

Pre-Algebra Basic Operations

2. A consultant charges \$45 for each hour she works on a consultation, plus a flat \$30 consulting fee. How many hours of work are included in a \$210 bill for a consultation?

F. $2\frac{4}{5}$
 G. 4
 H. $4\frac{2}{3}$
 J. $5\frac{1}{2}$
 -- -

3. Vehicle A averages 14 miles per gallon of gasoline, and Vehicle B averages 36 miles per gallon of gasoline. At these rates, how many more gallons of gasoline does Vehicle A need than Vehicle B to make a 1,008-mile trip?

A. 25
 B. 28
 C. 44
 D. 50
 E. 72

3. A copy machine makes 60 copies per minute. A second copy machine makes 80 copies per minute. The second machine starts making copies 2 minutes after the first machine starts. Both machines stop making copies 8 minutes after the first machine started. Together, the 2 machines made how many copies?

A. 480
 B. 600
 C. 680
 D. 720
 E. 960

5. Joelle earns her regular pay of \$7.50 per hour for up to 40 hours of work in a week. For each hour over 40 hours of work in a week, Joelle is paid $1\frac{1}{2}$ times her regular pay. How much does Joelle earn for a week in which she works 42 hours?

A. \$126.00
 B. \$315.00
 C. \$322.50
 D. \$378.00
 E. \$472.50

7. If $9(x - 9) = -11$, then $x = ?$

A. $-\frac{92}{9}$
 B. $-\frac{20}{9}$
 C. $-\frac{11}{9}$
 D. $-\frac{2}{9}$
 E. $\frac{70}{9}$

8. Discount tickets to a basketball tournament sell for \$4.00 each. Enrico spent \$60.00 on discount tickets, \$37.50 less than if he had bought the tickets at the regular price. What was the regular ticket price?

F. \$ 2.50
 G. \$ 6.40
 H. \$ 6.50
 J. \$ 7.50
 K. \$11.00

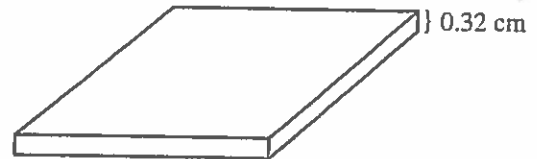
8. The shipping rate for customers of Ship Quick consists of a fee per box and a price per pound for each box. The table below gives the fee and the price per pound for customers shipping boxes of various weights.

Weight of box (pounds)	Fee	Price per pound
Less than 10	\$ 5.00	\$1.00
10-25	\$10.00	\$0.65
More than 25	\$20.00	\$0.30

Gregg wants Ship Quick to ship 1 box that weighs 15 pounds. What is the shipping rate for this box?

F. \$ 9.75
 G. \$16.50
 H. \$19.75
 J. \$20.00
 K. \$24.50

9. A computer chip 0.32 cm thick is made up of layers of silicon. If the top and bottom layers are each 0.03 cm thick and the inner layers are each 0.02 cm thick, how many inner layers are there?



A. 13
 B. 15
 C. 16
 D. 52
 E. 64

13. For 2 consecutive integers, the result of adding the smaller integer and triple the larger integer is 79. What are the 2 integers?

A. 18, 19
 B. 19, 20
 C. 20, 21
 D. 26, 27
 E. 39, 40

16. What is the least common multiple of 70, 60, and 50?

F. 60
 G. 180
 H. 210
 J. 2,100
 K. 210,000

16. A car accelerated from 88 feet per second (fps) to 220 fps in exactly 3 seconds. Assuming the acceleration was constant, what was the car's acceleration, in feet per second per second, from 88 fps to 220 fps?

- F. $\frac{1}{44}$
- G. $29\frac{1}{3}$
- H. 44
- J. $75\frac{1}{3}$
- K. $102\frac{2}{3}$

19. In scientific notation, $670,000,000 + 700,000,000 = ?$

- A. 1.37×10^{-9}
- B. 1.37×10^7
- C. 1.37×10^8
- D. 1.37×10^9
- E. 137×10^{15}

19. What is the smallest integer greater than $\sqrt{58}$?

- A. 4
- B. 7
- C. 8
- D. 10
- E. 30

27. A hot-air balloon 70 meters above the ground is falling at a constant rate of 6 meters per second while another hot-air balloon 10 meters above the ground is rising at a constant rate of 15 meters per second. To the nearest tenth of a second, after how many seconds will the 2 balloons be the same height above the ground?

- A. 8.9
- B. 6.7
- C. 2.9
- D. 0.4
- E. 0.2

40. If there are 8×10^{12} hydrogen molecules in a volume of 4×10^4 cubic centimeters, what is the average number of hydrogen molecules per cubic centimeter?

- F. 5×10^{-9}
- G. 2×10^3
- H. 2×10^8
- J. 32×10^{16}
- K. 32×10^{48}

45. Which of the following is a rational number?

- A. $\sqrt{2}$
- B. $\sqrt{\pi}$
- C. $\sqrt{7}$
- D. $\sqrt{\frac{5}{25}}$
- E. $\sqrt{\frac{64}{49}}$

46. A container is $\frac{1}{8}$ full of water. After 10 cups of water are added, the container is $\frac{3}{4}$ full. What is the volume of the container, in cups?

- F. $13\frac{1}{3}$
- G. $13\frac{1}{2}$
- H. 15
- J. 16
- K. 40

48. $\frac{4}{\sqrt{2}} + \frac{2}{\sqrt{3}} = ?$

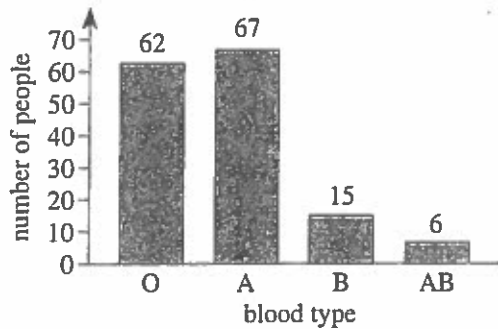
- F. $\frac{4\sqrt{3} + 2\sqrt{2}}{\sqrt{5}}$
- G. $\frac{4\sqrt{3} + 2\sqrt{2}}{\sqrt{6}}$
- H. $\frac{6}{\sqrt{2} + \sqrt{3}}$
- J. $\frac{6}{\sqrt{5}}$
- K. $\frac{8}{\sqrt{6}}$

58. For every positive 2-digit number, x , with tens digit t and units digit u , let y be the 2-digit number formed by reversing the digits of x . Which of the following expressions is equivalent to $x - y$?

- F. $9(t - u)$
- G. $9(u - t)$
- H. $9t - u$
- J. $9u - t$
- K. 0

Ratio, Proportion, and Percent

1. The blood types of 150 people were determined for a study as shown in the figure below.



If 1 person from this study is randomly selected, what is the probability that this person has either Type A or Type AB blood?

- A. $\frac{62}{150}$
 B. $\frac{66}{150}$
 C. $\frac{68}{150}$
 D. $\frac{73}{150}$
 E. $\frac{84}{150}$
3. On a particular road map, $\frac{1}{2}$ inch represents 18 miles. About how many miles apart are 2 towns that are $2\frac{1}{2}$ inches apart on this map?
- A. 18
 B. $22\frac{1}{2}$
 C. 36
 D. 45
 E. 90
6. Jorge's current hourly wage for working at Denti Smiles is \$12.00. Jorge was told that at the beginning of next month, his new hourly wage will be an increase of 6% of his current hourly wage. What will be Jorge's new hourly wage?
- F. \$12.06
 G. \$12.60
 H. \$12.72
 J. \$18.00
 K. \$19.20
7. If 40% of a given number is 8, then what is 15% of the given number?
- A. 1.2
 B. 1.8
 C. 3.0
 D. 5.0
 E. 6.0

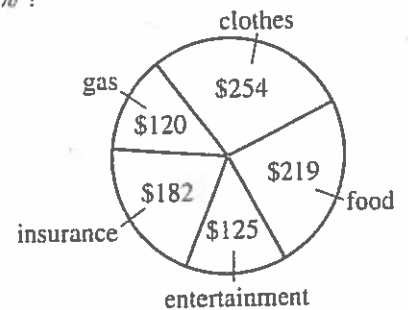
18. Janelle cut a board 30 feet long into 2 pieces. The ratio of the lengths of the 2 pieces is 2:3. What is the length, to the nearest foot, of the shorter piece?

F. 5
 G. 6
 H. 12
 J. 15
 K. 18

21. To get a driver's license, an applicant must pass a written test and a driving test. Past records show that 80% of the applicants pass the written test and 60% of those who have passed the written test pass the driving test. Based on these figures, how many applicants in a random group of 1,000 applicants would you expect to get driver's licenses?

A. 200
 B. 480
 C. 600
 D. 750
 E. 800

25. Last month, Lucie had total expenditures of \$900. The pie chart below breaks down these expenditures by category. The category in which Lucie's expenditures were greatest is what percent of her total expenditures, to the nearest 1%?



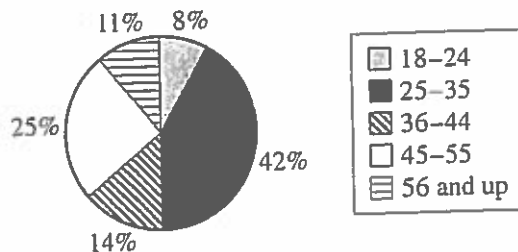
A. 24%
 B. 28%
 C. 32%
 D. 34%
 E. 39%

35. Jerome, Kevin, and Seth shared a submarine sandwich. Jerome ate $\frac{1}{2}$ of the sandwich, Kevin ate $\frac{1}{3}$ of the sandwich, and Seth ate the rest. What is the ratio of Jerome's share to Kevin's share to Seth's share?

