Sample Set (Gallop Rules)

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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 Colt Round

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Gallop Colt Round Set 1 Answer Sheet

Team ID _____ Team Name _____

Room # _____ Student Name(s) _____

1.

2.

3.

Gallop Colt Round

Gallop Colt Round Set 1 Answer Sheet

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1.

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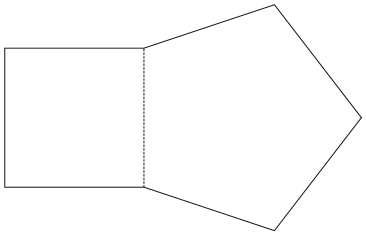
Gallop Colt Round Set 1

1. [10] Amy, Beth, and Carlos want to stand in a line to take a group photo. However, Beth and Carlos refuse to stand directly next to each other. How many ways can Amy, Beth, and Carlos be ordered from left to right?

2. [10] A figure is made of a square and a regular pentagon, which share an side of length 2, as shown in the figure below. What is the perimeter of the figure?



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 Colt Round

Gallop Colt Round Set 1

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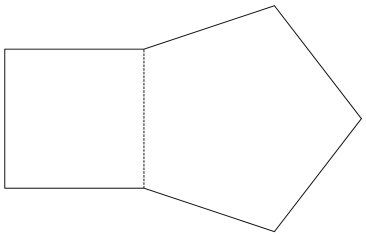

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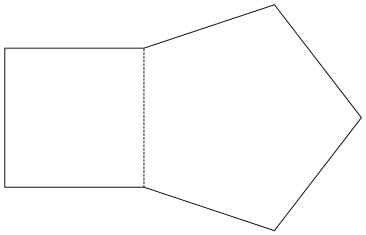

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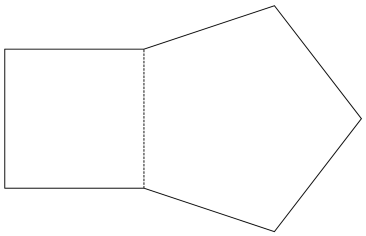

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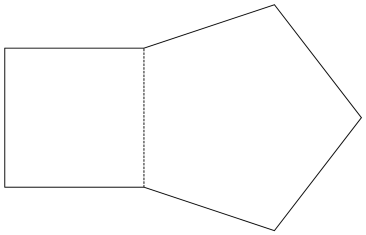

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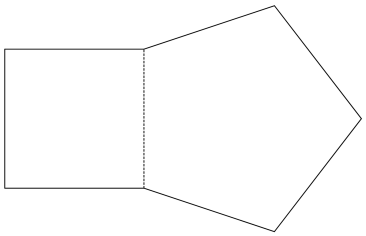

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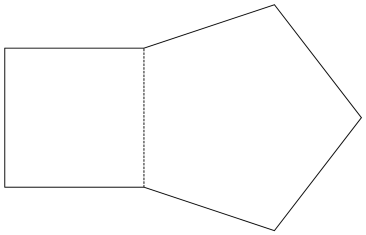

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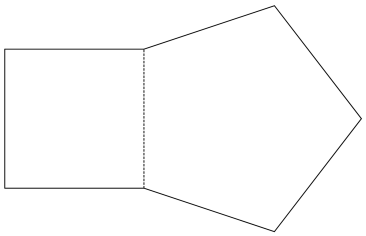

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Gallop Colt Round Set 2 Answer Sheet

Team ID _____ Team Name _____

Room # _____ Student Name(s) _____

4.

5.

6.

Gallop Colt Round

Gallop Colt Round Set 2 Answer Sheet

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Room # _____ Student Name(s) _____

4.

5.

6.

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

6. [11] 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?

Gallop Colt Round

Gallop Colt Round Set 2

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Gallop Colt Round Set 3 Answer Sheet

Team ID _____ Team Name _____

Room # _____ Student Name(s) _____

7.

8.

9.

Gallop Colt Round

Gallop Colt Round Set 3 Answer Sheet

Team ID _____ Team Name _____

Room # _____ Student Name(s) _____

7.

8.

9.

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Gallop Colt Round Set 3

7. [12] The number $2024^2 = 4096576$ has 63 positive divisors. How many of these divisors are greater than 2024?

8. [12] 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?

9. [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?

Gallop Colt Round

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Gallop Colt Round Set 4 Answer Sheet

Team ID _____ Team Name _____

Room # _____ Student Name(s) _____

10.

11.

12.

Gallop Colt Round

Gallop Colt Round Set 4 Answer Sheet

Team ID _____ Team Name _____

Room # _____ Student Name(s) _____

10.

11.

12.

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Gallop Colt Round Set 4

10. [13] 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.

11. [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.

12. [13] 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.

Gallop Colt Round

Gallop Colt Round Set 4

10. [13] Find the least real number N such that there exist no values of x greater than or equal to N that satisfy
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where $\lfloor y \rfloor$ denotes the greatest integer less than or equal to y.

11. [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.

12. [13] 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.

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Gallop Colt Round Set 4

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Gallop Colt Round

Gallop Colt Round Set 4

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Gallop Colt Round Set 5 Answer Sheet

Team ID _____ Team Name _____

Room # _____ Student Name(s) _____

13.

14.

15.

Gallop Colt Round

Gallop Colt Round Set 5 Answer Sheet

Team ID _____ Team Name _____

Room # _____ Student Name(s) _____

13.

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15.

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Gallop Colt 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] Find the greatest multiple of 11 whose digits are all distinct.

15. [14] 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.

Gallop Colt Round

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Gallop Colt Round Set 6 Answer Sheet

Team ID _____ Team Name _____

Room # _____ Student Name(s) _____

16.

