1. 30 pts Is the function $f(z) = \text{Im} \cos z$ analytic? Justify your answer.
2.30 pts Does the function $f(z) = \text{Im}(\ln(z))$ defined on the upper half plane have the limit as $z \to 0$ from the upper-half plane?
3.30 pts Find the region of convergence of the series

\[ \sum_{n=1}^{\infty} \sin(\pi \frac{n}{n+1}) z^n \]
4.30 \text{ pts} \text{ The function } f(z) \text{ is entire. Is the function }

\begin{align*}
g(z) &= \begin{cases} 
\frac{f(z) - f(0)}{z}, & z \neq 0 \\
f'(0), & z = 0
\end{cases}
\end{align*}

also entire?
5.30 pts Compute the integral

\[ \int_C \sin^2(x + iy)dz \]

where \( C \) is: