AP Calculus
Integration by Parts

Formula for Integration by Parts: $\int u\,dv = uv - \int v\,du$

Where does it come from?

Start with the *Product Rule*: $\frac{d}{dx}(u\,v) =$

It's important to select dv as the expression that can be easily _____.

The expression selected for u (usually) eventually differentiates to _____.

Make your selection for u in the following order of functions:

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

2. $\int x \ln x \, dx$

3. $\int \frac{\ln x}{x^3} \, dx$

4. $\int x^2 e^x \, dx$

5. $\int e^x \sin x \, dx$

Practice

1. $\int x\sin x\ dx$
2. $\int \ln x\ dx$
3. $\int x\cos(2x)\ dx$
4. $\int \frac{\ln x}{x^3}\ dx$
5. $\int x^2 \ln x\ dx$
6. $\int x^2 \sin x\ dx$
7. $\int x^2 e^{3x}\ dx$
8. $\int e^x \cos x\ dx$
9. $\int x^3 \sin x\ dx$
10. $\int e^{2x}\sin(3x)\ dx$
11. $\int \tan^{-1} x\ dx$

Key

1. $-x\cos x+\sin x+C$
2. $x\ln x-x+C$
3. $\frac{1}{2}x\sin(2x)+\frac{1}{4}\cos(2x)+C$
4. $-\frac{\ln x}{2x^2}-\frac{1}{4x^2}$
5. $\frac{x^3\ln x}{3}-\frac{x^3}{9}+C$
6. $-x^2\cos x+2x\sin x+2\cos x+C$
7. $\frac{1}{3}x^2e^{3x}-\frac{2}{9}xe^{3x}+\frac{2}{27}e^{3x}+C$
8. $\frac{1}{2}e^x(\sin x+\cos x)+C$
9. $-x^3\cos x+3x^2\sin x+6x\cos x-6\sin x+C$
10. $\frac{1}{6}e^{2x}(\sin 3x-\cos 3x)+C$
11. $x\tan^{-1}x-\frac{1}{2}\ln\left|x^2+1\right|+C$