



Arkansas
Comprehensive Testing, Assessment
& Accountability Program

***Algebra I Midyear
End of Course Examination
Released Item Booklet***

January 2004 Administration

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Arkansas Department of Education

Table of Contents

		<u>PAGE</u>
PART I	Overview	1
PART II	Released Multiple-Choice Items	2–17
PART III	Released Open-Response Items	18–32
	Algebra I Open-Response Item A	18
	Rubric for Algebra I Open-Response Item A	19-20
	Algebra I Open-Response Item B	21
	Rubric for Algebra I Open-Response Item B	22-23
	Algebra I Open-Response Item C	24
	Rubric for Algebra I Open-Response Item C	25-26
	Algebra I Open-Response Item D	27
	Rubric for Algebra I Open-Response Item D	28-29
	Algebra I Open-Response Item F	30
	Rubric for Algebra I Open-Response Item F	31-32
	End of Course Mathematics Reference Sheet	33
PART IV	Curriculum Frameworks	34
PART V	Item Correlation with Curriculum Framework	35

PART I Overview

The criterion-referenced tests implemented as part of the **Arkansas Comprehensive Testing, Assessment and Accountability Program** (ACTAAP) have been developed in response to Arkansas Legislative Act 1172, which requires the State Board of Education to develop a comprehensive testing program that includes performance assessment of the core concepts, abilities, thinking, and problem-solving skills defined by the *Arkansas Curriculum Frameworks* and the Algebra I Course Goals.

As part of this program, students in Arkansas public schools who had completed or were completing Algebra I by the end of the first semester participated in the *Algebra I Midyear End of Course Examination* in January of 2004.

This *Released Item Booklet* for the *Algebra I Midyear End of Course Examination* contains test questions or items that were asked of students during the January 2004 administration. The test items included in this booklet are those items that contributed to the student performance results for that administration.

Students had approximately forty-five minutes for each session, 1 through 4, and thirty minutes to take Session 5 during one day of testing in January of 2004. Students were permitted to use a calculator for both multiple-choice and open-response items. Students were also supplied with a reference sheet to be used so that all students would have equal access to this information during testing (see page 33 of this booklet). **All of the multiple-choice items in Part II of this booklet have the correct response marked with an asterisk(*).** The open-response questions in Part III of this booklet include scoring guides (rubrics) immediately following. These rubrics provide information on the scoring model used for the Algebra I open-response test items.

The development of the *Algebra I Midyear End of Course Examination* was based on the *Arkansas Curriculum Frameworks* and the Algebra I Course Goals. These frameworks have common distinct levels: *strands* to be taught in concert, *content standards* within each strand, and *student learning expectations* within each content standard. The Algebra I Course Goals, an abridged version of the *Curriculum Frameworks for Mathematics*, can be found in Part IV of this booklet. It is important to note that this abridged version lists only the predominant strand, content standards, and student learning expectations associated with test items. However, since many key concepts within the *Arkansas Curriculum Frameworks* are interrelated, in many cases there are other item correlations or associations across strands, standards, and expectations.

Part V of the *Released Item Booklet* contains a tabular listing of the content standard and student learning expectation that each Algebra I question was designed to assess within the Patterns, Algebra & Functions Strand. The multiple-choice and open-response items found on the *Algebra I Midyear End of Course Examination* were developed in close association with the Arkansas education community. Arkansas teachers participated as members of the Algebra I Content Advisory Committee, providing routine feedback and recommendations for all items. The number of items associated with specific content standards and student learning expectations was based on approximate proportions suggested by the Content Advisory Committee, and their recommendations were accommodated to the greatest extent possible given the overall test design. Part V of the *Released Item Booklet* provides Arkansas educators with specific information on how the *Algebra I Midyear End of Course Examination* items align or correlate with the *Arkansas Curriculum Frameworks* to provide models for classroom instruction.

1. Which one of the following is an irrational number?

A. -1

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

* C. $\sqrt{7}$

D. $\frac{30}{4}$

2. Solve for x : $\frac{4}{x} = \frac{2}{5}$

A. 2

B. $\frac{5}{2}$

C. 5

* D. 10

Use the chart below to answer question 3.

Prices of house	Square feet in the house
\$100,000	1,000
\$165,000	1,500
\$130,000	1,250
\$210,000	2,000
\$190,000	1,850

3. Which equation **best** describes the data above? P represents the price of a house, and s represents the square feet in the house.

A. $P = s + 90,000$

B. $P = s + 163,500$

* C. $P = 100s$

D. $P = 110,000 - s$

4. Examine the set of points:

$$\{(1, 3), (1, 4), (3, 7), (-2, 1)\}$$

What is the domain of this set?

A. $\{1, 3\}$

* B. $\{-2, 1, 3\}$

C. $\{-2, 1, 7\}$

D. $\{1, 3, 4, 7\}$

5. Simplify: $(x - 3)(x^2 + 6)$

- * A. $x^3 - 3x^2 + 6x - 18$
- B. $x^3 - 3x^2 + 6x - 9$
- C. $x^3 - 3x^2 + 6x + 3$
- D. $x^3 + 3x - 18$

6. Which of the following is **not** a factor of 63?

- A. 3
- * B. 6
- C. 7
- D. 9

7. Solve: $7t - (2t + 1) \geq -5$

- A. $t \geq -\frac{6}{5}$
- * B. $t \geq -\frac{4}{5}$
- C. $t \leq \frac{1}{7}$
- D. $t \leq \frac{3}{7}$

8. Tanya is in charge of ordering for a clothing store. In May, she orders 16 shirts and 40 tank tops. Tanya orders 12 shirts and 50 tank tops in June. In July, she orders 45 tank tops. Which matrix represents this information?

A.

	Shirts	Tank Tops
May	16	50
June	40	0
July	12	45

B.

	Shirts	Tank Tops
May	16	40
June	12	50
July	45	0

C.

	Shirts	Tank Tops
May	40	16
June	50	12
July	45	0

* D.

	Shirts	Tank Tops
May	16	40
June	12	50
July	0	45

Use the table below to answer question 9.

x	$f(x)$
0	0
0.75	7.5
$\frac{9}{10}$	9
1	10
2	20
3.5	35

9. What is the function rule for the table above?
- A. $f(x) = x$
 B. $f(x) = x + 9$
 * C. $f(x) = 10x$
 D. $f(x) = 100x$
10. What is the greatest common factor of the monomials $24x^2y^3$ and $16x^3y$?
- A. $2xy$
 B. $4xy$
 C. $4x^2y$
 * D. $8x^2y$

11. Rolland walks at a steady rate of 3.5 miles per hour. The distance traveled depends on the amount of time, t , that Rolland walks. Which expression represents the distance walked?
- A. $t + 3.5$
 B. $\frac{t}{3.5}$
 C. $\frac{3.5}{t}$
 * D. $3.5t$

Use the inequality below to answer question 12.

$$3n - 4 < 8$$

12. Which sentence describes the inequality above?
- A. Eight is less than 3 times a number, n , decreased by 4.
 * B. Three times a number, n , decreased by 4 is less than 8.
 C. Three times a number, n , minus 4 is greater than 8.
 D. Three times the quantity of a number, n , minus 4 is less than 8.

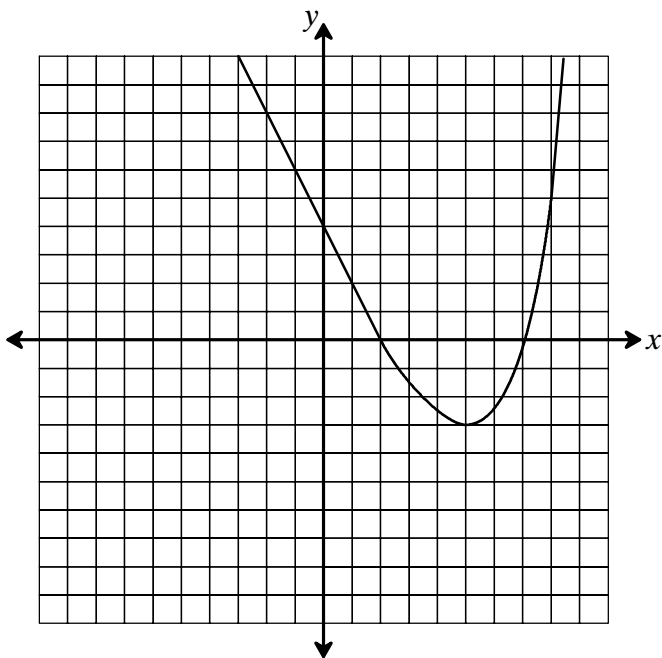
PART II Released Multiple-Choice Items — Algebra I

13. Justin and his friends measured their heights in centimeters. The heights are listed below. What is the mean of these data?

Tim	171 cm	Andy	171 cm	Osman	189 cm
Ridwan	189 cm	Ben	189 cm	Jason	170 cm
Justin	168 cm	Patrick	168 cm		

- A. 170.5 cm
- * B. 176.875 cm
- C. 180 cm
- D. 1,415 cm

Use the graph below to answer question 14.



14. What are the zeros of the function graphed above?
- A. 5 and -3
 - B. 4 and 0
 - * C. 2 and 7
 - D. 2 and 0

15. Solve for x : $-9 = x^2 + 6x$

- A. $x = -9$
- * B. $x = -3$
- C. $x = 3$
- D. $x = 6$

16. Which of the following would be an intermediate step in solving the equation $8y + 5 - 3y = 10$?

- * A. $5y = 5$
- B. $5y = 15$
- C. $11y = 5$
- D. $11y = 15$

PART II Released Multiple-Choice Items — Algebra I

17. Two bedrooms, each with 352 square feet of wall space, are scheduled to be painted. One can of paint covers 400 square feet. How many full cans of paint should be purchased if each room needs 2 coats of paint?

- A. 1 can
- B. 2 cans
- C. 3 cans
- * D. 4 cans

Use the table below to answer question 18.

time	9:00 A.M.	12:00 P.M.	2:00 P.M.
amount produced	9 items	27 items	39 items

18. Throughout his shift, Randall recorded the total number of items he had produced so far that day. How many items did Randall produce each hour?

- A. 4.5
- B. 5
- * C. 6
- D. 12

19. Jamie's family is on a trip. The distance they travel is a function of the time they are on the road. Which must be a true statement?

- A. The distance is the independent variable.
- B. The time is the dependent variable.
- C. The speed is the dependent variable.
- * D. The time is the independent variable.

20. A rectangular field of corn is 1.3×10^3 yards long and 2.4×10^2 yards wide. What is the area of the field?


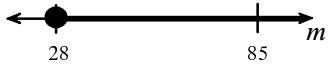
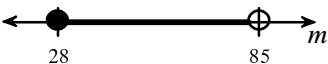
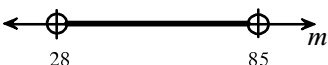
- A. 3,080 yd.²
- * B. 312,000 yd.²
- C. 370,000 yd.²
- D. 3,120,000 yd.²

21. Which of the following expressions represents the smallest number?
- A. $\left(\frac{1}{2}\right)^{-10}$
 - B. $2,010 \times 10^{-8}$
 - * C. 0.0000000576×10^2
 - D. $\left(\frac{1}{20}\right) \times \left(\frac{1}{20}\right) \times \left(\frac{1}{20}\right)$
22. The sum of the measures of two angles is 180° . One angle measures 30° more than the other. What are the measures of the angles?
- A. 60° and 90°
 - * B. 75° and 105°
 - C. 85° and 105°
 - D. 150° and 30°
23. It is -5°F at 3 A.M. and 19°F at 11 A.M. What is the hourly rate of change in degrees?
- A. -3 degrees per hour
 - B. $\frac{7}{4}$ degrees per hour
 - * C. 3 degrees per hour
 - D. 24 degrees per hour
24. If $f(x) = 5x^2 + 7$, determine $f(-2)$.
- A. -13
 - B. 16
 - * C. 27
 - D. 107
25. Simplify the expression:
- $$3x(-2 + 5) + 10x$$
- A. $-19x$
 - * B. $19x$
 - C. $-19x^2$
 - D. $19x^2$

26. Which one of the following expressions is equivalent to $\frac{x + y}{z}$?

- A. $\frac{x}{z} + y$
- * B. $\frac{x}{z} + \frac{y}{z}$
- C. $x + (y \div z)$
- D. $x + y \div z$

27. Which of the following represents the solution to $2m + 57 > 113$?

- * A. 
- B. 
- C. 
- D. 

Use the matrix below to answer question 28.

April Order

	Blue	Gold	Silver
Baubles	500	300	400
Trinkets	600	450	350

28. The matrix above represents Tracey's Trinkets' April order. The manager at Tracey's Trinkets decides to order twice as many baubles and half as many trinkets on the May order. Which matrix represents the store's May order?

A.

	Blue	Gold	Silver
	1,000	600	800
	1,200	900	700

* B.

