Simplest form of DEQ

$$\frac{dy}{dx} = f(x)$$

↑ Know antiderivative

$$\frac{dy}{dx} = \cos x$$

$$y = \sin x + C$$

$$\frac{dy}{dx} = \sec^2 x$$

$$y = \tan x + C$$

$$\frac{du}{dt} = \frac{1}{1+t^2}$$

$$u = \tan^{-1}(t) + C$$

$$\frac{dr}{d\theta} = \frac{1}{\sqrt{1-\theta^2}}$$

$$r = \sin^{-1}(\theta) + C$$

Initial Value Problem

$$\frac{dr}{d\theta} = \frac{1}{\sqrt{1-\theta^2}}$$

$$r = \sin^{-1}(\theta) + C$$ ← general solution

I.C. $\theta = \frac{1}{2}, r = \frac{\pi}{3}$

$$\frac{\pi}{3} = \sin^{-1}\left(\frac{1}{2}\right) + C$$

$$\frac{\pi}{3} = \frac{\pi}{6} + C$$

$$C = \frac{\pi}{6}$$

$$r = \sin^{-1}(\theta) + \frac{\pi}{6}$$ ← particular solution

Implications of Chain Rule

$$\frac{dy}{dx} = \cos\left(6x^2\right) \cdot (12x)$$

$u = 6x^2$

$\frac{du}{dx} = 12x$

$$= \cos(u) \cdot du$$

$$y = \sin(u) + C$$

$$= \sin(6x$$