Sample Set (Gallop Rules)

- This round contains 27 problems to be solved in 60 minutes.
- Problems are divided into 9 sets of 3 problems each.
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- Point values for each set:

Round #	1	2	3	4	5	6	7	8	9	Total Pts.
Pts/Problem	10	11	12	13	14	16	18	21	25	420

L N I I S O O M N E O W V R K **W R A P** A A O L E W Y N I N A G D T Y

Gallop Foal Round

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L N I I S O O M N E O W V R K **W R A P** A A O L E W Y N I N A G D T Y

Gallop Foal Round Set 1 Answer Sheet

Team ID _____ Team Name _____

Room # _____ Student Name(s) _____

1.

2.

3.

Gallop Foal Round

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Team ID _____ Team Name _____

Room # _____ Student Name(s) _____

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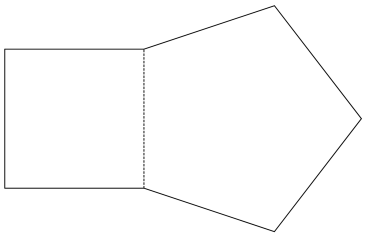

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3. [10] A birthday cake costs \$10.00, plus an additional \$0.50 for every decoration on it. Mr. Li orders two birthday cakes, the first of which has three decorations on it. If the subtotal was \$24.00, how many decorations were on the second cake?

Gallop Foal Round

Gallop Foal Round Set 1

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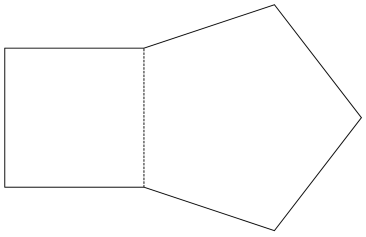

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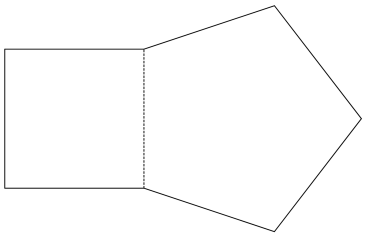

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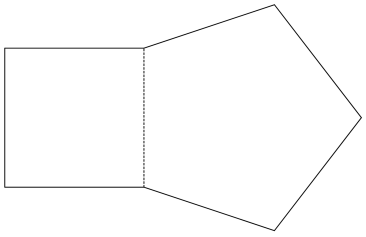

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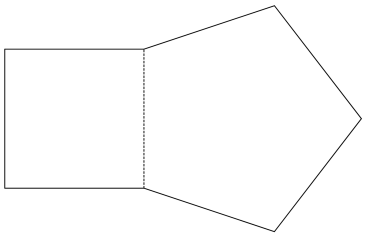

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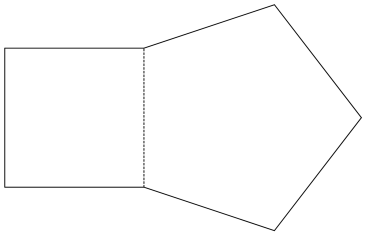

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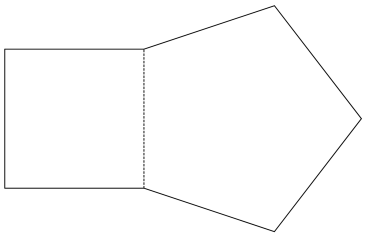

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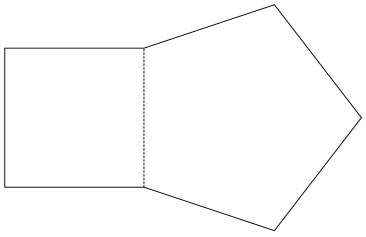

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Gallop Foal Round Set 2 Answer Sheet

Team ID _____ Team Name _____

Room # _____ Student Name(s) _____

4.

5.

6.

Gallop Foal Round

Gallop Foal Round Set 2 Answer Sheet

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4.

5.

6.

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Gallop Foal Round Set 2

4. [11] There are initially 1000 bacteria in a petri dish. Every 20 minutes, each bacterium splits into two bacteria. How many bacteria are in the petri dish after 60 minutes?

5. [11] A palindrome is a sequence of letters that are in the same order when read from left to right or right to left. For example, *abcba* is a palindrome. How many ways can the seven letters in *pompoms* be rearranged to form a palindrome?

6. [11] The number $2024^2 = 4096576$ has 63 positive divisors. How many of these divisors are greater than 2024?

Gallop Foal Round

Gallop Foal Round Set 2

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Gallop Foal Round Set 3 Answer Sheet

Team ID _____ Team Name _____

Room # _____ Student Name(s) _____

7.

8.

9.

Gallop Foal Round

Gallop Foal Round Set 3 Answer Sheet

Team ID _____ Team Name _____

Room # _____ Student Name(s) _____

7.

8.

9.

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Gallop Foal Round Set 3

7. [12] A square and a circle are drawn on a piece of paper. What is the maximum number of intersection points between the two shapes?

8. [12] Tom's favorite number has four digits. The sum of the first three digits is 16, and the sum of the last three digits is 7. What is the first digit?

9. [12] Ethan puts five slips of paper into a basket, labelled 1, 2, 3, 4, and 5. He then randomly draws out three slips of paper one by one, without replacement. Determine the probability that the last number Ethan drew was the largest of the three.

Gallop Foal Round

Gallop Foal Round Set 3

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Gallop Foal Round Set 4 Answer Sheet

Team ID _____ Team Name _____

Room # _____ Student Name(s) _____

10.

11.

12.

Gallop Foal Round

Gallop Foal Round Set 4 Answer Sheet

Team ID _____ Team Name _____

Room # _____ Student Name(s) _____

10.

11.

12.

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Gallop Foal Round Set 4

10. [13] Let p be a prime number. The sum of the positive divisors of $2p$ is 42. What is p?

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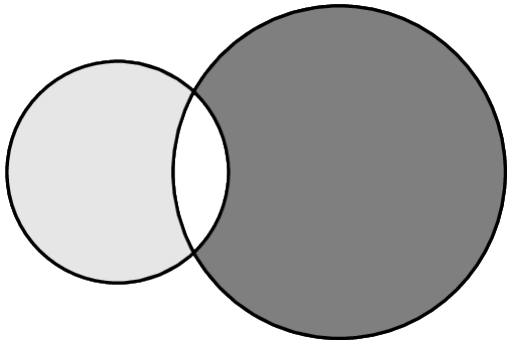

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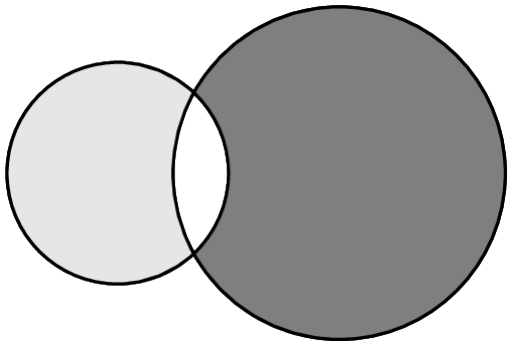

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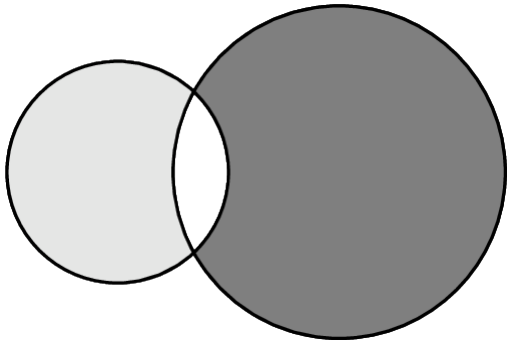

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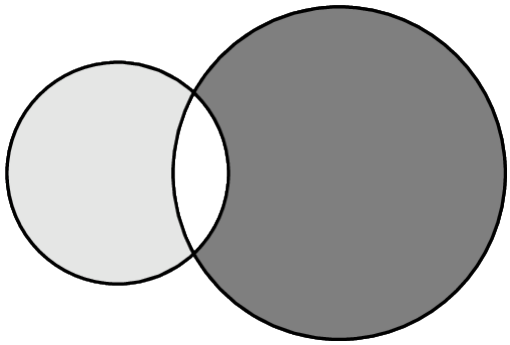

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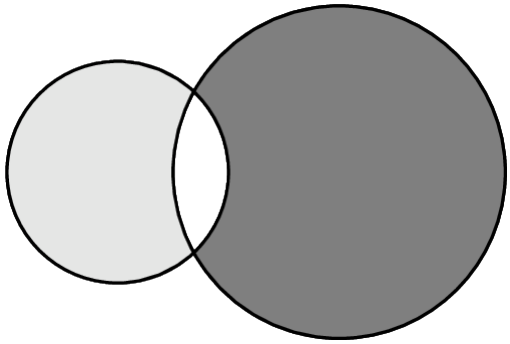

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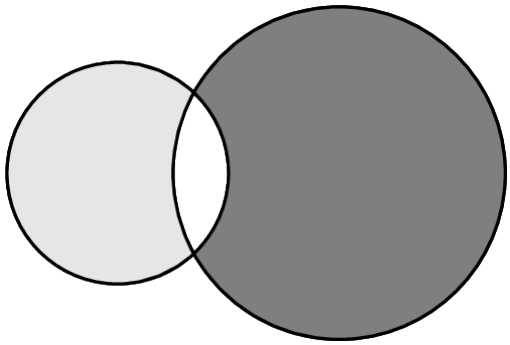

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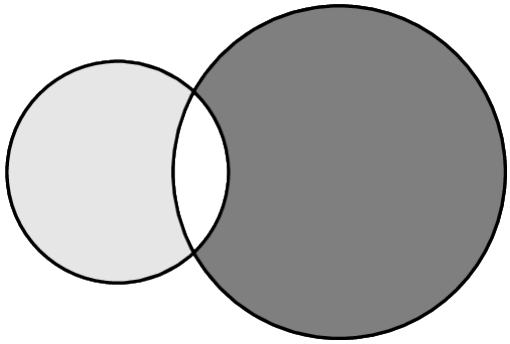

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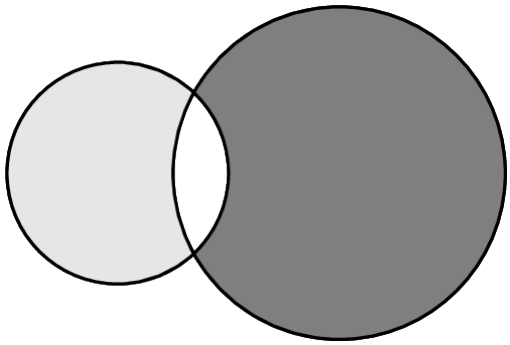

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Gallop Foal Round Set 5 Answer Sheet

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Gallop Foal Round

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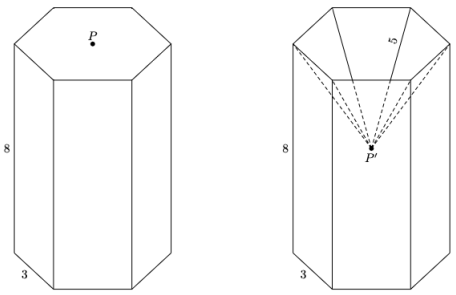
Gallop Foal Round Set 5

13. [14] Find the least real number N such that there exist no values of x greater than or equal to N that satisfy
$$\lfloor x^2 + \lfloor x^2 + \lfloor x^2 + \lfloor x^2 \rfloor \rfloor \rfloor \rfloor = 100,$$
where $\lfloor y \rfloor$ denotes the greatest integer less than or equal to y.

14. [14]

Consider a hexagonal prism whose height is 8 and base side length 3. Let point P be the center of the top face. Let point P be the center of the top face. This point P is "pushed" down to a new point P', which deforms the prism by creating a dent, making it lose volume. All the six new edges connecting P' have length 5. What fraction of the prism's original volume did it lose in this process?



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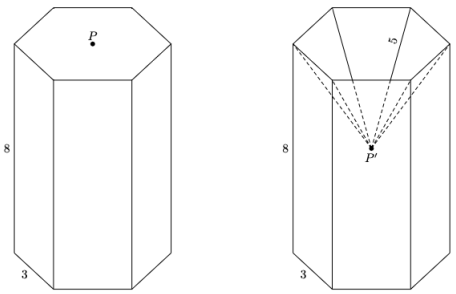

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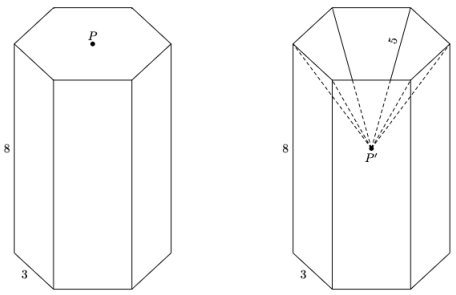

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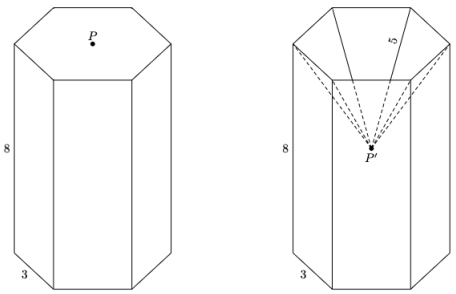

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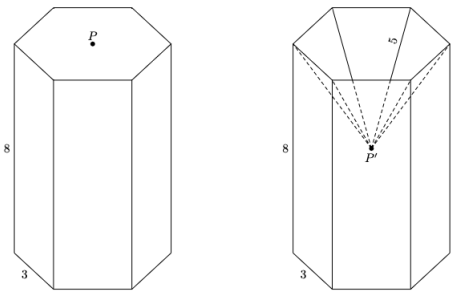

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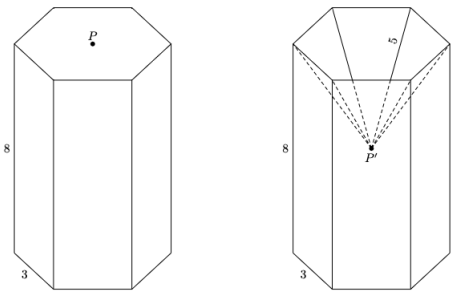

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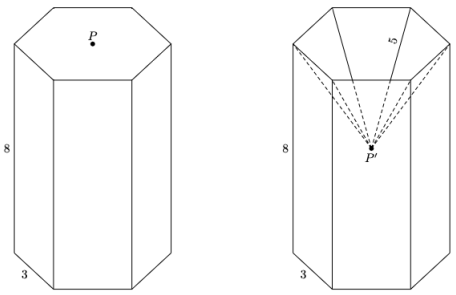

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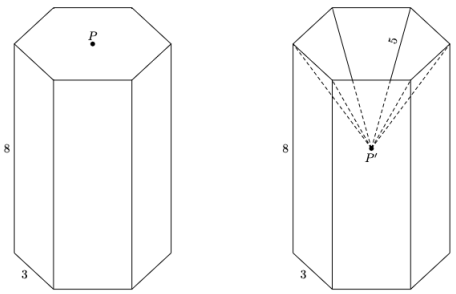

