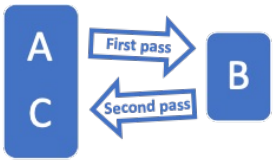
2024 SENIOR REGIONALS SHU
Shuttle Round

Practice Question C0



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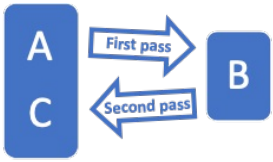
Practice Question C0



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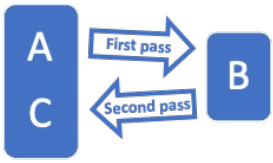
Practice Question C0



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C0.

Let *N* be the number you receive. Find $\lfloor \sqrt{N} \rfloor$. HINT: $\lfloor x \rfloor$ is a floor function, it means round x down to the nearest integer.

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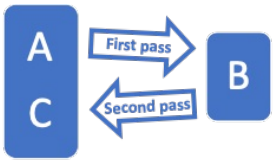
Question C1



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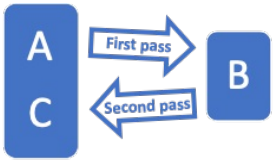
Question C1



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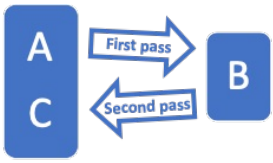
Question C1



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C1.

Let k be the number you receive.

Find the area between the $x-$ axis and $y = x^2 - 2x$ between $x = 2$ and $x = k$. Give your answer as a mixed fraction in its simplest form.

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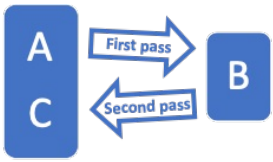
Question C2



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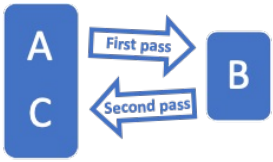
Question C2



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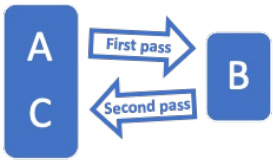
Question C2



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C2.

Let k be the number you receive.

In $\triangle ABC$, $D(-4, 1)$ is the midpoint of $\overline{AB}$, $E(3, k)$ is the midpoint of $\overline{AC}$, and $F(-2, -3)$ is the midpoint of $\overline{BC}$. If (a, b) are the coordinates of point C, find $a + b$.

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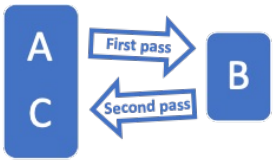
Question C3



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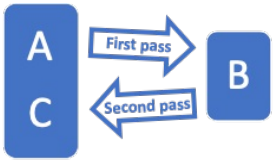
Question C3



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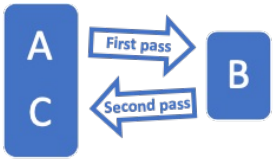
Question C3



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C3.

Let k be the number you receive.

Find t so that $|x + 12| + |x - k| = t$ has infinitely many solutions.

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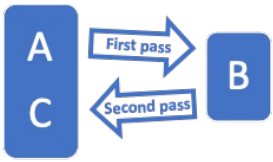
Question C4



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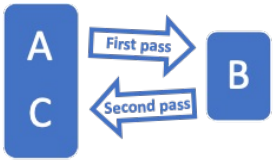
Question C4



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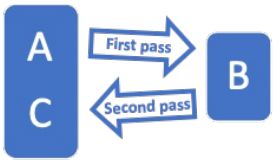
Question C4



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C4.

Let k be the number you receive.

Evaluate $\sum_{n=2}^{\infty} \frac{-2}{(n+1)(n+k)}$

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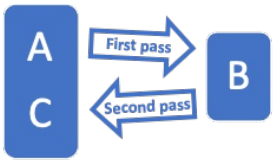
Question C5



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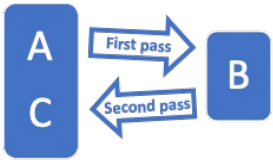
Question C5



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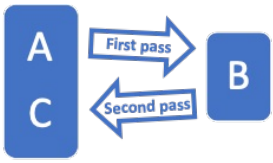
Question C5



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C5.

Let k be the number you receive.

How many real zeros does the polynomial $P(x) = x^6 + kx^4 - 16x^2 - 16k$ have?

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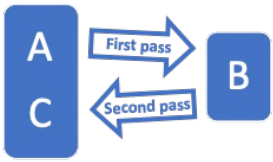
Question C6



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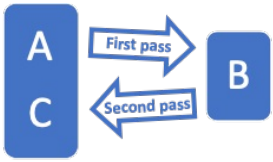
Question C6



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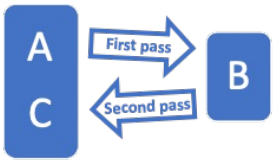
Question C6



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C6.

