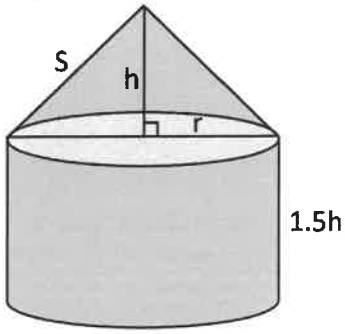
This is an individual test. No outside resources are allowed, not even calculators. Answer every question to the best of your ability, and circle your answer choice.

1. Given is an image of a cone atop a cylinder, with the same radii. If $r = 3\sqrt{8}$, $s = 5\sqrt{2}$, and $h = \sqrt{12}$, find the surface area of the figure. Include the bottom of the cylinder.

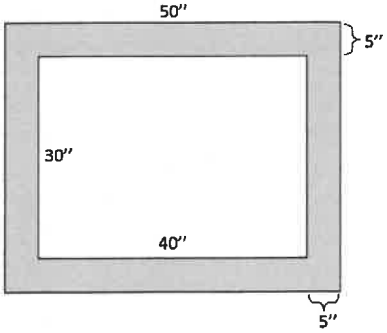


   (a) $(132+36\sqrt{8})\pi$
   (b) $(132+36\sqrt{6})\pi$
   (c) $(60+36\sqrt{6})\pi$
   (d) $(72+24\sqrt{8})\pi$

2. A rectangle is inscribed within a circle with a radius of 30 units. If one side of the rectangle is $\frac{3}{4}$ the length of the side adjacent to it, what is the area of the rectangle?

   (a) 1728 units^2
   (b) 1500 units^2
   (c) 1834 units^2
   (d) 1782 units^2

3. In the image, what is the ratio of the shaded outside region to the area of the white inside region?



   (a) 1:3
   (b) 1:5
   (c) 2:3
   (d) 3:5

4. If the perimeter of a regular hexagon is 72 units, what is the area of the figure?

   (a) $120\sqrt{4}$
   (b) $168\sqrt{3}$
   (c) $216\sqrt{3}$
   (d) $168\sqrt{5}$

5. A swimming pool is 30 feet long and 20 feet wide. In the shallow end, it is 3 feet deep, and it steadily increases to 10 feet deep in the deep end. How long will it take to fill the pool at a rate of 1 $ft^3 min$?

   (a) 39 hours

   (b) 65 hours

   (c) 32 hours and 30 minutes

   (d) 43 hours and 13 minutes

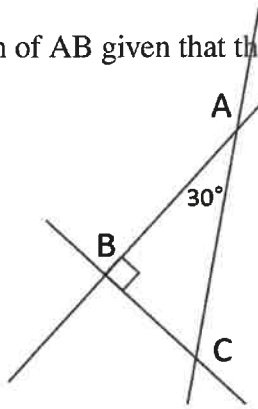
6. Using the information in the figure, find the length of AB given that the length of AC is $9\sqrt{2}$.

   (a) $\frac{9\sqrt{3}}{2\sqrt{2}}$

   (b) $9\sqrt{3}$

   (c) $9\sqrt{2}$

   (d) $4\sqrt{2}$



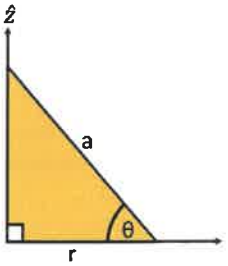
7. Given the image of a right triangle with one side along the $\hat{z}$ axis, what is the volume of a solid generated by a revolution around this axis?

   (a) $ra\sin\theta/2$

   (b) $\pi r^2 a/2$

   (c) $\pi r^2 a\sin\theta/3$

   (d) $\pi r^3 a\cos\theta/3$



8. An object moves 8 cm in a straight line from point A to point B, turns at angle α (measured in radians and chosen at random from the interval $(0, \pi)$), and moves 5 cm in a straight line to point C. What is the probability that AC < 7?

   Hint: Use the law of cosines, which says that for a triangle with sides of length a, b, and c, there is the relationship $c^2 = a^2 + b^2 - 2ab\cos\theta$ where θ is the angle between the sides of length a and b.

   (a) 1/6

   (b) 1/5

   (c) 1/3

   (d) 1/2

9. The number of x-intercepts on the graph of $y = \sin(1/x)$ in the interval $(0.0001, 0.001)$ is closest to:

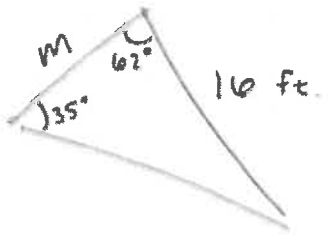
   (a) 2900
   (b) 3000
   (c) 3100
   (d) 3300

10. How many different handshakes occur between the members of a group of 9 people if everyone shakes everyone else's hand exactly once?

    (a) 72
    (b) 9!
    (c) 81
    (d) 36

11. Farmer John is constructing an irregularly shaped pen for his livestock and needs to know the length of the perimeter to buy the rope. Imaged is his sketch of what measurements he's taken thus far. What is the length of side m (in feet)?

    (a) 27.7
    (b) 0.1
    (c) 2.4
    (d) 20.4



12. Which answer is equivalent to $\tan^2\sigma \dfrac{1}{1-\cos^2\sigma}$?

    (a) $\dfrac{1}{\sin^2\sigma}$
    (b) $\dfrac{1}{1+\sin^2\sigma}$
    (c) $\dfrac{1}{1-\sin^2\sigma}$
    (d) $\dfrac{1}{1+\cos^2\sigma}$

13. Approximate the following number: $\dfrac{(9.8)^{42}(0.246)}{(0.662)^{-3}(20-10.2)^{7}} = ?$

(a) $\frac{27}{32}10^{6}$

(b) $\frac{27}{32}10^{35}$

(c) $\frac{2}{27}10^{6}$

(d) $\frac{2}{27}10^{35}$

14. At high noon, a fly is flying 7 feet off the ground, and a frog is sitting 12 inches away from the fly's shadow. The frog can jump 5.5 feet in the air. How long does the frog's tongue have to be to reach the fly?

(a) $6\sqrt{13}$ inches

(b) $6\sqrt{15}$ inches

(c) $5\sqrt{13}$ inches

(d) $5\sqrt{15}$ inches

15. Which of the following is ruled out as being a root of $15x^3 - 10x + 24$ by the Rational Roots Theorem?

(a) $\frac{8}{3}$

(b) 4

(c) $\frac{4}{5}$

(d) $\frac{1}{2}$