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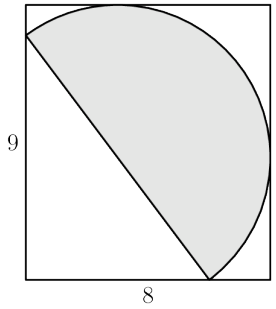
Gallop Foal Round Set 6

16. [16] Let ω be a circle of radius 1 and A be its center. Let B be a point on the circumference of ω. If point C is chosen uniformly and random from the interior of ω, find the probability that $\triangle ABC$ is obtuse.

17. [16] A semicircle is inscribed within an 8×9 rectangle, such that the two endpoints of its diameter lie on two sides of the rectangle, and its arc is tangent to the other two sides. Find the length of the diameter of the semicircle.



18. [16] There are 11 balls in a bag, labeled with distinct integers from 1 to 11. Every minute, Ann takes two of the balls from the bag at random, throws away the one with the smaller label, and puts the other back into the bag. After nine minutes, there are two balls left in the bag. What is the probability that one of these balls is the one with the label 10?

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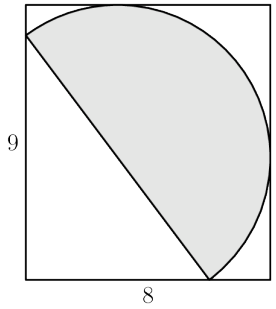

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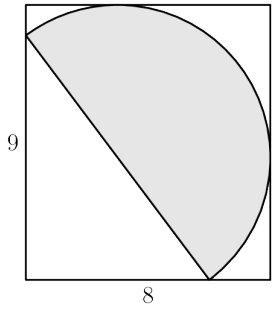

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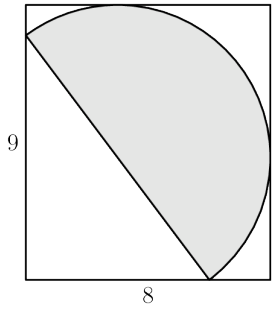

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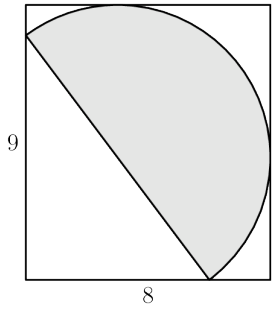

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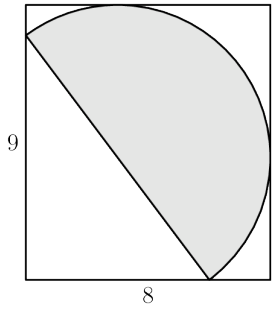

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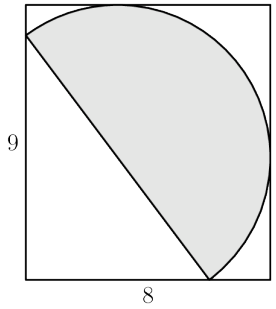


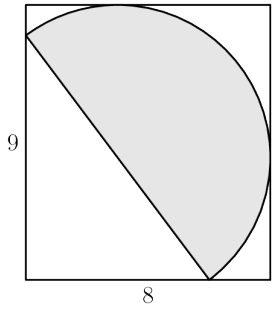
18. [16] There are 11 balls in a bag, labeled with distinct integers from 1 to 11. Every minute, Ann takes two of the balls from the bag at random, throws away the one with the smaller label, and puts the other back into the bag. After nine minutes, there are two balls left in the bag. What is the probability that one of these balls is the one with the label 10?

Gallop Foal Round

Gallop Foal Round Set 6

16. [16] Let ω be a circle of radius 1 and A be its center. Let B be a point on the circumference of ω. If point C is chosen uniformly and random from the interior of ω, find the probability that $\triangle ABC$ is obtuse.

17. [16] A semicircle is inscribed within an 8×9 rectangle, such that the two endpoints of its diameter lie on two sides of the rectangle, and its arc is tangent to the other two sides. Find the length of the diameter of the semicircle.



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Gallop Foal Round Set 7 Answer Sheet

Team ID _____ Team Name _____

Room # _____ Student Name(s) _____

19.

20.

21.

Gallop Foal Round

Gallop Foal Round Set 7 Answer Sheet

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Room # _____ Student Name(s) _____

19.

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21.

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Gallop Foal Round Set 7

19. [18] Let $ABCD$ be a rectangle with side lengths $AB = 10$ and $BC = 1$. A circle ω passes through A and B and is tangent to $\overline{CD}$. Find the radius of ω.

20. [18] Suppose a is a real number such that the equation $x^3 + ax^2 - 1000 = 0$ has three real solutions in x, one of which equals the sum of the other two. Determine the value of a.

21. [18] Find the greatest multiple of 11 whose digits are all distinct.

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Gallop Foal Round Set 8 Answer Sheet

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Room # _____ Student Name(s) _____

22.

23.

24.

Gallop Foal Round

Gallop Foal Round Set 8 Answer Sheet

Team ID _____ Team Name _____

Room # _____ Student Name(s) _____

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24.

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Gallop Foal Round Set 8

22. [21] Suppose that a, b, and c are positive integers such that $\gcd(a, b, c) = 2024$ and $\text{lcm}(a, b, c) = 2024000$. Let M be the greatest possible value of $\gcd(a, b) \cdot \gcd(b, c) \cdot \gcd(c, a)$. How many positive divisors does M have?

23. [21] Let $ABCDEF$ be a regular hexagon with side length 1, and let M and N denote the midpoints of $\overline{BC}$ and $\overline{CD}$, respectively. Define P to be the intersection of $\overline{AM}$ and $\overline{BN}$. Find the area of $\triangle BPM$.

24. [21] You have just received a plant with 3 special healthy flowers. Each flower independently has a $\frac{1}{3}$ chance to wilt during any given day, after which it will stay permanently wilted. Given that at least one flower is healthy at the end of Day 1, the probability that all flowers have wilted by the end of Day 2 can be written as $\frac{m}{n}$ for relatively prime positive integers m and n. Find $m + n$.

Gallop Foal Round

Gallop Foal Round Set 8

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Gallop Foal Round Set 9 Answer Sheet

Team ID _____ Team Name _____

Room # _____ Student Name(s) _____

25.

26.

27.

Gallop Foal Round

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Team ID _____ Team Name _____

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Gallop Foal Round Set 9

Congratulations on reaching the end of the Gallop Round! The last set of three problems in the Gallop Round is the Estimation Round, where you try your best to get as close as possible to the correct answer as possible. **IMPORTANT NOTE:** Any submission that is *not* a positive integer will receive a 0.

25. [25] Ten distinct cells are chosen randomly from a 100×100 grid. Let p be the probability that there is a pair of chosen cells in the same row or the same column. Estimate the integer nearest $1000p$.
Submit a positive integer N. If the correct answer is A, you will receive $\max(25(2 - \max(\frac{A}{N}, \frac{N}{A})), 0)$ points.

26. [25] Gilbert thinks of a number n, and writes down the equation

$$\frac{1}{a} + \frac{1}{b} = \frac{1}{n}.$$

This equation is satisfied by at least 200 ordered pairs of positive integers (a, b). Estimate the smallest possible value of n.
Submit a positive integer N. If the correct answer is A, you will receive $\max(25 - \sqrt{|A - N|}, 0)$ points.

27. [25] Four points are chosen independently and uniformly at random from the interior of a unit square. Let p be the probability that these points are the vertices of a convex quadrilateral. Estimate the integer nearest $1000p$.
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Gallop Foal Round

Gallop Foal Round Set 9

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