A. 2:3:6
 B. 2:6:3
 C. 3:1:2
 D. 3:2:1
 E. 6:3:2

43. The circle graph below shows the distribution of registered voters, by age, for a community. Registered voters are randomly selected from this distribution to be called for jury duty. What are the odds (in the age range: not in the age range) that the first person called for jury duty is in the age range of 25–35 years?

Distribution of Registered Voters by Age



- A. 1:3
 B. 7:8
 C. 7:43
 D. 21:29
 E. 42:25

47. Only tenth-, eleventh-, and twelfth-grade students attend Washington High School. The ratio of tenth graders to the school's total student population is 86:255, and the ratio of eleventh graders to the school's total student population is 18:51. If 1 student is chosen at random from the entire school, which grade is that student most likely to be in?

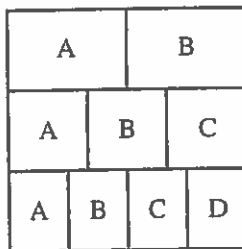
- A. Tenth
 B. Eleventh
 C. Twelfth
 D. All grades are equally likely.
 E. Cannot be determined from the given information

51. If $x:y = 5:2$ and $y:z = 3:2$, what is the ratio of $x:z$?

- A. 3:1
 B. 3:5
 C. 5:3
 D. 8:4
 E. 15:4

56. The square below is divided into 3 rows of equal area. In the top row, the region labeled A has the same area as the region labeled B. In the middle row, the 3 regions have equal areas. In the bottom row, the 4 regions have equal areas. What fraction of the square's area is in a region labeled A?

- F. $\frac{1}{9}$
 G. $\frac{3}{9}$
 H. $\frac{6}{9}$
 J. $\frac{13}{12}$
 K. $\frac{13}{36}$



Absolute Value and Ordering Numbers by Value

1. $|7-3| - |3-7| = ?$

- A. -8
- B. -6
- C. -4
- D. 0
- E. 8

18. In which of the following are $\frac{1}{2}$, $\frac{5}{6}$, and $\frac{5}{8}$ arranged in ascending order?

F. $\frac{1}{2} < \frac{5}{8} < \frac{5}{6}$

G. $\frac{5}{6} < \frac{1}{2} < \frac{5}{8}$

H. $\frac{5}{6} < \frac{5}{8} < \frac{1}{2}$

J. $\frac{5}{8} < \frac{1}{2} < \frac{5}{6}$

K. $\frac{5}{8} < \frac{5}{6} < \frac{1}{2}$

26. $-3|-6+8| = ?$

- F. -42
- G. -6
- H. -1
- J. 6
- K. 42

32. What fraction lies exactly halfway between $\frac{2}{3}$ and $\frac{3}{4}$?

F. $\frac{3}{5}$

G. $\frac{5}{6}$

H. $\frac{7}{12}$

J. $\frac{9}{16}$

K. $\frac{17}{24}$

42. What rational number is halfway between $\frac{1}{5}$ and $\frac{1}{3}$?

F. $\frac{1}{2}$

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

H. $\frac{2}{15}$

J. $\frac{4}{15}$

K. $\frac{8}{15}$

46. If $a < b$, then $|a - b|$ is equivalent to which of the following?

F. $a + b$

G. $-(a + b)$

H. $\sqrt{a - b}$

J. $a - b$

K. $-(a - b)$

Probability

12. In the school cafeteria, students choose their lunch from 3 sandwiches, 3 soups, 4 salads, and 2 drinks. How many different lunches are possible for a student who chooses exactly 1 sandwich, 1 soup, 1 salad, and 1 drink?
- F. 2
G. 4
H. 12
J. 36
K. 72
23. In a basketball passing drill, 5 basketball players stand evenly spaced around a circle. The player with the ball (the passer) passes it to another player (the receiver). The receiver cannot be the player to the passer's immediate right or left and cannot be the player who last passed the ball. A designated player begins the drill as the first passer. This player will be the receiver for the first time on which pass of the ball?
- A. 4th
B. 5th
C. 6th
D. 10th
E. 24th
28. A hiking group will go from a certain town to a certain village by van on 1 of 4 roads, from the village to a waterfall by riding bicycles on 1 of 2 bicycle paths, and then from the waterfall to their campsite by hiking on 1 of 6 trails. How many routes are possible for the hiking group to go from the town to the village to the waterfall to their campsite?
- F. 6
G. 12
H. 24
J. 48
K. 220
31. To make a 750-piece jigsaw puzzle more challenging, a puzzle company includes 5 extra pieces in the box along with the 750 pieces, and those 5 extra pieces do not fit anywhere in the puzzle. If you buy such a puzzle box, break the seal on the box, and immediately select 1 piece at random, what is the probability that it will be 1 of the extra pieces?
- A. $\frac{1}{5}$
B. $\frac{1}{755}$
C. $\frac{1}{750}$
D. $\frac{5}{755}$
E. $\frac{5}{750}$
32. A bag contains 12 red marbles, 5 yellow marbles, and 15 green marbles. How many additional red marbles must be added to the 32 marbles already in the bag so that the probability of randomly drawing a red marble is $\frac{3}{5}$?
- F. 13
G. 18
H. 28
J. 32
K. 40
51. An integer from 100 through 999, inclusive, is to be chosen at random. What is the probability that the number chosen will have 0 as at least 1 digit?
- A. $\frac{19}{900}$
B. $\frac{81}{900}$
C. $\frac{90}{900}$
D. $\frac{171}{900}$
E. $\frac{271}{1,000}$
59. As part of a probability experiment, Elliott is to answer 4 multiple-choice questions. For each question, there are 3 possible answers, only 1 of which is correct. If Elliott randomly and independently answers each question, what is the probability that he will answer the 4 questions correctly?
- A. $\frac{27}{81}$
B. $\frac{12}{81}$
C. $\frac{4}{81}$
D. $\frac{3}{81}$
E. $\frac{1}{81}$

Mean, Median, and Mode

2. The monthly fees for single rooms at 5 colleges are \$370, \$310, \$380, \$340, and \$310, respectively. What is the mean of these monthly fees?
- F. \$310
 G. \$340
 H. \$342
 J. \$350
 K. \$380

4. Marlon is bowling in a tournament and has the highest average after 5 games, with scores of 210, 225, 254, 231, and 280. In order to maintain this exact average, what *must* be Marlon's score for his 6th game?
- F. 200
 G. 210
 H. 231
 J. 240
 K. 245

10. The table below shows the number of cars Jing sold each month last year. What is the median of the data in the table?

Month	Number of cars sold
January	25
February	15
March	22
April	19
May	16
June	13
July	19
August	25
September	26
October	27
November	28
December	29

- F. 13
 G. 16
 H. 19
 J. 20.5
 K. 23.5

33. The table below shows the total number of goals scored in each of 43 soccer matches in a regional tournament. What is the average number of goals scored per match, to the nearest 0.1 goal?

Total number of goals in a match	Number of matches with this total
0	4
1	10
2	5
3	9
4	7
5	5
6	1
7	2

- A. 1.0
 B. 2.8
 C. 3.0
 D. 6.1
 E. 17.1

37. What is the difference between the mean and the median of the set {3, 8, 10, 15}?

- A. 0
 B. 1
 C. 4
 D. 9
 E. 12

47. Tom has taken 5 of the 8 equally weighted tests in his U.S. History class this semester, and he has an average score of exactly 78.0 points. How many points does he need to earn on the 6th test to bring his average score up to exactly 80.0 points?

- A. 90
 B. 88
 C. 82
 D. 80
 E. 79

Elementary
Algebra

Substitution

2. If $r = 9$, $b = 5$, and $g = -6$, what does $(r + b - g)(b + g)$ equal?
- F. -20
 - G. -8
 - H. 8
 - J. 19
 - K. 20

4. Given $f = cd^3$, $f = 450$, and $d = 10$, what is c ?
- F. 0.45
 - G. 4.5
 - H. 15
 - J. 45
 - K. 150

19. A group of cells grows in number as described by the equation $y = 16(2)^t$, where t represents the number of days and y represents the number of cells. According to this formula, how many cells will be in the group at the end of the first 5 days?
- A. 80
 - B. 160
 - C. 400
 - D. 512
 - E. 1,280

30. A formula used to compute the current value of a savings account is $A = P(1 + r)^n$, where A is the current value; P is the amount deposited; r is the rate of interest for 1 compounding period, expressed as a decimal; and n is the number of compounding periods. Which of the following is closest to the value of a savings account after 5 years if \$10,000 is deposited at 4% annual interest compounded yearly?
- F. \$10,400
 - G. \$12,167
 - H. \$42,000
 - J. \$52,000
 - K. \$53,782

54. A formula for finding the value, A dollars, of P dollars invested at $i\%$ interest compounded annually for n years is $A = P(1 + 0.01i)^n$. Which of the following is an expression for P in terms of i , n , and A ?
- F. $A - 0.01i^n$
 - G. $A + 0.01i^n$
 - H. $\left(\frac{A}{1 + 0.01i}\right)^n$
 - J. $\frac{A}{(1 - 0.01i)^n}$
 - K. $\frac{A}{(1 + 0.01i)^n}$

Using Variables
to Express
Relationships

1. The weekly fee for staying at the Pleasant Lake Campground is \$20 per vehicle and \$10 per person. Last year, weekly fees were paid for v vehicles and p persons. Which of the following expressions gives the total amount, in dollars, collected for weekly fees last year?
- A. $20v + 10p$
 - B. $20p + 10v$
 - C. $10(v + p)$
 - D. $30(v + p)$
 - E. $10(v + p) + 20p$
6. Which of the following mathematical expressions is equivalent to the verbal expression "A number, x , squared is 39 more than the product of 10 and x "?
- F. $2x = 39 + 10x$
 - G. $2x = 39x + 10x$
 - H. $x^2 = 39 - 10x$
 - J. $x^2 = 39 + x^{10}$
 - K. $x^2 = 39 + 10x$
24. The fixed costs of manufacturing basketballs in a factory are \$1,400.00 per day. The variable costs are \$5.25 per basketball. Which of the following expressions can be used to model the cost of manufacturing b basketballs in 1 day?
- F. $\$1,405.25b$
 - G. $\$5.25b - \$1,400.00$
 - H. $\$1,400.00b + \5.25
 - J. $\$1,400.00 - \$5.25b$
 - K. $\$1,400.00 + \$5.25b$
54. A dog eats 7 cans of food in 3 days. At this rate, how many cans of food does the dog eat in $3 + d$ days?
- F. $\frac{7}{3} + d$
 - G. $\frac{7}{3} + \frac{d}{3}$
 - H. $\frac{7}{3} + \frac{7}{3d}$
 - J. $7 + \frac{d}{3}$
 - K. $7 + \frac{7d}{3}$

