MASSACHUSETTS
Department of Elementary
and Secondary Education

Release of Spring 2025 MCAS Test Items

from the

Grade 10 Mathematics Paper-Based Test

July 2025
Massachusetts Department of Elementary and Secondary Education

MASSACHUSETTS
Department of Elementary
and Secondary Education

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Overview of Grade 10 Mathematics Test

The spring 2025 grade 10 Mathematics test was administered in two formats: a computer-based version and a paper-based version. Most students took the computer-based test. The paper-based test was offered as an accommodation for eligible students who were unable to use a computer. More information can be found on the MCAS Test Administration Resources page at www.doe.mass.edu/mcas/admin.html.

Most of the operational items on the grade 10 Mathematics test were the same, regardless of whether a student took the computer-based version or the paper-based version. In places where a technology-enhanced item was used on the computer-based test, an adapted version of the item was created for use on the paper test. These adapted paper items were multiple-choice, multiple-select, or short-answer items that tested the same Mathematics content and assessed the same standard as the technology-enhanced item.

This document displays released items from the paper-based test. Released items from the computer-based test are available on the MCAS Resource Center website at mcas.onlinehelp.cognia.org/released-items.

Test Sessions and Content Overview

The grade 10 Mathematics test was made up of two separate test sessions. Each session included selected-response, short-answer, and constructed-response questions. On the paper-based test, the selected-response questions were multiple-choice items and multiple-select items, in which students select the correct answer(s) from among several answer options.

Standards and Reporting Categories

The grade 10 Mathematics test was based on high school standards in the *Massachusetts Curriculum Framework for Mathematics* (2017). The standards in the 2017 framework are organized under the five major conceptual categories listed below.

- Number and Quantity
- Algebra
- Functions
- Geometry
- Statistics and Probability

The grade 10 test assessed standards that overlap between the Model Algebra I/Model Geometry and Model Mathematics I/Model Mathematics II courses. The *Massachusetts Curriculum Framework for Mathematics* is available on the Department website at www.doe.mass.edu/frameworks/current.html.

Mathematics test results for grade 10 are reported under four MCAS reporting categories, which are based on the five framework conceptual categories listed above.

The table at the conclusion of this document provides the following information about each released operational item: reporting category, standard covered, item type, and item description. The correct answers for selected-response and short-answer questions are also displayed in the table.

Reference Materials and Tools

Each student taking the grade 10 Mathematics test was provided with a grade 10 Mathematics Reference Sheet. A copy of the reference sheet follows the final question in this document.

During Session 2, each student had sole access to a calculator. Calculator use was not allowed during Session 1.

During both Mathematics test sessions, the use of authorized bilingual word-to-word dictionaries and glossaries was allowed for students who are currently or were ever reported as English learners. No other reference tools or materials were allowed.

Grade 10 Mathematics

SESSION 1

This session contains 21 questions.

You may use your reference sheet during this session.
*You may **not** use a calculator during this session.*

Directions

Read each question carefully and then answer it as well as you can. You must record all answers in this Test & Answer Booklet.

For some questions, you will mark your answers by filling in the circles in your Test & Answer Booklet. Make sure you darken the circles completely. Do not make any marks outside of the circles. If you need to change an answer, be sure to erase your first answer completely.

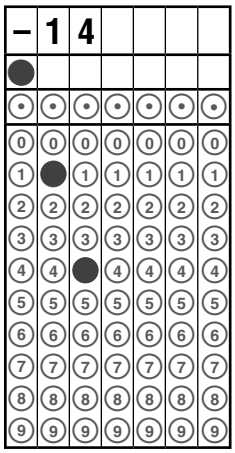
For other questions, you will need to fill in an answer grid. Directions for completing questions with answer grids are provided on the next page.

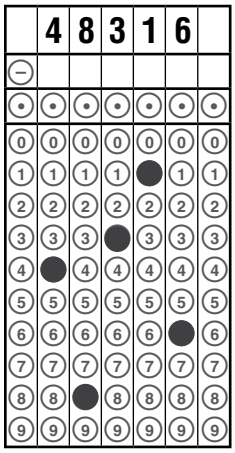
If a question asks you to show or explain your work, you must do so to receive full credit. Write your response in the space provided. Only responses written within the provided space will be scored.

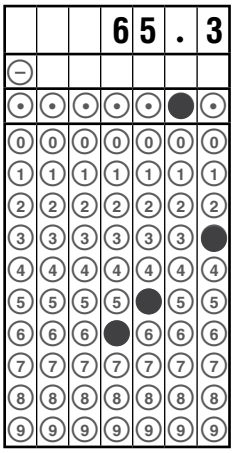
Directions for Completing Questions with Answer Grids

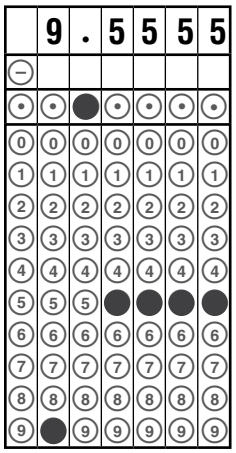
1. Work the question and find an answer.
2. Enter your answer in the answer boxes at the top of the answer grid.
3. Print only one number or symbol in each box. Do not leave a blank box in the middle of an answer.
4. Under each answer box, fill in the circle that matches the number or symbol you wrote above. Make a solid mark that completely fills the circle.
5. Do not fill in a circle under an unused answer box.
6. Fractions cannot be entered into an answer grid and will not be scored. Enter fractions as decimals.
7. If you need to change an answer, be sure to erase your first answer completely.
8. See below for examples of how to correctly complete an answer grid.

Examples









1 What is the minimum value of x that makes this inequality true?

$$12 - 2x \leq 4$$

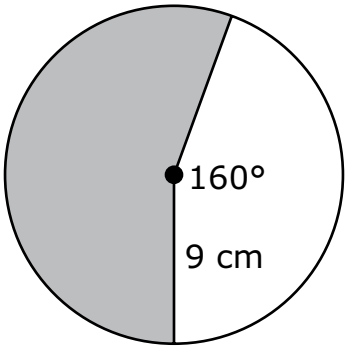
Ⓐ -8

Ⓑ -4

Ⓒ 4

Ⓓ 8

2 A circle with a shaded sector is shown in this diagram.



In the diagram,

- the radius of the circle is 9 cm, and
- the measure of the angle of the unshaded sector of the circle is 160°.

Which of the following is equivalent to the area, in square centimeters, of the **shaded** sector of the circle?

Ⓐ $\frac{200}{360}(\pi)(9^2)$

Ⓑ $\frac{160}{360}(9)(\pi^2)$

Ⓒ $\frac{200}{160}(9)(\pi^2)$

Ⓓ $\frac{160}{200}(\pi)(9^2)$

3 A student solved this equation.

$$17x - 2 = 3x + 5$$

Which of the following tables shows the correct explanations for each step the student used to solve the equation?

Ⓐ

Step	Explanation
$17x - 2 = 3x + 5$	Given
$14x - 2 = 5$	added 2 to both sides
$14x = 7$	divided both sides by 14
$x = \frac{1}{2}$	subtracted 2 from both sides

Ⓑ

Step	Explanation
$17x - 2 = 3x + 5$	Given
$14x - 2 = 5$	subtracted $3x$ from both sides
$14x = 7$	subtracted 2 from both sides
$x = \frac{1}{2}$	divided both sides by 7

Ⓒ

Step	Explanation
$17x - 2 = 3x + 5$	Given
$14x - 2 = 5$	added $3x$ to both sides
$14x = 7$	added 2 to both sides
$x = \frac{1}{2}$	divided both sides by 14

Ⓓ

Step	Explanation
$17x - 2 = 3x + 5$	Given
$14x - 2 = 5$	subtracted $3x$ from both sides
$14x = 7$	added 2 to both sides
$x = \frac{1}{2}$	divided both sides by 14

4 What is the value of this expression?

$$(\sqrt[3]{64})^2$$

Ⓐ 2

Ⓑ 4

Ⓒ 8

Ⓓ 16

5 Consider this expression.

$$x^2 - 7x + 10$$

For which values of x is the expression equal to 0?

Select the **two** correct answers.

Ⓐ −10

Ⓑ −5

Ⓒ 2

Ⓓ 5

Ⓔ 7

This question has four parts. Be sure to label each part of your response.

6 Maya plays on her high school basketball team. This table shows x, the number of minutes she played, and y, the number of points she scored, in each of the first eight games of the season.

Maya's Basketball Games

Minutes Played, x	Points Scored, y
10	4
14	10
14	14
16	12
16	14
18	16
18	18
20	17

A. On the coordinate plane provided in your answer space, create a scatter plot using the data from the table.

B. Based on the data, which of the following describes the correlation between the number of minutes Maya played and the number of points she scored per game?

Mark your answer by filling in the appropriate circle on the next page.

A strong positive correlation

B weak positive correlation

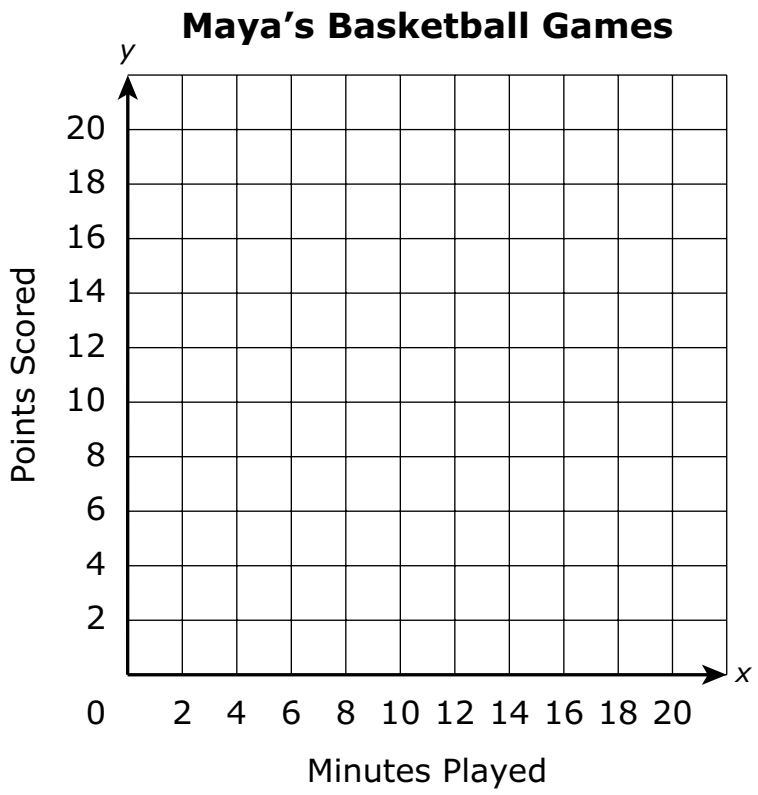
C strong negative correlation

D weak negative correlation

C. Based on the data, what is the expected number of points Maya will score if she plays in a game for 12 minutes? Show or explain how you got your answer.

D. Create a linear equation that could represent the data.

6 A.



B. Ⓐ strong positive correlation Ⓑ weak positive correlation

Ⓒ strong negative correlation Ⓓ weak negative correlation

7 A student drew right triangle XYZ.

- $m\angle X = 39°$
- $m\angle Z = 90°$

Which of the following is equivalent to sin X?

Ⓐ cos(39°)

Ⓑ cos(51°)

Ⓒ tan(51°)

Ⓓ tan(90°)

8 Two lines are graphed on a coordinate plane. The equations of the lines are shown.

$$y = -3x + 5$$

$$y = 6x - 22$$

Which of the following is the x-coordinate of the point on the coordinate plane where the lines intersect?

Ⓐ 2

Ⓑ 3

Ⓒ 4

Ⓓ 5

9 The first four terms in a geometric sequence are shown.

$$4,\ 12,\ 36,\ 108, \ldots$$

Which of the following expressions represents the nth term in the sequence, where $n \geq 1$?

Ⓐ $3(4)^{n-1}$

Ⓑ $4(3)^{n-1}$

Ⓒ $4 + 8(n - 1)$

Ⓓ $4 + 12(n - 1)$

10 Triangle UVW is congruent to triangle XYZ.

Which of the following **must** be true?

Select the **three** correct answers.

Ⓐ $\overline{UV} \cong \overline{XY}$

Ⓑ $\overline{VW} \cong \overline{XZ}$

Ⓒ $\angle V \cong \angle Y$

Ⓓ $\angle U \cong \angle X$

Ⓔ $\angle W \cong \angle X$

This question has two parts.

11 Two students each write a polynomial expression.

Part A

The first student writes this expression.

$$2x(x - 4)$$

Which of the following is an equivalent expression?

Ⓐ $2x^2 + 8x$

Ⓑ $2x^2 + 4x$

Ⓒ $2x^2 - 4x$

Ⓓ $2x^2 - 8x$

Part B

The second student writes this expression that represents the product of two polynomials.

$$(x - 2)(x^2 + 3x + 1)$$

The second student correctly simplifies the expression by finding the product of the polynomials and combining all like terms.

How many terms are in the student's simplified expression?

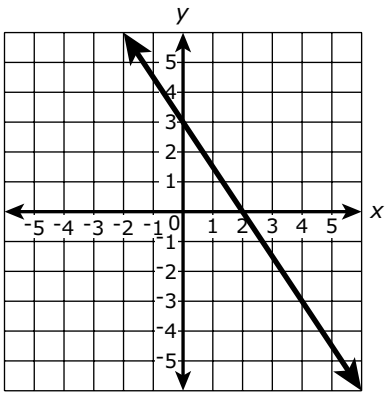
Ⓐ 3

Ⓑ 4

Ⓒ 5

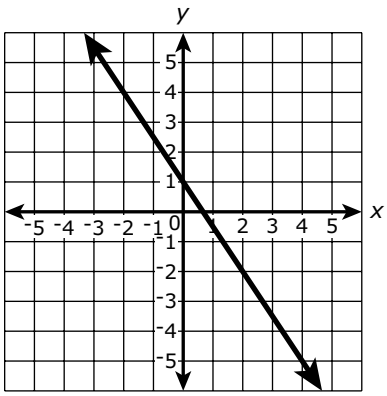
Ⓓ 6

12 Linear function $f(x)$ is graphed on this coordinate plane.

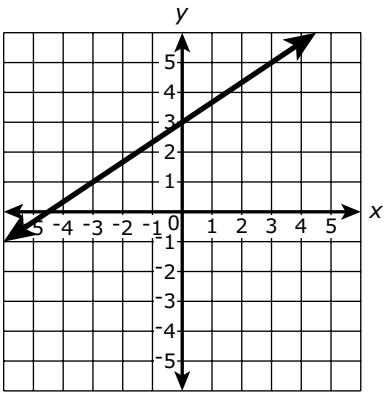


Which of the following graphs represents $f(x) - 2$?

