
VIII. Mathematics, Grade 8

Grade 8 Mathematics Test

The spring 2004 Grade 8 MCAS Mathematics Test was based on learning standards in the Massachusetts *Mathematics Curriculum Framework (2000)*. The *Framework* identifies the five major content strands listed below.

- Number Sense and Operations
- Patterns, Relations, and Algebra
- Geometry
- Measurement
- Data Analysis, Statistics, and Probability

The grade 7–8 learning standards for each of these strands appear on pages 62–66 of the *Mathematics Curriculum Framework*, which is available on the Department website at www.doe.mass.edu/frameworks/math/2000/final.pdf.

In *Test Item Analysis Reports* and on the *Subject Area Subscore* pages of the MCAS *School Reports* and *District Reports*, Mathematics test results are reported under five MCAS reporting categories, which are identical to the five *Mathematics Curriculum Framework* content strands listed above.

Test Sessions and Content Overview

The grade 8 Mathematics Test contained two separate test sessions. Each session included multiple-choice and open-response questions. Session 1 also included short-answer questions. Common test items are shown on the following pages as they appeared in test booklets.

Reference Materials and Tools

During testing, each student taking the Grade 8 Test was provided with a *Grade 8 Mathematics Reference Sheet* and a plastic ruler. A copy of the reference sheet follows the final question in this chapter.

While answering questions during Session 2, each student had sole access to a calculator with at least four functions and a square root key. Calculator use was not allowed during Session 1. No other reference tools or materials were allowed, with the exception of bilingual word-to-word dictionaries used by limited English proficient students.

Cross-Reference Information

The table at the conclusion of this chapter indicates each item’s reporting category and the *Framework* learning standard it assesses. The correct answers for multiple-choice and short-answer questions are also displayed in the table.

HOW TO ANSWER OPEN-RESPONSE QUESTIONS

Be sure to

- read all parts of each question carefully.
- make each response as clear, complete, and accurate as you can.
- check your answers.

Mathematics

SESSION 1

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



DIRECTIONS

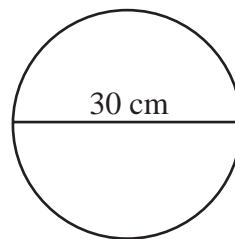
This session contains fifteen multiple-choice questions, five short-answer questions, and two open-response questions. Mark your answers to these questions in the spaces provided in your Student Answer Booklet.

- 1 What is the value of the expression below when $x = 12$ and $y = -12$?

$$(x - y)(x + y)$$

- A. 288
- B. 144
- C. 12
- D. 0

- 2 The circles below represent the gears of a bicycle. The diameter of Gear A is 30 centimeters. The ratio of the diameter of Gear A to the diameter of Gear B is 3:1.



Gear A



Gear B

What is the circumference, in centimeters, of Gear B?

- A. 5π cm
- B. 10π cm
- C. 15π cm
- D. 30π cm

- 3 Which of the following is equivalent to the equation below?

$$\frac{n}{6} = 30$$

- A. $n = 30 \cdot 6$
B. $6 = 30 \cdot n$
C. $n = \frac{30}{6}$
D. $6 = \frac{30}{n}$

- 4 The owner of a car dealership noticed a pattern in the weekly car sales, as shown in the table below.

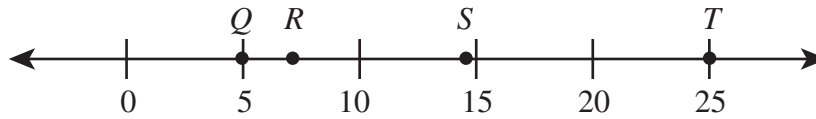
Weekly Car Sales

Week (w)	Number of Cars Sold (s)
1	12
2	18
3	24
4	30

For weeks 1 through 4, which of the following equations could represent the pattern of s cars sold during week w ?

- A. $s = 6w$
B. $s = 12w$
C. $s = 6(w + 6)$
D. $s = 6(w + 1)$

- 5 A part of the real number line is shown below.



Which letter best represents the location of $\sqrt{50}$?

- A. *Q*
B. *R*
C. *S*
D. *T*
-
- 6 What value of a makes the equation below true?

$$-12 + (-3a) = 0$$

- A. 5
B. 4
C. -4
D. -5

Questions 7 and 8 are short-answer questions. Write your answers to these questions in the boxes provided in your Student Answer Booklet. Do not write your answers in this test booklet. You may do your figuring in the test booklet.

- 7 Acme Doll Company makes the Super Hero Doll that sells for \$10. The table below shows that the profit the company earns is based proportionally on the number of dolls sold.

Super Hero Doll Profits

Sales (number of dolls)	Profits
1,000	\$50
1,500	\$75
3,000	\$150
4,500	\$225

What is the profit for sales of 15,000 Super Hero Dolls?

