

Office hours cancelled for Wed Jan 28. Please send message in web campus if you want to talk on zoom later today or tomorrow. Regular office hours resume on Friday

Solve $\frac{dy}{dx} = \frac{x(1-x)}{y(-2+y)}$ using separation of variables.

Put all x 's on one side, all y 's on the other, integrate to get an implicit solution:

$$\int y(-2+y) dy = \int x(1-x) dx$$

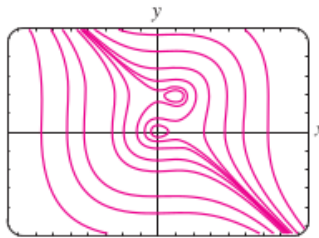
mult out to integrate

$$\int (-2y + y^2) dy = \int (x - x^2) dx$$

$$-y^2 + \frac{1}{3}y^3 = \frac{1}{2}x^2 - \frac{1}{3}x^3 + C$$

← implicit solution...

60. (a) $\frac{dy}{dx} = \frac{x(1-x)}{y(-2+y)}$
numbers of level c

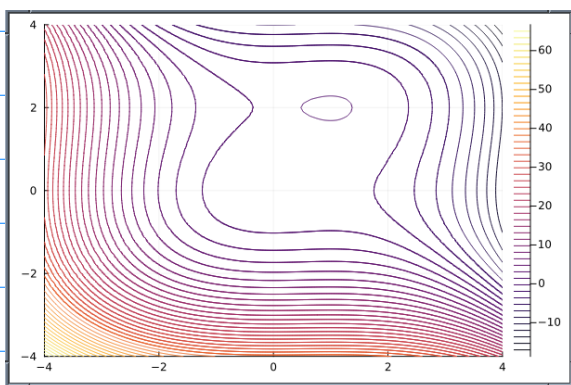


$$f(x, y) = \frac{1}{2}x^2 - \frac{1}{3}x^3 + y^2 - \frac{1}{3}y^3$$

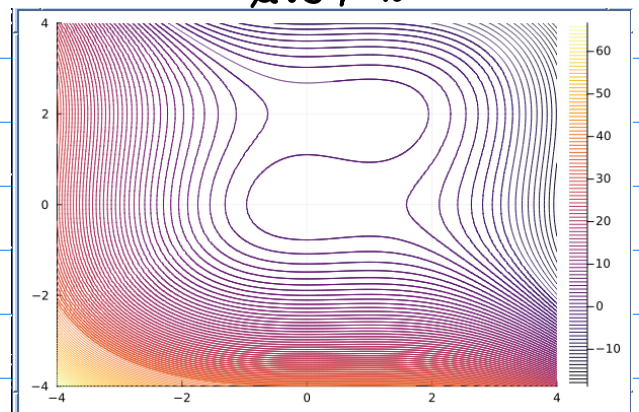
Now solutions are $f(x, y) = C$ ← one parameter family of solutions...

visualize the whole family of solutions by drawing level curves to the function f :

levels=50



levels=100



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julia> using Plots
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julia> f(x,y)=1/2*x^2-1/3*x^3+y^2-1/3*y^3  
f (generic function with 1 method)
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```
julia> contour(-4:0.01:4, -4:0.1:4, f, levels=50)
```

```
julia> contour(-4:0.01:4, -4:0.1:4, f, levels=100)
```

$$7. \frac{dy}{dx} = e^{3x+2y}$$

$$\frac{dy}{dx} = e^{3x} e^{2y}$$

$$\int \frac{1}{e^{2y}} dy = \int e^{3x} dx$$

$$\int e^{-2y} dy = \int e^{3x} dx$$

implicit solution:

$$-\frac{1}{2} e^{-2y} = \frac{1}{3} e^{3x} + C \quad \checkmark$$

$$19. \frac{dy}{dx} = \frac{xy + 3x - y - 3}{xy - 2x + 4y - 8} = \frac{x(y+3) - (y+3)}{x(y-2) + 4(y-2)} = \frac{(x-1)(y+3)}{(x+4)(y-2)}$$

$$\frac{dy}{dx} = \frac{(x-1)(y+3)}{(x+4)(y-2)}$$

$$\int \frac{y-2}{y+3} dy = \int \frac{x-1}{x+4} dx$$

Step 1

$$\int \frac{y-2}{y+3} dy = \int \left(1 + \frac{-5}{y+3}\right) dy = y - 5 \ln|y+3| + C$$

$$\begin{array}{r} \overline{) y-2} \\ y+3 \\ \hline -5 \end{array}$$

step 2

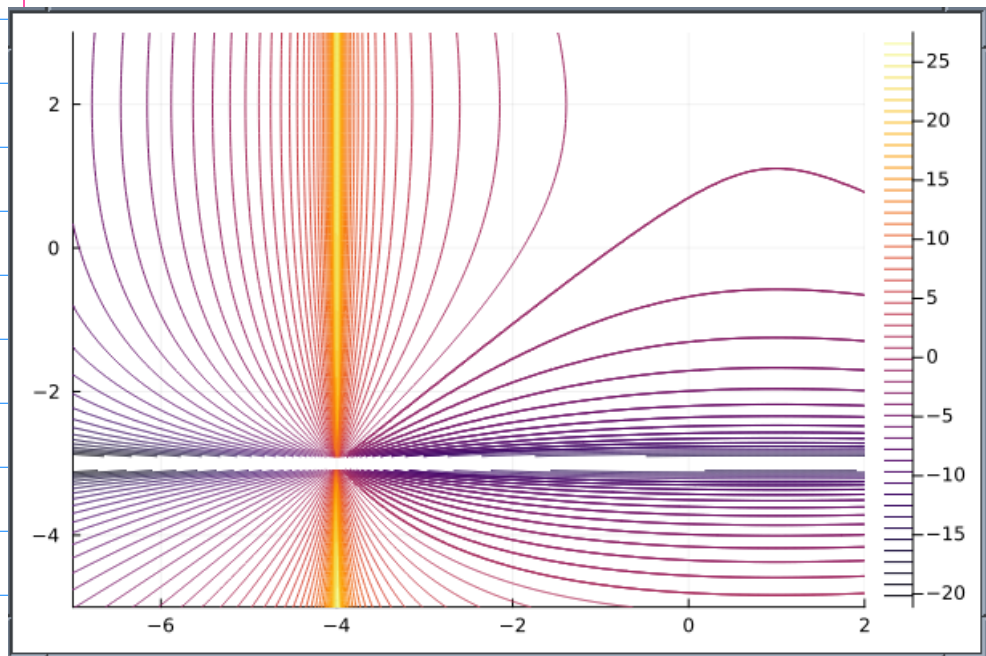
$$\int \frac{x-1}{x+4} dx = \int \frac{x+4-5}{x+4} dx = \int \left(1 - \frac{5}{x+4}\right) dx$$
$$= x - 5 \ln|x+4| + C$$

Implicit solution

$$y - 5 \ln|y+3| = x - 5 \ln|x+4| + C$$

$$f(x,y) = x - 5 \ln|x+4| - y + 5 \ln|y+3|$$

level curves of $f(x,y)$.



```
f(x,y)=x-5*log(abs(x+4))-y+5*log(abs(y+3))
```

```
julia> contour(-7:0.01:2,-5:0.1:3,f,levels=50)
```