Good Luck! :)

1. Ningguang's regular attacks create 3 stones that hover behind her back. The stones are arranged in the shape of an equilateral triangle, with each angular bisector of the triangle having a length of 6 units. What is the numeric value of the area of the triangular formation formed by the hovering gems plus its perimeter?

   A. $24\sqrt{3}$ B. $12\sqrt{3}$ C. $9\sqrt{3}$ D. $18+9\sqrt{3}$ E. NOTA

2. Find the volume of the figure formed if the figure from the previous question was rotated about one of its sides.

   A. $64\pi\sqrt{3}$ B. $72\pi\sqrt{3}$ C. $48\pi\sqrt{3}$ D. $24\pi\sqrt{3}$ E. NOTA

3. If Hinata uses the Byakugan while fighting alone, her field of vision is a hemisphere above the ground with a radius of 3.7km. Let A be the volume of said hemisphere. However, when Hinata is fighting with Naruto, her field of vision has volume B, which is 1/3 of what it is when she fights alone. Find A/B.

   A. $\frac{1}{3}$ B. 50.653 C. 67.5373 D. 3 E. NOTA

4. Zhongli's stone obelisk takes 6 seconds to summon. The obelisk materializes as a rectangular prism at a constant rate, from the ground up. When completely summoned, it has a square base with a side length of x and a height of 8. The only dimension that changes as the obelisk is summoned is the height, and the volume of the obelisk 3.25 seconds after Zhongli begins summoning it is 39. Find x.

   A. 2 B. 3 C. 9 D. 12 E. NOTA

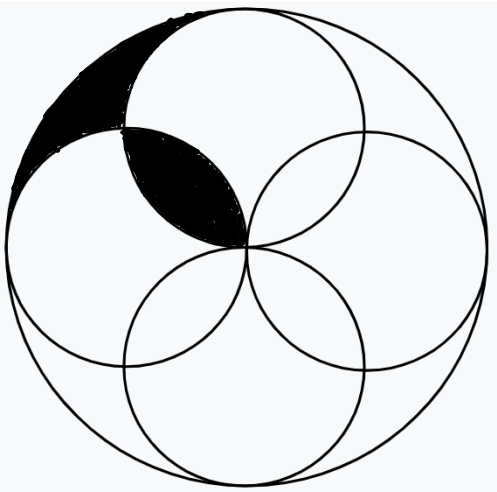
5. All Regisvines have a circular attack, in which they form a circle P with center O. McKayla and Will are fighting a Pyro Regisvine. To avoid its circular attack, Will stands at point W and McKayla stands at point M. WM is tangent to circle P, and has a length of 8. Another tangent line is drawn from point W to a point A on the circle, and $\angle AWM$ is 60 degrees. If $OW = OM$, and WA is extended to point B such that WBM forms a triangle with circle P inscribed in WBM, find the area of the region inside the triangle but outside the circle.

   A. $64\sqrt{3}-\frac{64\pi}{3}$ B. $-16\sqrt{3}+\frac{16\pi}{3}$

   C. $16\sqrt{3}-\frac{16\pi}{3}$ D. Not enough information E. NOTA

6. Miyamura Izumi is standing on vertex H of a cube with side length 11. If he can only move along space and face diagonals, what is the shortest distance he must travel to reach Hori Kyouko Hori, who is standing on vertex I of the same cube. H and I are adjacent vertices.

A. 11 B. $121\sqrt{3}$
C. $11\pi - 11\sqrt{2}$ D. $363 + 11\sqrt{2}$ E. NOTA

7. 

Albedo's Solar Isotoma is in the shape of the picture to the Left, which displays 5 circles. The largest circle has a radius of 2. Each of the smaller circles has radius 1 and passes through the center of the largest circle. It is also known that if you rotate the picture by a multiple of 90 degrees, the picture does not change. Find the area of the region shaded in black. Picture is not drawn to scale; it only serves as a reference.

A. $\pi - 1$ B. $\pi - 2$
C. $\frac{3\pi}{2} - 3$ D. $\frac{\pi}{2} - 1$ E. NOTA

8. Kamado Tanjiro is falling and executes his Second Form: Water Wheel to break his fall. The radius of the water wheel is 20 feet. The water wheel's center forms at point P, 200 feet above point G on the ground, and he falls straight down. The area of the shape that is covered by his water wheel is $a + b\pi$ where a, b are rational. Find $a + b$. (He stops falling when the bottom of his water wheel hits the ground.)

