Complex Numbers in Polar Form

$z=x+iy$, $r=|z|=\sqrt{x^2+y^2}$, $x= r\cos\theta$, $y=r\sin\theta$

$\theta=\arctan(y/x)+k\pi$ (according to the quadrant)

$$z=r(\cos\theta + i\sin\theta)=re^{i\theta}$$

Multiplication and Division in Polar Form

$z_1=r_1e^{i\theta}$, $z_2=r_2e^{i\varphi}$

$z_1z_2= r_1r_2e^{i(\theta+\varphi)}$, $z_1/z_2= r_1/r_2\, e^{i(\theta-\varphi)}$

De Moivre's Formula

$$z^n=r^n(\cos n\theta + i\sin n\theta)=r^ne^{ni\theta}$$

Roots

Equation $w^n=z$ has n solutions

$w_k=\sqrt[n]{r}\,(\cos(\theta+2\pi k)/n + i\sin(\theta+2\pi k)/n)$,

$k=0,1,\ldots,n-1$

Points w_0, w_1, …, w_{n-1} lie on a circle of radius $\sqrt[n]{r}$ and center 0 and constitute the vertices of a regular polygon.

Quadratic Equation

$z^2+pz+q=0$,

$z_{1,2}=(-p\pm\sqrt{p^2-4q})/2$