	Blue	Gold	Silver
	1,000	600	800
	300	225	175

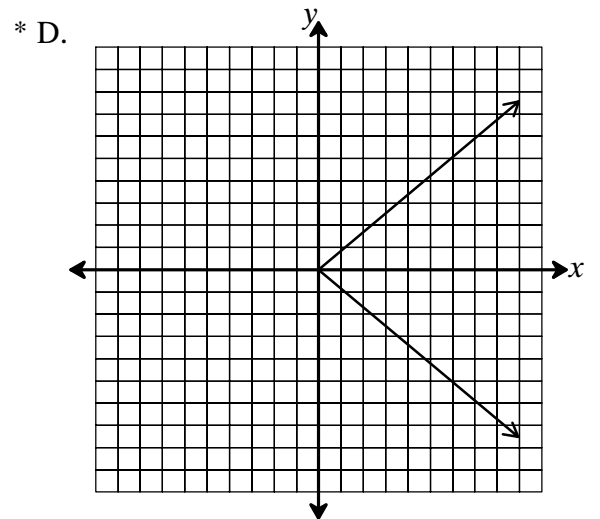
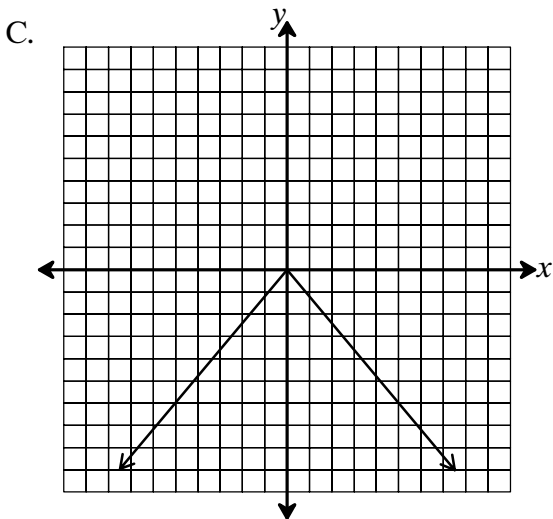
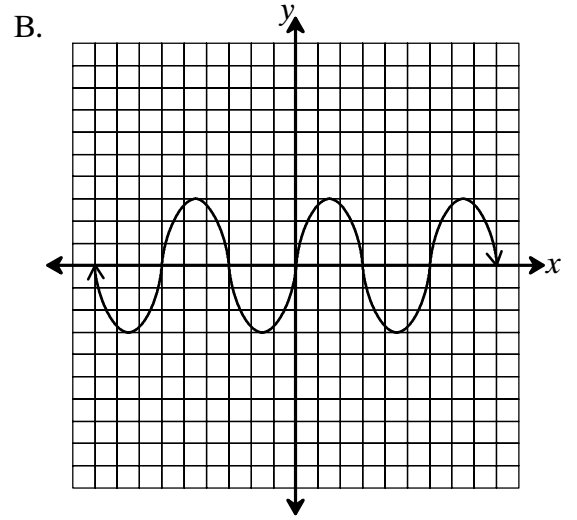
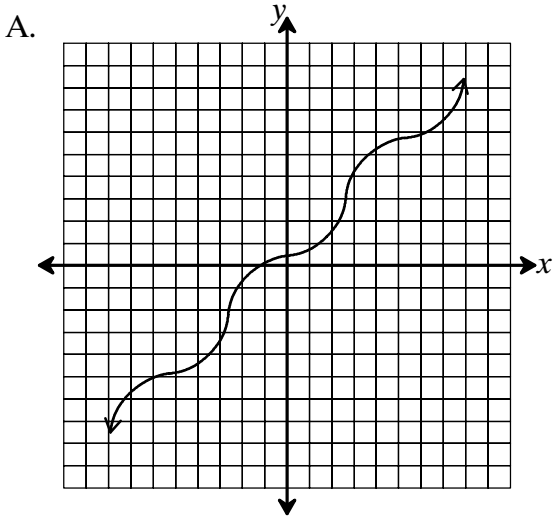
C.

	Blue	Gold	Silver
	250	150	200
	300	225	175

D.

	Blue	Gold	Silver
	250	150	200
	1,200	900	700

29. Which of the following graphs is **not** a function?



30. Factor:

$$x^2 - 2x - 24$$

- A. $(x - 6)(x - 4)$
- * B. $(x - 6)(x + 4)$
- C. $(x + 6)(x - 4)$
- D. $(x + 6)(x + 4)$

31. Translate this verbal sentence into an inequality:

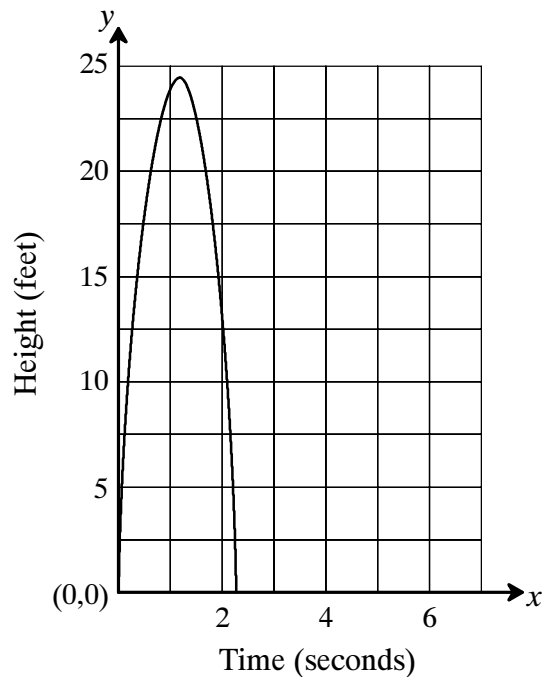
The sum of two numbers is less than 86.

- * A. $x + y < 86$
- B. $x + y \leq 86$
- C. $x + y > 86$
- D. $x + y \geq 86$

32. Which is equal to 5 square feet?
(1 square foot = 144 square inches.)

- A. 12 square inches
- B. 29 square inches
- C. 149 square inches
- * D. 720 square inches

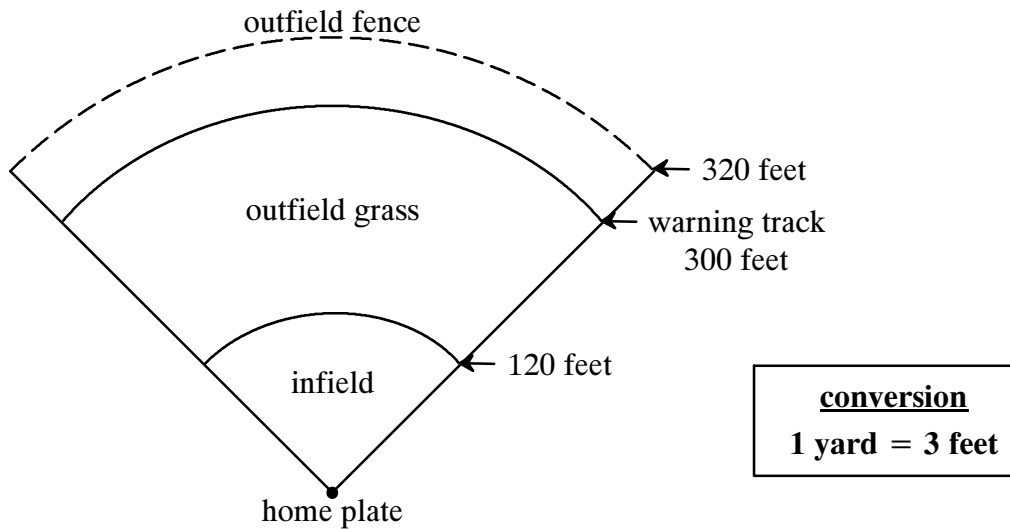
Use the graph below to answer question 33.



33. Tina hits a softball during a game. The flight of the ball is shown in the graph above. The ball's height is a function of time. No one catches the ball. What is the approximate time that the ball will hit the ground?

- A. 0 seconds
- B. 1.1 seconds
- * C. 2.3 seconds
- D. 5 seconds

Use the figure below to answer question 34.



