**1. (A)** The area of a circle can be found by the formula So the area of a circle with radius 3 inches is . To find the number of coins, divide 5 dollars by 25 cents to get 20 coins. So the total area of his coins is .

**2. (B)** The volume per cent of the 25-cent coins is , while that of the 10-cent coins is , which is greater, so we need as many 10-cent coins as possible. This means that there will be 32 10-cent coins and 1 25-cent coin, so the total volume is

**3. (C)** If the diameter is 6 feet, the radius must be 3 feet. Using Area = , the horizontal cross sectional of one column is 9π ft2. 46 x 9π = **414π ft2**

**4. (D)** Connect the center of the both circles to one endpoint of the chord. Also connect the center of the circles to the tangent point to the smaller circle. This makes a right triangle with hypotenuse 5 and one side 3. The other side is 4 which is half the length of the spoke so the spoke is **8 units**

**5. (D)** First we convert 3 feet into inches by using the conversion 1 ft = 12 in. So 3ft is 36 in. The outer radius of the globe is 36 in, while the inner radius is 3 in. Subtracting volume using the inner radius from volume using the outer radius will give us the volume of material used to construct the globe. Using the formula , we get 62208π - 47916π = **14292π** in**3**

**6. (C)** Using our answer from the previous question,

To convert to tons, we simply divide by 2000 to get 5.3595 tons, which rounds to **5 tons**

**7. (B)** The squared ratio of the sides of two similar triangles is equal to the ratio of the areas. The small triangle has a base of length 5 cm to the entire harp’s of 20.

Call the area of the harp 400 cm squared, so the area between the vertex and the small string is 25 cm squared. The area of the bottom trapezoid = area of harp – area of triangle with base 13. Area of harp = 400. Using the ratio of areas again means the area of the triangle with base 13 is 169. 400 – 169 = 231. So the final ratio of areas is **.**

**8. (D)** If 800 km is 7/360 of the earth’s circumference, the circumference is = 41143 km which rounds to **41000km**.

**9. (E)** The cube ratio of the sides of two similar tetrahedrons is the ratio of the volumes. .. So the small tetrahedron has side length **7 units.**

**10. (B)** Between each night, he moves up 500 feet. On the 17th day, he reaches 9000 ft and slides down to 8500 ft. On the **18th day**, he climbs to 9500 ft and reaches the summit.

**11.** **(A)** This is the definition of the contrapositive. You negate the converse statement.

**12. (A)** The sheep can roam three-quarters of a circle with radius 35 yards, which has area yards squared. It can also roam a quarter of a circle with radius 15 yards when the rope is against the side with length 20 yards and a quarter circle with radius 5 yards when the rope is against the side with length 30 yards. These two together have area . Adding these two areas together gives an answer of yards squared.

**13.** **(C)** Let half of angle B = b and half of angle C = c.  **degrees**.

**14.** **(D)** Using Stewart’s Theorem (, where is the base, and are the sides, and are the segments of the base [with opposite and opposite ], and is the segment connecting the upper vertex to the base), we get

**15. (C)**

Since the pizza has a 16-inch diameter and therefore an area of , the area of the pizza that they eat approaches .

**16. (D)** From the Pythagorean theorem, the sides of the triangle are 12, 35 and 37. The larger angle will be opposite of the larger side. So the sine is .

**17. (B)** Call the radius of Brighten’s cylinder 1 and the height 1. The volume of Brighten’s map is . Filippo’s map then has volume of . Simplifying gives **Filippo has a larger volume by 8%**

**18. (D)** Using triangle inequality, the last side integer length is larger than 1 and less than 21. There are **19** such numbers.

**19. (A)** The reciprocals of altitudes have an inequality. The reciprocal of one height must be less than the sum of the reciprocal of the second height and the reciprocal of the third height. This means and . Solving these two inequalities means x can be any integer from 4 to 13. There are **10** such numbers.

**20.** **(A)** The formula gives the number of diagonals in a regular n-gon. Plugging in 5 gives **5 diagonals**.

**21.** **(D)** If the colosseum crumbles at a rate of 5 bricks every hour and there are 100,000 bricks, this would take hours, which is equal to  **minutes**

**22. (A)** The diameter of the arch is 14 feet, so the radius is 7 ft. if the apex of the arch is 23 feet off the ground, the height of the rectangle must be 23 - 7 = 16 ft. 16 x 14 + ½ π(7)2 = **224 + 49/2 π**

**23.** **(B)** We have to find the shortest distance from (6,4) to (-3,8) passing by the x-axis. All the possible routes go down from (6,4) to the x-axis and then go back up from the x-axis to (-3,8), and we need to find the shortest one of these routes. If we reflect (-3,8) over the x-axis, we get the point (-3,-8). Now all the paths from one point to another through the x-axis that we had before each become two segments that connect at the x-axis. Now we can see that the shortest one of these is the one that is a straight line, so the original problem simplifies to finding the linear distance between (6,4) and (-3,8). Using the distance formula, we get that the distance is

**24. (E)** If we take one section of the handrail and imagine that it goes around a cylinder, we can unroll the cylinder, and this creates a right triangle with the handrail as the hypotenuse. The height is since the handrail goes around 10 times, and the base of the triangle is meters long since the radius of the staircase is 2 meters. This means that the hypotenuse of the triangle is equal to meters. Since the handrail goes around 10 times, we multiply this answer by 10 to find that the total length of the handrail is  **meters**

**25.** **(C)** If the major axis has length 10, a = 5 and its given that c = 4. So b = 3. The length of the entire chord is 2b which is **6 units**.

**26.** **(B)** The innermost path has a length of 500 x 2 + 200π while the outermost path has a length of 500 x 2 + 250π. 1000 + 200(3) = 1600 ft, 1000 + 250(3) = 1750 ft. 1600/50 = 32s, 1750/50 = 35s. 35-32 = **3 seconds**

**27.** **(E)** Draw the altitudes down to the base from D and C. The creates two right triangles and a rectangle. The height of the right triangles gives the following equation from the Pythagorean theorem, if you let x equal the length from the foot of the altitude of C to B. Solving the equation gives x = 7. The longer diagonal is a right triangle with its base on the CD and altitude as the altitude of the trapezoid. Plugging 7 back in gives the altitude is . The longer diagonal has 13 as its base. Using Pythagorean once again gives the diagonal has length

**28.** **(A)** A general form of a monic quadratic is . Plugging in the points (1,5) and (2,2) gives and . Solving gives a = -6. From vieta’s formulas, the sum of the roots is –a = **6**.

**29. (B)** Using Surface Area of a hemisphere = 2πr2, we get an area of 3362π m2. The area of all the windows is 16 x 2 x 3 = 96 m2. So the total painted area is **82π – 96 m2**

**30. (D)** . Solving for x which is the side length of the equilateral triangles gives . The perimeter of the equilateral triangle is then and the perimeter of the hexagon is **36**