Derivatives

$(c)' = 0$

$(x)' = 1$

$(x^n)' = nx^{n-1}$

$(e^x)' = e^x$

$(b^x)' = b^x \ln(b)$

$(\ln(x))' = \frac{1}{x}$

$(\sin x)' = \cos x$

$(\cos x)' = -\sin x$

$(\tan x)' = \sec^2 x$

$(\csc x)' = -\csc x \cot x$

$(\sec x)' = \sec x \tan x$

$(\cot x)' = -\csc^2 x$

$(\arcsin x)' = \frac{1}{\sqrt{1-x^2}}$ $(\operatorname{arccsc} x)' = \frac{-1}{|x|\sqrt{x^2-1}}$

$(\arccos x)' = \frac{-1}{\sqrt{1-x^2}}$ $(\operatorname{arcsec} x)' = \frac{1}{|x|\sqrt{x^2-1}}$

$(\arctan x)^{-1} = \frac{1}{1+x^2}$ $(\operatorname{arccot} x)' = \frac{-1}{1+x^2}$

Derivative rules

$(u \pm v)' = u' \pm v'$

$(uv)' = u'v + uv'$

$\left(\frac{u}{v}\right)' = \frac{u'v - uv'}{v^2}$

$F'(x) = f'(g(x)) \cdot g'(x)$

Integrals

$$\int x^n dx = \frac{1}{n+1} x^{n+1} \quad (n \neq -1)$$

$$\int \sin x \, dx = -\cos x$$

$$\int \cos x \, dx = \sin x$$

$$\int \frac{1}{x} dx = \ln|x|$$

$$\int uv \, dx = u \int v \, dx - \int u' \left(\int v \, dx\right) dx$$

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

$$\int \tan x \, dx = -\ln(\cos x)$$

$$\int \frac{1}{ax+b} dx = \frac{1}{a} \ln|ax+b|$$

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

$$\int \frac{1}{(x+a)^2} dx = -\frac{1}{x+a}$$

$$\int \frac{1}{a^2+x^2} dx = \frac{1}{a} \tan^{-1} \frac{x}{a}$$

$$\int \frac{1}{\sqrt{a^2-x^2}} dx = \sin^{-1} \frac{x}{a}$$

$$\int e^{ax} dx = \frac{1}{a} e^{ax}$$

$$\int x e^x dx = (x-1) e^x$$

Trig

$$\sin^2\theta + \cos^2\theta = 1$$
$$\tan^2\theta + 1 = \sec^2\theta$$
$$1 + \cot^2\theta = \csc^2\theta$$

$$\sin(-\theta) = -\sin\theta$$
$$\cos(-\theta) = \cos\theta$$
$$\tan(-\theta) = -\tan\theta$$

$$\sin 2\theta = 2\sin\theta\cos\theta$$
$$\cos 2\theta = \cos^2\theta - \sin^2\theta$$
$$\cos 2\theta = 2\cos^2\theta - 1$$
$$\cos 2\theta = 1 - 2\sin^2\theta$$
$$\tan 2\theta = \frac{2\tan\theta}{1-\tan^2\theta}$$

$$\sin\left(\frac{\theta}{2}\right) = \pm\sqrt{\frac{1-\cos\theta}{2}}$$
$$\cos\left(\frac{\theta}{2}\right) = \pm\sqrt{\frac{1+\cos\theta}{2}}$$
$$\tan\left(\frac{\theta}{2}\right) = \pm\sqrt{\frac{1-\cos\theta}{1+\cos\theta}}$$

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

$$\sin(\alpha\pm\beta) = \sin\alpha\cos\beta \pm \cos\alpha\sin\beta$$
$$\cos(\alpha\pm\beta) = \cos\alpha\cos\beta \mp \sin\alpha\sin\beta$$
$$\tan(\alpha\pm\beta) = \frac{\tan\alpha \pm \tan\beta}{1\mp\tan\alpha\tan\beta}$$

$$\sin\alpha\sin\beta = \frac{1}{2}(\cos(\alpha-\beta) - \cos(\alpha+\beta))$$
$$\cos\alpha\cos\beta = \frac{1}{2}(\cos(\alpha-\beta) + \cos(\alpha+\beta))$$
$$\sin\alpha\cos\beta = \frac{1}{2}(\sin(\alpha+\beta) + \sin(\alpha-\beta))$$

$\cos\alpha \sin\beta = \frac{1}{2}(\sin(\alpha+\beta) - \sin(\alpha-\beta))$

When solving for system of differential equations and the flow line

- if x is in y derivative and vice versa, substitute it into when integrating

Circular field → counterclockwise

circular swaps x and y, 1 neg

$v = -yi + xj$

$x(t) = a\cos t \quad y(t) = a\sin(t)$

$x^2 + y^2 = a^2$

Circular field → clockwise

$v = yi - xj$

$x(t) = a\sin t \quad y(t) = a\cos(t)$

$x^2 + y^2 = a^2$

Normal cre $\rightarrow$ cx

$$v = xi + yj$$

flip bottom + integrate

$$x = ae^{t} \quad y = be^{t}$$

$$y = \frac{b}{a}x = cx$$

One over $\rightarrow$ c/x

$$v = xi - yj$$

$$x = ae^{t} \quad y = be^{-t}$$

$$y = \frac{ab}{x} = \frac{c}{x}$$

Hyperbolic

$$v = yi + xj$$

flipped but

function t

second der. & gues $x(t) = e^{kt}$

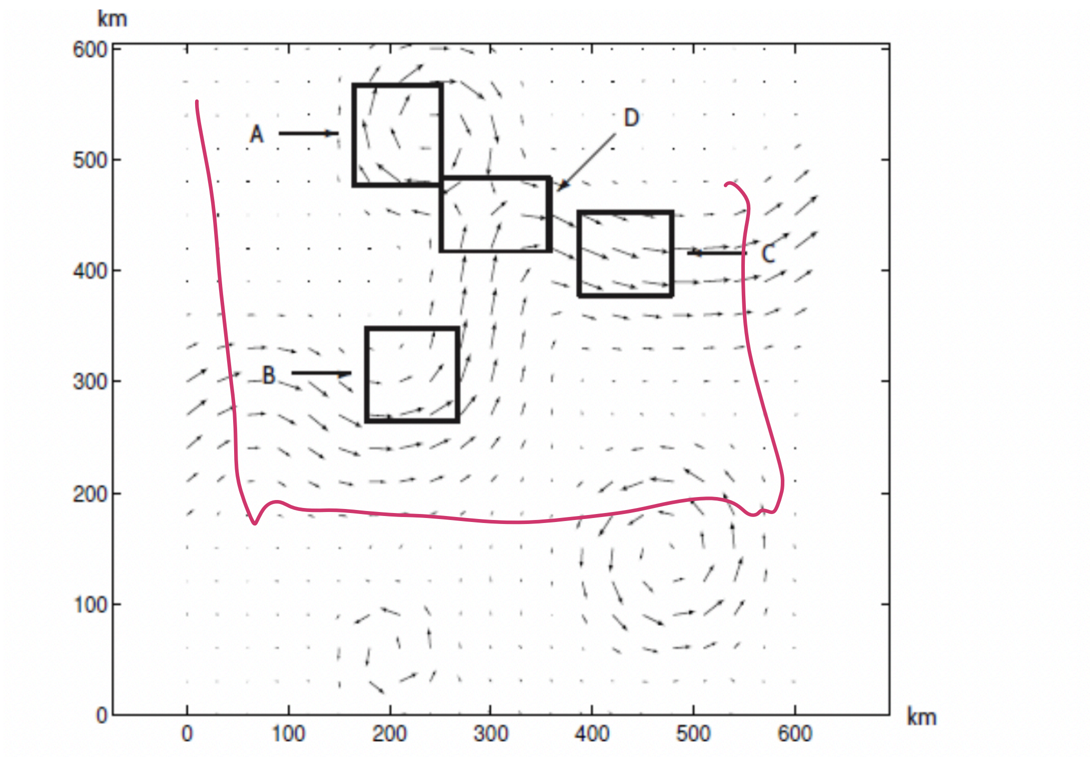
$$x = ae^{t} + be^{-t}$$

$$y = ae^{t} - be^{-t}$$

$$x + y = 2ae^{t}$$

$$x - y = 2be^{-t}$$

$$(x+y)(x-y) = x^2 - y^2 = 4ab$$



If sin & cos things in integral are weird, use polar coordinates

$x = r\cos\theta$

$y = r\sin\theta$

$\iint \ldots r\,dr\,d\theta$