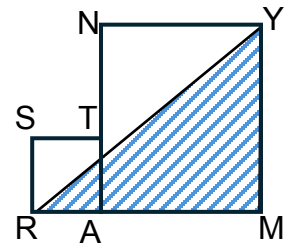


The abbreviation “NOTA” found in choice E of answer choices means “None of The Above [Answers]” and should be chosen if choices A, B, C and D are not correct. Diagrams may not be drawn to scale. Angle measures are in degrees. If units are not given in the question or answer choices, then linear measures should be assumed to be cm, area in square cm, and volume in cubic cm. “Area of” a polygon/circle is defined as the area of the region on the plane enclosed by...” All measures and answers are real.

1. Square STAR has each side of length 3. Square MANY has each side length 8. A, T and N are collinear. R, A and M are collinear. Find the area of the shaded region, the interior of $\triangle RYM$.



A. $\sqrt{185}$ B. $5\sqrt{35}$ C. 24 D. 44 E. NOTA

2. A right triangle, $\triangle RST$, has hypotenuse of length 13 and one leg of length 12. Find the perimeter of $\triangle RST$.

A. 25 B. 27 C. 30 D. 32 E. NOTA

3. A regular polygon has one interior angle of measure 144° and each side of length 4. What is the perimeter of this polygon?

A. 576 B. 144 C. 40 D. 36 E. NOTA

4. The radius of a circle is increased by 10%. If the original radius was r , which ratio below is that of the new circumference of the circle to the new diameter of the circle?

A. $1.1r : 1$ B. $10\pi : 1$ C. $10 : 1$ D. $\pi : 1$ E. NOTA

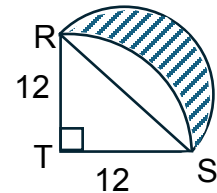
5. A square and an equilateral triangle have equal perimeters. The triangle encloses an area of $\frac{9}{16}\sqrt{3}$. Find the length of the diagonal of the square.

A. $\frac{9}{4}\sqrt{6}$ B. $\frac{9}{8}\sqrt{2}$ C. $\frac{4}{3}\sqrt{2}$ D. $\frac{3}{4}\sqrt{6}$ E. NOTA

6. An isosceles triangle has perimeter 24 and each side of integral (integer) length. Find the largest possible area enclosed by the triangle.

A. $16\sqrt{3}$ B. $18\sqrt{2}$ C. $20\sqrt{6}$ D. $2\sqrt{30}$ E. NOTA

7. The unshaded part of the diagram to the right shows a right triangle, and the segment of a circle with the right triangle as central angle. The segment and triangle use arc $\widehat{RS}$ and hypotenuse $\overline{RS}$, respectively. The outer arc in the diagram has the same endpoints R and S, but the circle which contains the outer arc has $\angle RTS$ as an inscribed angle. $RT = TS = 12$. Give the area of the shaded region, outside of the arc with radius RT, and inside of the circle with inscribed angle $\angle RTS$.



A. 36π B. 72 C. 18π D. 36 E. NOTA

8. A right pyramid has a square base with base edges 12 each. The height of the pyramid is 8. Find the lateral area of the pyramid (which does not include the area of the base).

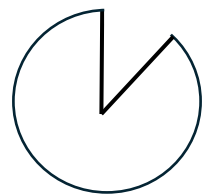
A. 240 B. 196 C. 192 D. 120 E. NOTA

9. A sphere of radius 4 has an enclosed volume which is twice the volume of another sphere. What is the radius of the smaller sphere?

A. $4\sqrt{2}$ B. $4\sqrt[3]{2}$ C. $2\sqrt[3]{4}$ D. $8\sqrt[3]{2}$ E. NOTA

10. A sector of a circle has measure 300 degrees. Its area is 10π square cm. What is the radius of this sector, in cm?

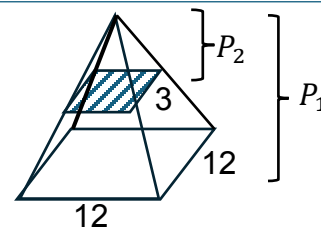
A. 6 B. $3\sqrt{2}$ C. 4 D. $2\sqrt{3}$ E. NOTA



11. A triangle has side lengths 13, 14 and 15. What is the area enclosed by the triangle?

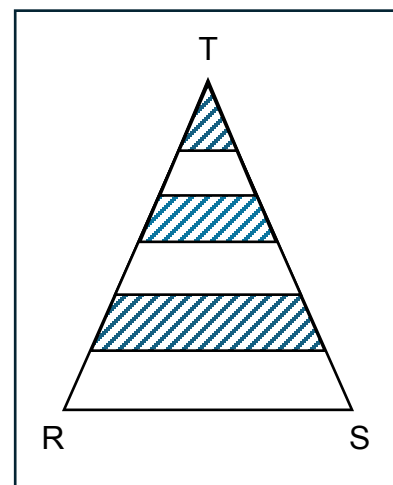
A. 92 B. 84 C. 52.5 D. 48.5 E. NOTA

12. A right pyramid P_1 has a square base with each edge 12 cm. **Four cm above the base**, a plane intersects the pyramid, parallel to the plane that contains the base. The square cross section shown is the intersection of the parallel plane and P_1 . The cross section has each side of length 3 cm. The right pyramid P_2 has this cross section as base, and it shares the apex point of the larger pyramid (the point where the lateral faces all intersect). Find the volume of pyramid P_2 in cubic cm.

