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**QUESTION 1**

Shaquille has just said something stupid. Because of this, he must wear a dunce cap in the shape of a cone with radius 3 and height 4. Let

$A$  = the volume of the cap.

$B$  = the lateral area of the cap.

$C$  = the volume of a sphere with the same radius as the cap.

$D$  = the surface area of a sphere with the same radius as the cap.

Compute the value of  $A + B + C + D$ .

**QUESTION 2**

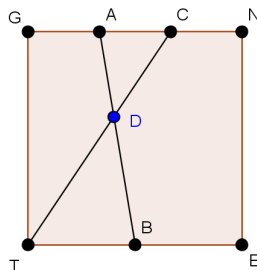
A triangle is to be made from three distinct numbers of the set  $\{3, 4, 5, 6, 7, 8\}$  where each number represents one side length. What is the probability that the three numbers chosen can be the lengths of the sides of a nondegenerate triangle?

## QUESTION 3

The distance between the centroid and circumcenter of equilateral triangle  $JOE$ , where  $OJ = 1$ , is  $P$ .

In right triangle  $IAN$  an altitude drawn to hypotenuse  $\overline{IN}$  divides  $\overline{IN}$  into two line segments of lengths 7 and 3. Let  $Q$  equal the length of this altitude.

In square  $TENG$ , shown below, with side length 3, points  $A$  and  $C$  are chosen on  $\overline{GN}$  and point  $B$  is chosen on  $\overline{TE}$  such that  $GA = AC = CN$  and  $TB = 2$ . The intersection of line segments  $\overline{AB}$  and  $\overline{TC}$  is  $D$ . The area of  $\triangle TDB$  is  $R$ .



Compute the value of  $P + Q + R$ .

## QUESTION 4

Let  $A$  be the maximum number of regions formed in a circle if 4 lines are drawn through the circle.

In a circle with center  $O$  and radius 7, chord  $\overline{MN}$  is drawn such that  $MN = 2$ . Let  $B$  equal the area of triangle  $OMN$ .

Two chords in circle  $P$  intersect at an angle of  $72^\circ$ . The two chords cut off two arcs of the circle with the measure of one of these arcs 7 times the measure of the other. Let  $C$  be the measure of the smaller arc, in degrees.

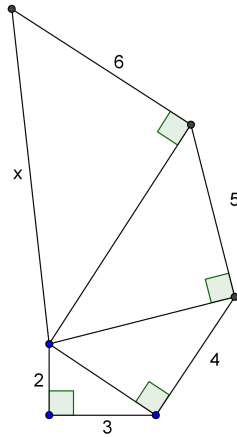
For two concentric circles, a chord drawn in the larger circle has length 20 and is tangent to the smaller circle. The area of the annulus of the two circles is  $D$ .

Compute the value of  $A + B + C + D$ .

## QUESTION 5

A square with area 128 is circumscribed about a circle. Another square is inscribed within this circle. Let  $A$  be the area of this smaller square.

Let  $B$  be the value of  $x$  in the diagram below.

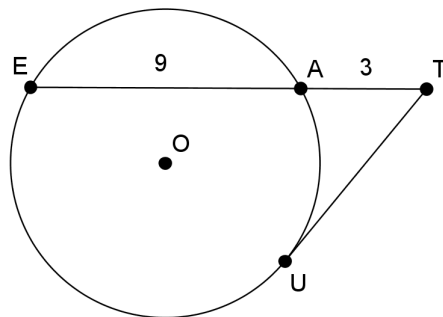


Compute the value of  $AB$ .

## QUESTION 6

Three congruent pairwise tangent circles, each with a radius of 10, are drawn. The area of the triangle formed by connecting the centers of each of these circles is  $A$ .

For circle  $O$  shown below, point  $T$  is chosen on the exterior of  $O$  and line segments  $\overline{TU}$  and  $\overline{TE}$  are drawn such that  $\overline{TU}$  is a tangent and  $\overline{TE}$  is a secant.  $\overline{TE}$  intersects the circle at point  $A$  and  $TA = 3$  and  $EA = 9$ . Let  $B$  be equal to the length of  $TU$ .



