

---

## IX. Mathematics, Grade 10

# Grade 10 Mathematics Test

The spring 2004 Grade 10 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 9–10 learning standards for each of these strands appear on pages 72–75 of the *Mathematics Curriculum Framework*, which is available on the Department website at [www.doe.mass.edu/frameworks/math/2000/final.pdf](http://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 10 Mathematics Test included two separate test sessions, which were administered on consecutive days. Both sessions 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 10 Test was provided with a *Grade 10 Mathematics Reference Sheet*. A copy of this reference sheet follows the final question in this chapter.

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 during this session.  
You may **not** use a calculator during this session.



### DIRECTIONS

This session contains fourteen multiple-choice questions, four short-answer questions, and three 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?

$$6(5^2 - 5)$$

- A. 25
- B. 30
- C. 120
- D. 145

- 2 The chart below shows the heights of 13 players on a women's basketball team.

**Basketball Team**

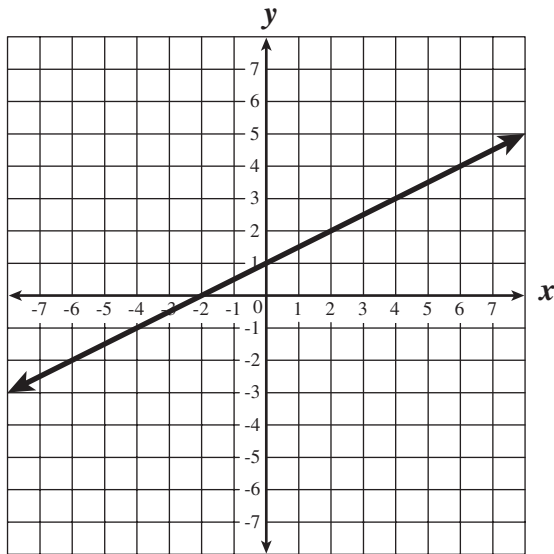
Player	Height
1	5 ft. 4 in.
2	5 ft. 6 in.
3	5 ft. 7 in.
4	5 ft. 7 in.
5	5 ft. 7 in.
6	5 ft. 9 in.
7	5 ft. 9 in.
8	5 ft. 10 in.
9	5 ft. 11 in.
10	5 ft. 11 in.
11	6 ft.
12	6 ft. 1 in.
13	6 ft. 2 in.

If a player whose height is 6 feet 6 inches joined the team, which of the following statistical measures of players' heights would **not** change?

- A. mean
- B. median
- C. mode
- D. range

- 3 What is the  $y$ -intercept of the line defined by  $y = 6x - 4$ ?
- A.  $-4$
- B.  $-\frac{2}{3}$
- C.  $\frac{2}{3}$
- D.  $4$
- 4 Which statement is **not** true?
- A.  $4^3 < 70 < 5^3$
- B.  $2(5^2) < 70 < 3(5^2)$
- C.  $8^2 < 70 < 9^2$
- D.  $3^3 < 70 < 4^3$
- 5 The wheels on Bill's bicycle each have a radius of 35 centimeters. Which of the following is closest to the distance the bicycle moves along the ground in one complete revolution of the wheels?
- A. 35 cm
- B. 55 cm
- C. 110 cm
- D. 220 cm
- 6 What is the value of the expression below?
- $$-3|6 - 10| + 4$$
- A.  $-16$
- B.  $-8$
- C.  $12$
- D.  $16$

- 7 What is the apparent  $x$ -intercept of the line graphed below?



- A. 2
- B. 1
- C. -1
- D. -2

- 8 A certain car averages 28 miles per gallon. Gasoline costs \$1.11 per gallon. Which of the following is closest to the number of miles the car would be expected to go on \$250 worth of gasoline?
- A. 400 miles
  - B. 6,000 miles
  - C. 12,000 miles
  - D. 30,000 miles

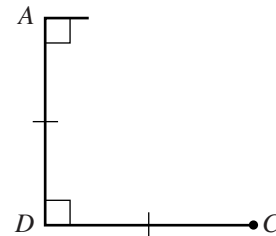
- 9 The Sun is approximately 93,000,000 miles from Earth. Light travels approximately 186,000 miles per second.

$$\left( \text{time} = \frac{\text{distance}}{\text{speed}} \right)$$

Which of the following is **closest** to the number of seconds it takes light to travel from the Sun to Earth?

