

1. What is the remainder when 53876 is divided by 17?
- a) 9      b) 2      c) 16      d) 3      e) none of these
2. How many distinct four-digit numbers are divisible by 3, if the last two digits are 32?
- a) 26      b) 30      c) 34      d) 80      e) none of these
3. How many distinct ways can you arrange all of the letters in "MATH" ?
- a) 0      b) 12      c) 16      d) 24      e) none of these
4.  $\sqrt{27} + \sqrt{12}$  equals
- a)  $6\sqrt{6}$       b)  $\sqrt{39}$       c)  $\sqrt{75}$       d) 8.66      e) none of these
5. If  $\sin(A) = \frac{3}{5}$  and the  $\cos(B) = \frac{12}{13}$ , what is the largest possible negative value of  $\cos(A + B)$ ?
- a)  $\frac{-20}{65}$       b)  $\frac{-63}{65}$       c)  $\frac{-16}{65}$       d)  $\frac{-33}{65}$       e) none of these
6. Suppose that  $(x + a)^4 = x^4 + a_1x^3 + a_2x^2 + a_3x + a_4$  and  $a_1 + a_2 + a_3 = 64$ . Then the real number  $a$  is equal to
- a) -2      b) -1      c) 1      d) 2      e) none of these

7. The lengths of two sides of a triangle are 7 and 10 units. In the same units what is the range of possible values for the third side?

- a)  $3 < x < 17$       b)  $3 \leq x \leq 17$       c)  $4 < x < 16$   
d)  $10 < x < 17$       e) none of these

8. The size of a spherical shaped orange is increased twice. The ratio of its surface area to its volume will

- a) decrease 4 times      b) decrease 2 times      c) will not change  
d) will increase 2 times      e) none of these

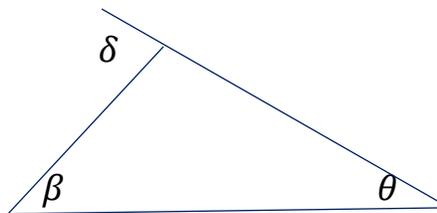
9. Solve for x if  $\sqrt{x} + \frac{1}{\sqrt{x}} = \sqrt{6.25}$

- a) {4, 0.5}      b) { 4, 0.25}      c) {2.5}      d) {16}      e) none of these

10. A right triangle has sides of integral length and they form an arithmetic progression. Which of the following is a possible length of any of the sides?

- a) 13      b) 81      c) 61      d) 34      e) none of these

11. What is the average of the three angles marked?



- a)  $\frac{2\delta}{3}$       b)  $60^\circ$       c)  $45^\circ$       d)  $\frac{\beta+\theta}{2}$       e) none of these

12. What percent of 30 is 90% of 50?

- a) 45      b) 66.7%      c) 54%      d) 60%      e) none of these

13. Which of the following describes the value of  $21431_5$  (21431 in base 5 representation) when it is converted to base 10?

- a) less than 500      b) between 499 and 900      c) between 899 and 1500  
d) between 1499 and 2000      e) none of these

14. If angles  $\beta$  and  $\theta$  are both between  $\pi/2$  and  $\pi$  in value with  $\beta > \theta$ , which of the following is the largest?

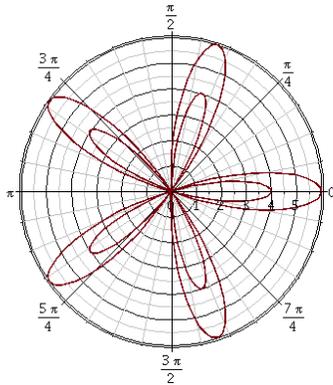
- a)  $\sin(\beta)$       b)  $\tan(\beta)$       c)  $\sin(\theta)$       d)  $\tan(\theta)$       e)  $\cos(\theta)$

15. A bag contains 5 red, 7 blue and 8 green marbles. If one is drawn at random what is the probability it is either red or green?

