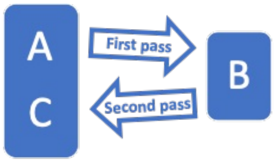
2024 SENIOR REGIONALS SHU
Shuttle Round

Practice Question B0



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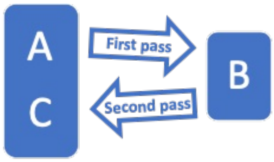
Practice Question B0



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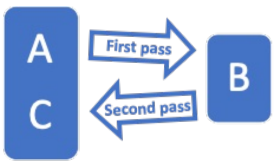
Practice Question B0



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B0.

Let N be the number you receive. Across 11 complete years, how many months contain exactly N days each?

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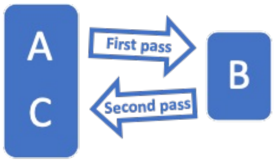
Question B1



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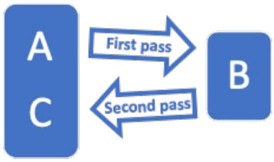
Question B1



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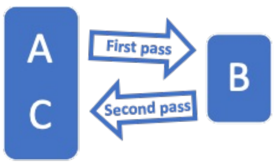
Question B1



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B1.

Let k be the number you receive.

Evaluate $\displaystyle\int_0^k \left[\frac{d}{dx}\left(x^2 - 3\right)\right] dx.$

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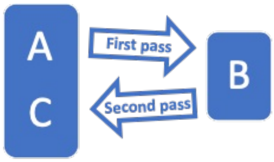
Question B2



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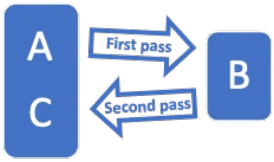
Question B2



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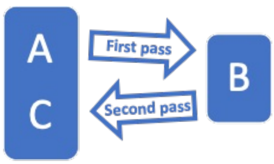
Question B2



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B2.

Let k be the number you receive.

If $\lim\limits_{x \to 1} \dfrac{(2x+k)\left(\sqrt{x}-1\right)}{2x^2-3x+1} = \dfrac{a}{b}$, a fraction in its simplest form, find $a-b$.

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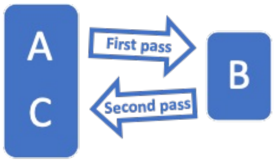
Question B3



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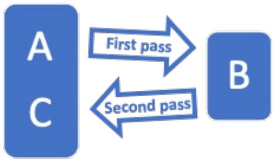

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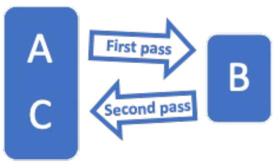
Question B3



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B3.

Let k be the number you receive and let $j = \log_{10}(k)$.

The parabola $y = ax^2 - j$ intersects the $x-$ axis and $y-$ axis at 3 distinct points that form an equilateral triangle.

Determine the value of a.

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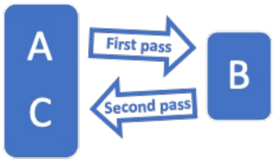
Question B4



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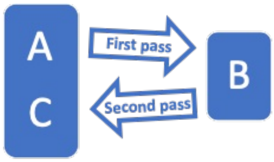
Question B4



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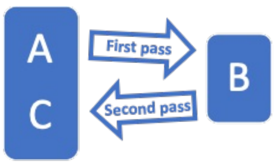
Question B4



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B4.

Let k be the number you receive.

if $\ln\left(x^2y^3\right) = 1$ and $\ln\left(x^5y^7\right) = k,$ find the value of $\ln\left(xy^3\right)$.

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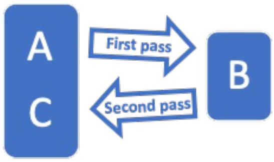
Question B5



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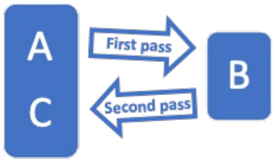
Question B5



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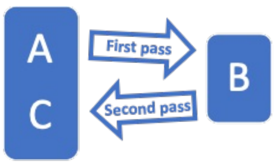
Question B5



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B5.

Let k be the number you receive.

Find the area of the triangle with sides of length $10, 17, \text{ and } k$.

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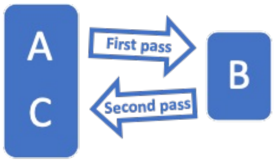
Question B6



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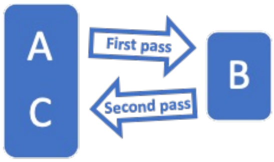
Question B6



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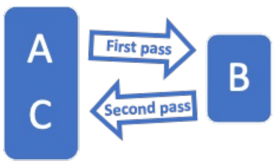
Question B6



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B6.

Let k be the number you receive.

The four-digit number $56yx$ in base 7 equals the four-digit number $k750$ in base 8. Find the value of y.

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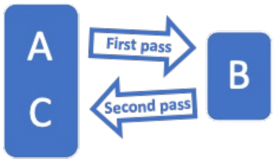
Question B7



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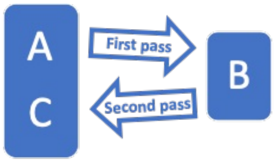
Question B7



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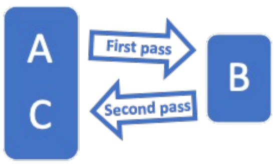
Question B7



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B7.

Let k be the number you receive and let $j = k - 1$.

Solve for x where $x \in \mathbb{Z}^+$.

$$\sqrt{j + \sqrt{j + \sqrt{j...}}} = x.$$

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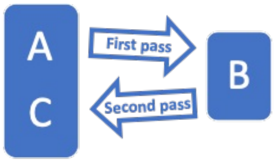
Question B8



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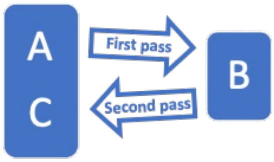
Question B8



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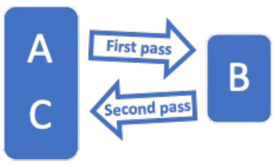
Question B8



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B8.

Let k be the number you receive and let $j = k - 2$.

The function $f(x) = \dfrac{x+1}{x^2+j}$ has maximum value at $(a, f(a))$ and a minimum value at $(b, f(b))$.

Find $a - b$.

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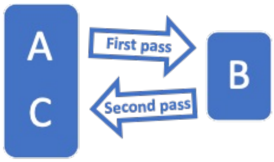
Question B9



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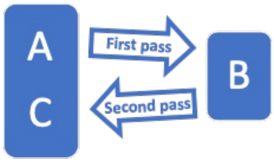
Question B9



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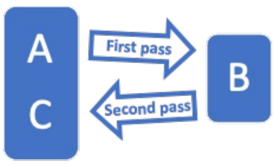
Question B9



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B9.

Let k be the number you receive.

The equation of the tangent line to $(3x-2y)^2+(x-y)^2=2$ at the point $(k+2, k+3)$ is $y=mx+b$.

Find the value of m.

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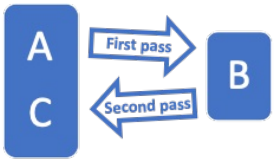
Question B10



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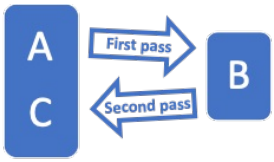
Question B10



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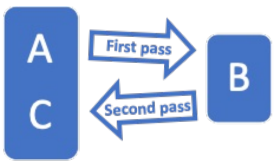
Question B10



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B10.

Let k be the number you receive and let $j = 3k$.

The area of one petal of the Polar curve $r = j\sin(2\theta)$ is $\frac{n\pi}{2}$. Find the value of n.

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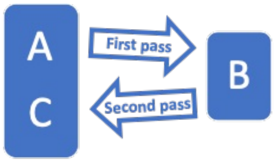
Question B11



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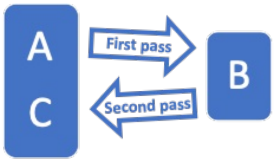
Question B11



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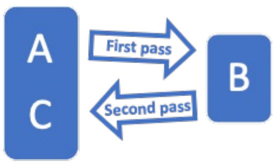
Question B11



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B11.

Let k be the number you receive.

$ABCD$ is a square. From each of the vertices $A, B,$ and C, parallel lines, l_2, l_1 and l_3 respectively, are drawn so that l_2 is between l_1 and l_3.

The distance between l_1 and l_2 is k, and the distance between l_2 and l_3 is 2.

Find the area of the square.

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The distance between l_1 and l_2 is k, and the distance between l_2 and l_3 is 2.

Find the area of the square.

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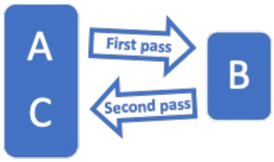
Question B12



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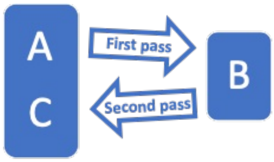
Question B12



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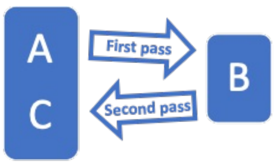
Question B12



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B12.

Let k be the number you receive.

When you evaluate $\arctan\left(\frac{1}{2}\right) + \arctan\left(\frac{1}{k}\right)$, you get $\frac{\pi}{N}$.

Find the value of N.

B12.

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Find the value of N.

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Find the value of N.