



MASSACHUSETTS

Department of Elementary
and Secondary Education

Release of Spring 2023

MCAS Test Items

from the

Grade 10 Mathematics

Paper-Based Test

June 2023

**Massachusetts Department of
Elementary and Secondary Education**



MASSACHUSETTS
Department of Elementary
and Secondary Education

This document was prepared by the
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Jeffrey C. Riley
Commissioner

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Overview of Grade 10 Mathematics Test

The spring 2023 grade 10 Mathematics test was a next-generation assessment that 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.pearsonsupport.com/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 chapter.

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 bilingual word-to-word dictionaries was allowed for current and former English learner students only. 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	4				
●						
○	○	○	○	○	○	○
0	0	0	0	0	0	0
1	●	1	1	1	1	1
2	2	2	2	2	2	2
3	3	3	3	3	3	3
4	4	●	4	4	4	4
5	5	5	5	5	5	5
6	6	6	6	6	6	6
7	7	7	7	7	7	7
8	8	8	8	8	8	8
9	9	9	9	9	9	9

	4	8	3	1	6	
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○	○	○	○	○	○	○
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3	3	3	●	3	3	3
4	●	4	4	4	4	4
5	5	5	5	5	5	5
6	6	6	6	6	●	6
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2	2	2	2	2	2	2
3	3	3	3	3	3	●
4	4	4	4	4	4	4
5	5	5	5	●	5	5
6	6	6	●	6	6	6
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	9	.	5	5	5	5
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○	○	○	○	○	○	○
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3	3	3	3	3	3	3
4	4	4	4	4	4	4
5	5	5	●	●	●	●
6	6	6	6	6	6	6
7	7	7	7	7	7	7
8	8	8	8	8	8	8
9	●	9	9	9	9	9

- 1 The area, in square units, of a rectangle is represented by this expression.

$$6x^2 + 15x$$

Which of the following also represents the area, in square units, of the rectangle?

- Ⓐ $3x(2x + 5)$
- Ⓑ $3x(2x + 15)$
- Ⓒ $6x(x + 9)$
- Ⓓ $6x(x) + 15$

- 2 A circle graphed on a coordinate plane has its center at $(2, -4)$ and a radius of 4 units.

Which of the following is an equation of the circle?

- Ⓐ $(x + 2)^2 + (y - 4)^2 = 2^2$
- Ⓑ $(x - 2)^2 + (y + 4)^2 = 4^2$
- Ⓒ $(x + 2)^2 + (y - 4)^2 = 8^2$
- Ⓓ $(x - 2)^2 + (y + 4)^2 = 16^2$

- 3 Consider this expression.

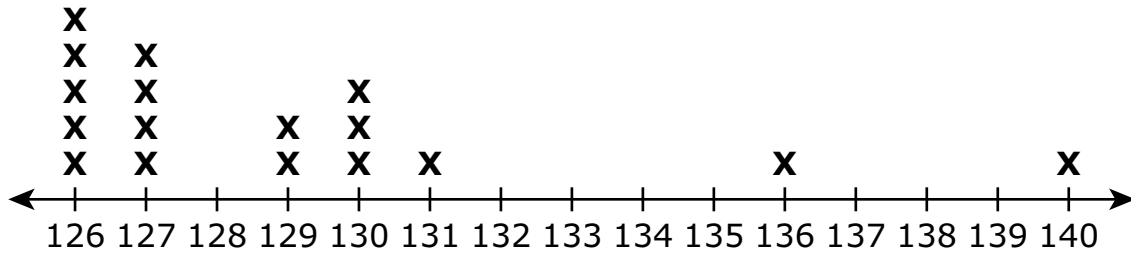
$$(\sqrt{6})^2$$

Which of the following is the value of the expression?

- Ⓐ 6
- Ⓑ 12
- Ⓒ 36
- Ⓓ 216

- 4 This line plot shows the number of people who attended each showing of a new film at a movie theater.

Number of People Attending Each Film Showing



Based on the line plot, what is the median number of people who attended the new film’s showings at the movie theater?

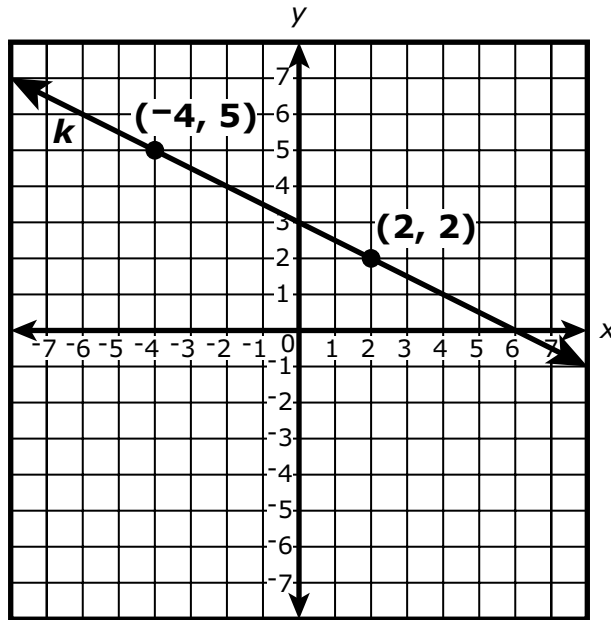
- Ⓐ 126
 - Ⓑ 127
 - Ⓒ 129
 - Ⓓ 133
- 5 Which of the following is equivalent to this expression?

$$14 - 2(x - 4)$$

- Ⓐ $10 - 2x$
- Ⓑ $12 - 2x$
- Ⓒ $20 - 2x$
- Ⓓ $22 - 2x$

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

- 6 Line k is shown on this coordinate plane.



A. What is the slope of line k ? Show or explain how you got your answer.

B. Line p is parallel to line k . The y -intercept of line p is the point $(0, -4)$. Create an equation that represents line p .

C. Line r passes through the points $(-2, 1)$ and $(1, 0)$.

Is line r parallel to line k ? Explain your reasoning.

D. Line s is **perpendicular** to line k . Line s passes through the point $(5, -2)$. Create an equation that represents line s .

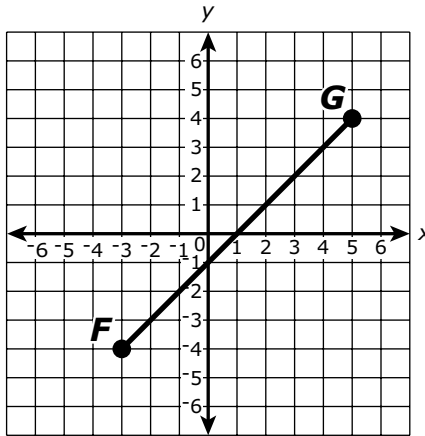
- 7 This inequality represents h , the number of hours Emma needs to work this week to earn at least \$360 by the end of the month.

$$12h + 240 \geq 360$$

What is the minimum number of hours Emma needs to work this week to earn at least \$360 by the end of the month?

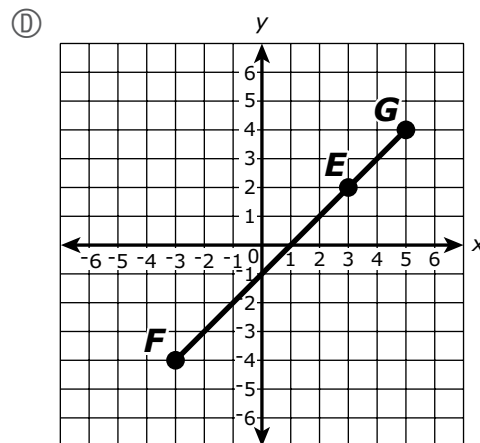
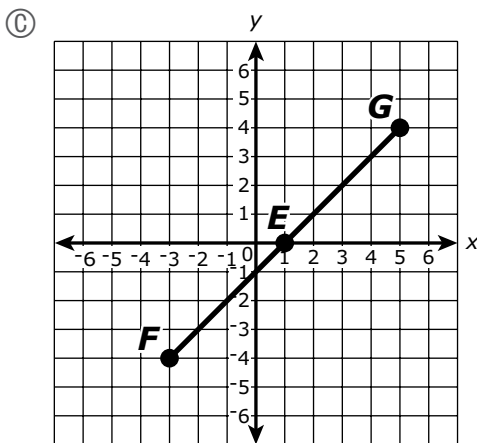
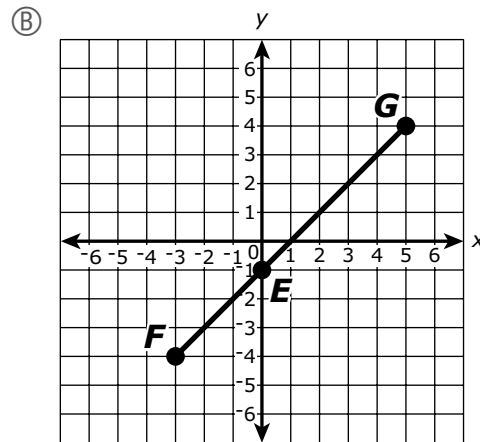
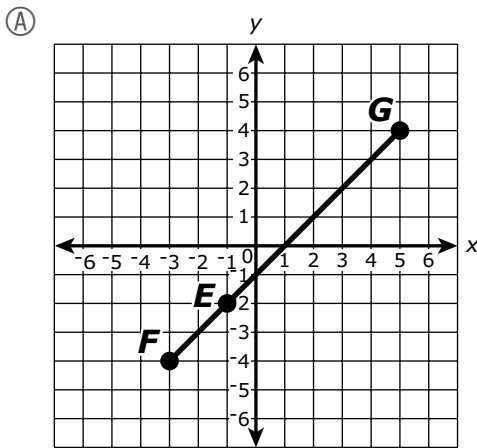
- Ⓐ 5
- Ⓑ 10
- Ⓒ 30
- Ⓓ 50

- 8 Line segment \overline{FG} is graphed on this coordinate plane.



Point E lies on \overline{FG} such that the length of \overline{EF} is 3 times the length of \overline{EG} .

Which of the following graphs shows the correct location of point E ?

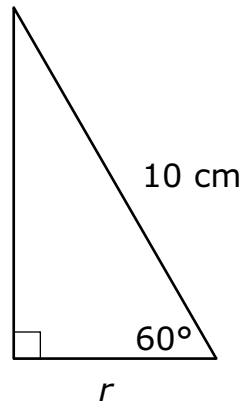


- 9 What are the solutions of this equation?

$$(x - 5)(x + 7) = 0$$

- Ⓐ -5 and -7
- Ⓑ -5 and 7
- Ⓒ 5 and -7
- Ⓓ 5 and 7

- 10 A right triangle and some of its measurements are shown in this diagram.



Based on the diagram, what is the value of r ?

- Ⓐ 5 cm
- Ⓑ $5\sqrt{2}$ cm
- Ⓒ $5\sqrt{3}$ cm
- Ⓓ 6 cm

This question has two parts.

11 Part A

Which of the following statements about rational and irrational numbers is **not** true?

- Ⓐ The sum of two rational numbers is rational.
- Ⓑ The product of two rational numbers is rational.
- Ⓒ The sum of a rational number and an irrational number is rational.
- Ⓓ The product of a non-zero rational number and an irrational number is irrational.

Part B

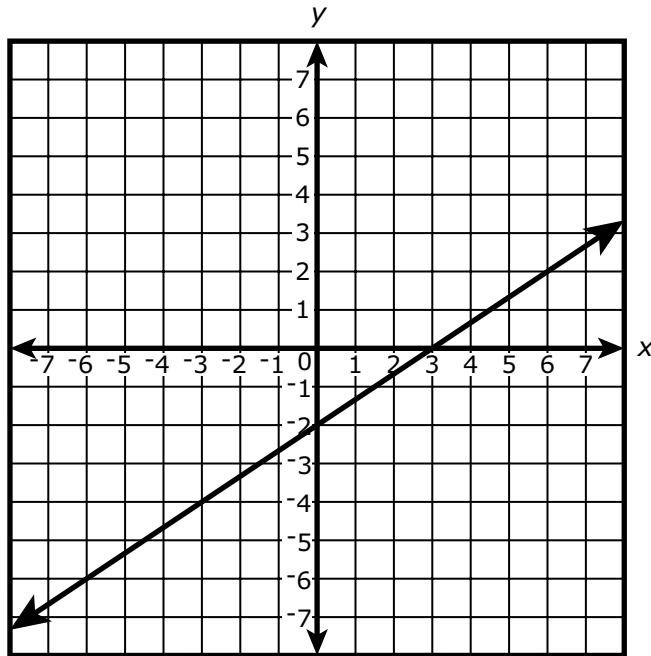
Consider this expression.

$$\frac{2-6\sqrt{25}}{\sqrt{4}}$$

Which of the following statements **best** describes the value of the expression?

- Ⓐ The value of the expression is rational because all of the terms are rational.
- Ⓑ The value of the expression is rational because all of the terms are irrational.
- Ⓒ The value of the expression is irrational because one of the terms is rational.
- Ⓓ The value of the expression is irrational because one of the terms is irrational.

- 12 A line is graphed on this coordinate plane.



Which of the following equations best represents the line?