Performing Algebraic Operations

4. $t^2 - 59t + 54 - 82t^2 + 60t$ is equivalent to:

- F. $-26t^2$
- G. $-26t^6$
- H. $-81t^4 + t^2 + 54$
- J. $-81t^2 + t + 54$
- K. $-82t^2 + t + 54$

6. The expression $(4z + 3)(z - 2)$ is equivalent to:

- F. $4z^2 - 5$
- G. $4z^2 - 6$
- H. $4z^2 - 3z - 5$
- J. $4z^2 - 5z - 6$
- K. $4z^2 + 5z - 6$

8. The 6 consecutive integers below add up to 447.

$$\begin{array}{l} x-2 \\ x-1 \\ x \\ x+1 \\ x+2 \\ x+3 \end{array}$$

What is the value of x ?

- F. 72
- G. 73
- H. 74
- J. 75
- K. 76

9. The expression $(3x - 4y^2)(3x + 4y^2)$ is equivalent to:

- A. $9x^2 - 16y^4$
- B. $9x^2 - 8y^4$
- C. $9x^2 + 16y^4$
- D. $6x^2 - 16y^4$
- E. $6x^2 - 8y^4$

21. $(a + 2b + 3c) - (4a + 6b - 5c)$ is equivalent to:

- A. $-4a - 8b - 2c$
- B. $-4a - 4b + 8c$
- C. $-3a + 8b - 2c$
- D. $-3a - 4b - 2c$
- E. $-3a - 4b + 8c$

23. Which of the following expressions is equivalent to

$$\frac{1}{2}y^2(6x + 2y + 12x - 2y)?$$

- A. $9xy^2$
- B. $18xy$
- C. $3xy^2 + 12x$
- D. $9xy^2 - 2y^3$
- E. $3xy^2 + 12x - y^3 - 2y$

55. If x and y are real numbers such that $x > 1$ and $y < -1$, then which of the following inequalities *must* be true?

- A. $\frac{x}{y} > 1$
- B. $|x|^2 > |y|$
- C. $\frac{x}{3} - 5 > \frac{y}{3} - 5$
- D. $x^2 + 1 > y^2 + 1$
- E. $x^{-2} > y^{-2}$

Quadratic Equations

21. What values of x are solutions for $x^2 + 2x = 8$?

- A. -4 and 2
- B. -2 and 0
- C. -2 and 4
- D. 0 and 2
- E. 6 and 8

24. An artist makes a profit of $(500p - p^2)$ dollars from selling p paintings. What is the fewest number of paintings the artist can sell to make a profit of at least \$60,000?

- F. 100
- G. 150
- H. 200
- J. 300
- K. 600

59. In the equation $x^2 + mx + n = 0$, m and n are integers. The *only* possible value for x is -3 . What is the value of m ?

- A. 3
- B. -3
- C. 6
- D. -6
- E. 9

Rational and Radical Expressions

Intermediate Algebra

15. If $3^x = 54$, then which of the following must be true?

- A. $1 < x < 2$
- B. $2 < x < 3$
- C. $3 < x < 4$
- D. $4 < x < 5$
- E. $5 < x$

22. If a , b , and c are positive integers such that $a^b = x$ and $c^b = y$, then $xy = ?$

- F. ac^b
- G. ac^{2b}
- H. $(ac)^b$
- J. $(ac)^{2b}$
- K. $(ac)^{b^2}$

22. For all $a > 1$, the expression $\frac{3a^4}{3a^6}$ equals:

- F. $\frac{1}{2}$
- G. $-a^2$
- H. a^2
- J. $-\frac{1}{a^2}$
- K. $\frac{1}{a^2}$

25. The expression $-8x^3(7x^6 - 3x^5)$ is equivalent to:

- A. $-56x^9 + 24x^8$
- B. $-56x^9 - 24x^8$
- C. $-56x^{18} + 24x^{15}$
- D. $-56x^{18} - 24x^{15}$
- E. $-32x^4$

26. If $\frac{3\sqrt{7}}{a\sqrt{7}} = \frac{3\sqrt{7}}{7}$ is true, then $a = ?$

- F. 1
- G. $\sqrt{7}$
- H. 7
- J. 21
- K. 49

35. $(3x^3)^3$ is equivalent to:






- A. x
- B. $9x^6$
- C. $9x^9$
- D. $27x^6$
- E. $27x^9$

49. In the real numbers, what is the solution of the equation $8^{2x+1} = 4^{1-x}$?

- A. $-\frac{1}{3}$
- B. $-\frac{1}{4}$
- C. $-\frac{1}{8}$
- D. 0
- E. $\frac{1}{7}$

Absolute Value Equations and Inequalities

58. Which of the following number line graphs shows the solution set to the inequality $|x - 5| < -1$?

- F. 
- G. 
- H. 
- J. 
- K. 
(empty set)

60. The solution set of which of the following equations is the set of real numbers that are 5 units from -3 ?

- F. $|x + 3| = 5$
- G. $|x - 3| = 5$
- H. $|x + 5| = 3$
- J. $|x - 5| = 3$
- K. $|x + 5| = 3$

Sequences

7. The first term is 1 in the geometric sequence 1, -3, 9, -27, ... What is the SEVENTH term of the geometric sequence?

A. -243
B. -30
C. 81
D. 189
E. 729

58. What is the sum of the first 4 terms of the arithmetic sequence in which the 6th term is 8 and the 10th term is 13?

F. 10.5
G. 14.5
H. 18
J. 21.25
K. 39.5

60. The sum of an infinite geometric series with first term a and common ratio $r < 1$ is given by $\frac{a}{1-r}$. The sum of a given infinite geometric series is 200, and the common ratio is 0.15. What is the second term of this series?

F. 25.5
G. 30
H. 169.85
J. 170
K. 199.85

Systems

15. This month, Kami sold 70 figurines in 2 sizes. The large figurines sold for \$12 each, and the small figurines sold for \$8 each. The amount of money he received from the sales of the large figurines was equal to the amount of money he received from the sales of the small figurines. How many large figurines did Kami sell this month?

A. 20
B. 28
C. 35
D. 42
E. 50

41. The equations below are linear equations of a system where a , b , and c are positive integers.

$$ay + bx = c$$
$$ay - bx = c$$

Which of the following describes the graph of at least 1 such system of equations in the standard (x,y) coordinate plane?

- I. 2 parallel lines
II. 2 intersecting lines
III. A single line

A. I only
B. II only
C. III only
D. I or II only
E. I, II, or III

49. For what value of a would the following system of equations have an infinite number of solutions?

$$2x - y = 8$$
$$6x - 3y = 4a$$

A. 2
B. 6
C. 8
D. 24
E. 32

Inequalities

29. The inequality $6(x + 2) > 7(x - 5)$ is equivalent to which of the following inequalities?

A. $x < -23$
B. $x < 7$
C. $x < 17$
D. $x < 37$
E. $x < 47$

36. Which of the following is equivalent to the inequality $4x - 8 > 8x + 16$?

F. $x < -6$
G. $x > -6$
H. $x < -2$
J. $x > 2$
K. $x < 6$

52. Which of the following is the solution statement for the inequality shown below?

$$-5 < 1 - 3x < 10$$

F. $-5 < x < 10$
G. $-3 < x$
H. $-3 < x < 2$
J. $-2 < x < 3$
K. $x < -3$ or $x > 2$

Functions

5. If $f(x) = (3x + 7)^2$, then $f(1) = ?$

- A. 10
- B. 16
- C. 58
- D. 79
- E. 100

14. A function $f(x)$ is defined as $f(x) = -8x^2$. What is $f(-3)$?

- F. -72
- G. 72
- H. 192
- J. -576
- K. 576

32. Given $f(x) = 4x + 1$ and $g(x) = x^2 - 2$, which of the following is an expression for $f(g(x))$?

- F. $-x^2 + 4x + 1$
- G. $x^2 + 4x - 1$
- H. $4x^2 - 7$
- J. $4x^2 - 1$
- K. $16x^2 + 8x - 1$

42. Given $f(x) = x - \frac{1}{x}$ and $g(x) = \frac{1}{x}$, what is $f\left(g\left(\frac{1}{2}\right)\right)$?

- F. -3
- G. $-\frac{3}{2}$
- H. $-\frac{2}{3}$
- J. 0
- K. $\frac{3}{2}$

43. A formula to estimate the monthly payment, p dollars, on a short-term loan is

$$p = \frac{\frac{1}{2}ary + a}{12y}$$

where a dollars is the amount of the loan, r is the annual interest rate expressed as a decimal, and y years is the length of the loan. When a is multiplied by 2, what is the effect on p ?

- A. p is divided by 6
- B. p is divided by 2
- C. p does not change
- D. p is multiplied by 2
- E. p is multiplied by 4

Logic

55. Kelly asked 120 students questions about skiing. The results of the poll are shown in the table below.

Question	Yes	No
1. Have you skied either cross-country or downhill?	65	55
2. If you answered Yes to Question 1, did you ski downhill?	28	37
3. If you answered Yes to Question 1, did you ski cross-country?	45	20

After completing the poll, Kelly wondered how many of the students polled had skied both cross-country *and* downhill. How many of the students polled indicated that they had skied both cross-country and downhill?

- A. 73
- B. 65
- C. 47
- D. 18
- E. 8

Matrices

11. Daisun owns 2 sportswear stores (X and Y). She stocks 3 brands of T-shirts (A, B, and C) in each store. The matrices below show the numbers of each type of T-shirt in each store and the cost for each type of T-shirt. The value of Daisun's T-shirt inventory is computed using the costs listed. What is the total value of the T-shirt inventory for Daisun's 2 stores?

	A	B	C	Cost
X	100	200	150	A: \$5
Y	120	50	100	B: \$10
				C: \$15

- A. \$2,200
 B. \$2,220
 C. \$4,965
 D. \$5,450
 E. \$7,350
45. Given that $a \begin{bmatrix} 2 & 6 \\ 1 & 4 \end{bmatrix} = \begin{bmatrix} x & 27 \\ y & z \end{bmatrix}$ for some real number a , what is $x + z$?
- A. $\frac{4}{3}$
 B. $\frac{27}{2}$
 C. 26
 D. 27
 E. 48

53. The *determinant* of a matrix $\begin{bmatrix} a & b \\ c & d \end{bmatrix}$ equals $ad - cb$.

What must be the value of x for the matrix $\begin{bmatrix} x & 8 \\ x & x \end{bmatrix}$ to have a determinant of -16 ?

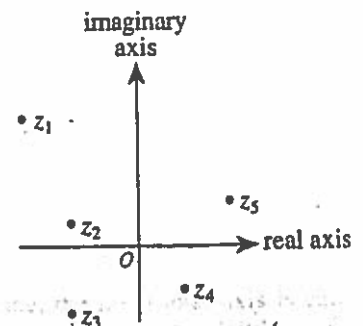
- A. -4
 B. -2
 C. $-\frac{8}{5}$
 D. $\frac{8}{3}$
 E. 4

Complex Numbers

29. What is the product of the complex numbers $(-3i + 4)$ and $(3i + 4)$?

- A. 1
 B. 7
 C. 25
 D. $-7 + 24i$
 E. $7 + 24i$

48. In the complex plane, the horizontal axis is called the *real axis* and the vertical axis is called the *imaginary axis*. The complex number $a + bi$ graphed in the complex plane is comparable to the point (a, b) graphed in the standard (x, y) coordinate plane. The *modulus* of the complex number $a + bi$ is given by $\sqrt{a^2 + b^2}$. Which of the complex numbers $z_1, z_2, z_3, z_4,$ and z_5 below has the greatest modulus?

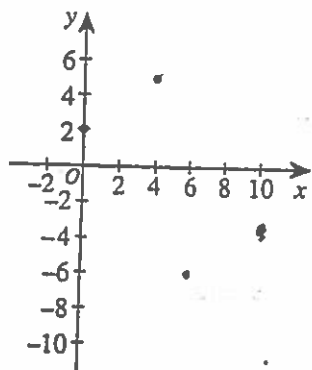


- F. z_1
 G. z_2
 H. z_3
 J. z_4
 K. z_5

Graphing

Coordinate Geometry

10. Rectangle $ABCD$ has vertices $A(4,5)$, $B(0,2)$, and $C(6,-6)$. These vertices are graphed below in the standard (x,y) coordinate plane. What are the coordinates of vertex D ?



- F. $(10, -3)$
- G. $(9, -2)$
- H. $(8, 2)$
- J. $(7, 1)$
- K. $(2, -9)$

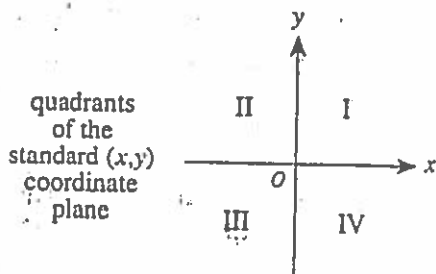
11. Students studying motion observed a cart rolling at a constant rate along a straight line. The table below gives the distance, d feet, the cart was from a reference point at 1-second intervals from $t = 0$ seconds to $t = 5$ seconds.

t	0	1	2	3	4	5
d	14	20	26	32	38	44

Which of the following equations represents this relationship between d and t ?

- A. $d = t + 14$
- B. $d = 6t + 8$
- C. $d = 6t + 14$
- D. $d = 14t + 6$
- E. $d = 34t$

23. If point M has a nonzero x -coordinate and a nonzero y -coordinate and the coordinates have opposite signs, then point M must be located in which of the 4 quadrants labeled below?



- A. I only
- B. III only
- C. I or III only
- D. I or IV only
- E. II or IV only

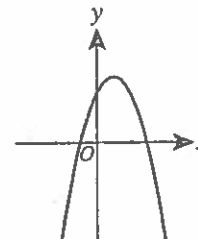
28. As part of a lesson on motion, students observed a cart rolling at a constant rate along a straight line. As shown in the chart below, they recorded the distance, y feet, of the cart from a reference point at 1-second intervals from $t = 0$ seconds to $t = 5$ seconds.

t	0	1	2	3	4	5
y	14	19	24	29	34	39

Which of the following equations represents this data?

- F. $y = t + 14$
- G. $y = 5t + 9$
- H. $y = 5t + 14$
- J. $y = 14t + 5$
- K. $y = 19t$

28. The equation $y = ax^2 + bx + c$ is graphed in the standard (x,y) coordinate plane below for real values of a , b , and c . When $y = 0$, which of the following best describes the solutions for x ?

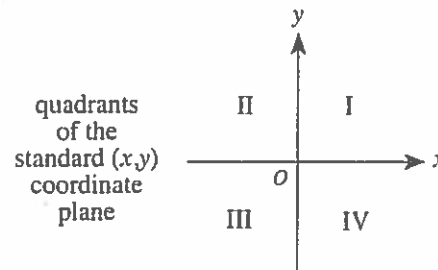


- F. 2 distinct positive real solutions
- G. 2 distinct negative real solutions
- H. 1 positive real solution and 1 negative real solution
- J. 2 real solutions that are not distinct
- K. 2 distinct solutions that are not real

30. The sides of a square are 3 cm long. One vertex of the square is at $(2,0)$ on a square coordinate grid marked in centimeter units. Which of the following points could also be a vertex of the square?

- F. $(-4, 0)$
- G. $(0, 1)$
- H. $(1, -1)$
- J. $(4, 1)$
- K. $(5, 0)$

33. What are the quadrants of the standard (x,y) coordinate plane below that contain points on the graph of the equation $4x - 2y = 8$?

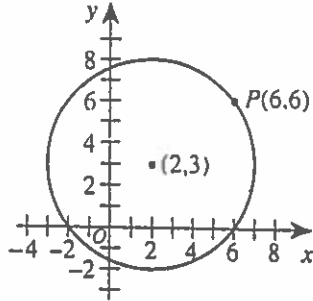


- A. I and III only
- B. I, II, and III only
- C. I, II, and IV only
- D. I, III, and IV only
- E. II, III, and IV only

34. The graph of $y = -5x^2 + 9$ passes through $(1, 2a)$ in the standard (x, y) coordinate plane. What is the value of a ?

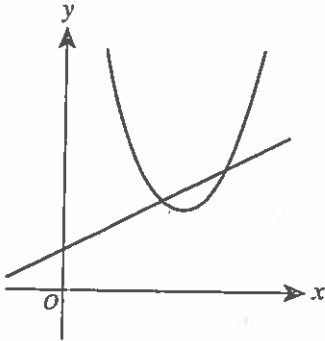
- F. 2
- G. 4
- H. 7
- J. -1
- K. -8

37. As shown in the standard (x, y) coordinate plane below, $P(6, 6)$ lies on the circle with center $(2, 3)$ and radius 5 coordinate units. What are the coordinates of the image of P after the circle is rotated 90° clockwise (C) about the center of the circle?



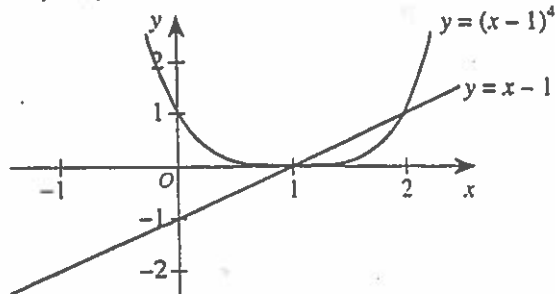
- A. (2, 3)
- B. (3, 2)
- C. (5, -1)
- D. (6, 0)
- E. (7, 3)

38. Which of the following describes a true relationship between the functions $f(x) = (x - 3)^2 + 2$ and $g(x) = \frac{1}{2}x + 1$ graphed below in the standard (x, y) coordinate plane?



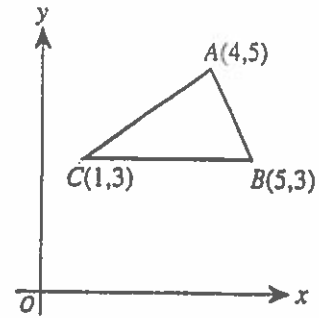
- F. $f(x) = g(x)$ for exactly 2 values of x
- G. $f(x) = g(x)$ for exactly 1 value of x
- H. $f(x) < g(x)$ for all x
- J. $f(x) > g(x)$ for all x
- K. $f(x)$ is the inverse of $g(x)$

57. The graphs of the equations $y = x - 1$ and $y = (x - 1)^4$ are shown in the standard (x, y) coordinate plane below. What real values of x , if any, satisfy the inequality $(x - 1)^4 < (x - 1)$?



