## XIV. Mathematics, Grade 8

## Grade 8 Mathematics Test

The spring 2007 grade 8 MCAS Mathematics test was based on learning standards in the Massachusetts Mathematics Curriculum Framework (2000). The Framework identifies five major content strands, listed below.

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

The grades 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 Web site at www.doe.mass.edu/frameworks/ current.html.

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 Framework content strands listed above.

## Test Sessions

The MCAS grade 8 Mathematics test included two separate test sessions. Each session included multiple-choice and open-response questions. Session 1 also included short-answer questions.

## Reference Materials and Tools

Each student taking the grade 8 Mathematics test was provided with a plastic ruler and a grade 8 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.

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.

The use of bilingual word-to-word dictionaries was allowed for current and former limited English proficient students only, during both Mathematics test sessions. No 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 <br> 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 Samir made a pattern by starting with 9 and repeatedly dividing by 3 , as shown below.

$$
9,3,1, \frac{1}{3}, ?, \frac{1}{27}, \ldots
$$

What number belongs in the position indicated by the question mark?
A. $\frac{1}{6}$
B. $\frac{1}{9}$
C. $\frac{1}{12}$
D. $\frac{1}{18}$

2 Between which two consecutive integers on the number line does $\sqrt{11}$ lie?
A. 3 and 4
B. 5 and 6
C. 11 and 12
D. 22 and 23

3 The graph below shows the distance an airplane traveled over time.

## Airplane Trip



Which of the following is closest to the average speed of the airplane?
A. 100 miles per hour
B. 250 miles per hour
C. 500 miles per hour
D. 1000 miles per hour

4 The minimum distance from Neptune to Earth is about 2.68 billion miles. What is 2.68 billion written in scientific notation?
A. $2.68 \times 10^{6}$
B. $2.68 \times 10^{7}$
C. $2.68 \times 10^{9}$
D. $2.68 \times 10^{10}$

5 What is the value of the expression below?

$$
|15|+|-10|
$$

A. -25
B. -5
C. 5
D. 25

6 The floor of the lobby of a theater is shaped like a rectangle, as shown below.


Before a performance starts, a velvet rope is stretched diagonally across the lobby. Which of the following best describes the diagonal length of the lobby?
A. between 8 and 9 meters
B. between 9 and 10 meters
C. between 10 and 11 meters
D. between 11 and 12 meters

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) In the figure below, parallel lines $l$ and $m$ are intersected by transversal $p$.


If the measure of $\angle 1$ is $50^{\circ}$, what is the degree measure of $\angle 2$ ?

8 A large jet has a wingspan of $87 \frac{1}{3}$ yards, as shown below.


What is the wingspan, in feet, of the jet?

Question 9 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 9 in the space provided in your Student Answer Booklet.

9 Marisa drank one cup of milk and ate $x$ small vanilla cookies for a snack. The linear equation below represents $y$, the total number of calories in Marisa's snack.

$$
y=12 x+120
$$

a. What is the $y$-intercept of the line represented by this equation?
b. Explain what the $y$-intercept tells us about Marisa's snack.
c. What is the slope of the line represented by this equation?
d. Explain what the slope tells us about Marisa's snack.
e. If Marisa eats 9 small vanilla cookies, what is the total number of calories in her snack? Show or explain how you got your answer.

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 Which of the following graphs best represents the equation below?

$$
y=-2 x+1
$$

A.

C.

B.

D.


