# MATH 1420: WORKSHEET FOR SECTION 3.1

There are two types of rules for derivatives: rules that tell you how to differentiate a basic function, and rules that tell you what to do when a function is built up from simpler functions. Here's some rules to get us started.

## Rules for basic functions

**Constant Rule.** Whenever $c$ is a constant,

$$\frac{\mathrm{d}}{\mathrm{d}x}c = 0.$$

**Power Rule.** When $n$ is a positive integer

$$\frac{\mathrm{d}}{\mathrm{d}x}x^n = nx^{n-1}.$$

**Extended Power Rule.** More generally this works for any (nonzero) power:

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

## Rules for building up from simpler functions

**Multiplication by a constant.**

$$\frac{\mathrm{d}}{\mathrm{d}x}cf(x) = c\frac{\mathrm{d}}{\mathrm{d}x}f(x) = cf'(x).$$

**Adding functions.**

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

**Product rule.**

$$\frac{\mathrm{d}}{\mathrm{d}x}f(x)g(x) = f'(x)g(x) = f(x)g'(x).$$

**Quotient rule.**

$$\frac{\mathrm{d}}{\mathrm{d}x}\frac{f(x)}{g(x)} = \frac{f'(x)g(x) - f(x)g'(x)}{g(x)^2}$$

Using these rules, you can compute the derivative of any polynomial or any rational function. Here's some functions to differentiate.

(1) $a(x) = x^2 = x \cdot x$. Try this with both the power rule and the product rule.

(2) $b(x) = 4x^5 - 3x^2 + 2x + 3$.

(3) $c(x) = \frac{1}{x}$.

(4) $d(x) = \frac{1}{x^3}$. Try this with both the extended power rule and the quotient rule.

(5) $e(x) = \frac{(x-1)(x+1)}{x^2}$.

(6) $f(x) = 1 - \frac{1}{x^2}$. (You should get a formula for $f'(x)$ equivalent to what you got for $e'(x)$. Why?)

(7) $g(x) = 3x^2 + \frac{2x-1}{x+2}$.