

Massachusetts MCAS 2022

Grade 8 Math

Reference Materials
Page 2

Exam Materials
Pages 3 - 27

Answer Key Materials
Pages 28 - 29

Massachusetts Comprehensive Assessment System Grade 8 Mathematics Reference Sheet

CONVERSIONS

1 cup = 8 fluid ounces

1 pint = 2 cups

1 quart = 2 pints

1 gallon = 4 quarts

1 gallon \approx 3.785 liters

1 liter \approx 0.264 gallon

1 liter = 1000 cubic centimeters

1 inch = 2.54 centimeters

1 meter \approx 39.37 inches

1 mile = 5280 feet

1 mile = 1760 yards

1 mile \approx 1.609 kilometers

1 kilometer \approx 0.62 mile

1 pound = 16 ounces

1 pound \approx 0.454 kilogram

1 kilogram \approx 2.2 pounds

1 ton = 2000 pounds

AREA (A) FORMULAS

square $A = s^2$

rectangle $A = bh$

OR

$A = lw$

parallelogram $A = bh$

triangle $A = \frac{1}{2}bh$

trapezoid $A = \frac{1}{2}h(b_1 + b_2)$

circle $A = \pi r^2$

CIRCLE FORMULAS

area. $A = \pi r^2$

circumference. $C = 2\pi r$

OR

$C = \pi d$

VOLUME (V) FORMULAS

cube $V = s^3$

(s = length of an edge)

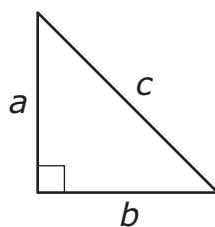
sphere $V = \frac{4}{3}\pi r^3$

cone $V = \frac{1}{3}\pi r^2 h$

right circular cylinder $V = \pi r^2 h$

right prism $V = Bh$

PYTHAGOREAN THEOREM



$$a^2 + b^2 = c^2$$



MASSACHUSETTS DEPARTMENT OF
ELEMENTARY AND SECONDARY
EDUCATION

*Release of Spring 2022
MCAS Test Items*

from the

*Grade 8 Mathematics
Paper-Based Test*

June 2022

**Massachusetts Department of
Elementary and Secondary Education**

Grade 8 Mathematics

SESSION 1

This session contains 10 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.
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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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9	9	9	9	9	9	9

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9	9	9	9	9	9	9

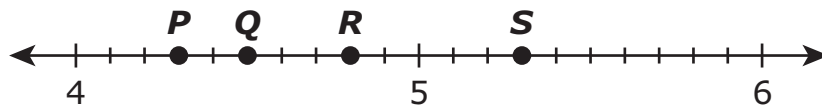
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	9	.	5	5	5	5
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6	6	6	6	6	6	6
7	7	7	7	7	7	7
8	8	8	8	8	8	8
9	<input checked="" type="radio"/>	9	9	9	9	9

1 What is 5.17×10^{-6} written in standard notation?

- Ⓐ 0.00517
- Ⓑ 0.000517
- Ⓒ 0.0000517
- Ⓓ 0.00000517

2 Which point on the number line best approximates the location of $\sqrt{20}$?



- Ⓐ point *P*
- Ⓑ point *Q*
- Ⓒ point *R*
- Ⓓ point *S*

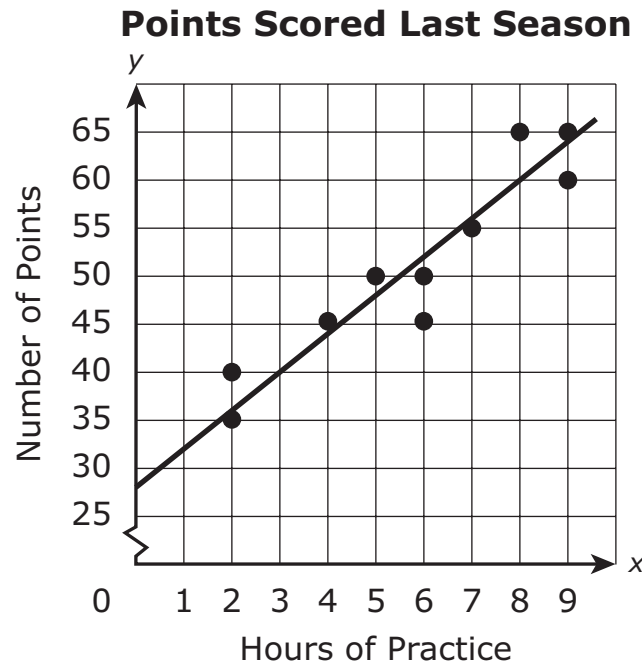
3 Which of the following equations are true?

Select the **two** true equations.

- Ⓐ $\sqrt{100} = 50$
- Ⓑ $\sqrt{121} = 11$
- Ⓒ $\sqrt[3]{27} = 9$
- Ⓓ $\sqrt[3]{64} = 4$
- Ⓔ $\sqrt[3]{125} = 42$

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

- 4 The coach of a basketball team recorded x , the number of hours the team practiced before each game last season, and y , the number of points the team scored in each game. The coach made a scatter plot and drew a line of best fit for the data, as shown on this coordinate plane.



The equation for the line of best fit is $y = 4x + 28$.

- A. What does the y -intercept of the line of best fit represent in the context of this situation? Explain your reasoning.
- B. What does the slope of the line of best fit represent in the context of this situation? Explain your reasoning.
- C. Based on the line of best fit for the data, how many points would the team be expected to score in a game if they practiced for 8 hours before the game? Show or explain how you got your answer.
- D. Based on the line of best fit for the data, for how many hours would the team need to practice if they wanted to score 70 points in a game? Show or explain how you got your answer.

4

5 Which of the following is equivalent to $\frac{7}{11}$?

Ⓐ 0.63

Ⓑ $0.\overline{63}$

Ⓒ $0.\overline{63}$

Ⓓ 0.64

6 Which of the following systems of equations has **no** solution?

Ⓐ $2x + 3y = 8$
 $3y - 2x = 16$

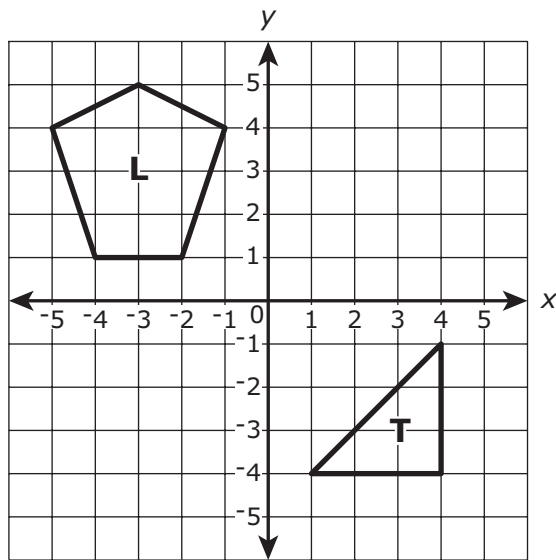
Ⓑ $8x + 6y = 14$
 $6x + 8y = 28$

Ⓒ $x + 3y = 8$
 $3x - y = 4$

Ⓓ $4x + 3y = 12$
 $3y + 4x = 10$

This question has two parts.

- 7 Pentagon L and triangle T are graphed on this coordinate plane.



Part A

Pentagon L will be reflected over the y -axis.

Which of the following **must** be true about the image of pentagon L?

- Ⓐ It intersects both the x -axis and the y -axis.
- Ⓑ Its area is larger than the area of pentagon L.
- Ⓒ Each of the coordinates of its vertices is negative.
- Ⓓ Its perimeter is equal to the perimeter of pentagon L.

Part B

Triangle T will be translated 5 units up and 3 units to the left.

Which of the following **must** be true about the image of triangle T?

- Ⓐ It intersects the x -axis.
- Ⓑ It is a reflection of triangle T.
- Ⓒ Its area is equal to the area of triangle T.
- Ⓓ Each of the coordinates of its vertices is positive.

- 8 In this table, y is a linear function of x .

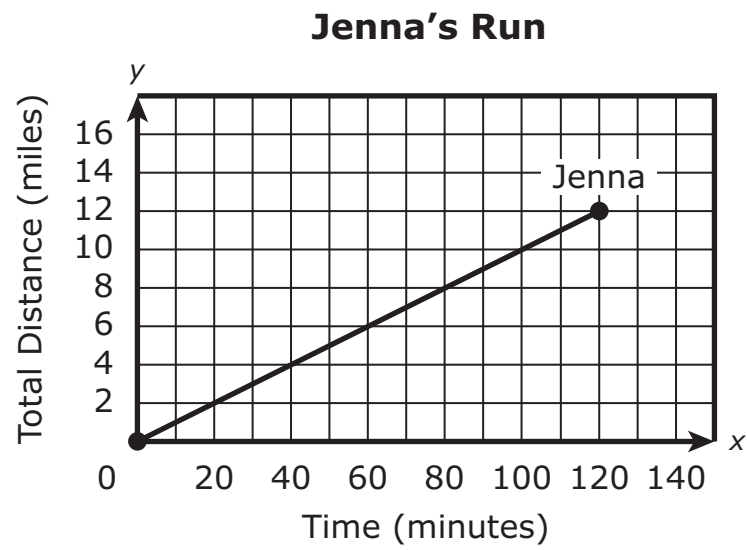
x	y
-1	-2
0	1
1	4

Which of the following statements about the slope **and** the y -intercept of the function shown in the table are true?

Select the **two** true statements.

- Ⓐ The slope of the function is 1.
- Ⓑ The slope of the function is 3.
- Ⓒ The slope of the function is 4.
- Ⓓ The y -intercept of the function is 0.
- Ⓔ The y -intercept of the function is 1.
- Ⓕ The y -intercept of the function is 3.

- 9 George and Jenna each completed a 12-mile run. This graph shows the total distance, in miles, that Jenna ran over time.



George ran at a constant rate of 5 miles per hour. In the first hour of their run, how many more miles did Jenna run than George ran?

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
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7	7	7	7	7	7	7	7
8	8	8	8	8	8	8	8
9	9	9	9	9	9	9	9

- 10** Consider this expression.

$$3^6 \cdot 3^2$$

Which of the following is equivalent to the expression?

- Ⓐ 9^{12}
- Ⓑ 9^8
- Ⓒ 3^{12}
- Ⓓ 3^8

Grade 8 Mathematics

SESSION 2

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EXAMPLES

-	1	4					
●							
○	○	○	○	○	○	○	○
0	0	0	0	0	0	0	0
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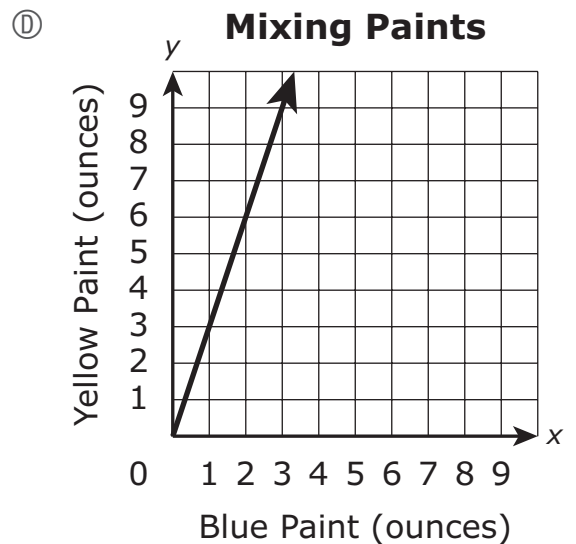
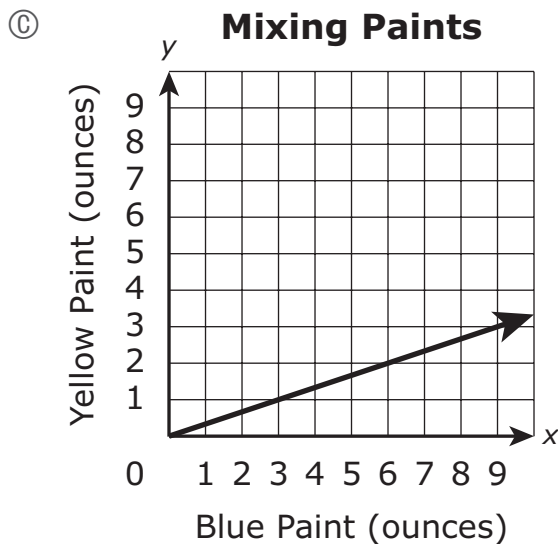
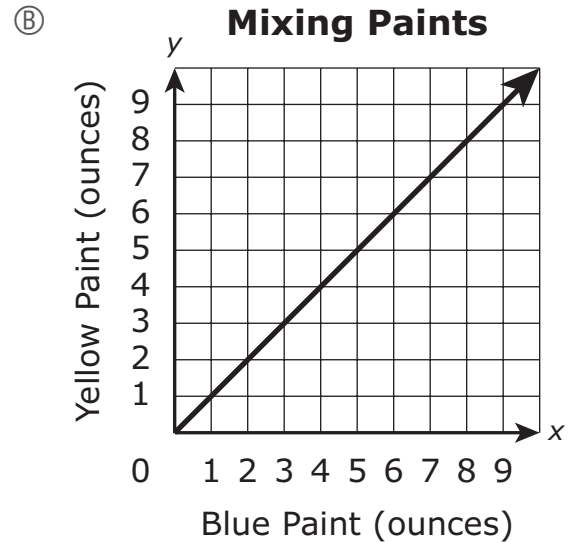
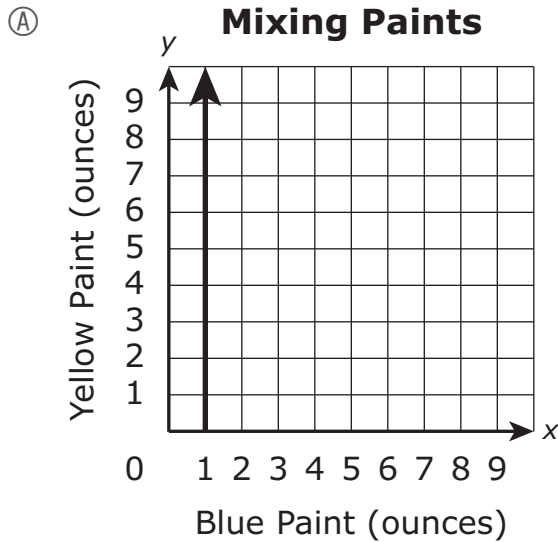
	4	8	3	1	6	
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6	6	6	6	6	●	6
7	7	7	7	7	7	7
8	8	●	8	8	8	8
9	9	9	9	9	9	9

				6	5	.	3
⊖							
⊙	⊙	⊙	⊙	⊙	⊙	●	⊙
①	①	①	①	①	①	①	①
②	②	②	②	②	②	②	②
③	③	③	③	③	③	③	●
④	④	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	⑦
⑧	⑧	⑧	⑧	⑧	⑧	⑧	⑧
⑨	⑨	⑨	⑨	⑨	⑨	⑨	⑨

	9	.	5	5	5	5
(-)						
(.)	(.)	(.)	(.)	(.)	(.)	(.)
(0)	(0)	(0)	(0)	(0)	(0)	(0)
(1)	(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)	(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)

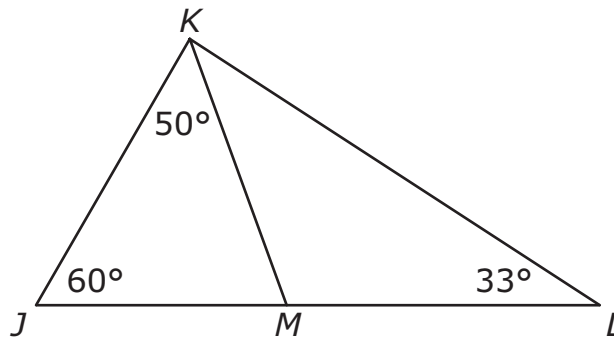
- 11 An artist makes green paint by mixing 1 ounce of blue paint for every 3 ounces of yellow paint.

Which of the following graphs shows the relationship between x , the number of ounces of blue paint, and y , the number of ounces of yellow paint the artist mixes to make the green paint?



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

- 12 This figure is composed of triangles JKL , JKM , and KML .

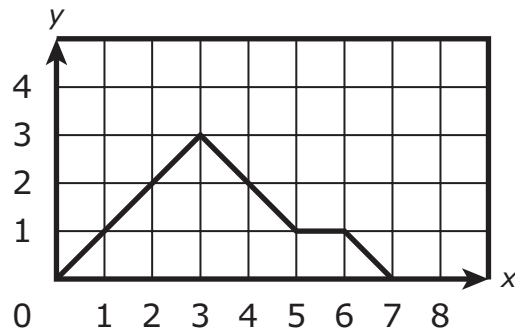


In the figure,

- point M lies on side JL ,
 - the measure of $\angle JKM$ is 50° ,
 - the measure of $\angle KJM$ is 60° , and
 - the measure of $\angle KLM$ is 33° .
- A. What is the measure, in degrees, of $\angle JMK$? Show or explain how you got your answer.
- B. What is the sum of the measures, in degrees, of $\angle JMK$ and $\angle KML$? Show or explain how you got your answer.
- C. What is the measure, in degrees, of $\angle MKL$? Show or explain how you got your answer.
- D. Is triangle JKL similar to triangle KML ? Explain your reasoning.

12

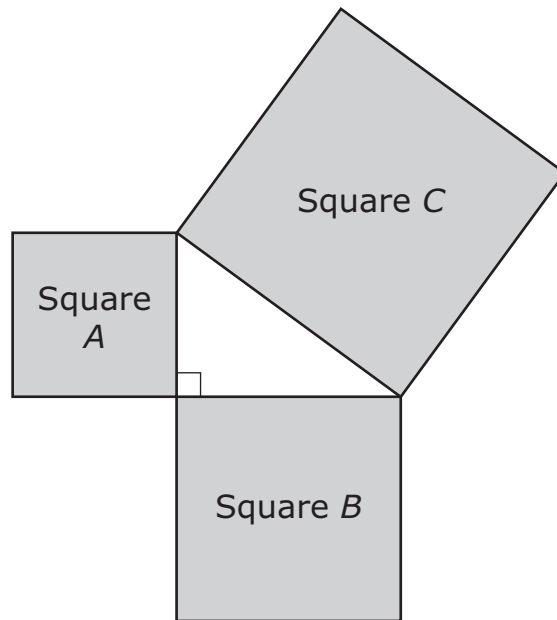
- 13 The graph of a function is shown.



Which of the following statements describes an interval of the function?

- Ⓐ The function is decreasing from $x = 5$ to $x = 6$.
- Ⓑ The function is decreasing from $x = 2$ to $x = 4$.
- Ⓒ The function is increasing from $x = 6$ to $x = 7$.
- Ⓓ The function is increasing from $x = 0$ to $x = 3$.

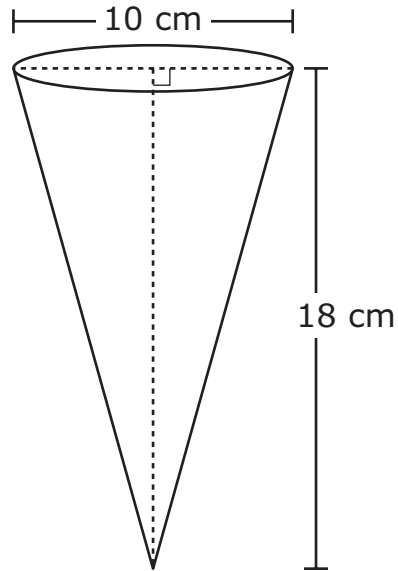
- 14 A right triangle is formed by the sides of three squares joined at their vertices, as shown in this diagram.



Which statement about the squares is true?

- Ⓐ The sum of the areas of square *A* and square *C* is equal to the area of square *B*.
- Ⓑ The sum of the areas of square *A* and square *B* is equal to the area of square *C*.
- Ⓒ The sum of the areas of square *A* and square *C* is less than the area of square *B*.
- Ⓓ The sum of the areas of square *A* and square *B* is greater than the area of square *C*.

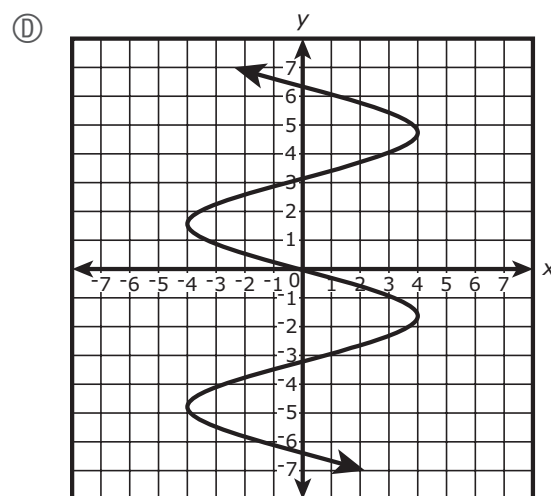
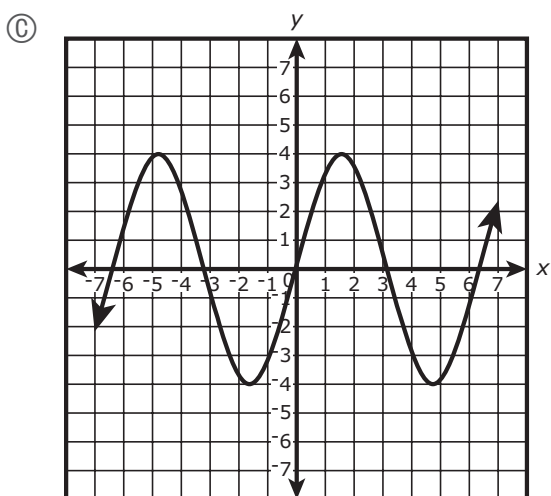
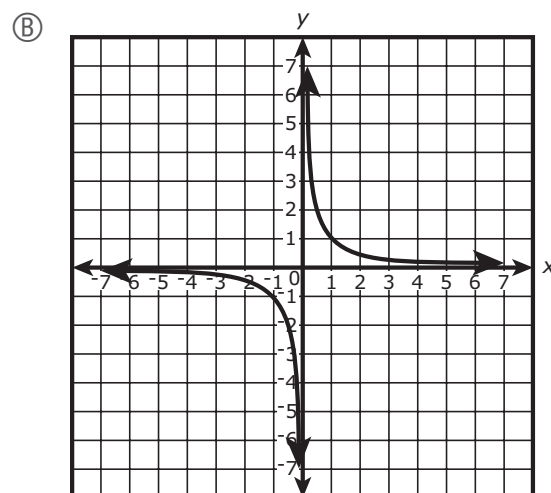
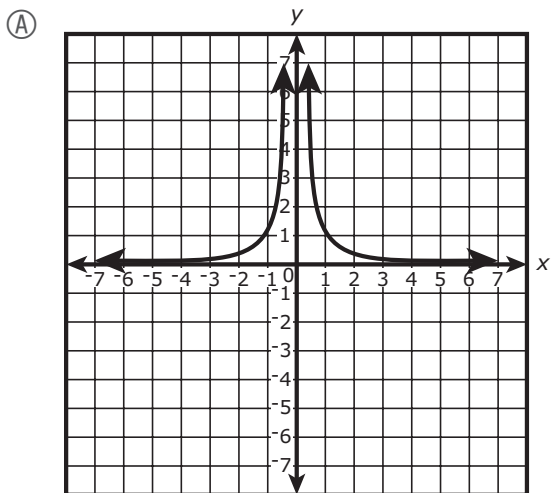
- 15 A cone and some of its dimensions are shown.



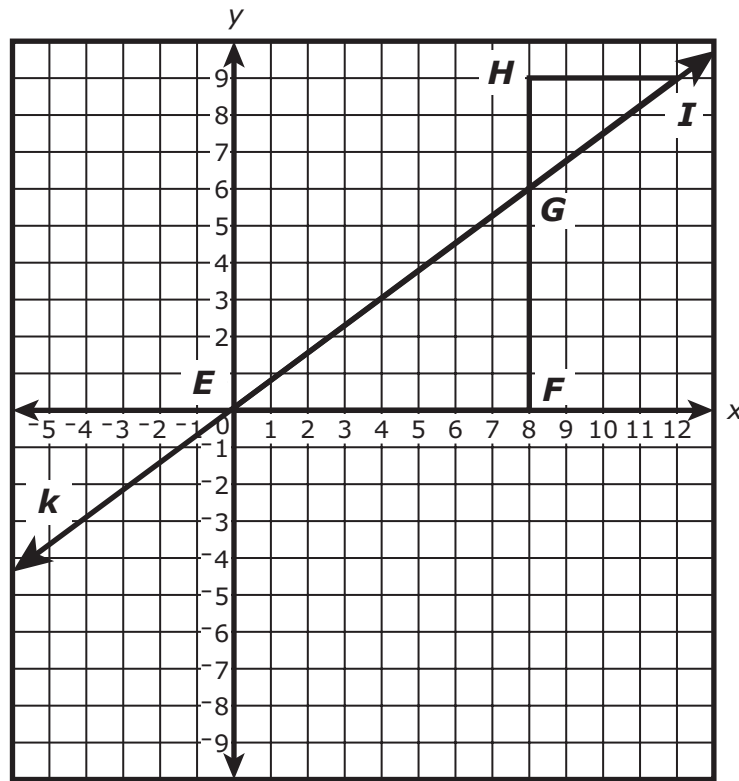
What is the volume, in cubic centimeters, of the cone?

- Ⓐ 30π
- Ⓑ 150π
- Ⓒ 450π
- Ⓓ 600π

- 16 Which of the following graphs shows a relationship that is **not** a function?



- 17 Kelly drew line k , and triangles EGF and IGH , on a coordinate plane, as shown.



Based on what Kelly drew, which of the following statements **must** be true?

- Ⓐ $FG = HG$
- Ⓑ $EG = IG$
- Ⓒ Angle FEG is congruent to angle HGI .
- Ⓓ The slope of EG is equal to the slope of IG .

- 18** This table shows a relationship between x and y .

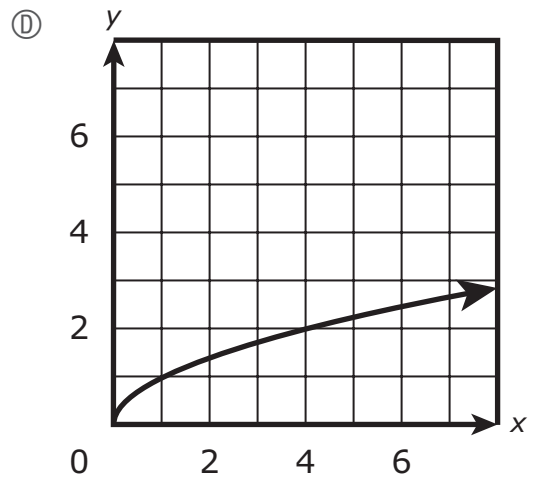
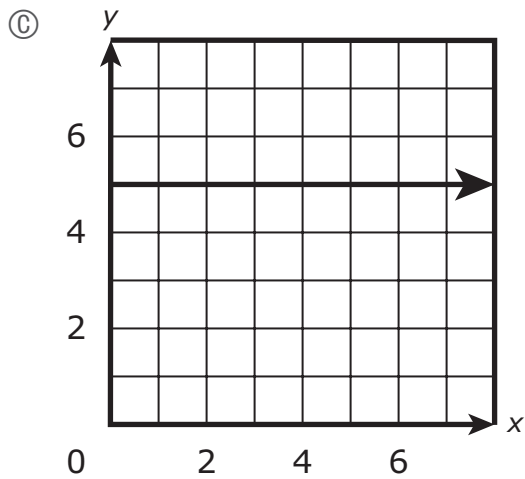
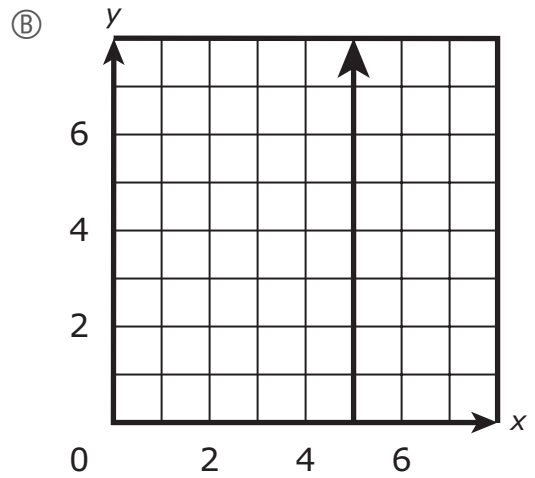
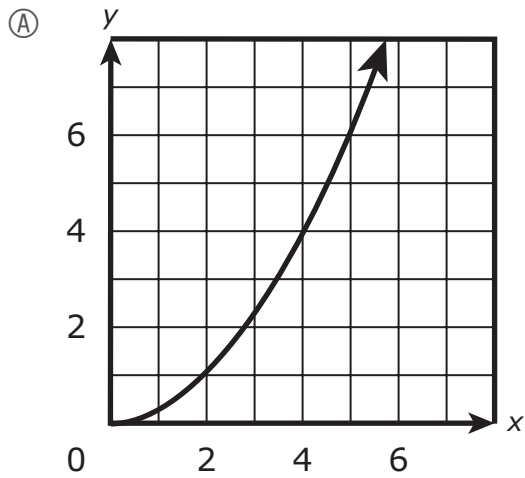
x	y
2	12
3	17
4	2
5	9