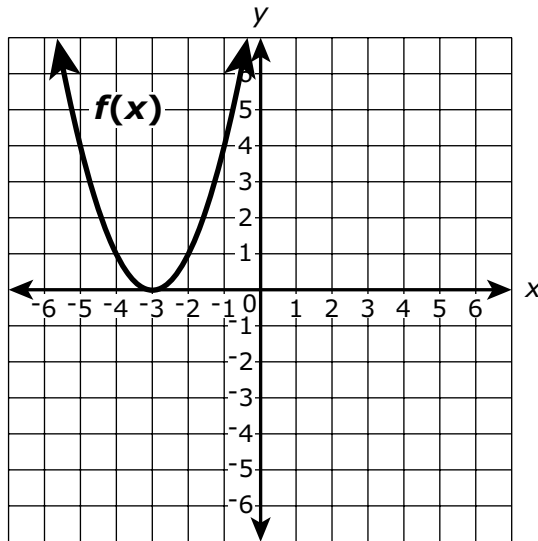
- Ⓐ $y = \frac{2}{3}x - 2$
- Ⓑ $y = \frac{2}{3}x + 3$
- Ⓒ $y = \frac{3}{2}x - 2$
- Ⓓ $y = \frac{3}{2}x + 3$

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

- 13** The price of a ticket at a theater is x dollars. The manager of the theater uses the function $t(x) = 100x - 4x^2$ to predict $t(x)$, the total ticket sales in dollars.
- A. What are the predicted total sales, in dollars, when the price of a ticket is 10 dollars? Show or explain how you got your answer.
 - B. What is the increase or decrease in the predicted total sales, in dollars, when the price of a ticket is increased from 10 dollars to 12 dollars? Show or explain how you got your answer.
 - C. What is the ticket price, in dollars, that results in the maximum value for the predicted total sales? Show or explain how you got your answer.
 - D. What is the maximum value, in dollars, for the predicted total sales? Show or explain how you got your answer.

This question has two parts.

- 14 This graph shows quadratic function $f(x)$.



This table represents points on the graph of a different quadratic function, $g(x)$.

x	-4	-2	0	2	4	6
$g(x)$	-7	-4	-3	-4	-7	-12

Part A

Which of the following statements about functions $f(x)$ and $g(x)$ is true?

- (A) The minimum value of $f(x)$ is equal to the maximum value of $g(x)$.
- (B) The minimum value of $f(x)$ is less than the maximum value of $g(x)$.
- (C) The minimum value of $f(x)$ is greater than the maximum value of $g(x)$.
- (D) The minimum value of $f(x)$ cannot be compared to the maximum value of $g(x)$.

Part B

Which of the following statements about $f(x)$ and $g(x)$ is **not** true?

- Ⓐ The graphs of the functions open in opposite directions.
- Ⓑ The functions have different y -intercepts.
- Ⓒ The functions have the same domain.
- Ⓓ The functions have the same range.

- 15 A student is folding a piece of paper in half repeatedly. This table shows the number of layers of paper for each of the first 4 folds the student makes.

**Number of Layers as Paper
is Folded in Half**

Number of Folds, x	Number of Layers of Paper, y
1	2
2	4
3	8
4	16

Based on the pattern shown in the table, which of the following equations shows the relationship between x , the number of folds, and y , the number of layers of paper?

- Ⓐ $y = 2x$
- Ⓑ $y = \frac{2}{x}$
- Ⓒ $y = x^2$
- Ⓓ $y = 2^x$

- 16 A librarian purchased books and e-readers for the school library.
- The school received 11 shipments of books.
 - The average price of the books was \$189.20 per shipment.
 - The school received 18 e-readers.
 - The price of each e-reader was \$54.90.

Which of the following is **closest** to the total amount the librarian spent on the shipments of books and the e-readers?

- Ⓐ \$1,500
- Ⓑ \$2,500
- Ⓒ \$3,000
- Ⓓ \$4,000

- 17 This equation is graphed on a coordinate plane.

$$2x + 3y = 8$$

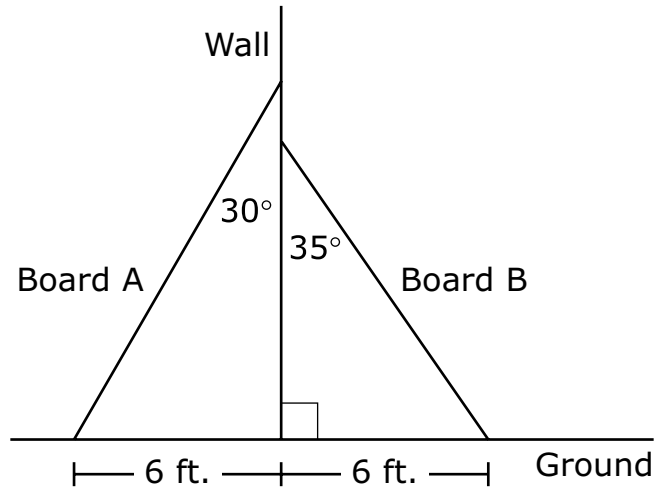
Which of the following ordered pairs represent a solution of the equation?

Select the **two** correct answers.

- Ⓐ $(-1, 2)$
- Ⓑ $(0, 8)$
- Ⓒ $(2, 1)$
- Ⓓ $(4, 0)$
- Ⓔ $(7, -2)$

This question has two parts.

- 18 Two boards are leaning against opposite sides of a wall. Each of the boards touches the ground at a distance of 6 feet from the base of the wall. The boards and the angles they create with the wall are shown in this diagram.



Part A

Based on the diagram, what is the length, in feet, of board A?

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

⊖							
⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙
0	0	0	0	0	0	0	0
1	1	1	1	1	1	1	1
2	2	2	2	2	2	2	2
3	3	3	3	3	3	3	3
4	4	4	4	4	4	4	4
5	5	5	5	5	5	5	5
6	6	6	6	6	6	6	6
7	7	7	7	7	7	7	7
8	8	8	8	8	8	8	8
9	9	9	9	9	9	9	9

Part B

Which of the following represents the length, in feet, of board B?

- Ⓐ $6 \sin 35^\circ$
- Ⓑ $6 \cos 35^\circ$
- Ⓒ $\frac{6}{\sin 35^\circ}$
- Ⓓ $\frac{6}{\cos 35^\circ}$

- 19 A student correctly solved this equation.

$$3(1 + 2x) = 4$$

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

Ⓐ

Step	Justification
$3(1 + 2x) = 4$	Given
$3(2x + 1) = 4$	distributive property
$6x + 3 = 4$	commutative property
$6x = 1$	division property of equality
$x = \frac{1}{6}$	subtraction property of equality

Ⓑ

Step	Justification
$3(1 + 2x) = 4$	Given
$3(2x + 1) = 4$	distributive property
$6x + 3 = 4$	commutative property
$6x = 1$	subtraction property of equality
$x = \frac{1}{6}$	division property of equality

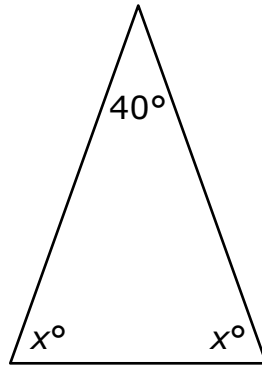
Ⓒ

Step	Justification
$3(1 + 2x) = 4$	Given
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Ⓓ

Step	Justification
$3(1 + 2x) = 4$	Given
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$6x + 3 = 4$	distributive property
$6x = 1$	subtraction property of equality
$x = \frac{1}{6}$	division property of equality

- 20 A triangle and some of its measurements are shown.



