1. Polygon A is a regular polygon with the distance from the center to any vertex equal to 10. Let P be the perimeter of A, then which of the following is the lowest value that is still an upper bound for P?

   a. 10   b. 10π c. 20   d. 20π e. NOTA

2. A circle of radius 6 is inscribed in a hexagon, which is inscribed in a larger circle. What is the circumference of the larger circle?

   a. $4\pi\sqrt{3}$ b. $6\pi\sqrt{3}$ c. $8\pi\sqrt{3}$ d. $12\pi\sqrt{3}$ e. NOTA

3. What is the circumference of the circle given by the equation $(x-5)^2 + (y+2)^2 = 16$?

   a. 8π b. 16π c. 32π d. 4π e. NOTA

4. A region is bounded by a 60 degree circular arc of a circle with radius 6 and a line segment that connects the endpoints of the arc. What is the area of this region?

   a. $6\pi - 9\sqrt{3}$ b. $12\pi - \sqrt{3}$ c. 12π d. 18π e. NOTA

5. What is the volume of a cylinder with height 8 and base circumference 32?

   a. $\dfrac{1024}{\pi}$ b. 1024π c. $\dfrac{2048}{\pi}$ d. 2048π e. NOTA

6. Person A is chasing Person B around a circle of circumference 20 miles. Person A starts out 4 miles behind Person B. Person A runs at 10 miles per hour, and Person B runs at 8 miles per hour. How far along the circle's circumference (shortest distance) will Person A be from her starting position when she catches up to Person B?

   a. 1 mile   b. 0 miles   c. 2 miles   d. 4 miles   e. NOTA

7. How many degrees is arc AB, if the line AC is a diameter of the circle?
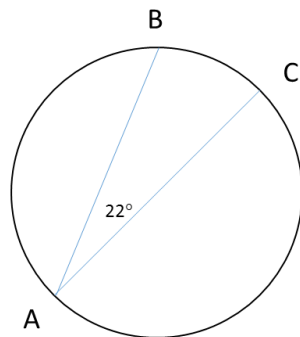
   a. 44°   b. 156°   c. 132°   d. 144°   e. NOTA

8. The radius of the great circle of Sphere A is four times larger than the radius of the great circle of Sphere B. If the volume of Sphere B is 2, what is the volume of Sphere A?

     a. 64   b. 128   c. 36   d. 100   e. NOTA

9. A sphere has a diameter of 1028 feet. You wrap a string around the circumference of the great circle of this sphere. How much more string would you need in order to lift every part of the string two feet off of the surface of the sphere?

     a. 1028π feet   b. 2056π feet   c. 8π feet   d. 4π feet   e. NOTA

10. There is an infinite series of circles, each with a radius ¼ the radius of the previous circle. If the first circle has an enclosed area of 4, what is the total enclosed area of all of the circles?

     a. $\frac{64}{15}$ b. 16   c. $\frac{36}{5}$ d. $\frac{32}{3}$ e. NOTA

11. What is the volume of the solid formed when the region $x^2 + (y - 2)^2 \leq 1$ is revolved around the x axis?

     a. π^2 b. 2π c. 8   d. $4\pi^2$ e. NOTA

12. What is the ratio of the circumference of a circle with radius r to the volume of a cone with that circle as its base, and a height of 10?

     a. $\frac{3}{\pi r}$ b. $\frac{3}{r}$ c. $\frac{3}{r^2}$ d. $\frac{3}{5r}$ e. NOTA

13. What is the total perimeter of the following figure (a rectangle with a semicircle on its upper side), if the radius of the semicircle is 7 and the height of the rectangle is 18?
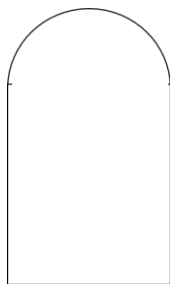
     a. $7\pi + 32$ b. $7\pi + 50$ c. 14π d. $7\pi + 32$ e. NOTA

14. A cone is cut parallel to its base, resulting in a frustum for the bottom portion. If the original cone has height 10 and slant height $\frac{20}{\sqrt{3}}$, and if the distance between the bases of the frustum is 8, what is the volume of the frustum?

    a. $\frac{248\pi}{3}$ b. 312π c. $\frac{64\pi}{5}$ d. 248π e. NOTA

15. Odie the Ant is painting a circular region of radius 10, starting from the outside and working radially in. If he has painted 90% of the circle by area, what is the circumference of the circle that is left unpainted?

