For all questions, answer choice (E) NOTA means that none of the given answers is correct. Good Luck!

1. If he is the better Tanmay, then his last name is Natani. Assuming the previous sentence is true, which of the following statements is also logically true?

   (A) If his last name is not Natani, then he is not the better Tanmay.
   (B) If he is not the better Tanmay, then his last name is not Natani.
   (C) If his last name is Natani, then he is the better Tanmay.
   (D) If his last name is not Natani, he is the better Tanmay.
   (E) NOTA

2. Anish's head is a polyhedron with 76 faces and 98 vertices. How many edges does Anish's head have?

   (A) 174 (B) 22 (C) 172 (D) 87 (E) NOTA

3. Haldiya and Natani, brothers from different mothers, have an odd obsession with circles. The external tangent between Natani and Haldiya's circles is 5 meters long. If Natani's circle has a radius of 9 and Haldiya's circle has a radius of 4, what is the distance between the centers of the two circles?

   (A) $5\sqrt{2}$ (B) $7\sqrt{3}$ (C) 5 (D) $5\sqrt{3}$ (E) NOTA

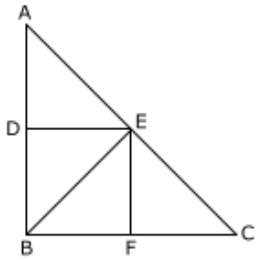
4. Natani has realized that his counterpart twin Haldiya has an oddly shaped tail, which is comprised of a right square pyramid on top of a sphere. If the square pyramid has a height of 4 inches and a base of 8 inches, which is also the diameter of the sphere, what is the volume of Haldiya's tail?

   (A) $\frac{1024\pi + 256}{3}$ (B) $\frac{256\pi + 256}{3}$ (C) $\frac{128}{3}$ (D) $\frac{128\pi + 274}{3}$ (E) NOTA

5. Himank and Johnathan are similar polyhedrons. If Himank has a surface area of 9 and a volume of 27 and Johnathan has a volume of 1728, what is the surface area of Johnathan.

   (A) 144 (B) 3 (C) 12 (D) 14 (E) NOTA

6. $DEFB$ is a square with points D and F on lines AB and BC, respectively. BE forms a right angle with line AC. If CE has a length of 1, what is the area of triangle ABC.



   (A) 2 (B) 4 (C) $\sqrt{2}$ (D) 1 (E) NOTA

7. While eating, Daniel dropped his circular plate when someone mentioned iKON, his favorite idol group. As he put the plate back together, he noticed a crack in the shape of a straight line running through the circle. If Daniel's plate has a diameter 34 inches and the crack can be considered as a chord with length 30 inches, how far is the crack from the center of the plate in inches?

   (A) 2 (B) 4 (C) 8 (D) 16 (E) NOTA

8. Three distinct points create which of the following undefined terms?

   (A) Plane (B) Line (C) Triangle (D) Point (E) NOTA

9. Haasini really likes to draw shapes within each other. Today she drew an equilateral triangle inscribed in a circle circumscribed by a regular quadrilateral. If the regular quadrilateral has a semiperimeter of 8, what is the area of the equilateral triangle?

(A) 6 (B) $6\sqrt{6}$ (C) $6\sqrt{2}$ (D) $6\sqrt{3}$ (E) NOTA

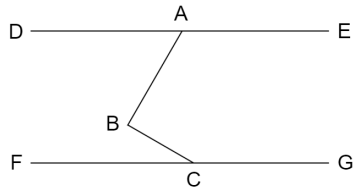
10. Vibav wore a costume in the shape of a cone for Halloween last year. The costume has a height of 4 inches and a radius of 2 inches. If the top half cone was removed (and the height is halved), what would be the volume of the remaining frustum?

(A) $\frac{8\pi}{3}$ (B) $\frac{14\pi}{3}$ (C) $\frac{7\pi}{6}$ (D) $\frac{2\pi}{3}$ (E) NOTA

11. Tashigi creates an isosceles triangle with side lengths of 5, 5, and 8. Each side is rotated 180° about its midpoint. What is the area of the new shape?

(A) 10 (B) 16 (C) 12 (D) 20 (E) NOTA

12. If $\angle ABC = 80°$ and $\angle BCF = 20°$, what is the measure of $\angle DAB$?



(A) 60° (B) 50° (C) 40° (D) 70° (E) NOTA

13. Sagar accidentally tied his pet horse Morb so that he was stuck outside of his stable! The stable is a regular octagon $ABCDEFGH$ with a side length of 6 feet. Morb is tied to point A with a 10-foot long rope and the stable is closed, meaning that Morb can only roam outside the stable. Find the total area that Morb is able to roam around in (assume Morb has no area).

(A) 100π (B) $\frac{53\pi}{2}$ (C) $\frac{133\pi}{2}$ (D) $\frac{133\pi}{4}$ (E) NOTA

14. In an alternate reality on the planet Aerth, Viswa has decided to pursue his passion of gambling and took a journey from Tallahville to Las Vegas (every alternate reality has a Las Vegas). If the angle created from Tallahville, the center of the Aerth, and Las Vegas is 30°, and the arc distance from Tallahville to Las Vegas is 300 miles, find the volume of Aerth in cubic miles (assume that it has a perfectly spherical shape).

(A) $\frac{5760000}{\pi}$ (B) $\frac{3240000}{\pi}$ (C) $\frac{7776000000}{\pi^2}$ (D) $\frac{1728000000}{\pi^2}$ (E) NOTA

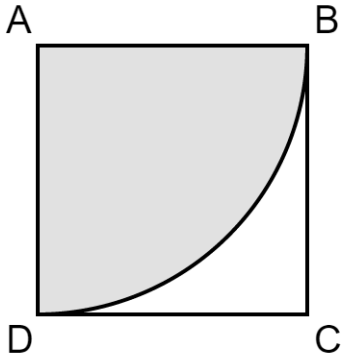
15. Regular pentagon $ABCJK$ with side length 1 is located on the top of regular octagon $JCDEFGHI$. Find the area of triangle BCD, given that $\sin(117°)$ is approximately 0.9.

(A) 0.45 (B) 0.50 (C) 0.25 (D) 0.15 (E) NOTA

16. Suhas is known worldwide as one of the best professional Valorant players. His gaming computer is in the shape of a cone with a height of 12 and radius 5. What is the volume of the largest sphere that can fit inside Suhas' gaming computer?

(A) $\frac{4000\pi}{81}$ (B) $\frac{500\pi}{3}$ (C) $\frac{9\pi}{125}$ (D) $\frac{4000\pi}{3}$ (E) NOTA

17. While scurrying around looking for cheese, Terry the rat had found himself stuck in a square. This square, $ABCD$, had a quarter arc centered at A going through B and D. If AB has a length of 1, Find the area of the largest triangle that can be made inside square $ABCD$ but outside of the gray area.



(A) $6-4\sqrt{2}$ (B) $\frac{\sqrt{2}}{2}$ (C) $3-2\sqrt{2}$ (D) $2\sqrt{3}-3$ (E) NOTA

18. Find the area of the region in Quadrant I bounded by $y=0$, $x=0$, and $\left(x+\sqrt{2}\right)^2+y^2=4$.

(A) $\frac{\pi}{2}$ (B) $\frac{\pi}{2}-2$ (C) $\frac{3\pi}{2}+1$ (D) $\frac{\pi}{4}$ (E) NOTA

19. Consider an equilateral triangle ABC with side length 5. Let line l go through point A such that it is parallel to side BC. If there exists a point D on line l such that $\angle ABD$ is a right angle, find the length of DC.

(A) $5\sqrt{5}$ (B) $\frac{5\sqrt{10}}{2}$ (C) $\frac{10\sqrt{3}}{3}$ (D) $5\sqrt{7}$ (E) NOTA

20. A right triangle ABC with hypotenuse AB has an altitude drawn from C to AB that intersects AB at point D. If AD has a length of 3 and DB has a length of 12, what is the area of triangle ABC?

(A) 45 (B) $15\sqrt{15}$ (C) 90 (D) 30 (E) NOTA

21. Vaneesha is trying to draw a 15-75-90 triangle. She wants it to be as accurate as possible, so she is using trigonometric ratios. She knows that $\sin(15^\circ)$ is $\frac{\sqrt{6}-\sqrt{2}}{4}$, but she doesn't know $\cos(15^\circ)$. Help Vaneesha by finding $\cos(15^\circ)$.

(A) $\frac{\sqrt{6}+\sqrt{3}}{4}$ (B) $\frac{\sqrt{6}-\sqrt{3}}{4}$ (C) $\frac{\sqrt{6}+\sqrt{2}}{4}$ (D) $\frac{\sqrt{3}+\sqrt{2}}{4}$ (E) NOTA

22. Circle O has distinct points A, B, C, and D, in clockwise order. When extended, lines AB and CD intersect at point E, with $AE > BE$ and $DE > CE$. If $AB = 4$, $CD = 7$, and $DE = 12$, find BE.

(A) 11 (B) $\frac{35}{4}$ (C) 8 (D) 6 (E) NOTA

23. Using the circle and points from the previous question, if $\overset{\frown}{AD}= 170^\circ$ and $\overset{\frown}{BC}= 100^\circ$, find $\angle AED$.

(A) 140° (B) 70° (C) 50° (D) 35° (E) NOTA

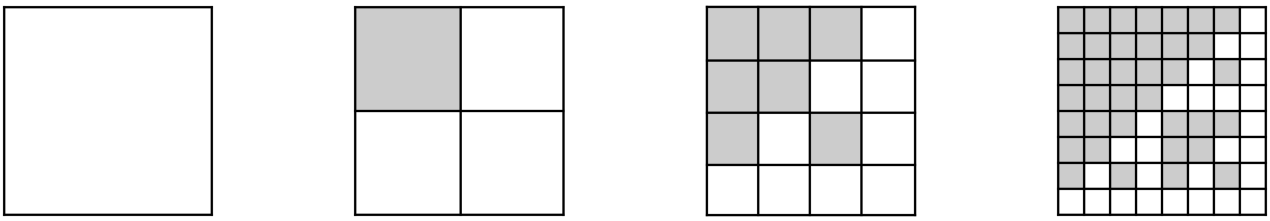
24. At Rickards High School, the speed at which Tanmay travels when someone mentions food is widely known. However, he can only travel in the direction of the line $3x+4y=8$. Anish, who also likes food, travels in a line whose slope, when multiplied by the slope of Tanmay's line, equals -1. What is the slope of Anish's line travels?

(A) $\frac{4}{3}$ (B) $\frac{4}{5}$ (C) $\frac{3}{4}$ (D) $-\frac{3}{4}$ (E) NOTA

25. Mr. Morale prefers corrections on past test papers in the shape of a regular polygon with an exterior angle of $20°$. How many sides does this polygon have?

(A) 18 (B) 19 (C) 20 (D) 16 (E) NOTA

26. Assuming the pattern continues, what fraction of the whole figure will be shaded at step infinity?



Step 1 Step 2 Step 3 Step 4

(A) $\frac{3}{4}$ (B) 1 (C) $\frac{7}{8}$ (D) $\frac{15}{16}$ (E) NOTA

27. The line $3x + 4y = 16$ intersects a circle at $(-4, 7)$ and another point (x, y). If the circle has a radius of 5, what is the sum of the coordinates of the other point of intersection given that the circle intersects the y-axis at $(0, 9)$ and $(0, -1)$?

(A) -4 (B) 5 (C) 8 (D) 3 (E) NOTA

28. Vibav is known across nations as the only man who can eat the most nutella sandwiches in 1 minute. To calculate the number of sandwiches he can eat, find the numerical value of the supplement of the complement of the complement of the complement of the complement of the complement of $10°$.

(A) $100°$ (B) $10°$ (C) $80°$ (D) $10°$ (E) NOTA

29. Sukeerth ate up all the cookies in the cookie jar! While eating the cookies, he noticed that each cookie was a square with a side length of 8 inches and had two chocolate chips on top, each in the shape of a square with a length of 2 inches. One chocolate chip must remain touching the border of the cookie, both of the chocolate chips must remain within the border of the cookie, and the chocolate chips can overlap. If, under these conditions, the chocolate chips are randomly placed on the cookie, what is the probability that the chocolate chips do not overlap?

(A) $\frac{13}{18}$ (B) $\frac{22}{27}$ (C) $\frac{51}{63}$ (D) $\frac{71}{90}$ (E) NOTA

30. How many sides does an octagon have?

(A) 5 (B) 8 (C) 1 (D) 30 (E) NOTA