11 Mr. Lee has one mathematics class with 16 students and one with 24 students. He wants to divide each class into groups with the same number of students in each group. What is the greatest number of students Mr. Lee can have in each group?
A. 2
B. 4
C. 6
D. 8

12 Which of the following is equivalent to the expression below?

$$
3(1.50)+3(2.50)
$$

A. $3(1.50+2.50)$
B. $3(1.50)(2.50)$
C. $3(1.50+3) 2.50$
D. $3(3)+(1.50)(2.50)$

13 Abe tested 85 Brand $X$ light bulbs to determine their life spans. The histogram below shows the results of his test.


What was the total number of Brand X light bulbs that had life spans greater than or equal to 1000 hours?
A. 72
B. 56
C. 51
D. 21

14 Which of the following is equivalent to the expression below?

$$
-2(x-3)
$$

A. $x-5$
B. $x+6$
C. $-2 x-5$
D. $-2 x+6$

15 Which of the following is equivalent to the expression below?

$$
\frac{2}{3} \div \frac{3}{4}
$$

A. $\frac{2}{3} \div \frac{4}{3}$
B. $\frac{2}{3} \cdot \frac{4}{3}$
C. $\frac{3}{2} \div \frac{3}{4}$
D. $\frac{3}{2} \cdot \frac{3}{4}$

16 The table below shows the relationship between the number of a term in a pattern and the value of that term. The same rule is used to find the value of the term in each row.

| Term Number | Value of Term |
| :---: | :---: |
| 1 | 3 |
| 2 | 5 |
| 3 | 7 |
| 4 | 9 |
| $n$ | $?$ |

Based on the pattern shown in the table, which of the following expressions could represent the value of the $n$th term?
A. $3 n$
B. $n+2$
C. $n+5$
D. $2 n+1$

17 Which of the following lines appears to have a $y$-intercept of 4 and a slope of $\frac{1}{3}$ ?
A.

C.

B.

D.


18 What is the value of the expression below?

$$
\sqrt{36}+13 \cdot 2
$$

A. 32
B. 38
C. 62
D. 98

Questions 19 and 20 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.

19 A shipping box is in the shape of a rectangular prism, as shown below.


- It has a length of 12 inches.
- It has a width of 6 inches.
- It has a volume of 288 cubic inches.

What is the height, in inches, of the shipping box?

20 Mr. Johnson noted that $\frac{3}{8}$ of the students at his school were in the band. He also noted that $\frac{1}{2}$ of the students in the band were girls. What fractional part of the students at the school were girls in the band?

Question 21 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.
21) What is the value of $x$ that makes the equation below true?

$$
2 x-3=11
$$

Question 22 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 22 in the space provided in your Student Answer Booklet.

22 Mora bought a box of cereal that was a rectangular prism with a length of 7.5 inches, a width of 2.5 inches, and a height of 11 inches, as shown below.

a. What is the total number of vertices of Mora's cereal box? Show or explain how you got your answer.
b. What is the total number of faces of Mora's cereal box? Show or explain how you got your answer.
c. In your Student Answer Booklet, draw a net (flat pattern) that can be folded to form a box with the same dimensions as Mora's cereal box. Be sure to label your drawing of the net with the lengths, in inches, of the line segments.

# Mathematics <br> 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 What is the value of the expression below when $x=3$ and $y=5$ ?

$$
2 x^{2}+3 y
$$

A. 27
B. 33
C. 51
D. 53

24 Tuan answered 20 customer service calls in 3 hours. At this rate, how many customer service calls can Tuan answer in 7.5 hours?
A. 45
B. 50
C. 60
D. 80

25 Intersecting sidewalks surround a playground shaped like a quadrilateral, as shown in the diagram below.


Based on the angle measures in the diagram, what is the value of $x$ ?
A. 70
B. 80
C. 120
D. 150

26 In David's school district, there is a positive correlation between the grade level and the weight of the mathematics textbook used by each grade.
Which of the following scatterplots best represents this correlation?
A.
Mathematics Textbooks

C.
Mathematics Textbooks


D.
Mathematics Textbooks


27 What is the slope of the line represented by the equation below?

$$
y=\frac{1}{2} x+3
$$

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

Questions 28 and 29 are open-response questions.

- BE SURE TO ANSWER AND LABEL ALL PARTS OF EACH 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 28 in the space provided in your Student Answer Booklet.

