**Directions: Select the correct answer choice for each question and bubble it in the appropriate place on your Scantron. For all questions, “E) NOTA” means “None of These Answers.” Good Luck!**

1. In Greece, the shape of coins is a perfect circle with a radius of 3 inches. Filippo has exactly enough coins to buy an apple for 5 dollars. If each coin is worth 25 cents and if the coins are laid side by side, what is the total area of his coins that is visible in square inches?

**A. B. C. D. E. NOTA**

2. In addition to the 25-cent coins with radius 3 inches from the previous question, there are also coins that are perfectly circular with a radius of 2 inches and are worth 10 cents. All coins are a quarter of an inch thick. Anuj knows he has exactly $3.45 worth of coins in his pocket, but he doesn’t know how many of each coin he has. What is the maximum possible volume of the coins that he has in inches3?

**A. B. C. D. E. NOTA**

3. Alex Y. was bored and started counting all the columns in the Parthenon, the largest temple in Athens, Greece! He counted 46 total outer columns. If each column has a diameter of 6 feet, what is the total horizontal cross-sectional area of all outer columns in the Parthenon?

**A.** ft2 **B.** ft2 **C.**  ft2 **D.** ft2 **E. NOTA**

4. The wheels on a merchant's cart are two concentric circles with radius of 5 units and 3 units. A spoke is a chord of the larger circle and is tangent to the smaller circle. What is the length of the spoke?

**A. 3 units B. 4 units C. 6 units D. 8 units E. NOTA**

5. Nathan makes his way to the town square, where he sees a bronze statue of Atlas, the titan who holds up the sky. He is holding a globe that has a radius of 3 ft. If the globe is hollow, with a thickness of 3 in, what is the volume of bronze used to construct the globe?

**A.** in3 **B.** in3 **C.** in3 **D.** in3 **E. NOTA**

6. If bronze has a density of 0.25 pounds per cubic inch, what is the weight of the globe from the previous question to the nearest ton? (Use 3 for this question)

**A. 10719 tons B. 21 tons C. 5 tons D. 6 tons E. NOTA**

7. A street musician is playing the harp (which is in the shape of a triangle). The harp's two main strings are parallel to base of the harp. The two strings are 5 cm and 13 cm long while the base is 20 cm long. What is the ratio of the area between the vertex of the harp and the smaller string to the area between the base and the longer string?

**A. 5/80 B. 25/231 C. 25/169 D. 169/400 E. NOTA**

8. Sihala recalls the story of how Eratosthenes estimated the circumference of the earth (believed to be a perfect sphere). He found that 2 sticks, placed in 2 cities 800km apart, cast shadows of 7° difference. What did he calculate the circumference to be? Round to the nearest thousand. (Hint: that means that the cities are 7° apart on the circumference of the earth)

**A. 16 km B) 129,000 km C) 15,000 km D) 41,000 km E) NOTA**

9. Brighten sees a distant mountain in Greece that looks like a regular tetrahedron with a similar smaller tetrahedron cut off the top. He imagines that the larger tetrahedron has a side length of 10 miles and the mountain has a volume of the larger tetrahedron. In this imaginary scenario, what is the side length, in miles, of the smaller tetrahedron?

**A. 3 B. 4 C. 5 D. 6 E. NOTA**

10. David is trying to get to get to the top of Mount Olympus, which is 9,499 feet tall. He climbs 1000 feet a day, however, Poseidon hates him for littering on the beach and causes an earthquake each night that makes him slide down 500 feet. On which day does he reach the summit?

**A. 17th B. 18th C. 19th D. 20th E. NOTA**

11. To get a free ice cream, Kaitlyn needs to answer the question: What is the contrapositive of the statement, "If you know the contrapositive, then you know the answer?". If Kaitlyn desperately needs some ice cream, what answer should she give?

**A. "If you don't know the answer, then you don't know the contrapositive."**

**B. “If you don’t know the contrapositive, then you don’t know the answer.”**

**C. “If you know the answer, you know the contrapositive.”**

**D. “Just give me some ice cream!”**

**E. NOTA**

12. While walking through Athens, Chris notices a barn with a sheep tied to the outside corner of it. The barn is rectangular with dimensions 20 yards by 30 yards. The sheep is tied to the corner of the barn with a rope of length 35 yards. What is the area the sheep can roam in square yards?

**A. B. C. D. E. NOTA**

13. Bryan wants to walk from Greece to Rome. To navigate the way, he drops pins onto a map and connects them with lines. This weird method ends up creating a triangle shown below with angle bisectors drawn at B and C. What is the angle BIC, where I is the incenter of the triangle if angle A is 44 degrees?

**A. 79 degrees B. 100 degrees C. 112 degrees D. 120 degrees E. NOTA**

14. While Filippo and Brighten are walking around the Roman Forum, Filippo sees a rock that is in the shape of a triangle (shown below) with side lengths AB = 5 feet, AC = 4 feet, and BC = 7 feet. The rock has a crack which is represented by segment AD in the diagram below. If BD = 3 feet and the crack is straight, what is the length of the crack in feet?

A

C

B

3

D

**A. B. C. D. E. NOTA**

15. The group is hungry, so they stop to eat a pizza. Filippo, Bryan, Brighten, and Kaitlyn are eating the pizza. They take turns eating fractions of a perfectly circular 16-inch-diameter pizza, and the fractions they eat follow the pattern , , , , …, where the first person eats of the pizza, the second person eats of the pizza, and so on. If this process continues infinitely, what does the total area of the pizza they eat approach in inches2 assuming that each person can eat more than one slice?