The ordered pair $(2, 2)$ will be added to the table.

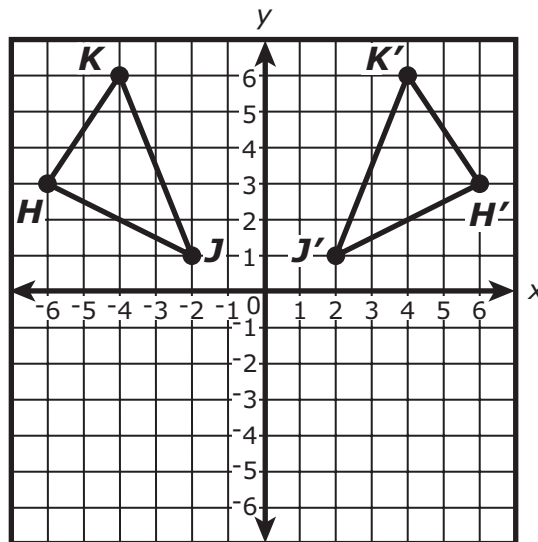
Which of the following statements about the relationship between x and y after the ordered pair is added to the table is true?

- Ⓐ When the ordered pair $(2, 2)$ is added to the table, the table will represent y as a function of x because each value of x will correspond to a unique value of y .
- Ⓑ When the ordered pair $(2, 2)$ is added to the table, the table will not represent y as a function of x because each value of x will correspond to a unique value of y .
- Ⓒ When the ordered pair $(2, 2)$ is added to the table, the table will represent y as a function of x because each value of x will not correspond to a unique value of y .
- Ⓓ When the ordered pair $(2, 2)$ is added to the table, the table will not represent y as a function of x because each value of x will not correspond to a unique value of y .

- 19 Which of the following graphs shows a linear function?



- 20 A transformation of triangle HJK resulted in its image, triangle $H'J'K'$, as shown on this coordinate plane.



Which of the following statements correctly describe the transformation of triangle HJK that resulted in its image, triangle $H'J'K'$?

Select the **two** correct answers.

- Ⓐ Triangle HJK was reflected over the x-axis to form triangle $H'J'K'$.
- Ⓑ Triangle HJK was reflected over the y-axis to form triangle $H'J'K'$.
- Ⓒ Triangle HJK was translated 4 units to the right to form triangle $H'J'K'$.
- Ⓓ Triangle HJK was rotated 90 degrees clockwise about the origin to form triangle $H'J'K'$.
- Ⓔ Triangle HJK is congruent to triangle $H'J'K'$.
- Ⓕ Triangle HJK is not congruent to triangle $H'J'K'$.

