



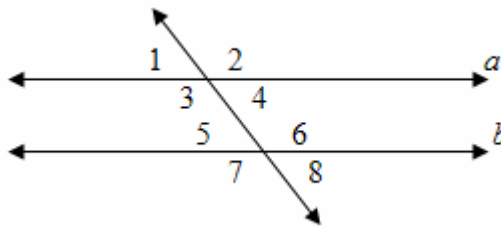
1. Find the volume, in cubic centimeters, formed by rotating an asymmetrical shape with area 4 cm^2 around an axis that is 4 cm away from the centroid of the shape.

- A. 16π B. 32π C. $64\pi^2$ D. $128\pi^2$ E. NOTA

2. What is the volume of the largest cone that can fit into a sphere of volume 81π ?

- A. 16π B. 48π C. 24π D. 36π E. NOTA

3. In the diagram below what is the relationship between the angles 1 and 7 if $a \parallel b$?



- A. Corresponding Angles B. Alternating Interior Angles C. Alternating Exterior Angles
D. Opposing Exterior Angles E. NOTA

4. What is the name given to the polygon with 12 sides?

- A. octagon B. hexagon C. dodecagon D. icosagon E. NOTA

5. What is the volume, in cm^3 , of the smallest cone that circumscribes a sphere with radius 5 cm?

- A. $\frac{1000\pi}{3}$ B. 250π C. $\frac{500\pi}{3}$ D. $\frac{250\pi}{3}$ E. NOTA

6. The two regions formed by the graphs of $y = x^2$, $x = 0$, $x = 1$, $y = 0$, and $y = 1$ are named A and B, where the area of A is larger than the area of B. Find the ratio of the area of A to B.

- A. 1:1 B. 2:1 C. 2:3 D. 4:9 E. NOTA

7. For the same two regions A and B in problem 6, both regions are rotated around the y-axis to form A' and B' respectively. Find the ratio of the volumes of A' to B'.

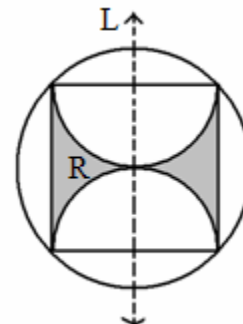
- A. 1:1 B. 2:1 C. 2:3 D. 4:9 E. NOTA

8. What is the maximum volume of a tetrahedron inside of a sphere of radius 12 cm?

- A. $512\sqrt{3}$ B. $256\sqrt{3}$ C. $128\sqrt{3}$ D. $64\sqrt{3}$ E. NOTA



9. The shaded region R is formed by a square and two semicircles, each with diameter equal to the side of the square they are inside of, yet these semicircles do not overlap. The square is inscribed in the outer circle. The shaded region R is rotated around the center vertical axis L. What is the ratio of this volume to the volume of the entire sphere, when the circle is rotated in the same manner?



- A. 2:1 B. 1:1 C. $\sqrt{2} : 8$ D. 1:4 E. NOTA
10. For the same rotated figure in question 9, what is the ratio of the surface area of rotated region R to the surface area of the outer sphere?
- A. 2:1 B. 1:1 C. 1:2 D. 1:4 E. NOTA
11. The region S is formed by the functions $y = x^{2/3}$, $y = 0$ and the line $x = 8$. What is the perimeter of the region S?

- A. $\frac{80\sqrt{10} + 316}{27}$ B. $\frac{80\sqrt{10} - 8}{27}$ C. $\frac{80\sqrt{10}}{27}$ D. $\frac{80\sqrt{10}}{27} + 12$ E. NOTA

12. When finding the area under the curve $f(t) = \sin(t)$ from 0 to x . At what rate is the area changing when $x = \pi/2$?

- A. -1 B. 0 C. 1/2 D. 1 E. NOTA

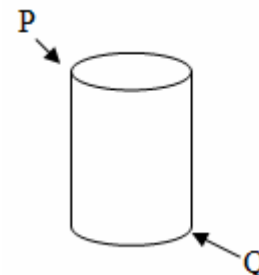
13. A pile of sand is forming in the shape of a regular cone from an inverted hemispherical bowl of sand above it. If the height of the cone is 4 cm when its radius is 3 cm, and the sand is pouring from a hole in the bowl at a rate of $1 \text{ cm}^3/\text{sec}$, then at what rate is the height changing at this time?

- A. $\frac{16}{9\pi} \text{ cm/sec}$ B. 1 cm/sec C. $\frac{1}{9\pi} \text{ cm/sec}$ D. 16 cm/sec E. NOTA

14. For the same system in question 13, how far above the base of the cone (in cm) must the base of the bowl be placed in order for the cone to touch the bowl, just as the bowl runs out of sand, assuming the bowl initially held volume of 144π cubic centimeters of sand?