- A. 0.005 second
- B. 0.050 second
- C. 500 seconds
- D. 5000 seconds

- 10 A partial drawing of a quadrilateral is shown below.



If no other sides or angles are congruent, which **best** describes the figure?

- A. square
- B. rectangle
- C. parallelogram
- D. trapezoid

- 11 What is the value of the expression below?

$$6(5 - 3) - 4(2 + 5 - (3 - 2))$$

- A. -15
- B. -12
- C. 4
- D. 8

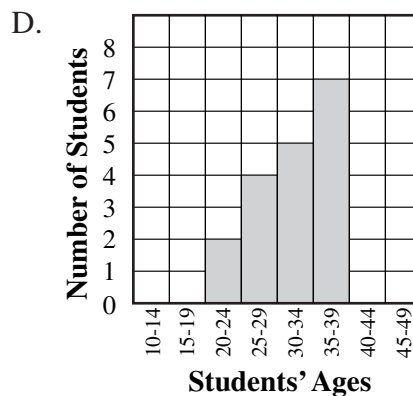
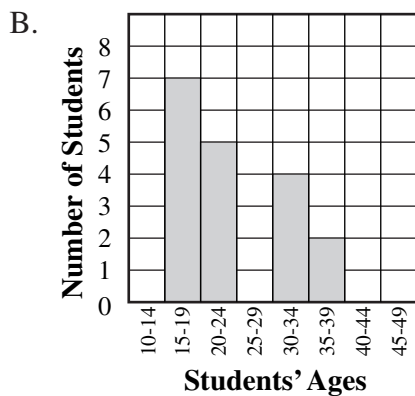
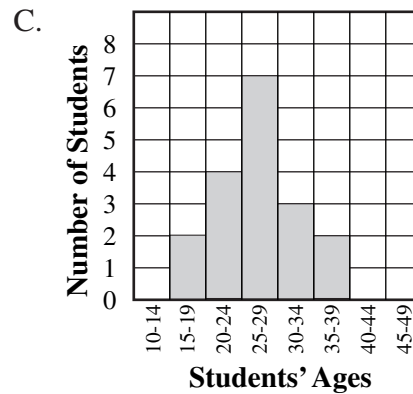
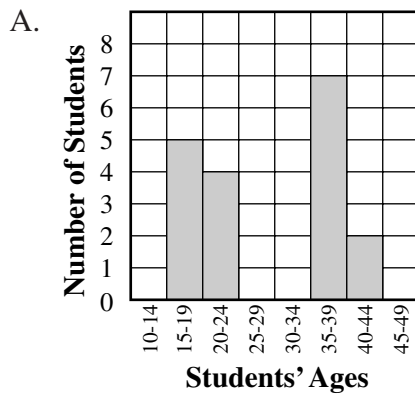
- 12 Shelley is registering at a hotel that has 14 rooms available on the first floor, 10 rooms available on the second floor, and 16 rooms available on the third floor. If Shelley is assigned one of these hotel rooms at random, what is the probability that it will be on the second floor?

- A.  $\frac{1}{4}$
- B.  $\frac{3}{10}$
- C.  $\frac{1}{3}$
- D.  $\frac{2}{5}$

- 13 The chart below shows a random sample of students' ages at a community college.

22	18	35	43	44	19
18	38	36	20	19	37
37	20	19	38	38	21

Administrators at the college constructed a histogram of the students' ages. Which of the following histograms **best** represents the distribution of students' ages?





- 14 Which of the following is closest to  $\sqrt{53}$ ?
- A. 6.7
  - B. 7.3
  - C. 7.7
  - D. 8.3

Questions 15 and 16 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.

- 15 The table shown below represents a linear relationship between  $x$  and  $y$ .

$x$	$y$
1	8
3	10
5	12
7	14
9	16

Write an equation for  $y$  in terms of  $x$ .

- 16 The length of the hypotenuse of a right triangle is 13 centimeters, and the length of one leg is 12 centimeters. What is the area of the triangle?

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 Each of the statements below is true for particular values of real numbers  $p$ ,  $t$ ,  $v$ , and  $z$ .

$$\begin{aligned}v \cdot p &= v \text{ and } v \neq 0 \\8 \cdot z &= p \\v + 5 &= t \\t + p &= p\end{aligned}$$

- What is the numerical value of  $p$ ? Write the equation or equations you used to find its numerical value and explain your reasoning.
- What is the numerical value of  $t$ ? Write the equation or equations you used to find its numerical value and explain your reasoning.
- What is the numerical value of  $v$ ? Write the equation or equations you used to find its numerical value and explain your reasoning.
- What is the numerical value of  $z$ ? Write the equation or equations you used to find its numerical value and explain your reasoning.

Questions 18 and 19 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.

18 Latrice plans to ride her bicycle a mean of 80 miles per week. During the last four weeks, she has recorded distances of 76, 80, 82, and 74 miles. How many miles must Latrice ride this week to obtain a 5-week mean of 80 miles?

19 A cube has a volume of 64 cubic inches. What is the length, in inches, of each edge of the cube?

Questions 20 and 21 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 20 in the space provided in your Student Answer Booklet.

**20** The first four terms in a pattern are shown below.

$$3x, 4x^2, 5x^3, 6x^4, \dots$$

The formula given for this pattern is

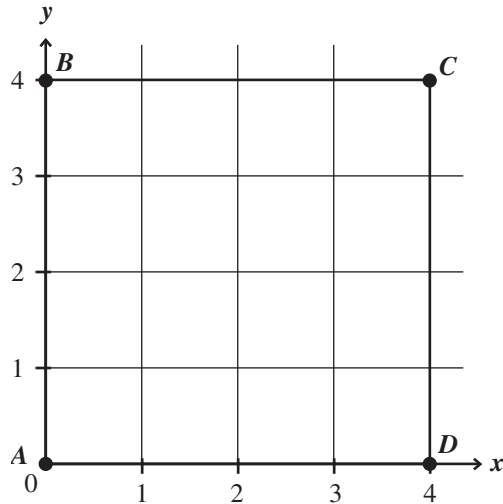
$$a_n = (2 + n)x^n$$

where  $n$  = the number (position) of the term in the pattern. The first term is  $3x$ , the second term is  $4x^2$ , and so on. When  $x = 10$ , the value of the first term is 30, since  $3(10) = 30$ .

- What is the value of the fifth term in the pattern when  $x = 2$ ? Show or explain how you obtained your answer.
- Using the formula, what will be the seventh term in the pattern? Show or explain how you obtained your answer.
- List the values, in order, of the first six terms in the pattern when  $x = -1$ .
- Which term in the pattern will have the numerical coefficient 24? Show or explain how you obtained your answer.

Write your answer to question 21 in the space provided in your Student Answer Booklet.


- 21 The graph of square  $ABCD$  is shown below.



- What is the slope of diagonal  $\overline{AC}$  of the square? Show or explain how you got your answer.
- What is the slope of diagonal  $\overline{BD}$  of the square? Show or explain how you got your answer.
- What is the equation of the line containing diagonal  $\overline{AC}$  of the square? Show or explain how you got your answer.
- What is the equation of the line containing diagonal  $\overline{BD}$  of the square? Show or explain how you got your answer.
- What is the relationship between the line containing diagonal  $\overline{AC}$  and the line containing diagonal  $\overline{BD}$  of the square? Explain your answer.

# Mathematics

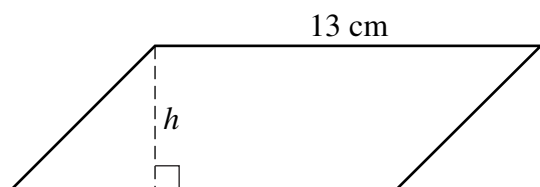
## SESSION 2

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

### DIRECTIONS

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

- 22 What is  $h$ , the height of the parallelogram represented below, if its area is 91 square centimeters?



- A. 7 cm
- B. 9 cm
- C. 11 cm
- D. 15 cm

- 23 Ralph simplified the expression

$$15\left(\frac{1}{3} + \frac{2}{5}\right)$$

to

$$(5 + 6).$$

Which of the following properties of the real numbers did Ralph use?