- 8 Compute:

$$\frac{1}{3} \times 1\frac{1}{2}$$

Question 9 is an open-response question.

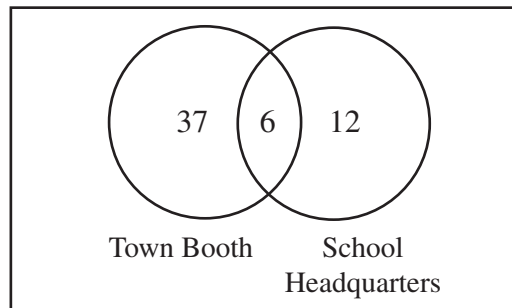
- **BE SURE TO ANSWER AND LABEL ALL PARTS OF THE QUESTION.**
- **Show all your work (drawings, tables, or computations) in your Student Answer Booklet.**
- **If you do the work in your head, explain in writing how you did the work.**

Write your answer to question 9 in the space provided in your Student Answer Booklet.

- 9 Last weekend, Lauren helped organize some students to participate in a fundraiser for charity. The students had a choice of working one shift at the information booth in town or one shift at the school headquarters. Students could also choose to work 2 shifts, one in town and one at school.

After the fundraiser, Lauren prepared a report for the school board. In her report, she drew the Venn diagram below to show where the students worked.

Students Working at the Fundraiser



- Based on the Venn diagram, how many students worked shifts at the Town Booth?
- Based on the Venn diagram, how many students participated in the fundraiser?
- Lauren could have drawn a bar graph to represent the same information as the Venn diagram. In your Student Answer Booklet, create a bar graph that contains the same information as the Venn diagram.

Mark your answers to multiple-choice questions 10 through 18 in the spaces provided in your Student Answer Booklet. Do not write your answers in this test booklet. You may do your figuring in the test booklet.

- 10 Erin determined the masses of some samples for her science project. The mass of each sample is listed below.

Sample	Mass (grams)
1	17
2	16.7
3	17.6
4	16.67

Which of the following correctly lists the samples in order from the **least** mass to the **greatest** mass?

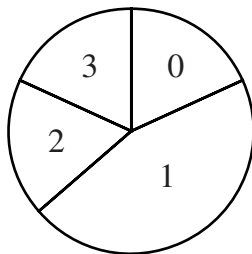
- A. 1, 2, 3, 4
- B. 2, 3, 4, 1
- C. 2, 4, 1, 3
- D. 4, 2, 1, 3

- 11 Stephanie conducted a survey to determine the number of siblings that each of her classmates has. The data appears in the table below.

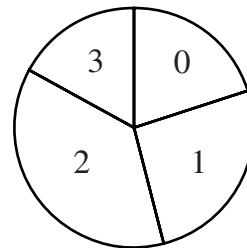
Number of Siblings	Classmates Having That Number of Siblings
0	/// I
1	/// III
2	/// /// I
3	///

Which of the following circle graphs best represents the data in the table?

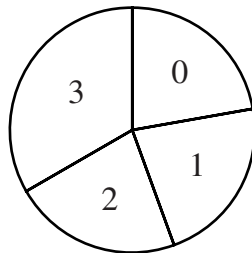
- A. **Comparison of Classmates By Number of Siblings**



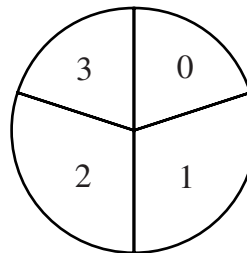
- C. **Comparison of Classmates By Number of Siblings**



- B. **Comparison of Classmates By Number of Siblings**



- D. **Comparison of Classmates By Number of Siblings**



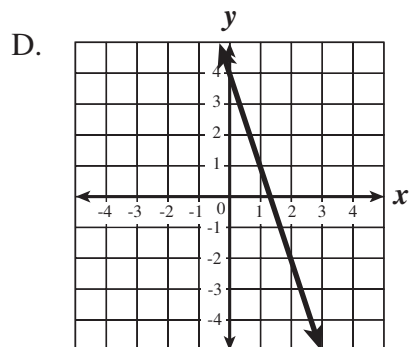
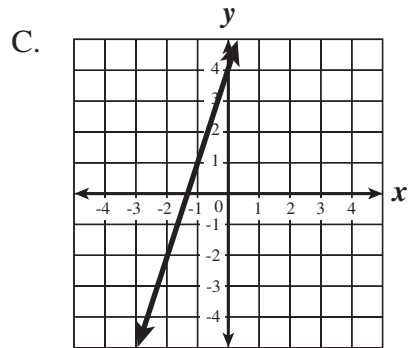
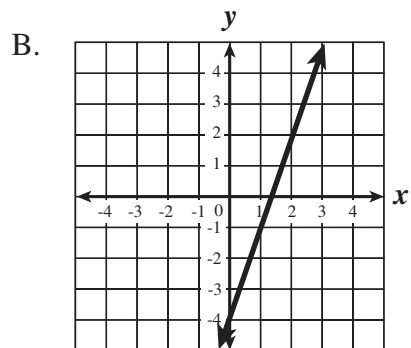
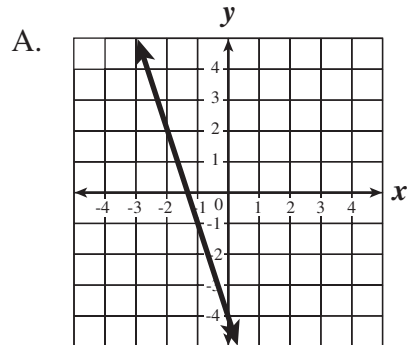
12 What is the prime factorization of 300?

