Differentiation Rules (Chapter 3)

1. $\dfrac{d}{dx}[cf(x)] = cf'(x)$ for any constant c (constants pull out)
2. $\dfrac{d}{dx}[f(x)+g(x)] = f'(x)+g'(x)$ and $\dfrac{d}{dx}[f(x)-g(x)] = f'(x)-g'(x)$
   (derivative of a sum or difference = sum or difference of the derivatives)
3. **Product Rule**: $\dfrac{d}{dx}[f(x)g(x)] = f(x)g'(x)+f'(x)g(x)$
4. **Quotient Rule**: $\dfrac{d}{dx}\left[\dfrac{f(x)}{g(x)}\right] = \dfrac{g(x)f'(x)-f(x)g'(x)}{[g(x)]^2}$ or $\left(\dfrac{u}{v}\right)' = \dfrac{v\,du - u\,dv}{v^2}$
5. **Chain Rule**: $\dfrac{d}{dx}f(g(x)) = f'(g(x))\cdot g'(x)$ or $\dfrac{dy}{dt} = \dfrac{dy}{dx}\cdot\dfrac{dx}{dt}$

Some Specific Derivative Formulas

1. $\dfrac{d}{dx}(c) = 0$ for any constant c (derivative of a constant is zero)
2. $\dfrac{d}{dx}(mx+b) = m$ (derivative of a line = slope)
3. **Power Rule**: $\dfrac{d}{dx}x^n = nx^{n-1}$ for any real number n
4. $\dfrac{d}{dx}e^x = e^x$
5. $\dfrac{d}{dx}b^x = \ln b\cdot b^x$ for any real number $b>0$
6. $\dfrac{d}{dx}\sin x = \cos x$ and $\dfrac{d}{dx}\cos x = -\sin x$
7. $\dfrac{d}{dx}\tan x = \sec^2 x$ and $\dfrac{d}{dx}\cot x = -\csc^2 x$
8. $\dfrac{d}{dx}\sec x = \sec x\cdot\tan x$ and $\dfrac{d}{dx}\csc x = -\csc x\cdot\cot x$
9. $\dfrac{d}{dx}\sin^{-1} x = \dfrac{1}{\sqrt{1-x^2}}$ and $\dfrac{d}{dx}\cos^{-1} x = -\dfrac{1}{\sqrt{1-x^2}}$
10. $\dfrac{d}{dx}\tan^{-1} x = \dfrac{1}{1+x^2}$ and $\dfrac{d}{dx}\cot^{-1} x = -\dfrac{1}{1+x^2}$
11. $\dfrac{d}{dx}\ln x = \dfrac{1}{x}$
12. $\dfrac{d}{dx}\log_b x = \dfrac{1}{\ln b\cdot x}$