- A. 4 B. $4\sqrt[3]{4}$ C. 9 D. $4\sqrt[3]{12}$ E. NOTA

15. An ant is perched on the top edge of a mini soft drink can at the right and is represented by point P. The ant wants to get to point Q, directly opposite of P. If the ant can slide down the can at 2 cm/s but can only slide horizontally at 1 cm/s, then how long, in seconds, does it take the ant to crawl from P to Q if the radius is 1 cm and the height is 4 cm?

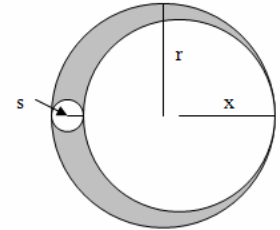


- A. 2 B. π C. 1 D. $\sqrt{4 + \pi^2}$ E. NOTA



16. Circle with radius r is greater than circle of radius x . Find the limit, as x approaches r , of the ratio of the area of the shaded region to the area of the circle with radius s .

A. 0 B. 1 C. π D. does not exist E. NOTA



17. A room in the shape of a rectangular prism has two square walls that are 10 feet tall and 20 feet apart. A spider sitting on one of the square walls is 2 feet from the ceiling and in the middle of the wall horizontally. There is a bug on the opposite wall 2 feet from the floor, but still in the middle of that wall horizontally as well. Find the shortest distance, in feet, that the spider can crawl (without jumping or falling) using any sides of the room?

A. 10 B. 20 C. 30 D. 40 E. NOTA

18. What is the volume of the largest cube that can be contained within a sphere of radius 6?

A. 216 B. $192\sqrt{2}$ C. $192\sqrt{3}$ D. $216\sqrt{3}$ E. NOTA

19. A ball of putty is rolled into a perfect sphere, and the sliced into two equal hemispheres, each of which has surface area measuring A square units, and volume measuring A cubic units. Find the radius of the original ball.

A. 1.5 B. 3 C. 4 D. 4.5 E. NOTA

20. What is the maximum area of a triangle with two sides of length 4?

A. 4 B. 8 C. 16 D. 32 E. NOTA

21. A polyhedron has 12 edges, and 7 vertices, how many faces should it have?

A. 7 B. 8 C. 9 D. 10 E. NOTA

22. A point p is placed on one edge of a Möbius strip with uniform width y . A path starting at p is drawn along the edge of the Möbius strip until it meets back at p again. The length of this path is x . Find the total surface area of the Möbius strip.

A. $\frac{xy}{2}$ B. xy C. $2xy$
D. Cannot be determined E. NOTA

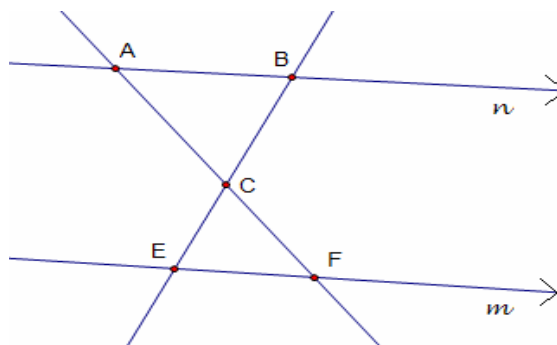
23. How many pieces can be made by slicing a pizza pie 4 times, if each slice must be a chord of the circle?

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



24. $AC = 4$, $BC = 7$, $AB = 5$, $CF = 3$
Find EF if $n \parallel m$.

- A. 5
B. 5.25
C. 3
D. 3.75
E. NOTA

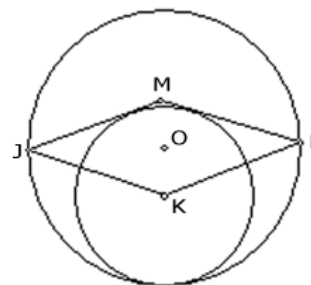


25. Find the volume of a frustum with height 6, base areas 81 and 16.

- A. 266 B. 194 C. 291 D. 147 E. NOTA

26. Points J and L of rhombus $JKLM$ form endpoints of a diameter of circle O . A circle with center K is tangent to circle O as well as to sides LM and MJ of the rhombus.

Consider the radius r of circle K ,
the radius R of circle O ,
the shorter diagonal d of the rhombus,
and the side s of the rhombus.



If $rRds = 72$, then what is the area of rhombus $JKLM$?

- A. 6 B. $6\sqrt{2}$ C. 36 D. 72 E. NOTA

27. What is the curvature for any point on a circle of radius 4?

- A. $1/4$ B. $1/2$ C. 1 D. 4 E. NOTA

28. Circle Q is inscribed in triangle DOG . If the perimeter of DOG is 12 and the area is 6, then what is the area of the circle Q ?

- A. $\frac{\pi}{4}$ B. $\frac{\pi}{2}$ C. π D. 2π E. NOTA

29. What is the name of the center of the circle Q , relative to the triangle DOG in problem 28?

- A. orthocenter B. incenter C. circumcenter D. centroid E. NOTA

30. Find the area under the curve $f(x) = \sqrt{4 - x^2}$ from $x = 0$ to $x = 2$.

- A. π B. 2π C. 4π D. 8π E. NOTA