28 A florist sells bouquets of carnations. He creates bouquets of different sizes by using 4 white carnations for every 3 pink carnations in a bouquet.
a. Write a proportion that can be used to find $p$, the number of pink carnations in a bouquet with $w$ white carnations.
b. What is the number of pink carnations in a bouquet with 16 white carnations? Show or explain how you got your answer.
c. The florist made a bouquet with a total of 35 carnations in it.

- What is the total number of pink carnations in the bouquet?
- What is the total number of white carnations in the bouquet?

Show or explain how you got your answers.

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

29 A rancher has two water tanks.

- Each water tank is in the shape of a cylinder.
- The base of each water tank is in the shape of a circle.

Diagrams of the two water tanks are shown below.

a. What is the circumference, in feet, of the base of Water Tank 1? Show or explain how you got your answer. (Use 3.14 for $\pi$.)
b. The circumference of the base of Water Tank 2 is 6.28 feet longer than that of Water Tank 1 . What is the diameter, in feet, of the base of Water Tank 2? Show or explain how you got your answer. (Use 3.14 for $\pi$.)
c. How many more square feet does the base of Water Tank 2 cover than the base of Water Tank 1? Show or explain how you got your answer. (Use 3.14 for $\pi$.)

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 Ruben surveyed 180 students in his school to find each student's favorite winter sport. He recorded his results in the circle graph below.

Favorite Winter Sport


Based on Ruben's graph, what is the total number of students whose favorite sport was either snowboarding or snow skiing?
A. 117
B. 115
C. 90
D. 65
(31) Jaime used $5 \frac{1}{2}$ tablespoons of lemonade mix to make 2 quarts of lemonade. At this rate, what is the total number of tablespoons of lemonade mix that Jaime will use to make 3 quarts of lemonade?
A. $6 \frac{1}{2}$
B. $8 \frac{1}{4}$
C. $10 \frac{1}{2}$
D. $16 \frac{1}{4}$
(32) Andrea went to an amusement park.

- The cost of admission was $\$ 5$.
- The cost for each ride was $\$ 0.75$.

The equation below shows $c$, Andrea's total cost to go to the amusement park and go on $r$ rides.

$$
c=5+0.75 r
$$

Based on the equation, which of the following statements is true?
A. As the value of $r$ increases, the value of $c$ increases.
B. As the value of $r$ decreases, the value of $c$ stays the same.
C. As the value of $c$ decreases, the value of $r$ increases.
D. As the value of $c$ increases, the value of $r$ stays the same.

33 Ms. Simmons made the box-and-whisker plot below to show some statistics about the ages of the students in her class at a community college.


## Ages of Students (in years)

Which of the following best represents the median age of the students in her class?
A. 25
B. 27
C. 29
D. 31

34 The directions for using a concentrated cleaning product say to add 3 capfuls of the product for every 2 quarts of water used. Which of the following equations can be used to calculate $c$, the number of capfuls of the product needed for 5 quarts of water?
A. $\frac{2}{3}=\frac{c}{5}$
B. $\frac{2}{3}=\frac{c}{7}$
C. $\frac{3}{2}=\frac{c}{5}$
D. $\frac{3}{2}=\frac{c}{7}$

35 Tara wrote a set of three numbers.

- The mean of her set is 8 .
- The range of her set is 14 .

Which of the following could be Tara's set of numbers?
A. $2,8,14$
B. $4,6,18$
C. $2,6,16$
D. $6,8,10$

36 Franco has a bag with four letter tiles in it. All of the tiles are the same size and shape, as shown below.


One face of each tile has a letter on it, and the other faces are blank.

