Condensed Test

0A: Get ready for a Musical Adventure! The number of songs Mauithedog10 listens to over time can be modeled by $f(x) = 2x - 1$. Let A be the value of x where $f(x)$ intersects the line $g(x) = x + 1$
0B: Get ready for a Musical Adventure! The number of songs Mauithedog10 listens to over time can be modeled by $f(x) = Ax$. If θ is the angle $f(x)$ makes with the positive x-axis, let B be the value of $\cos\theta$.
0C: Get ready for a Musical Adventure! The number of songs Mauithedog10 listens to over time can be modeled by $f(x) = \frac{1}{B}x^2 + 1$. Let C be the area in the first quadrant between $y = f(x)$ and $x = 1$.

1A: Consider the musical artist Phoebe B. and imagine you are arranging the letters PHOEBEB. Let A be the number ways are there to arrange the letters in PHOEBEB such that the P and H are next to each other.
1B: A vinyl record spins θ radians. If $\tan\theta = \frac{A}{60}$, let

$$B = \frac{1 + \cos^2\theta}{1 - \sin^2\theta}$$

1C: Charli XCX is going Vroom Vroom in her car which has a displacement given by $x(t) = \cos(t^B e^t)$. Let C be the velocity of the car when $t = 1$.

2A: Bad Bunny hops according to a strange sequence. Let

$$A = \frac{1}{\ln(2^{15})}\left(\ln(2^0) + \ln(2^1) + \ln(2^2) + \cdots + \ln(2^9)\right)$$

Note that A **must be expressed as an integer**.
2B: The Beatles are pointing on their album cover according to two vectors, given by $\vec{v}(t) = \hat{\imath} + \hat{\jmath}$ and $\hat{u}(t) = (A+1)\hat{\imath} - A\hat{\jmath}$. Let B be the tangent of the smaller angle between $\vec{v}(t)$ and $\vec{u}(t)$.
2C: Take The Eagles to the limit! Let

$$C = \lim_{x\to\infty}\left(\sqrt{x^2 + Bx} - \sqrt{x^2 - x}\right)$$

3A: Olivia Rodrigo has déjà vu! She keeps doing the same processes over and over again: She first starts with an equilateral triangle with side length 1. This triangle has area A_0. She then creates a new triangle by halving the length of all the side lengths. This triangle has area A_1. She then continues this to get A_2, A_3 and so on to infinity. Let $A = A_0 + A_1 + A_2 + A_3 + \ldots$, or the infinite sum of all the areas of the triangles.
3B: Harry Styles draws a Fine Line that can be written as $\vec{r}(t) = \vec{r_0} + \vec{v}t$. This line is parallel to both $(A^2)x + (\sqrt{3})y + (A\sqrt{3})z = 10$ and $(A^2\sqrt{3})x + 2y - Az = 15$. If the z-coordinate of $\vec{v}$ is 1, let B be the x-coordinate of $\vec{v}$.
3C: The Weeknd is blinded by the lights, and starts walking in a straight line directly away from a lamppost of height H meters at a speed of $|B|$ m/s. If The Weeknd has a height of of $H/3$ meters, let C be how fast is the length of his shadow changing when he is 10 meters away.

4A: Sabrina Carpenter is getting a Taste of the fundamentals of Calculus. Consider the following function f given by the table:

x	$f(x)$	$f'(x)$
-1	0	-1
0	-1	-2
1	-2	-3

Assume that f^{-1} exists and is continuous on $[-1,1]$. Let A be the approximation of $f^{-1}(1)$ using the value of $\int_{-1}^{1}(f^{-1})'(x)\,dx$, approximated by a left Riemann sum with 2 sub-intervals of length 1.
4B: After wrapping up on set, Dylan is Calling After Me to solve the following determinant:

$$B = \begin{vmatrix} A & -3 & -A \\ -5 & -A & -3 \\ -2 & 3A & 2 \end{vmatrix}$$

4C: Bruno Mars needs to study angles at the APT if he wants to get good at astronomy. Given triangle ΔPQR with $\overline{PQ} = \overline{QR} = B$ and $\angle Q = \frac{\pi}{4} + \frac{\pi}{3}$, let $C = (\overline{PR})^2$. **Note C is the square of the side length.**