Grade 8 Mathematics
Spring 2022 Released Operational Items

PBT Item No.	Page No.	Reporting Category	Standard	Item Type*	Item Description	Correct Answer**
1	4	<i>The Number System and Expressions and Equations</i>	8.EE.A.3	SR	Convert a number in scientific notation to standard notation.	D
2	4	<i>The Number System and Expressions and Equations</i>	8.NS.A.2	SR	Determine the approximate location of an irrational number on a number line.	B
3	4	<i>The Number System and Expressions and Equations</i>	8.EE.A.2	SR	Evaluate square roots of small perfect squares and cube roots of small perfect cubes.	B,D
4	5–6	<i>Statistics and Probability</i>	8.SP.A.3	CR	Interpret the meanings of the parts of an equation that represents a real-world context and use the equation to solve a real-world problem.	
5	7	<i>The Number System and Expressions and Equations</i>	8.NS.A.1	SR	Determine a decimal equivalent of a given fraction.	C
6	7	<i>The Number System and Expressions and Equations</i>	8.EE.C.8	SR	Determine which given system of equations has no solution.	D
7	8–9	<i>Geometry</i>	8.G.A.1	SR	Compare the properties of figures graphed on a coordinate plane after various transformations.	D;C
8	10	<i>Functions</i>	8.F.B.4	SR	Determine the rate of change and the initial value of a function from data represented in a table.	B,E
9	11	<i>The Number System and Expressions and Equations</i>	8.EE.B.5	SA	Determine and compare two rates of change in a given real-world context.	1
10	12	<i>The Number System and Expressions and Equations</i>	8.EE.A.1	SR	Determine which expression with an exponent is equivalent to a given expression featuring multiplication of two numbers with the same base but different exponents.	D
11	15	<i>The Number System and Expressions and Equations</i>	8.EE.B.5	SR	Determine which graph represents a proportional relationship based on a real-world context.	D
12	16–17	<i>Geometry</i>	8.G.A.5	CR	Use facts about the angle sum of triangles to calculate angle measures and determine whether two triangles are similar.	
13	18	<i>Functions</i>	8.F.B.5	SR	Determine where the graph of a function is increasing or decreasing.	D
14	19	<i>Geometry</i>	8.G.B.6	SR	Determine the relationship between the areas of three squares whose sides form a right triangle.	B
15	20	<i>Geometry</i>	8.G.C.9	SR	Find the volume of a cone given its diameter and height.	B
16	21	<i>Functions</i>	8.F.A.1	SR	Determine which graph shows a relationship that is not a function.	D
17	22	<i>The Number System and Expressions and Equations</i>	8.EE.B.6	SR	Use similar triangles to compare the slope of two line segments on the same line.	D
18	23	<i>Functions</i>	8.F.A.1	SR	Determine if the values in a table represent a function after adding an ordered pair to the table.	D
19	24	<i>Functions</i>	8.F.A.3	SR	Determine which graph represents a linear function.	C
20	25	<i>Geometry</i>	8.G.A.2	SR	Determine which transformation of a shape results in a given image.	B,E

* 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.

Grade 8 Mathematics
Spring 2022 Unreleased Operational Items

PBT Item No.	Reporting Category	Standard	Item Type*	Item Description
21	<i>Functions</i>	8.F.B.4	SR	Determine the rate of change and the initial value of a function from the graph of the line that represents the function.
22	<i>Geometry</i>	8.G.A.1	SR	Determine the effects of a rotation on the angles and sides of a triangle.
23	<i>Functions</i>	8.F.A.2	CR	Determine the initial values, rates, equations and solutions of linear relationships represented in different ways.
24	<i>The Number System and Expressions and Equations</i>	8.NS.A.2	SR	Compare two irrational numbers and one rational number by ordering them from least to greatest.
25	<i>Functions</i>	8.F.A.3	SR	Determine which statement about a linear equation is true.
26	<i>The Number System and Expressions and Equations</i>	8.EE.C.7	SR	Determine the number of solutions for a linear equation with one variable.
27	<i>The Number System and Expressions and Equations</i>	8.NS.A.1	SR	Identify an irrational number from a list of numbers.
28	<i>The Number System and Expressions and Equations</i>	8.EE.C.8	SR	Determine the coordinates of the solution of a system of equations.
29	<i>The Number System and Expressions and Equations</i>	8.EE.A.3	SR	Given two quantities, each expressed as a single digit multiplied by an integer power of ten, determine how many times as much one quantity is than the other.
30	<i>The Number System and Expressions and Equations</i>	8.EE.C.7	SA	Solve a linear equation by collecting like terms.
31	<i>Geometry</i>	8.G.A.5	SR	Determine which angles are congruent when two parallel lines are intersected by a transversal.
32	<i>Statistics and Probability</i>	8.SP.A.2	SR	Justify why a line drawn through data on a scatter plot is unsuitable as a line of best fit.
33	<i>Geometry</i>	8.G.A.3	SR	Given a sequence of transformations, determine the coordinates of the image of a given point.
34	<i>Geometry</i>	8.G.A.4	SR	Identify transformations which, when performed on a triangle, will result in a congruent figure.
35	<i>Geometry</i>	8.G.B.7	SA	Determine an unknown side length of a right triangle using the Pythagorean Theorem.
36	<i>Geometry</i>	8.G.A.3	SR	Determine the coordinates of a point in a figure on a coordinate plane after a reflection.
37	<i>The Number System and Expressions and Equations</i>	8.EE.B.5	CR	Graph a proportional relationship, interpreting the unit rate as the slope of the graph, and then compare that proportional relationship to another proportional relationship represented in a different way.
38	<i>Geometry</i>	8.G.A.2	SR	Identify a transformation that would not result in a congruent figure.
39	<i>The Number System and Expressions and Equations</i>	8.EE.A.1	SR	Use and apply properties of integer exponents to simplify a numerical expression.
40	<i>Statistics and Probability</i>	8.SP.A.4	SR	Use relative frequencies from a two-way frequency table to solve a real-world problem.

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