Compute the value of  $A + B$ .

## QUESTION 7

Let

$A$  = the area of a triangle with base length 4 and height 6

$B$  = the area of a right triangle with a hypotenuse of length 12 and one acute angle with a measure of  $30^\circ$

$C$  = the area of a triangle with perimeter of 18 and an inradius of length 8.

$D$  = the area of an equilateral triangle with side length of 3.

Compute the value of  $A + B + C + D$ .

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**QUESTION 8**

Determine the truth value of each of the conditional statements using the given information. Let each statement have a value of 5 if it is true,  $-3$  if it is false, and 2 if the truth value cannot be determined from the given information.

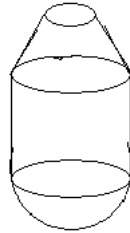
- (A) If Pratik is a penguin, then he likes cookies. Pratik likes cookies but is not a penguin.
- (B) If Kevin buys Pamela a pony, then Pamela throws Dr. Pepper at Kevin. Kevin buys Pamela a pony and Dr. Pepper was thrown at Kevin.
- (C) If Mihir has chubby cheeks, then Pamela will pinch them. Pamela pinches Mihir's cheeks.
- (D) If Eli grows a beard, then he will do well at math. Eli grows a beard and fails at math.

Compute the sum of the values of  $A$ ,  $B$ ,  $C$ , and  $D$ .



## QUESTION 9

Pamela's teleporter, shown below, consists of three sections. The top section of the teleporter is a frustum with lower radius 3, upper radius 1, and height 2. The middle section of the teleporter is a cylinder with a radius equal to that of the lower radius of the frustum and a height of 6. Finally, the bottom section of her teleporter is a hemisphere with radius equal to that of the cylinder.



Compute the volume of Pamela's teleporter.

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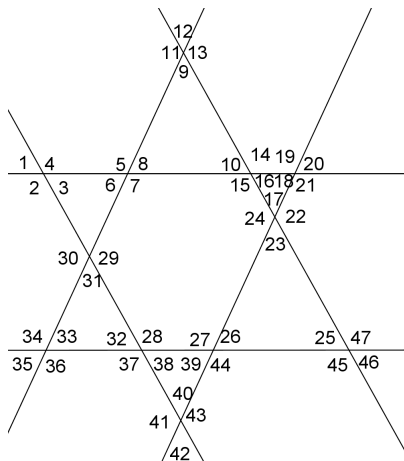
**QUESTION 10**

Let  $A$  be the area of the convex pentagon with vertices  $(1, 1)$ ,  $(4, -7)$ ,  $(2, -3)$ ,  $(-1, 7)$  and  $(0, -10)$ .

Two circles with radius 8 and radius 18 are externally tangent to each other. The length of the external tangent connecting the two circles is  $B$ .

Compute the value of  $A + B$ .

## QUESTION 11



In the diagram, all lines that appear parallel are in fact parallel. Given that  $m\angle 1 = 70^\circ$ ,  $m\angle 21 = 110^\circ$ ,  $m\angle 31 = 40^\circ$ ,  $m\angle 11 = 110^\circ$ , and  $m\angle 41 = 110^\circ$ , then let

$$A = m\angle 31 + m\angle 32 + m\angle 33$$

$$B = m\angle 18 + m\angle 20$$

$$C = m\angle 5 + m\angle 33$$

$$D = m\angle 25 + m\angle 33$$

Compute the value of  $A + B + C + D$ .

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**QUESTION 12**

Matthew is eating a circular cookie. Before he can bite into it, a regular, transparent heptagon falls onto it, circumscribing the cookie. The apothem of the heptagon is 13, and the length of the segment connecting one vertex of the heptagon to the center of the circle has a length of 19. Compute the area **outside** the cookie and **inside** the heptagon.

**QUESTION 13**

Compute the sum of the  $x$  and  $y$  coordinates of **all** intersection points in the graph of

$$y = 2x^2 - 14x + 7$$

$$y = \frac{3}{2}x - 3$$

$$y = -2x + 5$$

*Hint: There are 5 total intersection points.*

QUESTION 14

Determine the area of a circle with radius  $\pi$ .

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