- A. $3 \cdot 10^2$
- B. $2 \cdot 5^2 \cdot 6$
- C. $2^2 \cdot 3 \cdot 25$
- D. $2^2 \cdot 3 \cdot 5^2$

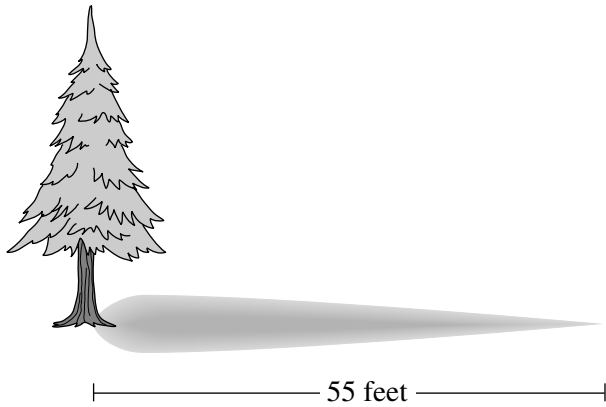
13 What is the **minimum** number of congruent, equilateral triangles needed to construct a three-dimensional figure if no other shapes are used?

- A. 3
- B. 4
- C. 6
- D. 8

14 Which graph below best represents $y = -3x + 4$?



- 15 At 4:00 P.M. on a sunny day, a stick 2 feet tall casts a shadow 5 feet long. At the same time, a tree nearby casts a shadow 55 feet long.



What is the height, in feet, of the tree?

- A. 137.5 feet
- B. 27.5 feet
- C. 22 feet
- D. 10 feet

- 16 The president of the science club brought 134 cans of juice on a field trip. Each person on the trip received 3 cans of juice, and there were 20 extra cans. Which equation could be used to find n , the number of people who went on the field trip?

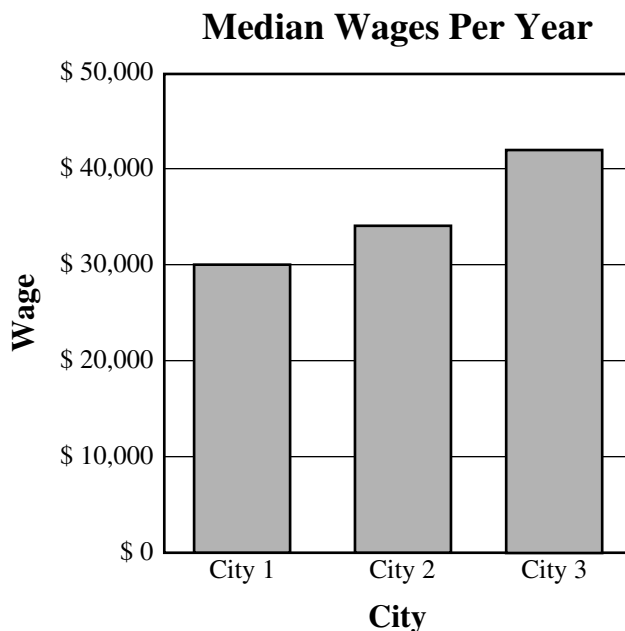
A. $134 = \frac{n}{3} - 20$

B. $134 = \frac{n}{3} + 20$

C. $134 = 3n - 20$

D. $134 = 3n + 20$

- 17 A comparison of the median wage for a business employee in three cities is shown below.



Which of the following is closest to the difference between the median wage in City 2 and the median wage in City 1?

- 18 If $7x + 3 = 17$, what is the value of $7x - 3$?
- A. 14
 - B. 11
 - C. 0
 - D. -3

Question 19 is a short-answer question. Write your answer to this question in the box provided in your Student Answer Booklet. Do not write your answer in this test booklet. You may do your figuring in the test booklet.

- 19 Sam's Pizza offers the luncheon special shown in the advertisement below.

