**Complex Numbers – Formula Sheet:**

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| **Complex Numbers in Rectangular Form:** | **Imaginary Numbers:**$$i=\sqrt{-1} i^{2}=-1 i^{3}=-i i^{4}=1$$**Complex Number in Rectangular Form:**$$z=a+bi$$$$a=r\cos(θ) b=r\sin(θ)$$**Absolute Value:**$$\left|z\right|=\sqrt{a^{2}+b^{2}}$$ |
| **Complex Numbers in Polar Form:** | **Complex Numbers in Polar Form:**$$z\_{1}=r\_{1}[\cos(θ\_{1}+i\sin(θ\_{1})])$$$$z\_{2}=r\_{2}[\cos(θ\_{2}+i\sin(θ\_{2})])$$**Modulus** $(r)$ **and Argument** $\left(θ\right)$**:**$$r=\sqrt{a^{2}+b^{2}}$$$$θ=tan^{-1}\left(\frac{b}{a}\right)$$ |
| **Product of Two Complex Numbers:**$$z\_{1}∙z\_{2}=r\_{1}r\_{2}\left[\cos(\left(θ\_{1}+θ\_{2}\right)+i\sin(\left(θ\_{1}+θ\_{2}\right)))\right]$$ | **Quotient of Two Complex Numbers:**$$\frac{z\_{1}}{z\_{2}}=\frac{r\_{1}}{r\_{2}}\left[\cos(\left(θ\_{1}-θ\_{2}\right))+i\sin(\left(θ\_{1}-θ\_{2}\right))\right]$$ |
| **De Moivre’s Theorem – Power of Complex Number:**$$z^{n}=r^{n}\left[\cos(\left(nθ\right))+i\sin(\left(nθ\right))\right]$$**Exponential to Polar Form:**$$e^{iθ}=\cos(θ)+i\sin(θ)$$$$e^{i(0°)}=1 e^{i(90°)}=i$$$$e^{i(180°)}=-1 e^{i\left(270°\right)}=-i$$ | **De Moivre’s Theorem – Roots of Complex Number:**$$z\_{k}=\sqrt[n]{r}\left[\cos(\left(\frac{θ+2πk}{n}\right)+i\sin(\left(\frac{θ+2πk}{n}\right)))\right]$$$$z\_{k}=\sqrt[n]{r}\left[\cos(\left(\frac{θ+360°k}{n}\right)+i\sin(\left(\frac{θ+360°k}{n}\right)))\right]$$$$k=0, 1, 2, 3, 4, …n-1$$**Shortcut Notation:**$$r cis θ=r[\cos(θ)+i\sin(θ)]$$ |