Let k be the number you receive.

The function $f(x) - f(2x)$ has derivative of 5 at $x = 1$, and a derivative of k at $x = 2$.

Find the value of the derivative of $f(x) - f(4x)$ at $x = 1$.

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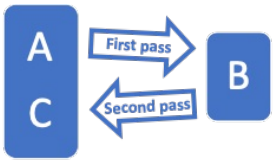
Question C7



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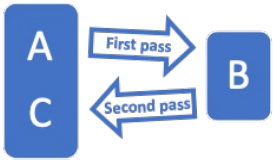
Question C7



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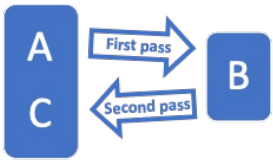
Question C7



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C7.

Let k be the number you receive.

Find the area between the polar curves $r = \cos(\theta)$ and $r = k\cos(\theta)$.

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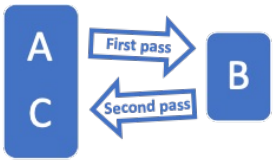
Question C8



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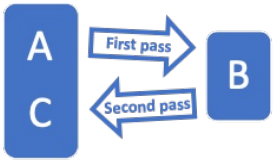
Question C8



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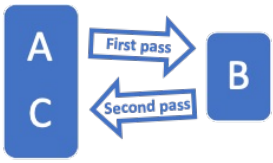
Question C8



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C8.

Let k be the number you receive.

The area, in the first quadrant, bounded by $f(x) = x^2$ and $g(x) = x + k$ is $\frac{a}{b}$, where $\frac{a}{b}$ is in simplest terms. Give the value of $a + b$.

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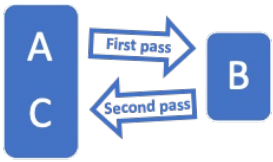
Question C9



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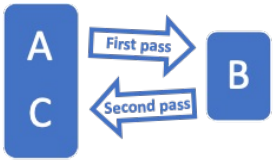
Question C9



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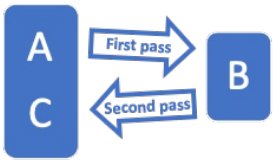
Question C9



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C9.

Let k be the number you receive.

Find the numerical coefficient of the fourth term when $(a + kb)^8$ is expanded and written in order of decreasing powers of a.

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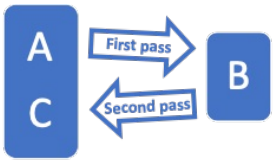
Question C10



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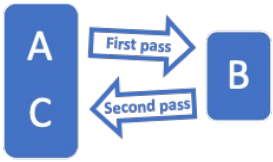
Question C10



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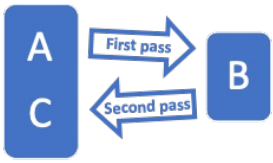
Question C10



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C10.

Let k be the number you receive.

Find $\lim_{x \to 1} \left[\ln\left(x^k\right) + 1\right]^{\frac{3}{k \cdot \ln(x)}}$. [Hint: L'Hospital's Rule]

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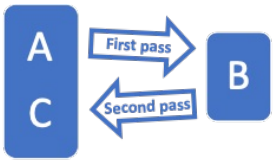
Question C11



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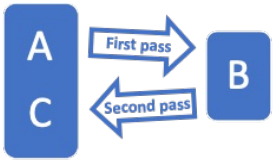
Question C11



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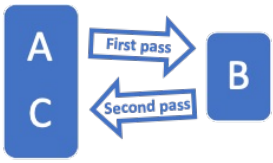
Question C11



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C11.

Let k be the number you receive.

Find the smallest integer, x, so that $|3x - k| < 3$.

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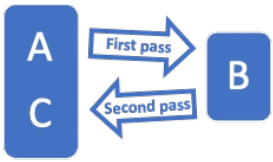
Question C12



Do not turn over until instructed to do so

2024 SENIOR REGIONALS SHU
Shuttle Round

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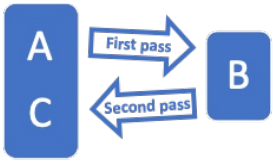

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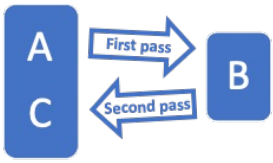

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C12.

Let n be the number you receive.

Find the area of the triangle with vertices $A(-1, 0, 2), B(2, 2, 0),$ and $C(0, n, 3)$.

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