What is the value of x ?

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

−							
•	•	•	•	•	•	•	•
0	0	0	0	0	0	0	0
1	1	1	1	1	1	1	1
2	2	2	2	2	2	2	2
3	3	3	3	3	3	3	3
4	4	4	4	4	4	4	4
5	5	5	5	5	5	5	5
6	6	6	6	6	6	6	6
7	7	7	7	7	7	7	7
8	8	8	8	8	8	8	8
9	9	9	9	9	9	9	9

- 21 This system of equations has one solution.

$$y = x^2 - 3$$

$$y = 2x - 4$$

Which of the following is the solution of the system of equations?

- Ⓐ $(-1, -6)$
- Ⓑ $(0, -3)$
- Ⓒ $(1, -2)$
- Ⓓ $(2, 0)$

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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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

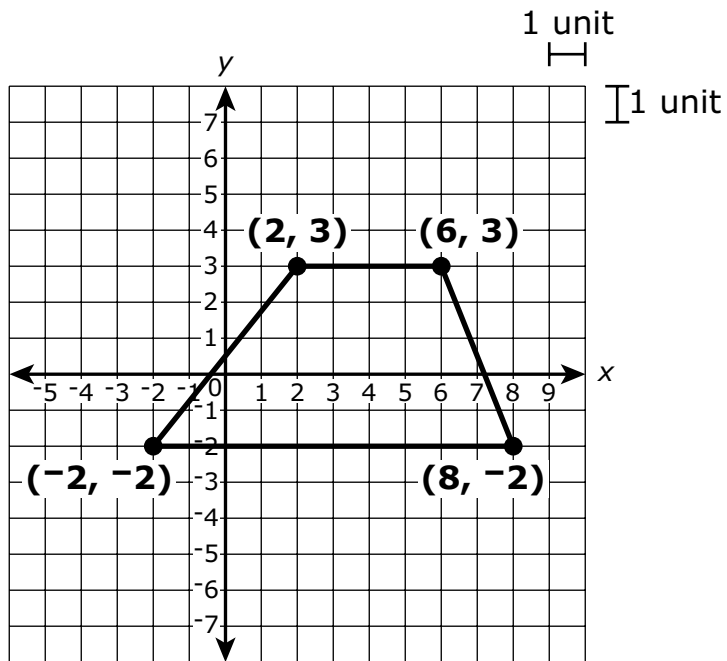
-	1	4				
●						
○	○	○	○	○	○	○
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○	○	○	○	○	○	○
○	○	○	○	○	○	○
○	○	○	○	○	○	○
○	○	○	○	○	○	○
○	○	○	○	○	○	○
○	○	○	○	○	○	○
○	○	○	○	○	○	○

- 22 A trapezoid is shown on this coordinate plane.



What is the area of the trapezoid?

- Ⓐ 25 square units
- Ⓑ 35 square units
- Ⓒ 50 square units
- Ⓓ 70 square units

- 23 Some of the terms of a sequence are shown in this table.

Term	2	3	4	5
Value	16	20	25	31.25

Which of the following functions can be used to find the n th term of the sequence?

- Ⓐ $f(n) = 1.25n$
- Ⓑ $f(n) = 16(1.25)^n$
- Ⓒ $f(n) = 10.24(1.25)^n$
- Ⓓ $f(n) = 31.25 + 1.25n$

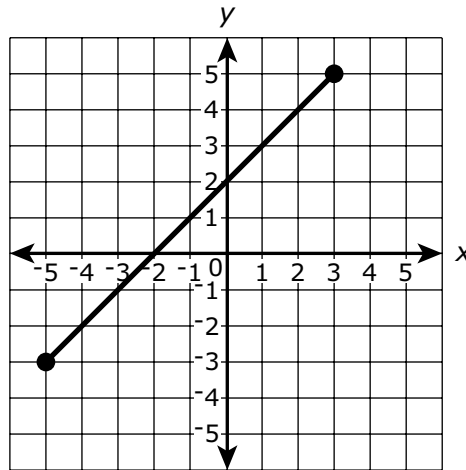
24 Grayson and Rosette both collect rare books. Grayson owns 23 rare books and Rosette owns 31 rare books. They are each planning to add to their collection by purchasing more books.

- Grayson will purchase 3 books per week.
- Rosette will purchase 1 book per week.

How many books will Grayson and Rosette each own when their collections have the same number of books?

- Ⓐ 33
- Ⓑ 35
- Ⓒ 43
- Ⓓ 54

- 25 The graph of a function is shown on this coordinate plane.

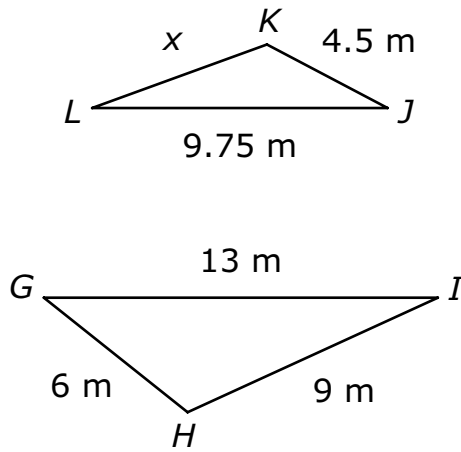


What are the domain **and** the range of the function?

Select the **two** correct answers.

- Ⓐ The domain is $-5 \leq x \leq 3$.
- Ⓑ The domain is $-3 \leq x \leq 5$.
- Ⓒ The domain is $0 \leq x \leq 5$.
- Ⓓ The range is $-5 \leq y \leq 5$.
- Ⓔ The range is $-3 \leq y \leq 5$.
- Ⓕ The range is $-2 \leq y \leq 2$.

- 26 In this diagram, $\triangle GHI \sim \triangle JKL$.



Which of the following proportions can be used to determine x , the length of \overline{KL} in meters?

- Ⓐ $\frac{6}{9} = \frac{x}{4.5}$
- Ⓑ $\frac{13}{9.75} = \frac{6}{x}$
- Ⓒ $\frac{13}{6} = \frac{x}{9.75}$
- Ⓓ $\frac{6}{4.5} = \frac{9}{x}$

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

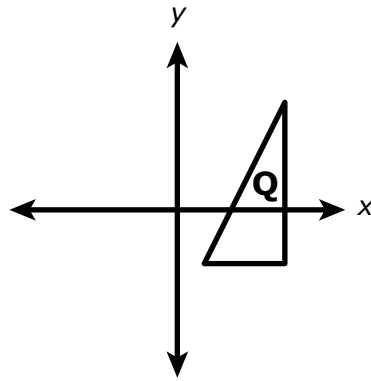
- 27 A marketing researcher surveyed 1,000 shoppers about whether they had watched a television commercial about a company’s shampoo and whether they had ever bought the shampoo. This table shows some of the results of the survey.