Ⓐ



Ⓑ



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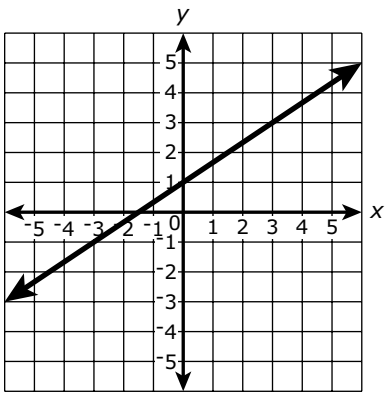
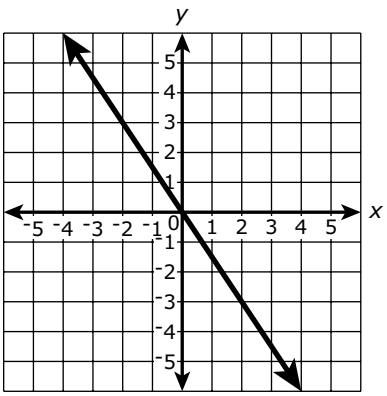


Ⓓ



This question has four parts. Be sure to label each part of your response.

13 Four students are studying expressions.

A. Lionel writes this radical expression.

$$(\sqrt{16})^2$$

What is the value of Lionel's expression? Show or explain how you got your answer.

B. Edith writes this exponential expression.

$$(25^{\frac{1}{2}})^2$$

What is the value of Edith's expression? Show or explain how you got your answer.

C. Walter writes this exponential expression.

$$(n^{\frac{1}{4}})^3$$

Which of the following radical expressions is equivalent to Walter's expression?

Mark your answer by filling in the appropriate circle on the next page.

A $\sqrt[3]{n^4}$

B $\sqrt[4]{n^3}$

C $\sqrt[4]{n^{13}}$

D $\sqrt[13]{n^4}$

D. Gloria writes this radical expression.

$$(\sqrt[3]{x})^2$$

Gloria's expression is equivalent to 4. What is the value of x in the expression? Show or explain how you got your answer.

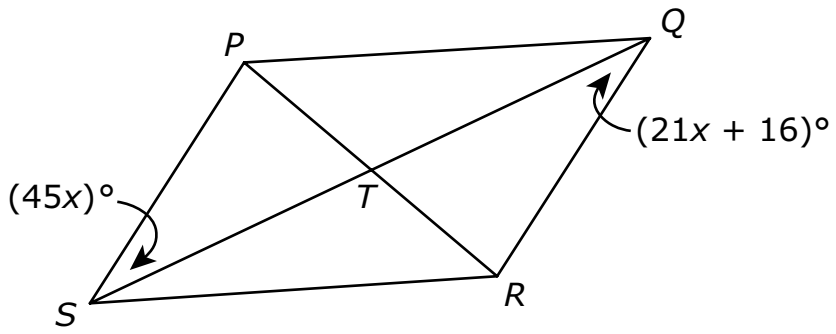
13

C. Ⓐ $\sqrt[3]{n^4}$ Ⓑ $\sqrt[4]{n^3}$

Ⓒ $\sqrt[4]{n^{13}}$ Ⓓ $\sqrt[13]{n^4}$

This question has two parts.

14 Parallelogram *PQRS*, its diagonals, and expressions representing some of its angle measures are shown in this diagram.



The diagonals of the parallelogram intersect at point *T*.

Part A

Based on the diagram, which of the following statements is **not** true?

Ⓐ $\overline{PQ} \cong \overline{SR}$

Ⓑ $\overline{PT} \cong \overline{RT}$

Ⓒ $\overline{PR} \cong \overline{SQ}$

Ⓓ $\overline{PS} \cong \overline{QR}$

Part B

Which of the following is the value of x in the diagram?

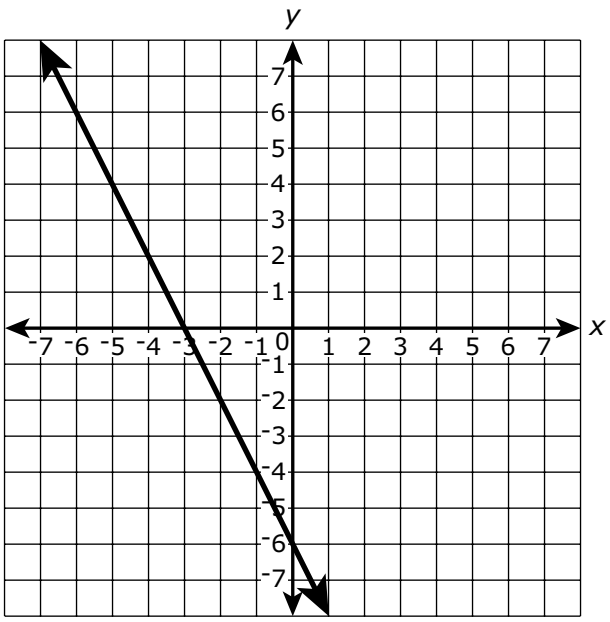
Ⓐ $x = \frac{2}{3}$

Ⓑ $x = \frac{3}{2}$

Ⓒ $x = \frac{8}{33}$

Ⓓ $x = \frac{33}{8}$

15 A line is shown on this coordinate plane.



Which of the following best represents an equation of the line?

Ⓐ $y = -2x - 6$

Ⓑ $y = 2x - 3$

Ⓒ $y = -3x - 6$

Ⓓ $y = 3x - 3$

16 Which of the following expressions have a value that is rational?

Select the **two** correct answers.

Ⓐ π^2

Ⓑ $\pi + 3$

Ⓒ $(2\sqrt[5]{3})^5$

Ⓓ $2^3 + (\sqrt{2})^4$

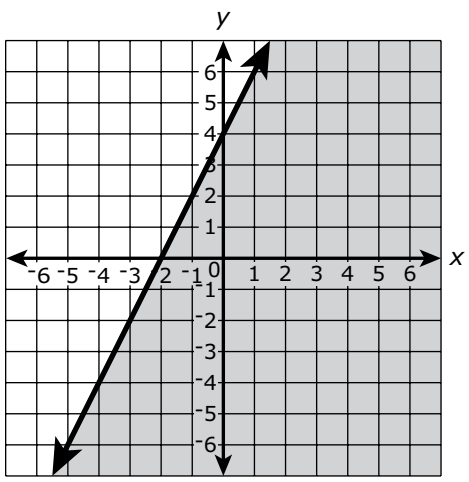
Ⓔ $5\sqrt{2} - 4\sqrt{2}$

17 Consider this inequality.

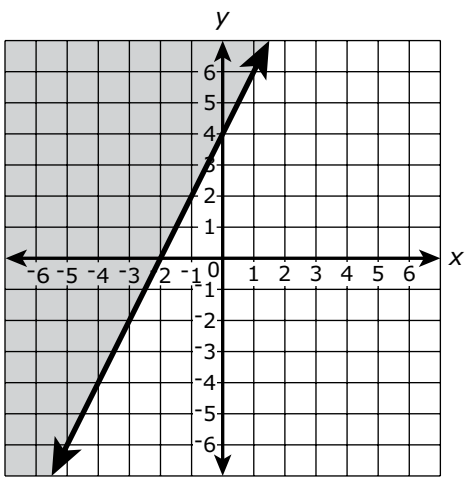
$$y \geq 2x + 4$$

Which of the following graphs represents the solution set of the inequality?

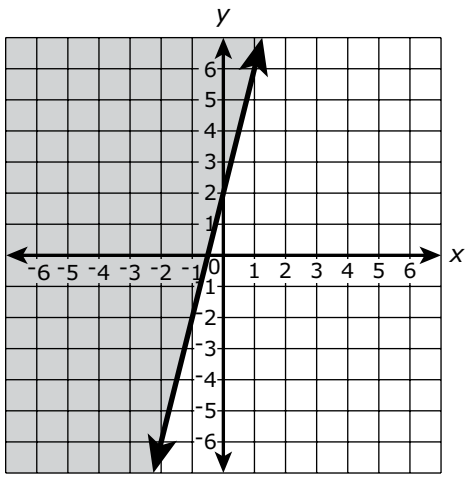
Ⓐ



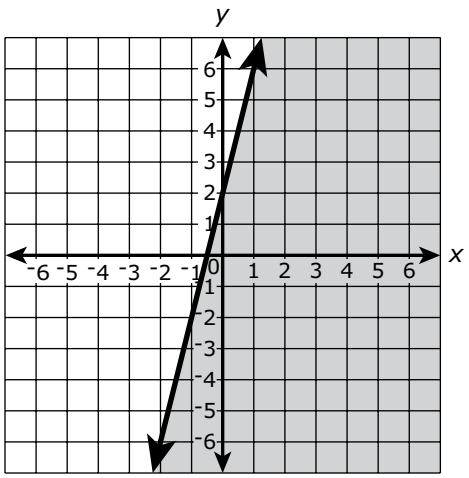
Ⓑ



Ⓒ

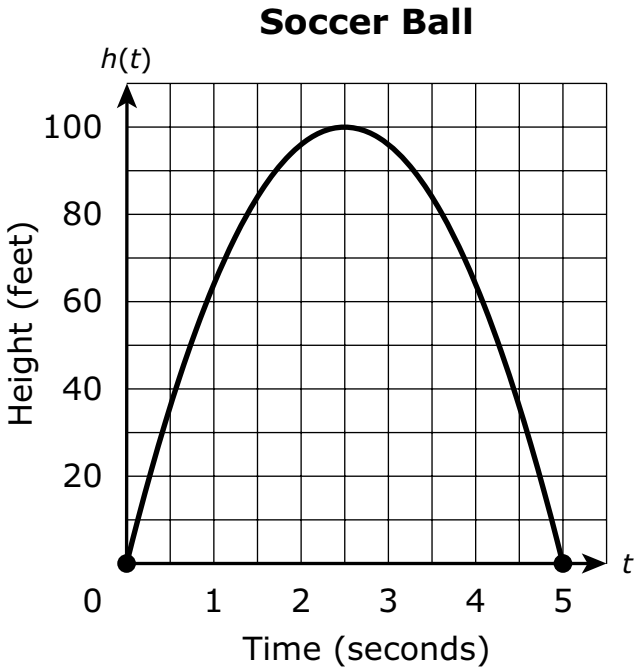


Ⓓ



This question has two parts.

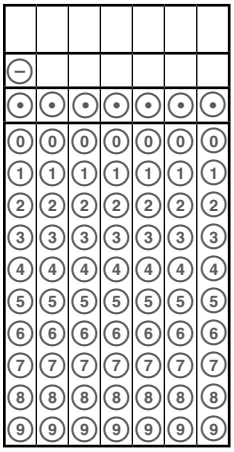
18 An athlete kicked a soccer ball upward from the ground. This graph represents $h(t)$, the height of the ball t seconds after it was kicked.



Part A

Based on the graph, after how many seconds did the ball reach its **maximum** height?

Enter your answer in the answer boxes at the top of the answer grid **and** completely fill the matching circles.



Part B

After 1 second, the soccer ball reached a height of 64 feet. Over which interval of time, in seconds, was the height of the soccer ball always greater than 64 feet?

Ⓐ $0 < t < 1$

Ⓑ $0 < t < 5$

Ⓒ $1 < t < 4$

Ⓓ $1 < t < 5$

19 The numbers of home runs hit by a baseball player in 10 seasons are listed in this box.

21, 13, 12, 16, 50, 18, 18, 24, 19, 8

Which of the following statements will be true if the outlier is removed from the list?

Ⓐ The mean and the median will both decrease.

Ⓑ The mean and the median will both stay the same.

Ⓒ The mean will stay the same, and the median will decrease.

Ⓓ The mean will decrease, and the median will stay the same.

20 A circle is graphed on a coordinate plane. An equation of the circle is shown.

$$(x - 2)^2 + (y + 1)^2 = 4$$

Based on the equation, which of the following statements are true?

Select the **two** correct answers.

Ⓐ The coordinates of the center of the circle are (2, –1).

Ⓑ The coordinates of the center of the circle are (–1, 4).

Ⓒ The coordinates of the center of the circle are (1, –2).

Ⓓ The radius of the circle is 2 units.

Ⓔ The radius of the circle is 16 units.

21 There is a linear relationship between the price of a car and the amount of deposit required by the dealership when the car is purchased.

Which of the following tables could represent the linear relationship?

Ⓐ

Price of Car ($)	Amount of Deposit ($)
10,000	100
15,000	200
20,000	400
25,000	800
30,000	1600

Ⓑ

Price of Car ($)	Amount of Deposit ($)
10,000	750
15,000	1000
20,000	1750
25,000	3500
30,000	7000

Ⓒ

Price of Car ($)	Amount of Deposit ($)
10,000	100
15,000	200
20,000	500
25,000	1000
30,000	1700

Ⓓ

Price of Car ($)	Amount of Deposit ($)
10,000	750
15,000	1000
20,000	1250
25,000	1500
30,000	1750

Grade 10 Mathematics

SESSION 2

This session contains 21 questions.

You may use your reference sheet during this session.
You may use a calculator during this session.

Directions

Read each question carefully and then answer it as well as you can. You must record all answers in this Test & Answer Booklet.

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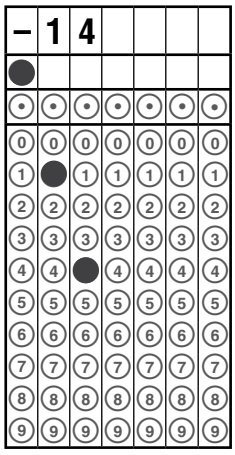
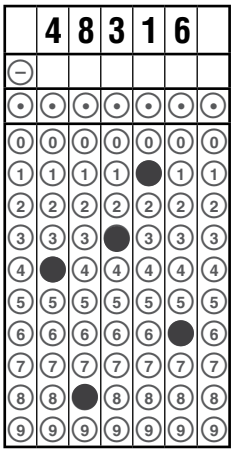
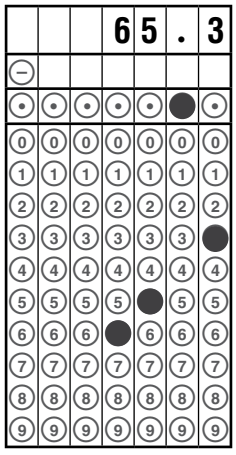
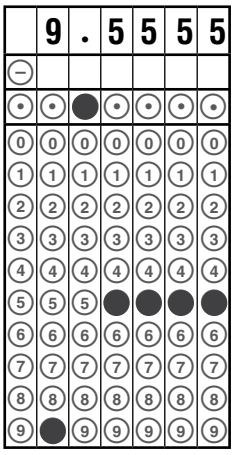
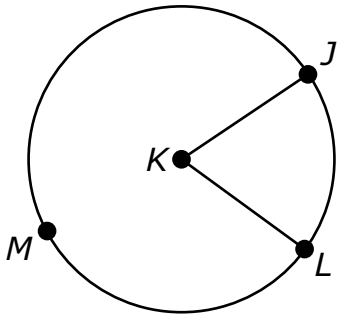








22 This diagram shows circle K.



On circle K, the measure of $\overset{\frown}{JML}$ is 290°.

What is the measure of $\angle JKL$?

Ⓐ 140°

Ⓑ 70°

Ⓒ 35°

Ⓓ 10°

23 Consider this expression.

$$3x^2 - x + 4$$

Which of the following correctly identifies the roles of each part of the expression?

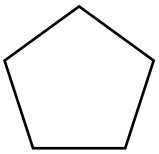
Ⓐ 2 is the coefficient
4 is the constant
x is the exponent
3 is the variable

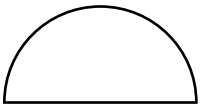
Ⓑ 3 is the coefficient
x is the constant
2 is the exponent
4 is the variable

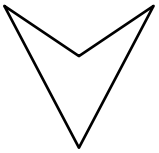
Ⓒ 2 is the coefficient
4 is the constant
3 is the exponent
x is the variable

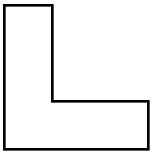
Ⓓ 3 is the coefficient
4 is the constant
2 is the exponent
x is the variable

24 Which of the following figures has rotational symmetry?

Ⓐ 

Ⓑ 

Ⓒ 

Ⓓ 

25 A high school basketball player claims he is 6 feet, 6 inches tall. His claim has a measurement error of about 4%.

Which of the following could be the player's actual height?

Ⓐ 6 feet, 2 inches

Ⓑ 6 feet, 3 inches

Ⓒ 6 feet, 10 inches

Ⓓ 6 feet, 11 inches

26 Kelly graphed a circle on a coordinate plane (not shown) with its center at point *P*. Then, Kelly plotted point *R* on the circle.

- The coordinates of point *P* are (0, 0).
- The coordinates of point *R* are (–6, 0).

Next, Kelly plotted point *Z* on the coordinate plane. The coordinates of point *Z* are (5, 3).

Which of the following sentences correctly describes the location of point *Z* in relation to the circle?

Ⓐ Point *Z* lies on the circle because the distance from point *P* to point *Z* is equal to the radius of the circle.

Ⓑ Point *Z* lies inside the circle because the distance from point *P* to point *Z* is less than the radius of the circle.

Ⓒ Point *Z* lies outside the circle because the distance from point *P* to point *Z* is less than the radius of the circle.

Ⓓ Point *Z* lies outside the circle because the distance from point *P* to point *Z* is greater than the radius of the circle.

This question has four parts. Be sure to label each part of your response.

27 A ball was kicked from the ground into the air. This function models the approximate height of the ball, above the ground, at any time until it returned to the ground.

$$h(t) = -16t^2 + 80t$$

In the function,

- t represents the number of seconds that have elapsed since the ball was kicked, and
- $h(t)$ represents the height of the ball, in feet, after t seconds.

A. What is the value of $h(0)$?

B. Which of the following is the value of $h(1)$?

Mark your answer by filling in the appropriate circle on the next page.

A 1

B 16

C 64

D 96

C. What is the value of $h(5)$? Explain what this value represents in this situation.

D. What is the value of $h(6)$? Explain what this value represents in this situation.

27

B. Ⓐ 1 Ⓑ 16

Ⓒ 64 Ⓓ 96

28 This table shows the number of desks of different colors and sizes in an office building.

Desks

	Brown	Gray	Total
Large	30	50	80
Small	10	30	40
Total	40	80	120

Based on the table, what is the probability that a randomly chosen desk in the building is brown?

Ⓐ $\frac{1}{12}$

Ⓑ $\frac{1}{4}$

Ⓒ $\frac{1}{3}$

Ⓓ $\frac{1}{2}$

29 A rare painting was purchased for an art museum. This function models the projected value of the painting x years after its purchase.

$$f(x) = 10{,}500(1.015)^x$$

Based on the function, which of the following statements is true?

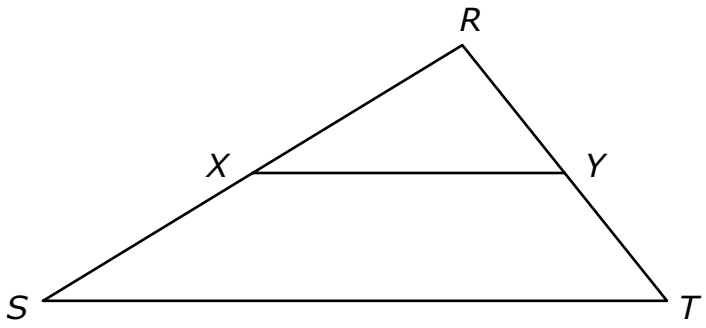
Ⓐ The painting's value is decreasing.

Ⓑ The painting's value at the time of its purchase was $10,500.

Ⓒ The painting's value is projected to increase by 15% per year.

Ⓓ The painting's value after 15 years will be twice its purchase price.

30 In this diagram, $\triangle RST \sim \triangle RXY$.



Which of the following **could** be the lengths, in units, of some of the sides of the triangles?

Ⓐ $RY = 2$, $RT = 4$, $RX = 3$, and $RS = 5$

Ⓑ $RY = 2$, $RT = 4$, $RX = 3$, and $RS = 6$

Ⓒ $RY = 2$, $RT = 5$, $RX = 4$, and $RS = 7$

Ⓓ $RY = 2$, $RT = 6$, $RX = 4$, and $RS = 8$

31 Which of the following statements about the slopes of two perpendicular lines **could** be true?

Ⓐ Both slopes are 0.

Ⓑ Both slopes are undefined.

Ⓒ One slope is 0; the other is 1.

Ⓓ One slope is 0; the other is undefined.

This question has two parts.

32 It takes workers at a factory 2 hours and 30 minutes to produce 160 umbrellas.

Part A

At this rate, which of the following is **closest** to the total number of umbrellas the workers can produce in 8 hours?

Ⓐ 300

Ⓑ 400

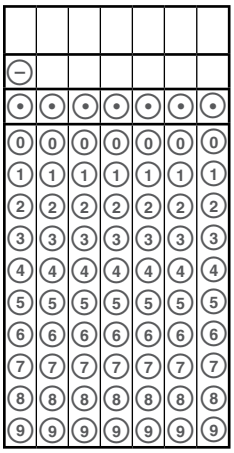
Ⓒ 500

Ⓓ 600

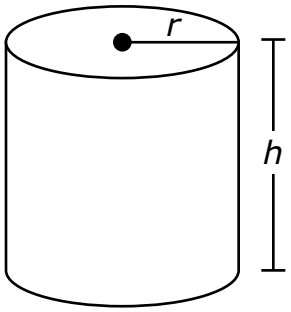
Part B

How many hours, rounded to the **nearest** hour, will it take the workers to produce 1,100 umbrellas?

Enter your answer in the answer boxes at the top of the answer grid **and** completely fill the matching circles.



33 A circular cylinder is shown in this diagram.



In the diagram,

- the radius of the cylinder is r units, and
- the height of the cylinder is h units.

Which of the following describe how the volume of the cylinder changes as its radius or its height changes?

Select the **two** correct answers.

Ⓐ If r is multiplied by 3, the volume will be 3 times as great.

Ⓑ If r is multiplied by 3, the volume will be 6 times as great.