<i>Sam's Pizza</i> <i>Luncheon Special</i>			\$5.99
Choose One Entrée, One Salad, One Drink			
<u><i>Entrées:</i></u> Pizza Sandwich Hot Plate	<u><i>Salads:</i></u> Tossed Green Cole Slaw	<u><i>Drinks:</i></u> Coffee Iced Tea Soda	

How many combinations of one entrée, one salad, and one drink are possible for the luncheon special?

Questions 20 and 21 are short-answer questions. Write your answers to these questions in the boxes provided in your Student Answer Booklet. Do not write your answers in this test booklet. You may do your figuring in the test booklet.

- 20 The stem-and-leaf plot below shows the ages of the people who bought skateboards at a store during a sale.

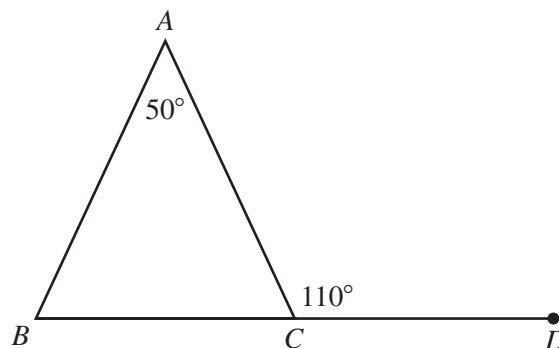
Ages of People

Stem	Leaf
1	1 3 4 5 5 6 6 6 8
2	0 1 7 8
3	9
4	3 6
5	
6	5 5
7	1

Key
6 2 represents 62

What is the range of ages of people who bought skateboards during the sale?

- 21 Triangle ABC is shown below. Points B , C , and D are collinear.



What is the degree measure of $\angle B$?

Question 22 is an open-response question.

- **BE SURE TO ANSWER AND LABEL ALL PARTS OF THE QUESTION.**
- **Show all your work (drawings, tables, or computations) in your Student Answer Booklet.**
- **If you do the work in your head, explain in writing how you did the work.**

Write your answer to question 22 in the space provided in your Student Answer Booklet.

- 22** Alex made a table of values based upon the rules of a new operation. The table has 7 columns and 6 rows as shown below.

		Columns						
		1	2	3	4	5	6	7
Rows	1	-1	-3	-5	-7	-9	-11	
	2		0	-2	-4	-6	-8	
	3	7	5	3	1	-1	-3	
	4	14	12	10	8	6	4	
	5	23	21	19	17	15	13	
	6							

- Each row of the table contains a pattern of numbers where each number is 2 less than the previous number in the row. Based on the pattern, what number belongs in column 1 and row 2 of the table?
- Based on the pattern, what numbers belong in rows 1 through 5 in column 7 of the table?
- Describe, in your own words, a rule that fits the pattern of numbers going down each column. Next, use the rule to determine the 7 numbers that belong in row 6 of the table.

Mathematics

SESSION 2

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



DIRECTIONS

This session contains fourteen multiple-choice questions and three open-response questions. Mark your answers to these questions in the spaces provided in your Student Answer Booklet.

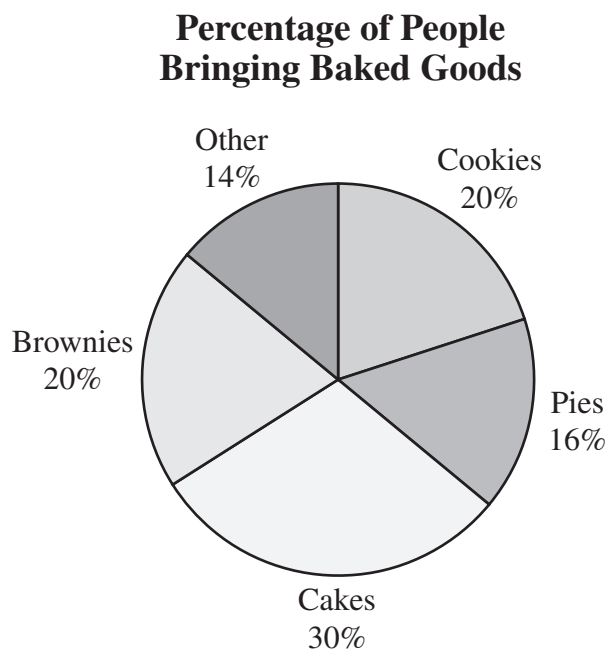
- 23 Orlando and Carol each started an exercise program that included riding a bike. The table below shows the number of miles each traveled for 5 weeks of the program.

Week	Orlando	Carol
1	8	5
2	8.5	6
3	9	7
4	9.5	8
5	10	9
6		
7		
8		

If both Orlando and Carol continue to increase the number of miles traveled each week at the constant rates shown in the table, which of the following is a true statement about week 8?

- A. Carol will travel more miles than Orlando.
- B. Orlando and Carol will travel the same number of miles.
- C. Carol will travel a total of 13 miles.
- D. Orlando and Carol will travel a total of 20 miles.

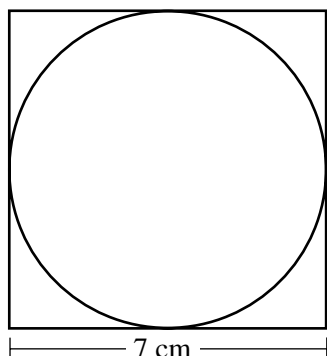
- 24 The circle graph below shows the percentages of people who brought each type of baked good to sell at a recent bake sale.



If 15 people brought cakes to sell, what is the total number of people who brought baked goods to sell at the bake sale?

- A. 45
- B. 50
- C. 70
- D. 75

- 25 The figure below shows a circle inscribed in a square.



Which of the following is closest to the area of the circle?

- A. 22 cm^2
- B. 38 cm^2
- C. 49 cm^2
- D. 154 cm^2

- 26 Pittsfield and Provincetown are approximately 258,000 meters apart. Which of the following shows this number in scientific notation?

- A. 258×10^3
- B. 258×10^{-3}
- C. 2.58×10^5
- D. 2.58×10^{-5}

- 27 An object is dropped from a small plane flying at a height of 1000 feet above the ground. As the object falls, d , its distance above the ground after t seconds, is given by the formula below.

$$d = -16t^2 + 1000$$

How far above the ground is the object when it has fallen for 4 seconds?

- A. 984 feet
- B. 936 feet
- C. 872 feet
- D. 744 feet

Questions 28 and 29 are open-response questions.

- **BE SURE TO ANSWER AND LABEL ALL PARTS OF EACH QUESTION.**
- **Show all your work (drawings, tables, or computations) in your Student Answer Booklet.**
- **If you do the work in your head, explain in writing how you did the work.**

Write your answer to question 28 in the space provided in your Student Answer Booklet.

- 28** Colin plans to order three types of skateboard parts. He plans to order a total of ten parts. He can order online (over the Internet) from Tony's Skateboard Shop, or he can order from a local store.

Colin's online order from Tony's Skateboard Shop is shown in the order form below.

<i>Tony's Skateboard Shop Order Form</i>			
Type of Part	Price per Unit	Units Ordered	Cost
Truck	\$8.95	2	
Wheel	\$6.95	4	
Package of Bearings	\$2.45	4	
Subtotal			
Online Discount			-\$2.00
Subtotal After Discount			
Sales Tax (5% of the Subtotal After Discount)			
Total Payment Due			

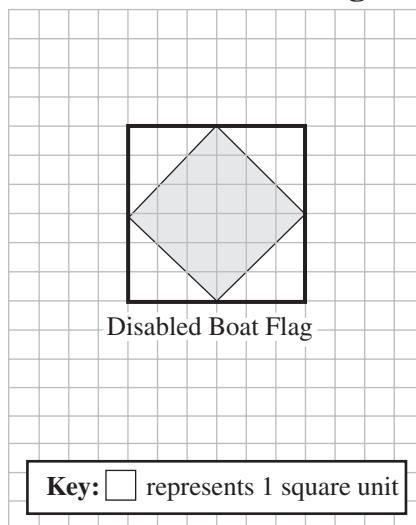
Use the order form above to answer parts a, b, and c.

- The Subtotal amount is the total cost of all ten parts before any discount or tax. What is the Subtotal amount for the ten parts that Colin plans to order? Show your work or explain your answer.
- By ordering online from Tony's Skateboard Shop, Colin is entitled to an Online Discount of \$2.00 off the Subtotal amount. Sales Tax of 5% is added to the Subtotal After Discount. What is the Total Payment Due if Colin orders online from Tony's Skateboard Shop? Show your work or explain your answer.
- Colin learns that the local store can provide the same ten parts, each one at the same Price per Unit that Tony's Skateboard Shop charges, but the local store will give Colin a 20% discount on the Subtotal amount. After this discount, Colin will still need to pay sales tax of 5%. If Colin orders from the local store, how much less will Colin pay for the skateboard parts than if he ordered the same parts online from Tony's Skateboard Shop?

Write your answer to question 29 in the space provided in your Student Answer Booklet.

- 29 Arsenio was studying signal flags in his sailing class. On grid paper, he made a drawing of the flag that means a boat is disabled, as shown below. The flag is a large, white square that contains a smaller, red square (shown shaded in the drawing).