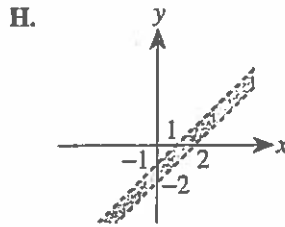
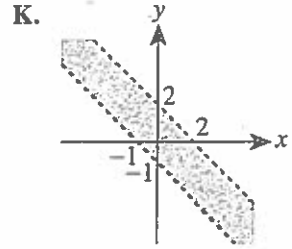
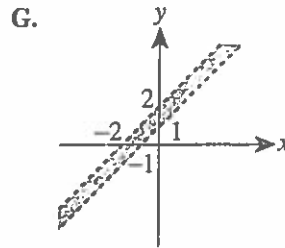
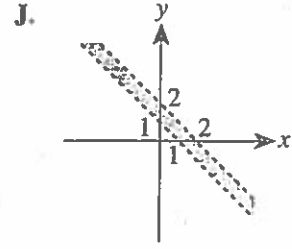
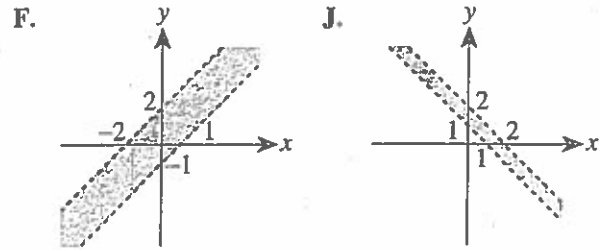
- A. No real values
- B. $x < 0$ and $x > 1$
- C. $x < 1$ and $x > 2$
- D. $0 < x < 1$
- E. $1 < x < 2$

59. In the figure below, the vertices of $\triangle ABC$ have (x, y) coordinates $(4, 5)$, $(5, 3)$, and $(1, 3)$, respectively. What is the area of $\triangle ABC$?

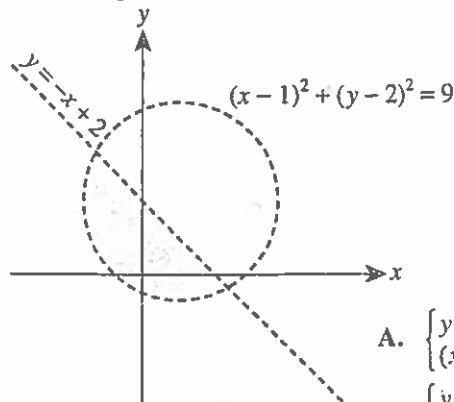


- A. 4
- B. $4\sqrt{2}$
- C. $4\sqrt{3}$
- D. 8
- E. $8\sqrt{2}$

36. Which of the following is the graph of the region $1 < x + y < 2$ in the standard (x, y) coordinate plane?



49. The shaded region in the graph below represents the solution set to which of the following systems of inequalities?



- A. $\begin{cases} y < -x + 2 \\ (x - 1)^2 + (y - 2)^2 < 9 \end{cases}$
- B. $\begin{cases} y > -x + 2 \\ (x - 1)^2 + (y - 2)^2 < 9 \end{cases}$
- C. $\begin{cases} y > -x + 2 \\ (x - 1)^2 + (y - 2)^2 > 9 \end{cases}$
- D. $\begin{cases} y < -x + 2 \\ (x - 1)^2 + (y - 2)^2 > 9 \end{cases}$
- E. $\begin{cases} (y - 2) < 3 \\ (x - 1) > 3 \end{cases}$

Distance, Midpoint, and Conics

Slope and Lines (Parallel and Perpendicular)

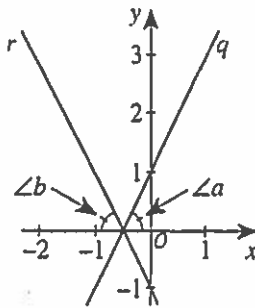
17. Which of the following is the slope of a line parallel to the line $y = \frac{2}{3}x - 4$ in the standard (x,y) coordinate plane?

- A. -4
- B. $-\frac{3}{2}$
- C. 2
- D. $\frac{3}{2}$
- E. $\frac{2}{3}$

24. Lines p and n lie in the standard (x,y) coordinate plane. An equation for line p is $y = 0.12x + 3,000$. The slope of line n is 0.1 greater than the slope of line p . What is the slope of line n ?

- F. 0.012
- G. 0.02
- H. 0.22
- J. 1.2
- K. 300

52. In the figure below, line q in the standard (x,y) coordinate plane has equation $-2x + y = 1$ and intersects line r , which is distinct from line q , at a point on the x -axis. The angles, $\angle a$ and $\angle b$, formed by these lines and the x -axis are congruent. What is the slope of line r ?



- F. -2
- G. $-\frac{1}{2}$
- H. $\frac{1}{2}$
- J. 2
- K. Cannot be determined from the given information

9. In the standard (x,y) coordinate plane, point M with coordinates $(5,4)$ is the midpoint of \overline{AB} , and B has coordinates $(7,3)$. What are the coordinates of A ?

- A. $(17,11)$
- B. $(9, 2)$
- C. $(6, 3.5)$
- D. $(3, 5)$
- E. $(-3,-5)$

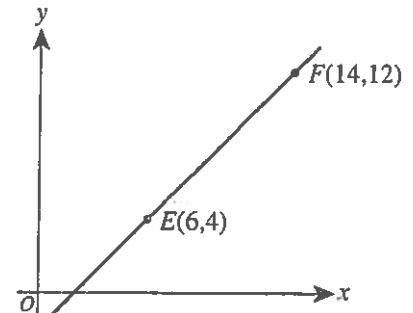
36. A particular circle in the standard (x,y) coordinate plane has an equation of $(x - 5)^2 + y^2 = 38$. What are the radius of the circle, in coordinate units, and the coordinates of the center of the circle?

	radius	center
F.	$\sqrt{38}$	$(5,0)$
G.	19	$(5,0)$
H.	38	$(5,0)$
J.	$\sqrt{38}$	$(-5,0)$
K.	19	$(-5,0)$

39. The coordinates of the endpoints of \overline{CD} , in the standard (x,y) coordinate plane, are $(-4,-2)$ and $(14,2)$. What is the x -coordinate of the midpoint of \overline{CD} ?

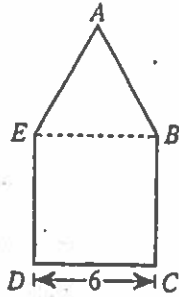
- A. 0
- B. 2
- C. 5
- D. 9
- E. 10

44. The points $E(6,4)$ and $F(14,12)$ lie in the standard (x,y) coordinate plane shown below. Point D lies on \overline{EF} between E and F such that the length of \overline{EF} is 4 times the length of \overline{DE} . What are the coordinates of D ?



- F. $(7, 5)$
- G. $(8, 6)$
- H. $(8, 8)$
- J. $(10, 8)$
- K. $(12,10)$

5. The figure below is composed of square $BCDE$ and equilateral triangle $\triangle ABE$. The length of \overline{CD} is 6 inches. What is the perimeter of $ABCDE$, in inches?



- A. 18
B. 24
C. 30
D. 42
E. 45

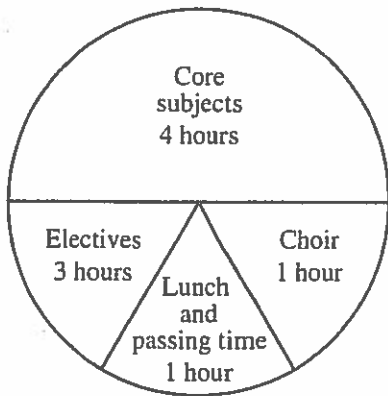
10. A rectangle has an area of 32 square feet and a perimeter of 24 feet. What is the shortest of the side lengths, in feet, of the rectangle?

- F. 1
G. 2
H. 3
J. 4
K. 8

12. The length of a rectangle with area 54 square centimeters is 9 centimeters. What is the perimeter of the rectangle, in centimeters?

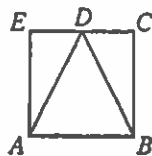
- F. 6
G. 12
H. 15
J. 24
K. 30

14. Antwan drew the circle graph below describing his time spent at school in 1 day. His teacher said that the numbers of hours listed were correct, but that the central angle measures for the sectors were not correct. What should be the central angle measure for the Core subjects sector?



- F. 72°
G. 80°
H. 160°
J. 200°
K. 288°

16. In square $ABCE$ shown below, D is the midpoint of \overline{CE} . Which of the following is the ratio of the area of $\triangle ADE$ to the area of $\triangle ADB$?



- F. 1:1
G. 1:2
H. 1:3
J. 1:4
K. 1:8

18. Four points, A , B , C , and D , lie on a circle having a circumference of 15 units. B is 2 units counterclockwise from A . C is 5 units clockwise from A and 8 units counterclockwise from A . D is 7 units clockwise from A and 8 units counterclockwise from A . What is the order of the points, starting with A and going clockwise around the circle?

- F. A, B, C, D
G. A, B, D, C
H. A, C, B, D
J. A, C, D, B
K. A, D, C, B

20. The length of a rectangle is 3 times the length of a smaller rectangle. The 2 rectangles have the same width. The area of the smaller rectangle is A square units. The area of the larger rectangle is kA square units. Which of the following is the value of k ?

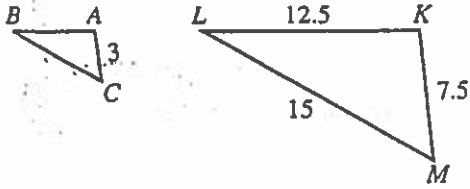
- F. $\frac{1}{9}$
G. $\frac{1}{3}$
H. 1
J. 3
K. 9

20. Sergio plans to paint the 4 walls of his room with 1 coat of paint. The walls are rectangular, and, according to his measurements, each wall is 10 feet by 15 feet. He will not need to paint the single 3-foot-by-5-foot rectangular window in his room and the $3\frac{1}{2}$ -foot-by-7-foot rectangular door. Sergio knows that each gallon of paint covers between 300 and 350 square feet. If only 1-gallon cans of paint are available, which of the following is the minimum number of cans of paint Sergio needs to buy to paint his walls?

