#1 Mu Ciphering
MAΘ National Convention 2021

Let L(x)= $\begin{cases} 4-x \ for \ 1 < x \leq 4 \\ 3x^2 \ for \ 0 \leq x \leq 1 \end{cases}$ and let U be the region bounded by the graph of L, the x-axis, and the lines x=k and x = k+2, where $0 \leq k \leq 1$. What value of "k" maximizes the area of U?

#2 Mu Ciphering
MAΘ National Convention 2021

In triangle JPF, side JP=3, side JF=5, and the $\sin J = \frac{1}{3}$. Find the product of all possible lengths of side PF.

#3 Mu Ciphering
MAΘ National Convention 2021

Find the volume of the solid formed by rotating the region bounded by $y = 3x - 2$, $y = 2 - x^2$ and $x \geq 0$ about the line $x = -1$.

#4 Mu Ciphering
MAΘ National Convention 2021

Find the area of a non-degenerate triangle formed using the endpoints of a latus rectum and a focus for the given conic: $x^2 - 4y^2 + 10x + 24y + 25 = 0$

#5 Mu Ciphering
MAΘ National Convention 2021

$$\int_{\frac{1}{2}}^{1} \frac{dx}{2\sqrt{x - x^2}} =$$

#6 Mu Ciphering
MAΘ National Convention 2021

Trapezoid WXYZ has $\overline{WZ}$ parallel to $\overline{XY}$, XZ = 1, $\angle ZXW = 23^\circ$, *and* $\angle XZY = 46^\circ$. The ratio of XY:WZ is 9:5. What is YZ?

#7 Mu Ciphering
MAΘ National Convention 2021

Find the area of the region that lies within $r = 1 + 2\cos\theta$ and outside r = 2.

#8 Mu Ciphering
MAΘ National Convention 2021

Mr. Lu plans to take the digits 8, 7, 4, 3, and 2 and put them in random order to make a 5-digit number. What is the probability that the resulting integer will be divisible by 11?

#9 Mu Ciphering
MAΘ National Convention 2021

Find the volume of a solid with regular hexagonal cross-sections perpendicular to the x-axis and the longest diagonal of the hexagon lying in the region bounded by the curve: $9x^2 = 36 - 4y^2$

#10 Mu Ciphering
MAΘ National Convention 2021

Find the product of the solutions to:

$$\log_4 k + \log_{k^2} \frac{1}{8} = 1.$$

#11 Mu Ciphering
MAΘ National Convention 2021

A region is bound between a parabola and its latus rectum. If this region is revolved about the latus rectum, the resulting solid has a volume that can be represented as $k\pi p^3$, where p is the distance from vertex to directrix. What is the value of k?

#12 Mu Ciphering
MAΘ National Convention 2021

Can you factor!! Simplify

$$\frac{\left(L^2-3^2-U^2\right)^2-4\left(3U\right)^2}{\left(L^2-U^2-6L+9\right)\left(L^2+3L+3U-U^2\right)}$$