MATH 210
RULES FOR DIFFERENTIATION

Atomic Rules

$$\frac{\mathrm{d}}{\mathrm{d}x}\, x^{\alpha} = \alpha x^{\alpha-1}$$

$$\frac{\mathrm{d}}{\mathrm{d}x}\, e^{x} = e^{x}$$

$$\frac{\mathrm{d}}{\mathrm{d}x}\, \ln x = \frac{1}{x}$$

$$\frac{\mathrm{d}}{\mathrm{d}x}\, \sin x = \cos x$$

$$\frac{\mathrm{d}}{\mathrm{d}x}\, \cos x = -\sin x$$

$$\frac{\mathrm{d}}{\mathrm{d}x}\, b^{x} = \ln(b)\cdot b^{x} \qquad (b>0 \text{ and } b\neq 1)$$

$$\frac{\mathrm{d}}{\mathrm{d}x}\, \log_b(x) = \frac{1}{\ln(b)x} \qquad (b>0 \text{ and } b\neq 1)$$

$$\frac{\mathrm{d}}{\mathrm{d}x}\, \tan x = \sec^2 x$$

$$\frac{\mathrm{d}}{\mathrm{d}x}\, \sec x = \sec x \tan x$$

$$\frac{\mathrm{d}}{\mathrm{d}x}\, \cot x = -\csc^2 x$$

$$\frac{\mathrm{d}}{\mathrm{d}x}\, \csc x = -\csc x \cot x$$

$$\frac{\mathrm{d}}{\mathrm{d}x}\, \arcsin x = \frac{1}{\sqrt{1-x^2}}$$

$$\frac{\mathrm{d}}{\mathrm{d}x}\, \arccos x = -\frac{1}{\sqrt{1-x^2}}$$

$$\frac{\mathrm{d}}{\mathrm{d}x}\, \arctan x = \frac{1}{1+x^2}$$

$$\frac{\mathrm{d}}{\mathrm{d}x}\, \operatorname{arcsec} x = \frac{1}{|x|\sqrt{x^2-1}}$$

$$\frac{\mathrm{d}}{\mathrm{d}x}\, \operatorname{arccsc} x = -\frac{1}{|x|\sqrt{x^2-1}}$$

$$\frac{\mathrm{d}}{\mathrm{d}x}\, \operatorname{arccot} x = -\frac{1}{1+x^2}$$

Combination Rules

$$\frac{\mathrm{d}}{\mathrm{d}x}\, c\cdot f(x) = c\cdot f'(x)$$

$$\frac{\mathrm{d}}{\mathrm{d}x}\, \big(f(x)+g(x)\big) = f'(x)+g'(x)$$

$$\frac{\mathrm{d}}{\mathrm{d}x}\, \big(f(x)-g(x)\big) = f'(x)-g'(x)$$

$$\frac{\mathrm{d}}{\mathrm{d}x}\, \big(u(x)\cdot v(x)\big) = u'(x)v(x)+u(x)v'(x)$$

$$\frac{\mathrm{d}}{\mathrm{d}x}\, \left(\frac{u(x)}{v(x)}\right) = \frac{u'(x)v(x)-u(x)v'(x)}{v(x)^2}$$

$$\frac{\mathrm{d}}{\mathrm{d}x}\, f(u(x)) = f'(u(x))\cdot u'(x)$$

$$\frac{\mathrm{d}y}{\mathrm{d}x} = \frac{\mathrm{d}y}{\mathrm{d}u}\cdot\frac{\mathrm{d}u}{\mathrm{d}x}$$