XII. Mathematics, Grade 6

Grade 6 Mathematics Test

The spring 2006 Grade 6 MCAS Mathematics Test was based on learning standards in the Massachusetts *Mathematics Curriculum Framework* (2000). The *Framework* identifies five major content strands, listed below. Page numbers for the grades 5–6 learning standards appear in parentheses.

- Number Sense and Operations (*Framework*, pages 25–26)
- Patterns, Relations, and Algebra (*Framework*, page 34)
- Geometry (*Framework*, page 42)
- Measurement (*Framework*, page 50)
- Data Analysis, Statistics, and Probability (*Framework*, page 58)

The *Mathematics Curriculum Framework* is available on the Department Web site 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

The MCAS Grade 6 Mathematics Test included two separate test sessions. Each session included multiple-choice, short-answer, and open-response questions.

Reference Materials and Tools

Each student taking the Grade 6 Mathematics Test was provided with a plastic ruler and a *Grade 6 Mathematics Reference Sheet*. A copy of the reference sheet follows the final question in this chapter. An image of the ruler is not reproduced in this publication.

The use of bilingual word-to-word dictionaries was allowed for limited English proficient students only, during both Mathematics test sessions. No calculators, other reference tools, or materials were allowed.

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.

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 twelve multiple-choice questions, two short-answer questions, and three open-response questions. Mark your answers to these questions in the spaces provided in your Student Answer Booklet.

1 Charlotta wrote the equation below on a card.

$$\square \div 8 = 5$$

If Charlotta's equation is true, which of the following is also true?

A. $\square = 5 \times 8$

B. $\square = 5 - 8$

C. $\square = 5 \div 8$

D. $\square = 5 + 8$

2 Sheila started the geometric pattern shown below.

1, 3, 9, 27, ?

If the pattern continues as shown, what is the next term in the pattern?

A. 36

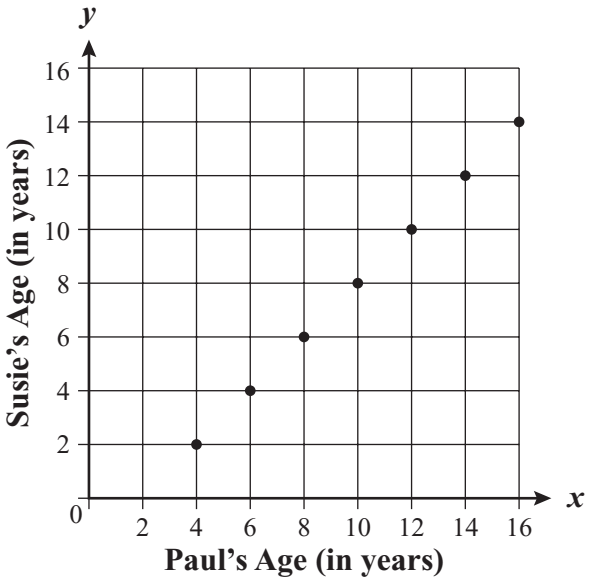
B. 54

C. 81

D. 108

3 The graph below represents the relationship between Paul's age and Susie's age.

Relationship between Ages



Which of the following best describes the relationship between Paul's age and Susie's age for all the points shown on the graph?

A. Susie is twice as old as Paul.

B. Susie is 2 years older than Paul.

C. Susie is half as old as Paul.

D. Susie is 2 years younger than Paul.

4 The chart below lists the sizes of popcorn, sizes of drinks, and kinds of snacks available at a movie theater.

Movie Theater Concessions

Popcorn Sizes	Drink Sizes	Kinds of Snacks
Small Medium Large	Small Medium Large Jumbo	Candy Bar Pretzel Hot Dog Licorice Sour Pops Ice Cream Bar

What is the total number of different combinations of 1 size of popcorn, 1 size of drink, and 1 kind of snack?