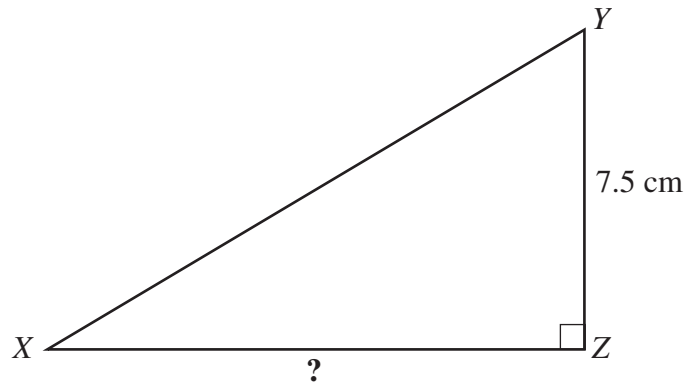
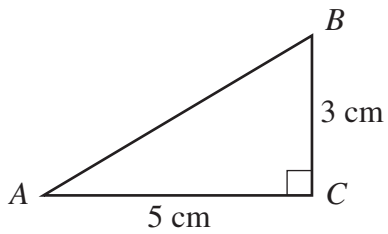
- A. associative property of multiplication
- B. commutative property of multiplication
- C. distributive property
- D. multiplicative identity property

- 24 Which of the following is one of the factors of the expression below?

$$4x^2 - 25$$

- A.  $(4x - 5)$
- B.  $(2x + 1)$
- C.  $(4x - 1)$
- D.  $(2x - 5)$

- 25 In the figures shown below,  $\triangle ABC$  is similar to  $\triangle XYZ$ .



What is the length of  $\overline{XZ}$ ?

- A. 2.0 cm
- B. 4.5 cm
- C. 12.5 cm
- D. 22.5 cm



- 26 Which of the following is an equation for a line that is **not** parallel to the line with this equation?

$$-x + 4y - 8 = 0$$

A.  $y = \frac{1}{4}x - 1$

B.  $y = \frac{1}{4}x + 21$

C.  $-2x + 4y - 8 = 0$

D.  $-x + 4y + 8 = 0$

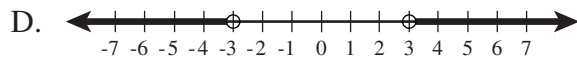
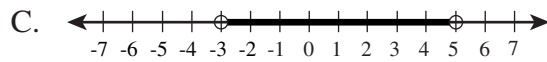
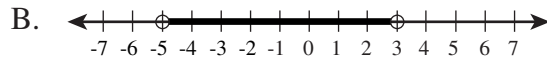
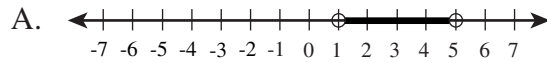
- 27 What is the 9th term in the quadratic sequence shown below?

$$2, 5, 10, 17, 26, \dots$$

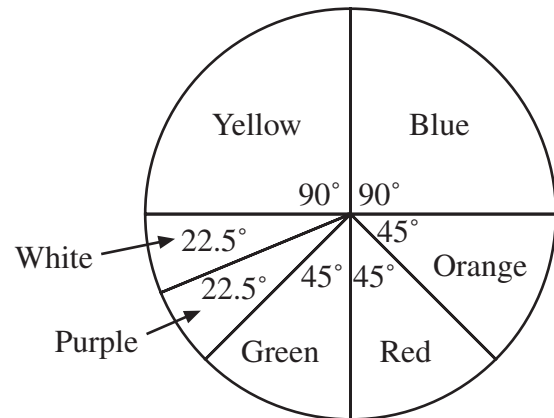
- A. 97
- B. 82
- C. 71
- D. 65

- 28 Which of the following graphs shows the solution set for the inequality shown below?

$$|x + 1| < 4$$



- 29 The circle graph below shows the colors of 160 marbles.

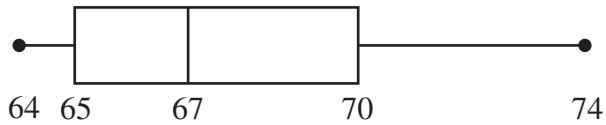


What is the total number of green marbles?