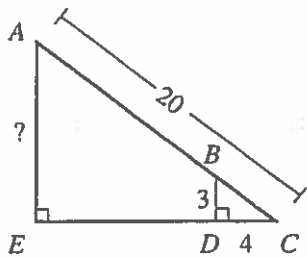
- F. 1
G. 2
H. 3
J. 4
K. 5

25. In the figure below, where $\triangle ABC \sim \triangle KLM$, lengths given are in centimeters. What is the perimeter, in centimeters, of $\triangle ABC$?

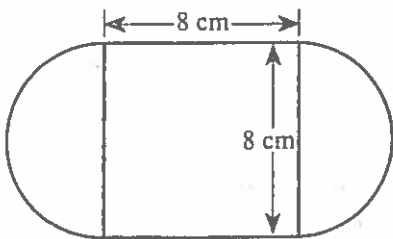
(Note: The symbol \sim means "is similar to.")



- A. 12
 B. 14
 C. $21\frac{1}{2}$
 D. 35
 E. $71\frac{3}{4}$
27. In right triangle $\triangle ACE$ below, \overline{BD} is parallel to \overline{AE} , and \overline{BD} is perpendicular to \overline{EC} at D . The length of \overline{AC} is 20 feet, the length of \overline{BD} is 3 feet, and the length of \overline{CD} is 4 feet. What is the length, in feet, of \overline{AE} ?

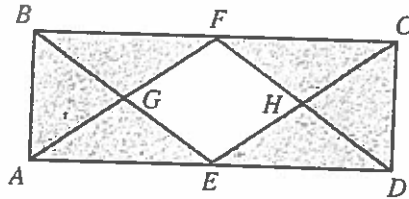


- A. 10
 B. 12
 C. 15
 D. 16
 E. 17
37. The figure below consists of a square and 2 semicircles, with dimensions as shown. What is the outside perimeter, in centimeters, of the figure?

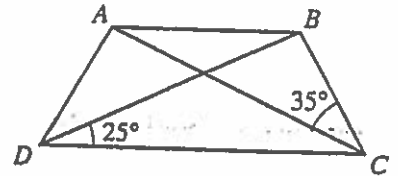


- A. $8 + 8\pi$
 B. $16 + 8\pi$
 C. $16 + 16\pi$
 D. $32 + 8\pi$
 E. $32 + 16\pi$

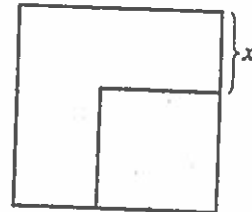
38. In the figure below, points E and F are the midpoints of sides \overline{AD} and \overline{BC} of rectangle $ABCD$, point G is the intersection of \overline{AF} and \overline{BE} , and point H is the intersection of \overline{CE} and \overline{DF} . The interior of $ABCD$ except for the interior of $EGFH$ is shaded. What is the ratio of the area of $EGFH$ to the area of the shaded region?



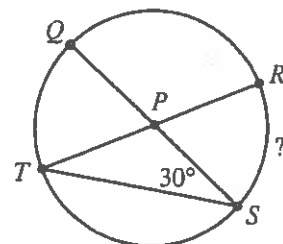
- F. 1:2
 G. 1:3
 H. 1:4
 J. 1:6
 K. Cannot be determined from the given information
43. In isosceles trapezoid $ABCD$, \overline{AB} is parallel to \overline{DC} , $\angle BDC$ measures 25° , and $\angle BCA$ measures 35° . What is the measure of $\angle DBC$?



- A. 85°
 B. 95°
 C. 105°
 D. 115°
 E. 125°
44. In the figure below, the area of the larger square is 50 square centimeters and the area of the smaller square is 18 square centimeters. What is x , in centimeters?



- F. 2
 G. $2\sqrt{2}$
 H. $4\sqrt{2}$
 J. 16
 K. 32
48. In the circle shown below, chords \overline{TR} and \overline{QS} intersect at P , which is the center of the circle, and the measure of $\angle PST$ is 30° . What is the degree measure of minor arc \overline{RS} ?

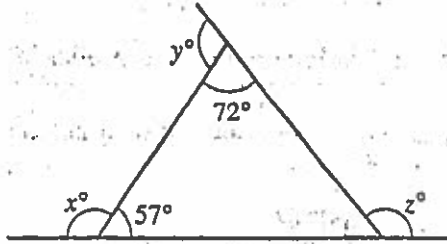


- F. 30°
 G. 45°
 H. 60°
 J. 90°
 K. Cannot be determined from the given information

11. In $\triangle ABC$, the sum of the measures of $\angle A$ and $\angle B$ is 47° . What is the measure of $\angle C$?

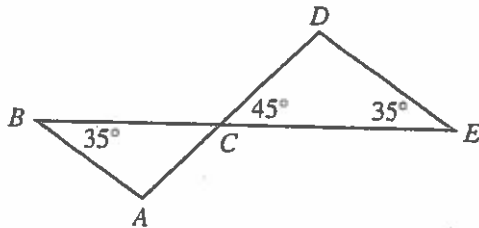
A. 47°
 B. 86°
 C. 94°
 D. 133°
 E. 143°

12. Given the triangle shown below with exterior angles that measure x° , y° , and z° as shown, what is the sum of x , y , and z ?



F. 180
 G. 231
 H. 309
 J. 360
 K. Cannot be determined from the given information

13. In the figure below, C is the intersection of \overline{AD} and \overline{BE} . If it can be determined, what is the measure of $\angle BAC$?



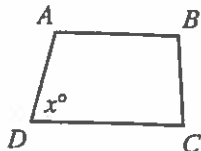
A. 80°
 B. 100°
 C. 110°
 D. 115°
 E. Cannot be determined from the given information

17. In a plane, the distinct lines \overleftrightarrow{AB} and \overleftrightarrow{CD} intersect at A , where A is between C and D . The measure of $\angle BAC$ is 47° . What is the measure of $\angle BAD$?

A. 43°
 B. 47°
 C. 94°
 D. 133°
 E. 137°

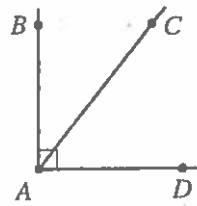
20. For trapezoid $ABCD$ shown below, $\overline{AB} \parallel \overline{DC}$, the measures of the interior angles are distinct, and the measure of $\angle D$ is x° . What is the degree measure of $\angle A$ in terms of x ?

F. $(180 - x)^\circ$
 G. $(180 - 0.5x)^\circ$
 H. $(180 + 0.5x)^\circ$
 J. $(180 + x)^\circ$
 K. x°

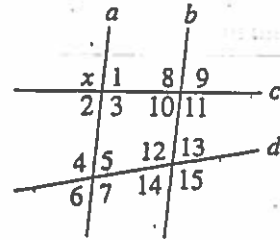


26. In the figure shown below, the measure of $\angle BAC$ is $(x + 20)^\circ$ and the measure of $\angle BAD$ is 90° . What is the measure of $\angle CAD$?

F. $(x - 70)^\circ$
 G. $(70 - x)^\circ$
 H. $(70 + x)^\circ$
 J. $(160 - x)^\circ$
 K. $(160 + x)^\circ$

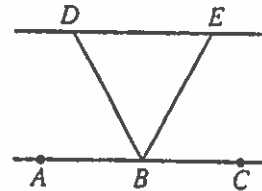


34. Lines a , b , c , and d are shown below and $a \parallel b$. Which of the following is the set of all angles that *must* be supplementary to $\angle x$?



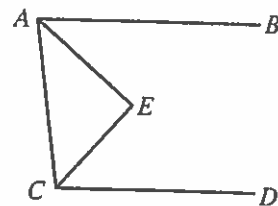
F. {1, 2}
 G. {1, 2, 5, 6}
 H. {1, 2, 9, 10}
 J. {1, 2, 5, 6, 9, 10}
 K. {1, 2, 5, 6, 9, 10, 13, 14}

39. In the figure below, B lies on \overline{AC} , \overline{BD} bisects $\angle ABE$, and \overline{BE} bisects $\angle CBD$. What is the measure of $\angle DBE$?



A. 90°
 B. 60°
 C. 45°
 D. 30°
 E. Cannot be determined from the given information

47. In the figure below, $\overline{AB} \parallel \overline{CD}$, \overline{AE} bisects $\angle BAC$, and \overline{CE} bisects $\angle ACD$. If the measure of $\angle BAC$ is 82° , what is the measure of $\angle AEC$?



A. 86°
 B. 88°
 C. 90°
 D. 92°
 E. Cannot be determined from the given information

17. Hot Shot Electronics is designing a packing box for its new line of Acoustical Odyssey speakers. The box is a rectangular prism of length 45 centimeters, width 30 centimeters, and volume 81,000 cubic centimeters. What is the height, in centimeters, of the box?

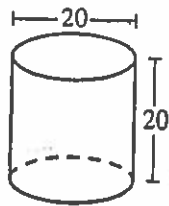
A. 75
 B. 60
 C. 48
 D. 27
 E. 18

29. Cube A has an edge length of 2 inches. Cube B has an edge length double that of Cube A. What is the volume, in cubic inches, of Cube B?

A. 4
 B. 8
 C. 16
 D. 32
 E. 64

31. A right circular cylinder is shown in the figure below, with dimensions given in centimeters. What is the total surface area of this cylinder, in square centimeters?

(Note: The total surface area of a cylinder is given by $2\pi r^2 + 2\pi rh$ where r is the radius and h is the height.)



A. 300π
 B. 400π
 C. 500π
 D. 600π
 E. $1,600\pi$

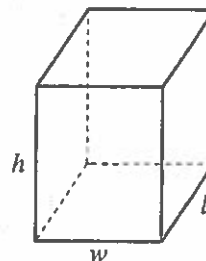
40. What is the surface area, in square inches, of an 8-inch cube?

