Derivatives Cheat sheet

How to write

Rect (x, y)
Polar (r, θ)
Compass: r at θ

Polar Coordinates

$$\cos(\theta) = \frac{x}{r} \qquad \sin(\theta) = \frac{y}{r}$$
$$x = r * \cos(\theta) \qquad y = r * \sin(\theta)$$
$$r^2 = \pm\sqrt{x^2 + y^2} \qquad \theta = \tan^{-1}(\frac{y}{x})$$

θ is counter-clockwise from the positive x-axis
θ may need $\pm$ 180 or π
Polar things can be represented many different ways

Compass Coordinates

θ is clockwise from the positive y-axis and is always positive
r and θ are both always positive
visualize where it should be

Imaginary Numbers

$a + bi \rightarrow r(\cos(\theta) + i\sin(\theta)) = r * cis(\theta)$
$r = sqrt(a^2 + b^2)$
$\theta = \tan^{-1}(\frac{b}{a})$
Make sure in right quadrant
Multiplying

$$[r_1 cis(\theta_1)] * [r_2 cis(\theta_2)] = (r_1 * r_2)cis(\theta_1 + \theta_2)$$

Dividing

$$\frac{r_1 cis(\theta_1)}{r_2 cis(\theta_2)} = (\frac{r_1}{r_2})cis(\theta_1 - \theta_2)$$

Raising to a power (n $\geq$ 1 and positive integer)

$$[rcis(\theta)]^n = r^n cis(n * \theta)$$

Getting n^{th} root of

$$[rcis(\theta)]^{\frac{1}{n}} = r^{\frac{1}{n}} cis(\frac{\theta}{n} + \frac{360}{n} * k)$$

where k = 0, 1, 2, ..., n - 1