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

6.3 Day 2

Solve the initial value problems

- Given x and y
- Integrate
- Plug in to solve for C

Choosing "u"

LIPET

L → ln x

I → inverse trig function

P → polynomial

E → Exponential

T → Trig function

Generally -

- u to be something that simplifies when you differientiate
- dv to be something managable when you integrate

$$\frac{dy}{dx} = 2x\, e^{-x} \qquad x = 0,\ y = 3$$

$$\int 2xe^{-x}\,dx$$

$u = 2x$ | $dv = e^{-x}dx$

$du = 2dx$ | $v = -e^{-x}$

$$\int e^{-x}\,dx \qquad u = -x$$

$$du = -1dx$$

$$-1du = dx$$

$$-\int e^{u}du = e^{u} = -e^{-x}$$

$$= u \cdot v - \int v\,du$$

$$= 2x(-e^{-x}) - \int -e^{-x} \cdot 2dx$$

$$= -2xe^{-x} + -2e^{-x} + C$$

$$3 = 0 + -2 + C$$

$$5 = C$$

$$\boxed{y = -2xe^{-x} - 2e^{-x} + 5}$$

$$\frac{dy}{dx} = x \sec^2 x \qquad x = 0,\ y = 1$$

$$\int x \sec^2 x \, dx$$

$u = x \quad | \quad dv = \sec^2 x \, dx$

$du = dx \quad | \quad v = \tan x$

$= u \cdot v - \int v \, du$

$= x \tan x - \int \tan x \, dx$

$= x \tan x - \int \frac{\sin x}{\cos x} dx$

$u = \cos x$

$du = -\sin x \, dx$

$-du = \sin x \, dx$

$-\int \frac{1}{u} du$

$-\ln|u| = -\ln|\cos x|$

$= x \tan x + \ln|\cos x| + c$

$\ln(1)$

$1 = 0 + 0 + c$

$1 = c$

$y = x \tan x + \ln|\cos x| + 1$

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

$u = e^x \quad | \quad dv = \sin x\,dx$

$du = e^x dx \quad | \quad v = -\cos x$

$= u \cdot v - \int v\,du$

$= -e^x \cos x + \int \cos x \cdot e^x dx$

$u = e^x \quad | \quad dv = \cos x\,dx$

$du = e^x dx \quad | \quad v = \sin x$

$\int e^x \sin x\,dx = -e^x \cos x + e^x \sin x - \int \sin x \cdot e^x dx$

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

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