    a. 6π b. 10π c. 12π d. 12π e. NOTA

16. What is the probability that a dart thrown randomly into the following area lands in the shaded region? The dartboard is a circle inscribed in a square inscribed in another square.
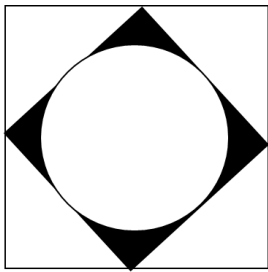
    a. $\frac{\pi}{2}-\frac{1}{2}$ b. $\frac{3}{2}-\frac{\pi}{4}$ c. $\frac{1}{2}-\frac{\pi}{4}$ d. $\frac{1}{2}-\frac{\pi}{8}$ e. NOTA

17. A right triangle with legs of lengths 6 and 8 is inscribed in a circle. What is the circumference of the circle?

    a. 10π b. 5π c. 100π d. 20π e. NOTA

18. You have a cylinder of base radius r that contains 400π cubic inches of water, reaching a height of 25 inches. You pour the water into a cone (point facing downwards) with a base radius r and a height of 18.75 inches until the cone is full, leaving the remaining water in the cylinder. What is the height of the water remaining in the cylinder?

    a. $\sqrt[3]{6}$ b. $\sqrt[3]{12}$ c. $\frac{2\sqrt[3]{6}}{3}$ d. $2\sqrt[3]{6}$ e. NOTA

19. The area of Circle A is 16 times the area of Circle B. What is the ratio of the circumference of Circle A to the circumference of Circle B?

    a. 2   b. 4   c. 8   d. 12   e. NOTA

20. You have a goat named Melanie. You want to use 50 feet of fencing to create an enclosure that gives Melanie the greatest possible area for grazing. Assume that you have a river that can form one side of the enclosure (so no fence is needed along the river). What is the maximum area you can enclose?

    a. 312.5   b. 1250   c. 5000   d. 3000   e. NOTA

21. A regular solid has 8 faces and 16 edges; how many vertices does it have?

    a. 6   b. 8   c. 10   d. 12   e. NOTA

22. A circular hoop of radius 10 feet is spinning at a rate of 20 radians per second. What is the speed of a point at the edge of the hoop?

    a. 200 ft/sec   b. 2 ft/sec   c. 10 ft/sec   d. 100 ft/sec   e. NOTA

23. A disk of radius 20 cm is spinning at a rate of $\frac{7\pi}{8}$ radians per second. An ant crawls from the center of the disk outwards at a rate of 5 cm/sec. How many degrees away from its starting position is the disk when the ant reaches the edge (smallest positive amount)? Assume the ant walks in a straight line relative to the disk.

    a. 180   b. 45   c. 90   d. 60   e. NOTA

24. What is the angle between the minute hand and the hour hand at exactly 3:20 (in degrees)?

    a. 20   b. 25   c. 30   d. 40   e. NOTA

25. What is the area of the annulus formed by a circle of radius 10 and a circle of radius 8?

    a. 20π b. 36π c. 6π d. 48π e. NOTA

26. What is the maximum number of cubes of side length 2 that can fit in a rectangular box of dimensions 20 x 15 x 12?

    a. 450   b. 400   c. 460   d. 420   e. NOTA

27. What is the volume of a sphere whose great circle has a circumference of 18?

    a. 972   b. $\dfrac{972}{\pi^2}$ c. 1944   d. $\dfrac{1944}{\pi^2}$ e. NOTA

28. A cone whose base is upward with base circumference 10π feet is filled with sand, which falls out at a rate of 4π cubic feet per second. If the cone starts out with sand up to a height of 30 feet, what is the height, in feet, of the sand left in the cone after 49 seconds? Assume the sand in the cone always retains a similar shape to the cone itself.

    a. 18   b. 20   c. 24   d. 28   e. NOTA

29. What is the shortest distance between the circle $x^2 + y^2 = 4$ and the line $x = -7$?

    a. 2.5   b. 4   c. 5   d. 7.5   e. NOTA

30. A circle of radius 9 inches rolls at a rate of 8π radians/second. At what linear speed does a point 2/3 of the way from the center of the circle to the edge of the circle travel?

    a. 48 in/s   b. 72 in/s   c. 48π in/s   d. 72π in/s   e. NOTA