- A. 8
- B. 20
- C. 40
- D. 45

- 30 The box-and-whisker plot shown below represents the heights, in inches, of the members of the Central High School girls' basketball team.

**Girls' Heights in Inches**



What is the median height of the members of the team?

- A. 67 inches
- B. 68 inches
- C. 69 inches
- D. 70 inches

Questions 31 is an open-response question.

- **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 31 in the space provided in your Student Answer Booklet.

- 31** In an experiment, Sue and Helise asked each of 30 students in a random sample of the juniors at their school to record the number of minutes they watched television on a Saturday and Sunday in April. The results, rounded to the nearest 30 minutes, are shown in the table.

**Minutes of Television Watching**

<b>Total Number of Minutes of Television Watched on Saturday and Sunday</b>	<b>Number of Junior Students</b>
0	1
60	3
90	6
120	5
180	5
240	2
300	5
420	1
540	2

- What number of minutes spent watching television should the girls report as the mode for this group of students? Justify your answer.
- Helise said that the median number of minutes for this group of students is 180, but Sue disagreed. Do you agree with Sue or Helise? Justify your answer.
- Suppose that Sue and Helise had used the entire class of 185 juniors as their sample. Based on the results from their smaller sample, what total number of the 185 juniors would probably have reported watching 300 minutes of television on that weekend? Show or explain how you obtained your answer.

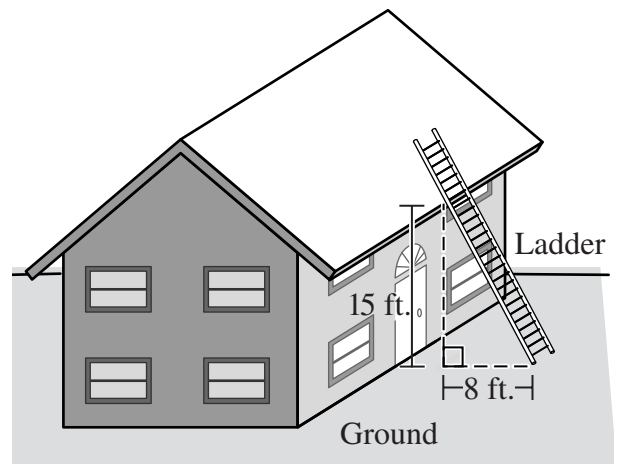
Mark your answers to multiple-choice questions 32 through 40 in the spaces provided in your Student Answer Booklet. Do not write your answers in this test booklet. You may do your figuring in the test booklet.

**32** Mr. Johnson purchased 20 concert tickets for a total of \$225. The concert tickets cost \$15 for adults and \$10 for children under 12.

How many tickets for children under 12 did Mr. Johnson purchase?

- A. 5
- B. 9
- C. 15
- D. 18

**33** Using the measures shown in the sketch, what is the length of the section of the ladder from the point where it rests on the ground to the point where it touches the house?



- A. 4.8 ft.
- B. 7 ft.
- C. 17 ft.
- D. 23 ft.

- 34 The force needed to stretch a spring is directly proportional to the amount the spring is to be stretched. If a force of 100 pounds stretches a certain spring 8 inches, how much force is needed to stretch the spring 12 inches?

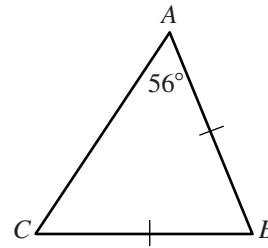
A. 25 pounds  
B. 50 pounds  
C. 100 pounds  
D. 150 pounds

- 35 Which of the following expressions is equivalent to the one shown below?

$$(x - 3)(2x + 5)$$

A.  $2x^2 - x - 15$   
B.  $2x^2 - 15$   
C.  $2x^2 + 11x - 15$   
D.  $2x^2 + 2$

- 36 What is the measure of  $\angle B$  in the figure below?



A.  $34^\circ$   
B.  $56^\circ$   
C.  $62^\circ$   
D.  $68^\circ$

- 37 A right circular cylindrical can is 6 inches high, and the area of its top is  $36\pi$  square inches. What is the minimum number of square inches of construction paper it would take to cover the lateral surface of this can?

