Team Relay
Test #341
Question #0
Seat 1 – Theta

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Seat 2 – Alpha

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Question #0
Seat 3 – Mu

Question #0
Seat 1 – Theta

Let A be the area of a circle with diameter $2\sqrt{2}$.

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Question #0
Seat 2 – Alpha

Let B be the period of the function $f(x) = A\sin(Ax) + A$.

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Question #0
Seat 3 – Mu

Let $f(x) = x^4 + 4x^2 + 3$. Let C be $f'(B)$.

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Question #1
Seat 1 – Theta

Let A be the constant term of $\left(x^2 - \frac{1}{x}\right)^6$.

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Question #1
Seat 2 – Alpha

Let k be the number of distinct terms in the expansion of $(x + y + 1)^A$. Let B be the sum of the digits of k.

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Question #1
Seat 3 – Mu

Let C be the coefficient of the $x^{-\frac{3}{2}}$ term of the binomial expansion of $(x + B)^{\frac{1}{2}}$.

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Question #2
Seat 1 – Theta

Let A be the sum of the solutions to $|2x - 6| + |3x - 4| = 8$.

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Question #2
Seat 2 – Alpha

Given that $\tan(\alpha) = A$, and $\cos(\beta) = \frac{-60}{61}$, with $\frac{33\pi}{2} \leq \beta \leq 17\pi$, $\tan(\alpha - \beta)$ can be expressed as $\frac{m}{n}$, where m is an integer, n is a positive integer, and $\gcd(|m|, n) = 1$. Let B be $m + n$.

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Question #2
Seat 3 – Mu

Let K be $f^{(B)}(0)$, where $f(x) = e^{3x} - \sin(4x) + \cos(2x)$. Let C be the remainder when $|K|$ is divided by 10.

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Question #3
Seat 1 – Theta

Let A be the area of a triangle with side lengths 17, 25, and 28.

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Question #3
Seat 2 – Alpha

A is the area of a triangle with side lengths x, 25, and 28. Let B be the largest possible value of x^2.

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Question #3
Seat 3 – Mu

A triangle is expanding, with all three side lengths increasing at the same constant rate of $2C$ units per second. At the moment where the sides of the triangle are 3, 4, and 5, its area is expanding at a rate of B square units per second.

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Question #4
Seat 1 – Mu

A particle moving in the number line has an acceleration function defined by $a(t) = 2t - 8$ and a velocity function with $v(0) = -9$. Let A be the total length of the intervals of time in which the particle's speed is increasing for $t \in (0,12)$.

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Question #4
Seat 2 – Theta

Alan, located at the point $(15, -1)$, needs to get to Sam, located at the point $(A, 0)$. Before reaching Sam, Alan needs to get some water from a river represented by the equation $y = x$. Let B be the minimum distance that Alan must travel.

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Question #4
Seat 3 – Alpha

Let $M = \begin{bmatrix} x & -3 & 2 \\ 0 & x & -4 \\ 1 & 5 & 8 \end{bmatrix}$ be a matrix such that $\det(M) = B$. Find the positive value of x.

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Seat 1 – Mu

$A = \lim_{x \to 0} \left(\frac{\sin 2x}{x} + \frac{\arcsin 2x}{x} \right)$.

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Question #5
Seat 2 – Theta

A circle of radius A is inscribed in an $60°$ sector of another circle. Let B be the radius of the sector.

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Question #5
Seat 3 – Alpha

Potato starts at the origin and faces east. She first walks straight for B units, then turns $\frac{\pi}{2}$ radians counterclockwise, then walks $\frac{B}{2}$ units straight in that direction. This pattern continues, with Potato turning $\frac{\pi}{2}$ radians counterclockwise and then walking half of her previous straight-line distance. After an infinite amount of time, Potato ends up at the point (x, y). Let C be $x + y$.

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Question #6
Seat 3 – Alpha

Question #6
Seat 1 – Mu

Let A be the number of ways to express 9^{15} as a^b, where a and b are both integers.

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Question #6
Seat 2 – Theta

Let B be the number of lattice points inside the triangle with vertices at $(0,0), (0, A)$, and $(A, 0)$.

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Question #6
Seat 3 – Alpha

Let $M = \left\lfloor \frac{B}{10} \right\rfloor$ and $N = B - 10M$. Let C be the shortest distance from the point $(5, M, N)$ to the line $x - 1 = y - 2 = z + 6$.

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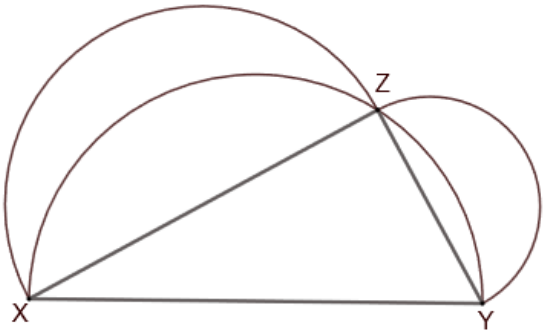
Question #7
Seat 1 – Alpha

The figure to the right shows 3 semicircles. If $XY = 10$, and Z is 4 units away from XY, compute the area of the regions that are inside the two smaller semicircles but outside the largest semicircle.



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Question #7
Seat 2 – Mu

A sphere of radius 2 is cut so that it forms two different figures, such that the distance between the center of the sphere and the base of the cross section at the cut is $\frac{A}{20}$. The volume of the smaller of the two figures is $\frac{m\pi}{n}$ for relatively prime positive integers m, n. Let $B = m + n$.

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Question #7
Seat 3 – Theta

Let C be the number of ordered pairs of integers that satisfy $x^2 + 8x - y^2 + 6y = B$.

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Question #8
Seat 1 – Alpha

Hexagon $SAMUEL$ is equilateral, with $\angle SAM = \angle AMU = \angle UEL = \angle ELS = 135°$, and $SA = 1$. The area of $SAMUEL$ is $m + n\sqrt{2}$ where m, n are rational. Let A be $m + n$.

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Question #8
Seat 2 – Mu

Kevin, who weighs 150 lbs., is being pulled up from a ditch that is A **yards** deep. The rope is a special rope that has a uniform weight density of 2lb/ft. Let B be the sum of the digits of the total work, in ft-lbs., required to pull Kevin out of the ditch.

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Question #8
Seat 3 – Theta

Let k be the sum of digits of B. There are k parking spots in a row in the Buchholz high school parking lot. Nick, Kevin, and Samuel are trying to park. Let C be the number of arrangements of the 3 distinct cars, given that there must be at least one empty parking spot between parked cars.

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Question #9
Seat 1 – Alpha

Let A be the sum of the real solutions to the equation $8^x - 4^x - 2^{x+3} - 2^{x+1} - 8 = 0$.

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Question #9
Seat 2 – Mu

At Buchholz High School, a school with $2N + A$ students, there are N boys and $N + A$ girls. Let P_B be the probability that if two students are randomly chosen from Buchholz's student body, both will be boys. Let P_G be the probability that if two students are randomly chosen from Buchholz's student body, both will be girls. Let B be the least value of N such that $P_G - P_B < \frac{1}{13}$.

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Question #9
Seat 3 – Theta

Let $p, q,$ and r be roots of the polynomial $x^3 + Bx + B = 0$. Find

$$\frac{r}{p+q} + \frac{p}{q+r} + \frac{q}{p+r}.$$