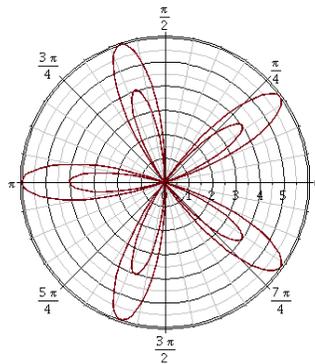
- a)  $\frac{5}{20}$       b)  $\frac{13}{20}$       c)  $\frac{2}{20}$       d)  $\frac{15}{20}$       e) none of these

16. Which of the following is the correct graph of  $r = 1 + 5 \cos(5\theta)$

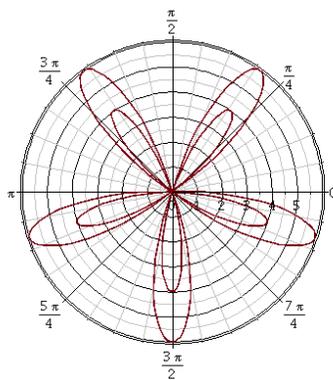
a)



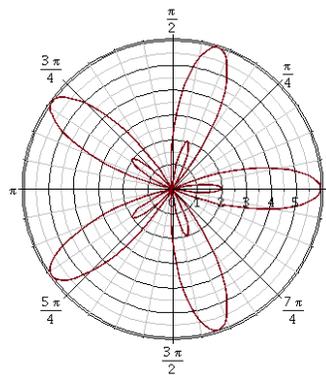
b)



c)



d)



e) none are correct

17. What is the average of the five smallest whole numbers?

a) 3

b) 2

c) 10

d) 15

e) none of these

18. A cube measures 4" by 4" by 4". This cube is dropped into a bucket of red paint and allowed to dry. It is then cut up into 64 one-inch by one-inch by one-inch cubes. How many of the smaller cubes do not have at least one side painted red?

- a) 8                      b) 4                      c) 16                      d) 27                      e) none of these

19. The length and width of a rectangle are  $w$  and  $3w$  respectively. The hypotenuse on a 30-60-90 right triangle is  $2w$ . What is the ratio of the area of the rectangle to the area of the triangle?

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

20. Evaluate

$$\tan 1^\circ \cdot \tan 2^\circ \cdot \tan 3^\circ \dots \tan 88^\circ \cdot \tan 89^\circ$$

- a)  $-1$                       b)  $2\pi$                       c)  $\tan 100^\circ$                       d)  $1$                       e) none of these

21. Find all the real values of  $x$  for which  $y$  is real, and  $y$  satisfies the equation  $25y^2 + 5xy + x + 8 = 0$ .

- a)  $(-\infty, -4]$  or  $[8, \infty)$               b)  $(-\infty, -8]$  or  $[4, \infty)$

- c)  $[-4, 8]$                       d)  $[-8, 4]$                       e) none of these

22. Which of the following is the largest?

- a)  $3A_{16}$                       b)  $212_5$                       c)  $330_4$                       d)  $67_9$                       e)  $100000_2$

23. During a two hour span a motorboat traveled 4 km downstream and then 10 km upstream (with respect to land distance). The speed of the current in the water is 3 km/hr. What is the speed of the boat in still water?

- a) 9 km/hr      b) 7 km/hr      c) 2 km/hr      d) 11 km/hr  
e) none of these

24. If  $\alpha$  and  $\beta$  are the roots of  $x^2 + 2x - 5 = 0$ , what is the value of  $(\alpha + 4)(\beta + 4)$ ?

- a)  $-7$               b) 3              c) 5              d) 24              e) none of these

25. What is the constant term of the expression  $\left(x^4 - 1 + \frac{1}{x}\right)^8$  when it is multiplied out?

- a)  $-1$               b) 0              c)  $-279$               d) 281              e) none of these

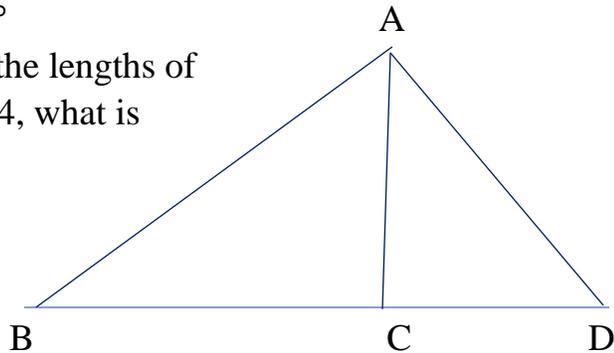
26. Find the area in the fourth quadrant bounded by the x axis, y axis and the line with equation  $y = \frac{2}{3}x - 8$ .

- a) 96              b) 48              c) 60              d) 24              e) none of these

27. If  $a^3 + b^3 = 3$  and  $a + b = 3$ , what is the value of  $ab$ ?

- a) 27              b) 9              c) 3              d)  $\frac{9}{2}$               e) none of these

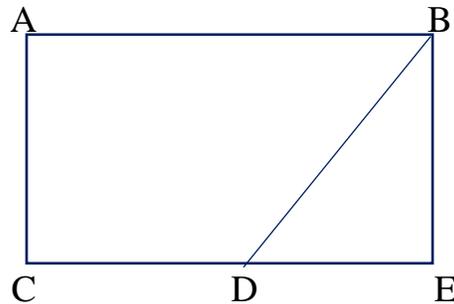
28. In triangle ABD angle A is  $90^\circ$  and AC is perpendicular to BD. If the lengths of BC and CD are respectively 9 and 4, what is the area of triangle ABD.



- a) 39      b) 78      c) 26      d) 42      e) none of these
29. A man went for a walk. He first walked on level ground at 4 mph, then uphill at 3 mph, then downhill at 6 mph. Then he turned around and walked the same path back in the other direction. If the entire trip took him 6 hours, how far did he walk?

- a) 20 miles      b) 24 miles      c) 28 miles      d) 26 miles      e) none of these

30. ABEC is a rectangle with  $AC = 6$  and  $CD:AC = 2$ . The area of triangle DBE is 4. What is the area of ABEC?



- a) 80      b) 24      c) 72      d) 12      e) none of these
31. If a and b are the solutions to the equation  $(x - 7)(x + 13) + 99 = 0$ , what is the value of the product ab?
- a)  $-12$       b) 12      c)  $-8$       d) 8      e) none of these

32. Find the sum of the squares of all real values of  $x$  which solve the equation

$$x^{512} - (65536)^{32} = 0$$

- a) 8                      b) 16                      c) 64                      d) 512                      e) none of these

33. You have four boxes numbered 1,2,3 and 4. You have four identical marbles. How many ways can you place the marbles in the boxes so that a box numbered  $k$  has no more than  $k$  marbles in it?

- a) 15                      b) 20                      c) 24                      d) 35                      e) none of these

34. Find the remainder when  $x^{100} - 2$  is divided by  $x - 1$ .

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

35. Solve the system  $2x + 4y = 22$  and  $5x + 3y = 27$  for  $(x,y)$ . What is the value of the expression  $4xy$  ?

- a) 56                      b) 36                      c) 48                      d) -24                      e) none of these

36. Given that  $x + 2$  is a factor of  $f(x) = x^3 + kx + 6$ , find the value of  $k$ .

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

37. If  $p(x)$  is a polynomial with rational coefficients and zeroes of  $0, 1, \sqrt{3}$  and  $1 + \sqrt{2}$ , then the least possible degrees of  $p(x)$  is

- a) 4                      b) 5                      c) 6                      d) 7                      e) none of these

38. If  $x$  is the solution to  $3x + 20 = 44$ , what is the value of  $\sqrt[3]{x} + \sqrt{2x}$  ?

- a) 6                      b) -2                      c) 6 or -2                      d) 8                      e) none of these

39. An isosceles right triangle and a square have equal areas. What is the ratio of the length of the hypotenuse of the triangle to the diagonal of the square?

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

40. When the fraction  $\frac{7}{8}$  is converted to a percent it is

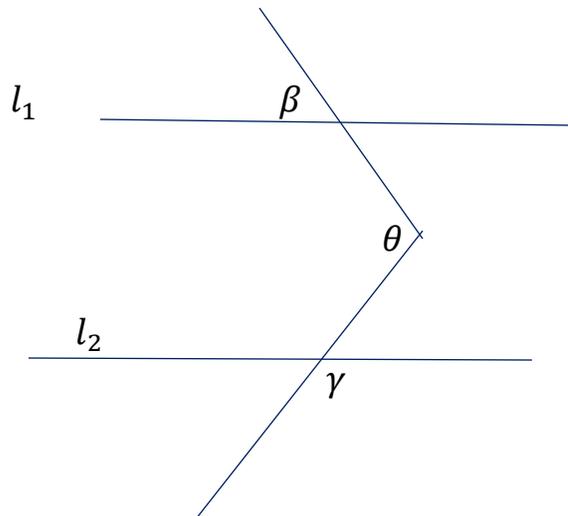
- a)  $\frac{7}{8}\%$                       b) 0.875%                      c) 8.75%                      d) 87.5%                      e) none of these

41. A bag contains three red marbles, four blue marbles and  $K$  green marbles. If a marble is drawn at random the probability it is not green is one-third. Then the value of  $K$  is

- a) 21                      b) 14                      c) 7                      d) 4                      e) none of these

42. In the figure below line  $l_1$  is parallel to line  $l_2$ . The measure of angle  $\gamma$  is  $103^\circ$  and the measure of angle  $\beta$  is  $52^\circ$ . What is the measure of angle  $\theta$ ?