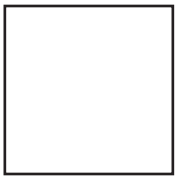
A. 7

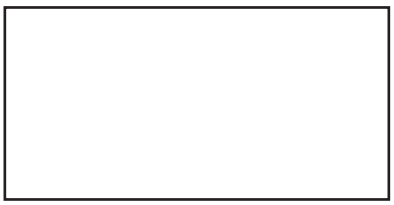
B. 13

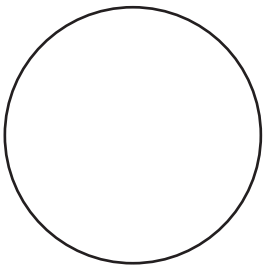
C. 48

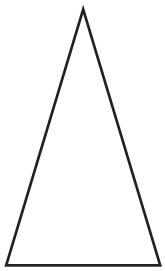
D. 72

5 Which of the following shapes appears to have **exactly** two lines of symmetry?

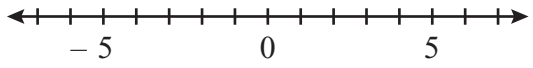
A. 

B. 

C. 

D. 

6 What is the distance between -2 and 2 on the number line shown below?



A. 0 units

B. 3 units

C. 4 units

D. 5 units

7 What is the value of the 2 in the number below?

54.625

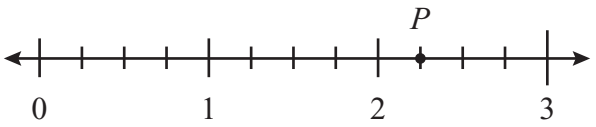
A. two hundred

B. twenty

C. two tenths

D. two hundredths

8 Which of the following best represents the location of point P on the number line below?



A. 2.5

B. 2.33

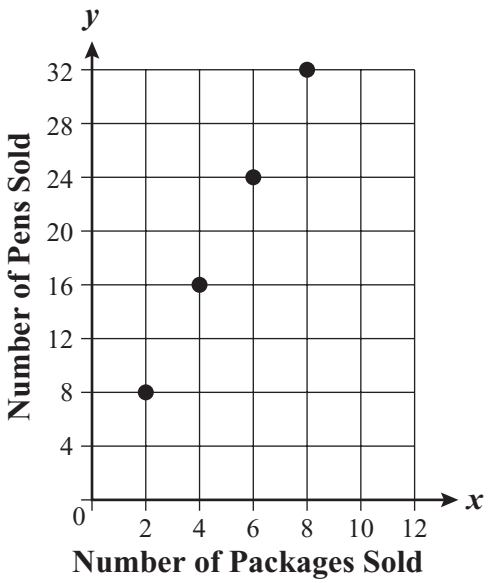
C. 2.25

D. 2.1

9 A store sells packages of pens. Each package contains the same number of pens.

The graph below displays the relationship between the total number of packages sold and the total number of pens sold.

Relationship between Pens and Packages Sold



What is the total number of pens in each package?

A. 2

B. 4

C. 6

D. 8

Question 10 is an open-response question.

- **BE SURE TO ANSWER AND LABEL ALL PARTS OF THE QUESTION.**
- **Show all your work (diagrams, 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 10 in the space provided in your Student Answer Booklet.

10 A local bakery celebrated its one-year anniversary on Saturday. On that day, every 4th customer received a free cookie. Every 6th customer received a free muffin.

a. Did the 30th customer receive a free cookie, a free muffin, both, or neither? Show or explain how you got your answer.

b. Casey was the first customer to receive both a free cookie and a free muffin. What number customer was Casey? Show or explain how you got your answer.

c. Tom entered the bakery after Casey. He received a free cookie only. What number customer could Tom have been? Show or explain how you got your answer.

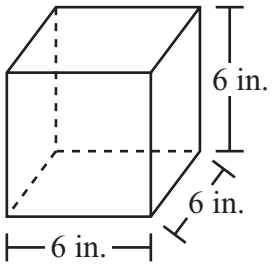
d. On that day, the bakery gave away a total of 29 free cookies. What was the total number of free muffins the bakery gave away on that day? Show or explain how you got your answer.

Questions 11 and 12 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.

11 A rectangle has a width of 6 feet, as shown below.

The perimeter of the rectangle is 34 feet. What is the length, in feet, of the rectangle?

12 What is the volume, in cubic inches, of the cube below?

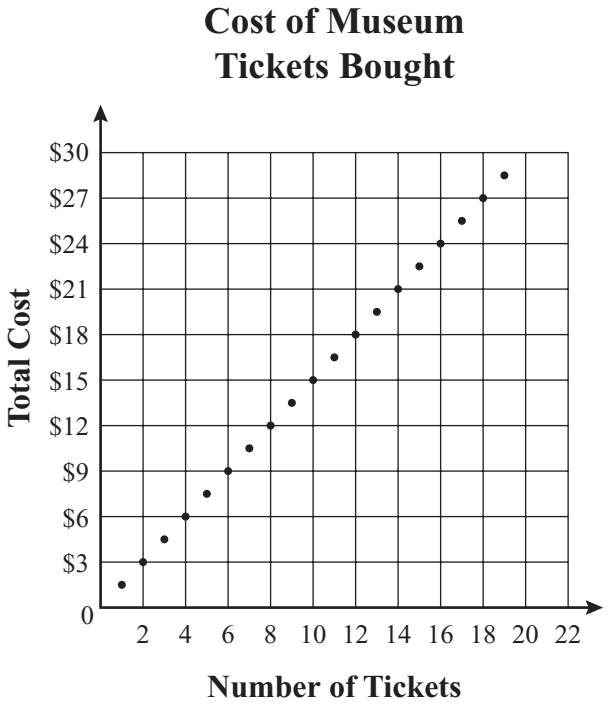


Question 13 is an open-response question.

- **BE SURE TO ANSWER AND LABEL ALL PARTS OF THE QUESTION.**
- **Show all your work (diagrams, 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 13 in the space provided in your Student Answer Booklet.

13 The graph below shows the relationship between the number of museum tickets bought and the total cost of the tickets.



a. What is the greatest number of museum tickets that can be bought for $21?

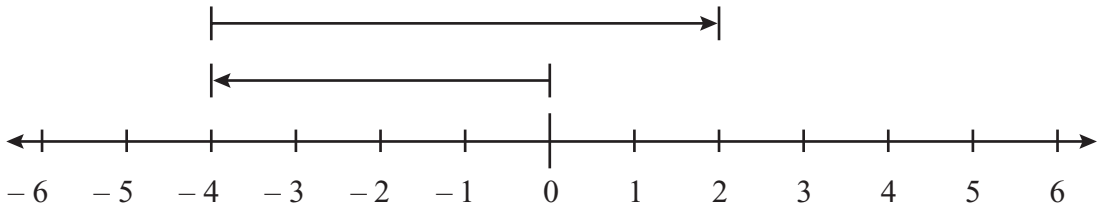
b. What is the cost of 1 museum ticket? Show or explain how you got your answer.

c. Using numbers, words, or symbols, write a rule that could be used to find the total cost of any number of museum tickets. You may use n to represent the number of museum tickets bought.

d. Calvin bought a one-year museum pass for $45. The pass allows him to visit the museum an unlimited number of times during one year. What is the least number of times Calvin must visit the museum, during one year, in order for his one-year pass to be less expensive than buying a single museum ticket for each visit? Show or explain how you got your answer.

Mark your answers to multiple-choice questions 14 through 16 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.

14 Corazon used the number line model shown below to help her write a true number sentence.



Which of the following could be Corazon's number sentence?

A. $-4 + 2 = 6$

B. $-4 + 6 = 2$

C. $2 + 6 = -4$

D. $2 + -4 = 6$

---

15 Henry had a piece of rope that was $23\frac{1}{2}$ inches long. Henry cut the rope into two pieces so that one piece was $8\frac{1}{4}$ inches long. What was the length of the other piece of rope?

A. $15\frac{1}{4}$ inches

B. $15\frac{1}{2}$ inches

C. $31\frac{1}{3}$ inches

D. $31\frac{3}{4}$ inches

16 A class of 25 students went to a zoo.

- The total admission cost for the 25 students was \$56.25.
- The admission cost was the same for each student.

What was the admission cost for 1 student?

A. \$2.15

B. \$2.20

C. \$2.25

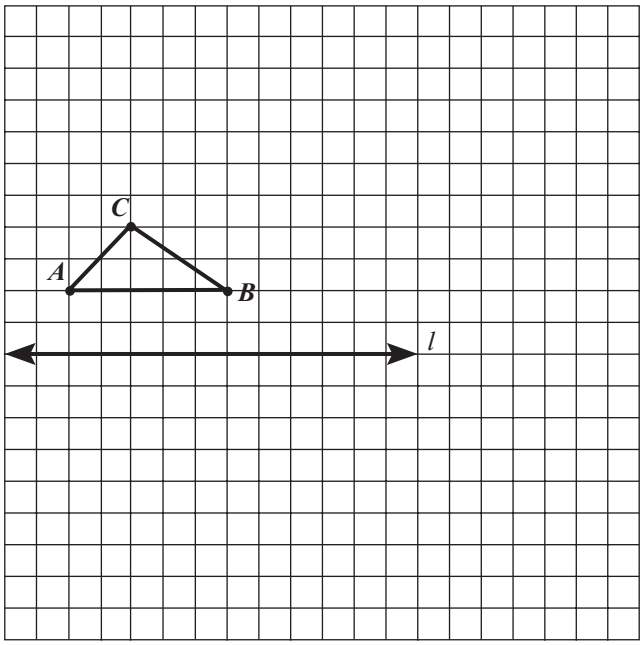
D. \$2.50

Question 17 is an open-response question.

- **BE SURE TO ANSWER AND LABEL ALL PARTS OF THE QUESTION.**
- **Show all your work (diagrams, 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 17 in the space provided in your Student Answer Booklet.

17 Copy triangle *ABC* and line *l*, shown below, onto the grid in your Student Answer Booklet. Be sure to label points *A*, *B*, and *C* in your drawing.



a. Is triangle *ABC* equilateral, isosceles, or scalene? Explain your reasoning.

b. On the grid in your Student Answer Booklet, draw the reflection of triangle *ABC* over line *l*. Label the new triangle *DEF*.

c. On the grid in your Student Answer Booklet, draw the translation of triangle *ABC* after it has been moved 7 units right and 3 units up. Label the new triangle *GHI*.

d. Are triangle *DEF* and triangle *GHI* congruent? Explain your reasoning.

Mathematics

SESSION 2

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 seventeen multiple-choice questions, three short-answer questions, and two open-response questions. Mark your answers to these questions in the spaces provided in your Student Answer Booklet.

18 What values of △ and □ make **both** equations below true?

$$\triangle + 12 = 21$$
$$\square + \triangle = 16$$

A. △ = 8 and □ = 8

B. △ = 9 and □ = 7

C. △ = 9 and □ = 8

D. △ = 9 and □ = 6

19 Which of the following is equivalent to 6.25?

A. $6\frac{1}{5}$

B. $6\frac{1}{4}$

C. $6\frac{2}{5}$

D. $6\frac{3}{4}$

20 The poster below shows the costs at a fall carnival.

Which of the following expressions represents the total cost, in dollars, of 1 admission and r rides, for any number of rides?

A. $10 + 2r$

B. $10(r + 2)$

C. $10 - 2r$

D. $10 + r + 2$

21 Michael's math quiz scores are shown below.

88, 87, 95, 72, 78, 80, 83, 80

Which of the following is a stem-and-leaf plot that correctly shows Michael's math quiz scores?

A. **Math Quiz Scores**

8	8 7 0 3 0
9	5
7	2 8

Key
8 | 5 represents 85

C. **Math Quiz Scores**

9	5
7	2 8
8	0 0 3 7 8

Key
8 | 5 represents 85

B. **Math Quiz Scores**

7	2 8
8	0 0 3 7 8
9	5

Key
8 | 5 represents 85

D. **Math Quiz Scores**

7	2 8
8	0 3 7 8
9	5

Key
8 | 5 represents 85

22 For 4 weeks, Ms. Gonzalez's class collected canned food for a food bank.

- The class collected 16 cans during the first week.
- During each week after the first week, the class collected 12 **more** cans than they had collected the week before.

Based on the information above, which of the following tables correctly displays the number of cans of food the class collected during each week?

A.

Cans Collected by Ms. Gonzalez's Class

Week	Number of Cans Collected during the Week
1	16
2	12
3	12
4	12

B.

Cans Collected by Ms. Gonzalez's Class

Week	Number of Cans Collected during the Week
1	16
2	28
3	40
4	52

C.

Cans Collected by Ms. Gonzalez's Class

Week	Number of Cans Collected during the Week
1	16
2	12
3	24
4	36

D.

Cans Collected by Ms. Gonzalez's Class

Week	Number of Cans Collected during the Week
1	16
2	32
3	64
4	128

23 What is the value of the expression below?

$$2 + (-5)$$

A. 7
B. 3
C. -3
D. -7

24 A game uses a spinner that is divided into 8 sections of equal size. The sections are labeled with the numbers below:

2, 3, 4, 4, 5, 6, 8, 8

If the arrow is spun one time, what is the probability that the arrow will land on a section labeled with an even number?

A. $\frac{1}{4}$
B. $\frac{1}{2}$
C. $\frac{5}{8}$
D. $\frac{3}{4}$

25 Which of the following shows 0.56 written in expanded notation?

A. $(5 \times 10) + (6 \times 100)$
B. $(5 \times 100) + (6 \times 1000)$
C. $(5 \times 0.1) + (6 \times 0.01)$
D. $(5 \times 0.01) + (6 \times 0.001)$

26 Muriel has 20 flowers in her garden. Exactly 16 of the flowers are tulips. What percent of the flowers in Muriel's garden are tulips?

A. 4%
B. 16%
C. 40%
D. 80%

Question 27 is an open-response question.

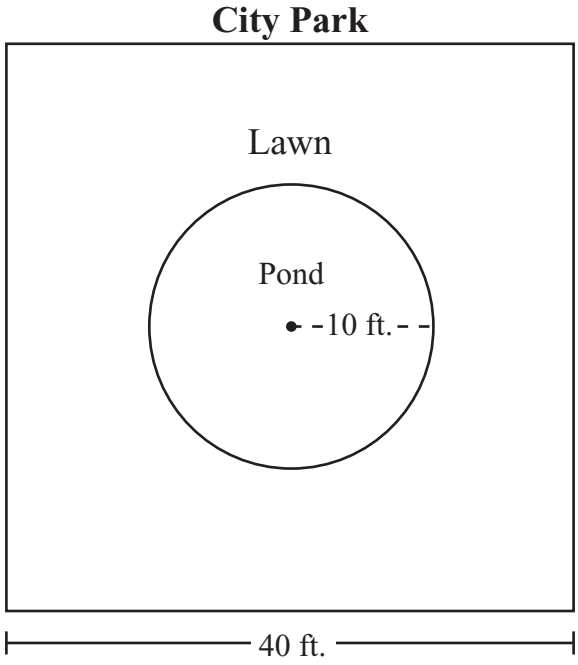
- **BE SURE TO ANSWER AND LABEL ALL PARTS OF THE QUESTION.**
- **Show all your work (diagrams, tables, or computations) in your Student Answer Booklet.**
- **If you do the work in your head, explain in writing how you did the work.**

Write your answer to question 27 in the space provided in your Student Answer Booklet.

27 A city park is in the shape of a square, with each side measuring 40 feet.

a. What is the area, in square feet, of the city park? Show or explain how you got your answer.

The city has decided to put a pond in the shape of a circle in the center of the park. The circle will have a radius of 10 feet, as shown in the diagram below. The remaining portion of the park will be a lawn.



b. What is the approximate area, in square feet, of the circle? Show your work. (Use 3.14 for π.)

c. A landscaper plans to fertilize the lawn of the park. What is the approximate area, in square feet, of the lawn of the park? Show or explain how you got your answer.

d. One bag of GrowFast fertilizer can fertilize 50 square feet. How many bags of GrowFast will the landscaper need in order to fertilize the lawn of the park? Show or explain how you got your answer.

