

# Integration by Parts

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## Product Rule

$$\frac{\textcolor{red}{d}}{\textcolor{red}{dx}} \left[ f(x) g(x) \right] = \textcolor{red}{f}'(\textcolor{red}{x}) g(x) + f(x) \textcolor{red}{g}'(\textcolor{red}{x})$$

## Integration by Parts

$$\int \textcolor{blue}{f}(\textcolor{blue}{x}) \textcolor{red}{g}(\textcolor{red}{x}) dx = \textcolor{blue}{F}(\textcolor{blue}{x}) g(x) - \int \textcolor{blue}{F}(\textcolor{blue}{x}) \textcolor{red}{g}'(\textcolor{red}{x}) dx$$

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1. Compute derivative and integral.

$$\frac{d}{dx} \left[ 4x e^{5x} \right]$$

$$\int 4x e^{5x} dx$$

$$\frac{d}{dx} \left[ 2x \sin(3x) \right]$$

$$\int 2x \sin(3x) dx$$

$$\frac{d}{dx} \left[ 2x \ln(x) \right]$$

$$\int 2x \ln(x) dx$$

$$\frac{d}{dx} \left[ x \sec(x) \tan(x) \right]$$

$$\int x \sec(x) \tan(x) dx$$

2. Substitute then integrate by parts:

$$\int e^{\sqrt{x}} dx$$

3. Solve using integration by parts:

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

$$\int \arctan(x) dx$$

4. Use double integration by parts:

$$\int x^2 \sin(3x) dx$$

5. Use circular integration by parts:

$$\int \sin x \cos x dx$$

6. Figure out the reduction formula for

$$\int \cos^n(x) dx$$