Franco will select a tile at random, record the letter, and put the tile back. If he does this two times, what is the probability that Franco will select a T and then a B?
A. $\frac{1}{16}$
B. $\frac{1}{12}$
C. $\frac{1}{4}$
D. $\frac{1}{2}$

37 Amanda rents space at an outdoor market. Each month she pays the owner of the outdoor market $\$ 79$ plus 10 percent of $s$, her total monthly sales.
Which of the following expressions represents the total amount of money that Amanda pays the owner for one month?
A. $79(0.1 s)$
B. $79 s \div 0.1$
C. $79 s+0.1$
D. $79+0.1 s$

38 The chart below shows the low temperatures, in degrees Fahrenheit, outside Maya's house for a seven-day period in December.

## Temperatures Outside Maya's House

| Date | Temperature |
| :---: | :---: |
| December 12 | $-3^{\circ} \mathrm{F}$ |
| December 13 | $-9^{\circ} \mathrm{F}$ |
| December 14 | $8^{\circ} \mathrm{F}$ |
| December 15 | $7^{\circ} \mathrm{F}$ |
| December 16 | $-4^{\circ} \mathrm{F}$ |
| December 17 | $5^{\circ} \mathrm{F}$ |
| December 18 | $8^{\circ} \mathrm{F}$ |

What is the median of the temperatures in the chart?
A. $5^{\circ} \mathrm{F}$
B. $6^{\circ} \mathrm{F}$
C. $7^{\circ} \mathrm{F}$
D. $8^{\circ} \mathrm{F}$

## Question 39 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 39 in the space provided in your Student Answer Booklet.

39 Brad made the Venn diagram below to show the number of cars in a parking lot that were red, had four doors, had a sunroof, or had any combination of those features. He left one number off his Venn diagram.

## Features of Cars in Parking Lot



Four Doors
a. Describe what the 6 represents in the Venn diagram.
b. A total of 20 cars in the parking lot were red, had four doors, had a sunroof, or had any combination of those features. What number should Brad put in place of the "?" in the center section of his Venn diagram? Show or explain how you got your answer.
c. What was the total number of cars in the parking lot that were red? Show or explain how you got your answer.

## Massachusetts Comprehensive Assessment System Grade 8 Mathematics Reference Sheet

## PERIMETER FORMULAS

square $\qquad$ $P=4 s$
rectangle........ $P=2 b+2 h$
OR

$$
P=2 l+2 w
$$

triangle $\qquad$

## AREA FORMULAS

$$
\begin{aligned}
& \text { square } \ldots \ldots \ldots . . A=s^{2} \\
& \text { rectangle } \ldots \ldots \ldots A=b h
\end{aligned}
$$

OR

$$
A=l w
$$

parallelogram..... $A=b h$
triangle......... $A=\frac{1}{2} b h$
trapezoid. . . . . . . $A=\frac{1}{2} h\left(b_{1}+b_{2}\right)$
circle.

$$
A=\pi r^{2}
$$

## TOTAL SURFACE AREA FORMULAS

rectangular prism $. . S A=2(l w)+2(h w)+2(l h)$
cylinder $\ldots \ldots$. . . . $S A=2 \pi r^{2}+2 \pi r h$
sphere
$S A=4 \pi r^{2}$

## VOLUME FORMULAS

rectangular prism $\qquad$
OR

$$
\begin{gathered}
V=B h \\
(B=\text { area of a base })
\end{gathered}
$$

cube

$$
V=s^{3}
$$

( $s=$ length of an edge)
cylinder $\ldots \ldots . . . . . . V=\pi r^{2} h$
sphere
$V=\frac{4}{3} \pi r^{3}$

## CIRCLE FORMULAS

$C=2 \pi r$
OR
$C=\pi d$
$A=\pi r^{2}$

PYTHAGOREAN THEOREM


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

Grade 8 Mathematics
Spring 2007 Released Items:
Reporting Categories, Standards, and Correct Answers
$\left.\begin{array}{|c|c|l|c|c|}\hline \text { Item No. } & \text { Page No. } & & \text { Reporting Category } & \text { Standard }\end{array} \begin{array}{c}\text { Correct Answer } \\ \text { (MC/SA)* }\end{array}\right]$

* 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.