F. 512
 G. 384
 H. 320
 J. 256
 K. 192

50. You can find the volume of an irregularly shaped solid object by completely submerging it in water and calculating the volume of water the object displaces. You completely submerge a solid object in a rectangular tank that has a base 40 centimeters by 30 centimeters and is filled with water to a depth of 20 centimeters. The object sinks to the bottom, and the water level goes up 0.25 centimeters. What is the volume, in cubic centimeters, of the object?

F. 300
 G. 240
 H. 200
 J. 150
 K. 75

53. A formula for the surface area (A) of the rectangular solid shown below is $A = 2lw + 2lh + 2wh$ where l represents length; w , width; and h , height. By doubling each of the dimensions (l , w , and h), the surface area will be multiplied by what factor?



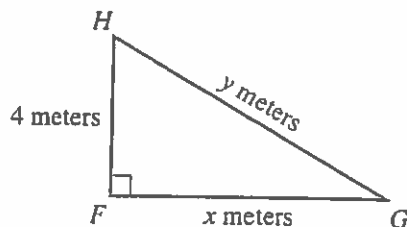
A. 2
 B. 4
 C. 6
 D. 8
 E. 12

21. What is the perimeter, in inches, of the isosceles right triangle shown below, whose hypotenuse is $8\sqrt{2}$ inches long?

- A. 8
- B. $8 + 8\sqrt{2}$
- C. $8 + 16\sqrt{2}$
- D. 16
- E. $16 + 8\sqrt{2}$



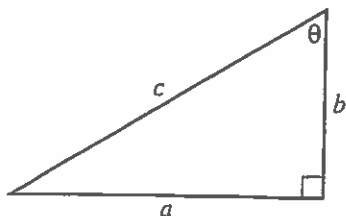
31. For $\triangle FGH$, shown below, which of the following is an expression for y in terms of x ?



- A. $x + 4$
- B. $\sqrt{x^2 + 4}$
- C. $\sqrt{x^2 + 8}$
- D. $\sqrt{x^2 - 16}$
- E. $\sqrt{x^2 + 16}$

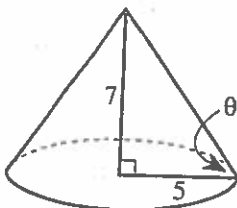
22. The dimensions of the right triangle shown below are given in feet. What is $\sin \theta$?

- F. $\frac{a}{b}$
- G. $\frac{a}{c}$
- H. $\frac{b}{c}$
- J. $\frac{b}{a}$
- K. $\frac{c}{a}$



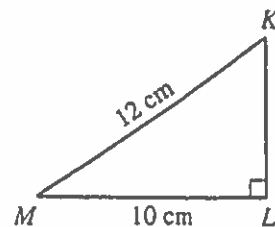
30. The radius of the base of the right circular cone shown below is 5 inches, and the height of the cone is 7 inches. Solving which of the following equations gives the measure, θ , of the angle formed by a slant height of the cone and a radius?

- F. $\tan \theta = \frac{5}{7}$
- G. $\tan \theta = \frac{7}{5}$
- H. $\sin \theta = \frac{5}{7}$
- J. $\sin \theta = \frac{7}{5}$
- K. $\cos \theta = \frac{7}{5}$



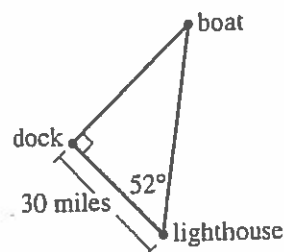
38. For right triangle $\triangle KLM$ below, what is $\sin \angle M$?

- F. $\frac{10}{12}$
- G. $\frac{12}{10}$
- H. $\frac{\sqrt{44}}{10}$
- J. $\frac{10}{\sqrt{44}}$
- K. $\frac{\sqrt{44}}{12}$



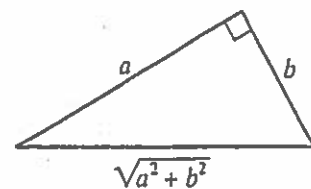
42. According to the measurements given in the figure below, which of the following expressions gives the distance, in miles, from the boat to the dock?

- F. $30 \tan 52^\circ$
- G. $30 \cos 52^\circ$
- H. $30 \sin 52^\circ$
- J. $\frac{30}{\cos 52^\circ}$
- K. $\frac{30}{\sin 52^\circ}$

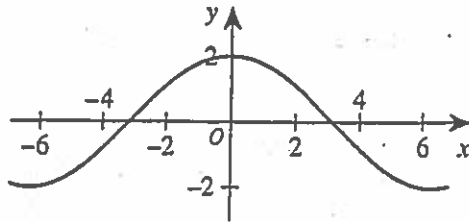


53. In the right triangle below, $0 < b < a$. One of the angle measures in the triangle is $\tan^{-1}\left(\frac{a}{b}\right)$. What is $\cos\left[\tan^{-1}\left(\frac{a}{b}\right)\right]$?

- A. $\frac{a}{b}$
- B. $\frac{b}{a}$
- C. $\frac{a}{\sqrt{a^2 + b^2}}$
- D. $\frac{b}{\sqrt{a^2 + b^2}}$
- E. $\frac{\sqrt{a^2 + b^2}}{a}$



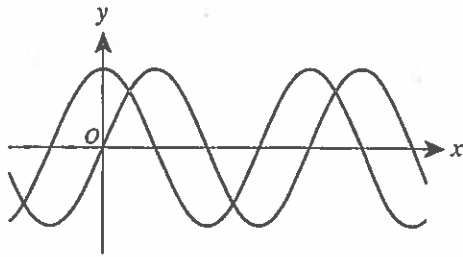
is shown below.



The function is:

- F. even (that is, $f(x) = f(-x)$ for all x).
- G. odd (that is, $f(-x) = -f(x)$ for all x).
- H. neither even nor odd.
- J. the inverse of a cotangent function.
- K. undefined at $x = \pi$.

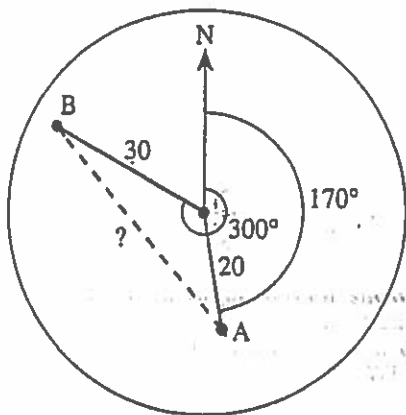
57. The functions $y = \sin x$ and $y = \sin(x + a) + b$, for constants a and b , are graphed in the standard (x, y) coordinate plane below. The functions have the same maximum value. One of the following statements about the values of a and b is true. Which statement is it?



- A. $a < 0$ and $b = 0$
- B. $a < 0$ and $b > 0$
- C. $a = 0$ and $b > 0$
- D. $a > 0$ and $b < 0$
- E. $a > 0$ and $b > 0$

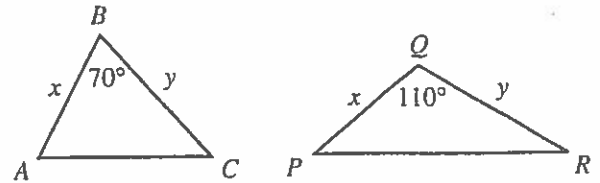
41. In the figure below, a radar screen shows 2 ships. Ship A is located at a distance of 20 nautical miles and bearing 170° , and Ship B is located at a distance of 30 nautical miles and bearing 300° . Which of the following is an expression for the straight-line distance, in nautical miles, between the 2 ships?

(Note: For $\triangle ABC$ with side of length a opposite $\angle A$, side of length b opposite $\angle B$, and side of length c opposite $\angle C$, the law of cosines states $c^2 = a^2 + b^2 - 2ab \cos \angle C$.)



- A. $\sqrt{20^2 + 30^2 - 2(20)(30)\cos 60^\circ}$
- B. $\sqrt{20^2 + 30^2 - 2(20)(30)\cos 130^\circ}$
- C. $\sqrt{20^2 + 30^2 - 2(20)(30)\cos 170^\circ}$
- D. $\sqrt{20^2 + 30^2 - 2(20)(30)\cos 300^\circ}$
- E. $\sqrt{20^2 + 30^2 - 2(20)(30)\cos 470^\circ}$

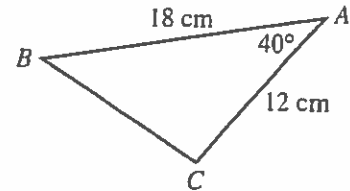
56. Triangles $\triangle ABC$ and $\triangle PQR$ are shown below. The given side lengths are in centimeters. The area of $\triangle ABC$ is 30 square centimeters. What is the area of $\triangle PQR$, in square centimeters?



- F. 15
- G. 19
- H. 25
- J. 30
- K. 33

57. Triangle $\triangle ABC$ is shown in the figure below. The measure of $\angle A$ is 40° , $AB = 18$ cm, and $AC = 12$ cm. Which of the following is the length, in centimeters, of \overline{BC} ?

(Note: For a triangle with sides of length a , b , and c opposite angles $\angle A$, $\angle B$, and $\angle C$, respectively, the law of sines states $\frac{\sin \angle A}{a} = \frac{\sin \angle B}{b} = \frac{\sin \angle C}{c}$ and the law of cosines states $c^2 = a^2 + b^2 - 2ab \cos \angle C$.)



- A. $12 \sin 40^\circ$
- B. $18 \sin 40^\circ$
- C. $\sqrt{18^2 - 12^2}$
- D. $\sqrt{12^2 + 18^2}$
- E. $\sqrt{12^2 + 18^2 - 2(12)(18) \cos 40^\circ}$

60. The sides of an acute triangle measure 14 cm, 18 cm, and 20 cm, respectively. Which of the following equations, when solved for θ , gives the measure of the smallest angle of the triangle?

