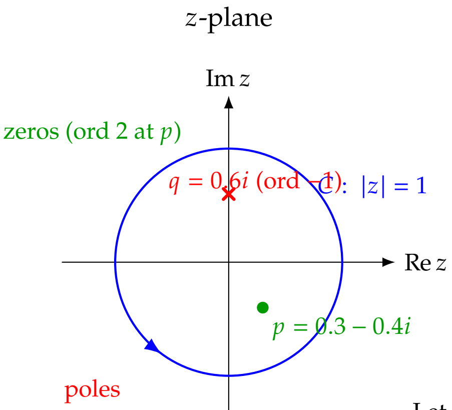

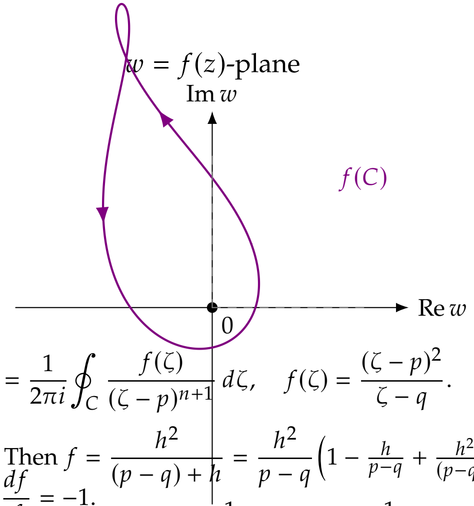

$$a_n = \frac{1}{2\pi i}\oint_C \frac{f(\zeta)}{(\zeta - p)^{n+1}}\,d\zeta, \quad f(\zeta) = \frac{(\zeta - p)^2}{\zeta - q}.$$

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

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

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

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

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