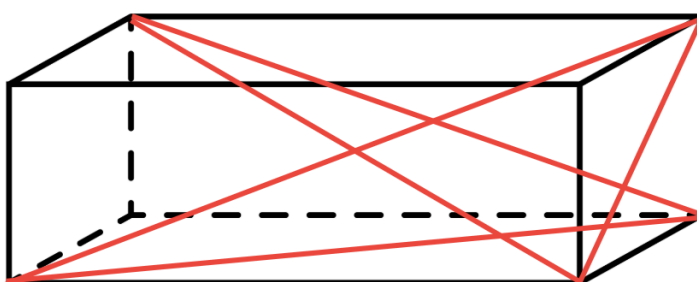


SJA MATHEMATICS CONTEST II

April 11, 2025

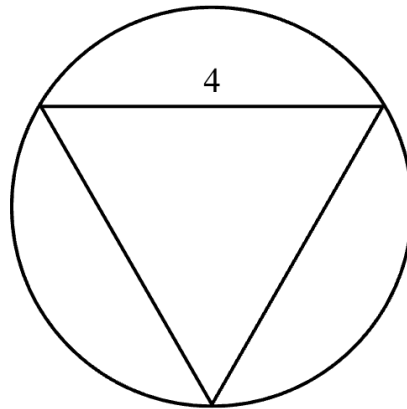
INTERMEDIATE TEAM ROUND

1. The given rectangular prism's length, width, and height are 4, 3, and 2, respectively. You are making a shape using five pieces of yarn. One piece of yarn is used to connect one vertex to another. What is the average length of the pieces of yarn used to create the following shape?

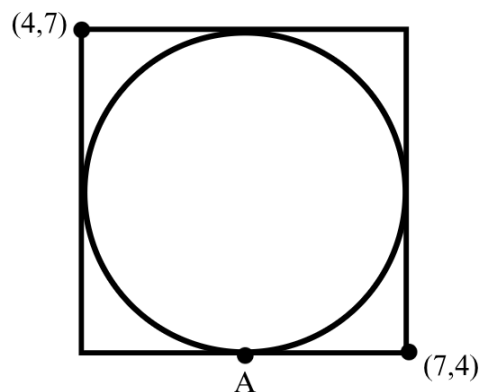


2. There are 8 Pokpo and 4 Shikmoolji students in a room. Hilly wants to choose 4 people randomly. The probability of choosing an equal number of Pokpo and Shikmoolji students is, in its simplest form, $\frac{a}{b}$. Find $a + b$.
3. Two trains are on the tracks. Each train is traveling at a constant speed of 75 km/h towards each other. Two trains are initially 300 km apart. A bird starts flying from the front of one train towards the other train at a constant speed of 100 km/h. Once the bird reaches a train, it turns around and flies back towards the first train. This back-and-forth motion continues until the trains collide. Assume that the bird maintains constant speed through its journey. In kilometer, what is the total distance flown by the bird?

4. The triangle below is an equilateral triangle that is inscribed in a circle. What is the area of the circle?



5. How many triangles can be formed by connecting vertices in a regular decagon?
6. A square with a circle inscribed is on a coordinate plane, as shown. The circle is rotated 810° by point A , resulting in three areas bounded by the shapes. Express the ratio of largest area and smallest area in $\frac{a}{\pi} - b$ format.



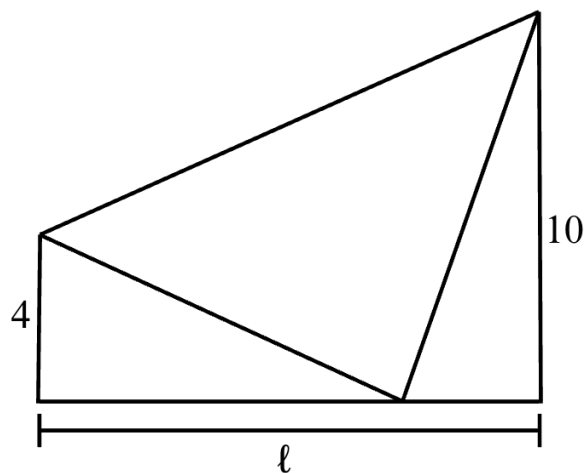
7. The polynomial $x^4 + ax^3 - 7x^2 - x + b$ is divisible by $(x - 2)$ and $(x + 1)$. Find $a + b$.

8. The Least Common Multiply of the two numbers is 840, and their Greatest Common Divisor is 14. If one of the numbers is 42, what is the other number?

9. What is the remainder when 2^{2025} is divided by 5?

10. Hilly could climb up a ramp at a speed of 2m/s and walk down the ramp at a speed of 5m/s. Her friend could walk up and down the ramp at a speed of 5m/s. The ramp has a base of 30 m and a height of 40 m. They both start at the very bottom of the ramp. If Hilly's friend starts 20 seconds after Hilly starts climbing up the ramp, how long, in seconds, will it take for both to meet each other again?

11. The triangle below is an equilateral triangle. What is the value of side L?

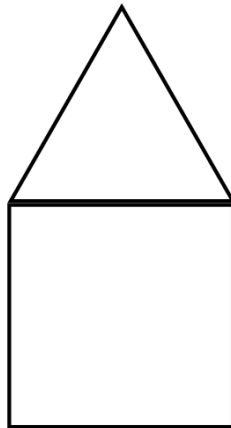


12. In how many ways can the set $\{a, a, a, b, b, b, b, b, c, c\}$ be arranged?

13. If $x = 2k$ ($k \neq 0$) is a solution to the quadratic equation $4x^2 + x - 2 = 0$. What is the value of $\frac{k-1}{k^2}$?

14. Let $f(x) = x^3 - 4x^2 + x + 6$. Find the sum of its greatest root and smallest root.

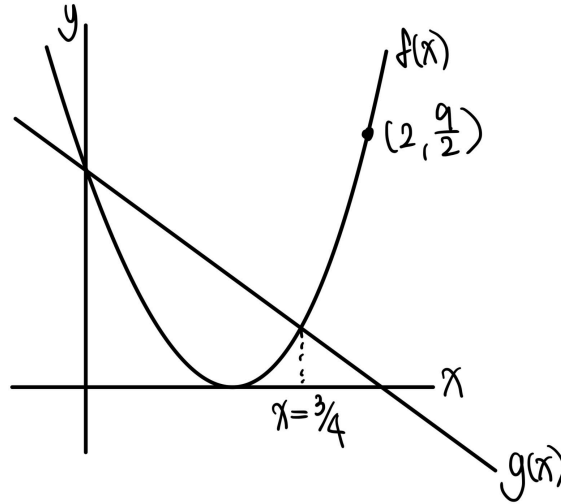
15. The figure is created with an equilateral triangle and a square. The distance between the centroid of the equilateral triangle and the vertex is 9. What is the area of the given figure?



16. Hilly is setting up a new password. His password must include at least one number from 1 to 5, at least one uppercase letter from A to D , and at least one lowercase letter from a to d . The length of his password should be between 3 to 5 characters. If each letter or number could be used only once, how many valid passwords could he create?

17. Two graphs intersect one another as shown in the figure below. Given

$f(x) = ax^2 + bx + \frac{1}{2}$ where a and b are both integers, find the leading coefficient of $g(x)$.



18. Number a is a factor of $10!$ and also is a perfect square. What is the sum of the digits of a ?

19. Line $y = -3x + 18$ forms a right triangle with the positive axes. If line $y = kx$ ($k > 0$) divides the area of the right triangle in half, find the value of k .

20. A factor of 320 is chosen randomly, what would be the probability that the factor is even?