Integration By Parts

Formula $\boxed{uv - \int v\,du}$

Purpose – used to integrate a product of
2 functions

Steps
① Choose the function with the more simple derivative to be u
- let the remaining terms be dv

② Find du by taking derivative of u
Find v by integrating dv

③ plug 4 pieces into formula

④ Simplify formula

⑤ repeat process if needed

⑥ dont forget $+ C$

Ex 1 $\int x \cos x \, dx$

let $u = x$ let $dv = \cos x \, dx$
so $du = dx$ and $v = \sin x$

Formula $x \sin x - \int \sin x \, dx$

$\Bigl[_{so}$ $\boxed{x \sin x + \cos x + c}$

Ex 2

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

let $u = x^2$ let $dv = \sin x \, dx$
so $du = 2x \, dx$ and $v = -\cos x$

Formula $-x^2 \cos x + \int 2x \cos x \, dx$

                       $u = 2x$ $dv = \cos x \, dx$ repeat proc
                       $du = 2 \, dx$ $v = \sin x$

           Formula
$-x^2 \cos x + \Bigl[$ $2x \sin x - 2 \int \sin x \, dx$
                $2x \sin x$ $+ 2\cos x$

so

$$\boxed{-x^2 \cos x + 2x \sin x + 2\cos x + C}$$