

1. Find a branch of $\log(z^3 - 1)$ (that is, $\mathcal{L}_\tau(z^3 - 1)$ for a suitable τ) that is analytic at $z = 0$ and takes the value $i\pi$ there.
2. Compute the following integrals. In some cases you must find a suitable parametrization for the given contour:

(a) $\int_\gamma (\operatorname{Im}(z))^2 dz$ where γ is parametrized by $z(t) = 3t + 2it$, $-2 \leq t \leq 2$.

(b) $\int_\gamma \frac{z+1}{\bar{z}} dz$ where γ is the right half of the unit circle from $-i$ to i .

(c) $\int_\gamma |z|^2 dz$ where γ is $z(t) = t^2 + \frac{i}{t}$, $1 \leq t \leq 2$.

(d) $\int_\gamma e^{\bar{z}} dz$ where γ consists of the line segment from $z = 0$ to $z = 2$ followed by the line segment from $z = 2$ to $z = 1 + \pi i$.

(e) $\int_\gamma \operatorname{Re}(z) dz$ where γ is the circle of radius 2 with positive orientation.