

## Math Review for the PSAT\*

Advanced Placement Strategies™, Inc.

- The purpose of the following 101 problems is to give the student an overview of many of the categories (listed below) of questions likely to be tested on the PSAT.
- The first 77 questions give an overview of each category. The last 24 (78-101), one or more from most of the categories, are difficult questions.
- The number in parentheses is an estimation of how many problems of this type will appear on a test. However, sometimes a question may be in 2 or 3 categories. For example: computing the area of a circle on a coordinate plane.

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| 1. Number Logic (4-6)                                    | 12. Perimeter (1)  |
| 2. Absolute Value (1)                                    | 13. Area (2)   |
| 3. Function Notation (1)                                 | 14. Volume (1)   |
| 4. Probability (1)                                       | 15. Ratio and Proportion (1-2)   |
| 5. Arithmetic Mean (Average), Median, and Mode (2)       | 16. The Pyth. Th. and Special Right Triangles (1)  |
| 6. Percent (1)   | 17. Circles (2)  |
| 7. The Number Line or Points on a Line (1)               | 18. Logic (1)  |
| 8. The Coordinate Plane with 1 Slope Question (2-3)      | 19. Word Problems (1-2)  |
| 9. Simplifying or Finding the Value of an Expression (1) | 20. Interpreting Charts, Tables, and Graphs (2)  |
| 10. Solving Equations (2)                                | 21. Weird and Unfamiliar Symbols (1) - but maybe<br>0 because this type was not on the 2005 PSATs. |
| 11. Angle Measure (3-4)                                  | 22. Exponents (1)  |

**Answers to 1-77 are on page 10. Answers and Explanations to 78-101 are on pages 15-22.**

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### 1. Number Logic (4-6)

Number Logic is our terminology for certain questions that comprise 15% to 20% of the test. These problems deal with aspects of odd numbers, even numbers, prime numbers, positive and negative numbers, divisors or factors, digits, multiples, decimals, sets, sequences, combinations, remainders, and consecutive integers.

- Which of the following cannot be written as the sum of 2 consecutive odd integers?  
(A) 8 (B) 15 (C) 16 (D) 24 (E) 32
- How many integers from 100 to 200 contain at least one digit that is a 3?  
(A) 0 (B) 9 (C) 10 (D) 19 (E) 20
- If  $a$ ,  $b$ , and  $c$  are three different prime numbers greater than 2, which of the following sums could possibly be a prime number?  
(A)  $a + b$  (B)  $a + b + c$  (C)  $a + b + 2c$  (D)  $a + 2b + 3c$  (E)  $2a + 2b + 2c$
- How many 4-digit positive integers can be formed using the digits 5, 6, 7, and 8 if the units (ones) digit is 8 and no digit is repeated within an integer?  
(A) 1 (B) 4 (C) 6 (D) 12 (E) 27

The following question requires a student-produced response that will be entered on a grid on the test answer sheet.

- In the sequence,  $[135, 45, 15, \dots]$ , each term after the 1st term is  $\frac{1}{3}$  of the term preceding it. What is the 6th term of the sequence?

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6. If  $x > 1$ , which of the following must be greater than 1?

I.  $\frac{x}{1+x}$       II.  $\frac{x^2}{(x+1)(x-1)}$       III.  $\frac{-x}{1-x}$

(A) I only   (B) II only   (C) III only   (D) I and II   (E) II and III

7. If  $x$  is an integer from 2 to 5 inclusive, and  $y$  is an integer from 3 to 6 inclusive, what is the greatest possible value of  $\frac{1}{xy}$ ? (Student-Produced Response)

8. If the sum of five consecutive integers is 0, what is the greatest of the five integers? (Student-Produced Response)

9. When 27 is divided by a positive integer  $c$ , the remainder is 3. For how many different values of  $c$  is this true?  
(A) zero   (B) one   (C) three   (D) four   (E) five

## 2. Absolute Value (1)

10. If  $2 < |x + 2| < 4$ , which of the following could be a value of  $x$ ?

(A) 4   (B) 2   (C) -3   (D) -4   (E) -5

11. If  $|x - 3| + |y| = 4$ , what is the least possible value of  $x$ ?

(A) 4   (B) 2   (C) -1   (D) -3   (E) -7

## 3. Function Notation (1)

12. For the function  $f(x) = x + b$ ,  $b$  is a constant. If  $f(7) = 5$ , what is the value of  $b$ ?

(A) -2   (B) 0   (C) 2   (D) 5   (E) 7

13. Let the function  $f$  be defined by  $f(x) = x^2 - 3$ . If  $a > 0$ , and  $f(a) = 13$ , what is the value of  $a$ ?

(A) -16   (B) 0   (C) 4   (D) 16   (E) 256

14. For the linear function  $h$ , the table to the right gives function values for selected values of  $t$ .

Which of the following defines  $h$ ?

(A)  $h(t) = t^2 + 3$

(B)  $h(t) = -2t + 3$

(C)  $h(t) = -4t + 1$

(D)  $h(t) = 6t - 5$

(E)  $h(t) = -3t + 1$

$t$	$h(t)$
-2	7
0	1
2	-5
4	-11

15. The graph of  $y = f(x)$  is shown to the right.

For what value of  $x$  does  $f(x) = 3$ ?

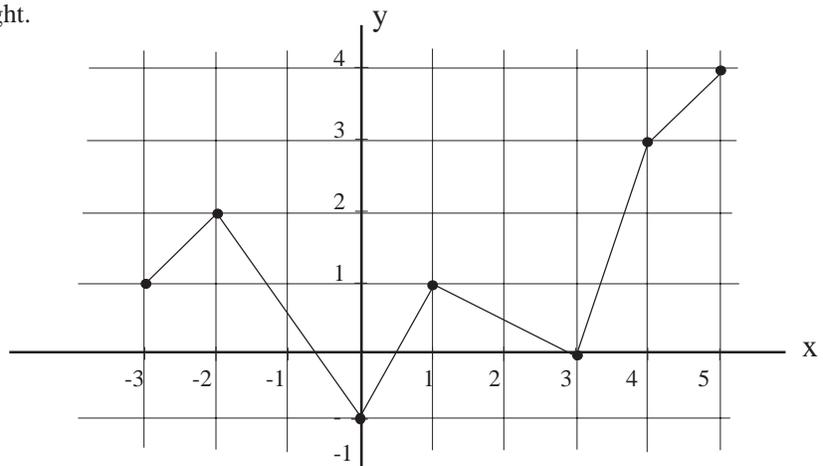
(A) -1

(B) 0

(C) 1

(D) 3

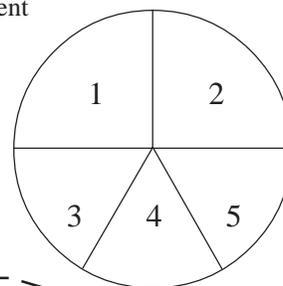
(E) 4



**4. Probability (1)**

16. The probability of picking a red pen out of a container that contains 600 pens of different colors is  $\frac{4}{15}$ . How many red pens are in the container? (Student-Produced Response)

17. The circle to the right is divided into 5 regions. Regions 1 and 2 each have an area equal to  $\frac{1}{4}$  of the total area of the circle. Regions 3, 4, and 5 each have an area equal to  $\frac{1}{6}$  of the total area of the circle. If a pin is randomly stuck into one of the regions, what is the probability that the region will be an even-numbered region?



(A)  $\frac{2}{5}$  (B)  $\frac{2}{7}$  (C)  $\frac{3}{7}$  (D)  $\frac{5}{12}$  (E)  $\frac{1}{24}$

**5. Arithmetic Mean (Average), Median, and Mode (2)**

18. If the average of 3, 4, and  $x$  is 15, what is the value of  $x$ ? (Student-Produced Response)

19. A list of 10 numbers has a mode of  $b$ . A new list of 10 numbers is formed by tripling the numbers in the original list. If  $c$  is the mode of the second list, which of the following must be true?

(A)  $b = c$  (B)  $b = 3c$  (C)  $c = 10b$  (D)  $c = 3b$  (E)  $c = (b)(\frac{1}{3})$

20. If the median of 9 consecutive even integers is 30, what is the least of the 9 integers?

(A) 12 (B) 14 (C) 21 (D) 22 (E) 24

21. The average of four numbers is 11. When a fifth number is added, the average of the five numbers is 12. What is the value of the fifth number? (Student-Produced Response)

22. If the average of  $x$ ,  $x - 2$ ,  $2x + 5$ ,  $x + 5$ , and  $3x - 8$ , is 8, what is the median of the five numbers?

(A) 1 (B) 5 (C) 7 (D) 8 (E) 26

**6. Percent (1)**

23. If  $x$  is positive, which of the following represents  $x$  percent of 6?

(A)  $0.006x$  (B)  $0.06x$  (C)  $0.6x$  (D)  $6x$  (E)  $60x$

24. If the positive number  $x$  is 20% of  $y$ , and if  $y$  is 150% of  $g$ , then  $x$  is what percent of  $g$ ?

(A) 20% (B) 30% (C) 75% (D) 300% (E) 3000%

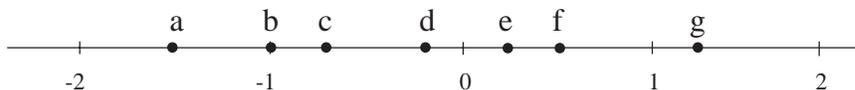
25. A new issue of stock initially sold for \$160 per share. At the end of the first month, the value of a share of stock had increased by 25%. From the price per share at the end of the first month to the end of the second month, the stock price per share declined by 25%. What was the price per share of stock at the end of the second month?