Questions 28 and 29 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.

28 Marcus has a bag of 20 table tennis balls. The probability of selecting a yellow table tennis ball, without looking, is $\frac{3}{10}$. What is the total number of yellow table tennis balls in the bag?

29 In 27 years, Julia will be 43 years old. How old is Julia now?

Question 30 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.

30 Write a rule that describes the relationship between the input (x) and the output (y) in the input-output table below.

Input (x)	2	5	10	11
Output (y)	5	11	21	23

Question 31 is an open-response question.

- **BE SURE TO ANSWER AND LABEL ALL PARTS OF THE QUESTION.**
- **Show all your work (diagrams, 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 31 in the space provided in your Student Answer Booklet.

31 Katie will take a total of 5 mathematics tests. She has taken 4 mathematics tests so far. The scores on her first 4 tests are shown in the table below.

Katie's Mathematics Test Scores

Test	Score
1	94
2	98
3	86
4	92
5	?

a. What is the median of Katie's first 4 mathematics test scores? Show or explain how you got your answer.

b. What is the mean of Katie's first 4 mathematics test scores? Show or explain how you got your answer.

c. What score must Katie get on her 5th test in order to have a mean score of 90 on all 5 of her mathematics tests? Show or explain how you got your answer.

Mark your answers to multiple-choice questions 32 through 39 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.

32 What is the value of the expression below when $\triangle = 6$?

$$2 + \frac{\triangle}{3}$$

A. 4
B. 5
C. 11
D. 20

33 Kim sold 315 boxes of cards. The cost of each box of cards was $2.90. Which of the following is the **most reasonable** estimate of the total cost of the boxes of cards Kim sold?

A. $1300
B. $1200
C. $900
D. $600

34 If $\triangle = 4$ and $\square = 5$, what is the value of the expression below?

$$3(\triangle) + 6(\square)$$

A. 9
B. 18
C. 39
D. 42

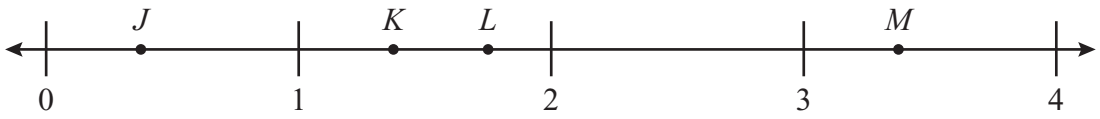
35 Johanna separated 36 index cards by color into four groups, as follows:

- 6 of the index cards were blue.
- 25% of the index cards were green.
- $\frac{1}{3}$ of the index cards were yellow.
- $\frac{1}{4}$ of the index cards were pink.

Which color group contained the greatest number of cards?

A. blue
B. green
C. yellow
D. pink

36 Which point on the number line shown below appears to be located at $1\frac{3}{8}$?



A. *J*

B. *K*

C. *L*

D. *M*

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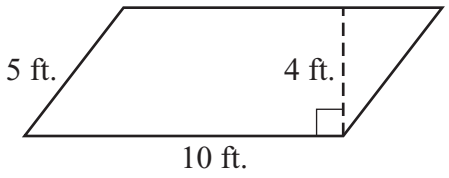
37 A parallelogram has the dimensions shown below.



What is the area of the parallelogram?

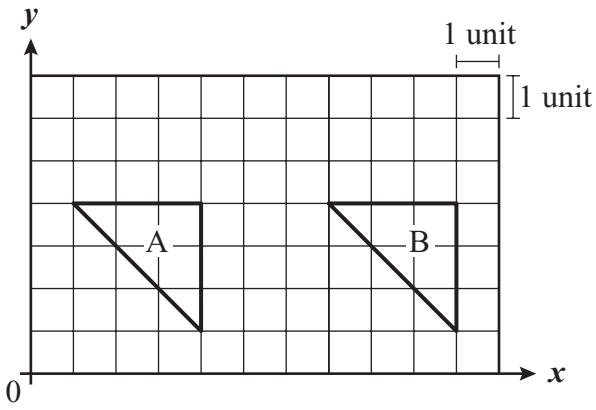
A. 100 sq. ft.