34. A baseball player standing at home plate hits the ball 80 yards before it hits the ground. Using the figure above, where will the ball land?
- A. on the infield
 - * B. on the outfield grass
 - C. on the warning track
 - D. over the fence

PART II Released Multiple-Choice Items — Algebra I

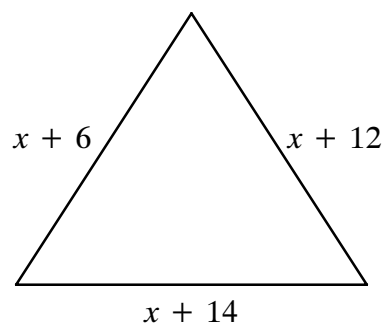
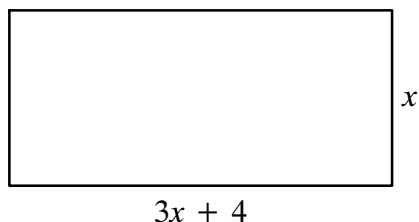
35. Which of the following is true about the graph of $y = x^2 - 9$?

- A. The y -intercept is 9.
- B. The parabola opens downward.
- C. The parabola has 1 x -intercept.
- * D. The parabola has 2 x -intercepts.

36. Which of the following are equations?

- I. $\pi = \frac{C}{d}$
 - II. $l \times w \times h$
 - III. $A = \pi r^2$
- A. II only
 - B. III only
 - C. I and II
 - * D. I and III

Use the figures below to answer question 37.



37. The rectangle and the triangle have the same perimeter. What is the value of x ?

- A. $3\frac{7}{11}$
- * B. 4.8
- C. 6
- D. 28

Use the stem-and-leaf plot below to answer question 38.

4	3
7	2 3 4 5
8	1 1 2 2 5 5 5
10	0 0 2

38. The stem-and-leaf plot above represents the number of points the basketball team scored during their last 15 games. What is the mode of the data given?
- A. 81
 B. 82
 * C. 85
 D. 102
39. Earth's oceans have a volume of about 1,286,000,000 cubic kilometers. The volume of Earth's fresh water is about 35,000,000 cubic kilometers. What is the approximate ratio of the volume of the oceans to the volume of fresh water?
- * A. 3.7×10^1 to 1
 B. 3.7×10^2 to 1
 C. 3.5×10^7 to 1
 D. 1.286×10^9 to 1

Use the chart below to answer question 40.

Number of Sheets of Paper	Price
120	\$1.79
180	\$1.99

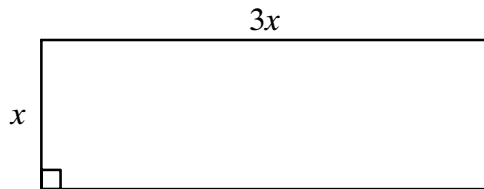
40. The chart lists the sale prices of two sizes of packages of paper. Which equation represents the correct linear relationship between the amount of paper per package (n) and price (P)?
- * A. $P = \frac{1}{300}n + 1.39$
 B. $P = \frac{1}{60}n - 0.21$
 C. $P = \frac{1}{30}n - 4.01$
 D. $P = 3n - 1.81$

41. Simplify the following expression:

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

- * A. -37
- B. -25
- C. -16
- D. -10

Use the figure below to answer question 42.



42. The area of the rectangle above is 48 square feet. What are the dimensions of the rectangle?

- A. 2 ft. \times 6 ft.
- * B. 4 ft. \times 12 ft.
- C. 6 ft. \times 8 ft.
- D. 48 ft. \times 1 ft.

Use the chart below to answer question 43.

Population of Metroland

Year	Population
1970	500
1980	600
1990	720
2000	864

43. Using the chart above, which statement is true about the population of Metroland?
- A. The population is growing linearly.
 - B. The population is decaying linearly.
 - * C. The population is growing non-linearly.
 - D. The population is decaying non-linearly.
44. The equation $y = 250 + 15x$ expresses how much Jill will earn (y) for a particular job based on the number of hours she works (x). What information is given by the **slope** of this equation?
- * A. Jill earns \$15 per hour.
 - B. Jill earns at least \$15 for this job.
 - C. Jill earns at least \$250 for this job.
 - D. Jill earns \$250 per hour.

45. Simplify the expression:

$$(4x^2 - x - 3) - (x^2 + 4x - 2)$$

- A. $3x^2 + 3x - 5$
- B. $5x^2 - 5x + 5$
- C. $3x^2 - 3x - 1$
- * D. $3x^2 - 5x - 1$

46. Which of the following is a correct prime factorization of 360?

- A. $2 \cdot 3 \cdot 5 \cdot 6$
- B. $3 \cdot 3 \cdot 4 \cdot 5$
- * C. $2 \cdot 2 \cdot 2 \cdot 3 \cdot 3 \cdot 5$
- D. $2 \cdot 2 \cdot 3 \cdot 3 \cdot 3 \cdot 5$

47. Each of the following inequalities can be solved in one step. Which one also requires a reversal of the inequality sign?

- A. $40x \geq -1,600$
- B. $1,600 \geq 32x$
- * C. $-40x \leq 1,600$
- D. $-1,600 \leq 32x$

48. Using the following numbers as data, what is the median?

$$\{1, 2, 6, 2, 7, 3, 5, 2, 6, 3, 7\}$$

- A. 2
- * B. 3
- C. 4
- D. 5

Use the matrix below to answer question 49.

Jayne's Trophy Shop

	Small	Medium	Large
Trophies	5.95	9.95	16.95
Plaques	4.95	8.95	13.95

49. Companies often charge a percent of the purchase price for shipping the product to the customer. The store prices at Jayne's Trophy Shop are shown in the matrix above. In addition, the shop charges 11% of the store price to ship all merchandise. Which matrix represents the **shipping cost** at Jayne's Trophy Shop?

* A. $\begin{bmatrix} 0.65 & 1.09 & 1.86 \\ 0.54 & 0.98 & 1.53 \end{bmatrix}$

B. $\begin{bmatrix} 5.30 & 1.09 & 15.09 \\ 4.41 & 7.97 & 12.42 \end{bmatrix}$

C. $\begin{bmatrix} 6.60 & 11.04 & 18.81 \\ 5.49 & 9.93 & 15.48 \end{bmatrix}$

D. $\begin{bmatrix} 11.25 & 18.81 & 32.04 \\ 9.36 & 16.92 & 26.37 \end{bmatrix}$

50. Which one of these four sets does **not** represent a function?

- A. $\{(1, 1), (2, 2)\}$
- * B. $\{(1, 1), (1, 2)\}$
- C. $\{(1, 1), (2, 1)\}$
- D. $\{(1, 2), (2, 1)\}$

51. Completely factor:

$$49a^2 - 42ab + 9b^2$$

- * A. $(7a - 3b)(7a - 3b)$
- B. $(7a + 3b)(7a - 3b)$
- C. $(7a + 3b)(7a + 3b)$
- D. $(49a - b)(a - 9b)$

52. Two buses carry 30 students from school to the movies. Bus *Y* carries 6 fewer than twice the number of students on Bus *X*. Which system represents this situation?

- A. $\begin{cases} x + y = 30 \\ y = 2x + 6 \end{cases}$
- * B. $\begin{cases} x + y = 30 \\ y = 2x - 6 \end{cases}$
- C. $\begin{cases} x - y = 6 \\ y = 2x \end{cases}$
- D. $\begin{cases} x - y = 24 \\ y = 2x + 30 \end{cases}$

53. Carpet sells for \$27.50 per square yard. What is the approximate cost of a square **foot**? (1 square yard = 9 square feet.)

