# Announcements

1) Work on Labs

2) New Webwork up

# Consequence of Mean Value Theorem

Let $f$ be continuous on $[a,b]$, differentiable on $(a,b)$. If $f'(x)=0$ for all $x$ in $(a,b)$, then $f$ is constant on $[a,b]$.

This is easy since for all points $x, z$ in $[a,b]$, there is a point $c$ in $(x,z)$ with

$$f'(c) = \frac{f(x)-f(z)}{x-z}$$

$$\parallel$$

$$0$$

. This means $f(x) = f(z)$, and so $f$ is constant.

# Antiderivatives

(section 3.9)

Starting with a function $f$, you want to find a function $g$ with $g'(x) = f(x)$.

Find antiderivative for

$$f(x) = x.$$

Want some function g with

$$g'(x) = x.$$

$g(x) = \frac{x^2}{2}$ works

since $g'(x) = \frac{1}{2} 2 \cdot x = x$.

Could also have used

$$g(x) = \frac{x^2}{2} + 1$$

because $g'(x) = \frac{1}{2} \cdot 2x + 0$

$$= x$$

In fact, $g(x) = \frac{x^2}{2} + C$

will work for any constant

$C$.

**Theorem:** Suppose f and h are functions that are differentiable everywhere. If $f'(x) = h'(x)$ for all real numbers $x$, then there is a number $C$ with

$$f(x) = h(x) + C.$$

Apply previous result to $f(x) - h(x)$.

The moral: Once you know one antiderivative for F, you know them all - just add constants.

## Example 1. $f(x) = x^7 - 3x^4 + 11x^2$

Find all antiderivatives for $f$.

One is $g(x) = \dfrac{x^8}{8} - 3\left(\dfrac{x^5}{5}\right) + 11\left(\dfrac{x^3}{3}\right)$

Check: $g'(x) =$

$$\frac{\cancel{8}x^7}{\cancel{8}} - 3\left(\frac{\cancel{5}x^4}{\cancel{5}}\right) + 11\left(\frac{\cancel{3}x^2}{\cancel{3}}\right)$$

$$= x^7 - 3x^4 + 11x^2 = f(x).$$

All antiderivatives are of the form

$$\frac{x^8}{8} - \frac{3x^5}{5} + \frac{11x^3}{3} + C$$