XIV. Mathematics, Grade 8

Grade 8 Mathematics Test

Test Sessions and Content Overview

The spring 2016 grade 8 Mathematics test was made up of two separate test sessions. Each session included:

❚ Twenty-one common items, including multiple-choice, short-answer, and open-response questions. These common items are the items on which each student's 2016 MCAS Mathematics score will be based.

❚ Three items developed by the Partnership for Assessment of Readiness for College and Careers (PARCC), including multiple-choice, multiple-select, and open-response questions. Students' performance on these PARCC items will **not** be factored into their MCAS scores.

Approximately half of the common test items are shown on the following pages as they appeared in test booklets.

The PARCC items are not being released in this document. The Department will post information about these items to the Student Assessment webpage in a separate document. See page 4 of the Introduction to this document for more information about the inclusion of PARCC items in the 2016 MCAS tests.

Standards and Reporting Categories

The common items in the spring 2016 grade 8 Mathematics test assessed standards in the five domains for grade 8 in the *Massachusetts Curriculum Framework for Mathematics* (March 2011). The grade 8 standards can be found on pages 65–69 in the *Framework*, and the five domains are listed below.

❚ The Number System
❚ Expressions and Equations
❚ Functions
❚ Geometry
❚ Statistics and Probability

The *Massachusetts Curriculum Framework for Mathematics* is available on the Department website at www.doe.mass.edu/frameworks/current.html.

Mathematics test results are reported under five MCAS reporting categories, which are identical to the five framework domains listed above.

The tables at the conclusion of this chapter indicate each released and unreleased common item's reporting category and the framework standard it assesses. The correct answers for released multiple-choice and short-answer questions are also displayed in the released item table.

Standards and reporting categories for the PARCC items in the grade 8 Mathematics test will be listed in a separate document, which will be posted to the Student Assessment webpage.

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.

During both Mathematics test sessions, the use of bilingual word-to-word dictionaries was allowed for current and former English language learner students only. No other reference tools or materials were allowed.

Grade 8 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 eight multiple-choice questions, two short-answer questions, and one open-response question. Mark your answers to these questions in the spaces provided in your Student Answer Booklet.

1 The graph below shows a relationship between x and y.
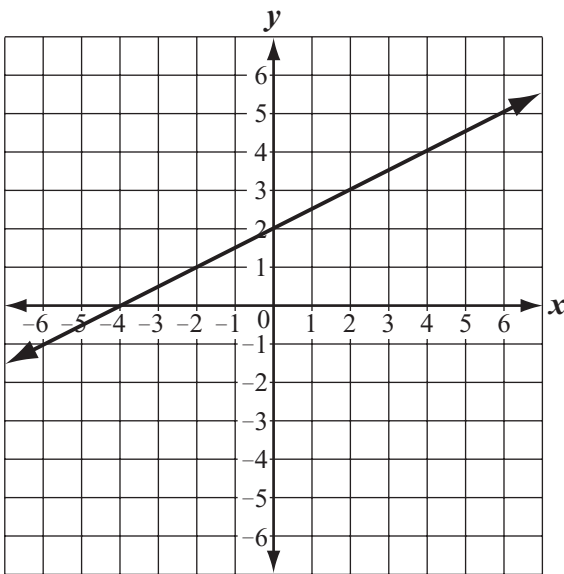
Which of the following equations best represents this relationship?

A. $y = 2x$

B. $y = x + 2$

C. $y = \frac{1}{2}x + 2$

D. $y = 2x + \frac{1}{2}$

2 What is the value of the expression below?

$$8 - 3\sqrt{16}$$

A. -40

B. -4

C. 2

D. 20

3 During the first year of operation, a company produced 8.4×10^9 reams of paper. During the second year, the company produced 5.6 times the number of reams of paper that it produced during the first year.

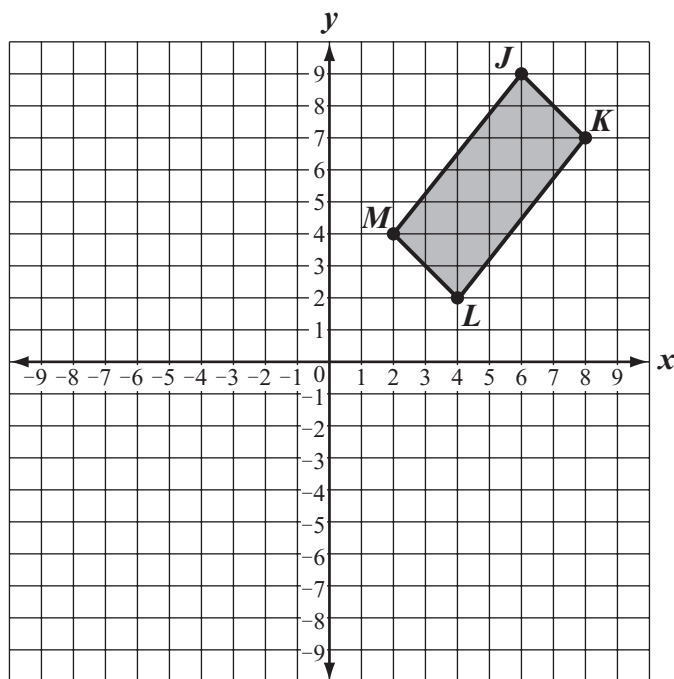Which expression represents the number of reams of paper the company produced during the second year?

A. 1.5×10^9

B. 1.5×10^{10}

C. 4.704×10^9

D. 4.704×10^{10}

4 What are the solutions to the system of equations below?

$$3y = x - 2$$
$$y = -2x + 4$$

A. $x = 0; \quad y = 2$

B. $x = 1; \quad y = -2$

C. $x = 2; \quad y = 0$

D. $x = -2; \quad y = 4$

5 Quadrilateral *JKLM* is shown on the coordinate grid below.

Quadrilateral *JKLM* will be reflected over the *x*-axis to create its image, quadrilateral *J'K'L'M'*. What will be the *x*-coordinate of vertex *K'*?

A. -8

B. -7

C. 7

D. 8

Questions 6 and 7 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.

6   What is the decimal equivalent of $\frac{5}{6}$?

7   What value of x makes the equation below true?

$$9^5 \cdot 9^7 = 9^x$$

Mark your answers to multiple-choice questions 8 through 10 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.

8   An equation is incorrectly solved below.

Equation: $2x + 3 = -4$

Step 1: $2x + 3 - 3 = -4 - 3$

Step 2: $2x = -1$
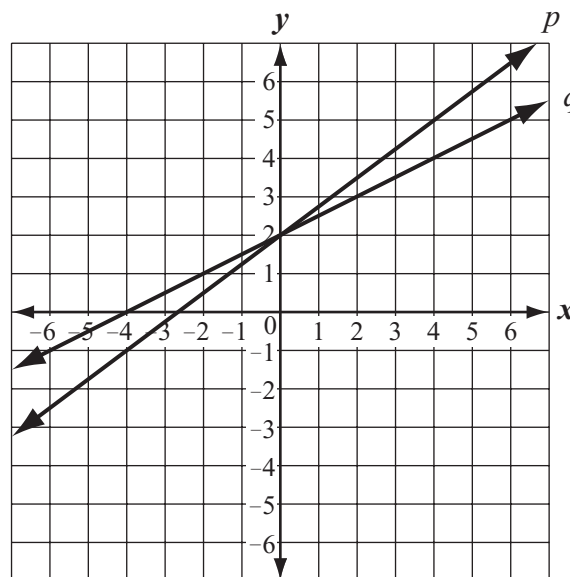
Step 3: $\dfrac{2x}{2} = -\dfrac{1}{2}$

Step 4: $x = -\dfrac{1}{2}$

What is the first step that shows an error in the solution to the equation?

