# CH 7.1 INTEGRATION BY PARTS

**NOTE:** Integration by SUBSTITUTION undoes the CHAIN RULE. The next method that we will learn, INTEGRATION by PARTS, undoes the PRODUCT RULE.

## DERIVATION of THE FORMULA

**INTEGRATION by PARTS** is useful when our integrand is a product. We choose "u" and "dv", apply the formula, and hope that $\int v\,du$ is simpler than $\int u\,dv$

## PROCEDURE

**STEP 1:** Choose "u" according to L.I.P.E.T.

**STEP 2:** Let "dv" be what's left!

**STEP 3:** Find "du" by differentiating "u" and find "v" by integrating "dv". Then apply the formula!

## PART 1: BASIC EXAMPLES

**Ex 1** Compute the following indefinite integrals using INTEGRATION by PARTS

**A** $\int xe^x dx$

sol:

**B** $\int t\sin(t)\,dt$

sol:

C $\int 30x^4 \ln(x)\,dx$

sol:

## PART 2: DEFINITE INTEGRALS

Ex 2. Compute the following definite integrals using INTEGRATION by PARTS

A $\int_1^2 \frac{\ln(x)}{x^2}\,dx$

sol:

## PART 3. IT WORKS!

For some integrals, it may not look like integration by parts will apply, but it still works!

**Ex 3.** Compute the following integrals using INTEGRATION by PARTS

**A** $\int \ln(4x)\,dx$

Sol:

**B** $\int \arctan(2x)\,dx$

Sol:

## PART 4: MORE COMPLEX EXAMPLES

**Ex 4. [DOUBLE BY PARTS]** $\int t^2 \cos(t)\,dt$

**Sol:**

Ex 5. [THE GENIUS MOVE] $\int e^x \cos(2x)\, dx$

Sol: