^2$
   C. $-1^2,\ (-1)^2,\ -2^2,\ (-2)^2$
   D. $(-1)^2,\ -1^2,\ -2^2,\ (-2)^2$
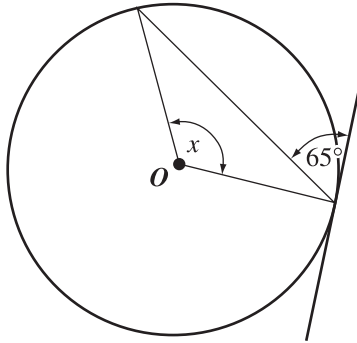
Note: The diagram shown above has **not** been drawn to scale. The letter *O* represents the centre of the circle.

26. If the line shown above is a tangent to the circle, then the measure of angle *x* is

    A.   110°

    B.   115°

    C.   130°

    D.   155°

Use the following information to answer question 27.

Connie buys a horse for $750 (including GST). She considers the two payment plans shown below.

          Plan 1   Pay $150 now and $25 each month
          Plan 2   Pay $200 now and $55 each month

27. How many **fewer** monthly payments could Connie make if she selects Plan 2?

    A.   10

    B.   14

    C.   20

    D.   24

The simplifications of two different expressions are shown below.

Expression X	**Expression Y**
$(3^2)^3 - 4^4 + 4^2 \times (-5)^2$	$2^6 \div 2^2 + (-5^2) \times 3$
$= 3^6 - 4^4 + 4^2 \times (-5)^2$	$= 2^3 + (-5^2) \times 3$
$= 729 - 256 + 16 \times 25$	$= 8 + (-25) \times 3$
$= 729 - 256 + 400$	$= 8 + (-75)$
$= 873$	$= -67$

28. Which of the following statements about the simplifications above is true?

    A. The simplifications of both expressions are correct.

    B. The simplifications of both expressions are incorrect.

    C. The simplification of Expression X is correct and the simplification of Expression Y is incorrect.

    D. The simplification of Expression Y is correct and the simplification of Expression X is incorrect.

Numerical Response

8. How many whole numbers could represent the value of x in the inequality statement $\frac{1}{4} < \frac{3}{x} < 0.5$?

Answer: _____ **whole numbers**

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

Legend

$\blacksquare$ = 1 | = x ■ = x^2
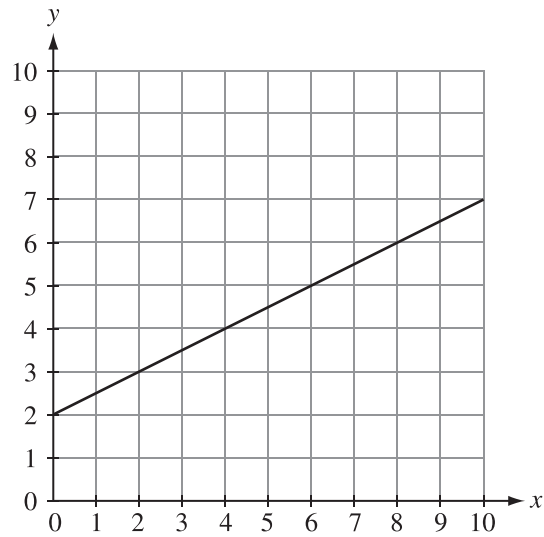
□ = -1 ‖ = $-x$ □ = $-x^2$

29. Which of the following polynomial expressions could be added to the expression shown above to result in a sum that contains only a constant term?

A. $x^2 + 5x + 3$

B. $4x^2 + 8x$

C. $-x^2 - 5x - 3$

D. $-4x^2 - 8x$

30. The line created by the relation $y = 5 - x$ will intersect the line shown on the graph above at

A. (0, 5)

B. (5, 0)

C. (2, 3)

D. (3, 2)

31. The value of x in the equation $2(x + 5) - 12 = 50$ is

A. 24

B. 26

C. 32

D. 36

The two ✗s shown on the map below represent the locations of two communities in Alberta. The distance between the two communities is 1 000 km.
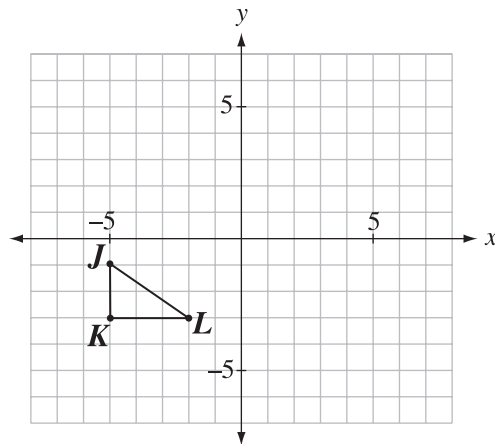
Alberta

32. Which of the following ratios represents the scale used to create the map?

- **A.** 1 cm:10 km
- **B.** 1 cm:100 km
- **C.** 1 cm:1 000 km
- **D.** 1 cm:10 000 km

Triangle *JKL,* shown below, undergoes the following transformations:

- a 90° clockwise rotation about vertex *L*
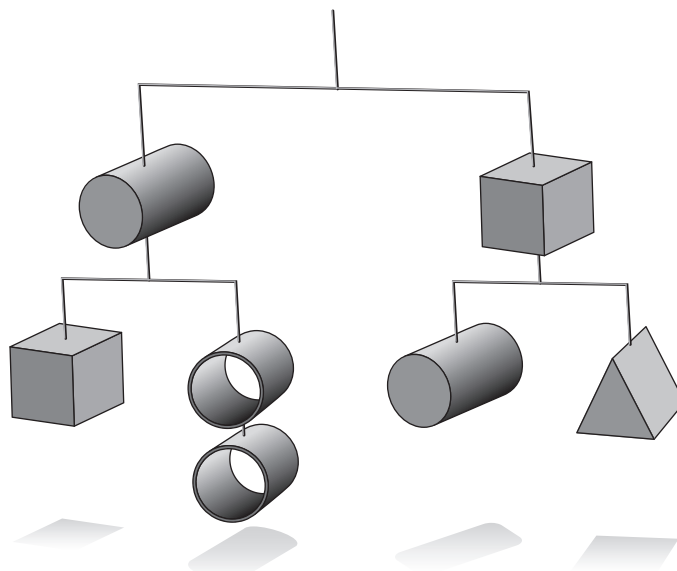- a translation of 3 units right and 4 units up

33. Which of the following rows represents the ordered pair for each vertex after **both** the transformations described above have been completed?
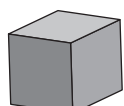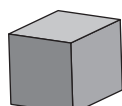
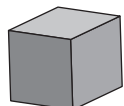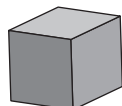| Row	*J″*	*K″*	*L″*
A.	(1, 1)	(1, 4)	(3, 4)
B.	(1, 1)	(1, –2)	(–1,–2)
C.	(4, 3)	(2, 3)	(2, 0)
D.	(3, 4)	(1, 4)	(1, 1)
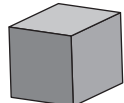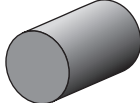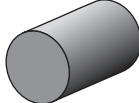
The following diagram represents a balanced mobile.

34. Which of the following equations correctly represents the relationship between some of the objects shown in the diagram above?
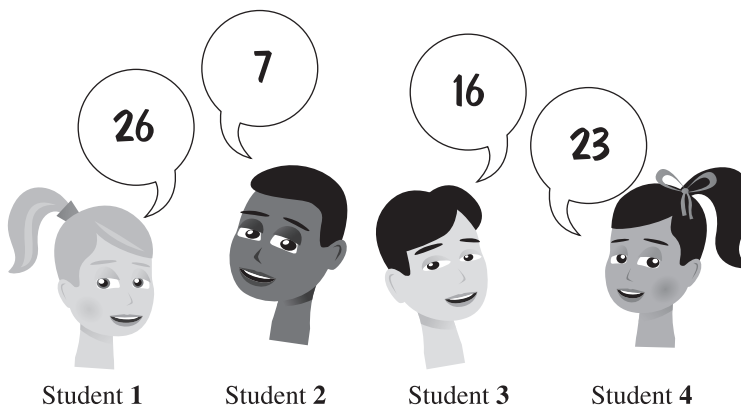
A.

B.

C.

D.

Each of the four students shown below simplifies the following expression.

$$4 + 3 \times 5 - 6^4 \div (4 + 2)^3 \times 2$$

26   7   16   23

Student **1**   Student **2**   Student **3**   Student **4**

35. Which student correctly simplified the expression?

- **A.** Student 1
- **B.** Student 2
- **C.** Student 3
- **D.** Student 4

Numerical Response

9. The quotient of $(-12x^2 - 9x) \div \blacksquare x$ is $-4x - 3$. What is the value of $\blacksquare$?

Answer: _____

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

X: -0.054

Y: $-\dfrac{11}{3}$

Z: $-\dfrac{15}{4}$

36. Which of the following inequalities represents the rational numbers shown above?

    A. $Y < Z < X$

    B. $Y < X < Z$

    C. $Z < X < Y$

    D. $Z < Y < X$

Emily's cellphone plan charges her $0.05 per text message, $0.06 per minute of voice usage and a $5.00 base fee each month.

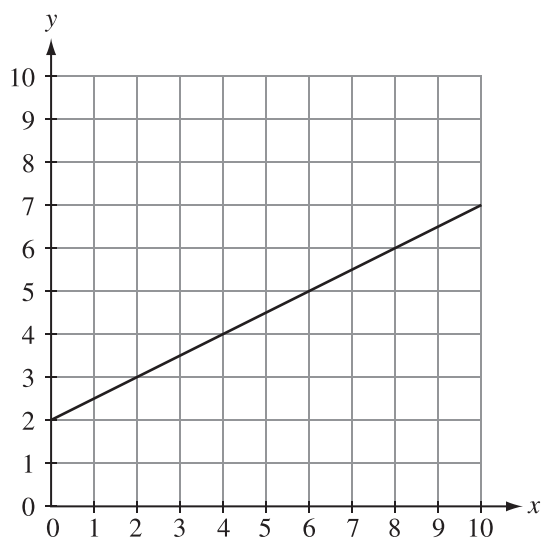**37.** What is Emily's cellphone bill if she sent 33 text messages and talked for 47 minutes in one month?

    A. $5.11

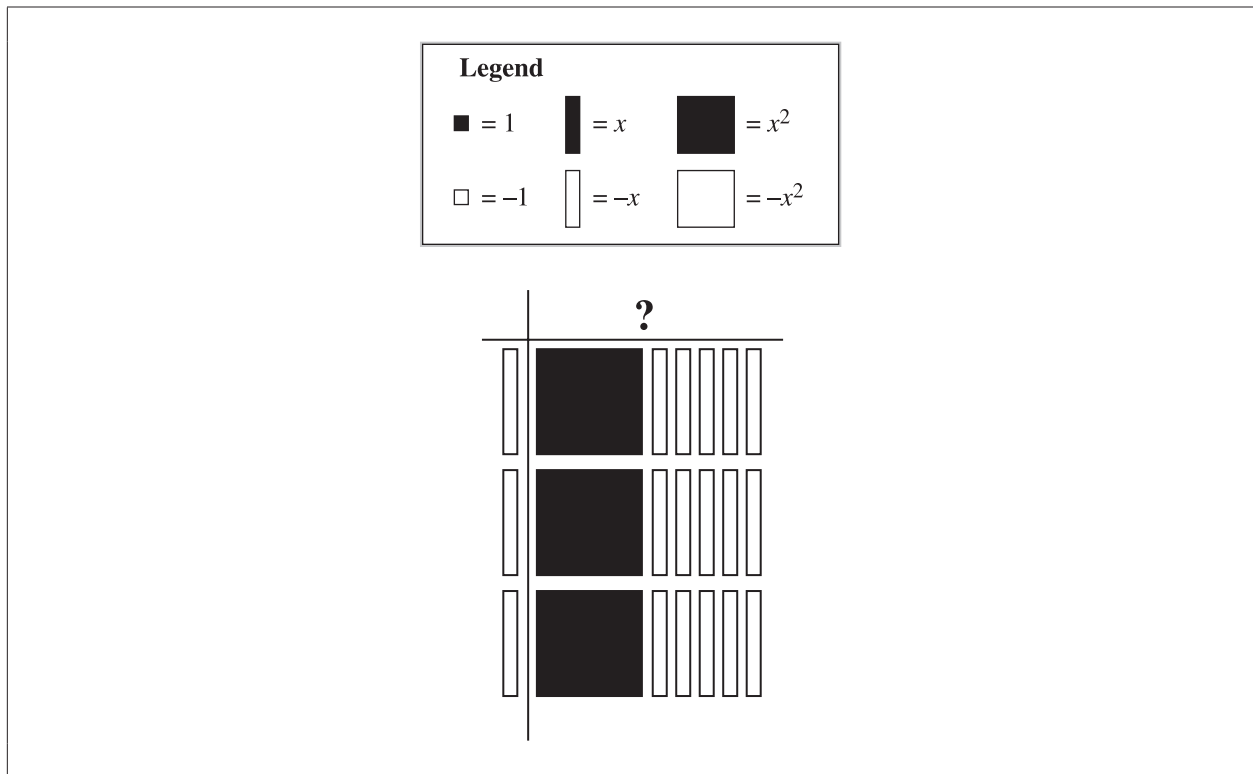   **B.** $6.65

    C. $7.82

    D. $9.47

38. The equation representing the linear relation on the graph shown above is

    A. $y = 0.5x + 2$

    B. $y = 0.5x - 2$

    C. $y = 2x + 4$

    D. $y = 2x - 4$

Legend

■ $= 1$ ▮ $= x$ ◼ $= x^2$

□ $= -1$ ▯ $= -x$ ▢ $= -x^2$

?

39. Which of the following polynomials represents the unknown expression in the model shown above?

A. $x^2 - 5x$

B. $-x^2 + 5x$

C. $x - 5$

D. $-x + 5$

Ethan conducts a survey to determine the demand for an outdoor skating rink in his community.

40. Ethan can **best** minimize the bias in his survey by collecting data from people who

- **A.** are different ages
- **B.** live in different cities
- **C.** participate in figure skating
- **D.** visit the rink at the same time each day

Patricia wants to buy a new pair of ice skates that cost $250 including GST. She already has $86 she plans to use towards this purchase. She earns $10.25/hour at her part-time job.

Numerical Response

10. What is the minimum number of hours that she must work to save enough money to purchase the pair of ice skates?

Answer: _____ **hours**

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

You have now completed the test.
If you have time, you may wish to check your answers.