

Integration by parts.

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

$$\Rightarrow \underbrace{\int \frac{d}{dx} [f(x) \cdot g(x)] dx}_{f(x) \cdot g(x)} = \int f'(x)g(x) dx + \int f(x)g'(x) dx$$

$$\Rightarrow \int f(x)g'(x) dx = f(x)g(x) - \int f'(x)g(x) dx$$

Again

$$(uv)' = u'v + v'u.$$

$$\Rightarrow uv' = (uv)' - u'v$$

$$\Rightarrow \int u dv = uv - \int v du.$$

Ex1: $\int x \cos x dx$

Ex2: $\int \ln(x) dx$

Ex3: $\int x^2 \sin(\pi x) dx$

Ex4: $\int e^{2\theta} \sin(3\theta) d\theta$ (cyclic)

Ex5: $\int_1^4 \sqrt[4]{t} \ln(t) dt.$ Definite Integrals.