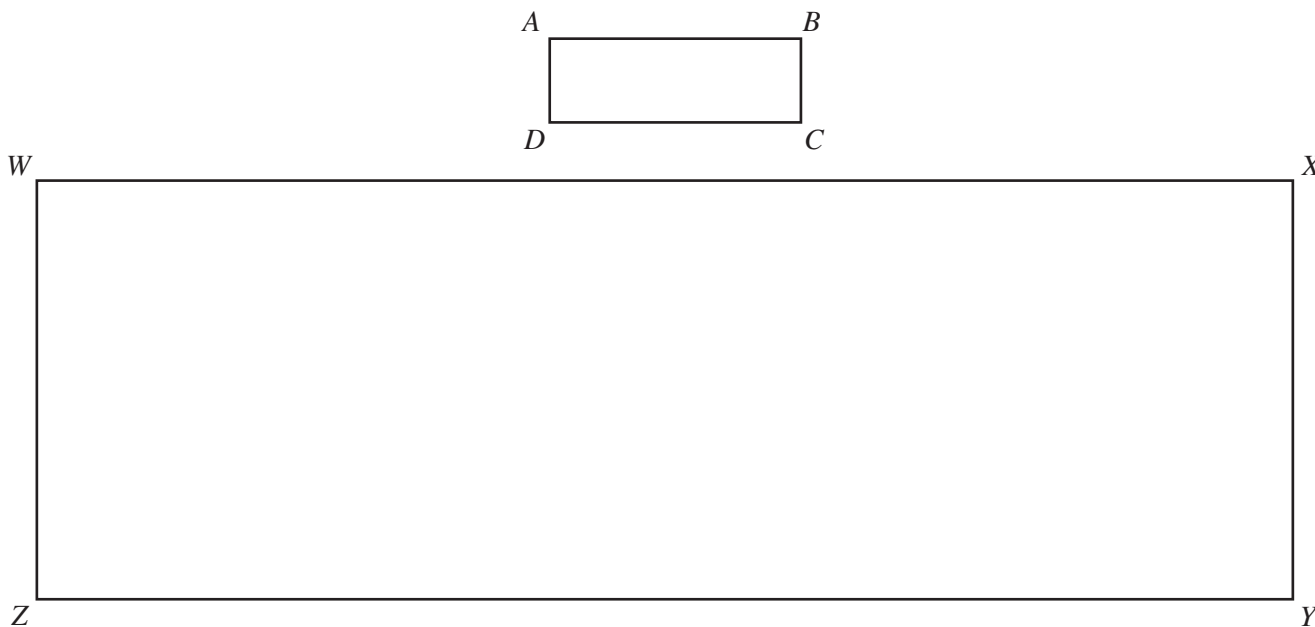
Arsenio's Drawing



- What is the area, in square units, of the large square in Arsenio's drawing of the flag? Show your work or explain how you got your answer.
- What is the total area, in square units, of the 4 unshaded interior parts of Arsenio's drawing of the flag? Show your work or explain how you got your answer.
- What is the perimeter, in units, of the smaller square in Arsenio's drawing of the flag? Show your work or explain how you got your answer.

Mark your answers to multiple-choice questions 30 through 38 in the spaces provided in your Student Answer Booklet. Do not write your answers in this test booklet. You may do your figuring in the test booklet.

- 30 Two rectangles, $ABCD$ and $WXYZ$, are shown below. The measure of each side of $WXYZ$ is 5 times the measure of each corresponding side of $ABCD$.



Which statement is true of the areas of these two rectangles?

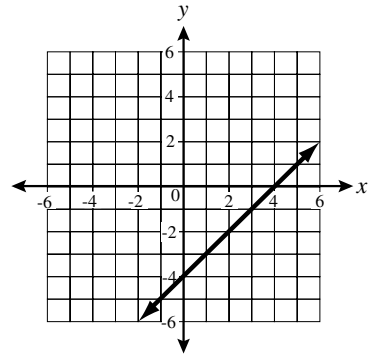
- A. The area of $WXYZ$ is 5 times the area of $ABCD$.
- B. The area of $WXYZ$ is 10 times the area of $ABCD$.
- C. The area of $WXYZ$ is 20 times the area of $ABCD$.
- D. The area of $WXYZ$ is 25 times the area of $ABCD$.

31 A sugar cookie recipe calls for $3\frac{1}{2}$ cups of sugar to make 6 dozen cookies. Based on the recipe, how many cups of sugar must be used to make 20 dozen sugar cookies?

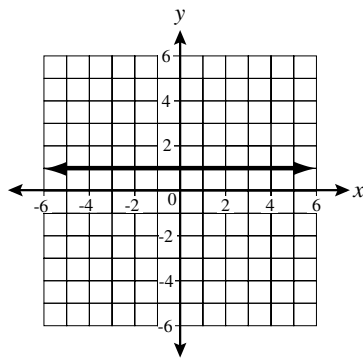
- A. $9\frac{1}{2}$ cups
- B. $11\frac{2}{3}$ cups
- C. 61 cups
- D. 70 cups

32 Which of the following shows the graph of a line with positive slope?

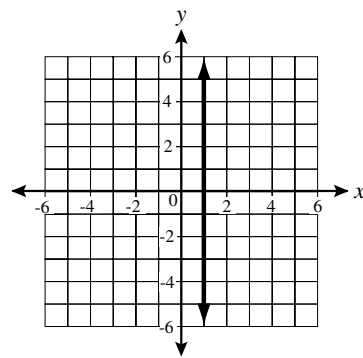
A.