- A. \$0.75
- B. \$2.25
- * C. \$3.00
- D. \$9.00

54. Through which quadrant will the graph of the equation $y = mx + b$ **not** pass if $m < 0$ and $b < 0$?

- * A. quadrant I
- B. quadrant II
- C. quadrant III
- D. quadrant IV

55. What is the independent variable in the function $f(x) = \pi x$?

- A. π
- * B. x
- C. $f(x)$
- D. f

56. Solve: $x^2 - 8x + 16 = 0$

- A. $\{-4, 4\}$
- B. $\{-2, -8\}$
- * C. $\{4\}$
- D. $\{2, 8\}$

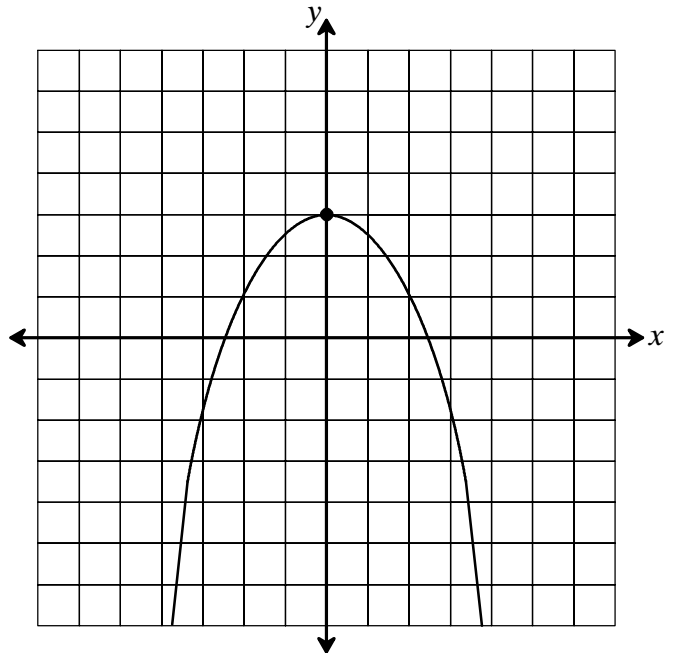
57. Which is the approximate value of $5\sqrt{32}$?

- A. 1.114
- B. 2
- C. 6.4
- * D. 28.28

58. John is on a 7-hour flight from Atlanta to Seattle. After $2\frac{1}{2}$ hours, the pilot announces they are over Kansas City, Missouri, a distance of 750 miles from Atlanta. If they travel at the same speed for the rest of the trip, what is the distance between Atlanta and Seattle?

- A. 300 miles
- B. 1,875 miles
- * C. 2,100 miles
- D. 5,250 miles

Use the graph below to answer question 59.



59. What is the range of the function pictured above?

- A. $\{\text{all real numbers}\}$
- B. $\{y \geq 3\}$
- * C. $\{y \leq 3\}$
- D. $\{-5 \leq y \leq 3\}$

60. Rewrite the number 0.000000512 using scientific notation.

- A. 0.512×10^{-7}
- * B. 5.12×10^{-7}
- C. 0.512×10^7
- D. 5.12×10^7

PART III Released Open-Response Items – Algebra I

CALCULATOR PERMITTED ON ALL ITEMS

ALGEBRA I OPEN-RESPONSE ITEM A

- A. Josiah kept track of his favorite stock over a 7-day period. The price of that stock each day is listed in the table below.

Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
50.25	49.75	49.25	48.75	48.25	47.75	47.25

1. Josiah noticed that the stock prices followed a pattern. The same pattern continued on days 8 through 10. Determine the value of the stock on day 8, day 9, and day 10. Show or explain all of your work even if you use mental math or a calculator.
2. Write the equation that represents the value, V , of the stock after d days. Show or explain all of your work even if you use mental math.
3. Determine the value of Josiah's favorite stock on day 15. Show or explain all of your work even if you use mental math or a calculator.
4. Josiah decides to buy the stock the day it is priced at \$38.00. On which day will the stock have this price? Show or explain all of your work even if you use mental math or a calculator.

BE SURE TO LABEL YOUR RESPONSES (1), (2), (3), AND (4).

PART III Released Open-Response Items — Algebra I

RUBRIC FOR ALGEBRA I OPEN-RESPONSE ITEM A

SCORE	DESCRIPTION
4	The student earns 5 points.
3	The student earns 3.5 – 4.5 points.
2	The student earns 2 – 3 points.
1	The student earns .5 – 1.5 points. OR The student demonstrates minimal understanding of translating word expressions to symbolic expressions and/or solving simple equations.
0	No understanding. Work is either incorrect or irrelevant.
Blank	No response.

Score Point Description:

- Part 1:** Score **1 point** for determining the stock price on days 8, 9, and 10 with support.
OR
Score **.5 point** for correct stock price on days 8, 9, and 10 with minimal or no support; **or** for incorrect stock price(s) on days 8, 9, and/or 10, but work shown or explanation provided shows clear understanding that the pattern is a constant decrease of \$.50 per day.
- Part 2:** Score **2 points** for the correct equation with support.
OR
Score **1 point** for correct equation with minimal or no support; **or** for correct procedure for deriving the equation, but with an incorrect equation due to calculation error(s); **or** for an equation with a correct slope or y-intercept with support.
OR
Score **.5 point** for an equation with a correct slope or y-intercept with no support.
- Part 3:** Score **1 point** for correctly determining the stock value on day 15 with support (may be based on an error in part 1 or an incorrect equation in part 2).
OR
Score **.5 point** for correct stock value on day 15 with no support; **or** for work or explanation demonstrating correct procedure with an incorrect answer due to calculation error(s).
- Part 4:** Score **1 point** for correct answer with support (may be based on an incorrect equation in part 2).
OR
Score **.5 point** for correct answer with no support; **or** for work or explanation demonstrating correct procedure with an incorrect answer due to calculation error(s).

RELEASED MATERIALS. MAY BE DUPLICATED.

Sample Solution:

Part 1: day 8: $47.25 - 0.50 = \mathbf{46.75}$
 day 9: $46.75 - 0.50 = \mathbf{46.25}$
 day 10: $46.25 - 0.50 = \mathbf{45.75}$

Part 2: $V = -0.50d + 50.75$ {or $V = 50.25 - 0.50(d - 1)$ }
 Since the pattern shows a constant decrease of \$.50 per day, the function is therefore linear, with a slope of $-.50$, and the equation is:
 $V = md + b$, (or, using day 1):
 $50.25 = -0.50d + b$
 $50.75 = b$, so
 $V = -.050d + 50.75$

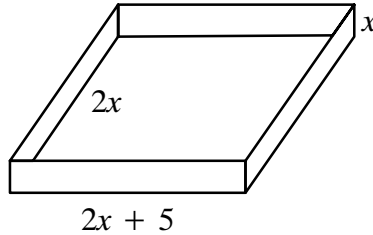
Part 3: **43.25**
 $V = -0.50(15) + 50.75$
 $V = -7.50 + 50.75$
 $V = 43.25$
 (or equivalent, including continuing the chart out to day 15)

Part 4: **“Sometime on day 25” ($d = 25.5$) or “It will never happen”**
(Accept answers of “day 25” or “day 26” or “it will never be \$38.00”)

$38 = -0.50d + 50.75$ $38 - 50.75 = -0.50d$ $-12.75 = -0.50d$ $d = 25.5$	or	extends the chart correctly day 25 = 38.25 day 26 = 37.75
---	----	---

ALGEBRA I OPEN-RESPONSE ITEM B

B. The plans for a box are shown below.



(Not drawn to scale.)