(Note: For any triangle with sides of length a , b , and c that are opposite angles A , B , and C , respectively, $\frac{\sin A}{a} = \frac{\sin B}{b} = \frac{\sin C}{c}$ and $c^2 = a^2 + b^2 - 2ab \cos C$.)

- F. $\frac{\sin \theta}{14} = \frac{1}{18}$
- G. $\frac{\sin \theta}{14} = \frac{1}{20}$
- H. $\frac{\sin \theta}{20} = \frac{1}{14}$
- J. $14^2 = 18^2 + 20^2 - 2(18)(20)\cos \theta$
- K. $20^2 = 14^2 + 18^2 - 2(14)(18)\cos \theta$

Use the following information to answer questions 13–15.

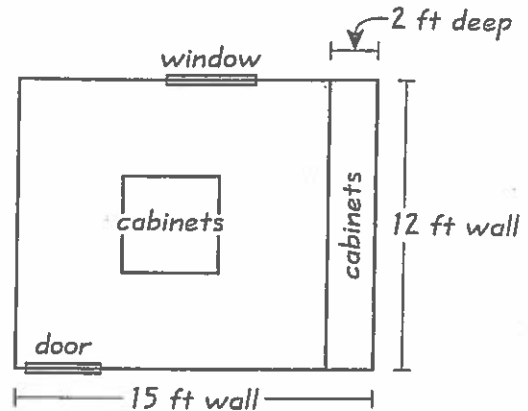
A poll of 200 registered voters was taken before the election for mayor of Springdale. All 200 voters indicated which 1 of the 4 candidates they would vote for. The results of the poll are given in the table below.

Candidate	Number of voters
Blackcloud	50
Lue	80
Gomez	40
Whitney	30

13. What percent of the voters polled chose Whitney in the poll?
- A. 15%
 B. 20%
 C. 25%
 D. 30%
 E. 40%
14. If the poll is indicative of how the 10,000 registered voters of Springdale will actually vote in the election, which of the following is the best estimate of the number of votes Lue will receive in the election?
- F. 1,500
 G. 2,500
 H. 4,000
 J. 5,000
 K. 8,000
15. If the information in the table were converted into a circle graph (pie chart), then the central angle of the sector for Gomez would measure how many degrees?
- A. 54°
 B. 72°
 C. 90°
 D. 108°
 E. 144°

Use the following information to answer questions 33–35.

Gianna is converting a 12-foot-by-15-foot room in her house to a craft room. Gianna will install tile herself but will have CC Installations build and install the cabinets. The scale drawing shown below displays the location of the cabinets in the craft room (0.25 inch represents 2 feet).

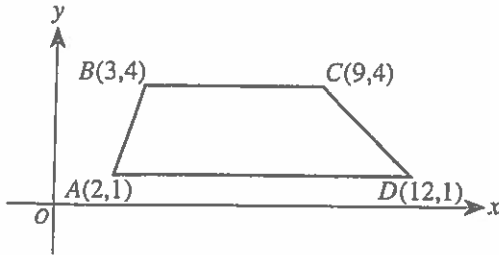


Cabinets will be installed along one of the 12-foot walls from floor to ceiling, and 4 cabinets that are each 3 feet tall will be installed in the middle of the room. These are the only cabinets that will be installed, and each of them will be 2 feet wide and 2 feet deep. CC Installations has given Gianna an estimate of \$2,150.00 for building and installing the cabinets.

33. A 15-foot wall is how many inches long in the scale drawing?
- A. 1.5
 B. 1.875
 C. 3
 D. 3.375
 E. 3.75
34. Gianna will install tile on the portion of the floor that will NOT be covered by cabinets. What is the area, in square feet, of the portion of the floor that will NOT be covered by cabinets?
- F. 72
 G. 90
 H. 140
 J. 156
 K. 164
35. CC Installations' estimate consists of a \$650.00 charge for labor, plus a fixed charge per cabinet. The labor charge and the charge per cabinet remain the same for any number of cabinets built and installed. CC Installations would give Gianna what estimate if the craft room were to have twice as many cabinets as Gianna is planning to have?
- A. \$2,800.00
 B. \$3,000.00
 C. \$3,450.00
 D. \$3,650.00
 E. \$4,300.00

Use the following information to answer questions 39–41.

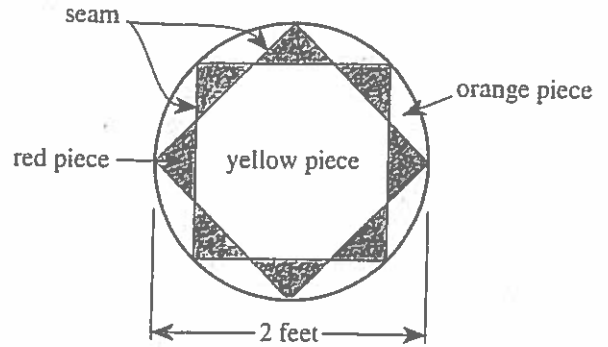
Trapezoid $ABCD$ is graphed in the standard (x,y) coordinate plane below.



39. What is the slope of \overline{CD} ?
- A. -3
 B. -1
 C. 1
 D. $\frac{5}{21}$
 E. $\frac{3}{2}$
40. When $ABCD$ is reflected over the y -axis to $A'B'C'D'$, what are the coordinates of D' ?
- F. $(-12, 1)$
 G. $(-12, -1)$
 H. $(12, -1)$
 J. $(1, 12)$
 K. $(1, -12)$
41. Which of the following vertical lines cuts $ABCD$ into 2 trapezoids with equal areas?
- A. $x = 2.5$
 B. $x = 3.5$
 C. $x = 4.5$
 D. $x = 5.5$
 E. $x = 6.5$

Use the following information to answer questions 44–46.

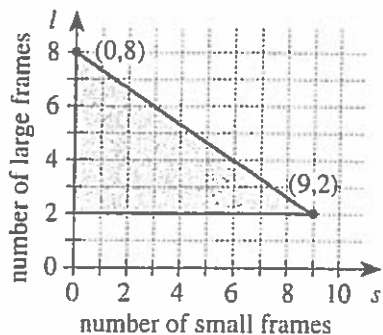
The figure below shows the design of a circular stained-glass panel on display at Hopewell's Antique Shop. Seams separate the pieces of the panel. All red triangular pieces shown are congruent and have a common vertex with each adjoining triangular piece. The 2 squares shown are inscribed in the circle. The diameter of the panel is 2 feet.



4. The design of the stained-glass panel has how many lines of symmetry in the plane of the panel?
- F. 2
 G. 4
 H. 8
 J. 16
 K. Infinitely many
45. What is the area of the stained-glass panel, to the nearest 0.1 square foot?
- A. 3.1
 B. 4.0
 C. 6.2
 D. 8.0
 E. 12.6
46. Kaya wants to install a new circular stained-glass window in her living room. The design of the window will be identical to that of the panel. The diameter of the new window will be 75% longer than the diameter of the panel. The new window will be how many feet in diameter?
- F. 1.50
 G. 2.50
 H. 2.75
 J. 3.50
 K. 4.00

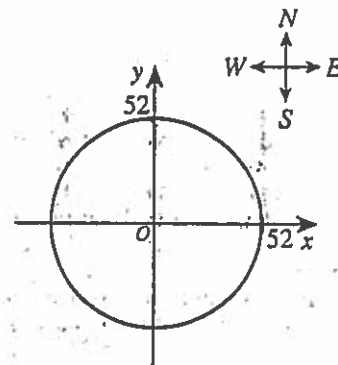
Use the following information to answer questions 50–52.

Marcia makes and sells handcrafted picture frames in 2 sizes: small and large. It takes her 2 hours to make a small frame and 3 hours to make a large frame. The shaded triangular region shown below is the graph of a system of inequalities representing weekly constraints Marcia has in making the frames. For making and selling s small frames and l large frames, Marcia makes a profit of $30s + 70l$ dollars. Marcia sells all the frames she makes.



Use the following information to answer questions 54–56.

The radio signal from the transmitter site of radio station WGGW can be received only within a radius of 52 miles in all directions from the transmitter site. A map of the region of coverage of the radio signal is shown below in the standard (x, y) coordinate plane, with the transmitter site at the origin and 1 coordinate unit representing 1 mile.



50. The weekly constraint represented by the horizontal line segment containing $(9, 2)$ means that each week Marcia makes a minimum of:

F. 2 large frames.
 G. 9 large frames.
 H. 2 small frames.
 J. 9 small frames.
 K. 11 small frames.

51. For every hour that Marcia spends making frames in the second week of December each year, she donates \$3 from that week's profit to a local charity. This year, Marcia made 4 large frames and 2 small frames in that week. Which of the following is closest to the percent of that week's profit Marcia donated to the charity?

A. 6%
 B. 12%
 C. 14%
 D. 16%
 E. 19%

52. What is the maximum profit Marcia can earn from the picture frames she makes in 1 week?

F. \$410
 G. \$460
 H. \$540
 J. \$560
 K. \$690

54. Which of the following is closest to the area, in square miles, of the region of coverage of the radio signal?

F. 2,120
 G. 2,700
 H. 4,250
 J. 8,500
 K. 16,990

55. Which of the following is an equation of the circle shown on the map?

A. $x + y = 52$
 B. $(x + y)^2 = 52$
 C. $(x + y)^2 = 52^2$
 D. $x^2 + y^2 = 52$
 E. $x^2 + y^2 = 52^2$

56. The transmitter site of radio station WGGW and the transmitter site of another radio station, WGWB, are on the same highway 100 miles apart. The radio signal from the transmitter site of WGWB can be received only within a radius of 60 miles in all directions from the WGWB transmitter site. For how many miles along the highway can the radio signals of *both* stations be received?

(Note: Assume the highway is straight.)

F. 8
 G. 12
 H. 40
 J. 44
 K. 48