**A. B. C.**  **D. E. NOTA**

16. Vera sees a mountain in the distance. From her point of view, it looks like a right triangle with hypotenuse on the ground. If the legs of the triangle have a length 12 and 35, what is the sine of the second largest angle in the triangle?

**A. B. C. D. E. NOTA**

17. Brighten has a map of Europe in his hands. When rolled up, it is a perfect cylinder. Filippo, always the competitor, brags that his map of China (which is also rolled up into a perfect cylinder) has a 20% larger radius but 25% less height. Who actually has the larger volume and what is the percentage difference?

**A. Brighten by 8% B. Filippo by 8% C. Brighten by 32.5%**

**D. Filippo by 32.5% E. NOTA**

18. Tired of so much walking, John stretches his arms out. They form two sides of a triangle. One of his arms has a length of 10 inches while the other has a length of 11 inches. What is the number of possible integral lengths for the side connecting the endpoints of his arms?

**A. 15 B. 16 C. 18 D. 19 E. NOTA**

19. Copycat Chris also stretches his arms out to form a triangle. He notices two of the altitudes of the triangle are 5 and 8. What is the number of possible integral lengths for the last height of the triangle?

**A. 10 B. 11 C. 12 D. 13 E. NOTA**

20. In the Colosseum, gladiators have regular pentagon-shaped shields. How many diagonals do the shields have?

**A. 5 B. 7 C. 10 D. 15 E. NOTA**

21. David wants to visit the Colosseum. He knows that it contains 100,000 bricks and that it is crumbling at a rate of 5 bricks every hour. He has to go before it is completely destroyed. How much time does David have to visit the colosseum?

**A. 120,000 minutes B. 50,000 minutes C. 500,000 minutes**

**D. 1,200,000 minutes E. NOTA**

22. Hayden notices that the colosseum’s arches are composed of a semicircle stacked directly on top of a rectangle. The rectangle is 14 feet wide, and the apex of the arch is 23 feet off the ground. What’s the area of one of the arches?

**A.** ft2 **B.** ft2 **C.** ft2**D.** ft2**E. NOTA**

23. Filippo is at the Vatican, which is located at point (6,4). He has to meet up with Brighten at St. Peter’s Basilica, which is at the point (-3,8). However, Filippo runs out of water, so he has to stop to drink from the Tiber River along the way. If the Tiber River runs along the x-axis, what is the shortest distance that he can travel to meet Brighten?

**A. 10 units B. 15 units C. 20 units D. 25 units E. NOTA**

24. Vera and Kaitlyn go to see Trajan’s Column. As they are walking to the top of the spiral staircase, they try to figure out the length of the handrail. The handrail rises 30 meters total and goes around 10 times in a perfect circle with radius 2 meters. What is the length of the handrail in meters?

**A. B. C. D. E. NOTA**

25. Brighten is staring at the sky. He notices a distant planet's orbit in the shape of an ellipse. He also sees a comet fly through the planet’s orbit forming a chord with the orbit. If the ellipse’s major axis has length 10 and the distance from the center to a focus is 4. The comet passes through the center of the ellipse and perpendicular to the major axis. What is the length of the chord that the comet makes?

**A. 3 B. 5 C. 6 D. 10 E. NOTA**

26. Alex H. and Alex Y. decide to determine who is the superior Alex through a chariot race. Both chariots travel at the same speed (50 ft/s). The path of the innermost chariot is composed of a 500 ft by 200 ft rectangle with two semicircles of diameter 200ft on the ends.The outermost lane is a 500 ft x 250 ft rectangle with two semicircles of diameter 250 ft on the ends. How much faster is one lap on the innermost lane than on the outermost lane? (use 3 for this question)

**A. 1.5 seconds B. 3 seconds C. 6 seconds D. 30 seconds E. NOTA**

27. The pedestal of a statue of a Roman man is in the shape of a trapezoid ABCD with sides AB parallel to CD. If AB has length 17, BC has length 17, CD has length 6, and DA has length 16. What is the square of the length of the longer diagonal in the trapezoid?

**A. 339 B. 367 C. 391 D. 408 E. NOTA**

28. A rock on a Roman catapult is launched through the air. Filippo calculates that the trajectory of the rock is in the shape of a parabola. The monic quadratic passes through the points (1,5) and (2,2). What is the sum of the roots of the parabola?

**A. 6 B. 9 C. 10 D. 16 E. NOTA**

29. While Bryan and Nathan are visiting St. Peter’s Basilica, they get bored and decide to calculate the inner surface area of the dome that has been painted. The dome in St. Peter’s Basilica has an inner radius of 41 meters. It contains 16 windows, which have dimensions of 2 m x 3 m. What is the inner painted surface area of the dome (minus the windows)? Assume the dome is a perfect hemisphere while windows are perfectly flat rectangles.

**A. m2 B. m2 C. m2 D. m2 E. NOTA**

30. Being a clumsy person, Kaitlyn tips over a piece of pottery and it shatters. One of the pieces of the pottery is in the shape of a regular hexagon with side length 6. If an equilateral triangle has the same area as the hexagon, what is the sum of the perimeters of the triangle and the hexagon?

**A. B. C. D. E. NOTA**