A. Step 1

B. Step 2

C. Step 3

D. Step 4

9   Line p and line q are shown on the coordinate grid below.

Which of the following statements best describes the lines?

A. Line p has the same slope as line q.

B. Line p has a greater slope than line q.

C. The y-intercept of line p is greater than the y-intercept of line q.

D. The x-intercept of line q is greater than the x-intercept of line p.

**10**   Which of the following is closest to 0.0432?

A. 4×10^{-2}

B. 4×10^{-1}

C. 4×10^{1}

D. 4×10^{2}

Question 11 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 11 in the space provided in your Student Answer Booklet.

11 Each of the four functions below shows a relationship between x and y.
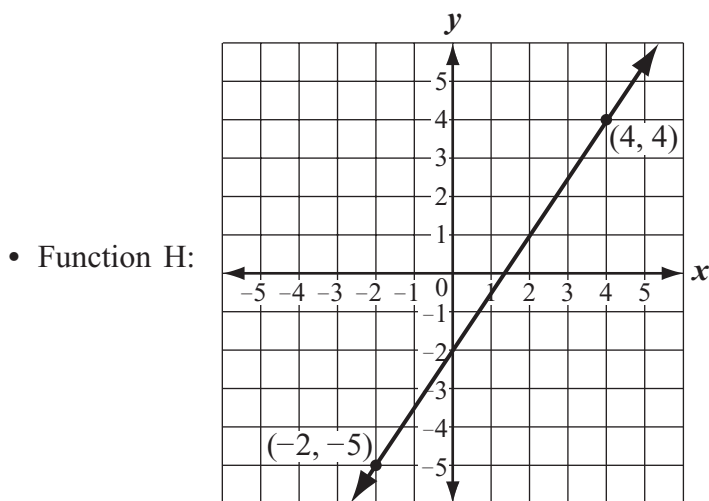
  - Function H:

  - Function I: $y = 2.5x + 8$

  - Function J: Multiply the x value by 3 and subtract 6 to get the y value.

  - Function K:

x	y
–2	4
0	6
2	8
4	10
6	12

a. What is the slope of the line that represents Function H? Show or explain how you got your answer.

b. Write an equation in terms of x and y to represent the graph of **Function J**.

c. What is the y-intercept of **Function K**? Show or explain how you got your answer.

d. List the four functions in order from the function with the least rate of change to the function with the greatest rate of change.

Grade 8 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 eight multiple-choice questions, one short-answer question, and one open-response question. Mark your answers to these questions in the spaces provided in your Student Answer Booklet.