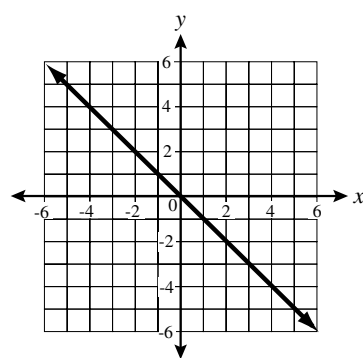
B.



C.



D.



- 33 In a citywide survey, bicycle owners were asked how many bicycles they owned, and whether any had been stolen during the previous year. The results indicated that people in the city owned 9017 bicycles and, of these, 450 had been stolen. Based on this information, which conclusion is most reasonable?
- A. No bicycle owners will have their bicycles stolen this year.
 - B. All bicycle owners will have their bicycles stolen this year.
 - C. The probability that any one bicycle will be stolen is about $\frac{1}{5}$.
 - D. The probability that any one bicycle will be stolen is about $\frac{1}{20}$.

- 34 A group of 36 people from the Nantucket Recreation Center plans to purchase tickets for a cruise to Bermuda. The standard fare for an individual ticket is shown below.

Cruise Price

	Standard Fare
Individual Ticket Price	\$1200

The group is informed that, because of the size of the group, the standard fare will be reduced by 30%.

With the discount of 30%, how much does **each** member of the Nantucket Recreation Center have to pay for a cruise ticket?

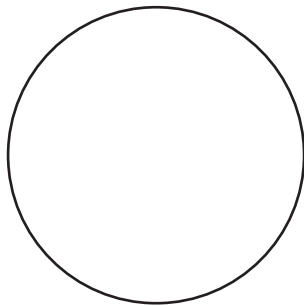
- 35 Which of the following is equivalent to the expression below?

$$(4)(-x)(-y)$$

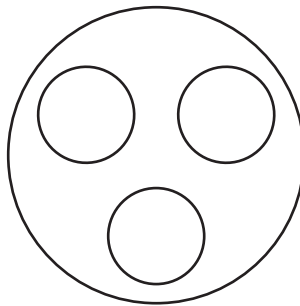
- A. $4xy$
- B. $-4xy$
- C. $(-4)(x)(y)$
- D. $(-4)(-x)(-y)$

- 36 Mr. Lowery has $8\frac{3}{4}$ pounds of ground beef that he will use to make hamburgers for a picnic. What is the maximum number of quarter-pound hamburgers he can make?
- A. 9
 - B. 17
 - C. 35
 - D. 36

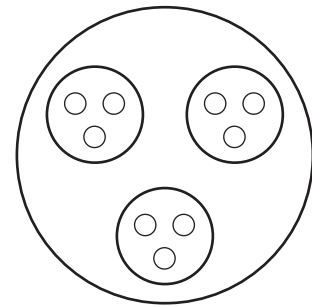
- 37 An artist creates a design by drawing circles in steps, as shown below.



Step 1



Step 2



Step 3

The table below shows a pattern of the total number of circles formed at each step.

Pattern of Circles

Step	1	2	3	4	5
Total Number of Circles	1	4	13		

If the pattern shown in the table continues, what will be the total number of circles formed at step 5?

- A. 52
- B. 117
- C. 121
- D. 283

- 38 The chart below shows basketball shots attempted and made by four players on a team.

Basketball Shots

Name	Shots Attempted	Shots Made
Kenzo	10	6
Chris	12	7
Kyle	5	4
Ramon	12	3

Which of the following lists the players in order from the **highest** to the **lowest** percentage of shots made out of shots attempted?

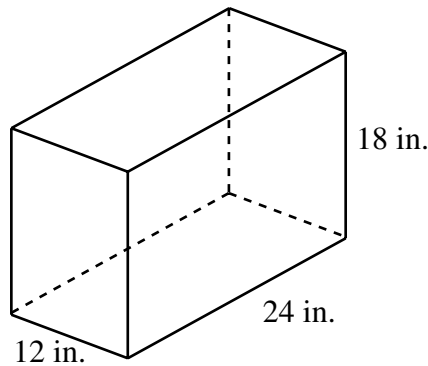
- A. Kyle, Kenzo, Chris, Ramon
- B. Chris, Kenzo, Kyle, Ramon
- C. Chris, Kyle, Kenzo, Ramon
- D. Kyle, Chris, Kenzo, Ramon

Question 39 is an open-response question.