1. The sum of the box's length, width, and height is 25 inches. Find the value of x . Show or explain all of your work even if you use mental math or a calculator.
2. The outside of the box will be painted. Write an algebraic expression for the area of the base of the box (there is no lid). Show or explain all of your work even if you use mental math or a calculator.
3. For heavy objects, the company will need to fit a support into the bottom of the box. The support will be installed along the diagonal of the base. Determine the length of the support. Show or explain all of your work even if you use mental math or a calculator.

BE SURE TO LABEL YOUR RESPONSES (1), (2), AND (3).

RUBRIC FOR ALGEBRA I OPEN-RESPONSE ITEM B

SCORE	DESCRIPTION
4	The student earns 6 points.
3	The student earns 4.5 – 5 points.
2	The student earns 2.5 – 4 points.
1	The student earns .5 – 2 points. OR The student demonstrates minimal understanding of representing 2-dimensional figures algebraically and/or using the Pythagorean Theorem, area, and perimeter formulas.
0	No understanding. Work is either incorrect or irrelevant.
Blank	No response.

Score Point Description:

- Part 1:** Score **2 points** for correctly finding the value of x with full support.
OR
Score **1 point** for correct value of x with incomplete or no support; **or** for demonstrating correct procedures with an incorrect value of x due to calculation error.
OR
Score **.5 point** for finding the value of x for a volume or perimeter of 25 inches.
- Part 2:** Score **2 points** for correct algebraic expression for the area of the base with full support.
OR
Score **1.5 points** for correct algebraic expression with no support.
OR
Score **1 point** for demonstrating correct procedures with an incorrect expression due to calculation error(s); **or** for an expression that is incorrect due to missing parentheses.
OR
Score **.5 point** for finding the actual area only (does not represent the area algebraically).
- Part 3:** Score **2 points** for correctly determining the length of the diagonal with full support.
OR
Score **1 point** for correct length with no support; **or** for demonstrating correct procedures with an incorrect answer due to calculation error(s).
OR
Score **.5 point** for demonstrating understanding of the Pythagorean Theorem, but the result is incorrect due to a procedural error (e.g., student stops at $233 = c^2$ or confuses a side with the hypotenuse).

Sample Solution:

Part 1: $x = 4$
 $(2x + 5) + 2x + x = 25$
 $5x + 5 = 25$
 $5x = 20$
 $x = 4$

Part 2: $4x^2 + 10x$ (base only) **OR** $12x^2 + 20x$ (surface area of bottom of box)
 $A = (2x + 5)(2x)$ $A = (2x + 5)(2x) + 2(x)(2x + 5) + 2(x)(2x)$
 $A = 4x^2 + 10x$ $A = 4x^2 + 10x + 4x^2 + 10x + 4x^2$
 $A = 12x^2 + 20x$

Part 3: **15.26 inches**
 Length: $2x + 5 = 2(4) + 5 = 8 + 5 = 13$ inches
 Width: $2x = 2(4) = 8$ inches
 Using the Pythagorean Theorem to find the length of the diagonal of the base (d = length of diagonal):
 $13^2 + 8^2 = d^2$
 $169 + 64 = d^2$
 $233 = d^2$
 $\sqrt{233} = d$
15.26 inches $\cong d$

ALGEBRA I OPEN-RESPONSE ITEM C

- C. A worker's weekly paycheck is a function of the number of hours (h) worked. Julia earns \$6.75 per hour. Julia's pay function is $J(h) = 6.75h$.
1. Sidney earns \$7.50 per hour. Write the function representing Sidney's pay.
 2. Each person works a 4-, 5-, or 6-hour shift per day and works no more than 2 days per week. Copy and complete the function tables for Julia and Sidney in your Student Answer Document. Show all of your work even if you use mental math or a calculator.

Julia's Pay (1 week)

h	$J(h)$
4	
5	
6	
8	
10	
12	

Sidney's Pay (1 week)

h	$S(h)$
4	
5	
6	
8	
10	
12	

3. Julia and Sidney are hired at the same time. After how many hours of work will Sidney have earned \$120 more than Julia? Show all of your work.

BE SURE TO LABEL YOUR RESPONSES (1), (2), AND (3).

RUBRIC FOR ALGEBRA I OPEN-RESPONSE ITEM C

SCORE	DESCRIPTION
4	The student earns 4 points.
3	The student earns 3 – 3.5 points.
2	The student earns 2 – 2.5 points.
1	The student earns .5 – 1.5 points. OR The student demonstrates minimal understanding of using function notation and/or solving simple equations.
0	No understanding. Work is either incorrect or irrelevant.
Blank	No response.

Score Point Description:

- Part 1:** Score **1 point** for the correct function representing Sidney’s pay.
OR
Score **.5 point** for correct function, but not in standard function notation format.
- Part 2:** Score **1.5 points** for correct and complete function table for both Julia and Sidney with support.
OR
Score **1 point** for all the required data with support, but not given in table format; **or** for correct and complete function table for both Julia and Sidney with no support; **or** for correct work shown with incorrect table entries due to calculation errors or incorrectly labeling the tables.
OR
Score **.5 point** for some correct work shown for generating the table; **or** for tables with some correct entries and no support.
- Part 3:** Score **1.5 points** for the correct number of hours with complete support.
OR
Score **1 point** for the correct number of hours with incomplete support; **or** for correct procedures shown to find the correct number of hours, but work shows a calculation error.
OR
Score **.5 point** for the correct number of hours with no support; **or** for some correct procedures shown for determining the number of hours.

Sample Solution:**Part 1:** $S(h) = 7.50h$ **Part 2:** **Julia's Pay**

h	$J(h)$
4	27
5	33.75
6	40.50
8	54
10	67.50
12	81

$$6.75(4) = 27, 6.75(5) = 33.75, 6.75(6) = 40.50, 6.75(8) = 54, 6.75(10) = 67.50, 6.75(12) = 81$$

Sidney's Pay

h	$S(h)$
4	30
5	37.50
6	45
8	60
10	75
12	90

$$7.5(4) = 30, 7.5(5) = 37.50, 7.5(6) = 45, 7.5(8) = 60, 7.5(10) = 75, 7.5(12) = 90$$

Part 3: **160 (hours)**

$$7.5(h) = 6.75(h) + 120$$

$$7.5(h) - 6.75(h) = 120$$

$$.75h = 120$$

$$h = 160$$

(OR any other mathematically correct method)

ALGEBRA I OPEN-RESPONSE ITEM D

- D. Charles's Law relates the volume of a gas to its temperature. Monica conducted an experiment where she changed the temperature of a gas and recorded the volume of the gas at the different temperatures. The following table shows her results.

Temperature ($^{\circ}\text{C}$)	Volume (m^3)
-100	173
-50	223
0	273
50	323
100	373

1. Identify the independent and dependent variables of Monica's experiment.
2. Assuming the relationship between the temperature (t) and the volume (v) is linear, find the equation that represents the data in the table. Show all of your work for each part of your equation.