5A: Billie Eilish wants to be THE GREATEST at calculus. Help her with the following problem: Let $A = V/\pi$, where V is the volume of the solid obtained from rotating the function $f(x) = 2xe^{-x+1}$ on the domain $[1,\infty)$ around the x-axis. **Note that A is not the value of the volume.**
5B: In her study of Supernovas and orbits, Chappell Roan considers the following conic:

$$9x^2 + 4y^2 - 18x + 8y + 13 - 36A^2 = 0$$

A quadrilateral is formed so that the diagonals of the quadrilateral are the axes of the conic. Let B be the area of this quadrilateral.
5C: Not all questions can be music themed, and not all areas can be found without knowing linear algebra. A convex region in the xy-plane with positive area k is redrawn so that every point (x,y) now has the coordinate $(3kx - y, Bx + 2y)$. This new region has area B^2. Let $C = k$.

6A: Not all questions can be music themed, and not all integrals can be solved without useful bounds.

$$\pi \ln(k) = \int_0^{\pi} \frac{x|\cos(x)|}{1+\sin(x)}\,dx$$

Let $A = k$. **Note A is not the value of the whole integral.**
6B: Rather than undefined, Natasha Bedingfield prefers the term *Unwritten*. If

$$f(x) = \frac{3Ax+1}{2x-5}$$

Let B be the value of x **not** in the domain of $f^{-1}(x)$.
6C: ABBA is trying to train their angle eyes by practicing their trigonometry. They are interested in finding the maximum value of

$$B\sqrt{3}\sin(\theta) + 2\cos(\theta + \pi/3)$$

Let C be **the square of this maximum value.**

7A: Avril Lavigne always makes things too complicated! If $Re(z)$ and $Im(z)$ gives the real and imaginary parts of complex number z respectively, let

$$A = |Re(\sqrt{3-4i})| + |Im(\sqrt{3-4i})|$$

7B: In an argument to settle who was the ultimate Pop Girl of the 2024 Summer, Dr. Santos gives Mr. Snampal the following differential equation: Let $y(x)$ be a function defined on the positive real numbers such that for all $x > 0$,

$$\left(\frac{y'}{x^2} - \frac{2y}{x^3}\right) = \frac{1}{x^2+1}$$

Given that $y(1) = A + \pi/4$, let $B = y(\sqrt{3})$.

7C: Not all questions can be music themed, and not all roots can be found without useful tricks. Let $B = n\pi + m$ for integers n, m. If p, q are the complex roots to the polynomial $nx^2 + mx + 1$, then let

$$C = \frac{1}{p-1} + \frac{1}{q-1}$$

8A: In order to test her true Solar Power, Lorde is studying orbits and considers the following (possibly degernate) conic:

$$3Ax^2 + xy + 2Ay^2 - 3Ax + 2y - 5A = 0$$

The conic is then rotated counterclockise by an acute angle θ so that the conic no longer has an xy term. Given that $\cos(4\theta) = 3/5$, and that A **is positive**, find A.

8B: Taylor Swift can do anything with a Broken Heart. After thinking she was the problem (it's me), she solves the following calculus problem: Let

$$B = \lim_{x \to 0} \left(e^{Ax^2}\right)^{\left(\left(\int_0^x e^{-t^2} \sin(t)\, dt\right)^{-1}\right)}$$

8C: The members of Magdelena Bay are Killing Time waiting for each other to arrive. Let $T = |\ln(B)|$. Two band members are going to a meeting that begins at 9 AM. One person will arrive anywhere from 9 AM to $(T + 1/2)$ hours after 9 AM, while the other person will arrive anywhere from **9:15 AM** to T hours after **9:15 AM**. Assume both people arrive at a random time uniformly on their respective intervals and are independent of each other. Let C be the probability that the two arrive within 15 minutes of each other.

9A: The 1975 had a Change of Heart, and are more interested in maximization than regular Precalculus. If (x, y, z) lies on a sphere of radius 3, let A be the maximum value of $xy + xz + yz$.

9B: The 1975 would Love It If We Made It optimal. If they wanted a cone with surface area $2A$, let $B = \pi V^2$, where V is the maximum volume that such a cone could have.

9C: The 1975 are done learning About You and moving on to Somebody Else. Matty is standing at (24, B) and must get to $(x, 20)$, where $x > 24$, while stopping along the line $y = 1$ along the way. They travel a distance D doing so. If $D^2 = 12025$, let C be the maximum value of x.