Ⓒ If r is multiplied by 3, the volume will be 9 times as great.

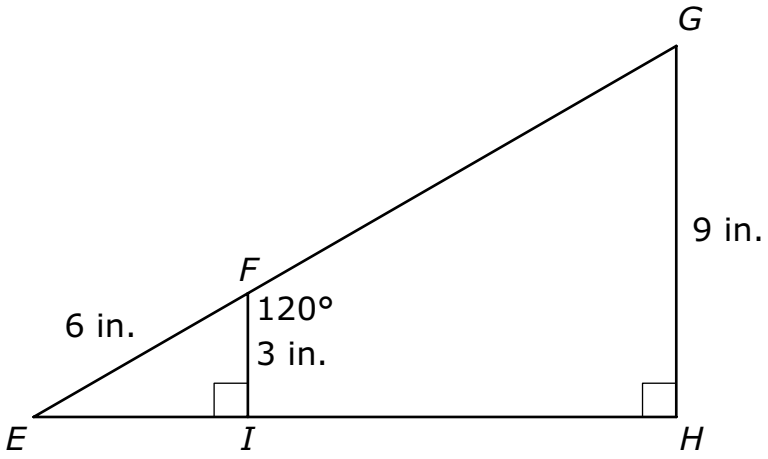
Ⓓ If h is multiplied by 4, the volume will be 4 times as great.

Ⓔ If h is multiplied by 4, the volume will be 8 times as great.

Ⓕ If h is multiplied by 4, the volume will be 16 times as great.

This question has four parts. Be sure to label each part of your response.

34 Triangle *EFI* is similar to triangle *EGH*. The triangles and some of their measurements are shown in this diagram.



A. What is the measure, in degrees, of $\angle E$? Show or explain how you got your answer.

B. The length of $\overline{EF}$ is 6 inches, and the length of $\overline{IF}$ is 3 inches.

What is the scale factor between the corresponding sides of the triangles? Show or explain how you got your answer.

C. What is the length, in inches, of $\overline{FG}$? Show or explain how you got your answer.

D. What is the length, in inches, of $\overline{IH}$? Show or explain how you got your answer.

34

This question has two parts.

35 A student computed the correlation coefficient, r, for a set of data. The result of the computation is shown.

$$r = 0.92$$

Part A

Based on the correlation coefficient, which of the following statements about the data is true?

Ⓐ The data have a weak positive correlation.

Ⓑ The data have a weak negative correlation.

Ⓒ The data have a strong positive correlation.

Ⓓ The data have a strong negative correlation.

Part B

The student will graph the line of best fit for the data on a coordinate plane.

Which of the following statements about the line of best fit is true?

Ⓐ The slope must be positive.

Ⓑ The slope must be negative.

Ⓒ The y-intercept must be positive.

Ⓓ The y-intercept must be negative.

36 On a farm, there are a variety of animals.

- 30% of the animals on the farm are chickens.
- 24% of the animals on the farm are chickens that lay eggs.

Given that a randomly selected animal from the farm is a chicken, what is the probability that it lays eggs?

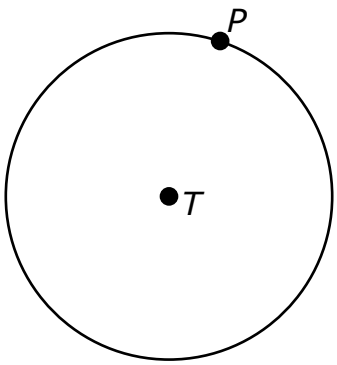
Ⓐ $\frac{6}{30}$

Ⓑ $\frac{24}{30}$

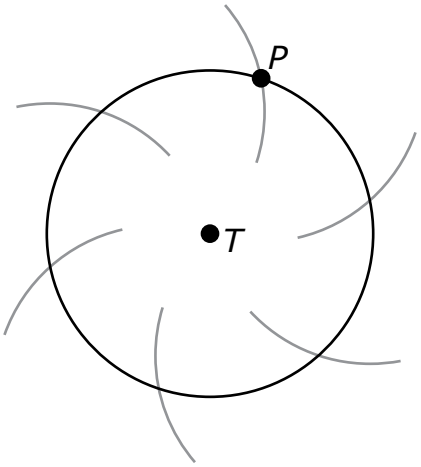
Ⓒ $\frac{6}{24}$

Ⓓ $\frac{30}{24}$

37 Point *P* lies on circle *T*, as shown.



A student used a compass and a straightedge to perform a geometric construction on the circle. First the student set the compass equal to the radius of circle *T*. Then the student used the compass to draw six consecutive arcs along the circle starting at point *P*, as shown.



The student then drew a point at each intersection of an arc and circle *T*. Finally, in a clockwise direction starting at point *P*, the student used the straightedge to draw line segments connecting each pair of consecutive points on the circle to complete the construction.

Which of the following **best** describes the student's completed construction?

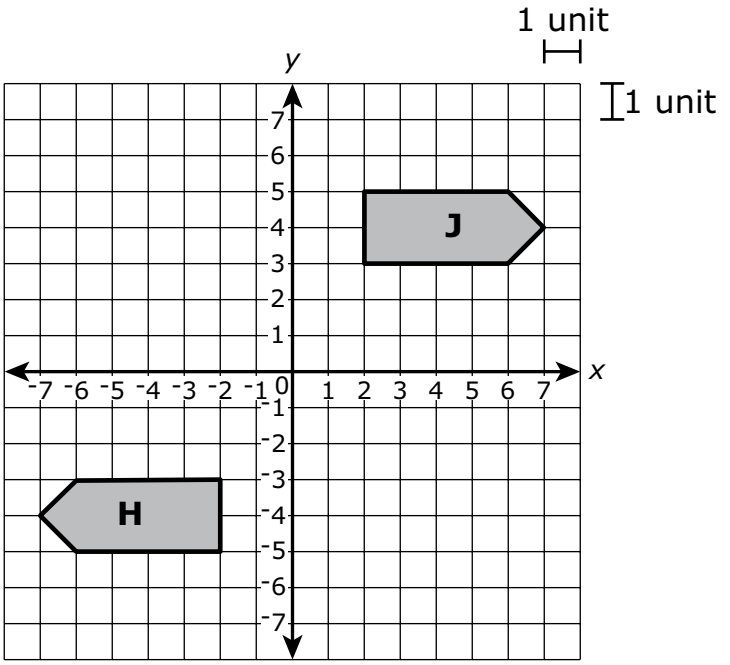
Ⓐ The student constructed an inscribed square.

Ⓑ The student constructed four inscribed triangles.

Ⓒ The student constructed two inscribed trapezoids.

Ⓓ The student constructed an inscribed regular hexagon.

38 Alfredo graphed congruent pentagons J and H on a coordinate plane, as shown.



Alfredo will perform a sequence of transformations on pentagon J such that its image is pentagon H.

Which of the following could be the sequence of transformations that Alfredo will perform?