- a)  $153^\circ$                       b)  $131^\circ$                       c)  $129^\circ$                       d)  $52^\circ$                       e) none of these



43. Solve:  $2 \cos^2(\theta) + \sin(\theta) = 2$  over the interval  $(0, \pi)$ .

- a)  $\frac{\pi}{3}, \frac{2\pi}{3}$       b)  $0, \frac{\pi}{6}, \frac{5\pi}{6}$       c)  $\frac{\pi}{6}, \frac{5\pi}{6}$       d)  $0, \frac{\pi}{6}$       e) none of these

44. A license plate is made of three digits followed by two letters from the alphabet. The restrictions are the first digit cannot be zero and the letter O is excluded from the choices of letters. How many such plates are possible?

- a) 562500      b) 625000      c) 302400      d) 540000      e) none of these

45. If  $\frac{x}{y} = \frac{1+\sqrt{3}}{2}$  what is the value of  $\frac{x+y}{x}$ ?

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

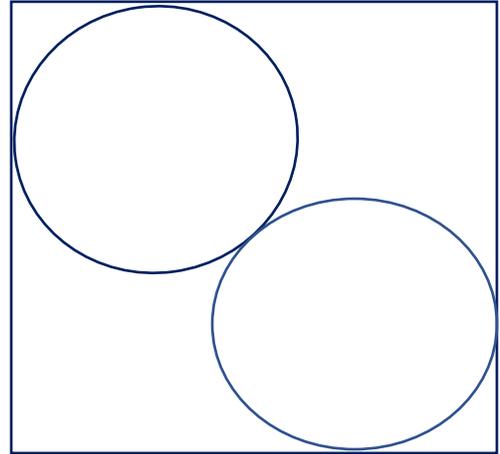
46. Which of the following is the largest?

- a)  $2^{50,000}$       b)  $3^{40,000}$       c)  $4^{30,000}$       d)  $5^{20,000}$       e)  $6^{10,000}$

47. If  $-1 \leq x \leq 1$  then  $\cos(2 \cos^{-1} x)$  equals

- a)  $-x$       b)  $2x^2 - 1$       c)  $2x$       d)  $1$       e) none of these

48. As shown in the diagram two congruent circles are tangent to each other and to the sides of a square. If the square has area one, what is the radius of the circles?

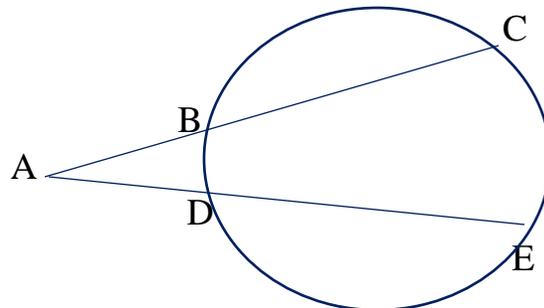


- a)  $\frac{\pi}{16}$       b)  $1 - \frac{\sqrt{2}}{2}$       c)  $\frac{\sqrt{2}}{5}$
- d)  $\sqrt{2} - \frac{\pi}{3}$       e) none of these

49. If  $2x + 3 = 11$  and  $5y - 9 = 6$ , which of the following is the smallest?

- a)  $x^y$       b)  $y^x$       c)  $x^x$       d)  $y^y$       e) 30

50. In the figure  $AB = 5$ ,  $BC = 7$ ,  $DE = 11$ . Find the length of  $AE$ .



- a) 4      b) 11      c) 15      d) 16      e) none of these

51. A tub has two faucets which can fill it. The first takes 10 minutes to fill it and the second can fill it in 15 minutes. How long will it take to fill the tub if both faucets are opened?