17.

18.

Gallop Colt Round

Gallop Colt Round Set 6 Answer Sheet

Team ID _____ Team Name _____

Room # _____ Student Name(s) _____

16.

17.

18.

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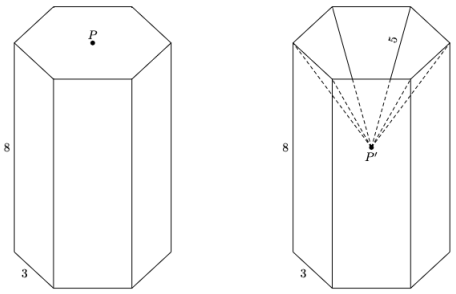
Gallop Colt Round Set 6

16. [16]

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?



17. [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?

18. [16] 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 $\triangle BPM$.

Gallop Colt Round

Gallop Colt Round Set 6

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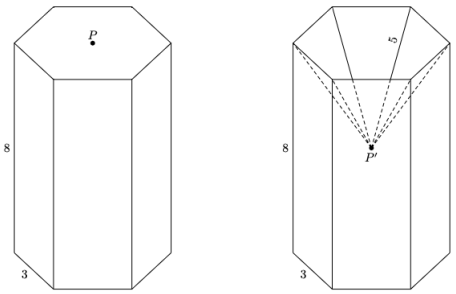

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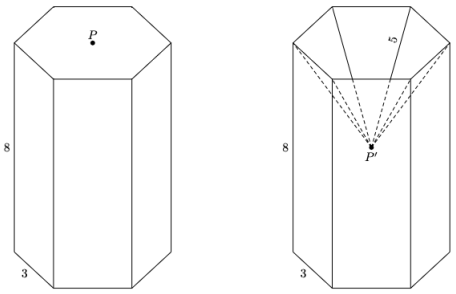

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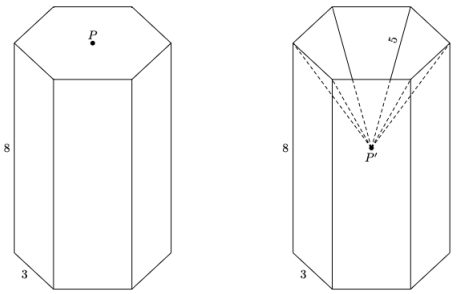

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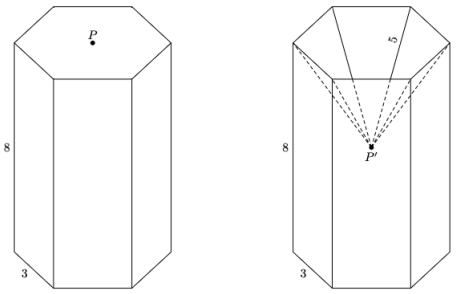

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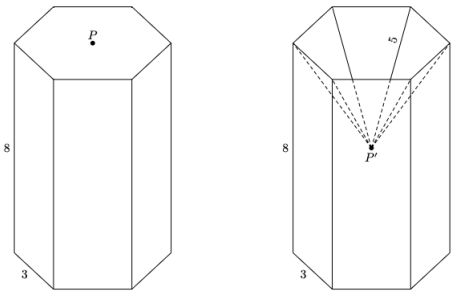

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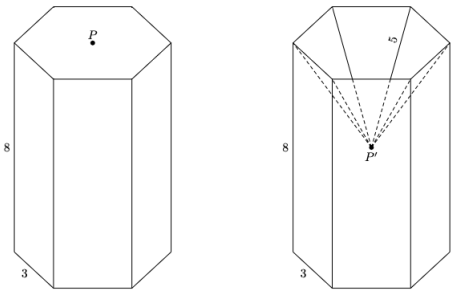

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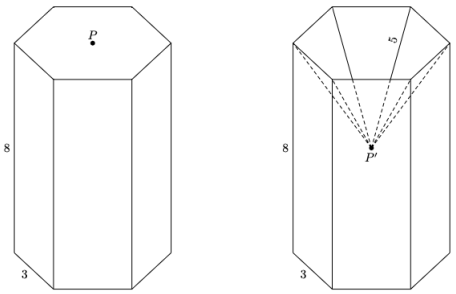

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Gallop Colt Round Set 7 Answer Sheet

Team ID _____ Team Name _____

Room # _____ Student Name(s) _____

19.

20.

21.

Gallop Colt Round

Gallop Colt Round Set 7 Answer Sheet

Team ID _____ Team Name _____

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Gallop Colt Round Set 7

19. [18] Determine the greatest positive integer N such that for all integers m, we have that N divides $m^7 - m$.

20. [18] Bob has 9 toys, one of which is a toy car, and 3 boxes. Yesterday, he tossed each toy into a random box. What is the expected value of the number of toys in the box containing the toy car (including the car itself)?

21. [18] Find the number of integers $1 \leq n \leq 2024$ for which the remainder when n^3 is divided by 2025 is odd.

Gallop Colt Round

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Gallop Colt Round Set 8 Answer Sheet

Team ID _____ Team Name _____

Room # _____ Student Name(s) _____

22.

23.

24.

Gallop Colt Round

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Gallop Colt Round Set 8

22. [21] 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 $a + b + c$.

23. [21] 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?

24. [21] 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 $\overline{AE}$.

Gallop Colt Round

Gallop Colt Round Set 8

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24. [21] 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 Colt Round Set 8

22. [21] Positive real numbers a, b, and c satisfy the following equations:

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

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

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Gallop Colt Round Set 9 Answer Sheet

Team ID _____ Team Name _____

Room # _____ Student Name(s) _____

25.

26.

27.

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Gallop Colt 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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