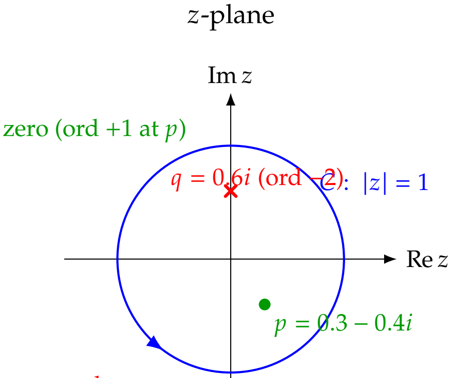

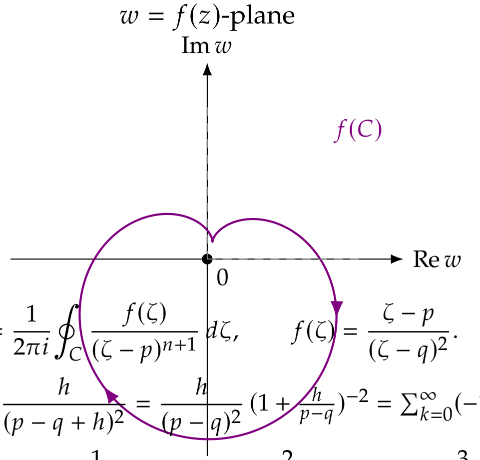

$$a_n = \frac{1}{2\pi i}\oint_C \frac{f(\zeta)}{(\zeta-p)^{n+1}}\,d\zeta, \qquad f(\zeta) = \frac{\zeta-p}{(\zeta-q)^2}.$$

$$f(z) = \frac{z-p}{(z-q)^2}, \quad \frac{df}{f} = \frac{dz}{z-p} - \frac{2\,dz}{z-q}.$$

Let $h = \zeta - p$. Then $f = \dfrac{h}{(p-q+h)^2} = \dfrac{h}{(p-q)^2}\left(1+\frac{h}{p-q}\right)^{-2} = \sum_{k=0}^{\infty}(-1)^k(k+1)\,\frac{h^{k+1}}{(p-q)^{k+2}}$.

$$\operatorname{ord}_p f = \frac{1}{2\pi i}\oint_{\partial D_\varepsilon(p)} \frac{df}{f} = +1, \quad \operatorname{ord}_q f = \frac{1}{2\pi i}\oint_{\partial D_\varepsilon(q)} \frac{df}{f} = -2.$$

$$\Rightarrow a_0 = 0, \quad a_1 = \frac{1}{(p-q)^2}, \quad a_2 = -\frac{2}{(p-q)^3}, \quad a_3 = \frac{3}{(p-q)^4}, \ \ldots$$

$\Rightarrow \ \#Z - \#P = 1 - 2 = -1.$

$$\operatorname{wind}\big(f(C), 0\big) = \#Z_C - \#P_C = 1 - 2 = -1 \ \Rightarrow \ \oint_C \frac{f'(z)}{f(z)}\,dz = -2\pi i.$$