Integration by Parts

Remember this formula:

$$\int u\,dv = uv - \int v\,du$$

Examples

- $\int xe^{2x}\,dx$
  - Why do we need to use integration by parts? (Why can't we use u-substitution, for example?)
  - Which function might make this better if we take the derivative of it?
- $\int t^2 \sin 3t\,dt$
- $\int x \sin x \cos x\,dx$
- $\int \sin x \ln(\cos x)\,dx$
- $\int e^{4t} \cos(3t)\,dt$

Trigonometric Substitution

For this we need to recall two identities:

- $\sin^2 x + \cos^2 x = 1$
- $\tan^2 x + 1 = \sec^2 x$

Solve the following integrals:

- $\displaystyle\int \frac{\sqrt{1+x^2}}{x}\,dx$
- $\displaystyle\int \frac{x^3}{x^2+4}\,dx$
- $\displaystyle\int \frac{dx}{x^5\sqrt{9x^2-1}}$
- $\displaystyle\int x\sqrt{1-4x^2}\,dx$
- $\displaystyle\int \frac{dt}{t\sqrt{t^2-16}}$

Trig Integrals

- $\int \sin^2 x \cos^3 x \, dx$
- $\int \sin^3 x \cos^4 x \, dx$
- $\int \sin^2 x \cos^4 x \, dx$

For the last one, use the fact that:

- $\sin^2 x = \frac{1}{2}(1 - \cos 2x)$
- $\cos^2 x = \frac{1}{2}(1 + \cos 2x)$