



# RAMC 2022

## Middle School Team Round

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- **SCORING:** The first 5 questions are worth 2 points each, and last 5 questions are worth 3 points each.
- This round contains 10 questions to be solved in 25 minutes. Problems towards the end tend to be more difficult than problems toward the beginning.
- No computational aids are permitted other than scratch paper, graph paper, and a pen/pencil. No calculators of any kind are allowed.
- All answers must be in a reasonably simplified form.
- 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 (Elem I/II, MS, HS), and explanation of the problem and your solution.

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

- Jake's Grocery Store has 20 identical aisles. Bob can finish cleaning the store's aisles in 1 hour by himself, and Tracy can finish in 2 hours by herself. If they both work in sync to clean 15 aisles, how many minutes does it take?
- Let the function  $f(x)$  reverse the order of the digits of  $x$ , and  $g(x) = x + 2^x + 3^x$ . Evaluate the function  $f(f(g(3)) + g(4))$ .
- Ana, Ben, and Catherine are running laps around the perimeter of the city's park, as shown in Diagram 1 (on the last page). In five hours, Ana can run 3 laps, Ben can run 4 and Catherine can run 5. When Damian runs for an hour, he runs an integer amount of units. He can run faster than Ana, but slower than Ben. In the time Catherine runs 6 laps, how many units will Damian run?
- How many positive factors does 65520 have?
- Let  $x$  be the shortest distance between Jolli's Bakery and Ralph's Hot Dogs, shown in Diagram 1 (on the last page), by walking only on the streets. Find the number of paths between the two points with distance  $x$ .
- A triangle  $\triangle ABC$  is circumscribed by a circle, with  $\overline{AB} = 6$  and  $\angle A = 120^\circ$ . Extend the angle bisector from  $A$  until it intersects the circle again at point  $D$ . If  $\overline{BD} = 14$ , what is  $\overline{AC}$ ?
- Michelle has a  $\frac{1}{4}$  chance of getting into each of 4 different programs and  $\frac{1}{3}$  chance of getting into each of 4 other programs. If getting into each program is independent to another, what are the chances that Michelle gets into at least 1 program?
- This following table shows 3 different phone plans that Felix can purchase.

	AB&C	Horizon	V-TabLet
membership fee and duration	\$20, paid monthly	\$70, paid quarterly	\$230, paid yearly
short distance per minute	\$0.75	\$0.50	\$0.60
long distance per minute	\$1.50	\$1.25	\$1.45

Felix needs to choose a phone plan, which he will use for 8 months. How many dollars will he save by using the cheapest plan over the most expensive plan, assuming he uses 4 hours of short distance calls and 3 hours of long distance calls?

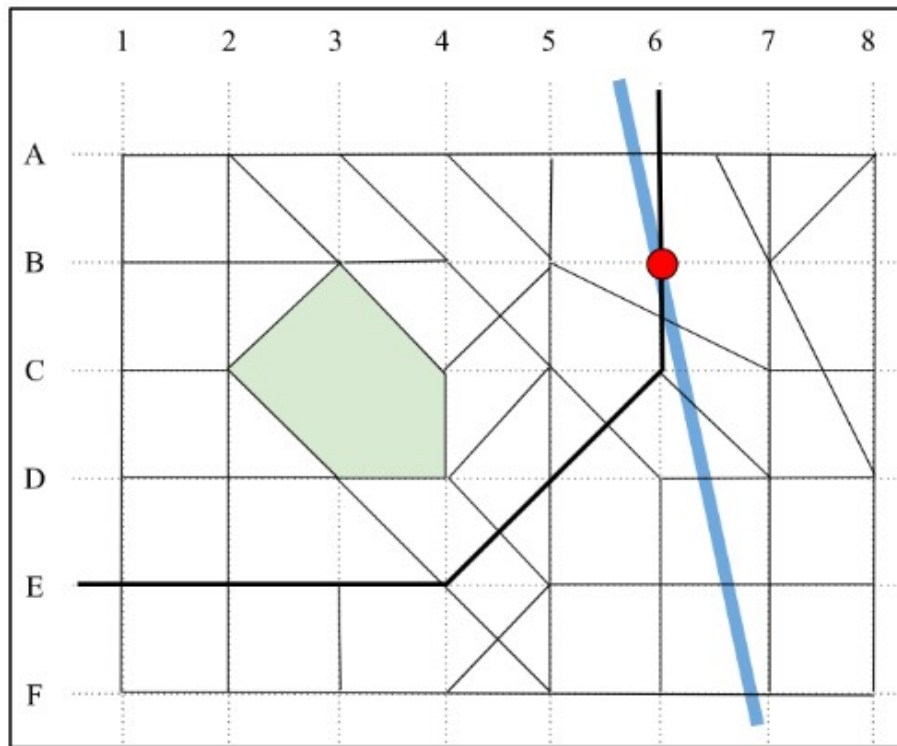
9. Ralph the raccoon is moving along a triangular frame, with points  $e_1, e_2$ , and  $e_3$  in clockwise order. Every step, Ralph moves 1 point to the left or right. When Ralph is at  $e_n$ , he has a  $\frac{1}{n+1}$  chance to move to the next point clockwise. Ralph will start at  $e_1$ . What is the probability that Ralph will get to  $e_3$  in 3 or less turns?

10. The grid shown in Diagram 1 (on the last page) directly translates to a Cartesian plane, with each grid vertex corresponding to a lattice point, and each grid unit is length 1. Let the straight flowing river flow through the red dot on B6. The Tracy High School on D2 represents  $(0, 19)$  on the Cartesian Plane. If the river has a slope of  $-\frac{21}{4}$ , find the number of non-negative Cartesian coordinate points strictly below the river.

Diagram 1.

RMCLand Map

Scale: 1 grid length = 1 unit



All **black** lines represent roads. Dotted lines are the grid lines. Green is the city park. The straight blue line is the river.

### City Directory

C8: Barbara's Barbeque and Grill  
 B7: Farmers Market  
 A4: Guo Elementary School  
 B5: Harry's Gym and Pool  
 B3: Jake's Grocery Store  
 A1: Jolly's Bakery

B8: Ralph's Hot Dogs  
 D7: Rent-a-bike  
 F6: Richard Middle School  
 E5: Ketchup Clinic *EX-PRSS* Care  
 D2: Tracy High School