DIRECTIONS: Please write your answers on the TEAM ANSWER SHEET provided. This part of the contest is 45 minutes. All 14 problems are counted equally. Calculators and other electronics MAY NOT be used.

1. Simplify to a single number:
   \[ \log_2(3) \log_3(4) \log_4(5) \log_5(6) \log_6(7) \log_7(8) \]
   Ans: 3

2. Calculate
   \[ \frac{1}{1} + \frac{1}{1+2} + \frac{1}{1+2+3} + \cdots \]
   Ans: 2

3. The parallel lines connect a vertex to a midpoint. What fraction of the total area is the shaded area?
   Ans: 1/3

4. I have 9 coins in my pocket: 3 nickels, 2 half dollars, 2 quarters, 2 pennies.
   If I randomly take 4 coins out what is the probability that I have 2 nickels?
   Ans: 5/14

5. List all numbers in \( \mathbb{Z}_{15} \) (integers mod 15) which have multiplicative inverses.
   Ans: 1,2,4,7,8,11,13,14

6. Find the smallest positive value x, in degrees, such that
   \[ \cos^2 x + \sin^2 x + \tan^2 x + \cot^2 x + \sec^2 x + \csc^2 x = 31. \]
   Ans: 15°

7. If the three cube roots of 1 are 1, w, and \( w^2 \) determine the value of
   \[ (1 + w - w^2)^3 + (1 - w + w^2)^3 \]
   as a single real number.
   Ans: -16

8. An isosceles right triangle is removed from each corner of a square piece of paper so that a rectangle remains. What is the length of a diagonal of the rectangle if the areas of all the cut off pieces is a total of 200?
   Ans: 20
9. Simplify \((-1 - \sqrt{3}i)^9\) 

Ans: 512

10. For what \(x\) is it true that 
\[\sqrt{x + 2\sqrt{x-1}} + \sqrt{x - 2\sqrt{x-1}} = 2\sqrt{x-1}\] 

Ans: all \(x \geq 1\)

11. Simplify to a single number: 
\[\frac{\sqrt{5} + 2\sqrt{13}}{\sqrt{5} - 2\sqrt{13}}\] 

Ans: 1

12. Find all ordered pairs of real numbers \((x, y)\) such that 
\[5^{xy}(x+y) = 1 \quad \text{and} \quad (x+y)^{xy} = 5\] 

Ans: (3, 2) and (-2/5, 3/5)

13. Suppose we have a cone formed in the following way: all points on the ellipse in the x-y plane whose equation is 
\[\frac{x^2}{25} + \frac{y^2}{81} = 1\] 
are connected by line segments to the point \((-5, 9, 7)\) 

What is the volume of this cone? 

Ans: \(105\pi\)

14. What is the shaded area below? 

Ans: 2/3