(A) \$138.75 (B) \$150 (C) \$160 (D) \$175 (E) \$200

**7. The Number Line or Points on a Line (1)**

26. Points A, X, and M are on a number line. Point A is 40 inches from point X. Point M is 15 inches from point X. What is the least possible distance, in inches, that point M can be from point A? (Student-Produced Response)

27. On the number line below,  $a$ ,  $b$ ,  $c$ ,  $d$ ,  $e$ ,  $f$ , and  $g$  are coordinates of points on the line.



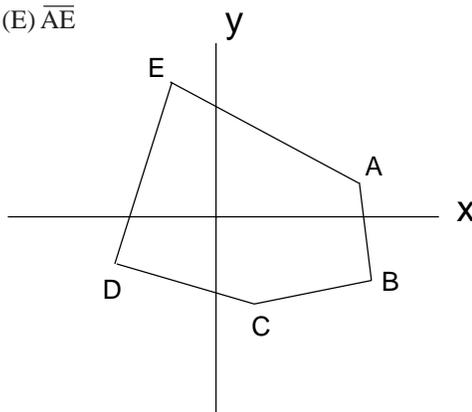
Which coordinate is closest to the value of  $|c - f|$ ?

(A)  $a$  (B)  $b$  (C)  $d$  (D)  $e$  (E)  $g$

### 8. The Coordinate Plane with 1 Slope Question (2-3)

28. Pentagon ABCDE is placed on the coordinate plane. Which side of the pentagon is the segment with the greatest slope?

- (A)  $\overline{AB}$  (B)  $\overline{BC}$  (C)  $\overline{CD}$  (D)  $\overline{DE}$  (E)  $\overline{AE}$

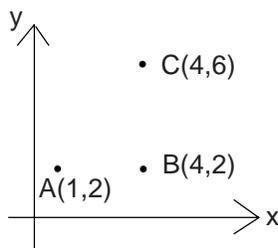


29. In the  $xy$ -plane, the line  $2x - 4y = 12$  is perpendicular to the line  $y = ax - 4$ . What is the value of  $a$ ?

- (A)  $-1/2$  (B)  $1/2$  (C)  $-2$  (D)  $2$  (E)  $1/3$

30. On the figure to the right, if point D is inserted so that rectangle ABCD will be formed, what will be the perimeter of rectangle ABCD?

- (A) 9 (B) 10 (C) 12 (D) 14 (E) 16

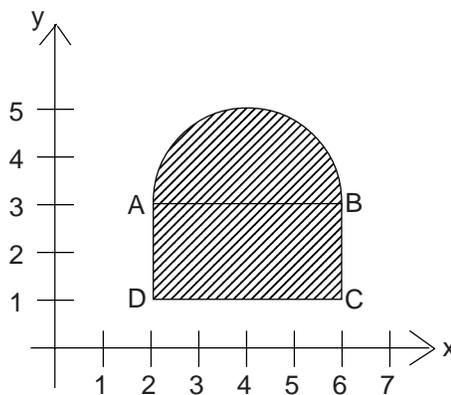


31. What is the area of a triangular region that is bounded by the  $x$ -axis, the  $y$ -axis and the graph of line  $x + y = 5$ ?

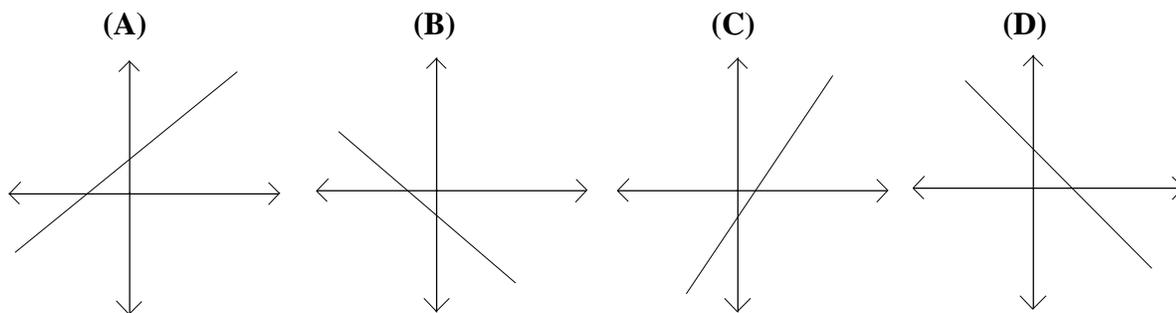
- (A) 5 (B) 10 (C) 12.5 (D) 25 (E)  $5\sqrt{2}$

32. If  $\overline{AB}$  is a diameter parallel to the  $x$ -axis with endpoints  $(2, 3)$  and  $(6, 3)$  and quadrilateral ABCD is a rectangle, what is the perimeter of the shaded region?

- (A)  $2\pi + 8$  (B)  $4\pi + 8$  (C)  $2\pi + 10$  (D)  $4\pi + 4$  (E)  $4\pi + 10$



33. From the following four linear functions, which has both a negative slope and a negative  $y$ -intercept?



### 9. Simplifying or Finding the Value of an Expression (1)

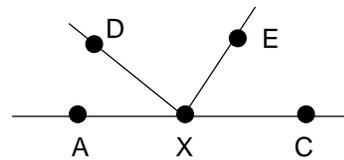
34. If  $bc = 8$ , and  $5abc = 40$ , what is the value of  $10a$ ?  
 (A) 0 (B) 0.1 (C) 1 (D) 10 (E) 100
35. If  $x^2 + y^2 = 25$ , and  $xy = 12$ , what is the value of  $(x + y)^2$ ?  
 (A) 14 (B) 25 (C) 37 (D) 49 (E) 625
36. If  $\frac{c}{d} = \frac{3}{4}$ , what is the value of  $\frac{3d}{c}$ ?  
 (A)  $\frac{1}{4}$  (B)  $\frac{3}{8}$  (C)  $\frac{9}{4}$  (D)  $\frac{3}{2}$  (E) 4

### 10. Solving Equations (2)

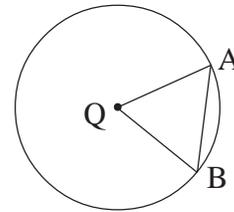
37. If  $3(x + 2y) - 9 = 12$ , what is the value of  $x + 2y$ ? (Student-Produced Response)
38. If  $3x + 4y = 27$ , and  $y = x - 2$ , what is the value of  $x$ ?  
 (A) -2 (B)  $\frac{15}{7}$  (C) 3 (D)  $\frac{29}{7}$  (E) 5

### 11. Angle Measure (3-4)

39. In the given figure, if  $m\angle AXE = 126^\circ$  and  $m\angle CXD = 135^\circ$ , what is the degree measure of  $\angle DXE$ ?  
 (A) 77 (B) 78 (C) 79 (D) 80 (E) 81

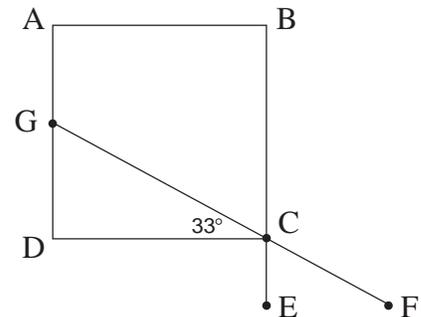


40. In Circle Q, QB and QA are radii. If  $m\angle QAB = 55^\circ$ , what is the degree measure of  $\angle AQB$ ?  
 (A) 50 (B) 55 (C) 60 (D) 70  
 (E) cannot be determined from the given information

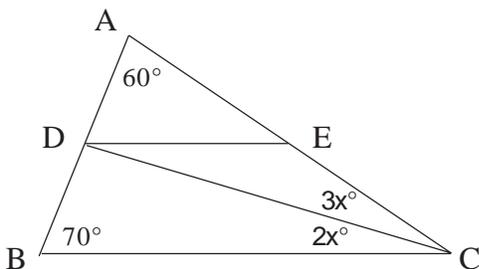


41. The hour hand on an alarm clock with a circular face makes two revolutions each 24-hour period. Through how many degrees does the hour hand turn from 1 PM to 5 PM on a Tuesday?  
 (A) 20 (B) 25 (C) 33.3 (D) 120 (E) 240

42. Quadrilateral ABCD is a square. Segments  $\overline{GF}$  and  $\overline{BE}$  intersect at C. The  $m\angle GCD = 33^\circ$ . What is the degree measure of  $\angle ECF$ ?  
 (A) 33 (B) 34 (C) 57 (D) 66 (E) 67



43. In the figure below, if  $\overline{DE} \parallel \overline{BC}$ ,  $m\angle ECD = 3x^\circ$ ,  $m\angle BCD = 2x^\circ$ , what is the degree measure of  $\angle EDC$ ?  
 (A) 10 (B) 20 (C) 30 (D) 40 (E) 50



