## Section 8.1 Integration By Parts

**Goal**: To be able to integrate more functions.

**Chapter 8: Techniques of Integration**





Integration using **substitution** can be thought of as the **chain rule** in reverse.

**Integration by parts** can be thought of as the **product rule** in reverse.

$$\frac{d}{dx}\left[f(x)\cdot g(x)\right]=f'(x)\cdot g(x)+f(x)\cdot g'(x)$$

$$\int\frac{d}{dx}\left[f(x)\cdot g(x)\right]dx=\int\left[f'(x)\cdot g(x)\right]dx+\int\left[f(x)\cdot g'(x)\right]dx$$

$$f(x)\cdot g(x)=\int\left[f'(x)\cdot g(x)\right]dx+\int\left[f(x)\cdot g'(x)\right]dx$$

$$f(x)\cdot g(x)-\int\left[f'(x)\cdot g(x)\right]dx=\int\left[f(x)\cdot g'(x)\right]dx$$

$$\int\left[f(x)\cdot g'(x)\right]dx=f(x)\cdot g(x)-\int\left[f'(x)\cdot g(x)\right]dx$$

$$\int \overset{u}{f(x)} \cdot \overset{dv}{g'(x)\,dx} = \overset{u}{f(x)} \cdot \overset{v}{g(x)} - \int \overset{v}{g(x)} \cdot \overset{du}{f'(x)\,dx}$$

$$u = f(x) \qquad v = g(x)$$

$$du = f'(x)\,dx \quad dv = g'(x)\,dx$$

$$\boxed{\int u\,dv = u \cdot v - \int v\,du}$$

Choose $u$ and choose $dv$

<u>**Big Picture**</u>: We are trading in one integral for another

$\int u\,dv$ $\qquad$ $\int v\,du$

**Goal**: To get a **simpler** integral than the original one

**1**. Choose $u$ to be a function that becomes simpler when **differentiated**

**2**. Make sure $dv$ can be readily **integrated**



Hierarchy Mneumonic to aid in choosing u

**L** : logarithmic functions

**I** : inverse trigonometric functions

**A** : algebraic functions

**T** : trigonometric functions

**E** : exponential functions

(T and E are interchangeable)