For all questions, answer choice "E. NOTA" means "none of the above answers is correct".

1. The area of a circle in square yards is the same as the circumference of the circle in feet. What is the radius in feet?

A. 2　　　　　　　　B. 6　　　　　　　　C. 12　　　　　　D. 18　　　　　E. NOTA

For #2-3, use the following two circles:
$$x^2 + (y - 4)^2 = 16$$
$$x^2 + (y - 4)^2 = 32$$
2. Which of the following gives an accurate relationship between the two circles?

A. The radius of the second is 16 units larger than that of the first
B. The radius of the second is 4 units larger than that of the first
C. The center of the second is 16 units higher than that of the first
D. The radius of the second is twice as large as that of the first
E. NOTA

3. What is the area between the two circles?

A. $\left(4\sqrt{2} - 4\right)^2 \pi$　　　　B. 4π　　　　　C. 16π　　　　D. 256π　　　E. NOTA

For #4-7, use the following function: $f(x) = \sqrt{-x^2 + 18x + 19}$
4. If I formed an isosceles triangle with one side on the x-axis and all its vertices on the graph of the function, what would be the sum of the base angles?

A. 30°　　　　B. 60°　　　　C. 90°　　　　D. 120°　　　E. NOTA

5. What is the area of the triangle?

A. $\frac{81}{2}$　　　　B. 81　　　　C. 100　　　　D. 162　　　E. NOTA

6. If I were to create a scalene triangle with the same conditions, what is the probability that the new triangle's area would be greater than that of the isosceles triangle?

A. 0　　　　B. $\frac{4}{9}$　　　　C. $\frac{5}{9}$　　　　D. 1　　　　E. NOTA

7. What is the surface area of the solid generated by taking the region enclosed by this function and the x-axis, and rotating it about the line $x = 9$?

A. 200π　　　B. 250π　　　C. 300π　　　D. 400π　　　E. NOTA

8. If a circle of radius r is drawn on the complex plane with its center at the complex number $2r + ri$, how many points on the circle are real numbers?

A. 0   B. 1   C. 2   D. depends on the value of r   E. NOTA

9. If the points $A(-2,1)$, $B(-2,5)$, and $D(3,-1)$ are on circle C, what is the radius of circle C?

A. $\frac{17}{10}$ B. $\frac{\sqrt{29}}{2}$ C. 3   D. $\frac{\sqrt{1769}}{10}$ E. NOTA

10. Assuming it is not degenerate, under what conditions must the following conic be a circle:
$$Ax^2 + Cy^2 + Dx + Ey + F = 0$$
A. $AC > 0$ B. $DE > 0$ C. $F < 0$ D. $A = C$ E. NOTA

11. Give the radius of the following circle: $9x^2 + 9y^2 + 36x + 36y - 189 = 0$

A. $\sqrt{13}$ B. $\sqrt{21}$ C. 5   D. $\sqrt{29}$ E. NOTA

12. Find $|ab + cd|$ if (a,b) and (c,d) represent the intersection points between the circle in #11 above and the following circle: $9x^2 + 9y^2 + 36x + 81y - 189 = 0$

A. 0   B. 5   C. 9   D. 45   E. NOTA

13. Two angles $0 < \alpha < \beta < 180°$ are such that $\sin \alpha = \sin \beta$. Which of the following must be true?

A. $\alpha + \beta = 90°$ B. $\alpha + \beta = 180°$ C. $\beta - \alpha = 90°$ D. $\cos\alpha = \cos\beta$ E. NOTA

14. Let $(x_1, y_1), (x_2, y_2), ..., (x_n, y_n)$ be points on the unit circle. Find $\sum_{i=1}^{n}(x_i^2 + y_i^2)$ in terms of n.

A. 1   B. n C. $2n$ D. n^2 E. NOTA

15. If Sphere A has 64 times the volume of Sphere B, then what is the ratio of the radius of sphere A to the radius of sphere B?

A. 4   B. 8   C. 16   D. 64   E. NOTA

16. A circle is inscribed in $\triangle ABC$, and three chords are drawn between the three points of tangency, forming four smaller triangles. Three of the four each shares a vertex with $\triangle ABC$. What kind of triangles must all three of these be?

A. Equilateral   B. Isosceles   C. Obtuse   D. Right   E. NOTA

For problems 17-19, use the following: Circle C lies on the coordinate plane, with points A(-4, -14) and B(2,-14) on the circle. The equation of a tangent to circle C is $y = \frac{3}{4}x - 11$.

17. Find the coordinates of the center of C.

A. $(-1, -18)$ B. $(-1, -14)$ C. $(-1, -11)$ D. $(-1, -10)$ E. NOTA

18. Let D be another point on the circle such that chord AD is a diameter. Write the equation of the tangent at point D.

A. $y = -\frac{4}{3}x - \frac{58}{3}$ B. $y = -\frac{4}{3}x - \frac{50}{3}$ C. $y = \frac{3}{4}x - \frac{39}{2}$ D. $y = \frac{3}{4}x - \frac{47}{2}$ E. NOTA

19. Find possible coordinates of point E such that minor arc EA is congruent to minor arc DB.

A. $(-5, -21)$ B. $(-5, -15)$ C. $(-4, -22)$ D. $(-4, -6)$ E. NOTA

For problems 20-23, use the following: Points A, B, D, E, and F are on circle C in clockwise order, such that chord DF is a diameter. Chords BF and EF are congruent, $m\angle EDF = (12x - 12)°$, $m\angle FDA = (7x + 3)°$, and the measure of minor arc FB is $(18x + 12)°$. P is the point of intersection between lines FD and BE, with $PC = 9$.

20. Solve for x.

A. 2   B. 3   C. 4   D. 5   E. NOTA

21. Find $m\angle DFE$.

A. 30°   B. 45°   C. 60°   D. 90°   E. NOTA

22. Find the length of arc AFE.

A. 9π B. 15π C. $7\pi\sqrt{3}$ D. 21π E. NOTA

23. Find the length of chord AF.

A. 9   B. $6\sqrt{6}$ C. 18   D. $18\sqrt{2}$ E. NOTA

24. A quadrilateral is inscribed in a circle. If I were to choose two of the four inscribed angles at random, which of the following statements must be true about the chosen angles?

A. They are supplementary.
B. They are equal.
C. They are either supplementary or equal.
D. They are neither supplementary nor equal.
E. NOTA

25. A right circular cone has a volume of 144π $in.^3$ and a height that is twice its radius. A plane parallel to the base intersects the cone so that the distance between the base and the plane is half that between the plane and the vertex. What is the circumference of the circle formed by this intersection?

A. 4π　　　　　B. $\dfrac{8\sqrt[3]{9}}{3}\pi$　　　　C. 8π　　　　　D. 16π　　　　E. NOTA

26. An inscribed angle and a chord intercept the same minor arc. If the degree measure of the inscribed angle is $2x$, which of the following is the degree measure of the angle made by a radius drawn to an endpoint of the chord and the chord itself?

A. $90 - 2x$　　　　　　B. $\dfrac{180-x}{2}$　　　　C. $180 - x$　　　D. $180 - 2x$　　　　　　E. NOTA

27. A spiral is made by taking the end of a semicircle 1 cm in radius and joining it to the end of a semicircle 2 cm in radius, then joining a semicircle 3 cm in radius to the other end of the semicircle with radius 2 cm, and so on. The semicircles are joined in such a way that the radius of each smaller semicircle lies entirely on the radius of the larger semicircle. If this pattern continued, what is the smallest number of semicircles needed for the spiral to have a total length of over $10,000\pi$ cm?

A. 138　　　　　B. 139　　　　　C. 140　　　　　D. 141　　　　　E. NOTA

28. A circle of radius 1 has a second circle internally tangent to it and passing through its center. The second circle also has a third circle internally tangent to it and passing through the center of the second circle. The pattern continues infinitely. If the area between the nth and the $(n + 1)^{th}$ circles is shaded for all positive even integers n, what is the total shaded area?

A. $\dfrac{\pi}{5}$　　　　　B. $\dfrac{\pi}{4}$　　　　　C. $\dfrac{\pi}{3}$　　　　　D. π　　　　　E. NOTA

29. A sphere is inscribed in a right circular cylinder. What is the ratio of the volume of the sphere to the volume of the cylinder?

A. 1:2   B. 2:3   C. 3:5   D. 5:9   E. NOTA

30. What would a math test be without logs? Right cylindrical logs of radius r are stacked on the ground in rows on top of each other so that each log on the second row is tangent to two logs on the first row. In terms of r, how high is the top of the second row above the ground?

A. $\sqrt{3}r$ B. $3r$ C. $(2 + \sqrt{3})r$ D. $4r$ E. NOTA