A. 7200 B. 7600 C. 8000 D. 8400 E. NOTA

9. When Tanjiro uses his Seventh Form: Drop Ripple Thrust, it forms 3 concentric circles, and any radius of the largest circle is trisected by the two smaller circles. What is the ratio of the area of the smallest circle to the area of the largest circle?

A. $\frac{1}{9}$ B. 36 C. $\frac{1}{8}$ D. $\frac{1}{3}$ E. NOTA

10. Aether receives a trophy from Jean. It contains a kite ABCD, with $AC = AB, CD = BD$, $\angle D = 90^o, \angle A = 60^o$, and the kite has a short diagonal with length 4. When Paimon flicks one side of the kite, ABDC rotates 360 degrees around AD. What is the volume of the figure formed when the kite is flicked?

A. $\frac{8\pi+8\pi\sqrt{3}}{3}$ B. $\frac{4\pi+4\pi\sqrt{3}}{3}$ C. $\frac{32\pi}{3}$ D. $4 + 4\pi\sqrt{3}$ E. NOTA

11. What is the name of the figure formed when a circle centered at (8, 8) with a radius of 2 is rotated about the y axis?

A. Icosahedron B. Sphere C. Torus D. Arc Spiral E. NOTA

12. A circular target with radius 6 has a regular hexagon ABCDEF inscribed in it. Ganyu is equally likely to hit any point within the circular target. She would like to hit one the regions enclosed by arc AB and chord AB, arc CD and chord CD, or arc EF and chord EF. If she hits the target, what is the probability that she hits one of the desired regions?

A. $\frac{\sqrt{3}}{4}$ B. $\frac{1}{2} - \frac{3\sqrt{3}}{4}$ C. $\frac{\pi}{2} - \sqrt{3}$ D. $18\pi - 27\sqrt{3}$ E. NOTA

13. Angie is at a SKZ concert and is walking around, looking for a good spot to stare at Hyunjin. Coincidentally, the path she walks in forms a 45-45-90 right triangle with a square inscribed in it such that one of the sides of the square lies along the hypotenuse of the triangle. What is the ratio of the area of the square to the area of the triangle?

A. 1 B. $\frac{4}{9}$ C. $\frac{1}{4}$ D. 4 E. NOTA

14. What is the area remaining of a regular hexagon with a side length of 4 when equilateral triangles of side length 1 are cut out of the centers of the equilateral triangles that are formed when each vertex is connected to the center of the hexagon?

A. $\frac{51\sqrt{3}}{2}$ B. $\frac{45\sqrt{3}}{2}$ C. $\frac{15\sqrt{3}}{4}$ D. $48\sqrt{3}$ E. NOTA

15. A right triangle ABC, with right angle at A, has a line drawn through A to a point D on BC. $\angle ABC$ and $\angle ADB$ are both 60 degrees. E is the midpoint of BC, and ED is x. If $AB = 1$, find x.

A. 0 B. $\frac{3}{2}$ C. $\sqrt{2}-1$ D. $\frac{\sqrt{3}}{2}$ E. NOTA

16. A regular dodecagon is formed by the numbers (hour signs) of the clock. A mega-clock shows 0-23 o'clock instead of 1-12 o'clock. These 24 numbers are also equally spaced out in the clock's perimeter. A regular icositetragon (polygon with 24 sides) is created by the numbers (hour signs) of this clock. If both clocks have radius 1, what is the ratio of the area of the dodecagon to the area of the icositetragon?

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

17. The Raiden Shogun has a ceremonial room in the shape of a square ABCD with a side length of 10 ft. There is also a fence of length 100 ft running along ray BA. Razor is tied to vertex A with a rope of length 40 ft. What is the total area Razor can move in?

A. 750π B. 800π C. 1125π D. 1150π E. NOTA

18. The outside of a cube with dimensions 4 cm × 4 cm × 4 cm is entirely colored black. Then, it is disassembled into smaller, 1 cm × 1 cm × 1 cm cubes. Each of the unpainted faces are painted red. Which color has more surface area, when the cube is disassembled, and by how much?

A. Black, 96 cm^2 B. Red, 288 cm^2
C. Red, 228 cm^2 D. Black, 384 cm^2 E. NOTA

19. In triangle ABC with side lengths 5,6,7, medians AD, BE, and CF are drawn such that they meet at point M. What is the ratio of the area of quadrilateral AEMF to the area of the figure ECBFM?

