Integration by Parts

Recall the product rule for derivatives

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

But this means that

.

Examples: Find the following antiderivatives:

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

2) $\int x^2 e^x \, dx$

3) $\int \ln x\,dx$

4) $\int \dfrac{xe^x}{(x+1)^2}\,dx$

5) $\int e^x \cos x \, dx$

6) Prove the following reduction formula:

$$\int \sin^n x\, dx = -\frac{1}{n}\cos x \sin^{n-1} + \frac{n-1}{n}\int \sin^{n-2} dx$$

where $n \geq 2$ is an integer.

Integration by parts for a definite integral:

Example: Evaluate the following definite integrals

1) $\displaystyle\int_{1}^{e} x^{3}(\ln x)^{2}\,dx$

2) $\int_0^1 (x-3)e^{3x}\,dx$

3) $\int_0^1 \tan^{-1} x\, dx$