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

$$y = \frac{1}{3}x + 4$$

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

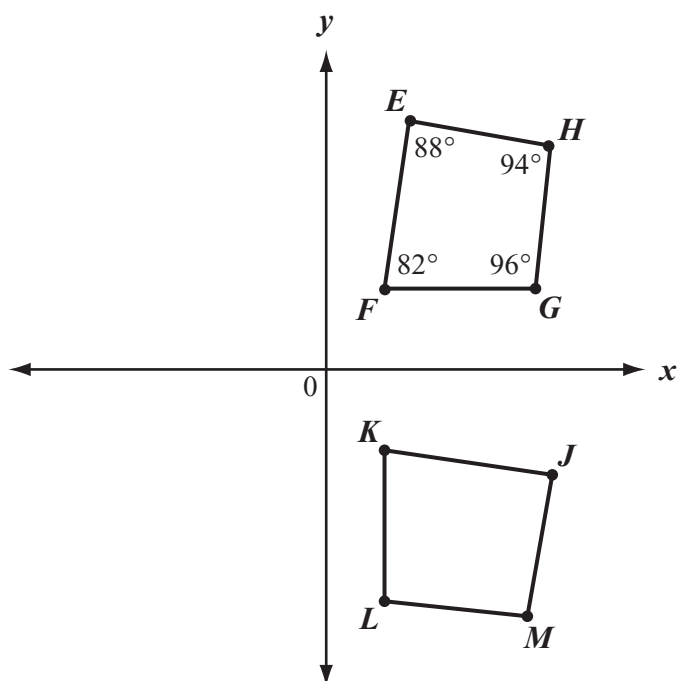B. $\frac{1}{3}$

C. 3

D. 4

13 Lines *m*, *n*, and *l* are parallel. Line *w* intersects each line, as shown in the diagram below.
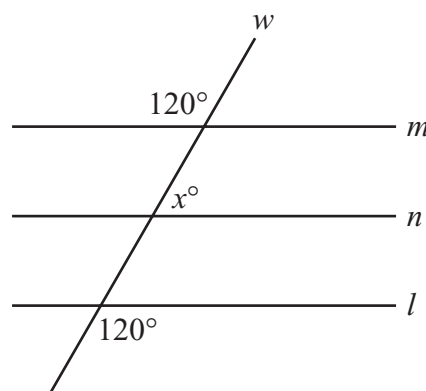
Based on the angle measures in the diagram, what is the value of *x*?
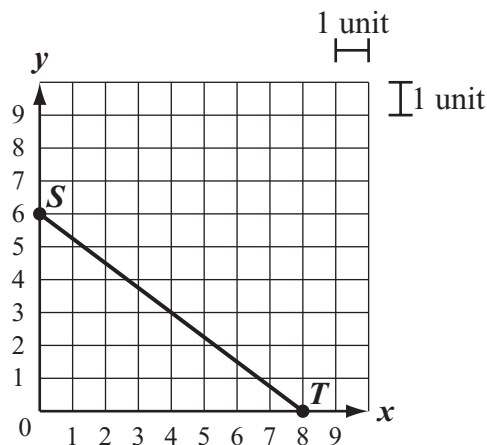
A. 20

B. 30

C. 60

D. 120

14 Quadrilateral *EFGH* is rotated 90° clockwise about the origin to create quadrilateral *JKLM*. Both quadrilaterals are shown on the coordinate plane below.

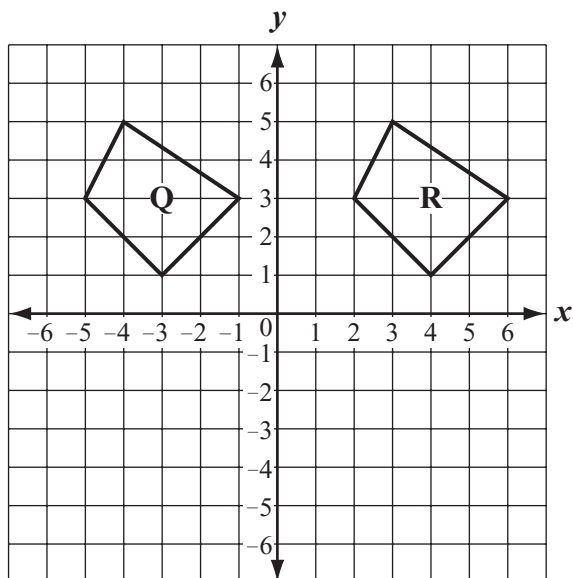What is the measure of ∠*J*?

A. 82°

B. 88°

C. 94°

D. 96°

15 Line segment *ST* is shown on the coordinate grid below.

What is the length, in units, of $\overline{ST}$?

A. 7

B. 8

C. 10

D. 14

16   Figures Q and R are shown on the coordinate grid below.

Which of the following transformations, when performed on Figure Q, will result in Figure R?

A. a translation of 7 units to the right

B. a rotation of 90° clockwise about the origin

C. a rotation of 270° counterclockwise about the origin

D. a reflection over the y-axis followed by a translation of 1 unit to the right

17   A jar of peanut butter is in the shape of a cylinder. The jar has an inside radius of 4 centimeters. It is filled with peanut butter to an inside height of 12 centimeters.

What is the total number of cubic centimeters of peanut butter in the jar? (Use 3.14 for π.)

A. 241.15 cubic centimeters

B. 301.44 cubic centimeters

C. 401.92 cubic centimeters

D. 602.88 cubic centimeters

Question 18 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.

18 A right triangle and some of its measurements are shown below.
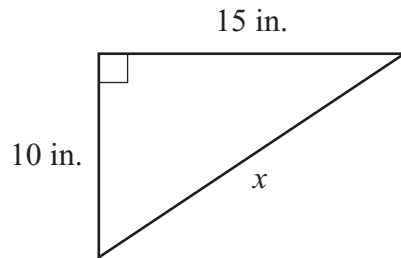
What is *x*, the length to the nearest inch of the third side of the triangle?

Mark your answers to multiple-choice questions 19 and 20 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.

19 Mia paddled her canoe from the shore of a lake to an island. She stopped on the island to eat lunch, and then paddled her canoe back to the shore. The graph below shows Mia's distance, in kilometers, from the shore over time.

Mia's Canoe Ride
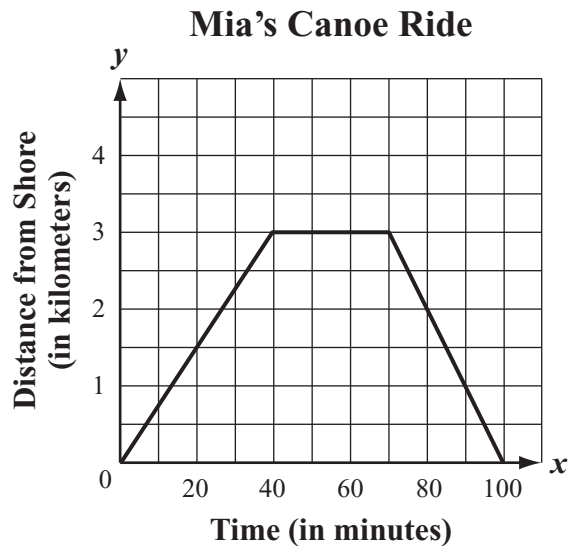
Based on the graph, which of the following statements is true?

A. Mia paddled a total distance of 3 kilometers.

B. Mia paddled for a total of 100 minutes.

C. Mia paddled faster on the way to the island than on the way back to the shore.

D. Mia paddled faster on the way back to the shore than on the way to the island.

20 A 9-foot flagpole cast a shadow 6 feet long, and at the same time, a nearby tree cast a shadow 14 feet long, as shown below.
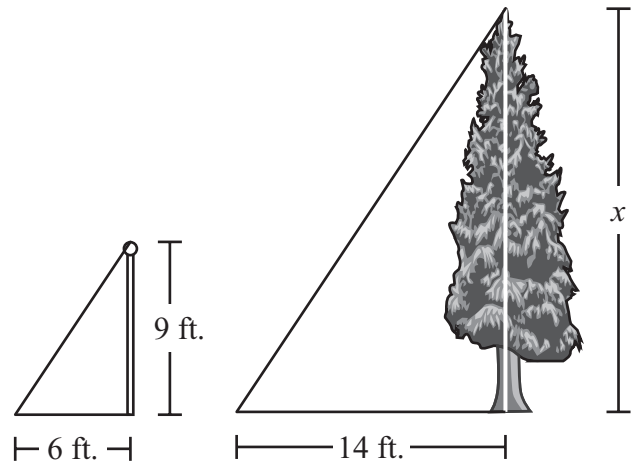
What is x, the height of the tree?

A.   7 feet

B. 14 feet

C. 17 feet

D. 21 feet

Question 21 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 21 in the space provided in your Student Answer Booklet.

21 An athletic director wants to add either tennis or gymnastics to the physical education program at her school. She surveyed the seventh-grade students and eighth-grade students to determine whether they preferred tennis or gymnastics. Some of the data from the survey is listed below.

- A total of 255 students were surveyed.
- 120 of the students surveyed are seventh-graders.
- 72 of the seventh-graders surveyed chose tennis.
- 62 of the eighth-graders surveyed chose gymnastics.

In your Student Answer Booklet, copy the table exactly as shown below.

Student Preference by Grade

	Tennis	Gymnastics
Seventh Grade		
Eighth Grade		

a. Use the data from the survey to complete your table. Show or explain how you got your answers.

b. Based on your table, what percentage of the eighth-graders chose tennis? Show or explain how you got your answer.

c. Among those students who chose gymnastics, what is the relative frequency of seventh-graders? Show or explain how you got your answer.

d. In which grade did a higher percentage of students choose tennis? Show or explain how you got your answer.

MASSACHUSETTS DEPARTMENT OF
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PERIMETER FORMULAS

square . . . . $P = 4s$

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

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

AREA FORMULAS

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

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

parallelogram . . . . . $A = bh$

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

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

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

TOTAL SURFACE AREA FORMULAS

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

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

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

VOLUME FORMULAS

rectangular prism . . . . . . $V = lwh$
OR
$V = Bh$
(B = area of a base)

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

cylinder . . . . $V = \pi r^2 h$
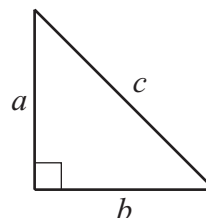
sphere . . . . $V = \frac{4}{3}\pi r^3$

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 2016 Released Items:
Reporting Categories, Standards, and Correct Answers*

Item No.	Page No.	Reporting Category	Standard	Correct Answer (MC/SA)*
1	225	*Expressions and Equations*	EE.6	C
2	225	*Expressions and Equations*	EE.2	B
3	225	*Expressions and Equations*	EE.4	D
4	226	*Expressions and Equations*	EE.8	C
5	226	*Geometry*	G.3	D
6	227	*The Number System*	NS.1	0.8333... or equivalent
7	227	*Expressions and Equations*	EE.1	12
8	228	*Expressions and Equations*	EE.7	B
9	228	*Expressions and Equations*	EE.5	B
10	228	*Expressions and Equations*	EE.3	A
11	229	*Functions*	F.2	
12	230	*Functions*	F.4	B
13	230	*Geometry*	G.5	C
14	231	*Geometry*	G.1	B
15	231	*Geometry*	G.8	C
16	232	*Geometry*	G.2	A
17	232	*Geometry*	G.9	*D*
18	233	*Geometry*	G.7	18 in.
19	234	*Functions*	F.5	D
20	234	*Geometry*	G.4	D
21	235	*Statistics and Probability*	SP.4	

* 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 the shaded cells, will be posted to the Department's website later this year.

Grade 8 Mathematics
Spring 2016 Unreleased Common Items:
Reporting Categories and Standards

Item No.	Reporting Category	Standard
22	*The Number System*	NS.2
23	*Functions*	F.4
24	*Geometry*	G.5
25	*Statistics and Probability*	SP.3
26	*Expressions and Equations*	EE.4
27	*Functions*	F.1
28	*The Number System*	NS.2
29	*Functions*	F.4
30	*Expressions and Equations*	EE.8
31	*Expressions and Equations*	EE.1
32	*Functions*	F.4
33	*Functions*	F.5
34	*Geometry*	G.3
35	*Geometry*	G.4
36	*Functions*	F.1
37	*Expressions and Equations*	EE.8
38	*Expressions and Equations*	EE.5
39	*Statistics and Probability*	SP.1
40	*Functions*	F.3
41	*Geometry*	G.7
42	*Geometry*	G.2