By the FTC, differentiation and integration are inverse processes (adjusted by an integration constant). That is, and

Note: In general, it is much more difficult to integrate than differentiate. In fact, all of chapter 8 is devoted to techniques of integration. At this point, we don’t have a “Product Rule” for integrals and thus cannot integrate, for example, . (Can do this using Integration By Parts – Ch 8)

Theorem: Antidifferentiation of a Composite Function

Let be a function whose range is an interval , and let be a function that is continuous on . If g is differentiable on its domain and is an antiderivative of on , then

If , then and

**Def:** Recall from sec. 5.1 that the set of all antiderivatives of the function is called the **indefinite integral**  of with respect to , and is symbolized by

*Rule* If is any differentiable function, then

Ex 1 (# 48) Find by substituting .

Often we will be asked to integrate functions that are the result of some chain rule. For cases like these

we employ a U substitution to help us find anti-derivatives of these types of functions.

*Theorem* *The Substitution Rule*

If is a differentiable function whose range is an interval and is continuous on , then

Ex 2 Integrate using substitution.

(# 11) Hint: Which is and which is ?

See bottom of first page of section 5.5 in book. “Exploration” Discuss whether or not we can find a pattern to what we choose for our “U” and how we go about finding it each time.

Steps For Subtitution:

1. Let be the most complicated part of the integrand. (Generally works.) When deciding how to define , look for what would be.
2. Find the differential and then solve for .
3. Substitute in and .
4. Integrate. Replace all by .

## Some common “tricks”

Sometimes will be off by a **multiple** of a constant! If so, don’t worry, it will all work out.

1. (T# 8)

Sometimes will be hidden because a constant is **added** to . That is ok too, because when you look for you know that that constant will be gone.

1. (T# 20)

Sometimes are not obvious so you may need to try some different values for U before you find the right one.

This is one of my favorite tricks!! It looks so clever.

1. 5.5.94

1. (T# 40)
2. (T# 42)
3. (T# 44)

Ex 3 Find using the trig identity: .

## Definite Integrals and U subs

When you make a u substitution on a definite integral, it is like translating the problem from one language to another. With a definite integral, all you have to remember is that your limits of integration are in the original language and if you make a u substitution, you need to translate the limits as well!!

Ex: Evaluate the definite Integral:

1. 5.5.96

## Integration of Even and Odd Functions

Integration of Even and Odd Functions

Let be integrable on the closed interval

1. If is an *even* function, then
2. If is an *odd* function, then

Ex: Evaluate the integral: