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f[z_] = 1 / (z^3 + 1)

$$\frac{1}{1 + z^3}$$


z1 = -1; z2 = Cos[Pi/3] + I Sin[Pi/3]; z3 = Cos[5 Pi/3] + I Sin[5 Pi/3];

z1
-1

res1 = I Limit[f[z] (z - z1), z → z1]

$$\frac{i}{3}$$


In[4]:= Cos[Pi/6] + I Sin[Pi/6]
Out[4]=  $\frac{i}{2} + \frac{\sqrt{3}}{2}$ 

res2 = FullSimplify[(Cos[Pi/6] + I Sin[Pi/6]) Limit[f[z] (z - z2), z → z2]]

$$-\frac{i}{3}$$


In[5]:= Cos[5 Pi/6] + I Sin[5 Pi/6]
Out[5]=  $\frac{i}{2} - \frac{\sqrt{3}}{2}$ 

res3 = FullSimplify[(Cos[5 Pi/6] + I Sin[5 Pi/6]) Limit[f[z] (z - z3), z → z3]]

$$-\frac{i}{3}$$


FullSimplify[2 Pi I (res1 + res2 + res3)]

$$\frac{2\pi}{3}$$


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