Marketing Research

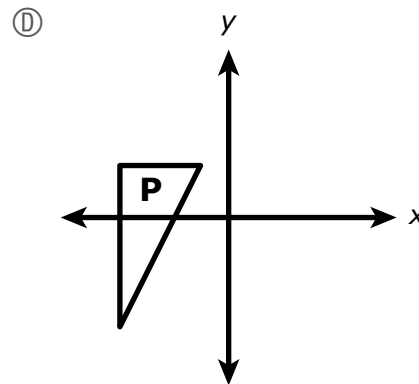
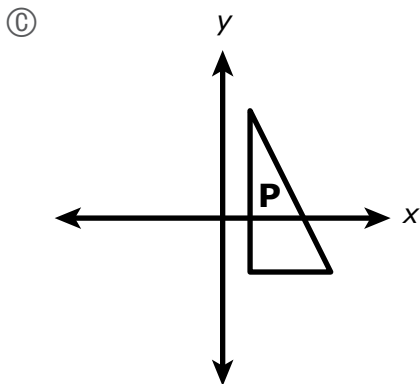
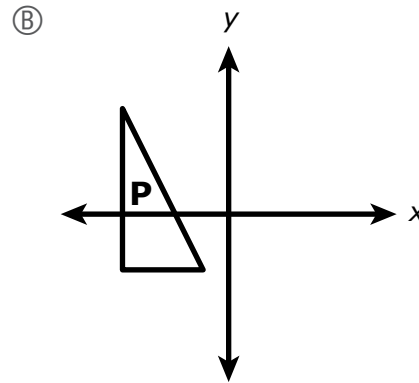
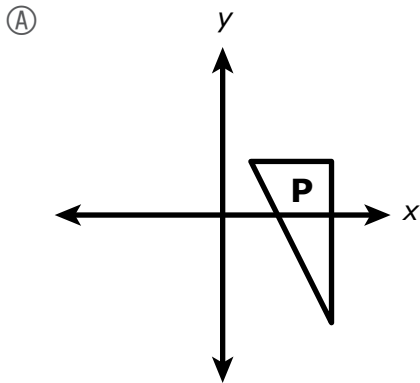
	Bought Shampoo	Did Not Buy Shampoo	Totals
Watched Commercial	300		750
Did Not Watch Commercial	50	200	250
Totals	350	650	1,000

- A. How many of the shoppers watched the commercial but did **not** buy the shampoo? Show or explain how you got your answer.
- B. Based on the survey data, what is the probability that a randomly selected shopper watched the commercial but did **not** buy the shampoo? Show or explain how you got your answer.
- C. Based on the survey data, what is the probability that a shopper bought the shampoo, given that the shopper watched the commercial? Show or explain how you got your answer.
- D. Based on the survey data, are watching the commercial and buying the shampoo independent events? Show or explain how you got your answer.

- 28 Triangle Q is graphed on a coordinate plane, as shown.



Triangle Q is the image of triangle P after triangle P was reflected over the x-axis. Which graph best represents triangle P?



- 29 John, Maria, and Robin are students at the same school. At the end of the school day yesterday, they each walked directly home. Each student walked at a constant rate.

The functions in this table can be used to find each student's distance from home, in miles, after walking for h hours.

Distance from Home

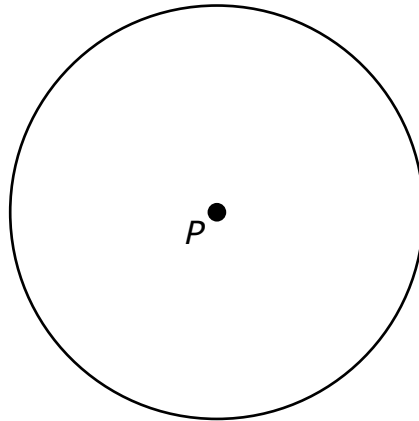
Student	Function
John	$J(h) = 0.9 - 3.5h$
Maria	$M(h) = 0.6 - 3.7h$
Robin	$R(h) = 1.1 - 3.7h$

Based on the functions in the table, which of the following statements are true?

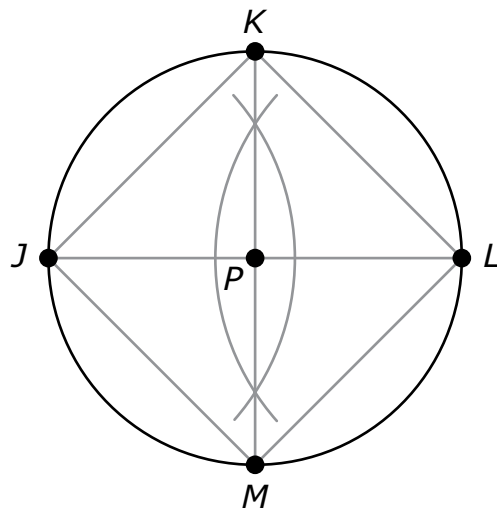
Select the **two** correct answers.

- Ⓐ John lives closest to the school.
- Ⓑ Maria walked at the slowest rate.
- Ⓒ Robin lives farthest from the school.
- Ⓓ Maria and Robin walked at the same rate.
- Ⓔ Maria and Robin live the same distance from the school.

- 30 Consider circle P .



A compass and a straightedge were used to perform a construction given circle P . This diagram shows the completed construction.



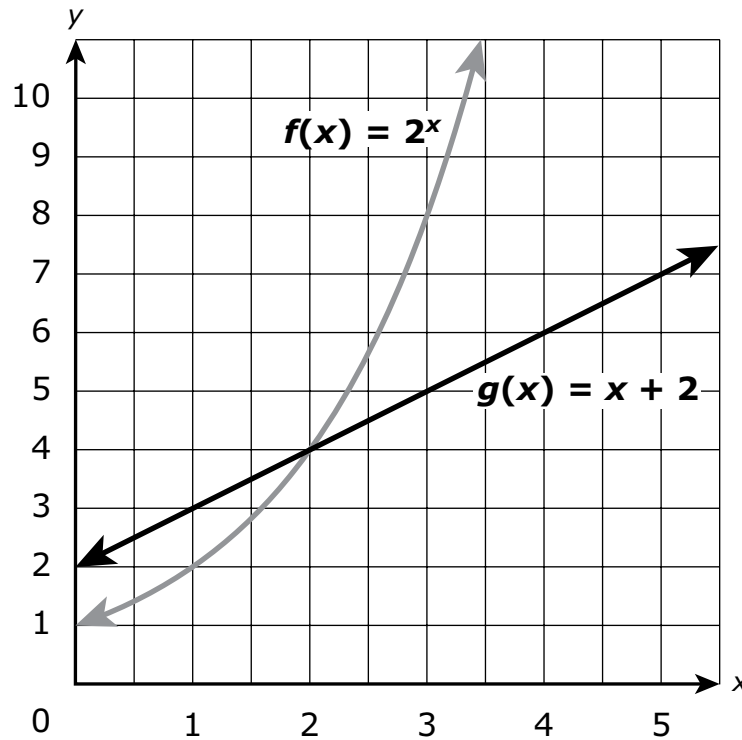
These steps were followed to complete the construction.

- A diameter was drawn, with the straightedge, through center P . The endpoints of the diameter were labeled J and L .
- Two arcs were drawn with the same compass setting, one from point J and one from point L .
- A diameter was drawn, with the straightedge, through the two points of intersection of the arcs. The endpoints of the diameter were labeled K and M .
- Segments were drawn, with the straightedge, from point J to point K , from point K to point L , from point L to point M , and from point M to point J .

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

- Ⓐ $KM > JL$
- Ⓑ $\angle JKL \cong \angle KLM$
- Ⓒ Angle KJM is a right angle.
- Ⓓ Quadrilateral $JKLM$ is a square.

- 31 Functions $f(x)$ and $g(x)$ are graphed on this coordinate plane.



Which statement about the functions is true?

- (A) For $x < 2$, the value of $f(x)$ is greater than the value of $g(x)$.
- (B) For $x < 2$, the value of $f(x)$ is equal to the value of $g(x)$.
- (C) For $x > 2$, the value of $f(x)$ is less than the value of $g(x)$.
- (D) For $x > 2$, the value of $f(x)$ is greater than the value of $g(x)$.

This question has two parts.

- 32 Ninth-grade and tenth-grade students at a high school were surveyed about their favorite season of the year. The results of the survey are shown in this table.

Favorite Season

	Winter	Spring	Summer	Fall	Total
Ninth-Grade	19	41	80	52	192
Tenth-Grade	37	42	71	34	184
Total	56	83	151	86	376

Part A

Based on the table, what percentage of students surveyed chose fall as their favorite season?

- (A) 22.9%
- (B) 27.1%
- (C) 29.7%
- (D) 39.5%

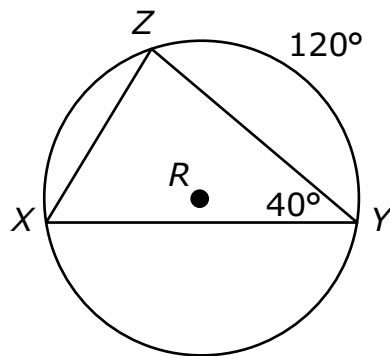
Part B

What percentage of students who chose summer as their favorite season were tenth-grade students?

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

⊖							
⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙
0	0	0	0	0	0	0	0
1	1	1	1	1	1	1	1
2	2	2	2	2	2	2	2
3	3	3	3	3	3	3	3
4	4	4	4	4	4	4	4
5	5	5	5	5	5	5	5
6	6	6	6	6	6	6	6
7	7	7	7	7	7	7	7
8	8	8	8	8	8	8	8
9	9	9	9	9	9	9	9

- 33 Points X , Y , and Z lie on circle R . The measure of angle XYZ is 40° and the measure of minor arc YZ is 120° , as shown in this diagram.



What is the measure of minor arc XY ?

- (A) 80°
- (B) 120°
- (C) 160°
- (D) 200°

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

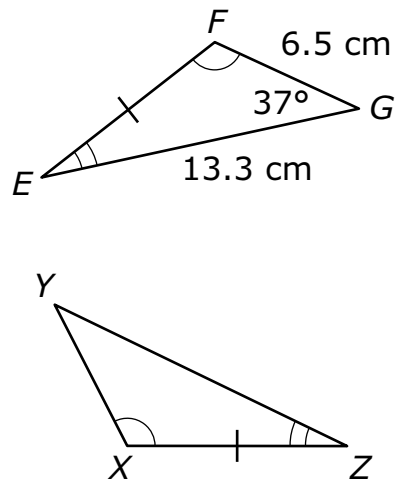
- 34** Ellis runs around a track at a constant speed.
- The distance around the track is $\frac{1}{4}$ mile.
 - It takes Ellis 3.2 minutes to run around the track once.
- A. What is the total amount of time, in minutes, it takes Ellis to run one mile? Show or explain how you got your answer.
- B. What is the total distance, in **feet**, Ellis runs in 1 minute? Show or explain how you got your answer.
- C. What is the rate, in miles per hour, Ellis runs around the track? Show or explain how you got your answer.
- D. Ellis will run for 40 minutes every day for 5 days, with a goal of running a total of 15 miles. Will Ellis meet this goal? Explain your reasoning.

34

A large rectangular box containing 24 horizontal lines for writing.

This question has two parts.

- 35 Two triangles and some of their measurements are shown in this diagram.



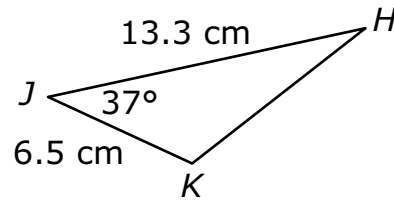
Part A

Based on the diagram, which of the following **must** be true?

- (A) $\angle E \cong \angle Y$
- (B) $\angle G \cong \angle Z$
- (C) $\overline{EF} \cong \overline{YX}$
- (D) $\overline{FG} \cong \overline{XY}$

Part B

This diagram shows $\triangle JHK$ and some of its measurements.



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

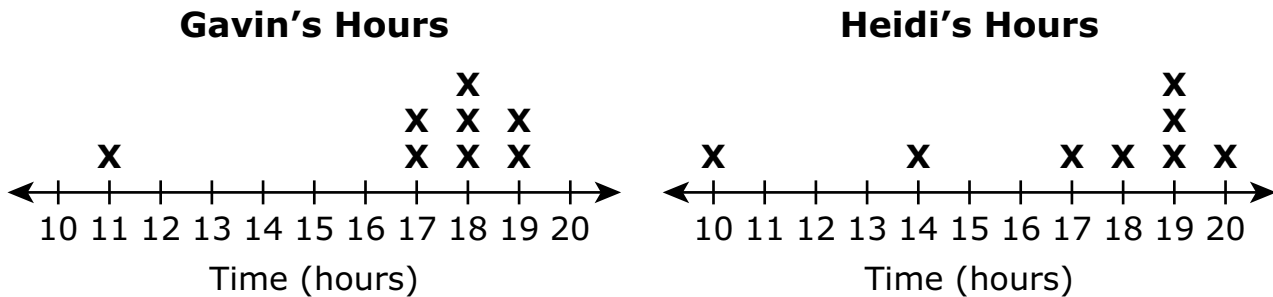
- Ⓐ $\triangle HJK \cong \triangle EFG$
- Ⓑ $\triangle HKJ \cong \triangle EFG$
- Ⓒ $\triangle JHK \cong \triangle EFG$
- Ⓓ $\triangle JKH \cong \triangle EFG$

- 36 A customer purchased a pumpkin at a farm stand.
- The customer paid \$1.38 per pound for the pumpkin.
 - The mass of the pumpkin was 4.8 **kilograms**, rounded to the nearest tenth of a kilogram.

Which of the following could have been the total amount the customer paid for the pumpkin?

- Ⓐ \$6.62
- Ⓑ \$9.66
- Ⓒ \$13.32
- Ⓓ \$14.46

- 37 Gavin and Heidi both worked at part-time jobs during the summer. The line plots show how many hours they each worked per week over an eight-week period.

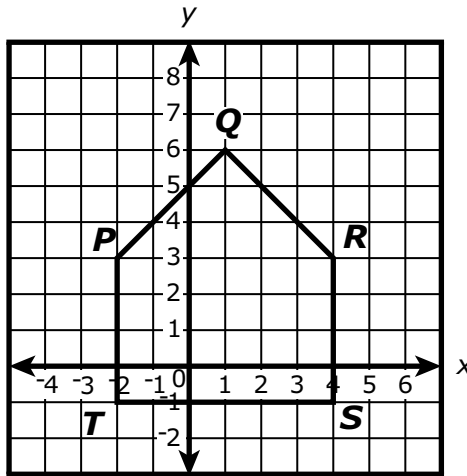


Which of the following statements about the centers and spreads of the two data sets represented by the line plots are true?

Select the **three** correct answers.

- Ⓐ The median is greater for Gavin's hours.
- Ⓑ The median is greater for Heidi's hours.
- Ⓒ The mean is greater for Gavin's hours.
- Ⓓ The mean is greater for Heidi's hours.
- Ⓔ The spread is greater for Gavin's hours.
- Ⓕ The spread is greater for Heidi's hours.

- 38 Pentagon $PQRST$ is shown on this coordinate plane.



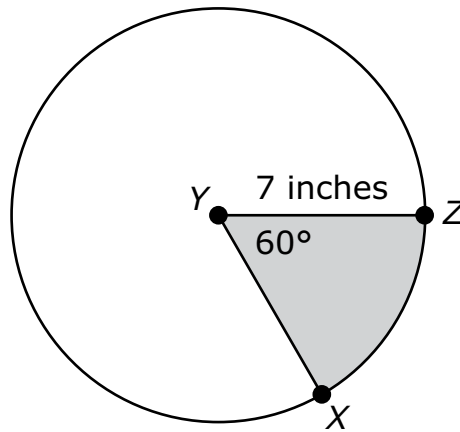
Pentagon $PQRST$ will be translated up 3 units and then reflected over the y -axis to create pentagon $P'Q'R'S'T'$.

Which of the following best represents the coordinates of point T' , the image of point T after the transformations?

- Ⓐ $(-2, -2)$
- Ⓑ $(-2, 2)$
- Ⓒ $(2, -2)$
- Ⓓ $(2, 2)$

This question has two parts.

- 39 This diagram shows circle Y , with one shaded sector.



In the diagram,

- the measure of angle XYZ is 60° , and
- the radius of circle Y is 7 inches.

Part A

Which of the following is **closest** to the area, in square inches, of the **shaded** sector of circle Y ?

- (A) 25.7 square inches
- (B) 51.3 square inches
- (C) 128.3 square inches
- (D) 153.9 square inches

Part B

What is the length, to the nearest tenth of an inch, of minor arc XZ?

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

−							
•	•	•	•	•	•	•	•
0	0	0	0	0	0	0	0
1	1	1	1	1	1	1	1
2	2	2	2	2	2	2	2
3	3	3	3	3	3	3	3
4	4	4	4	4	4	4	4
5	5	5	5	5	5	5	5
6	6	6	6	6	6	6	6
7	7	7	7	7	7	7	7
8	8	8	8	8	8	8	8
9	9	9	9	9	9	9	9

- 40 The value, in dollars, of a car is modeled by this expression.

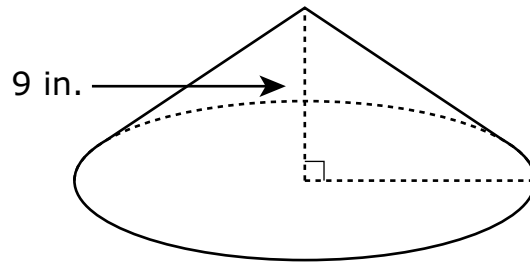
$$18,000(0.86)^x$$

In the expression, x represents the number of years since the car was purchased.

What do the factors in the expression represent?

- Ⓐ In the expression, 18,000 represents the decay factor, and 0.86 represents the growth factor.
- Ⓑ In the expression, 18,000 represents the growth factor, and 0.86 represents the decay factor.
- Ⓒ In the expression, 18,000 represents the purchase price of the car, and 0.86 represents the decay factor.
- Ⓓ In the expression, 18,000 represents the price of the car after x years, and 0.86 represents the growth factor.

- 41 This diagram shows a right circular cone and some of its measurements.



The volume of the cone is 432π cubic inches.

What is the radius of the cone?

- (A) 4 in.
- (B) 7 in.
- (C) 12 in.
- (D) 36 in.
- 42 A teacher claims that there is a strong negative correlation between the amount of time students spend playing video games and the amount of time students spend playing sports. The teacher conducted a survey, collected data, and computed an equation for the line of best fit for the data.
- Which of the following correlation coefficient values for the data would **best** support the teacher's claim?
- (A) -0.90
- (B) -0.15
- (C) 0.01
- (D) 0.92

CONVERSIONS

- | | | |
|----------------------------------|---------------------------|--------------------------|
| 1 cup = 8 fluid ounces | 1 inch = 2.54 centimeters | 1 pound = 16 ounces |
| 1 pint = 2 cups | 1 meter ≈ 39.37 inches | 1 pound ≈ 0.454 kilogram |
| 1 quart = 2 pints | 1 mile = 5280 feet | 1 kilogram ≈ 2.2 pounds |
| 1 gallon = 4 quarts | 1 mile = 1760 yards | 1 ton = 2000 pounds |
| 1 gallon ≈ 3.785 liters | 1 mile ≈ 1.609 kilometers | |
| 1 liter ≈ 0.264 gallon | 1 kilometer ≈ 0.62 mile | |
| 1 liter = 1000 cubic centimeters | | |

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 . . $SA = 2(lw) + 2(hw) + 2(lh)$

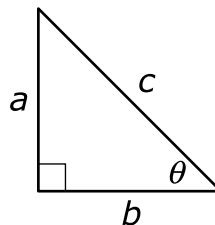
VOLUME (V) FORMULAS

- 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

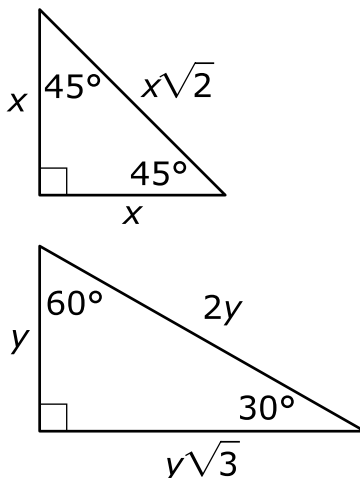
- pi $\pi \approx 3.14$
 circumference $C = 2\pi r$ OR $C = \pi d$
 area $A = \pi r^2$

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 2023 Released Operational Items

PBT Item No.	Page No.	Reporting Category	Standard	Item Type*	Item Description	Correct Answer**
1	4	<i>Algebra and Functions</i>	A-SSE.B.3	SR	Factor a quadratic expression to solve a problem in a real-world context.	A
2	4	<i>Geometry</i>	G-GPE.A.1	SR	Identify the equation of a circle given its center and radius.	B
3	4	<i>Number and Quantity</i>	N-RN.A.2	SR	Evaluate a radical expression that has an exponent using laws of exponents.	A
4	5	<i>Statistics and Probability</i>	S-ID.A.1	SR	Determine the median value of real-world data displayed in a line plot.	B
5	5	<i>Algebra and Functions</i>	A-APR.A.1	SR	Given a polynomial expression, identify an equivalent expression.	D
6	6–7	<i>Geometry</i>	G-GPE.B.5	CR	Given a line graphed on a coordinate plane, determine its slope, create an equation of a parallel line, determine whether another line is parallel, and create an equation of a perpendicular line passing through a given point.	
7	8	<i>Algebra and Functions</i>	A-REI.B.3	SR	Solve a linear inequality based on a real-world context.	B
8	9	<i>Geometry</i>	G-GPE.B.6	SR	Identify the point on a line segment that partitions the segment into a given ratio.	D
9	10	<i>Algebra and Functions</i>	A-REI.B.4	SR	Identify the solutions of a quadratic equation in factored form.	C
10	11	<i>Geometry</i>	G-SRT.C.6	SR	Determine the length of a leg of a right triangle based on angle measures.	A
11	12	<i>Number and Quantity</i>	N-RN.B.3	SR	Identify a statement about rational and irrational numbers that is not true and determine whether a given expression is rational.	C;A
12	13	<i>Algebra and Functions</i>	A-CED.A.2	SR	Identify the equation of a line graphed on a coordinate plane.	A
13	14–15	<i>Algebra and Functions</i>	F-IF.B.4	CR	Given a quadratic function that represents a context, evaluate the function for a specific input value, analyze how the function changes over different input values, and determine the maximum value of the function.	
14	16–17	<i>Algebra and Functions</i>	F-IF.C.9	SR	Compare properties of a quadratic function shown on a graph and another represented by values in a table.	C;D
15	18	<i>Algebra and Functions</i>	F-LE.A.2	SR	Construct an exponential function based on information in a table.	D
16	19	<i>Number and Quantity</i>	N-Q.A.2	SR	Use estimation skills to approximate the solution of a real-world problem.	C
17	19	<i>Algebra and Functions</i>	A-REI.D.10	SR	Identify the coordinates of points that lie on the graph of a linear equation.	D,E
18	20–21	<i>Geometry</i>	G-SRT.C.8	SA	Use trigonometric ratios to determine side lengths in different right triangles based on a real-world context.	12;C
19	22	<i>Algebra and Functions</i>	A-REI.A.1	SR	Justify each step in the solution of a linear equation.	D

PBT Item No.	Page No.	Reporting Category	Standard	Item Type*	Item Description	Correct Answer**
20	23	<i>Geometry</i>	G-CO.C.10	SA	Use the Triangle Sum Theorem to determine an angle measure.	70
21	24	<i>Algebra and Functions</i>	A-REI.C.7	SR	Identify the solution of a system of a linear equation and a quadratic equation.	C
22	27	<i>Geometry</i>	G-GPE.B.7	SR	Calculate the area of a trapezoid graphed on a coordinate plane.	B
23	28	<i>Algebra and Functions</i>	F-BF.A.2	SR	Identify a function that represents a geometric sequence partially displayed in a table.	C
24	29	<i>Algebra and Functions</i>	A-CED.A.1	SR	Create two one-variable equations and use them to solve a real-world problem.	B
25	30	<i>Algebra and Functions</i>	F-IF.A.1	SR	Identify the domain and range of a linear function from its graph.	A,E
26	31	<i>Geometry</i>	G-SRT.B.5	SR	Identify a proportion that can be used to find an unknown side length in a pair of similar triangles.	D
27	32–33	<i>Statistics and Probability</i>	S-CP.A.4	CR	Complete a two-way frequency table of data, use the data in the table to compute conditional probabilities, and determine whether the variables of interest are independent.	
28	34	<i>Geometry</i>	G-CO.A.5	SR	Identify the graph of a triangle on a coordinate plane after a transformation.	A
29	35	<i>Algebra and Functions</i>	F-LE.B.5	SR	Compare the parameters of three linear functions that represent a real-world context.	C,D
30	36–37	<i>Geometry</i>	G-CO.D.13	SR	Analyze the construction of a square inscribed in a circle.	A
31	38	<i>Algebra and Functions</i>	F-LE.A.3	SR	Compare the values of a linear function and an exponential function, graphed on a coordinate plane, as the value of the independent variable increases.	D
32	39	<i>Statistics and Probability</i>	S-ID.B.5	SA	Calculate relative frequencies from a two-way table based on a real-world context.	A;47
33	40	<i>Geometry</i>	G-C.A.2	SR	Determine an unknown arc measure in a diagram of a triangle inscribed in a circle.	C
34	41–42	<i>Number and Quantity</i>	N-Q.A.1	CR	Use dimensional analysis and translate between units to solve real-world problems, and then apply the solutions to a related problem.	
35	43–44	<i>Geometry</i>	G-CO.B.7	SR	Relate the side lengths and angle measures in pairs of congruent triangles.	D;B
36	45	<i>Number and Quantity</i>	N-Q.A.3	SR	Use estimation and dimensional analysis to solve a real-world problem involving mass and money.	D
37	46	<i>Statistics and Probability</i>	S-ID.A.2	SR	Compare measures of center and spreads of two real-world data sets displayed in line plots.	B,C,F
38	47	<i>Geometry</i>	G-CO.A.2	SR	Determine the coordinates of a vertex of a pentagon, graphed on a coordinate plane, after a sequence of transformations.	D

PBT Item No.	Page No.	Reporting Category	Standard	Item Type*	Item Description	Correct Answer**
39	48–49	<i>Geometry</i>	G-C.B.5	SA	Calculate the area of a sector of a circle and the length of an arc on the circle.	A;7.3
40	50	<i>Algebra and Functions</i>	A-SSE.A.1	SR	Interpret the parts of an exponential expression based on a real-world context.	C
41	51	<i>Geometry</i>	G-GMD.A.3	SR	Calculate the radius of a cone given its height and its volume.	C
42	51	<i>Statistics and Probability</i>	S-ID.C.8	SR	Identify the correlation coefficient that best represents a description of the results of a survey.	A

* 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.