



# RAMC 2024

## Elementary II Invitational Round

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- **SCORING:** The questions in this round are all worth 1 point each, for a total of 10 points.
- This round contains 10 questions to be solved in 30 minutes. All answers are integers.
- No computational aids are permitted other than scratch paper, graph paper, and a pen/pencil. No calculators of any kind are allowed.
- Fill out your information, and sign/initial the honor code on the answer sheet provided.
- If you believe there is an error on the test, submit a challenge to the proctors. Please include your name, level (E1/E2/MS/HS), and your solution to the problem with explanation.

Do not flip the page until the proctor begins the round!

1. Define the  $\star$  operation by  $a\star b = 2^a - b$ . Evaluate  $(2\star 0)\star(2\star 4)$ .
2. Anika's bedroom wall is 8 feet wide and 6 feet tall. She buys paint buckets that each can cover 100 square inches of wall. What is the minimum number of buckets she has to buy in order to completely cover her wall?
3. Four numbers are written down in a row. The average of the first two numbers is 11, the average of the middle two numbers is 9, and the average of the last two numbers is 2024. What is the average of the first and last numbers?
4. Katherine and Michelle are running on a 6-mile circular track. Katherine can finish each lap in 36 minutes while Michelle can finish each lap in 180 minutes. Katherine and Michelle start at the same place. Michelle starts running in one direction, and Katherine starts running in the other direction half an hour later. How many minutes will Katherine have run when she and Michelle first run into each other?
5. Joey and Nicole are taking turns practicing tennis serves. Nicole keeps serving until she makes one in, and then Joey does the same. Nicole makes 40% of her serves in, while Joey makes 50% of his in. If they stop practicing after two serves make it in, what is the percent chance that exactly 3 serves are attempted?
6. Leo has an unlimited number of quarters, dimes, nickels, and pennies in his pocket. He sees a vending machine and wants to buy a \$1 soda. However, this vending machine is a little bit broken and will not accept more than 7 coins. How many ways can Leo pay for his soda?
7. Finn has a cylindrical cup with a volume of 144 cubic centimeters. Emma has a different cylindrical cup that is the same height as Finn's cup, but with a volume of 196 cubic centimeters. The ratio between the radii of Emma's cup and Finn's cup is  $\frac{m}{n}$ , a fraction in simplest form. Find  $m + n$ .
8. Colin is putting his cookies away into jars. First, he tries to put 12 cookies in each jar. This leaves 3 jars empty, but the rest are filled. He then tries to put 10 cookies in each jar, but he is left with 4 cookies too many. How many cookies does Colin have?
9. The midpoint of the four sides of a rectangle are  $(-5, 1)$ ,  $(1, 1)$ ,  $(6, -3)$ ,  $(0, -3)$ . What is the area of the rectangle?
10. Find the number of pairs of integers  $(x, y)$  that satisfy  $x^2 + y^2 < 81$ .