A. 72 sq. in.  
B.  $72\pi$  sq. in.  
C. 432 sq. in.  
D.  $432\pi$  sq. in.

- 38 Which of the following expressions is equivalent to the one shown below?

$$(b^3 + 5b^2 - 2b) - (b^3 + b - 1)$$

- A.  $5b^2 - b$
- B.  $5b^2 - 3b + 1$
- C.  $4b^2 - b$
- D.  $5b^2 - 3b - 1$

- 39 Keesha and her family visit her grandparents once a month. Keesha recorded the driving time to her grandparents' house for 6 trips in the chart below.

**Driving Times**

Month	Time
January	3 hours, 23 minutes
February	3 hours, 5 minutes
March	3 hours, 50 minutes
April	3 hours, 52 minutes
May	3 hours, 15 minutes
June	3 hours, 35 minutes

Based on the data in the chart, what is the mean driving time to Keesha's grandparents' house?

- A. 3 hours, 23 minutes
- B. 3 hours, 26 minutes
- C. 3 hours, 30 minutes
- D. 3 hours, 35 minutes

- 40 Bailey noticed that many of the students at her school had red hair. She randomly chose 25 of the students in her school and found that 2 of them had red hair. If Bailey's sample is representative, which of the following is closest to the number of the 2200 students at her school who have red hair?

- A. 44
- B. 88
- C. 176
- D. 200

Questions 41 and 42 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 41 in the space provided in your Student Answer Booklet.

- 41 A glass containing water is in the shape of a right circular cylinder with a radius of 3 centimeters. The height of the water in the glass is 10 centimeters.
- a. What is the volume of the water in the glass? Be sure to include units of measure in your answer. Show or explain how you obtained your answer.
  - b. Five spherical marbles of equal size are dropped into the glass. The water in the glass rises to a height of 11 centimeters. What is the **increase** in the volume of the contents of the glass? Be sure to include units of measure in your answer. Show or explain how you obtained your answer.
  - c. What is the volume of one of the marbles? Be sure to include units of measure in your answer. Show or explain how you obtained your answer.
  - d. What is the radius of one of the marbles? Be sure to include units of measure in your answer. Show or explain how you obtained your answer.

Write your answer to question 42 in the space provided in your Student Answer Booklet.

- 42 A local ski club plans to charter transportation for a ski trip. Two different bus companies are available for charter services.

**SNOWBIRD CHARTER**  
Roundtrips Depart Daily 6 and 8 A.M.  
\$300, plus \$12 per person  
*Reservations are required.*

**MOUNTAIN CHARTER**  
*Roundtrips Daily at 6 and 8 A.M.*  
\$15 per person  
**Call for reservations.**

- If 72 club members sign up for the trip, what would be the total transportation cost for each of the two charter companies? Show your work and label each answer with the company name.
- Write an equation that expresses  $c$ , the total cost of using Snowbird Charter, in terms of  $p$ , the total number of club members who go on the trip.
- Write an equation that expresses  $c$ , the total cost for using Mountain Charter, in terms of  $p$ , the total number of club members who go on the trip.
- If the club members want to choose the less expensive of the two bus companies, which company should they choose? Justify your answer by explaining how the number of club members who go on the trip should affect their decision.



## Massachusetts Comprehensive Assessment System Grade 10 Mathematics Reference Sheet

---

### AREA FORMULAS

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

rectangle .....  $A = bh$

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

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

### CIRCLE FORMULAS

$C = 2\pi r$

$A = \pi r^2$

### VOLUME FORMULAS

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

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

OR

$V = Bh$

( $B$  = area of the base)

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

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

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

right square pyramid .....  $V = \frac{1}{3}s^2h$

### LATERAL SURFACE AREA FORMULAS

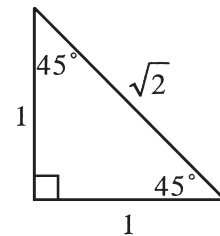
rectangular prism .....  $LA = 2(hw) + 2(lh)$

right circular cylinder .....  $LA = 2\pi rh$

right circular cone .....  $LA = \pi r\ell$

right square pyramid .....  $LA = 2s\ell$

( $\ell$  = slant height)



### TOTAL SURFACE AREA FORMULAS

cube .....  $SA = 6s^2$

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

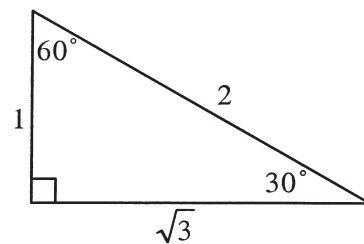
sphere .....  $SA = 4\pi r^2$

right circular cylinder .....  $SA = 2\pi r^2 + 2\pi rh$

right circular cone .....  $SA = \pi r^2 + \pi r\ell$

right square pyramid .....  $SA = s^2 + 2s\ell$

( $\ell$  = slant height)



**Grade 10 Mathematics**  
**Spring 2004 Released Items:**  
**Reporting Categories, Standards, and Correct Answers**

Item No.	Page No.	Reporting Category	Standard	Correct Answer (MC/SA)*
1	209	<i>Number Sense and Operations</i>	10.N.2	C
2	209	<i>Data Analysis, Statistics, and Probability</i>	10.D.1	C
3	210	<i>Patterns, Relations, and Algebra</i>	10.P.2	A
4	210	<i>Number Sense and Operations</i>	10.N.3	D
5	210	<i>Measurement</i>	10.M.1	D
6	210	<i>Number Sense and Operations</i>	10.N.2	B
7	211	<i>Patterns, Relations, and Algebra</i>	10.P.2	D
8	211	<i>Number Sense and Operations</i>	10.N.4	B
9	211	<i>Number Sense and Operations</i>	10.N.4	C
10	211	<i>Geometry</i>	10.G.1	D
11	212	<i>Number Sense and Operations</i>	10.N.2	B
12	212	<i>Data Analysis, Statistics, and Probability</i>	8.D.4	A
13	213	<i>Data Analysis, Statistics, and Probability</i>	10.D.1	A
14	214	<i>Number Sense and Operations</i>	10.N.3	B
15	215	<i>Patterns, Relations, and Algebra</i>	10.P.2	$y = x + 7$
16	215	<i>Measurement</i>	10.M.1	30 cm <sup>2</sup>
17	216	<i>Number Sense and Operations</i>	10.N.1	
18	217	<i>Data Analysis, Statistics, and Probability</i>	8.D.3	88 miles
19	217	<i>Number Sense and Operations</i>	10.N.3	4 in.
20	218	<i>Patterns, Relations, and Algebra</i>	10.P.1	
21	219	<i>Geometry</i>	10.G.7	
22	220	<i>Measurement</i>	10.M.1	A
23	220	<i>Number Sense and Operations</i>	10.N.1	C
24	221	<i>Patterns, Relations, and Algebra</i>	10.P.4	D
25	221	<i>Geometry</i>	10.G.4	C
26	222	<i>Geometry</i>	10.G.8	C
27	222	<i>Patterns, Relations, and Algebra</i>	10.P.1	B
28	222	<i>Patterns, Relations, and Algebra</i>	10.P.6	B
29	222	<i>Data Analysis, Statistics, and Probability</i>	10.D.1	B
30	223	<i>Data Analysis, Statistics, and Probability</i>	10.D.1	A
31	224	<i>Data Analysis, Statistics, and Probability</i>	10.D.1	
32	225	<i>Patterns, Relations, and Algebra</i>	10.P.8	C
33	225	<i>Geometry</i>	10.G.5	C
34	226	<i>Patterns, Relations, and Algebra</i>	10.P.7	D
35	226	<i>Patterns, Relations, and Algebra</i>	10.P.3	A
36	226	<i>Geometry</i>	10.G.5	D
37	226	<i>Measurement</i>	10.M.2	B
38	227	<i>Patterns, Relations, and Algebra</i>	10.P.3	B
39	227	<i>Data Analysis, Statistics, and Probability</i>	10.D.1	C
40	227	<i>Number Sense and Operations</i>	8.N.3	C
41	228	<i>Measurement</i>	10.M.2	
42	229	<i>Patterns, Relations, and Algebra</i>	10.P.8	

\* 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.