B. 50 sq. ft.

C. 40 sq. ft.

D. 30 sq. ft.

38 Which of the following describes the transformation from figure A to figure B on the grid below?



A. reflection across the *x*-axis

B. reflection across the *y*-axis

C. rotation about point (0, 0)

D. translation 6 units right

39 The clues below describe a three-digit number.

- The hundreds digit is 4.
- The ones digit is 3.
- The three-digit number is divisible by 3.

Which of the following could be the tens digit of the number?

A. 2

B. 3

C. 6

D. 9

Massachusetts Comprehensive Assessment System
Grade 6 Mathematics Reference Sheet

PERIMETER FORMULAS

perimeter = distance around

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

rectangle . . . . . $P = 2b + 2h$
OR
$P = 2l + 2w$

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

AREA FORMULAS

square . . . . . $A = s \times s$

rectangle . . . . . $A = bh$
OR
$A = lw$

parallelogram . . . . . $A = bh$

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

circle . . . . . $A = \pi r^2$

VOLUME FORMULAS

rectangular prism . . . . . $V = lwh$

cube . . . . . $V = s \times s \times s$
(s = length of an edge)

CIRCLE FORMULAS

$C = 2\pi r$
OR
$C = \pi d$

$A = \pi r^2$

Grade 6 Mathematics
Spring 2006 Released Items:
Reporting Categories, Standards, and Correct Answers

Item No.	Page No.	Reporting Category	Standard	Correct Answer (MC/SA)*
1	280	*Patterns, Relations, and Algebra*	6.P.3	A
2	280	*Patterns, Relations, and Algebra*	6.P.1	C
3	280	*Patterns, Relations, and Algebra*	6.P.6	D
4	281	*Data Analysis, Statistics, and Probability*	6.D.3	D
5	281	*Geometry*	6.G.7	B
6	282	*Geometry*	6.G.5	C
7	282	*Number Sense and Operations*	6.N.2	D
8	282	*Number Sense and Operations*	6.N.6	C
9	282	*Patterns, Relations, and Algebra*	6.P.6	B
10	283	*Number Sense and Operations*	6.N.8	
11	284	*Measurement*	6.M.1	11 feet
12	284	*Measurement*	6.M.6	216 cubic inches
13	285	*Patterns, Relations, and Algebra*	6.P.6	
14	286	*Number Sense and Operations*	6.N.10	B
15	286	*Number Sense and Operations*	6.N.9	A
16	286	*Number Sense and Operations*	6.N.9	C
17	287	*Geometry*	6.G.8	
18	288	*Patterns, Relations, and Algebra*	6.P.5	B
19	288	*Number Sense and Operations*	6.N.5	B
20	288	*Patterns, Relations, and Algebra*	6.P.4	A
21	289	*Data Analysis, Statistics, and Probability*	6.D.2	B
22	290	*Patterns, Relations, and Algebra*	6.P.7	B
23	291	*Number Sense and Operations*	6.N.15	C
24	291	*Data Analysis, Statistics, and Probability*	6.D.4	D
25	291	*Number Sense and Operations*	6.N.3	C
26	291	*Number Sense and Operations*	6.N.5	D
27	292	*Measurement*	6.M.1	
28	293	*Data Analysis, Statistics, and Probability*	6.D.4	6
29	293	*Number Sense and Operations*	6.N.9	16
30	294	*Patterns, Relations, and Algebra*	6.P.4	$y = 2x + 1$
31	295	*Data Analysis, Statistics, and Probability*	6.D.1	
32	296	*Patterns, Relations, and Algebra*	6.P.2	A
33	296	*Number Sense and Operations*	6.N.16	C
34	296	*Patterns, Relations, and Algebra*	6.P.2	D
35	296	*Number Sense and Operations*	6.N.7	C
36	297	*Number Sense and Operations*	6.N.4	B
37	297	*Measurement*	6.M.4	C
38	297	*Geometry*	6.G.6	D
39	298	*Number Sense and Operations*	6.N.8	A

* Answers are provided here for multiple-choice items 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 Web site later this year.