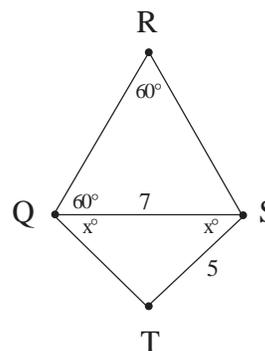
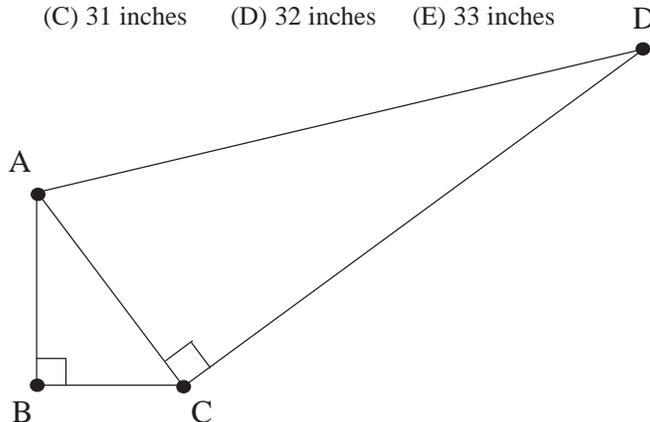
## 12. Perimeter (1)

44. If the volume of a cube is 1,000 cubic inches, what is the perimeter of one face of the cube?

- (A) 10 inches (B) 20 inches (C) 40 inches (D) 100 inches (E) 250 inches

45. What is the perimeter of quadrilateral ABCD if  $AD = 13$  inches,  $AB = 4$  inches, and  $AC = 5$  inches?

- (A) 29 inches (B) 30 inches (C) 31 inches (D) 32 inches (E) 33 inches



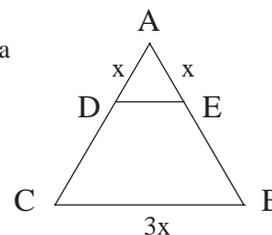
46. What is the perimeter of quadrilateral QRST if  $QS = 7$  and  $ST = 5$ ?

(Student-Produced Response)

## 13. Area (2)

47. Triangle ABC is equilateral, and the area of triangle AED is 4. What is the area of triangle ABC?

- (A) 12 (B) 16 (C) 24 (D) 32 (E) 36



48. The area of a rectangular plot of land is 144 square feet, and its length is 18 feet. What is the perimeter of the rectangular plot of land?

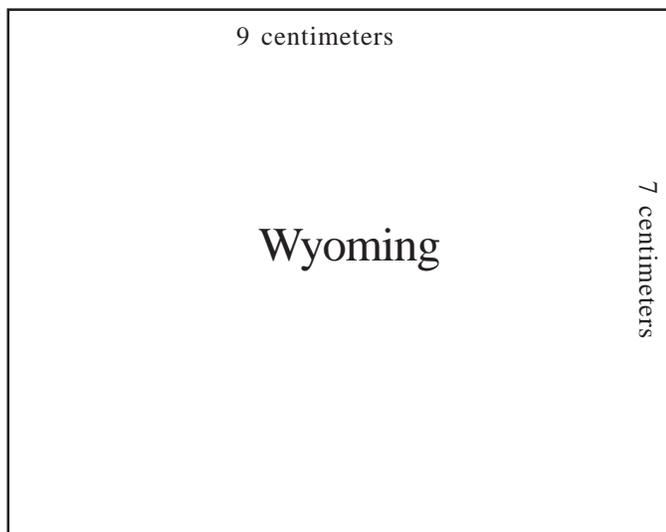
- (A) 8 feet (B) 26 feet (C) 52 feet (D) 64 feet (E) 72 feet

49. The scale drawing to the right (9 centimeters by 7 centimeters) represents the state of Wyoming.

The scale is  $1 \text{ cm} = 40 \text{ miles}$ .

Based on this scale drawing, what is the area of Wyoming in square miles?

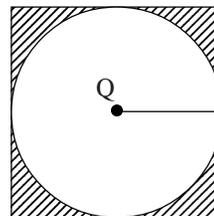
- (A) 63  
(B) 1,280  
(C) 2,520  
(D) 100,800  
(E) 128,000



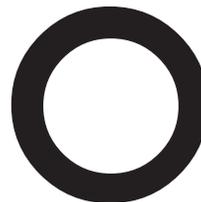
**13. Area (2) Continued**

50. In the given figure, circle Q is inscribed in a square. If the perimeter of the square is 40 centimeters, what, in square centimeters, is the area of the shaded region?

- (A)  $25\pi$  (B)  $100 - 25\pi$  (C)  $100 - 100\pi$  (D) 75 (E)  $100 - 5\pi$



51. The figure to the right consists of two circles that have the same center. If the shaded region has an area of  $28\pi$ , and the radius of the smaller circle is 6, what is the radius of the larger circle? (Student-Produced Response)



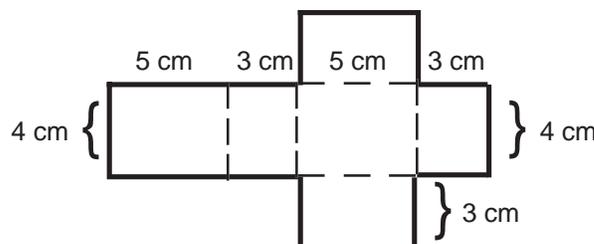
52. The length and width of a rectangle have integer values. If the area of the rectangle is 36 square inches, what is the greatest possible perimeter of the rectangle in inches? (Student-Produced Response)

**14. Volume (1)**

53. The total surface area of a cube is 96 square inches. What is the volume of the cube in cubic inches? (Student-Produced Response)

54. If the figure to the right is folded along the dashed lines, a rectangular box will be formed.

What is the volume of the box in cubic centimeters?  
(A) 15 (B) 20 (C) 30 (D) 40 (E) 60



55. How many cubes with dimensions of 2 inches by 2 inches by 2 inches will it take to make a cube that has dimensions of 10 inches by 10 inches by 10 inches?  
(A) 5 (B) 25 (C) 50 (D) 125 (E) 500

**15. Ratio and Proportion (1-2)**

56. A machine can produce  $p$  pencils in 4 minutes. At the same rate, how many pencils can the machine produce, in terms of  $p$ , in 2 hours?

- (A)  $1/2 p$  (B)  $8p$  (C)  $30p$  (D)  $50p$  (E)  $480p$

57. If there are exactly 4 blue marbles in a jar containing 12 marbles, what is the ratio of blue marbles to marbles that are not blue?

- (A) 1:1 (B) 1:2 (C) 1:3 (D) 1:4 (E) 2:3

58. A hockey team played twelve games, and there were no ties. All of the following could be the ratio of wins to losses EXCEPT

- (A) 1:12 (B) 1:11 (C) 1:3 (D) 1:2 (E) 1:1

59. If the ratio of boys to girls in a class is 5:4, and there are 20 boys in the class, how many students are in the class?  
(A) 16 (B) 20 (C) 25 (D) 36 (E) 45

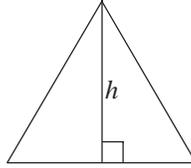
### 16. The Pythagorean Theorem and Special Right Triangles (1)

60. Two legs of a right triangle are both 10. Which of the following integers is closest to the length of the hypotenuse of the triangle?

- (A) 14 (B) 15 (C) 16 (D) 17 (E) 18

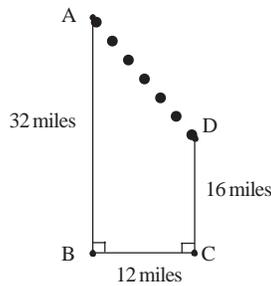
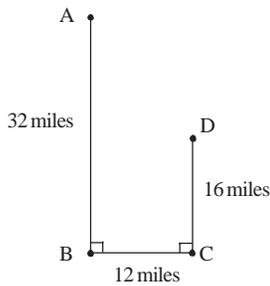
61. If the perimeter of the equilateral triangle to the right is 18, what is the length of the altitude  $h$ ?

- (A)  $3\sqrt{2}$  (B)  $3\sqrt{3}$  (C) 6 (D)  $6\sqrt{2}$  (E)  $6\sqrt{3}$



62. The figure on the left below shows a path from town A to town D passing through town B and town C. If one could go directly from A to D as shown with the dotted line in the figure on the right below, what would the distance for the direct path be in miles?

- (A) 16 (B) 18 (C) 20 (D) 22 (E) 24

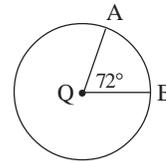


### 17. Circles (2)

63. In circle Q, radius  $BQ = 10$ , and the measure of central angle  $AQB$  is  $72^\circ$ .

What is the length of minor arc  $AB$ ?

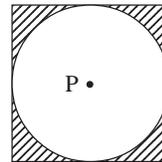
- (A)  $2\pi$  (B) 4 (C)  $4\pi$  (D) 10 (E)  $25\pi$



64. Circle P is inscribed in a square. The square has an area of 64.

What is the area of the shaded region?

- (A) 48 (B)  $16\pi$  (C)  $64\pi$  (D)  $64 - 16\pi$  (E)  $64 - 64\pi$

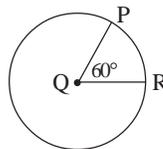


65. If the radius of a circle is tripled, what is the ratio of the area of the original circle to the area of the larger circle?

- (A) 1:3 (B)  $1:3\pi$  (C) 1:9 (D)  $\pi:9$  (E)  $1:9\pi$

66. The area of sector PQR is  $24\pi$ . What is the length of the radius of the circle?

- (A) 6 (B) 12 (C)  $4\pi$  (D) 24 (E)  $24\pi$



### 18. Logic (1)

67. Five blue socks and five black socks are in a drawer. A short person can reach into the drawer, but cannot see into the drawer. If the person pulls socks out one at a time, what is the least number of socks that would have to be pulled out of the drawer in order for the short person to be sure to have two blue socks?