A. $\frac{2}{3}$ B. $\frac{1}{3}$ C. $\frac{3}{4}$ D. $\frac{1}{2}$ E. NOTA

20. What is the area of a pentagon that has vertices on the points $(1,2)$, $(6,5)$, $(-4,8)$, $(-5,4)$ and $(3,7)$?

A. $\frac{41}{2}$ B. 41 C. 82 D. 83 E. NOTA

21. What is the sum of the four smallest areas of right triangles in which all three sides have integral lengths?

A. 114 B. 120 C. 180 D. 300 E. NOTA

22. A 240 degree sector is cut out of a circular piece of paper with radius 12, and a cone is formed by gluing the radii along where the cuts were made. The cone is put in a cylinder with the same radius and height as the cone. What is the volume of the region outside the cone and inside the cylinder?

A. 96π B. $\frac{256\pi\sqrt{5}}{3}$ C. $\frac{512\pi\sqrt{5}}{3}$ D. $\frac{512\pi\sqrt{3}}{5}$ E. NOTA

23. Jogo uses his Domain Expansion: Coffin of the Iron Mountain, which forms a cone. To counter this, Satoru Gojo uses Domain Expansion: Infinite Void. This causes the cone to be circumscribed by a sphere with the base of the cone lying on the great circle of the sphere. The sphere has a surface area of 1156π. Find the volume of the cone.

A. $\frac{39304\pi}{3}$ B. $\frac{289\pi}{2}$ C. $\frac{4913\pi}{3}$ D. $\frac{2024\pi}{3}$ E. NOTA

24. A store has infinite diamonds, all in the shape of regular tetrahedrons. There is only one piece of the largest diamond, and only two pieces of every other size of diamond. The largest diamond has a side length of 6, and each subsequent size of diamond has 1/3 of the volume of the next largest diamond. Find the sum of the volumes of all the diamonds.

A. $36\sqrt{2}$ B. $27\sqrt{2}$ C. $54\sqrt{2}$ D. $72\sqrt{2}$ E. NOTA

25. The apothem of a regular hexagon has a length of $\frac{7\sqrt{3}}{2}$. What is the area of the hexagon?

A. $\frac{1323\sqrt{3}}{2}$ B. $\frac{441\sqrt{3}}{8}$ C. $\frac{147\sqrt{3}}{2}$ D. $\frac{441\sqrt{3}}{2}$ E. NOTA

26. Consider an elliptical prism to be a prism with bases being 2 congruent, parallel ellipses. In the xy plane, the equation of one base of the ellipse is $4x^2 + 6y^2 + 8x - 36y = -10$. The center of the other base is $(-1,3,-5)$. What is the volume of the figure?

A. $20\pi\sqrt{6}$ B. $\frac{20\pi\sqrt{6}}{3}$ C. $\frac{\pi\sqrt{6}}{2}$ D. $\frac{10\pi}{3}$ E. NOTA

27. Two congruent, intersecting circles are drawn such that radii drawn from either circle to both points of intersection forms a 120° sector. In the overlap between both circles, a rhombus can be inscribed such that the longer diagonal connects the points of intersection of the circles. What is the area inside the overlap but outside the rhombus if the radius of both circles is 6?

A. $6\pi - 9\sqrt{3}$ B. 12π
C. $27\pi - 12\sqrt{3}$ D. $24\pi - 36\sqrt{3}$ E. NOTA

28. A circle O has chords AB and CD such that AB and CD do not intersect inside the circle. Extending AB past B and CD past D allows them to intersect at a point P outside the circle. The measure of minor arc AB is 20 degrees, and the measure of minor arc CD is 10 degrees. Angle APD is 57 degrees. Find the measure of the major arc AC.

A. $\frac{387^\circ}{2}$ B. $\frac{447^\circ}{2}$ C. 252° D. 222° E. NOTA

29. Mona's hat is in the shape of a cone. A plane parallel to the base cut it into two pieces, forming a frustrum and a smaller cone. The radius of the smaller cone that is formed is 2. If the radius of the hat is 4, and the slant height is 5, what is the height of the frustrum?

A. $\frac{5}{2}$ B. $\frac{3}{2}$ C. 2 D. $\sqrt{2}$ E. NOTA

30. Zhongli uses his Planet Befall skill, summoning a meteor in the shape of a sphere. The volume of the meteor is $\frac{500000\pi}{3}$. What is the surface area of the meteor?

A. 10000π B. 5000π C. 2500π D. 500000π E. NOTA