1) (20 points) Compute the integral \( \int_C (y + ix^2) \, dz \), where \( C \) is the triangle with vertices at the points 0, 1, and 1 + i (traversed counter-clockwise).
2) (20 points) Determine whether the following statements are true or false. Justify your answers.

a) If $C$ denotes the unit circle traversed counter-clockwise, then \[ \int_C \frac{dz}{e^{iz}} = 2\pi i \, . \]

b) If $f(z)$ is an entire function, $C$ is the unit circle traversed counter-clockwise, and $|z_0| < 1$, then
\[ \int_C \frac{f'(z)}{z - z_0} \, dz = \int_C \frac{f(z)}{(z - z_0)^2} \, dz \]

c) Let $\alpha$ and $\beta$ be arbitrary complex numbers and let $C$ be a path from $\alpha$ to $\beta$. Then,
\[ \int_C \bar{z} \, dz = (\bar{\beta}^2 - \bar{\alpha}^2)/2. \]
3) **(15 points)** Let $C$ be the square with vertices at the points $\pm 3 \pm 3i$ (oriented counterclockwise). Compute
\[
\int_C \frac{z^2 \, dz}{(z - i)^2(z + 1)}
\]
4) **(10 points)** Compute \( \int_C \frac{dz}{z + 1} \), where \( C \) is the path indicated by the picture.

5) **(7 points)** Let \( \sum_{n=0}^{\infty} a_n z^n \) be the Taylor expansion around \( z_0 = 0 \) of the function \( f(z) = \frac{e^z}{1 - z^3} \). Find the coefficient \( a_3 \).
6) (20 points) Find the Taylor expansion of the following functions at the indicated points: 

a) \( f(z) = \frac{1}{z(z + 1)} \) around \( z_0 = 1 \).

b) \( f(z) = \log(z + 1) \) around \( z_0 = 0 \).
7) (8 points) Prove that \[ \left| \int_C \frac{z^2}{1 + z} \, dz \right| < 12\pi \], where \( C \) is the piece of the circle \( |z| = 4 \) going from 4 to \( 4i \) counter-clockwise.