1. If $f(x) = ax^2 + bx + c$, $f(1) = 3$, and $f(-1) = 3$; then $a + c$ equals

   A. -3

   B. 0

   C. 3

   D. 6

   E. 2

2. The ratio of x to y is equal to one over their sum. Express y in terms of x.

   A. $\dfrac{x^2}{1-x}$

   B $\dfrac{1-x}{x^2}$

   C. $\dfrac{x}{1-x}$

   D. $\dfrac{(1-x)^2}{x}$

   E. $\dfrac{(1-x)^2}{x^2}$

3. The area of a triangle is 30. If its base is 4 more than its height, what is the length of its height?

   A. 10

   B. 8

   C. $\sqrt{15}$

   D. 6

   E. 4

4. (Tie Break No. 1) If $\log_x 2 = a$, $\log_x 3 = b$, and $\log_x 5 = c$; find $\log_x \frac{24}{25}$ in terms of *a*, *b*, and *c*.

A. $\frac{a^3 b}{c^2}$

B. $3a + b - 2c$

C. $2a - 3b - c$

D. $a + b - c$

E. It can not be determined.

5. Each small circle has diameter $d = 6m$. The small circles are tangent to a large circle from inside; and tangent to each other at the center of the large circle. Find the area of the shaded region.

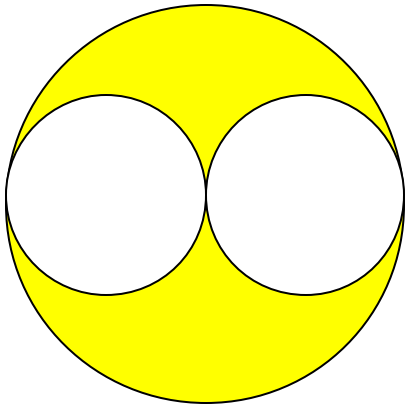
A. $9p\ m^2$

B. $18p\ m^2$

C. $27p\ m^2$

D. $36p\ m^2$

E. $81p\ m^2$



6. Solve the simultaneous equations $2x - 5y = 4$, and $3x + 2y = 25$; then use your answers to evaluate the expression $x^3 + 2y^2$.

A. 58

B. 351

C. 35

D. 106

E. 143

7. John Q. Ferris goes to ride the Ferris Wheel at the state fair. If the distance from the seat to the center of the wheel is 50 feet, and the wheel goes around 3 times every minute, find the speed in feet/sec of someone riding the wheel.

A. $10p \ \ feet/\sec$

B. $5p \ \ feet/\sec$

C. $300p \ \ feet/\sec$

D. $\frac{125p}{3} \ \ feet/\sec$

E. $50p \ \ feet/\sec$

8. Point A is 3 inches from line b as shown in the diagram. In the plane that contains point A and line b, what is the total number of points which are 5 inches from A and also 1 inch from b?

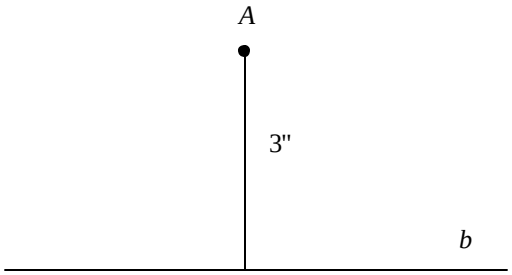
A. 0

B. 1

C. 2

D. 3

E. 4



9. Bob and Ted are on a bike ride. Ted runs into a tree, ruining his bike. They are 16 *km* from home. They decide that Ted will start on foot and Bob will ride his bike. After awhile Bob will leave his bike beside the road and continue on foot so that Ted can ride the bike home when he gets to where Bob left the bike. Bob walks $4km/hr$ and bikes $10km/hr$ while Ted walks $5km/hr$ and bikes $12km/hr$. For what length of time should Ted ride the bike if they are both to arrive home at the same time?

A. $\frac{1}{2}hr$

B. $1hr$

C. $\frac{3}{2}hr$

D. $2\,hr$

E. None of the above

10. Let $\{a_1, a_2, a_3\}$ be a finite geometric sequence and $1 < a_1 < a_2 < a_3$. Then $\{\log_{a_1} 5, \log_{a_2} 5, \log_{a_3} 5\}$ has the property:

A. It is an arithmetic sequence.

B. It is a geometric sequence.

C. The reciprocals of its terms form an arithmetic sequence.

D. The reciprocals of its terms form a geometric sequence.

E. No conclusion can be derived.

11. (Tie Break No.2) The domain of the function $f(x) = \log_a \dfrac{|x|-2}{2x+1}$ is

A. $(-2, -1/2) \cup (2, \infty)$

B. $(-1/2, 2)$

C. $(-\infty, -2) \cup (-1/2, \infty)$

D. $(-2, -1/2)$

E. $(-\infty, -2) \cup (-1/2, 2)$

12. The Simpson's want to build a deck with a railing around a corner of their house. The railing will measure 30 meters, $AB = DE$, and $BC = CD$. What should AB measure to maximize the area of the deck?

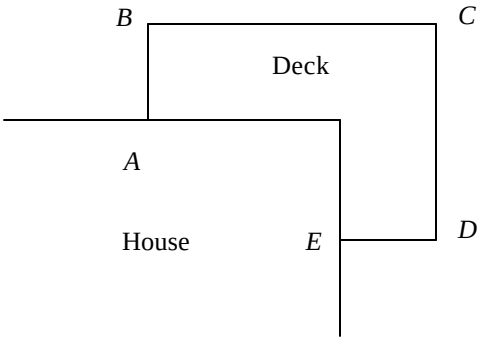
A. $5m$

B. $6m$

C. $8m$

D. $10m$

E. None of the above



13. Simplify $\dfrac{\sin 2x}{\sin^3 x + \sin x \cos^2 x}$

A. $2\tan x$

B. $2\cot x$

C. 2

D. $2\cos x$

E. $2\sin x$

14. Find $x+y+z$ given that $\dfrac{x}{3-x} = \dfrac{y}{5-y} = \dfrac{z}{16-z} = 2$

A. 10

B. 16

C. 20

D. 22

E. 24

15. If $\tan x = \dfrac{2ab}{a^2 - b^2}$ where $a > b > 0$ and $0^\circ < x < 90^\circ$, then $\sin x = ?$

A. $\dfrac{a}{b}$

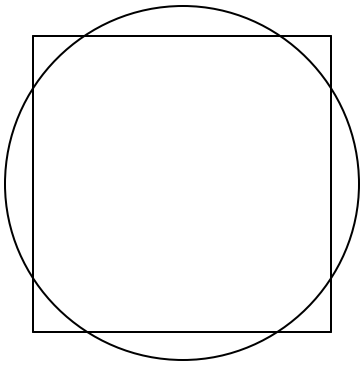
B. $\dfrac{b}{a}$

C. $\dfrac{\sqrt{a^2 - b^2}}{2a}$

D. $\dfrac{\sqrt{a^2 - b^2}}{2ab}$

E. $\dfrac{2ab}{a^2 + b^2}$

16. A circle with radius 1 and a square with side $\sqrt{3}$ have the same center. Find the area of the region overlapped by these two figures.



A. $p-\sqrt{3}$

B. $p/3+\sqrt{3}$

C. $p/3+\sqrt{3}/2$

D. $p/2+\sqrt{3}$

E. $p/3+3/2$

17. It takes one day to fill the vat
With this large pipe, two days with that;
The third pipe needs but one day more;
The fourth pipe fills the vat in four.
If all four pipes together run,
How long before the task is done?

A. $1/2$ *day*

B. $12/25$ *day*

C. $2/3$ *day*

D. $19/25$ *day*

E. $24/25$ *day*

18. *R* varies as the square of *z* and inversely as the cube of *T*. If *z* is tripled and *T* is doubled, the value of *R* is

A. multiplied by 3

B. multiplied by $9/8$

C. multiplied by 8

D. divided by 3

E. divided by $2/3$

19. Let $A=\begin{bmatrix} 7 & -5 & -8 \\ x & -2 & -3 \\ 6 & -4 & -7 \end{bmatrix}$ and $B=\begin{bmatrix} -2 & 3 & 1 \\ -3 & 1 & 3 \\ 0 & 2 & y \end{bmatrix}$. If $B=A^{-1}$, then $x+y=?$

A. 0

B. 1

C. 2

D. 3

E. 4

20. If the line through $(3, 2)$ and $(-4, p)$ is perpendicular to the line $x+5y=12$, then $p=?$

A. -33

B. $1/5$

C. 3

D. 5

E. 37

21. A merchant sells a radio making a profit equal to 25% of the cost. What is the ratio of the cost to the selling price?

A. $3/5$

B. $2/3$

C. $5/4$

D. $3/4$

E. $4/5$

22. Find the minimum value of the function $y = \sqrt{2}x^2 + \sqrt{8}x - 2$

A. 8

B. $-\sqrt{2} - 2$

C. $\sqrt{8}$

D. 0

E. $\sqrt{2} + 1$

23. (Tie Break No.3) Find the difference between the largest and the smallest values of x that satisfy the equation: $4(8^x) - 21(4^x) + 21(2^x) = 4$

A. 0

B. 1

C. 4

D. 2

E. None of the above.

24. If $\cos^4 x + \sin^4 x = \frac{5}{9}$ and $p < x < 3p/2$, find the exact value of $\sin 2x$.

A. $\frac{2\sqrt{2}}{3}$

B. $-\frac{2\sqrt{2}}{3}$

C. $\frac{\sqrt{3}}{4}$

D. $-\frac{\sqrt{3}}{4}$

E. None of the Above

25. Instead of walking along two adjacent edges of an empty rectangular lot, a boy decides on a shortcut and walks along the diagonal. If the two adjacent edges are 40 and 30 yards respectively, about what percent does he save?

A. 29

B. 33

C. 24

D. 22

E. 20

26. Find the area of a square that is inscribed in a circle, which is itself inscribed within a square whose side is 5 inches.

A. $12.5\ in.^2$

B. $6.25p\ in.^2$

C. $18\ in.^2$

D. $5\sqrt{5}\ in.^2$

E. $10\ in.^2$

27. Solve the equation $\sin 15x + \cos 15x = 0$. What is the sum of the three smallest positive solutions?

A. $\frac{p}{20}$

B. $\frac{p}{3}$

C. $\frac{7p}{20}$

D. $\frac{21p}{20}$

E. $\frac{21p}{4}$

28. Find all values of x in the interval $[0^\circ, 360^\circ]$ that satisfy the equation $\tan 3x + 1 = \sqrt{2}\sec 3x$ The sum of these values is

A. 260°

B. 270°

C. 360°

D. 405°

E. 675°

29. The domain of $f(x) = \log(\sin x)$ contains which of the following intervals?

A. $0 \le x \le \frac{p}{2}$

B. $-\frac{p}{2} \le x \le \frac{3p}{3}$

C. $0 < x < p$

D. $-\frac{p}{2} < x < \frac{p}{2}$

E. $\frac{p}{2} < x < \frac{3p}{2}$

30. Point (3, 2) lies on the graph of the inverse of $f(x) = 2x^3 + x + A$. The value of A is

A. 15

B. – 15

C. 18

D. 55

E. – 55

31. Which of the following is equivalent to $\sin(\tan^{-1} v)$?

A. $\dfrac{v}{\sqrt{1+v^2}}$

B. $\dfrac{1}{\sqrt{1+v^2}}$

C. $\dfrac{v^2-1}{\sqrt{1+v^2}}$

D. $\dfrac{v}{1-v^2}$

E. $\dfrac{v^2+1}{\sqrt{v^2-1}}$

32. If $\cos 20^\circ = K$ and $\cos x = 2K^2 - 1$, what are all the possible values of x between 0° and 360°?

A. 140°

B. 40°

C. $40^\circ, 140^\circ$

D. $40^\circ, 320^\circ$

E. $40^\circ, 140^\circ, 220^\circ, 320^\circ$

33. Find n such that the line $y = x + 8$ is tangent to the graph of the function $f(x) = n\sqrt{x}$.

A. $1/\sqrt{2}$

B. $2\sqrt{2}$

C. 4

D. $4\sqrt{2}$

E. 8

34. (Tie Break No. 4) Solve the equation $\sin^{-1} 2x = p/4 + \sin^{-1} x$ for x.

A. $\pm \dfrac{1}{\sqrt{10 - 4\sqrt{2}}}$

B. $\pm \dfrac{1}{\sqrt{10 + 4\sqrt{2}}}$

C. $\dfrac{1}{\sqrt{10 + 4\sqrt{2}}}$

D. $\dfrac{1}{\sqrt{10 - 4\sqrt{2}}}$

E. None of the above.

35. Given a circle having center D and a smaller circle having diameter DC, find the ratio of the areas of the triangles ABC and DEC that are inscribed in the large and small semicircle respectively.

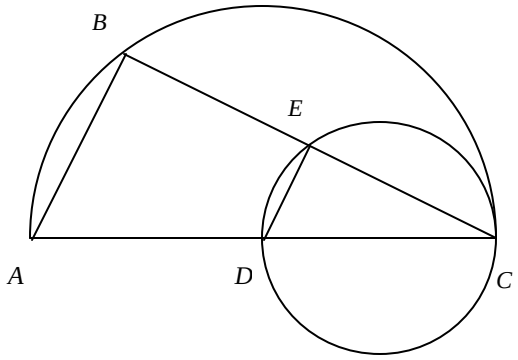
A. 4 : 1

B. 2 : 1

C. 3 : 2

D. 9 : 4

E. Not enough information given.



36. In ΔABC, $AB = 5$, $BC = 7$, $AC = 9$, and D is on the side AC such that $BD = 5$. Find the ratio $AD : DC$.

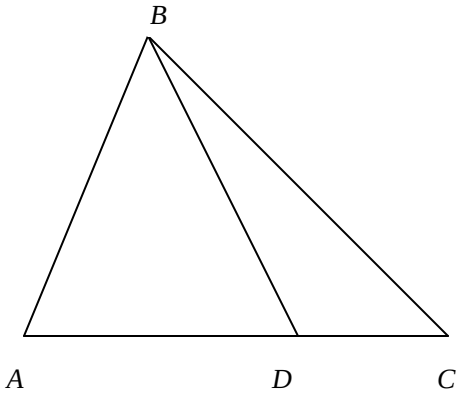
A. 4 : 3

B. 7 : 5

C. 11 : 6

D. 13 : 5

E. 19 : 8



37. A square of perimeter 20 is inscribed in a square of perimeter 28. What is the greatest distance between a vertex of the inner square and a vertex of the outer square?

A. $\sqrt{58}$

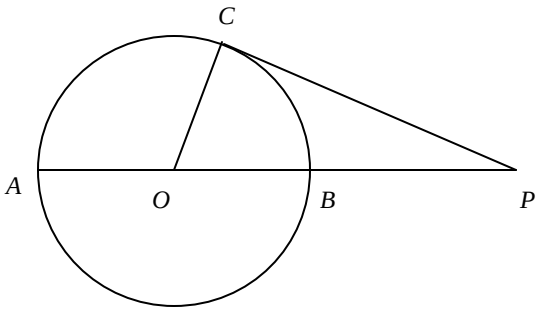
B. $\frac{7\sqrt{5}}{2}$

C. 8

D. $\sqrt{65}$

E. $5\sqrt{3}$

38. In the circle shown, *AP* is a secant line passing though the center *O* of the circle; and *CP* is a tangent line. The length of *AP* is 8, and the length of *CP* is 4. Find the length of the diameter *AB*.



A. 8

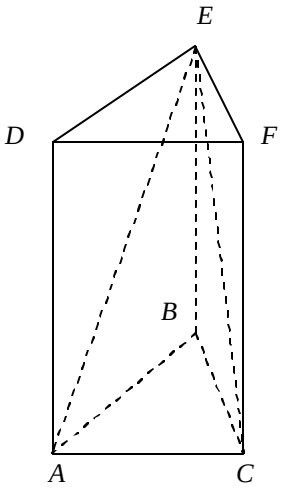
B. 3

C. 6

D. $3\sqrt{2}$

E. Cannot be determined from the information given

39. In the figure, *ABCDEF* is a right prism with triangle base. The altitude of the prism is *h*. If a plane cuts the figure through points *A, C*, and *E,* two solids, *EABC* and *EACFD* are formed. What is the ratio of the volume of *EABC* to the volume of *EACFD*?



A. 1 : 2

B. 1 : 3

C. $\sqrt{3}$: 3

D. $\sqrt{3}$: 4

E. 1 : 4

40. Judy and Beth planned a 5000 mile trip in a car with 5 tires, 4 on the car and one spare. They plan to rotate the tires so that each of the five tires is on the car for the same number of miles. How many miles will each tire travel?

A. 1000 miles

B. 4000 miles

C. 5000 miles

D. 20,000 miles

E. None of the above

41. The negation of the statement "For all sets, there is one subset" is

A. For all sets, there is not one subset

B. For no sets, there is one subset

C. For some sets, there is not one subset

D. For some sets, there is one subset

E. For no sets, there is not one subset

42. Let x and y be single digit natural numbers. Find the probability that $\frac{x}{y}$ is not equivalent to a natural number.

A. $\frac{1}{9}$

B. $\frac{8}{9}$

C. $\frac{23}{81}$

D. $\frac{58}{81}$

E. $\frac{19}{27}$

43. The four roots of the equation $(x^2 - 2x + m)(x^2 - 2x + n) = 0$ form an arithmetic sequence whose first term is $1/4$. Then $|m - n| = ?$

A. 1

B. $1/2$

C. $3/8$

D. $3/4$

E. 2

44. If the function $f(x) = a^x$ is decreasing on $(-\infty, \infty)$, and the graph of the function $f(x) = -x^2 + 3ax - 1$ is below the x-axis; we have

A. $-\frac{2}{3} < a < \frac{2}{3}$

B. $0 < a < \frac{2}{3}$

C. $0 < a \le \frac{2}{3}$

D. $0 \le a < \frac{2}{3}$

E. $0 < a < 3$

45. (Tie Break No.5) A set of consecutive positive integers beginning with 1 is written on the board. One of the numbers is erased. The average of the remaining numbers is $35\frac{7}{17}$. What number was erased?

A. 1

B. 7

C. 17

D. 69

E. None of the above