- (A) 2 (B) 3 (C) 6 (D) 7 (E) 10

**19. Word Problems (1-2)**

68. Joe has twice as many pets as Kim. Ronnie has four more pets than Joe. If the total number of pets owned by Joe, Kim, and Ronnie is 24 and if  $x$  represents the number of Kim's pets, which of the following equations could be used to find the value of  $x$ ?

- (A)  $4x + 4 = 24$  (B)  $4x - 4 = 24$  (C)  $5x - 4 = 24$  (D)  $5x + 4 = 20$  (E)  $5x + 4 = 24$

69. Tickets for a play sold for either \$20, \$30, or \$50 depending on the location of the seat. If there were twice as many \$20 tickets as \$30 tickets sold and 100 less \$50 tickets than \$30 tickets sold, what was the total number of \$50 tickets sold if the total ticket receipts were \$13,000?

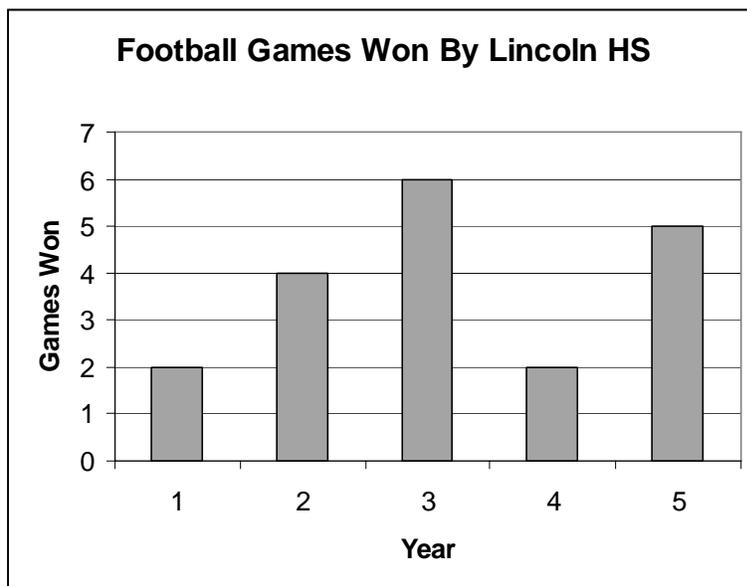
(Student-Produced Response)

70. Lucy won \$360,000 in a lottery. Immediately, 33% (not  $33\frac{1}{3}\%$ ) was deducted for state and federal taxes. The remaining amount was paid in 12 equal monthly payments. How much was each monthly payment?

- (A) \$9,900 (B) \$10,000 (C) \$20,000 (D) \$20,100 (E) \$30,000

**20. Interpreting Charts, Tables, and Graphs (2)**

Use the following graph for questions 71, 72, and 73



71. Between which two consecutive years was there the greatest change in the number of games won?

- (A) 2000 and 2001 (B) 2001 and 2002 (C) 2002 and 2003 (D) 2003 and 2004

72. The number of games won in 2002 is what percent greater than the number of games won in 2001?

- (A) 2% (B) 20% (C)  $33\frac{1}{3}\%$  (D) 50% (E) 100%

73. For the five football seasons, what is the median of games won?

- (A) 2 (B) 3.8 (C) 4 (D) 5 (E) 6

**21. Weird and Unfamiliar Symbols (1)**

74. Let  $r\#s$  be defined as  $r\#s = 2r + s$  for all numbers  $r$  and  $s$ . If  $x\#5 = 25$ , what is the value of  $x$ ?

- (A) 0 (B) 5 (C) 10 (D) 15 (E) 20

**22. Exponents (1)**

Make sure that you know the following about exponents.

- $(x^5) = (x)(x)(x)(x)(x)$
- $(x^a)(x^b) = x^{a+b}$  For example,  $(x^3)(x^5) = x^{3+5} = x^8$
- $\frac{x^a}{x^b} = x^{a-b}$  For example,  $\frac{x^8}{x^2} = x^{8-2} = x^6$
- $(x^5)^3 = (x^5)(x^5)(x^5) = x^{15}$
- $(x^a)^b = x^{(a)(b)}$  For example,  $(x^4)^5 = x^{(4)(5)} = x^{20}$
- If  $x^a = x^c$ , then  $a = c$ . This means that if the bases ( $x$ ) are the same, then the exponents ( $a$  and  $c$ ) are equal.  
For example, if  $2^{3x} = 2^{x+4}$ , then  $3x = x + 4$ , and  $x = 2$ .
- If a problem has different bases, try to make the bases the same so you can compare the exponents.  
For example, if  $3^{2x} = 81$  and since  $81 = 3^4$ , rewrite the equation as  $3^{2x} = 3^4$ . Therefore,  $2x = 4$ , and  $x = 2$ .

75. If  $y^2 \cdot y^a = y^8$ , and  $(y^2)^b = y^{12}$ , what is the value of  $a + b$ ?

(Student-Produced Response)

76. If  $2^{4x} = 2^{2x+2}$ , what is the value of  $x$ ?

(A) -1 (B) 0 (C) 1 (D) 2 (E) 3

77. If  $2^{3x} = 4^{2x-1}$ , what is the value of  $x$ ?

(A) -1 (B) 0 (C) 1/2 (D) 1 (E) 2

**Answers, 1-77**

1. B	26. 25	52. 74
2. D	27. E	53. 64
3. B	28. D	54. E
4. C	29. C	55. D
5. 5/9 or .555	30. D	56. C
6. E	31. C	57. B
7. 1/6 or .166	32. A	58. A
8. 2	33. B	59. D
9. E	34. D	60. A
10. E	35. D	61. B
11. C	36. E	62. C
12. A	37. 7	63. C
13. C	38. E	64. D
14. E	39. E	65. C
15. E	40. D	66. B
16. 160	41. D	67. D
17. D	42. C	68. E
18. 38	43. B	69. 50
19. D	44. C	70. D
20. D	45. D	71. C
21. 16	46. 24	72. D
22. C	47. E	73. C
23. B	48. C	74. C
24. B	49. D	75. 12
25. B	50. B	76. C
	51. 8	77. E

## Questions 78-101

(Answers and explanations begin on page 15)

- The following 24 questions are all difficult or very difficult.
- On the PSAT, about 10 questions out of 38 will be difficult questions.
- A student who gets 10 or more out of the following 24 questions correct is doing well.
- The purpose of these 24 questions is to assist a student who already does well in math to do even better.
- To improve, a student should seek to understand all questions that he or she initially answered incorrectly.

**78.** Let  $\otimes y$  be defined for all  $y$  by the equation  $\otimes y = 3y + 1$ . For example,  $\otimes 6$  will equal  $3(6) + 1$ , which is 19. If  $\otimes 3 - \otimes y = y$ , what is the value of  $y$ ?

- (A) 2 (B) 2.25 (C) 2.5 (D) 2.75 (E) 3

**79.** Three boys (Bill, Chad, and Dan) and four girls (Jane, Kim, Lola, and Maria) are trying out for the swim team. One boy and two girls will be chosen. How many different groups of chosen swimmers are possible? For example, Bill, Jane, and Kim would be one group.

(Student-Produced Response)

**80.** The first term of a sequence is  $-4$ , and every term after the first is 3 more than the term immediately preceding it. What is the value of the 51st term of the sequence?

- (A) 143 (B) 146 (C) 149 (D) 150 (E) 153

**81.** The ratio of Joe's marbles to Bill's marbles is  $3:4$ . The ratio of Joe's marbles to Nancy's marbles is  $2:5$ . What is the ratio of Bill's marbles to Nancy's marbles?

- (A) 2:1 (B) 3:10 (C) 1:2 (D) 4:5 (E) 8:15

**82.** If  $f(x) = x - 3$ , and  $f(\sqrt{m}) = 2$ , what is the value of  $m$ ?

(Student-Produced Response)

**83.** To receive health insurance benefits, an employee must have a regular workload of not less than 32 hours per week and not more than 40 hours per week. If  $w$  is the number of hours worked per week, which of the following describes all possible weekly workloads that would satisfy the requirement for receiving health insurance benefits?

- (A)  $|w - 36| \leq 4$  (B)  $|w - 36| \geq 4$  (C)  $|w - 36| = 4$  (D)  $|w + 36| = 4$  (E)  $|w + 36| \geq 4$

**84.** The price of a car is reduced by 20%, and the resulting price is then reduced by 40%. These two reductions would be the same as a single reduction of what percent?

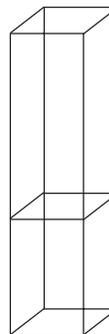
- (A) 80% (B) 60% (C) 52% (D) 48% (E) 30%

**85.** On a geometry test, the average score for the class was 90. If 20% of the students in the class scored 100, and 30% scored 80, what was the average test score for the remainder of the class?

- (A) 86 (B) 88 (C) 90 (D) 92 (E) 94

**86.** A clear tank in the shape of a rectangular solid has a height of 8 feet and a square base that is 2 feet by 2 feet. It contains 10 cubic feet of water. If 2 cubic feet of water are added to the tank, how many **inches** will the water in the tank rise?

- (A) 1/2 (B) 2 (C) 6 (D) 12 (E) 24

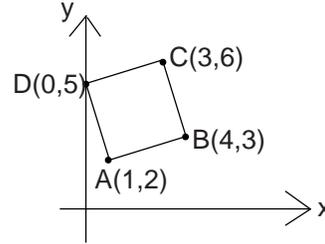


87. Six pool balls, which are numbered 1 through 6, are on a pool table. If two balls are picked up at random leaving 4 balls on the table, what is the probability that the sum of the numbers on the two picked-up pool balls is 8?

- (A)  $1/8$  (B)  $5/36$  (C)  $2/15$  (D)  $1/6$  (E)  $1/5$

88. In the figure to the right, if quadrilateral ABCD is a square, what is the area of the square ABCD in square units?

- (A) 9 (B) 10 (C) 12 (D) 14 (E) 16

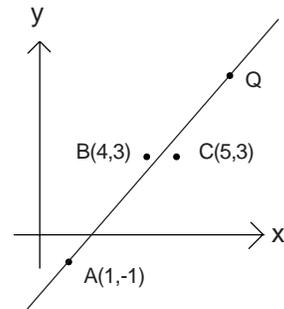


89. If  $x^2 + y^2 = 289$ , and  $xy = 120$ , what is the value of  $(x + y)^2$ ?

(Student-Produced Response)

90. On the coordinate plane to the right, line AQ passes between points B and C. What is one possible value of the slope of line AQ?

(Student-Produced Response)



91. If  $\frac{ay}{y+b} = 1$ , which of the following is equal to  $y$  if  $a$ ,  $b$ , and  $y$  are all greater than 1?

- (A)  $\frac{b}{a+1}$  (B)  $\frac{a-1}{b-1}$  (C)  $\frac{a-1}{b}$  (D)  $\frac{b}{a-1}$  (E)  $\frac{a-1}{b}$

92. If  $y = x - 2$ , what does  $x^2 - 3x + 2$  equal in terms of  $y$ ?

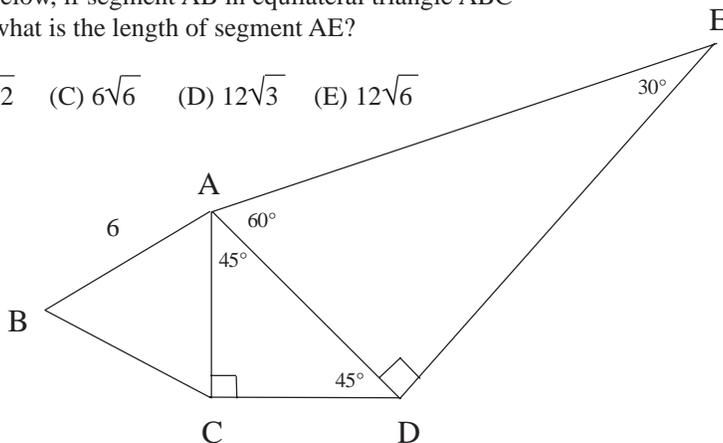
- (A)  $(y+2)^2$  (B)  $(y-2)^2$  (C)  $y(y+1)$  (D)  $y(y+2)$  (E)  $y(y+3)$

93. If the total cost of  $g$  gallons of gas is  $d$  dollars, what is the cost of 2 gallons of gas? All answers are in dollars.

- (A)  $2d/g$  (B)  $d/2g$  (C)  $2dg$  (D)  $2g/d$  (E)  $gd/3$

94. In the figure below, if segment AB in equilateral triangle ABC has a length of 6, what is the length of segment AE?

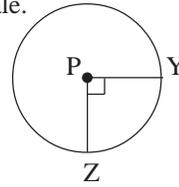
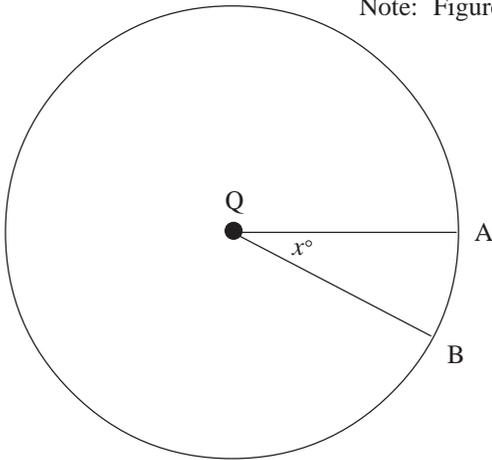
- (A) 12 (B)  $12\sqrt{2}$  (C)  $6\sqrt{6}$  (D)  $12\sqrt{3}$  (E)  $12\sqrt{6}$



95. If the length of the diameter of circle Q is three times the length of the diameter of circle P, what would  $x$ , the degree measure of central angle AQB have to be in order for the area of sector AQB to be equal to the area of sector YPZ? The  $m\angle YPZ = 90^\circ$ .

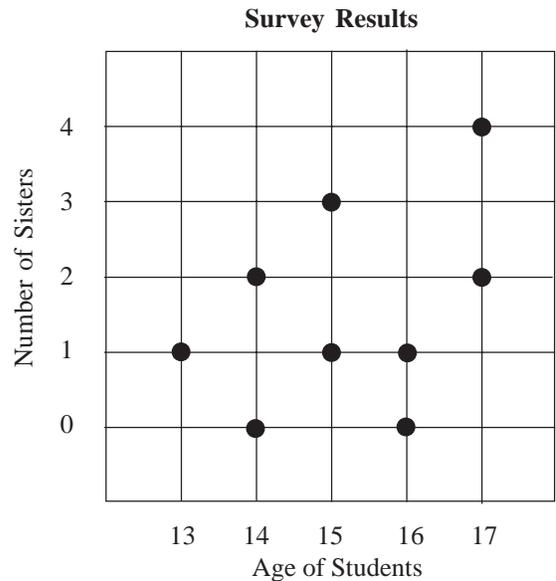
- (A) 45 (B) 30 (C) 22.5 (D) 15 (E) 10

Note: Figures not drawn to scale.



96. The results of a survey of 9 students at Lincoln High School are given in the grid to the right. It shows the number of sisters that students of various ages have in their families. If one more student is going to be surveyed, how many sisters would that student need to have in order for all 10 students to have an average of 1.5 sisters?

- (A) 0 (B) 1 (C) 2 (D) 3 (E) 4

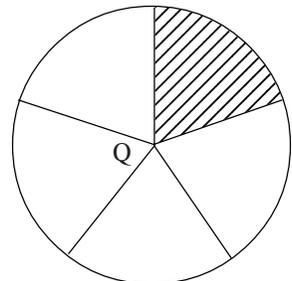


97. A store charges \$52.00 for a video game. This price is 30% greater than the store's cost to buy the game from its supplier. As an incentive to the store's clerks, the manager allows a clerk to purchase the video game for 10% less than the store's cost. How much would a store clerk have to pay for this video game?

- (A) \$15.60 (B) \$20.80 (C) \$31.20 (D) \$32.76 (E) \$36.00

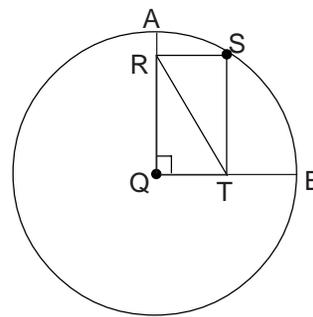
98. Circle Q to the right has an area of  $625\pi$  square centimeters and is divided into five equal regions. What is the perimeter of the shaded region in centimeters?

- (A)  $5\pi + 50$  (B)  $10\pi + 50$  (C)  $25\pi + 50$  (D)  $10\pi + 20$  (E)  $125\pi + 50$



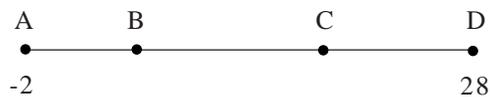
99. In circle Q to the right, quadrilateral RSTQ is a rectangle, and point S is on the circle. The circumference of circle Q is  $36\pi$ . What is the length of segment RT?

- (A) 6 (B) 18 (C)  $6\sqrt{2}$  (D)  $6\pi$  (E) 36



100. On a number line, point A has a coordinate of -2, and point D has a coordinate of 28. Point C is  $\frac{2}{3}$  of the way from point A to point D, and point B is  $\frac{1}{4}$  of the way from point A to point D. What is the length of BC?

(Student-Produced Response)



101. At Lincoln High School, there are 28 students in the math club and 25 students in the Key Club. Thirty-one students are members of just one of these two clubs. How many students are members of both clubs?

- (A) 3 (B) 6 (C) 8 (D) 11 (E) 22

## Answers and Explanations for Questions 78-101

- (B) **78.** Let  $\otimes y$  be defined for all  $y$  by the equation  $\otimes y = 3y + 1$ . For example,  $\otimes 6$  will equal  $3(6) + 1$ , which is 19. If  $\otimes 3 - \otimes y = y$ , what is the value of  $y$ ?  
 (A) 2 (B) 2.25 (C) 2.5 (D) 2.75 (E) 3

To  $\otimes 3 - \otimes y = y$ , apply the definition.

$$\begin{aligned}(3)(3) + 1 - (3y + 1) &= y \\ 9 + 1 - 3y - 1 &= y \\ 9 - 3y &= y \\ 9 &= 4y\end{aligned}$$

$$\boxed{2.25 = y \text{ CHOICE B}}$$

- 18 79.** Three boys (Bill, Chad, and Dan) and four girls (Jane, Kim, Lola, and Maria) are trying out for the swim team. One boy and two girls will be chosen. How many different groups of chosen swimmers are possible? For example, Bill, Jane, and Kim would be one group.  
 (Student-Produced Response)

Use the first letter of each person's name to write the groups that contain Bill.

B-JK, B-JL, B-JM, B-KL, B-KM, B-LM

Bill can be a part of six possible groups. The same is true for Chad and Dan.

Therefore, there are  $\boxed{18}$  possible groups.

- (B) **80.** The first term of a sequence is -4, and every term after the first is 3 more than the term immediately preceding it. What is the value of the 51st term of the sequence?  
 (A) 143 (B) 146 (C) 149 (D) 150 (E) 153

To find the second term, you add 3 once. To find the third term, you add 3 twice. To find the fourth term, you add 3 three times. Therefore, to find the 51st term, you add 3 fifty times. Adding 3 fifty times is the same as adding 150. Therefore, the answer is  $-4 + 150 = \boxed{146}$ . **CHOICE B**

In questions like this, you do not have time to write out all of the terms. Look for the pattern.

- (E) **81.** The ratio of Joe's marbles to Bill's marbles is 3:4. The ratio of Joe's marbles to Nancy's marbles is 2:5. What is the ratio of Bill's marbles to Nancy's marbles?  
 (A) 2:1 (B) 3:10 (C) 1:2 (D) 4:5 (E) 8:15

Using J, B, and N as abbreviations, it is given that  $\frac{J}{B} = \frac{3}{4}$  and  $\frac{J}{N} = \frac{2}{5}$ . You are to find  $\frac{B}{N}$ .

One method is to rewrite the proportions with the common letter (J) having the same value. You can then compare anything by using the numbers in the proportions.

Rewrite the proportions with  $J = 6$ .  $\frac{J}{B} = \frac{6}{8}$   $\frac{J}{N} = \frac{6}{15}$  Therefore,  $\frac{B}{N} = \frac{8}{15}$ , **CHOICE E.**

Another method to find  $\frac{B}{N}$  is to write ratios in a form so the Js will cancel. For example  $\frac{B}{J} \cdot \frac{J}{N} = \frac{B}{N}$ .

From the given information, you know that  $\frac{B}{J} = \frac{4}{3}$  and  $\frac{J}{N} = \frac{2}{5}$ . Therefore,  $\frac{B}{J} \cdot \frac{J}{N} = \frac{4}{3} \cdot \frac{2}{5} = \frac{8}{15} = \frac{B}{N}$ .

- 25 82.** If  $f(x) = x - 3$ , and  $f(\sqrt{m}) = 2$ , what is the value of  $m$ ?  
 (Student-Produced Response)

From the given information, you can write the equation  $2 = \sqrt{m} - 3$ . Therefore,  $5 = \sqrt{m}$ . Square both sides to get  $\boxed{25 = m}$ .

- (A) **83.** To receive health insurance benefits, an employee must have a regular workload of not less than 32 hours per week and not more than 40 hours per week. If  $w$  is the number of hours worked per week, which of the following describes all possible weekly workloads that would satisfy the requirement for receiving health insurance benefits?  
 (A)  $|w - 36| \leq 4$  (B)  $|w - 36| \geq 4$  (C)  $|w - 36| = 4$  (D)  $|w + 36| = 4$  (E)  $|w + 36| \geq 4$

One method is to test each of the five answer choices by doing the following.

- 1) Insert 32, 36, and 40 (hourly numbers that qualify for benefits) into each answer choice to see which have true statements every time. Choice A and Choice E will have true statements every time. Choices B, C, and D are eliminated.
- 2) Now, for Choice A and Choice E only, insert hourly numbers that would not qualify for benefits. If inserting one of these numbers results in an inequality that is a true statement, that choice is eliminated. For example, 50 will eliminate choice E. Therefore, the answer is **CHOICE A.**

Another method is to solve the inequalities or equations in the answer choices to see which results in numbers between 32 and 40 inclusive.

For example, to solve choice A,  $|w - 36| \leq 4$ , write  $-4 \leq w - 36 \leq 4$ . The result is  $32 \leq w \leq 40$ .

To solve choice B,  $|w - 36| \geq 4$ , write  $w - 36 \geq 4$  or  $w - 36 \leq -4$ . Therefore,  $w \geq 40$  or  $w \leq 32$ .

To solve choice C,  $|w - 36| = 4$ , write  $w - 36 = 4$  or  $w - 36 = -4$ . Therefore,  $w = 40$  or  $w = 32$ .

To solve choice D,  $|w + 36| = 4$ , write  $w + 36 = 4$  or  $w + 36 = -4$ . Therefore,  $w = -32$  or  $w = -40$ .

To solve choice E,  $|w + 36| \geq 4$ , write  $w + 36 \geq 4$  or  $w + 36 \leq -4$ . Therefore,  $w \geq -32$  or  $w \leq -40$ .

The result that includes just hourly numbers from 32 to 40 is CHOICE A.

- (C) **84.** The price of a car is reduced by 20%, and the resulting price is then reduced by 40%. These two reductions would be the same as a single reduction of what percent?  
 (A) 80% (B) 60% (C) 52% (D) 48% (E) 30%

Let the initial price of the car be \$100. After a 20% reduction, the price will be \$80. A further reduction of 40% of \$80 would be a reduction of \$32 ( $0.4 \times 80 = 32$ ). After this reduction the price of the car is \$48 ( $80 - 32 = 48$ ). After these two reductions the price of the car went from \$100 to \$48, which is a 52% reduction. **CHOICE C**

Another method is to call the price of the car  $p$ . After the first reduction the price would be  $p - 0.2p = 0.8p$ . After the second reduction the price would be  $0.8p - 0.4(0.8p) = 0.8p - 0.32p = 0.48p$ .

Therefore, the total reduction is  $0.52p$ , which is a 52% reduction.

- (D) **85.** On a geometry test, the average score for the class was 90. If 20% scored 100, and 30% scored 80, what was the average test score for the remainder of the class?  
 (A) 86 (B) 88 (C) 90 (D) 92 (E) 94

One method is to let the class be composed of 10 students (it is easy to find 20% and 30% of 10). Therefore 2 students (20%) made a 100, and 3 students (30%) made 80. The total points for these students is  $2 \times 100 + 3 \times 80$  or  $200 + 240 = 440$ . Since the average for the whole class (10 students) is 90, the point-total for the 10 students is 900. Therefore, the remainder of the class (5 students) would have a point-total of 460 ( $900 - 440 = 460$ ). Since  $460/5 = 92$ . The average for the remaining 5 students is **92. CHOICE D**

Another method is let  $n$  be the number of students in the class and let A be the average of the remainder of the class. Write the following equation and solve for A.

$$\frac{0.2n(100) + 0.3n(80) + 0.5n(A)}{n} = 90$$

$$20 + 24 + 0.5A = 90$$

$$44 + 0.5A = 90$$

$$0.5A = 46$$

$$\mathbf{A = 92}$$

- (C) 86. A clear tank in the shape of a rectangular solid has a height of 8 feet and a square base that is 2 feet by 2 feet. It contains 10 cubic feet of water. If 2 cubic feet of water are added to the tank, how many inches will the water in the tank rise?  
 (A) 1/2 (B) 2 (C) 6 (D) 12 (E) 24

The key is to find out how many cubic feet of water are in the tank when the height of the water is just 1 foot. This volume will be (2 feet)(2 feet)(1 foot) = 4 cubic feet.  
 (length)(width)(height)

Therefore, every additional 4 cubic feet of water added to the tank will cause the water level to rise 1 foot, and adding 2 cubic feet of water will cause the water to rise 1/2 foot or **6 inches**. **CHOICE C**

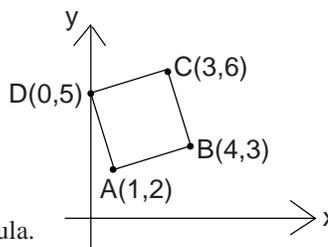
- (C) 87. Six pool balls, which are numbered 1 through 6, are on a pool table. If two balls are picked up at random leaving 4 balls on the table, what is the probability that the sum of the numbers on the two picked-up pool balls is 8?  
 (A) 1/8 (B) 5/36 (C) 2/15 (D) 1/6 (E) 1/5

There are 15 combinations for picking 2 balls. They are (1 and 2), (1 and 3), (1 and 4), (1 and 5), (1 and 6), (2 and 3), (2 and 4), (2 and 5), (**2 and 6**), (3 and 4), (**3 and 5**), (3 and 6), (4 and 5), (4 and 6), and (5 and 6).

Of these 15, two combinations would have a sum of 8. These are (**2 and 6**) and (**3 and 5**).

Therefore, the probability is **2/15**. **CHOICE C**

- (B) 88. In the figure to the right, if quadrilateral ABCD is a square, what is the area of the square ABCD in square units?  
 (A) 9 (B) 10 (C) 12 (D) 14 (E) 16



To find the area of a square, use the formula  $A = s^2$ .

You need the length of a side,  $s$ , to find the area.

One method to find the length of a side is to use the distance formula.

$$d = \sqrt{(y_2 - y_1)^2 + (x_2 - x_1)^2}$$

Pick two points such as A and B and insert the coordinates into the distance formula as follows:

$$AB = \sqrt{(3 - 2)^2 + (4 - 1)^2}$$

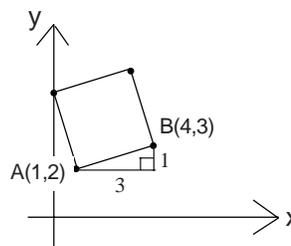
$$AB = \sqrt{(1)^2 + (3)^2}$$

$$AB = \sqrt{10}$$

$$\text{Area} = (\sqrt{10^2}) = 10 \quad \mathbf{CHOICE B}$$

Another method when the coordinate plane is involved (especially if you have difficulty remembering the distance formula) is to draw a right triangle with the hypotenuse as the length you are to find and use the Pythagorean Theorem.

For example, draw a right triangle, as shown to the right, with segment AB as the hypotenuse and with the legs as horizontal and vertical segments. The lengths of the legs are 3 and 1. Use the Pythagorean Theorem to write  $(3)^2 + (1)^2 = (AB)^2$  and solve.



- 529 89. If  $x^2 + y^2 = 289$ , and  $xy = 120$ , what is the value of  $(x + y)^2$ ?  
(Student-Produced Response)

This problem is not too difficult if you know that  $(x + y)^2 = x^2 + 2xy + y^2$ .  
Just rewrite  $x^2 + 2xy + y^2$  as  $x^2 + y^2 + 2xy$  and substitute 289 for  $x^2 + y^2$  and 120 for  $xy$ .

$$\begin{aligned} x^2 + y^2 + 2xy \\ 289 + 2(120) \\ 289 + 240 = \boxed{529} \end{aligned}$$

The following are three pairs of very important equivalent expressions. Knowing them will make questions similar to #89 much less difficult.

$$\begin{array}{c} \boxed{(x + y)^2} \\ | \\ \boxed{x^2 + 2xy + y^2} \end{array}$$

$$\begin{array}{c} \boxed{(x - y)^2} \\ | \\ \boxed{x^2 - 2xy + y^2} \end{array}$$

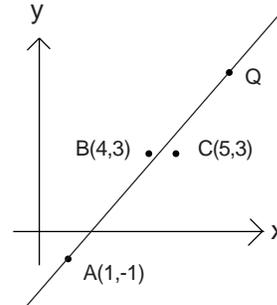
$$\begin{array}{c} \boxed{(x + y)(x - y)} \\ | \\ \boxed{x^2 - y^2} \end{array}$$

- 1 < m < 4/3 90. On the coordinate plane to the right, line AQ passes between points B and C. What is one possible value of the slope of line AQ?

The slope of line AB is  $4/3$ .  $m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{(3) - (-1)}{(4) - (1)} = \frac{4}{3}$ .

The slope of line AC is 1.  $m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{(3) - (-1)}{(5) - (1)} = \frac{4}{4} = 1$ .

Therefore, the slope of line AQ would have to be greater than 1, but less than  $4/3$ .



**The correct answer is any fraction or decimal number between 1 and 4/3.**

- (D) 91. If  $\frac{ay}{y + b} = 1$ , which of the following is equal to  $y$  if  $a$ ,  $b$ , and  $y$  are all greater than 1?

- (A)  $\frac{b}{a + 1}$  (B)  $\frac{a - 1}{b - 1}$  (C)  $\frac{a + 1}{b}$  (D)  $\frac{b}{a - 1}$  (E)  $\frac{a - 1}{b}$

To solve using algebra, begin by multiplying both sides of the given equation by  $y + b$ .

The result is  $ay = y + b$ .

Subtract  $y$  from both sides and proceed to solve for  $y$  (shown to the right).

$$\begin{aligned} ay &= y + b \\ -y &= -y \\ \hline ay - y &= b \\ y(a - 1) &= b \\ \frac{y(a - 1)}{a - 1} &= \frac{b}{a - 1} \\ y &= \frac{b}{a - 1} \end{aligned}$$

**CHOICE D**

Another method is to use the famous 3-step EZ McSqueezy Method, which enables you to solve problems like this with arithmetic instead of algebra.

**Step 1:** Choose your own value for each variable in the problem.

**Step 2:** Answer the question using your values for the variables. Make sure that you satisfy all conditions of the problem.

**Step 3:** Insert your values for the variables into each of the five answer choices and find the answer choice that matches your answer from Step 2.

Step 1: For the given equation,  $\frac{ay}{y + b} = 1$ , find values for  $a$ ,  $b$ , and  $y$  that will make a true statement.

For example, let  $y = 2$ ,  $a = 4$ , and  $b = 6$ , and you will have a true statement.  $\frac{(4)(2)}{2 + 6} = \frac{8}{8} = 1$

Step 2: The question asks for the value of  $y$ , which, using the values we have given to the variables, is **2**.

Step 3: Insert 4 for  $a$  and 6 for  $b$  into each answer choice to see which choice will have a result equal to  $y$ 's value of **2**. This works for **CHOICE D**.  $6/(4-1) = 6/3 = 2$ .

- (C) 92. If  $y = x - 2$ , what does  $x^2 - 3x + 2$  equal in terms of  $y$ .  
 (A)  $(y + 2)^2$  (B)  $(y - 2)^2$  (C)  $y(y + 1)$  (D)  $y(y + 2)$  (E)  $y(y + 3)$

This is another problem that is easy to solve with the famous 3-step EZ McSqueezy Method, but we will solve it with algebra first.

First, factor  $x^2 - 3x + 2$  to get  $(x - 2)(x - 1)$ . Since it is given that  $y = x - 2$ , you can rewrite  $(x - 2)(x - 1)$  as  $y(x - 1)$ .

Second, solve the given equation  $y = x - 2$  for  $x$ . You get  $x = y + 2$ .

Third, substitute  $y + 2$  for  $x$  in  $y(x - 1)$ . You get  $y(y + 2 - 1)$

Simplify to get  $y(y + 1)$  which is **CHOICE C**.

To solve using arithmetic instead of algebra, use the famous 3-step EZ McSqueezy Method.

Step 1: Choose your own values for the variables. For example, let  $x = 4$ , then  $y = 2$  ( $y = 4 - 2 = 2$ ).

Step 2: Answer the question (the value of  $x^2 - 3x + 2$ ) with your values, in this case  $x = 4$ .

$$(4)^2 - 3(4) + 2 = 16 - 12 + 2 = 6.$$

Step 3: Insert your value for  $y$  (2) into each answer choice to see which will match your answer from Step 2 (6).

$$(A) (2 + 2)^2 = 16 \quad (B) (2 - 2)^2 = 0 \quad (C) 2(2 + 1) = 6 \quad (D) 2(2 + 2) = 8 \quad (E) 2(2 + 3) = 10$$

**CHOICE C** is the only choice that works.

**Note: If more than one answer choice works, redo the 3 steps with different variable values on just the choices that worked the first time. The choice that works twice will be the correct answer.**

- (A) 93. If the total cost of  $g$  gallons of gas is  $d$  dollars, what is the cost of 2 gallons of gas? All answers are in dollars.  
 (A)  $2d/g$  (B)  $d/2g$  (C)  $2dg$  (D)  $2g/d$  (E)  $gd/3$

To solve with algebra, let  $P$  be the dollar cost of 2 gallons of gas, set up the proportion to the right, and solve for  $P$ .

$$\frac{\text{gallons}}{\text{dollars}} = \frac{\text{gallons}}{\text{dollars}}$$

$$\frac{g}{d} = \frac{2}{P}$$

$$gP = 2d$$

$$P = 2d/g$$

**CHOICE A**

To solve using arithmetic instead of algebra, use the famous 3-step EZ McSqueezy Method.

Step 1: Choose your own values for the variables.

For example, let  $g = 2$  and  $d = 6$ .

Step 2: Answer the question (the cost in dollars of 2 gallons of gas)

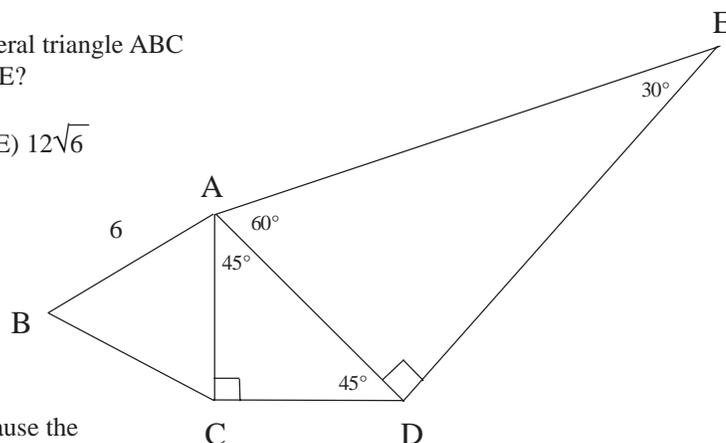
with your values. According to the chosen values, 2 gallons of gas will cost **\$6**.

Step 3: Insert 2 for  $g$  and 6 for  $d$  into each of the five answer choices to see which choice will match the answer from step 2 (6).

$$(A) 2(6)/2 = 6 \quad (B) 6/2(2) = 3/2 \quad (C) 2(6)(2) = 24 \quad (D) 2(2)/6 = 2/3 \quad (E) (2)(6)/3 = 4$$

- (B) 94. In the figure below, if segment  $AB$  in equilateral triangle  $ABC$  has a length of 6, what is the length of segment  $AE$ ?

$$(A) 12 \quad (B) 12\sqrt{2} \quad (C) 6\sqrt{6} \quad (D) 12\sqrt{3} \quad (E) 12\sqrt{6}$$



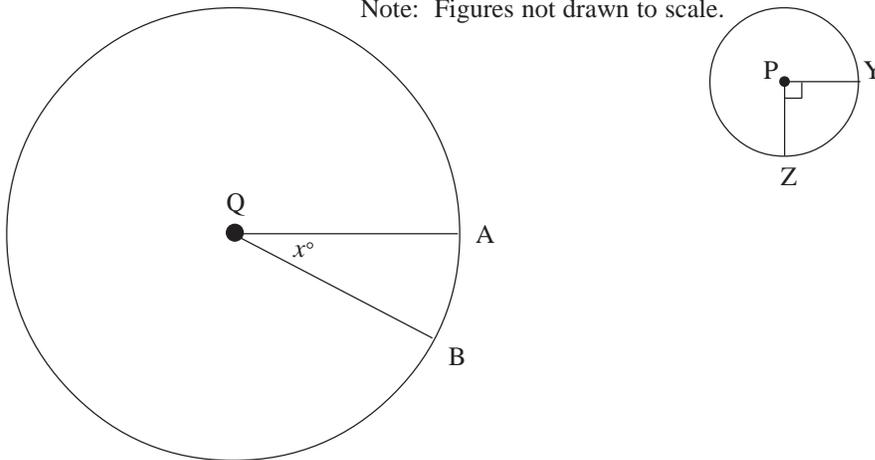
Since triangle  $ABC$  is equilateral, all three sides

have a length of 6. Since  $AC = 6$ ,  $AD = 6\sqrt{2}$  because the hypotenuse of a  $45^\circ$ - $45^\circ$ - $90^\circ$  triangle ( $\overline{AD}$  in this case) is equal

to the length of a leg times  $\sqrt{2}$ . Triangle  $AED$  is a  $30^\circ$ - $60^\circ$ - $90^\circ$  triangle. The hypotenuse,  $AE$ , is twice the length of the side opposite the  $30^\circ$  angle,  $\overline{AD}$ . Therefore,  $AE = (2)(6\sqrt{2}) = 12\sqrt{2}$ . **CHOICE B**

- (E) 95. If the length of the diameter of circle Q is three times the length of the diameter of circle P, what would  $x$ , the degree measure of central angle AQB have to be in order for the area of sector AQB to be equal to the area of sector YPZ? The  $m\angle YPZ = 90^\circ$ .  
 (A) 45 (B) 30 (C) 22.5 (D) 15 (E) 10

Note: Figures not drawn to scale.



All circles are similar to each other. The ratio of the area of similar figures is equal to the square of the ratio of any two corresponding lengths. For the circles above, the ratio of the diameters is 3/1.

$$\frac{\text{Area of circle Q}}{\text{Area of circle P}} = \left( \frac{\text{Diameter of circle Q}}{\text{Diameter of circle P}} \right)^2 = \left( \frac{3}{1} \right)^2 = \frac{9}{1}$$

Therefore, the area of circle Q is 9 times the area of circle P. Since the area of sector YPZ in circle P is 1/4 the area of circle P, the area of circle Q is 36 times the area of sector YPZ.

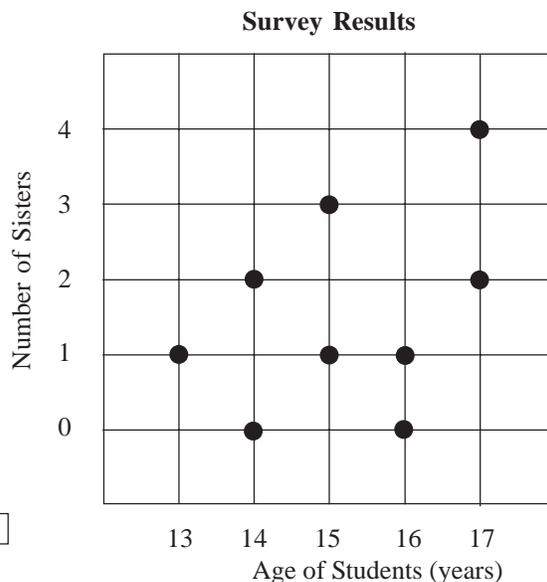
Therefore, for sector AQB to have the same area as sector YPZ, sector AQB would have to be 1/36 the area of circle Q. For this to happen,  $x$  would have to be 1/36 of 360 (the number of degrees in the arc of a circle). 1/36 of 360 = 10, the value of  $x$ . **CHOICE E**

- (B) 96. The results of a survey of 9 students at Lincoln High School are given in the grid to the right. It shows the number of sisters that students of various ages have in their families. If one more student is going to be surveyed, how many sisters would that student need to have in order for all 10 students to have an average of 1.5 sisters?

(A) 0 (B) 1 (C) 2 (D) 3 (E) 4

The nine students represented on the grid to the right have a total of 14 sisters. The additional student who is going to be surveyed would have to have exactly 1 sister in order for all 10 students to have an average of 1.5 sisters each.

Total sisters (15) divided by number of students surveyed (10) equals average number of sisters per student (1.5). **CHOICE B**



- (E) 97. A store charges \$52.00 for a video game. This price is 30% greater than the store's cost to buy the game from its supplier. As an incentive to the store's clerks, the manager allows a clerk to purchase the video game for 10% less than the store's cost. How much would a store clerk have to pay for this video game?  
 (A) \$15.60 (B) \$20.80 (C) \$31.20 (D) \$32.76 (E) \$36.00

Let the store's cost from the supplier be  $C$ . The price the store charges will be the store's cost from the supplier plus 30% of that cost.

Therefore, you can write the equation:

$$C + 0.3C = 52$$

$$1.3C = 52$$

$$C = 40$$

So, \$40 is the store's cost to buy the game from its supplier. Clerks are able to purchase this game at 10% less than \$40, or a discount of \$4. A clerk would have to pay \$36 for the video game. **CHOICE E**

- (B) 98. Circle Q to the right has an area of  $625\pi$  square centimeters and is divided into five equal regions. What is the perimeter of the shaded region in centimeters?  
 (A)  $5\pi + 50$  (B)  $10\pi + 50$  (C)  $25\pi + 50$  (D)  $10\pi + 20$  (E)  $125\pi + 50$

The perimeter of the shaded region consists of two radii and is  $1/5$  the circumference of the circle.

So, you must find the length of a radius, use that length to find the circumference of the circle, and find  $1/5$  of the circumference.

Since the area is given, you can substitute in the following equation to find the radius.

$$A = \pi r^2$$

$$625\pi = \pi r^2$$

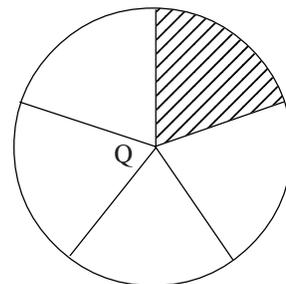
$$625 = r^2$$

$$25 = r$$

Use the formula  $C = 2\pi r$  to find the circumference.  $C = 2\pi(25) = 50\pi$ .

The arc of the shaded region has a length that is  $1/5$  of the circumference or  $(1/5)(50\pi) = 10\pi$ .

The perimeter of the shaded region in centimeters is  $10\pi + 50$ . **CHOICE B**



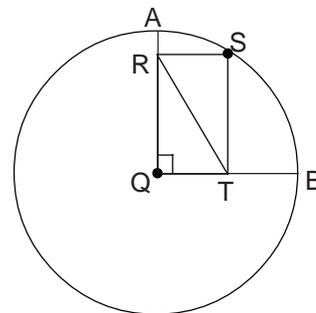
- (B) 99. In circle Q to the right, quadrilateral RSTQ is a rectangle, and point S is on the circle. The circumference of circle Q is  $36\pi$ . What is the length of segment RT?  
 (A) 6 (B) 18 (C)  $6\sqrt{2}$  (D)  $6\pi$  (E) 36

The key to this question is to know that the diagonals of a rectangle have the same length. This means that  $RT = QS$ . Since  $QS$  is a radius of circle Q, you need to find the length of the radius of circle Q, and you will know both the length of radius  $QS$  and  $RT$  (since  $RT = QS$ ).

Since you are given the circumference ( $36\pi$ ), you can find the radius by using the formula for circumference.  $C = 2\pi r$ .

Substitute  $36\pi$  for  $C$  and you get  $36\pi = 2\pi r$ . Divide both sides of the equation by  $2\pi$ , and  $r = 18$ ,  $QS = 18$  and  $RT = 18$ .

**CHOICE B**



- 12.5 or 25/2** **100.** On a number line, point A has a coordinate of -2, and point D has a coordinate of 28. Point C is  $\frac{2}{3}$  of the way from point A to point D, and point B is  $\frac{1}{4}$  of the way from point A to point D. What is the length of BC?  
(Student-Produced Response)



The distance from -2 to 28 is 30, so  $AD = 30$ . If point C is  $\frac{2}{3}$  of the way from A to D, then point C is  $\frac{2}{3}$  of 30 or 20 units from A to D. Therefore, the coordinate of point C is 18.

If point B is  $\frac{1}{4}$  of the way from A to D, then point B is  $\frac{1}{4}$  of 30 or 7.5 units from A to D. Therefore, the coordinate of point B is 5.5.

To find the length of BC, find the distance from 5.5 (the coordinate of B) to 18 (the coordinate of C).  
 $18 - 5.5 = 12.5$ . Therefore the answer to grid is **12.5 or 25/2**.

- (D) 101.** At Lincoln High School, there are 28 students in the math club and 25 students in the Key Club. Thirty-one students are members of just one of these two clubs. How many students are members of both clubs?  
(A) 3 (B) 6 (C) 8 (D) 11 (E) 22

The total membership of both clubs is 53 (28 plus 25). Thirty-one of the 53 are just in one of the two clubs. This means that 22 ( $53 - 31 = 22$ ) membership places are taken by students who are in both clubs. Therefore, **11** students are in both clubs. **CHOICE D**