


## SKILL #6: Integration by Parts

$$\int x \cos x \, dx = ?$$

Just as the Product Rule was used to **differentiate the product** of two expressions, we can often use 'Integration by Parts' to **integrate a product**.

 To integrate by parts:

$$\int u \frac{dv}{dx} dx = uv - \int v \frac{du}{dx} dx$$

### Example 1

$$\int x \cos x \, dx = ?$$

$$\int u \frac{dv}{dx} dx = uv - \int v \frac{du}{dx} dx$$

**STEP 1:** Decide which thing will be  $u$  (and which  $\frac{dv}{dx}$ ).

You're about to differentiate  $u$  and integrate  $\frac{dv}{dx}$ , so the idea is to pick them so differentiating  $u$  makes it 'simpler', and  $\frac{dv}{dx}$  can be integrated easily.  $u$  will always be the  $x^n$  term **UNLESS** one term is  $\ln x$ .

**STEP 2:** Find  $\frac{du}{dx}$  and  $v$ .

**STEP 3:** Use the formula.

I just remember it as " $uv$  minus the integral of the two new things timesed together"

### Example 2

Find  $\int x \ln x \, dx$

Here, the choice of  $u$  must be  $\ln x$  because  $\ln x$  is difficult to integrate

### Example 3

Find  $\int \ln x \, dx$

Here, the 'trick' is to write the integral as  $\int 1 \times \ln x \, dx$

Again, the choice of  $u$  must be  $\ln x$

# IBP twice! 😊

q Find  $\int x^2 e^x dx$



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## Example 5

Find  $\int e^x \cos x dx$

# Test Your Understanding

Q Find  $\int x^2 \sin x \, dx$