BE SURE TO LABEL YOUR RESPONSES (1) AND (2).

RUBRIC FOR ALGEBRA I OPEN-RESPONSE ITEM D

SCORE	DESCRIPTION
4	The student earns 4 points.
3	The student earns 3 – 3.5 points.
2	The student earns 2 – 2.5 points.
1	The student earns .5 – 1.5 points. OR The student demonstrates minimal understanding.
0	No understanding. Work is either incorrect or irrelevant.
Blank	No response.

Score Point Description:

- Part 1:** Score **1 point** for clearly identifying the correct independent and dependent variables.
OR
Score **.5 point** for some correct discussion of independent and dependent variables with an incorrect response.
- Part 2:** Score **3 points** for a correct equation with support demonstrating how both the slope and y-intercept were derived.
OR
Score **2 points** for correct equation with incomplete or no support; **or** for correct work for both parts of the equation, but the equation is incorrect due to calculation or copy error.
OR
Score **1 point** for an equation with a correct slope **or** y-intercept with support.
OR
Score **.5 point** for either a correct slope or y-intercept with no support; **or** for work that exhibits some correct understanding of how to develop a linear equation from linear data.

Sample Solution:

Part 1: Independent Variable - Temperature (t)
Dependent Variable - Volume (v)

Part 2: $v = t + 273$

Slope: Using the points (50, 323) and (100, 373),

$m = \{(373 - 323) / (100 - 50)\} = 50/50 = 1$; or equivalent

(From the chart, we can see that an increase in the independent variable, temperature, of 50° causes an increase in the volume of the gas by 50m^3 , then the slope (rise/run) would equal $50/50 = 1$.)

y-intercept: Using $y = mx + b$, and substituting the slope and one point from above,

$$323 = 1(50) + b$$

$$323 = 50 + b$$

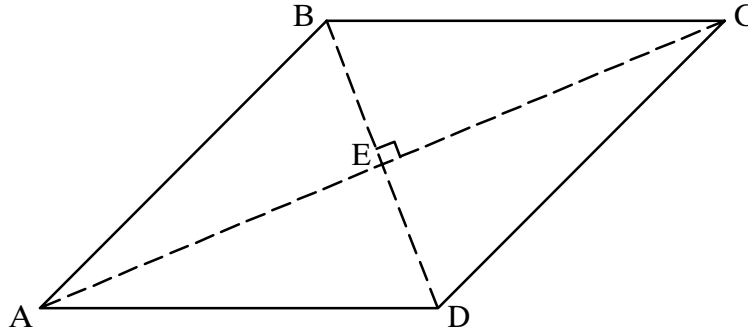
$$323 - 50 = b$$

$$273 = b, \quad \text{or equivalent}$$

(Since when temperature, the independent variable, equals 0 the volume equals 273, the y-intercept equals 273.)

ALGEBRA I OPEN-RESPONSE ITEM F

- F. A ceramic design studio has a hand-crafted set of tiles to be installed in a model home. The builder needs the dimensions of the tile. He has been given the drawing and specifications below.



$$AB = BC = CD = DA$$

$$AE = EC = (x + 1) \text{ cm}$$

$$DE = EB = x \text{ cm}$$

The perimeter of tile ABCD is 20 cm.

1. Copy and label the rhombus-shaped tile above into your Student Answer Document. Determine the length of each side of the tile. Show or explain all of your work.
2. Find the lengths of both diagonals, \overline{DB} and \overline{AC} . Explain all of your work.

BE SURE TO LABEL YOUR RESPONSES (1) AND (2).

RUBRIC FOR ALGEBRA I OPEN-RESPONSE ITEM F

SCORE	DESCRIPTION
4	The student earns 4 points.
3	The student earns 3 – 3.5 points.
2	The student earns 2 – 2.5 points.
1	The student earns .5 – 1.5 points. OR The student demonstrates minimal understanding of polynomial operations and/or solving second degree equations.
0	No understanding. Work is either incorrect or irrelevant.
Blank	No response.

Score Point Description:

Part 1: Score **1 point** for a correct answer with support.
OR
Score **.5 point** for a correct answer with no support; **or** for correct procedures with an incorrect answer due to calculation error.

Part 2: Score **2 points** for correctly determining the value of “ x ” with support.
OR
Score **1 point** for correctly determining the value of “ x ” with insufficient support; **or** for correct procedures to determine “ x ” with an incorrect answer due to calculation error(s).

AND

Score **1 point** for correctly determining the length of both diagonals with support.
OR
Score **.5 point** for correctly determining the length of both diagonals with no support; **or** for correct procedures to determine the length of the diagonals with an incorrect answer due to calculation error(s); **or** for correctly determining the length of one diagonal with support.

Note: Failure to include units on the answers in both parts 1 and 2 is a 3 / 4 issue. That is, to receive a score of “4,” the response must have correct units as part of the answer to parts 1 and 2. At all other score points, units may be missing or incorrect.

Sample Solution:**Part 1:** 5 cm

Since, from the given information, the sides of the rhombus are congruent and the perimeter equals 20 cm, then the length of each side would be:

$$20 / 4 = 5$$

Part 2: DB = 6 cm, AC = 8 cmSolve for x ($= DE = EB$):

Each triangle formed by the diagonals and a side of the rhombus is a right triangle, with the side of the rhombus as the hypotenuse. Therefore, we can use the Pythagorean Theorem to solve for x (the length of \overline{DE} and \overline{EB}):

$$x^2 + (x + 1)^2 = 5^2$$

$$x^2 + x^2 + 2x + 1 = 25$$

$$2x^2 + 2x - 24 = 0$$

$$(2x - 6)(x + 4) = 0$$

$$2x - 6 = 0$$

$$2x = 6$$

$$x = 3,$$

AND

$$x + 4 = 0$$

$$x = -4$$

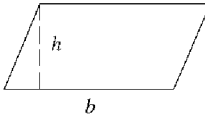
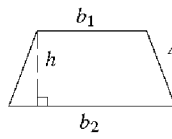
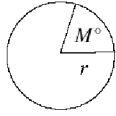
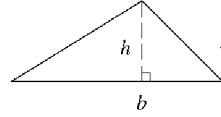
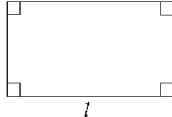
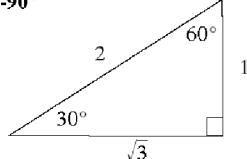
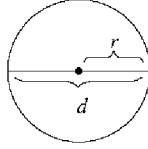
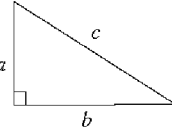
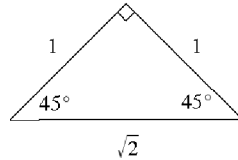
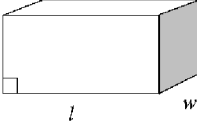
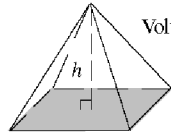
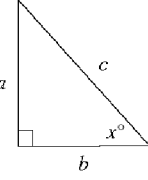
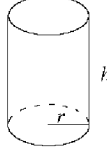
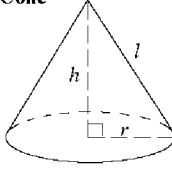
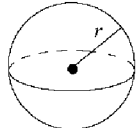
Since $x = -4$ is not a possible solution for length, then $x = 3$ cm.

If $x = DE = EB = 3$ cm, then $DB = DE + EB = 3$ cm + 3 cm = 6 cm, and

$AE = EC = x + 1 = 3 + 1 = 4$, then $AC = AE + EC = 4$ cm + 4 cm = 8 cm.

End of Course Mathematics Reference Sheet

This reference sheet was used in 2004 testing. Changes or additions may occur in future testing.

Parallelogram  $P = \text{sum of all sides}$ $A = bh$	Trapezoid  $A = \frac{h(b_1 + b_2)}{2}$	Arc and Sector  $\text{Arc Length} = \left(\frac{M}{360}\right) \cdot 2\pi r$ $\text{Sector area} = \left(\frac{M}{360}\right) \cdot \pi r^2$
Triangle  $P = \text{sum of all sides}$ $A = \frac{bh}{2}$	Rectangle  $P = 2l + 2w$ $A = lw$	30°-60°-90° 
Circle  $C = 2\pi r$ $C = \pi d$ $A = \pi r^2$ $\pi \approx 3.14$	Pythagorean Theorem  $a^2 + b^2 = c^2$	45°-45°-90° 
Rectangular Solid  $\text{Volume} = lwh$ $\text{Surface area} = 2lw + 2lh + 2wh$	Pyramid  $B = \text{area of base (shaded)}$ $\text{Volume} = \frac{Bh}{3}$	Trigonometric Ratios  $\sin x^\circ = \frac{a}{c}$ $\cos x^\circ = \frac{b}{c}$ $\tan x^\circ = \frac{a}{b}$
Cylinder  $\text{Volume} = \pi r^2 h$ $\text{Surface area} = 2\pi rh + 2\pi r^2$	Cone  $l = \text{slant height}$ $\text{Volume} = \frac{\pi r^2 h}{3}$ $\text{Surface area} = \pi rl + \pi r^2$	Sphere  $\text{Volume} = \frac{4\pi r^3}{3}$ $\text{Surface area} = 4\pi r^2$

Miscellaneous Formulas	Area of an equilateral triangle	$A = \frac{s^2\sqrt{3}}{4}$ $s = \text{length of a side}$
	Distance	rate • time
	Interest	principal • rate • time in years
	Sum of the angles of a polygon having n sides	$(n - 2)180^\circ$
	Distance between points on a coordinate plane	$d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$
	Midpoint	$\left(\frac{x_2 + x_1}{2}, \frac{y_2 + y_1}{2}\right)$
	Slope of a nonvertical line (where $x_2 \neq x_1$)	$m = \frac{y_2 - y_1}{x_2 - x_1}$
	Slope-intercept (where $m = \text{slope}$, $b = \text{intercept}$)	$y = mx + b$
	Last term of an arithmetic series	$a_n = a + (n - 1)d$
	Last term of a geometric series (where $n \geq 1$)	$a_n = ar^{n-1}$
	Quadratic formula	$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$
	Area of a square	$A = s^2$
Volume of a cube	$V = s^3$	
Area of a regular polygon	$A = \frac{1}{2}ap$ $a = \text{apothem}$, $p = \text{perimeter}$	

The Arkansas Mathematics Framework *

Patterns, Algebra & Functions Strand

Algebra I Course Goals

Content Standards/Goals	Student Learning Expectations
1. Language of Algebra	<ol style="list-style-type: none"> 1. Real number system: Recognize and use counting numbers, whole numbers, integers, rational numbers, and irrational numbers. 2. Know the fundamental language of algebra (e.g., sum, difference, product, quotient, factor, term, prime, composite, exponent, root, etc.). 3. Demonstrate ability to use the order of operations. 4. Understand the concept of variable as used in algebraic modeling. 5. Translate word expressions to symbolic expressions. 6. Distinguish between “expression,” “equation,” “simplify,” & “solve.” 7. Illustrate numerically and recognize: the meaning of powers and roots, basic algebraic properties (commutative, associative, distributive, reflexive), absolute value, and concept of inequality.
2. Solve Equations & Inequalities	<ol style="list-style-type: none"> 1. Solve equations involving: integers and fractions, ratios and proportions, simple absolute value, real-world applications ($d = rt$, percents, simple probability, etc.), and open-ended questions. 2. Solve simple inequalities. 3. Express answers using: estimation, appropriate units, and sentence form. 4. Integrate algebra and geometry in problems involving: student sketches of basic geometric shapes (square, rectangle, triangle, circle), formulas (Pythagorean theorem, area, perimeter), and representation of 1- and 2-dimensional figures algebraically.
3. Graphs and Tables (with and without graphing calculators)	<ol style="list-style-type: none"> 1. Read, construct, and interpret graphs and tables. Use the results to make predictions. 2. Use a simple matrix to represent data and perform the operations of addition, subtraction, and scalar multiplication. 3. Use and apply linear functions to model: slope/rate of change, intersection of lines graphically and algebraically, equations of the form $Ax + By = C$ and $y = mx + b$, the equation for the line of best fit, and real-life situations (meaning of slope/y-intercept, predictions). 4. Calculate measures of central tendency (e.g., determine mean, median, mode; and represent data by stem-and-leaf, box and whisker, and histogram).
4. Functions, Relations, & Patterns	<ol style="list-style-type: none"> 1. Use function notation. 2. Identify the domain and range of a relation (from ordered pairs or graphs). 3. Determine if a given relation is a function (from ordered pairs or graphs). 4. Find the zeros of a function by examining a graph. 5. Identify independent and dependent variable in a real-life situation. 6. Communicate graphically, algebraically, and verbally real-world problems.
5. Polynomial Operations	<ol style="list-style-type: none"> 1. Add, subtract, and multiply polynomials (combining similar terms). 2. Factor simple expressions. 3. Solve second degree equations by factoring and graphing. 4. Solve problems involving scientific notation.

*The Content Standards/Goals and Student Learning Expectations listed are those that specifically relate to the released test items in this document.

PART V Item Correlation with Curriculum Framework

Released Items for Algebra I *

Item	Content Standard/Goals	Expectation
1	1	1
2	2	1
3	3	1
4	4	2
5	5	1
6	1	2
7	2	2
8	3	2
9	4	1
10	5	2
11	1	4
12	2	3
13	3	4
14	4	4
15	5	3
16	1	6
17	2	4
18	3	3
19	4	5
20	5	4
21	1	1
22	2	1
23	3	3
24	4	1
25	5	1
26	1	3
27	2	2
28	3	2
29	4	3
30	5	2
31	1	5
32	2	3
33	4	4

Item	Content Standard/Goals	Expectation
34	3	1
35	5	3
36	1	6
37	2	4
38	3	4
39	5	4
40	4	6
41	1	3
42	2	4
43	3	1
44	4	6
45	5	1
46	1	2
47	2	2
48	3	4
49	3	2
50	4	3
51	5	2
52	1	5
53	2	3
54	3	3
55	4	5
56	5	3
57	1	7
58	2	1
59	4	2
60	5	4
A	1	5
B	2	4
C	4	1
D	3	1
F	5	1

*Only the predominant Content Standard/Goals and learning expectation is listed for the Algebra I items.

ACTAAP

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