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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 Stallion Round

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Gallop Stallion Round Set 1 Answer Sheet

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Room # _____ Student Name(s) _____

1.

2.

3.

Gallop Stallion Round

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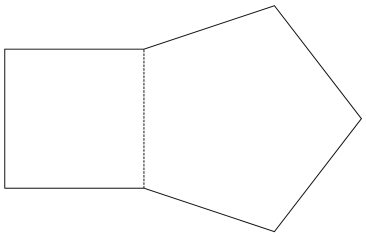

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3. [10] A birthday cake costs \$10.00, plus an additional \$0.50 for every decoration on it. Mr. Li orders two birthday cakes, the first of which has three decorations on it. If the subtotal was \$24.00, how many decorations were on the second cake?

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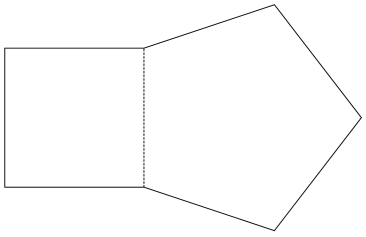

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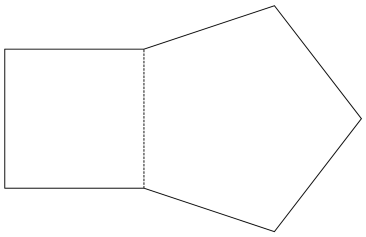

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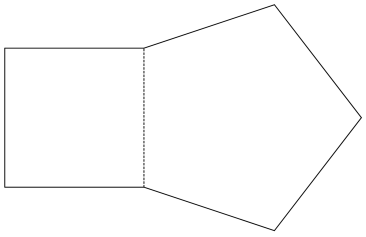

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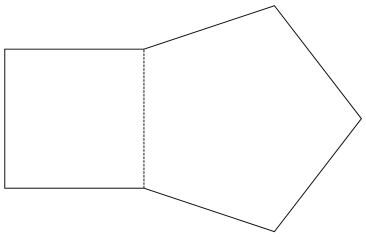

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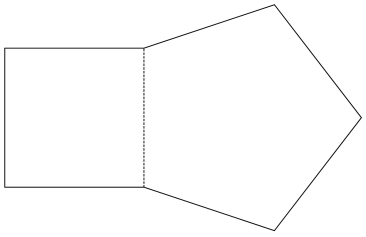

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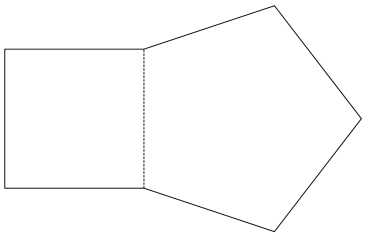

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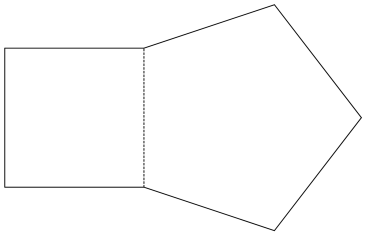

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Gallop Stallion Round Set 2 Answer Sheet

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Room # _____ Student Name(s) _____

4.

5.

6.

Gallop Stallion Round

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Room # _____ Student Name(s) _____

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Gallop Stallion Round Set 2

4. [11] A square and a circle are drawn on a piece of paper. What is the maximum number of intersection points between the two shapes?

5. [11] The number $2024^2 = 4096576$ has 63 positive divisors. How many of these divisors are greater than 2024?

6. [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?

Gallop Stallion Round

Gallop Stallion Round Set 2

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Gallop Stallion Round Set 3 Answer Sheet

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Room # _____ Student Name(s) _____

7.

8.

9.

Gallop Stallion Round

Gallop Stallion Round Set 3 Answer Sheet

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8.

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Gallop Stallion Round Set 3

7. [12] 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?

8. [12] 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?

9. [12] Let p be a prime number. The sum of the positive divisors of $2p$ is 42. What is p?

Gallop Stallion Round

Gallop Stallion Round Set 3

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Gallop Stallion Round Set 3

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8. [12] 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?

9. [12] Let p be a prime number. The sum of the positive divisors of $2p$ is 42. What is p?

Gallop Stallion Round Set 4 Answer Sheet

Team ID _____ Team Name _____

Room # _____ Student Name(s) _____

10.

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12.

Gallop Stallion Round

Gallop Stallion Round Set 4 Answer Sheet

Team ID _____ Team Name _____

Room # _____ Student Name(s) _____

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Gallop Stallion Round Set 4

10. [13] 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?

11. [13] 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.

12. [13] 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 Stallion Round

Gallop Stallion Round Set 4

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Gallop Stallion Round Set 5 Answer Sheet

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13.

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15.

Gallop Stallion Round

Gallop Stallion Round Set 5 Answer Sheet

Team ID _____ Team Name _____

Room # _____ Student Name(s) _____

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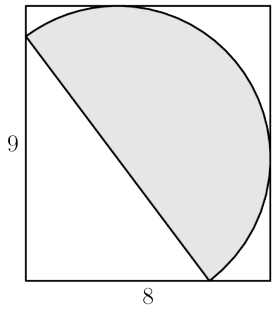
Gallop Stallion Round Set 5

13. [14] 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.

14. [14] 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 Stallion Round

Gallop Stallion Round Set 5

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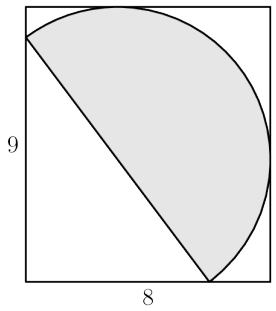

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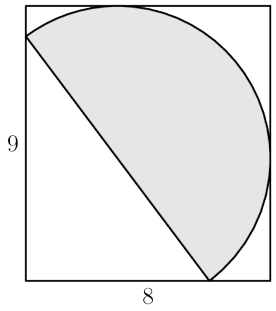

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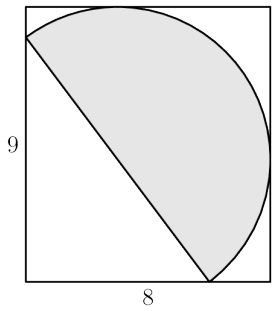

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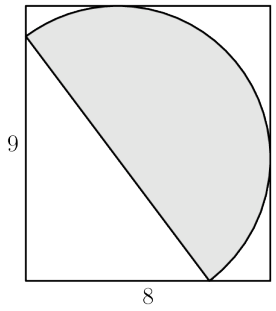

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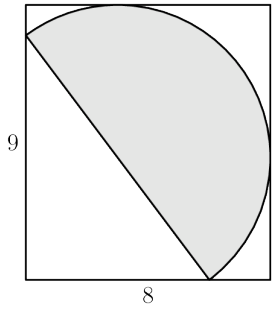

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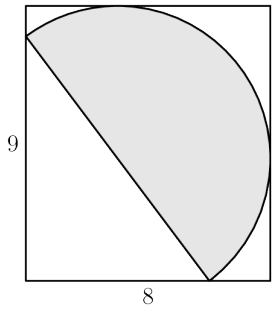

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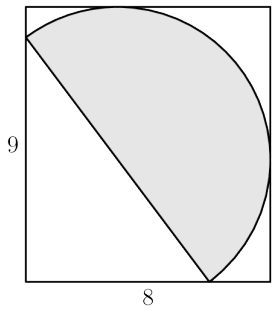

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Gallop Stallion Round Set 6 Answer Sheet

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Room # _____ Student Name(s) _____

16.

17.

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Gallop Stallion Round

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Room # _____ Student Name(s) _____

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Gallop Stallion Round Set 6

16. [16] 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?

17. [16] Find the number of integers $1 \leq n \leq 2024$ for which the remainder when n^3 is divided by 2025 is odd.

18. [16] Positive real numbers a, b, and c satisfy the following equations:

$$ab + \frac{1}{c} = 1$$

$$bc + \frac{1}{a} = 2$$

$$ca + \frac{1}{b} = 4$$

Find the least possible value of $a + b + c$.

Gallop Stallion Round

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Gallop Stallion Round Set 7 Answer Sheet

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19.

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Gallop Stallion Round

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Gallop Stallion Round Set 7

19. [18] Harry randomly selects six distinct integers between 0 and 9, inclusive. What is the probability that the product of three of these integers equals the product of the other three?

20. [18] 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.

21. [18] Let $ABCD$ be a rectangle with $AB = 120$ and $BC = 170$, and let $EFGH$ be a unit square within $ABCD$ such that $\overline{AB} \parallel \overline{EF}$ and E is the closest vertex to A. Given that $\angle ABF = \angle BCG$ and $\angle CDH = \angle DAE$, find the least possible length of $\overline{AE}$.

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Gallop Stallion Round Set 7

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20. [18] 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.

21. [18] Let $ABCD$ be a rectangle with $AB = 120$ and $BC = 170$, and let $EFGH$ be a unit square within $ABCD$ such that $\overline{AB} \parallel \overline{EF}$ and E is the closest vertex to A. Given that $\angle ABF = \angle BCG$ and $\angle CDH = \angle DAE$, find the least possible length of $\overline{AE}$.

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Gallop Stallion Round Set 8 Answer Sheet

Team ID _____ Team Name _____

Room # _____ Student Name(s) _____

22.

23.

24.

Gallop Stallion Round

Gallop Stallion Round Set 8 Answer Sheet

Team ID _____ Team Name _____

Room # _____ Student Name(s) _____

22.

23.

24.

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Gallop Stallion Round Set 8

22. [21] There exists a unique positive integer x for which $N = x^3 + 44x^2 + x$ is a perfect square. Find $\sqrt{N}$.

23. [21] A birthday cake is in the shape of a triangle with side lengths 27, 28, and 29. A straight line slices the cake into two pieces with equal perimeter. The ratio of the area of the larger piece to the area of the smaller piece is r. What is the maximum possible value of r?

24. [21] Let A, B, C, and D be points on a circle ω in that order such that $AB = 7$, $BC = \sqrt{14}$, $CD = \sqrt{34}$, and $DA = \sqrt{69}$. Find the area of ω.

Gallop Stallion Round

Gallop Stallion Round Set 8

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Gallop Stallion Round Set 9 Answer Sheet

Team ID _____ Team Name _____

Room # _____ Student Name(s) _____

25.

26.

27.

Gallop Stallion Round

Gallop Stallion Round Set 9 Answer Sheet

Team ID _____ Team Name _____

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Gallop Stallion 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 Stallion Round

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