Differentiation Tricks

Change roots to fractional exponents and use the Power Rule

$\frac{d}{dx}\left[\sqrt[7]{x^3}\right]=\frac{d}{dx}\left[x^{\frac{3}{7}}\right]$ $=\frac{3}{7}x^{-\frac{4}{7}}$	$\frac{d}{dx}\left[x\cdot\sqrt{2x}\right]=\frac{d}{dx}\left[x(2x)^{\frac{1}{2}}\right]$ $=\frac{d}{dx}\left[x\cdot 2^{\frac{1}{2}}\cdot x^{\frac{1}{2}}\right]$ $=\frac{d}{dx}\left[2^{\frac{1}{2}}x^{\frac{3}{2}}\right]$ $=2^{\frac{1}{2}}\cdot\frac{3}{2}x^{\frac{1}{2}}$

Change fractions to a product and use Product Rule

$\frac{d}{dx}\left[\frac{1}{x^2+1}\right]=\frac{d}{dx}\left[\left(x^2+1\right)^{-1}\right]$ $=-\left(x^2+1\right)^{-2}\cdot 2x$	$\frac{d}{dx}\left[\frac{\sin(x)}{x^2}\right]=\frac{d}{dx}\left[\sin(x)\cdot x^{-2}\right]$ $=\cos(x)\cdot x^{-2}+\sin(x)\cdot\left(-2x^{-3}\right)$

Use properties of logarithms to expand before differentiating

$\frac{d}{dx}\left[\ln\left(x^2\right)\right]=\frac{d}{dx}\left[2\ln(x)\right]=2\cdot\frac{1}{x}$	$\frac{d}{dx}\left[\ln\left(\frac{x}{x^2+1}\right)\right]=\frac{d}{dx}\left[\ln(x)-\ln\left(x^2+1\right)\right]$ $=\frac{1}{x}-\frac{1}{x^2+1}\cdot 2x$
$\frac{d}{dx}\left[\ln\left(\sin(x)\cdot x^2\right)\right]=\frac{d}{dx}\left[\ln\left(\sin(x)\right)+\ln\left(x^2\right)\right]$ $=\frac{d}{dx}\left[\ln\left(\sin(x)\right)+2\ln(x)\right]$ $=\frac{1}{\sin(x)}\cdot\cos(x)+2\cdot\frac{1}{x}$	