

1. Solve for  $x$  if  $3x + 5 = x + 23$

- a) 14      b) 9      c) 7      d) 13      e) none of these

2. An equilateral triangle has one side of length  $2x + 5$  and a second side of length  $4x - 3$ . What is the perimeter of the triangle?

- a) 4      b) 12      c) 13      d) 39      e) none of these

3. Given the addition problem to the right Bubba rounds to the nearest hundred then adds. Cletus adds then rounds to the nearest hundred. What is the positive difference in their two answers rounded to the nearest hundred?

$$\begin{array}{r} 2415 \\ 3299 \\ \hline +1550 \end{array}$$

- a) 0      b) 100      c) 200      d) 300      e) none of these

4. What is the numerical value when the sum of number of degrees of all of the angles in a triangle is divided by the average measure of the angles in a convex quadrilateral?

- a) 30      b) 60      c) 3      d) 90      e) none of these

5. If angle  $\theta$  is in the second quadrant and  $\sin(\theta) = \frac{3}{5}$ , what is the value of the  $\cos(2\theta)$ ?

- a)  $\frac{-7}{25}$       b)  $\frac{7}{25}$       c)  $\frac{24}{25}$       d)  $\frac{-25}{25}$       e) none of these

6. Suppose  $a + b = 10$  and  $a^2 + b^2 = 56$ , what is the value of  $ab$ ?

- a) 560      b) 22      c) 56      d) 44      e) none of these

7. Find the value of  $a + b$  if  $(a, b)$  is the solution to the system of equations

$$3^{a+1} = 27^b \quad \text{and} \quad 16^b = 4^{a-2}$$

- a)  $-5$       b)  $0$       c)  $3$       d)  $11$       e) none of these

8. How many real solutions to the system of equations:  $y = \sin(x)$  and

$$y = \frac{x}{2\pi}$$

- a)  $7$       b)  $3$       c)  $5$       d) infinitely many

e) none of these

9. An equilateral triangle and a regular pentagon have the same perimeter. If the length of one side of the triangle is 30. What is the length of one side of the pentagon?

- a) 15      b) 25      c) 24      d) 18      e) none of these

10. Evaluate the sum  $\sum_{n=1}^{24} \frac{1}{\sqrt{n} + \sqrt{n+1}}$

- a) 4      b)  $3 + 2\sqrt{2}$       c)  $2\sqrt{6} + 2$       d)  $2\sqrt{6}$       e) none of these

11. You are given three cards all the same size. Two cards are red on both sides, and one card is red on one side and blue on the other. One of these cards is selected at random and placed on the table and the top is red. What is the probability the bottom of the card is blue?

- a)  $\frac{1}{3}$       b)  $\frac{1}{6}$       c)  $\frac{1}{5}$       d)  $\frac{1}{12}$       e) none of these

12. Given the series  $1 + 2 + 3 + \dots + n$ , what is the smallest value of  $n$  which will give a sum which exceeds 200?

- a) 10      b) 21      c) 22      d) 30      e) none of these

13. How many of the following fractions are reduced to lowest terms?

$$\left\{ \frac{8}{12}, \frac{49}{66}, \frac{52}{91}, \frac{11}{111}, \frac{159}{160} \right\}$$

- a) 1      b) 2      c) 3      d) 4      e) 5

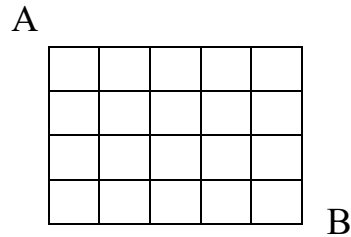
14. A rectangle has diagonal of length 20, and its width is four units less than its length. What is the perimeter of this rectangle?

- a) 56      b) 28      c) 16      d) 32      e) none of these

15. Eulers formula states that for any polyhedron that the number of faces plus the number of vertices is equal to the number of edges plus two. A soccer ball has 12 pentagons and 20 hexagons on its surface. How many vertices does it have on its faces?

- a) 50      b) 60      c) 72      d) 58      e) none of these

16.



In the grid above, point A is the upper left vertex and B is the lower right vertex. Starting at A and moving to point B there is a path of length 9. How many different paths of length 9 exist?

- a) 18      b) 20      c) 81      d) 126      e) none of these

17. Consider a vat of lemonade (Vat A) and a vat of orange juice (Vat B), with equal amounts in each vat. A cup of lemonade is taken from Vat A and dumped into Vat B. Then the exact same size cup is taken from Vat B and dumped in vat A. Which of the following is true

- a) There is more orange juice in Vat A than there is lemonade in Vat B
- b) There is more lemonade in Vat B than there is orange juice in Vat A
- c) There is the same amount of lemonade in Vat B as orange juice in Vat A
- d) Either a or b could be true , depending on the size of the vats
- e) Any of a, b, or c could be true, depending on the size of the vats

18. An involution is a function from a set to itself such that when composed with itself gives the identity function. That is  $f(f(x)) = x$ . For example,  $f(x) = \frac{1}{x}$  and  $g(x) = -x$  are involutions. How many of the following functions are involutions?

$$f(x) = \frac{x+1}{x-1} \quad g(x) = \frac{x-1}{x+1} \quad h(x) = e^{-\ln(x)} \quad k(x) = \ln(e^x)$$

- a) 0      b) 1      c) 2      d) 3      e) 4

19. Which of the following is the largest?

- a)  $2^{-300}$     b)  $3^{-250}$     c)  $5^{-200}$     d)  $6^{-150}$     e)  $10^{-100}$

20. Given the system of equations:  $3x + y = 11$   
 $x - 3y = -3$

the solution is:

- a) (1, 8)    b) (3, 2)    c) (4, -1)    d) (0,1)    e) none of these

21. What is the exact distance between the two polar points with polar coordinates  $(4, 37^\circ)$  and  $(3, -83^\circ)$ ?

- a) 5      b)  $\sqrt{37}$       c)  $\sqrt{13}$       d) 13      e) none of these

22. By what percent must one-half be increased to have a value of five-eighths?

- a) 20      b) 120      c) 25      d) 125      e) none of these

23. Simplify the given expression:

$$\left(\frac{12y}{y^4}\right)^3(3y)^0$$

- a)  $\frac{1728}{y^9}$       b)  $\frac{108}{y}$       c)  $\frac{27}{y^4}$       d)  $\frac{1728}{y^2}$       e) none of these

24. What is the value of  $\frac{(\log_{10} 20)(\log_{20} 144)}{(\log_{10} 11)(\log_{11} 12)}$ ?

- a) 4      b) 2      c)  $\frac{240}{11}$       d) 5      e) none of these

25. How many different prime numbers divide 25! (twenty-five factorial)?

- a) more than 50    b) between 40 and 50    c) between 25 and 40  
d) between 10 and 25    e) less than 10

26. A regular n-gon has an interior angle of 160 degrees. How many diagonals are in this n-gon?

- a) 135      b) 119      c) 152      d) 130      e) none of these

27. In a certain country postage stamps only are in value of 3 cents and 7 cents. All mail is based on its weight and charged accordingly. What is the largest monetary value of mail for which there is no correct value of stamps?

- a) 11 cents      b) 16 cents      c) 13 cents      d) 17 cents      e) none of these

28. Which of the following is the largest?

- a)  $\sin(133^\circ)$       b)  $\tan(92^\circ)$       c)  $\cos(314^\circ)$       d)  $\csc(317^\circ)$       e)  $\cot(177^\circ)$

29. Two fair coins are flipped. What is the probability both show heads?

- a)  $\frac{1}{2}$       b)  $\frac{1}{4}$       c)  $\frac{3}{4}$       d)  $\frac{1}{3}$       e) none of these

30. By what number must 48 be decreased by, and 14 increased by the same number, to get equal results?

- a) 17      b) 31      c) 12      d) 31      e) none of these

31. Find the product of the solutions to  $|2x+4| = |x+14|$

- a)  $-100$       b)  $-6$       c)  $\{10, -6\}$       d)  $-60$       e) none of these

32. How many real numbers solve the equation  $x^3 + 2x + 2 = 0$ ?

- a) 0      b) 1      c) 2      d) 3      e) none of these

33. If  $\cos(\theta) + \sin(\theta) = 1.25$ , find the value of  $|\sin(\theta) - \cos(\theta)|$

- a)  $\frac{\sqrt{7}}{4}$       b)  $\frac{1}{2}$       c)  $\frac{-1}{2}$       d)  $\frac{\sqrt{5}}{4}$       e) none of these

34. What is the greatest number  $n$ , of points in a plane with the property that if  $S$  is a set of  $n$  points, then any subset of  $S$  is the intersection of  $S$  with a set defined by a linear inequality?

- a) 2      b) 3      c) 4      d) 5      e) not enough information to determine

35. A farmer has 80 meters of fencing to enclose a rectangular vegetable garden. If the length of the garden is  $x$  meters, express the area  $A(x)$  as a function of the length.

- a)  $A(x) = x(40 - x)$     b)  $A(x) = x(80 - x)$     c)  $A(x) = x(20 - x)$   
d)  $A(x) = x(30 - x)$     e) none of these

36. The value of  $\log_3 108 - 2 \log_3 2$  is

- a) 3    b)  $\sqrt{3}$     c) 27    d) 32    e) none of these

37. Consider the lattice points in the plane ( that is, the points where both coordinates are integers) For each pair of points, flip a coin. If the coin lands “heads”, then draw a line segment connecting those two points. If the coin lands “tails”, do nothing with that pair. Which of the following is true?

- a) With probability at least  $\frac{1}{2}$  every point is connected to at least one other.  
b) It is certain that at least half of the points will each be connected to at least one other point.  
c) With probability  $\frac{1}{2}$ , the origin is connected to every other point.  
d) With probability at least 0.99, there are no unit sized squares in the figure.  
e) With probability at least 0.99, the letters “SIU” are spelled out somewhere in the figure.

38. A linear function is defined by the equation  $f(x) = (3 - m)x - 4$ . This function does not have a zero for  $m$  equal to what value?

- a)  $-3$     b) 0    c) 3    d) 4    e) it has a zero for all values of  $m$

39. A high-speed computer evaluates the number  $100!$ , and then converts it to base seven. How many zeroes are at the end of this base seven number?

- a) 12    b) 14    c) 16    d) 32    e) none of these

40. Let  $\frac{x}{y} = \frac{1+\sqrt{5}}{2}$ . What is the value of  $\frac{x+y}{x}$  ?

- a)  $\frac{1+\sqrt{5}}{2}$       b)  $1+\sqrt{5}$       c)  $\sqrt{5}$       \ d) 5      e) none of these

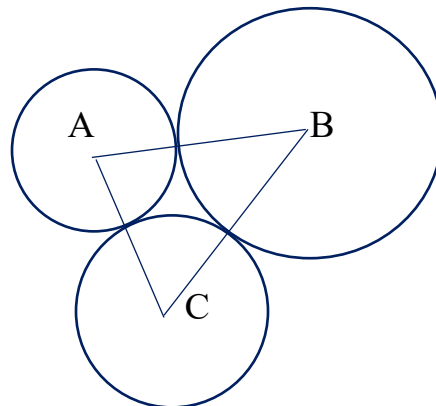
41. Troy Landy is known as the “King of the Swamp” and catches alligators for a living. One week he caught some alligators on Monday. On Tuesday he caught seven less than he caught on Monday. On Wednesday he caught 20 alligators and on Thursday he caught five more than half the number he caught on Monday. He caught 17 alligators on Friday. If his total number of alligators for the five days was 135, how many did he catch on Tuesday?

- a) 40      b) 50      c) 25      d) 33      e) none of these

42. By how much is  $\frac{7}{8}$  larger than  $\frac{2}{3}$ ?

- a)  $\frac{5}{24}$       b)  $\frac{-5}{24}$       c)  $\frac{1}{8}$       d)  $\frac{1}{6}$       e) none of these

43. Given the figure to the right there are 3 tangent circles. If  $AB = 12$ ,  $AC = 10$  and  $BC = 14$ , what is the radius of the largest circle?



- a) 12      b) 8      c) 6      d) 4      e) none of these

44. Suppose  $\alpha$  is an acute angle with  $\sqrt{3} \tan(\alpha) = 2 \sin(\alpha)$ . What is the value of  $\cos(\alpha)$ ?

- a)  $\sqrt{2}$       b)  $\frac{1}{2}$       c)  $\frac{\sqrt{2}}{2}$       d)  $\frac{\sqrt{3}}{2}$       e) none of these

45. How many of the following statements are true for all real values of  $x$ ?

$$\sqrt{x^2} = x \quad \sqrt[3]{x^3} = x \quad x^0 = 1 \quad (x^{-1})^{-1} = x$$

- a) 0      b) 1      c) 2      d) 3      e) 4

46. How many of the following are equal in value to  $\frac{\ln 15}{\ln 3}$

$$\left\{ \ln 5; \frac{\log 15}{\log 3}; 1 + \frac{\ln 5}{\ln 3}; \frac{\log_7 15}{\log_7 3} \right\}$$

- a) 0      b) 1      c) 2      d) 3      e) 4

47. What are the next three letters of this numerically related sequence of letters  $\{O, T, T, F, F, S, S, \dots\}$ ?

- a) E, N, T      b) U, V, V      c) U, G, G      d) A, H, H      e) none of these

48. The quadratic equation  $(m+2)x^2 + mx + m - 2 = 0$  has exactly one solution for two different values of  $m$  (not necessarily real values) which we will call  $m_1$  and  $m_2$ . What is the value of the product  $m_1 m_2$ ?

- a)  $\frac{1-\sqrt{3}}{2}$       b)  $\frac{-16}{5}$       c)  $\frac{-16}{3}$       d) 4      e) none of these

49. If three-fifths of a number is 21 more than one-fourth of a number, what is ten less than the number?

- a) 50                  b) 40                  c) 60                  d) 80                  e) none of these

50. On a table are two identical boxes. One contains three marbles individually numbered 2,3 and 4. The second contains two marbles individually numbered 5 and 6. A box is selected at random and a marble is chosen. What is the probability the marble has an even number on it?

- a)  $\frac{5}{12}$                   b)  $\frac{3}{5}$                   c)  $\frac{7}{12}$                   d)  $\frac{13}{24}$                   e) none of these

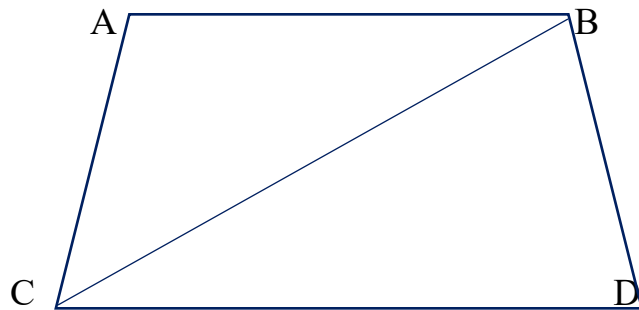
51. The equation  $x^2 - ax + b = 0$  has roots  $\frac{a}{3}$  and  $\frac{b}{2}$  where  $(a \neq 0)$ . What is the value of  $a$ ?

- a) 4                  b) 8                  c) 5                  d) 6                  e) none of these

52. There is a value of  $m$  for which the sequence  $\{2m + 11, m^2 + 3, 5 - m\}$  is both arithmetic and decreasing. In which of the following sets will you find  $m$ ?

- a)  $\{2, 4, 2 + \sqrt{2}\}$     b)  $\{-2, -3, 11\}$     c)  $\{3, 5, -11\}$     d)  $\{\frac{5}{2}, 8, 9\}$     e) none of these

53. Given the trapezoid as AB parallel to CD, what is the length of the longer base if angle ACB equals angle CDB, AC = 8, CB =12, BD =14.



- a) 21      b)  $\frac{48}{7}$       c) 16      d) 10      e) none of these

54. A farmer has only chickens and cows on his farm and all are normal for their species. His daughter counts them and tells him he has one more cow than he does chickens. His son counts them and says there are a total of 88 feet. How many cows does the farmer have?

- a) 12      b) 13      c) 14      d) 15      e) none of these

55. How many real solutions exist to the equation  $x^{x^2} = x$ ?

- a) 0      b) 1      c) 2      d) 3      e) infinitely many

56. Evaluate the series given by:  $\sum_{k=1}^{200}(k + 1)$

- a) 1010      b) 2030      c) 3020      d) 5050      e) none of these

57. If  $x$  and  $y$  are both positive with  $x^4 = 16$  and  $y^{-2} = \frac{1}{9}$ , which of the following is largest?

- a)  $x^y$       b)  $y^x$       c)  $y^3 - x^2$       d)  $5x + 2y$       e)  $x^3 + 3y$

58. A regular hexagon has area  $24\sqrt{3}$ . What is the length of one of its longest diagonals?

- a)  $8\sqrt{2}$       b) 8      c)  $8\sqrt{3}$       d)  $6\sqrt{3}$       e) none of these

59. For all values of  $x$  the expression  $(3x + 2)^2 - (2x - 3)^2$  simplifies to

- a)  $5x^2 - 5$       b)  $5x^2 + 13$       c)  $5x^2 + 24x - 5$   
d)  $5x^2 + 24x + 5$       e) none of these

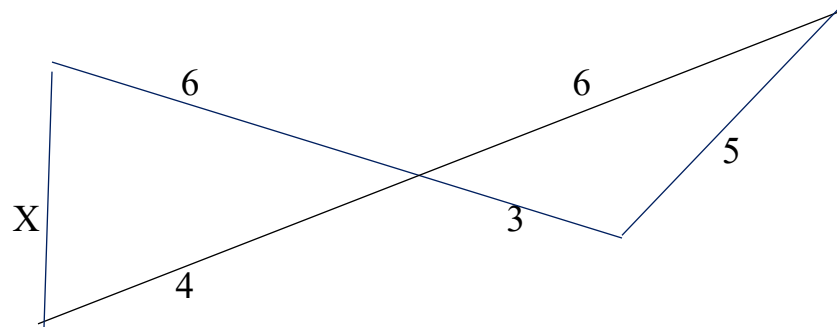
60. Solve if  $0 \leq \theta \leq 360^\circ$ .  $1 + \cos(\theta) = \sin^2(\theta)$

- a)  $\{60^\circ, 180^\circ, 300^\circ\}$       b)  $\{30^\circ, 180^\circ, 330^\circ\}$       c)  $\{60^\circ, 180^\circ\}$   
d)  $\{30^\circ, 180^\circ\}$       e) none of these

61. If  $\sqrt[3]{22^3 - 6(22^2) + 12(22) - 8}$  is evaluated, it equals

- a) 15      b) 16      c) 18      d) 20      e) none of these

62.



In the figure above what is the length of segment X?

- a)  $\frac{24}{5}$       b)  $\frac{20}{3}$       c)  $\sqrt{\frac{76}{3}}$       d) 5      e) none of these

63. What is the least common denominator when all the fractions  $\{\frac{1}{3}, \frac{7}{12}, \frac{7}{8}\}$  are added?

- a) 288      b) 24      c) 12      d) 36      e) none of these

64. A right triangle has its legs of length 16 and 8. A square has the same area as this triangle. What is the perimeter of the square?

- a) 32      b) 64      c) 48      d) 40      e) none of these

65. What is the base seven value of  $32_5 + 41_6$ ?

- a)  $42_7$       b)  $62_7$       c)  $61_7$       d)  $60_7$       e) none of these

66. What is the sum of the smallest three-digit prime number and the smallest two digit composite number?

- a) 200      b) 111      c) 113      d) 115      e) none of these

67. Solve for x if:  $2^{318} + 2^{318} + 2^{318} + 2^{318} = 16^x$

- a) 318      b) 40      c) 80      d) 60      e) none of these

68. You have eight identical steel spheres, all the exact same size, color and exact weight of 44 grams. You also have a ninth steel sphere which is the exact same size and color, but the weight is 43 grams. If all you have is a balance beam scale and NO weights for the scale, what is the fewest number of weighing's you will need to find the 43-gram sphere?

- a) 9      b) 8      c) 3      d) 2      e) none of these

69. In the class there are m girls and n boys. How many ways can you arrange them in a line so that all of the girls are together?

- a)  $m!n!$       b)  $(m+1)!n!$       c)  $m!(n+1)!$       d)  $(m+1)!(n+1)!$       e) none of these

70. If  $x$  is greater than 5, which of the following is always the largest?

- a)  $\frac{x}{5}$       b)  $\frac{5}{x-1}$       c)  $\frac{5}{x}$       d)  $\frac{x+1}{5}$       e) none of these