- **BE SURE TO ANSWER AND LABEL ALL PARTS OF EACH QUESTION.**
- **Show all your work (drawings, tables, or computations) in your Student Answer Booklet.**
- **If you do the work in your head, explain in writing how you did the work.**

Write your answer to question 39 in the space provided in your Student Answer Booklet.

- 39 The figure below shows an aquarium that is shaped like a rectangular prism.



- What is the volume, in cubic inches, of the aquarium?
- One gallon is equal to 231 cubic inches. How many gallons of water will the aquarium hold?
- If 10 gallons of water were poured into the empty aquarium, what would be the depth, in inches, of the water? Show your work or explain how you got your answer.



Massachusetts Comprehensive Assessment System Grade 8 Mathematics Reference Sheet

PERIMETER FORMULAS

square..... $P = 4s$

rectangle $P = 2b + 2h$

triangle..... $P = a + b + c$

CIRCLE FORMULAS

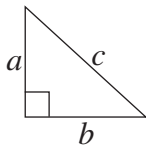
circle $C = 2\pi r$

OR

$$C = \pi d$$

$$A = \pi r^2$$

PYTHAGOREAN THEOREM



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

CONVERSIONS

1 mile = 5280 feet

1 square mile = 640 acres

AREA FORMULAS

square..... $A = s^2$

rectangle..... $A = bh$

OR

$$A = lw$$

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

circle $A = \pi r^2$

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

VOLUME FORMULAS

rectangular prism $V = Bh$
(B = area of base)

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

cylinder $V = \pi r^2 h$

cube..... $V = s^3$
(s = length of an edge)

Grade 8 Mathematics
Spring 2004 Released Items:
Reporting Categories, Standards, and Correct Answers

Item No.	Page No.	Reporting Category	Standard	Correct Answer (MC/SA)*
1	181	<i>Patterns, Relations, and Algebra</i>	8.P.2	D
2	181	<i>Geometry</i>	8.G.2	B
3	182	<i>Number Sense and Operations</i>	8.N.9	A
4	182	<i>Patterns, Relations, and Algebra</i>	8.P.9	D
5	183	<i>Number Sense and Operations</i>	8.N.2	B
6	183	<i>Number Sense and Operations</i>	8.N.8	C
7	184	<i>Patterns, Relations, and Algebra</i>	8.P.1	\$750
8	184	<i>Number Sense and Operations</i>	8.N.10	$\frac{1}{2}$
9	185	<i>Data Analysis, Statistics, and Probability</i>	8.D.2	
10	186	<i>Number Sense and Operations</i>	8.N.1	D
11	187	<i>Data Analysis, Statistics, and Probability</i>	8.D.2	C
12	188	<i>Number Sense and Operations</i>	8.N.5	D
13	188	<i>Geometry</i>	8.G.7	B
14	188	<i>Patterns, Relations, and Algebra</i>	8.P.6	D
15	189	<i>Measurement</i>	8.M.4	C
16	189	<i>Patterns, Relations, and Algebra</i>	8.P.4	D
17	190	<i>Data Analysis, Statistics, and Probability</i>	8.D.2	A
18	190	<i>Patterns, Relations, and Algebra</i>	8.P.7	B
19	191	<i>Data Analysis, Statistics, and Probability</i>	8.D.4	18
20	192	<i>Data Analysis, Statistics, and Probability</i>	8.D.3	60, or 11 to 71
21	192	<i>Geometry</i>	8.G.1	60°
22	193	<i>Patterns, Relations, and Algebra</i>	8.P.1	
23	194	<i>Patterns, Relations, and Algebra</i>	8.P.10	A
24	194	<i>Data Analysis, Statistics, and Probability</i>	8.D.2	B
25	195	<i>Measurement</i>	8.M.3	B
26	195	<i>Number Sense and Operations</i>	8.N.4	C
27	195	<i>Measurement</i>	8.M.5	D
28	196	<i>Number Sense and Operations</i>	8.N.12	
29	197	<i>Measurement</i>	8.M.3	
30	198	<i>Patterns, Relations, and Algebra</i>	8.P.8	D
31	199	<i>Number Sense and Operations</i>	8.N.3	B
32	199	<i>Patterns, Relations, and Algebra</i>	8.P.5	A
33	200	<i>Data Analysis, Statistics, and Probability</i>	8.D.4	D
34	200	<i>Number Sense and Operations</i>	8.N.10	D
35	200	<i>Patterns, Relations, and Algebra</i>	8.P.3	A
36	201	<i>Number Sense and Operations</i>	8.N.12	C
37	201	<i>Patterns, Relations, and Algebra</i>	8.P.1	C
38	202	<i>Number Sense and Operations</i>	8.N.1	A
39	203	<i>Measurement</i>	8.M.3	

* Answers are provided here for multiple-choice and short-answer items only. Sample responses and scoring guidelines for open-response items, which are indicated by shaded cells, will be posted to the Department's website later this year.