

Where applicable, "E. NOTA" indicates that none of the above answers is correct.

1. A rhombus has a perimeter of 100. The length of the longer diagonal of the rhombus is 40. Find the area enclosed by the circle inscribed in the rhombus.
A. 144π B. 400π C. 225π D. $8\sqrt{21}\pi$ E. NOTA
2. A triangle has vertices $A(-8,5)$, $B(-15,-19)$, and $C(1,-7)$. If the equation of the bisector $\angle BAC$ is written in general form $ax+by+c=0$, where a , b , and c are relatively prime integers with $a > 0$, find $a+c$.
A. 67 B. 74 C. 89 D. 111 E. NOTA
3. Where defined, simplify $\frac{a^{-1}+b^{-1}}{a^{-2}-b^{-2}}$
A. $\frac{b+a}{b^2-a^2}$ B. $\frac{ab}{b-a}$ C. $\frac{2a^2b^2}{a^2+b^2}$ D. $\frac{1}{b-a}$ E. NOTA
4. A regular hexagon is inscribed in a circle. If a = hexagon's side length and b = length of the arc subtended by a side of the hexagon, find $a:b$.
A. 1:1 B. 1:6 C. $1:\pi$ D. $3:\pi$ E. NOTA
5. Find the equation of a circle whose diameter is the latus rectum of $x^2-6x-16y+9=0$.
A. $x^2+y^2+6x+8y-39=0$ B. $x^2+y^2-6x-8y-39=0$
C. $x^2+y^2+6x-8y-39=0$ D. $x^2+y^2-6x+8y-39=0$ E. NOTA
6. Three identical tennis balls are stacked inside a cylindrical container. The middle tennis ball is externally tangent to the tennis balls above and below it. All three tennis balls are tangent to the cylindrical container. Let a = volume of the tennis balls and b = volume of the space inside the cylindrical container but outside the tennis balls. Find $a:b$.
A. 2:1 B. 2:3 C. 3:2 D. 4:3 E. NOTA
7. Find the coefficient of x^8y^2 in the expansion of $(x-2y)^{10}$.
A. -180 B. -20 C. 20 D. 180 E. NOTA
8. Marceline has a compass whose legs measure 15 cm. The largest angle that the hinge of the compass can form is 150° . Find the circumference, in cm, of the largest circle Marceline can construct using her compass.
A. $(15\sqrt{2}+15\sqrt{6})\pi$ B. $(15\sqrt{2}+30\sqrt{6})\pi$ C. $(30\sqrt{2}+15\sqrt{6})\pi$
D. $(30\sqrt{2}+30\sqrt{6})\pi$ E. NOTA

9. In $\triangle ABC$, $m\angle A = 60^\circ$, $AB = 8$, and $AC = 11$. Find the area enclosed by $\triangle ABC$.

- A. 22 B. $22\sqrt{3}$ C. 44 D. $44\sqrt{3}$ E. NOTA

10. Which of the following is the inverse function of the function $y = \frac{e^x}{5}$?

- A. $y = \ln x + \ln 5$ B. $y = 5 \ln x$ C. $y = \frac{1}{5} \ln x$ D. $y = \ln(x + 5)$ E. NOTA

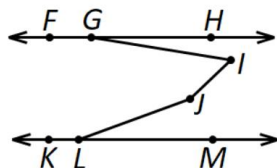
11. Simplify, where defined: $\frac{x^3 - 27}{x^2 + 5x - 36} \div \frac{x^2 - 9}{x^2 - x - 12}$

- A. $x^2 + 3$ B. $\frac{x^2 + 3x + 9}{x + 9}$ C. $x + 3$ D. $\frac{x + 3}{x + 9}$ E. NOTA

12. A parallelogram has sides that measure 5 and 12. Find the sum of the squares of the diagonals of the parallelogram.

- A. 288 B. 300 C. 338 D. 360 E. NOTA

13. If $\overrightarrow{FH} \parallel \overrightarrow{KM}$, find $m\angle FGI + m\angle GIJ + m\angle IJL + m\angle JLK$.



- A. 180° B. 360° C. 540° D. 720° E. NOTA

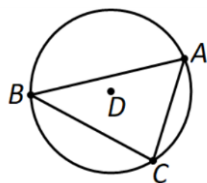
14. Simplify $1 + \frac{1}{1 + \frac{1}{1 + \frac{1}{1 - \frac{1}{3}}}}$.

- A. $\frac{5}{3}$ B. $\frac{9}{7}$ C. $\frac{12}{7}$ D. $\frac{13}{3}$ E. NOTA

15. One region in the xy -plane is bounded by the line $y = 8x + 4$, the x -axis, and $x = -2$; a second region is bounded by the line $y = 8x + 4$, the x -axis, and $x = 3$. Find the volume of the solid resulting from rotating these two regions about the x -axis.

- A. $\frac{688}{3}\pi$ B. 784π C. 880π D. $\frac{2960}{3}\pi$ E. NOTA

16. $\triangle ABC$ is inscribed in $\odot D$ with diameter of length 18. If AB has length 12, find $\tan C$.



- A. $\frac{\sqrt{5}}{2}$ B. $\frac{\sqrt{5}}{3}$ C. $\frac{2\sqrt{5}}{5}$ D. $\frac{4\sqrt{5}}{5}$ E. NOTA

17. Two chords of a circle intersect inside the circle. The first chord splits the segments of the second chord into a 3:1 ratio. The second chord splits the first chord into segments that measure 9 and 12. Find the positive difference in the lengths of the two chords.

- A. 3 B. 6 C. 18 D. 24 E. NOTA

18. Solve $\left| \frac{x+2}{2x-3} \right| < 4$.

- A. $\left(-\infty, \frac{10}{9}\right) \cup (2, \infty)$ B. $\left(\frac{10}{9}, 2\right)$ C. $\left(-\infty, \frac{10}{9}\right) \cup \left(\frac{3}{2}, \infty\right)$ D. $\left(\frac{3}{2}, 2\right)$ E. NOTA

19. Out of 22 students in class, 9 play football and tennis, 10 play football and baseball, and 11 play baseball and tennis. How many students play all 3 sports if it is known that each student plays at least one sport and each sport is played by a total of 15 students?

- A. 4 B. 5 C. 6 D. 7 E. NOTA

20. Three lines ℓ , k , and j lie in the same plane. Lines ℓ and k are parallel. Lines ℓ and j are perpendicular. Which one of the following correctly describes the relationship between lines k and j ?

- A. Lines k and j are skew lines. B. Lines k and j are parallel.
C. Lines k and j are perpendicular. D. Lines k and j intersect at a non-right angle.
E. NOTA

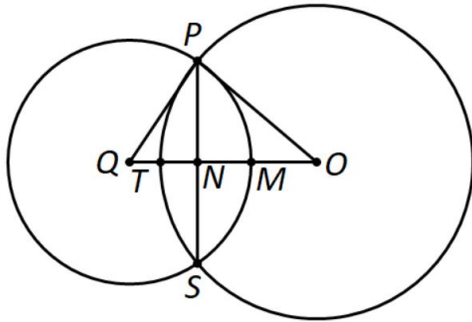
21. What is the smallest possible value of $x^2 + 2y^2 + 2xy + 6x + 2y$?

- A. -11 B. -12 C. -13 D. -14 E. NOTA

22. Find the product of the roots of the equation $10^{\log_x 10} = 10x^2$.

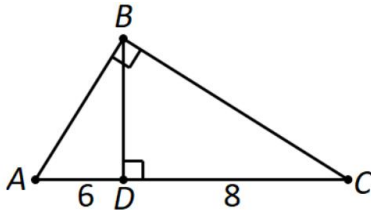
- A. $\frac{1}{10}$ B. $\frac{\sqrt{10}}{10}$ C. 1 D. -2 E. NOTA

23. $\overline{PS}$ is a common chord for $\odot O$ and $\odot Q$. If $\overline{OQ}$ has length 324 and the lengths of $\overline{MN}$ and $\overline{NT}$ are in the ratio 2:1, respectively, find the length of $\overline{OP}$ minus the length of $\overline{PQ}$.



- A. 36 B. 51 C. 54 D. 108 E. NOTA

24. Find BD .



- A. $2\sqrt{3}$ B. $4\sqrt{3}$ C. 24 D. 488 E. NOTA

25. Finn wants to build a rectangular pen for his dogs. He has 20 feet of fencing to use, but he wants to use the back of his house as one of the boundaries. So, he only needs fencing for three sides of the rectangular pen. Find the maximum area, in square feet, of the pen that can be constructed.

- A. $\frac{75}{2}$ B. $\frac{400}{9}$ C. 50 D. 100 E. NOTA

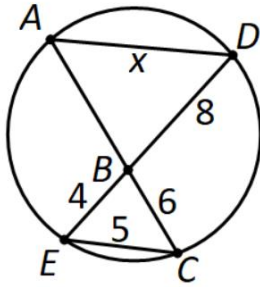
26. The line with equation $y = 2x - 6$ is reflected about the x -axis. Find the y -intercept of the new line.

- A. -6 B. -3 C. 3 D. 6 E. NOTA

27. Lumpy Space Princess (LSP) camps at Hobo Camp when she visits The Land of Ooo. Her campsite is in a large flat clearing next to a stream that flows in a straight path east to west. LSP is setting up a hammock 20 yards north of the stream when a large spark leaps from her lantern and sets her hammock aflame. An empty pail is 12 yards south and 21 yards west of where she is setting up the hammock. What is the shortest distance in yards LPS can travel to pick up the empty pail, take it to the stream, fill it with water, and return to her hammock to put out the fire?

- A. $3\sqrt{65}$ B. $20 + 3\sqrt{65}$ C. $37 + 3\sqrt{65}$ D. $35 + 3\sqrt{65}$ E. NOTA

28. $\overline{AC}$, $\overline{CE}$, $\overline{AD}$, and $\overline{DE}$ are chords in the circle below. $\overline{AC}$ and $\overline{DE}$ intersect at point B . If $\overline{BE}$, $\overline{CE}$, $\overline{BC}$, and $\overline{BD}$ have lengths 4, 5, 6, and 8, respectively, find the length of $\overline{AD}$.



- A. 6 B. $\frac{20}{3}$ C. $\frac{48}{5}$ D. 10 E. NOTA
29. Isosceles trapezoid $ABCD$ has bases $\overline{AB}$ and $\overline{CD}$ in which $\overline{AB}$ and $\overline{CD}$ have lengths 6 and 10, respectively. $\overline{KM}$ is constructed parallel to the bases such that the area enclosed by trapezoid $KMCD$ is 3 times the area enclosed by trapezoid $ABMK$. Find the length of $\overline{KM}$.
- A. $4\sqrt{3}$ B. 7 C. $2\sqrt{13}$ D. 8 E. NOTA
30. The base of an isosceles triangle has length $\sqrt{2}$. The medians from the base angles to the legs are perpendicular to each other. Find the area enclosed by the triangle.
- A. 2 B. $\frac{3}{2}$ C. $\frac{5}{2}$ D. $\frac{9}{2}$ E. NOTA