Ⓐ a reflection over the *x*-axis and a translation 4 units left

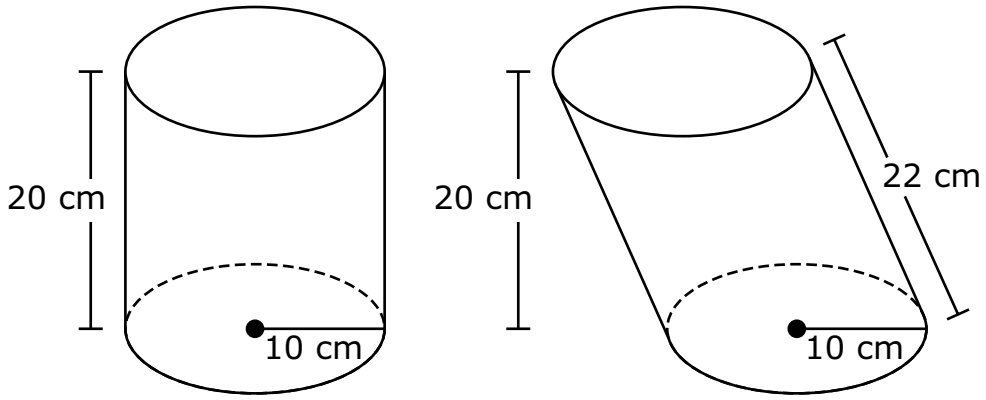
Ⓑ a reflection over the *x*-axis and a translation 8 units down

Ⓒ a reflection over the *y*-axis and a translation 8 units down

Ⓓ a reflection over the *y*-axis and a translation 4 units left and 8 units down

This question has two parts.

39 Cylinder E, cylinder F, and some of their dimensions are shown.

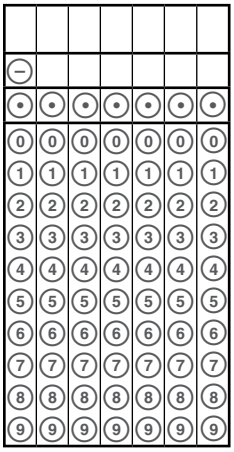


Cylinder E Cylinder F

Part A

What is the volume, rounded to the nearest cubic centimeter, of cylinder E?

Enter your answer in the answer boxes at the top of the answer grid **and** completely fill the matching circles.



Part B

The area of the base of cylinder E is equal to the area of the base of cylinder F.

Which of the following statements correctly compares the volumes of the two cylinders?

Ⓐ The volume of cylinder E is equal to the volume of cylinder F because the heights of the cylinders are equal.

Ⓑ The volume of cylinder E is equal to the volume of cylinder F because the slant heights of the cylinders are equal.

Ⓒ The volume of cylinder E is not equal to the volume of cylinder F because the heights of the cylinders are not equal.

Ⓓ The volume of cylinder E is not equal to the volume of cylinder F because the slant heights of the cylinders are not equal.

40 Consider this system of equations.

$$10x + 3y = -11$$

$$5x + 4y = 2$$

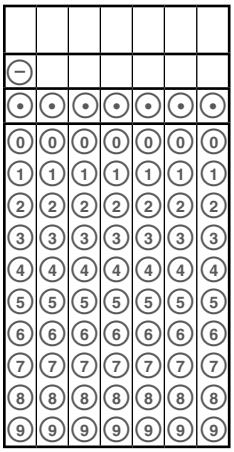
A student will solve the system by creating this equivalent system of equations, where a is an integer.

$$10x + 3y = -11$$

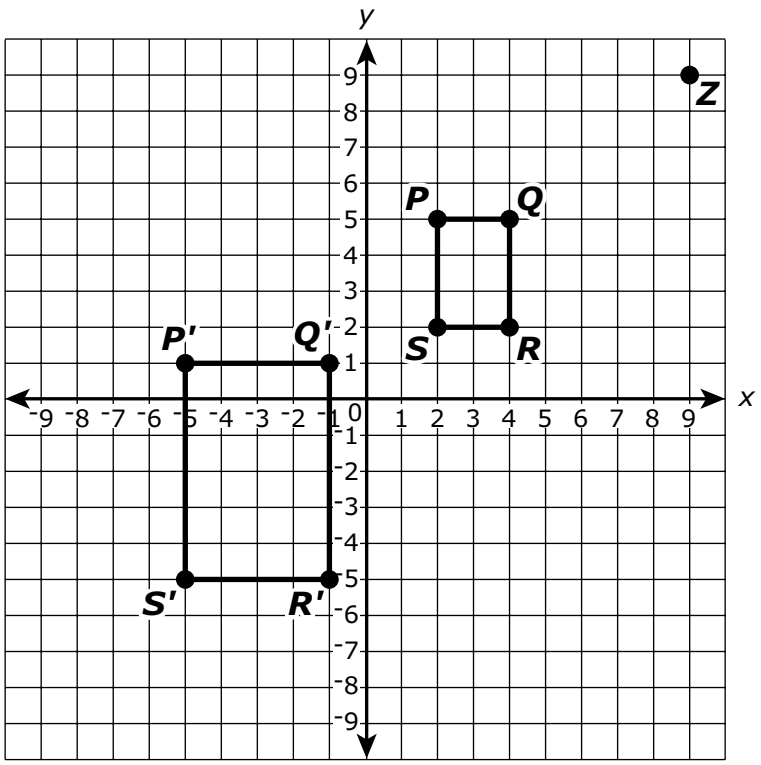
$$-10x + ay = -4$$

What is the value of a?

Enter your answer in the answer boxes at the top of the answer grid **and** completely fill the matching circles.



41 Two rectangles and point Z are shown on this coordinate plane.



Rectangle $P'Q'R'S'$ is the image of rectangle $PQRS$ after a dilation with respect to point Z.

What was the scale factor used in the dilation?

Ⓐ 2

Ⓑ 7

Ⓒ 9

Ⓓ 14

42 As the x-value of a linear function increases, the y-value decreases. Which of the following describes the slope of the graph of the function?

Ⓐ zero

Ⓑ positive

Ⓒ negative

Ⓓ undefined

Massachusetts Comprehensive Assessment System
Grade 10 Mathematics Reference Sheet

MASSACHUSETTS Department of Elementary and Secondary Education

CONVERSIONS

1 cup = 8 fluid ounces
1 pint = 2 cups
1 quart = 2 pints
1 gallon = 4 quarts
1 gallon ≈ 3.785 liters
1 liter ≈ 0.264 gallon
1 liter = 1000 cubic centimeters

1 inch = 2.54 centimeters
1 meter ≈ 39.37 inches
1 mile = 5280 feet
1 mile = 1760 yards
1 mile ≈ 1.609 kilometers
1 kilometer ≈ 0.62 mile

1 pound = 16 ounces
1 pound ≈ 0.454 kilogram
1 kilogram ≈ 2.2 pounds
1 ton = 2000 pounds

AREA (*A*) FORMULAS

square . . . . . $A = s^2$
rectangle . . . . . $A = lw$
parallelogram . . . . . $A = bh$
triangle . . . . . $A = \frac{1}{2}bh$
trapezoid . . . . . $A = \frac{1}{2}h(b_1 + b_2)$
circle . . . . . $A = \pi r^2$

TOTAL SURFACE AREA (*SA*) FORMULAS

cube . . . . . $SA = 6s^2$
right square pyramid . . . . $SA = s^2 + 2s\ell$
(ℓ = slant height)
right rectangular prism . . $SA = 2(lw) + 2(hw) + 2(lh)$

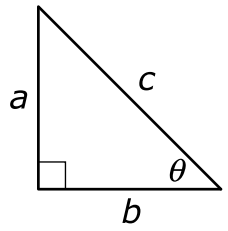
VOLUME (*V*) FORMULAS

cube . . . . . $V = s^3$
(s = length of an edge)
prism . . . . . $V = Bh$
cylinder . . . . . $V = \pi r^2 h$
cone . . . . . $V = \frac{1}{3}\pi r^2 h$
pyramid . . . . . $V = \frac{1}{3}Bh$
sphere . . . . . $V = \frac{4}{3}\pi r^3$

CIRCLE FORMULAS

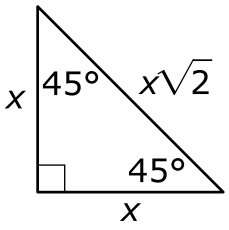
pi . . . . . $\pi \approx 3.14$
circumference . . . . $C = 2\pi r$ OR $C = \pi d$
area . . . . . $A = \pi r^2$

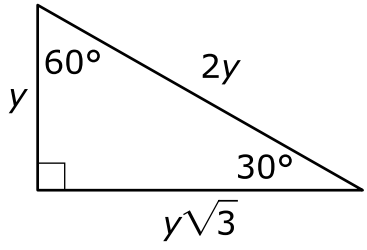
RIGHT TRIANGLES



Pythagorean Theorem
$a^2 + b^2 = c^2$
Trigonometric Ratios
$\sin\theta = \frac{a}{c}$
$\cos\theta = \frac{b}{c}$
$\tan\theta = \frac{a}{b}$

SPECIAL RIGHT TRIANGLES





Grade 10 Mathematics
Spring 2025 Released Operational Items

PBT Item No.	Page No.	Reporting Category	Standard	Item Type*	Item Description	Correct Answer**
1	4	*Algebra and Functions*	A-REI.B.3	SR	Given a linear inequality, identify the minimum value that makes the inequality true.	C
2	4	*Geometry*	G-C.B.5	SR	Identify an expression that represents the area of a sector of a circle given a radius and a central angle measure.	A
3	5	*Algebra and Functions*	A-REI.A.1	SR	Explain each step in the solution of a linear equation.	D
4	6	*Number and Quantity*	N-RN.A.2	SR	Use laws of exponents to evaluate a radical expression.	D
5	6	*Algebra and Functions*	A-SSE.B.3	SR	Determine the zeros of a quantity defined by a quadratic expression.	C,D
6	7–8	*Statistics and Probability*	S-ID.B.6	CR	Given a set of data, create a scatter plot, describe the relationship of the variables, interpolate the data, and create an equation that represents the data.	
7	9	*Geometry*	G-SRT.C.7	SR	Relate the sine and cosine of acute angles in a right triangle.	B
8	9	*Algebra and Functions*	A-REI.D.11	SR	Given the equations of two lines, identify the x-coordinate of the point at which the lines intersect.	B
9	10	*Algebra and Functions*	F-BF.A.2	SR	Identify an expression that represents a given geometric sequence.	B
10	10	*Geometry*	G-CO.B.7	SR	Identify congruent sides and angles of triangles based on a congruence statement.	A,C,D
11	11	*Algebra and Functions*	A-APR.A.1	SR	Given a quadratic expression, use the distributive property to identify an equivalent expression and analyze the product of a binomial and a trinomial.	D;B
12	12	*Algebra and Functions*	F-BF.B.3	SR	Identify the graph of a linear function over a vertical shift.	A
13	13–14	*Number and Quantity*	N-RN.A.1	CR	Evaluate expressions involving radicals and rational exponents, rewrite an exponential expression as a radical expression, and determine the value of the variable in a radical expression that gives the expression a known value.	
14	15	*Geometry*	G-CO.C.11	SR	Use properties of parallelograms to analyze the diagonals of a parallelogram and to solve a problem.	C;A
15	16	*Algebra and Functions*	A-CED.A.2	SR	Identify an equation of a line graphed on a coordinate plane.	A
16	16	*Number and Quantity*	N-RN.B.3	SR	Determine whether the values of given expressions are rational.	C,D
17	17	*Algebra and Functions*	A-REI.D.12	SR	Identify the solution set of a linear inequality in two variables on a coordinate plane.	B
18	18–19	*Algebra and Functions*	F-IF.C.7	SA	Analyze the maximum value of a quadratic function, and an interval over which the function exceeds a given value, based on its graph.	2.5;C
19	20	*Statistics and Probability*	S-ID.A.3	SR	Determine the effect on the mean and the median if an outlier is removed from a set of data.	D
20	20	*Geometry*	G-GPE.A.1	SR	Determine the coordinates of the center of a circle and its radius given its equation.	A,D
21	21	*Algebra and Functions*	F-LE.A.1	SR	Identify a table that represents a linear relationship from a description of a real-world situation.	D

PBT Item No.	Page No.	Reporting Category	Standard	Item Type*	Item Description	Correct Answer**
22	24	*Geometry*	G-C.A.2	SR	Find the measure of a central angle in a circle given a major arc measure.	B
23	24	*Algebra and Functions*	A-SSE.A.1	SR	Analyze the parts of a quadratic expression to identify their roles within the expression.	D
24	25	*Geometry*	G-CO.A.3	SR	Identify a figure that has rotational symmetry.	A
25	25	*Number and Quantity*	N-Q.A.3	SR	Use measurement error to calculate a value relating to a real-world claim.	B
26	26	*Geometry*	G-GPE.B.4	SR	Describe a point's location in relation to a circle given the coordinates of the center of the circle and a point that lies on the circle.	B
27	27–28	*Algebra and Functions*	F-IF.A.2	CR	Evaluate a quadratic function for different elements of its domain and interpret these values in terms of a context.	
28	29	*Statistics and Probability*	S-CP.A.4	SR	Calculate a probability from data shown in a two-way frequency table.	C
29	29	*Algebra and Functions*	F-LE.B.5	SR	Interpret the parameters of an exponential function that represents a real-world situation.	B
30	30	*Geometry*	G-SRT.A.2	SR	Use a proportion to determine possible side lengths of two similar triangles.	B
31	30	*Geometry*	G-GPE.B.5	SR	Describe possible slopes of two lines that are perpendicular.	D
32	31	*Number and Quantity*	N-Q.A.2	SA	Use proportional analysis to answer questions about a real-world situation.	C;17
33	32	*Geometry*	G-GMD.A.3	SR	Describe the change in the volume of a circular cylinder as its radius and its height are scaled.	C,D
34	33–34	*Geometry*	G-SRT.B.5	CR	Determine unknown side lengths and angle measures of two similar triangles based on a diagram of the triangles.	
35	35	*Statistics and Probability*	S-ID.C.8	SR	Describe the association of data and a linear model that represents it based on the correlation coefficient of the data.	C;A
36	36	*Statistics and Probability*	S-CP.B.6	SR	Identify a conditional probability from a context.	B
37	37	*Geometry*	G-CO.D.13	SR	Describe the completed construction of a figure inscribed in a circle.	D
38	38	*Geometry*	G-CO.A.5	SR	Identify a translation used to translate a pentagon graphed on a coordinate plane onto another pentagon.	C
39	39–40	*Geometry*	G-GMD.A.1	SA	Calculate the volume of a right cylinder and compare it to the volume of an oblique cylinder with similar dimensions.	6,280;A
40	41	*Algebra and Functions*	A-REI.C.5	SA	Given a system of linear equations, determine the value of a coefficient in an equivalent system.	–8
41	42	*Geometry*	G-SRT.A.1	SR	Identify the scale factor used in a dilation on a coordinate plane given a pre-image, an image, and the center of dilation.	A
42	43	*Algebra and Functions*	F-IF.B.4	SR	Describe the rate of change of a linear function based on a description of the behavior of the variables.	C

* Mathematics item types are: selected-response (SR), short-answer (SA), and constructed-response (CR).

** Answers are provided here for selected-response and short-answer items only. Sample responses and scoring guidelines for any constructed-response items will be posted to the Department's website later this year.