- a) 6 min.      b) 5 min.      c) 12 min.      d) 25 min.      e) none of these

52. What is one third of  $3^{36}$ ?

- a)  $1^{36}$       b)  $3^{12}$       c)  $3^{35}$       d)  $(3)^{\frac{36}{3}}$       e) none of these

53. Three fair dice are tossed. What is the probability the three numbers showing form an arithmetic progression with a common difference of 2?

- a)  $\frac{1}{4}$       b)  $\frac{1}{18}$       c)  $\frac{1}{36}$       d)  $\frac{1}{108}$       e) none of these

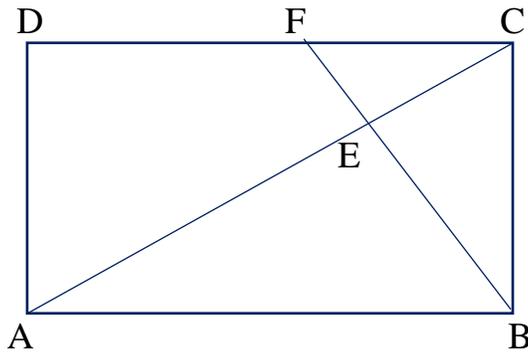
54. If one and one-half hens lay one and one-half eggs every day and a half, how many eggs will a single hen lay in three days?

- a) 2      b) 3      c) 6      d) 1      e) none of these

55. In the equiangular convex hexagon ABCDEF, we know that  $AB + BC = 11$  and  $FA - CD = 3$ . Then  $DE + BC$  is equal to

- a) 11      b) 12      c) 13      d) 14      e) none of these

56. ABCD is a rectangle with diagonal AC and segment BF dividing it into four regions. If the area of triangle CEB is 6 and the area of triangle ECF is 4 then what is the area of quadrilateral AEFD?



- a) 11      b) 12      c) 13      d) 14      e) none of these

57. If  $\frac{x^{12}y^bz^9}{x^ay^5z^c} = x^4y^5z^3$  then (a,b,c) equals

- a) ( 3,1,3 )      b) (8,1,3)      c) (8,10,6)      d) (8,0,6)      e) none of these

58. If  $n$  is a positive integer what is the value of  $\frac{1+3+5+\dots+(2n-1)}{1+3+5+\dots+(4n-1)}$  ?

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

59. Simplify  $\sqrt{6 + \sqrt{11}} + \sqrt{6 - \sqrt{11}}$

- a)  $\sqrt{12}$       b)  $\sqrt{22}$       c)  $6 + \sqrt{2}$       d)  $6 - \sqrt{2}$       e) none of these

60. Solve  $|x^2 + 5x| = 6$

- a)  $\{-6, -3, -2, 1\}$     b)  $\{-6, 1\}$     c)  $\{-3, -2\}$     d)  $\{1, -2\}$     e)  $\{-6, -3\}$

61. If we know that  $0 \leq x \leq 10$  and  $0 \leq y \leq 8$ , and if  $x$  and  $y$  are chosen at random, what is the probability that  $3x + 4y > 24$ ?

- a)  $\frac{7}{10}$     b)  $\frac{1}{2}$     c)  $\frac{3}{10}$     d)  $\frac{2}{5}$     e) none of these

62. A box contains a square, a rectangle which is not a square, an isosceles right triangle, a regular pentagon and an equilateral triangle. If one of these figures is chosen at random and one of its angles selected at random, what is the probability the angle selected is acute?

- a)  $\frac{1}{3}$     b)  $\frac{5}{19}$     c)  $\frac{2}{5}$     d)  $\frac{3}{11}$     e) none of these

63. What number or numbers when added to themselves, equal their squares?

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

64. When rounded to the nearest hundred the sum  $763 + 121 + 155 + 352$  is

- a) 1300    b) 1200    c) 1100    d) 1000    e) none of these

65. A triangle has two sides of length 7 and 8 with a perimeter of 20. What is its area?

- a) 28    b)  $10\sqrt{6}$     c)  $10\sqrt{3}$     d) 20    e) none of these

66. If  $\log_2 x = 5$  and  $\log_4 y = 3$ , what is  $\log_8 x^2 y^3$  ?

- a)  $\frac{28}{3}$       b)  $\frac{8}{3}$       c) 14      d) 19      e) none of these

67. If  $7x + 3 = 31$  then the value of  $x^3 - x^2$  is

- a) 4      b) 52      c) 56      d) 48      e) none of these