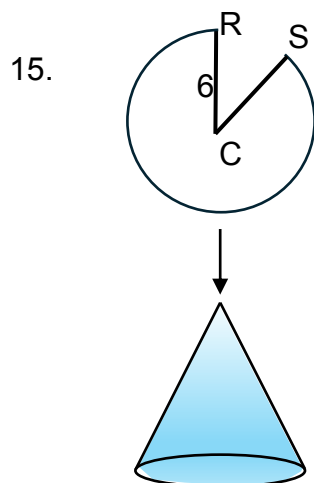


- A. 8 B. $4\sqrt{3}$ C. 4 D. $\frac{8}{3}$ E. NOTA
13. The great circle of a sphere has enclosed area 20 square cm. What is the surface area of the sphere, in square cm?
- A. 80 B. 40 C. 30 D. 20 E. NOTA

14. A triangle has its interior divided by five segments parallel to the base $\overline{RS}$. Each segment has endpoints on the sides of the triangle, as shown. Parallel segments are evenly spaced along the height. That is, from T to the top segment = the distance from the top and second segment, and so on. If the three shaded areas total 100 square cm, then what is the total of the areas of the three unshaded regions?



- A. 100 B. 140 C. 150 D. 180 E. NOTA



15. A sector of a circle of radius 6 has measure 300 degrees. $\angle RCS$ is a central angle. $\overline{RC}$ and $\overline{SC}$ are moved together so that the region inside of the sector becomes the lateral surface area of a cone. The volume of the cone is written in the form $\frac{a}{b}\pi\sqrt{c}$, for positive integers a, b and c , and c is not divisible by the square of any integer greater than 1. Find the sum $a + b + c$.

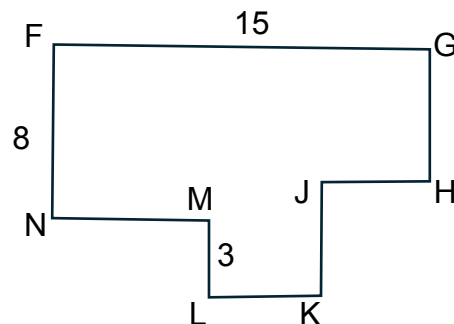
- A. 40 B. 39 C. 19 D. 13 E. NOTA

16. A solid metal sphere of radius 3 cm is melted, without loss of metal. The metal is used to form a right circular cylinder of radius 3 cm. What is the height of the cylinder in cm?

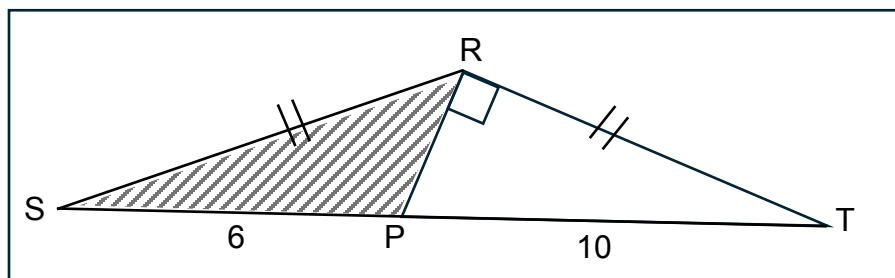
A. 6 B. 4 C. 3 D. 2 E. NOTA

17. Non-convex octagon FGHJKLMN has adjacent sides which intersect at right angles. $FN = 8$, $FG = 15$, and $ML = 3$. Find the perimeter of the octagon.

A. 52 B. 54
C. 56 D. 58
E. NOTA



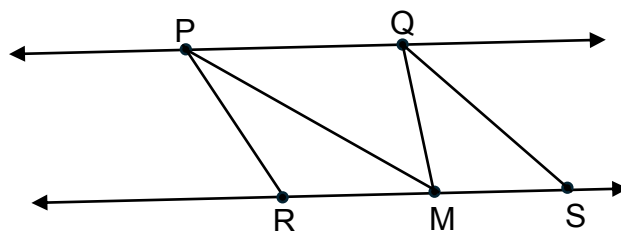
18. $\triangle RST$ has P on side $\overline{ST}$ so that $\angle PRT$ is a right angle. $\triangle RST$ is isosceles, with $RS = RT$. $SP = 6$ and $PT = 10$. Find the area enclosed by $\triangle SPR$ (shaded).



A. 32 B. 16 C. 14 D. 12 E. NOTA

19. Lines $\overleftrightarrow{PQ}$ and $\overleftrightarrow{RS}$ are parallel. M is the midpoint of $\overline{RS}$. The area enclosed by $\triangle PRM$ is 50, and $PR = 1.2(QM)$. Find the area enclosed by $\triangle QMS$.

A. 30 B. 40 C. 50 D. 60 E. NOTA



20. Right triangle RST is inscribed in a circle. The triangle has legs with lengths 6 and 8. Find the circumference of the circle.

A. 100π B. 25π C. 20π D. 10π E. NOTA

21. $\triangle RST$ is graphed on the xy -coordinate plane, with coordinates of the vertices $R(0,8)$, $S(3,4)$, and $T(0,4)$. Find the perimeter of $\triangle RST$.

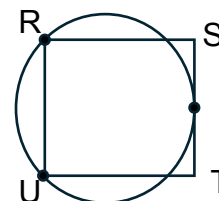
A. 15 B. 14 C. 13 D. 12 E. NOTA

22. Two similar polygons have perimeters in the ratio of 3 to 5. The larger polygon encloses an area which is 10 square cm more than the area enclosed by the smaller polygon. What is the area enclosed by the larger polygon, in square cm?

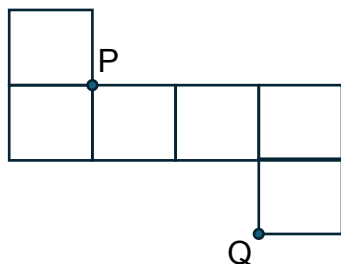
A. $\frac{45}{8}$ B. $\frac{45}{4}$ C. $\frac{45}{17}$ D. $\frac{125}{8}$ E. NOTA

23. A square $RSTU$ encloses an area of 144 square cm. It has vertices R and U on a circle, and side $\overline{ST}$ is tangent to the circle. What is the circumference of the circle in cm?

A. 24π B. 18π C. 15π D. 12π E. NOTA

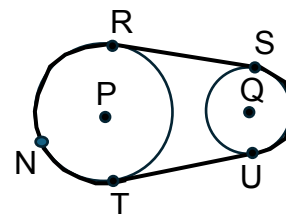


24. A cube is folded from the net shown. The total area of the net shown is 24 square cm. Points P and Q , when in the given positions on the net will end up on the cube what distance from each other? That is, what is the length of $\overline{PQ}$ in cm on the cube that results from the net? (note: 0 distance means that P and Q coincide.)



A. 0 B. 2 C. $2\sqrt{2}$ D. $2\sqrt{3}$ E. NOTA

25. Two circles have centers P and Q respectively, and the radii are 10 and 2 respectively. $PQ = 16$. A path is traced from R to S , for $\overline{RS}$ and $\overline{TU}$ tangent segments, along the minor arc $\widehat{SU}$, from U to T , and along major arc $\widehat{TNR}$. R , S , U and T are points of tangency for the tangent segments. The length of the path described is $a\sqrt{b} + c\pi$, for positive integers a and b and real number c , such that b is not divisible by the square of any integer greater than 1. Find $a + b + c$.

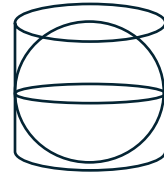


A. $33\frac{2}{3}$ B. $83\frac{1}{3}$ C. 85 D. 87 E. NOTA

26. A regular hexagon encloses an area of $6\sqrt{3}$. What is the perimeter of the hexagon?

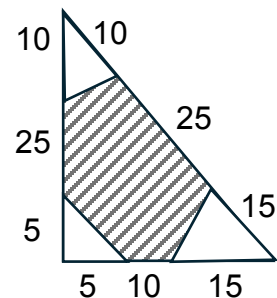
- A. 36 B. 18 C. 12 D. 10 E. NOTA

27. A sphere is in a right circular cylinder so that the sphere is tangent to the cylinder's bases at their centers, and the great circle of the sphere is on the surface of the cylinder as shown. If the sphere has radius 4 cm then find the total surface area of the cylinder (including base areas) in square cm.

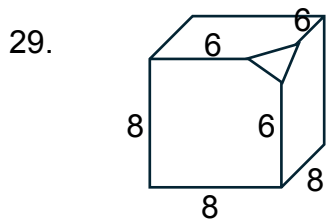


- A. 96π B. 94π C. 64π D. 60π E. NOTA

28. A triangle has side lengths 30, 40 and 50. Line segments are drawn at each vertex to create 3 isosceles triangles. One has legs of lengths 10 each, one has legs 5 each, and the last has legs 15 each, as shown. Remember that diagrams are not drawn to scale. The shaded region in the diagram to the right shows the area of the original triangle less the areas of the three isosceles triangles. Find the area of the shaded region, a hexagon.



- A. 467.5 B. 497.5 C. 501.5 D. 503 E. NOTA



A cube with edges 8 has one vertex/corner truncated so that three edges have length 6. This creates a seventh face, which is an equilateral triangle, and three faces are non-regular pentagons. Find the surface area of the new solid.

- A. $300 + 4\sqrt{3}$ B. $378 + 2\sqrt{3}$
C. $352 - 4\sqrt{3}$ D. $384 + 2\sqrt{3}$ E. NOTA

30. A circle has circumference 10 cm. Find the area enclosed by this circle, in square cm.

- A. $\frac{10}{\pi^2}$ B. $\frac{25}{\pi^2}$ C. $\frac{25}{\pi}$ D. $\frac{10}{\pi}$ E. NOTA