

1. Let $a = bc - 4$. If $c = 8$ then $a = 16$. What is a if c is 10?

- a) 11 b) 14 c) 20 d) 21 e) none of these

2. The total price of a new car (including 6% sales tax) is \$10631.80. How much of this is tax?

- a) \$631.91 b) \$567.91 c) \$678.63 d) \$601.80 e) \$523.45

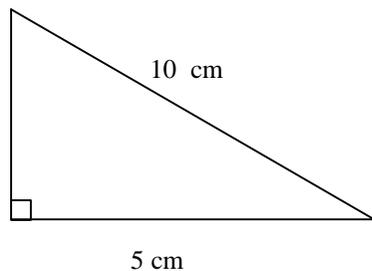
3. If the length of a diagonal of a square is $a + b$, then the area of the square is what?

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

4. The cost C of sending a parcel post package weighing P pounds, P an integer, is 10 cents for the first pound and 3 cents for each additional pound. The formula for the cost (in cents) is:

- a) $C = 10 + 3P$ b) $C = 10P + 3$ c) $C = 10 + 3(P - 1)$ d) $C = 9 + 3P$
e) $C = 10P - 7$

5. Find the perimeter of the triangle below.



- a) 20 cm b) $15 + 5\sqrt{6}$ cm c) $5\sqrt{3}$ cm d) $15 + 5\sqrt{3}$ cm e) $5\sqrt{6}$ cm

6. The mean age of 3 people in a room is 20 years. A 40 year-old person enters the room. What is now the mean age of the 4 people in the room?

- a) 15 years b) 20 years c) 25 years d) 30 years e) 35 years

7. The expression $(x^{-1} + y^{-1})^{-1}$ is equivalent to which of the following?

- a) $x + y$ b) $\frac{x+y}{xy}$ c) xy d) $\frac{1}{xy}$ e) $\frac{xy}{x+y}$

8. An empty swimming pool 25 feet wide, 40 feet long and 6 feet deep is to be filled at the rate of 2.5 cubic feet of water per minute. What will be the depth of the water 24 hours after it has begun to fill?

- a) 4 ft 3 in b) 4 ft 6 in c) 3 ft 7 in d) 3 ft e) 5 ft 2 in

9. At a certain time of the day the shadow of a 68-foot telephone pole was 85 feet long. At the same time the shadow of a tree was 123 feet long. Find the height of the tree.

- a) 334.6 ft b) 98.4 ft c) 47.0 ft d) 108.9 ft e) 107.6 ft

10. The number of gallons of water a spherical aquarium will hold varies directly as the cube of the radius in inches. An aquarium 21 inches in radius will hold 168 gallons. How many gallons will an aquarium with a radius of 35 inches hold?

- a) 315 gal b) 778 gal c) 2444 gal d) 280 gal e) 880 gal

11. Find the area of the triangle bounded by $y = \frac{4}{3}x + 2$, $y = 2$ and $y = -\frac{4}{3}x + 10$.

- a) 12 b) $\frac{1}{2}\sqrt{21}$ c) $\sqrt{42}$ d) $\sqrt{21}$ e) 14

12. If the circumference of circle A is 80% of the circumference of circle B, then the area of circle A is what percentage of the area of circle B?

- a) 64 b) 80 c) 0.64 d) 0.80 e) 80π

13. The product of the greatest common divisor and the least common multiple of 360 and 270.

- a) 21,600 b) 1,166,400 c) 8,100 d) 19,440 e) 97,200

14. Two planes leave simultaneously from the same airport, one flying due east and the other due south. The eastbound plane is flying 50 miles per hour faster than the southbound plane. After three hours the planes are 2440 miles apart. Approximately how many miles per hour was the eastbound plane traveling?

- a) 600 b) 1700 c) 650 d) 450 e) 550

15. Find the circumference of the circle $x^2 - 2x + y^2 + 4y = 3$.

- a) $8p$ b) $4p\sqrt{2}$ c) $2\sqrt{2}$ d) $16p$ e) $4p$

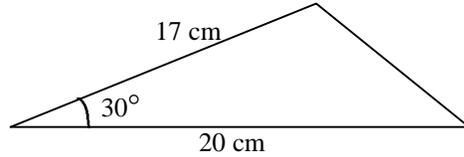
16. Find the distance between the vertex of $y = x^2 - 4x + 5$ and the x-intercept of $y = 3x + 6$.

- a) $\sqrt{17}$ b) $\sqrt{29}$ c) $\sqrt{85}$ d) $\sqrt{41}$ e) $\sqrt{61}$

17. Find the sum of the three complex roots of $p(x) = x^3 - i$, where i denotes the number whose square is -1.

- a) $-1 - i$ b) $1 - i$ c) $\frac{\sqrt{3}}{2} + \frac{i}{2}$ d) i e) 0

18. Find the perimeter of a triangle having sides of 17 cm and 20 cm and having an included angle of 30° .



- a) 54 cm b) 57 cm c) 47 cm d) 63 cm e) 48 cm

19. Find the largest base 10 number that can be written in base 4 using only 6 digits.

- a) 4095 b) 1023 c) 16383 d) 5460 e) 21844

20. If $\cos\alpha = p$, find $\cos(2\alpha+\pi)$.

- a) $\frac{\sqrt{1-2p^2}}{2}$ b) $\frac{2p}{-}$ c) $p\sqrt{-p}$ d) $2p$ e) $1-2p^2$

21. There are 8 men, two of whom are A and B , standing in a straight line. What is the probability that neither A nor B is at either end of the line?

- a) $\frac{9}{16}$ b) $\frac{21}{32}$ c) $\frac{1}{7}$ d) $\frac{6}{8}$ e) $\frac{15}{28}$

22. If the height of a cubical box were increased by 1 cm, the width by 2 cm and the length by 3 cm, the volume of the new box would be 3 times that of the original box. Find the length of an edge of the original box.

- a) 4.30 cm b) 4.40 cm c) 4.45 cm d) 4.50 cm e) 4.55 cm

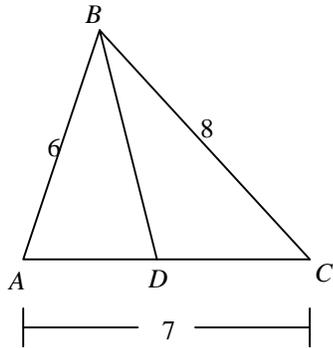
23. The sum of two of the solutions of $x^3 - 6x + a = 0$ is 2. Find a .

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

24. An increasing arithmetic sequence and a geometric sequence have the same first term, which is 4. Their third terms are also equal, but the second term of the arithmetic sequence exceeds the second term of the geometric sequence by 2. Find the 30th term of the arithmetic sequence.

- a) 120 b) 178 c) 184 d) 174 e) 180

25. In the figure below, BD bisects angle ABC . If $\overline{AB} = 6$, $\overline{BC} = 8$ and $\overline{AC} = 7$, find \overline{AD} .



- a) 4 b) 2 c) $3\frac{1}{2}$ d) 3 e) $3\frac{2}{7}$

26. Each stroke of an air pump removes one sixth of the air then in the cylinder. What portion of the air originally in the cylinder is removed in the first 6 strokes?

- a) $1 - \left(\frac{5}{6}\right)^6$ b) $1 - \left(\frac{1}{6}\right)^6$ c) $\left(\frac{5}{6}\right)^6$ d) 0 e) $\frac{5}{6}$

27. When $x^2 + bx + c$ is divided by $x - 2$ and $x - 3$, the remainders are 8 and 20 respectively. Find $b + c$.

- a) - 17 b) 17 c) 3 d) 28 e) - 3

28. If $\tan \mathbf{a} + \cot \mathbf{a} = m$, find the value of $\csc(2\mathbf{a})$.

- a) $\frac{m}{2}$ b) $\frac{1}{m}$ c) $2m$ d) $\frac{1}{2m}$ e) $\frac{2}{m}$

29. If $(1 - 2x)^7 = a_0 + a_1x + a_2x^2 + a_3x^3 + a_4x^4 + a_5x^5 + a_6x^6 + a_7x^7$, find the value of $a_0 + a_1 + a_2 + a_3 + a_4 + a_5 + a_6 + a_7$.

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

30. In traveling across flat land, you notice a mountain directly in front of you. The angle of elevation (to the peak) is 3.5° . After you drive 13 miles closer to the mountain, the angle of elevation is 9° . Approximate the height of the mountain.

- a) 7839 ft b) 4839 ft c) 5839 ft d) 6872 ft e) 6839 ft

31. At a certain factory, the daily output Q is given by $Q(K) = 660K^{1/2}$ units, where K denotes the capital investment measured in units of \$1000. The current capital investment is \$900,000. An additional capital investment of \$800 will increase the daily output by how much?

- a) 278.2 b) 30.0 c) 19800.9 d) 8.8 e) 53.6

32. A string of 2000 digits begins with the digit 6. Any number formed by two consecutive digits of the string is divisible by 17 or 23. What is the last digit?

- a) 0 b) 2 c) 4 d) 6 e) 8

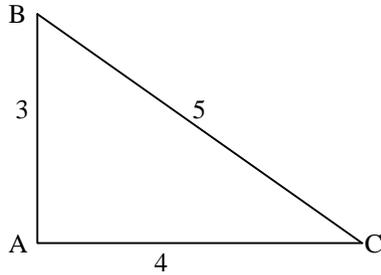
33. Express the value of $(1 + i)^{14}$ in the form $p + qi$ where p and q are real and $i^2 = -1$.

- a) $-128i$ b) $64i$ c) $-32i$ d) $32i$ e) $128 + 64i$

34. How many solutions does the equation $\sin x = \frac{x}{9}$ have?

- a) 4 b) 5 c) 6 d) 7 e) 8

35. Consider a right triangle ABC with sides 3, 4, and 5 as in the diagram below. What is the distance from vertex A to the midpoint of the hypotenuse?

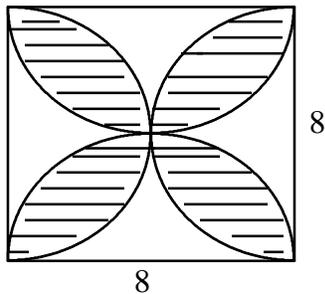


- a) $\frac{12}{5}$ b) $\frac{15}{4}$ c) $\frac{5}{2}$ d) $\frac{4}{3}$ e) $\frac{5}{3}$

36. There exist positive integers A, B and C , with no common factor greater than 1, such that $B \log_{12} 2 + A \log_{12} 3 = C$. Compute the sum of A, B and C .

- a) 3 b) 4 c) 6 d) 9 e) 10

37. Find the area of the shaded region below. The arcs are circular.



- a) $32p - 32$ b) $16p - 16$ c) $8p - 16$ d) $16p - 32$ e) $32p - 64$

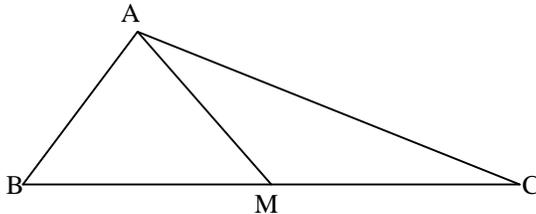
38. If $f(x) = \log\left(\frac{1+x}{1-x}\right)$ and $g(x) = \frac{3x+x^3}{1+3x^2}$, $(f \circ g)(x)$ is which of the following?

- a) $-f(x)$ b) $\frac{1}{f(x)}$ c) $[f(x)]^3$ d) $3f(x)$ e) $[f(x)]^2$

39. What is the equation of the perpendicular bisector of the line segment with end points in the xy -plane of $(1,5)$ and $(-3,2)$?

- a) $4x-3y-29=0$ b) $4x+3y-13=0$ c) $8x+6y+29=0$ d) $8x+6y-13=0$ e) $3x-4y-29=0$

40. In the triangle ABC below, $\overline{AB} = 4$ and $\overline{AC} = 8$. If M is the midpoint of BC and $\overline{AM} = 3$, what is the length of BC?



- a) $2\sqrt{26}$ b) $2\sqrt{31}$ c) 9 d) $4+2\sqrt{3}$
 e) not enough information given to solve this problem

41. The sum of the first three numbers in an arithmetic sequence is 52. Find the second number in the sequence.

- a) $\frac{728}{39}$ b) $\frac{-626}{69}$ c) $\frac{626}{69}$ d) $\frac{-52}{3}$ e) $\frac{52}{3}$

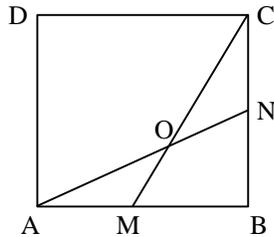
42. Find the area of that part of a circle lying between two parallel chords 6 cm apart and each 6 cm long.

- a) $36p$ b) $\frac{9p}{2} + 36$ c) $9p + 18$ d) $\frac{9p}{2} - 9$ e) $\frac{9p}{2} + 27$

43. Find the equation of the circle containing the points $(-1,-3)$ and $(-5,3)$ with center on the line $x - 2y + 2 = 0$.

- a) $x^2 + 12x + y^2 + 4y + 14 = 0$ b) $3x + 2y + 9 = 0$
 c) $x^2 - 12x + y^2 - 12y - 58 = 0$ d) $x^2 - 6x + y^2 - 8y - 40 = 0$
 e) $2x^2 + 9x - y + 1 = 0$

44. In the square ABCD below, M is the midpoint of AB, N is the midpoint of BC and AN and CM intersect at O. What is the ratio of the area of AOCD to the area of ABCD?



- a) $\frac{5}{6}$ b) $\frac{3}{4}$ c) $\frac{2}{3}$ d) $\frac{\sqrt{3}}{2}$ e) $\frac{\sqrt{3}-1}{2}$

45. The equation $r = 8 \cos \theta$ is the equation of a circle written in polar form. What is the radius of the circle?

- a) 1 b) 2 c) 3 d) 4 e) 8

46. How many vertical asymptotes does the graph of $f(x) = \frac{x-100}{x(x^2-100^2)}$ have?

- a) 0 b) 1 c) 2 d) 3 e) 100

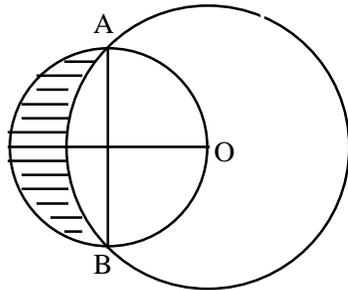
47. Find the area of a regular hexagon with a 9 cm apothem.

- a) $\frac{243\sqrt{3}}{8}$ b) $\frac{243\sqrt{3}}{3}$ c) $\frac{243\sqrt{3}}{2}$ d) $81\sqrt{3}$ e) $162\sqrt{3}$

48. Find the sum of all integers greater than 10,000 formed by using the digits 1,2,3,5 and 9 if no digits are repeated in any number?

- a) 5,333,280 b) 1,481,400 c) 1,483,080 d) 6,460,800 e) 11,438,520

49. In the two circles below AB is a diameter of the smaller circle and O is the center of larger circle. The radius of the smaller is 6 and the radius of the larger circle is $6\sqrt{2}$. Find the area of shaded region.



- a) $18p\sqrt{2} - 18$ b) $18p - 18$ c) 36 d) $18p$ e) $64\sqrt{2} - 18p$

50. Suppose there are five large barrels numbered 1 through 5. Marbles are placed into the barrels as follows. One marble is placed in the barrel numbered 1, then two marbles are placed in barrel 2, three marbles in barrel 3, four in barrel 4 and five in 5. Six marbles are placed in barrel 1, seven in barrel 2, eight in barrel 3, nine in barrel 4, ten in barrel 5, eleven in barrel 1 and so forth. Continuing in this manner, into what barrel will the one millionth marble be placed?

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

4. Charles has $5q+1$ quarters and Richard has $q+5$ quarters. The difference in their money in dimes is:

- a) $10(q-1)$ b) $\frac{2}{5}(4q-4)$ c) $\frac{2}{5}(q-1)$ d) $\frac{5}{2}(q-1)$ e) $10(4q-4)$

6. The number of revolutions of a wheel, with fixed center and with an outside diameter of 6 feet, required to cause a point on the rim to go one mile is (1 mile = 5,280 feet):

- a) 880 b) $\frac{440}{p}$ c) $\frac{880}{p}$ d) $444p$ e) none of these

27. Express 17 in base 2.

- a) 101 b) 1001 c) 1111 d) 10001 e) 11111

44. Find the radius of the circle with center (2,4) that is tangent to the line with equation $x + y - 4 = 0$.

- a) $\sqrt{3}$ b) $\frac{\sqrt{5}}{2}$ c) $\sqrt{2}$ d) $\frac{2\sqrt{7}}{3}$ e) $\frac{2\sqrt{3}}{3}$

11. A circular pond 126 feet in diameter is surrounded by a walkway $2\frac{1}{3}$ yards wide. Which of the choices below is the best approximation of the area of the walkway?

- a) 66 sq yds b) 207 sq yds c) 325 sq yds d) 201 sq yds e) 633 sq yds

31. Ann, Bob, Carl and Doc are all thinking of the same natural number. Ann says it consists of two digits. Bob says it is a divisor of 150. Carl says it is not 150. Doc says it is divisible by 25. Given that exactly three of them are telling the truth, which of them is not?

- a) Ann b) Bob c) Carl d) Doc e) cannot be determined

cipher

Find the sum of the solutions to $|x - 5| + 3 = |2x + 5|$.

If $\log_8 m + \log_8 \frac{1}{6} = \frac{2}{3}$, what is m ?

If $(\log_k x)(\log_5 k) = 3$, then what is x ?

9. The first three terms of a geometric sequence are $2x-4$, $5x-7$ and $10x+4$ for some value of x . What is the fourth term of the sequence?

- a) 5 or $\frac{13}{5}$ b) -7 c) 150 or 162 d) -90 e) -5 or $\frac{-13}{5}$