Derivative of $y = \ln(x)$ is $\frac{1}{x}$.

$$y = \ln(x)$$

$$e^y = e^{\ln(x)} = x$$

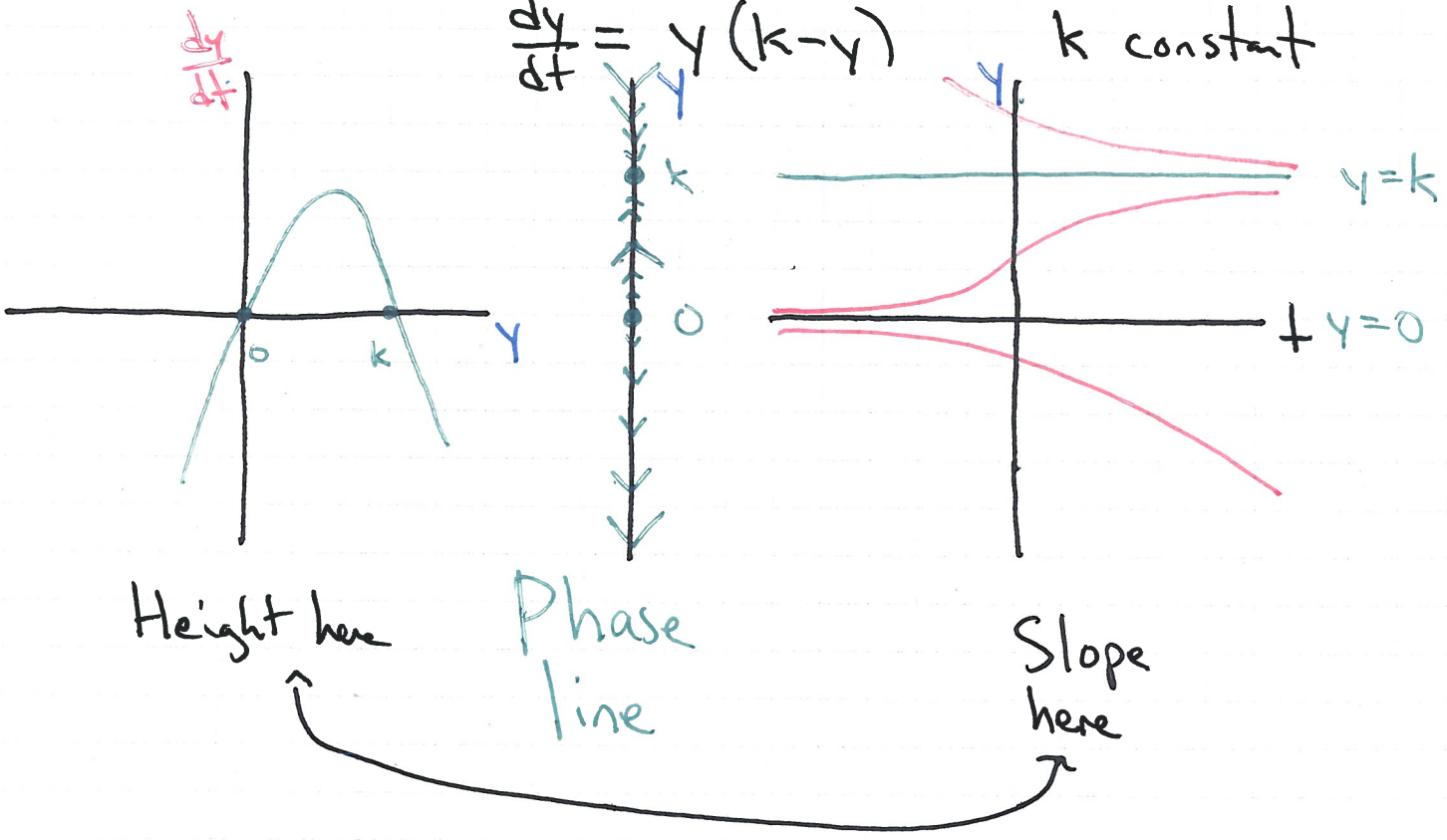
$$\left\{ \frac{d}{dy} \right.$$

$$e^y = \frac{d}{dy} e^y = \frac{dx}{dy}$$

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

Last time: Qualitative analysis.

$$\frac{dy}{dt} = y(k-y) \qquad k \text{ constant}$$



Height here

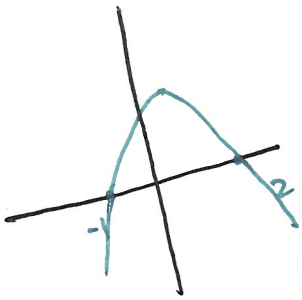
Phase line

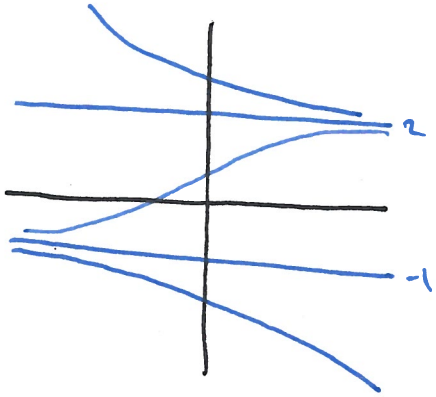
Slope here

MATH 102:107, AUTONOMOUS DIFFERENTIAL EQUATIONS EXERCISE

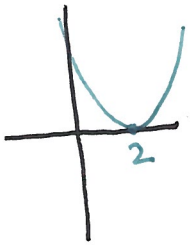
Qualitatively analyze the following differential equations. (Use the graph of dy/dt vs y to get you started.)

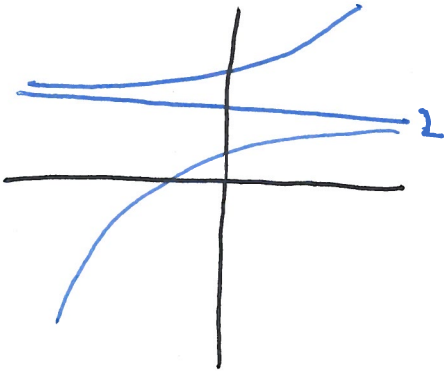
(1) $\frac{dy}{dt} = -(y-2)(y+1)$



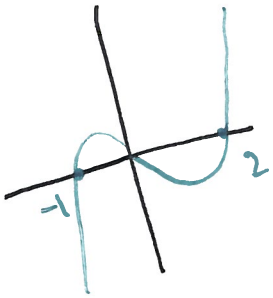


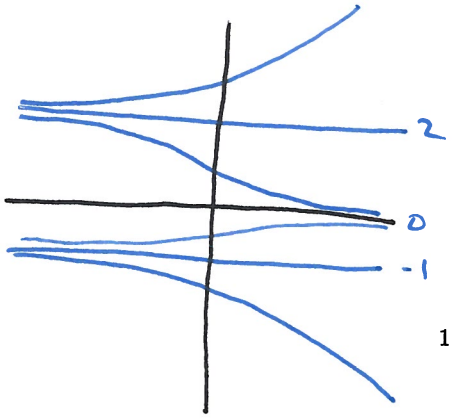
(2) $\frac{dy}{dt} = (y-2)^2$



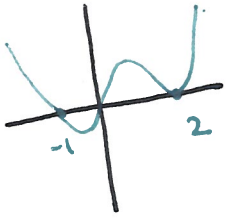


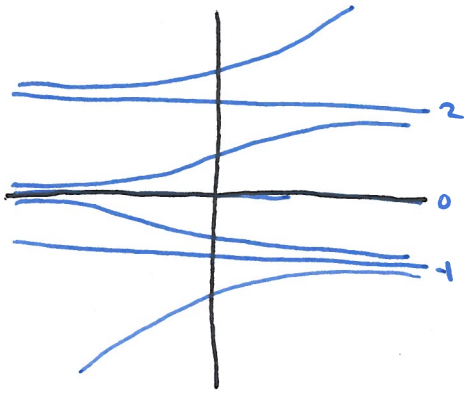
(3) $\frac{dy}{dt} = y(y-2)(y+1)$



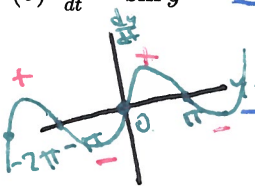


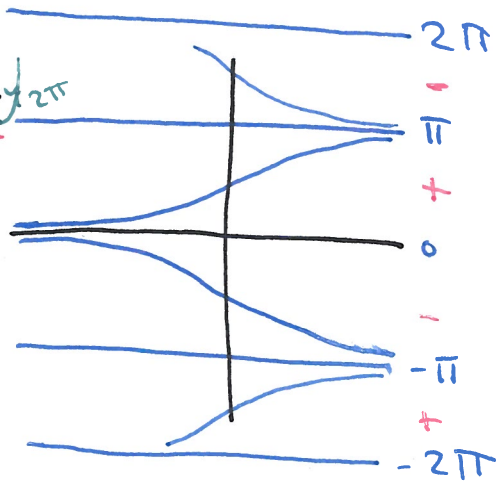
(4) $\frac{dy}{dt} = y(y-2)^2(y+1)$



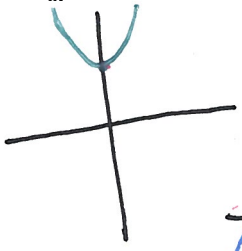


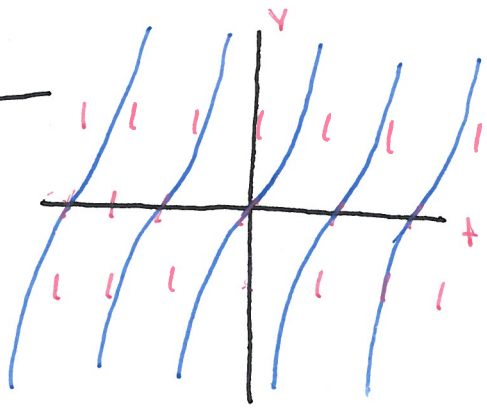
(5) $\frac{dy}{dt} = \sin y$





(6) $\frac{dy}{dt} = y^2 + 5$





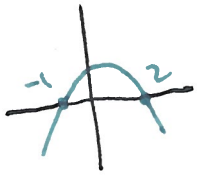
NO steady states

$y=0 \rightarrow$ slope 5

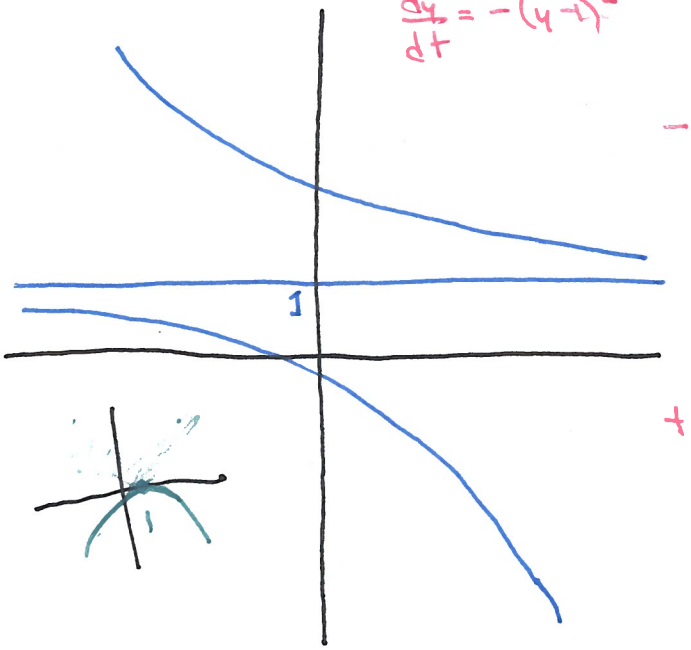
$y=2 \rightarrow$ 9

$y=-2$ 9

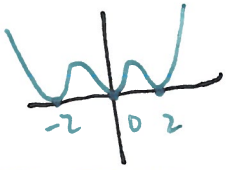
$\frac{dy}{dt} = -(y-2)(y+1)$



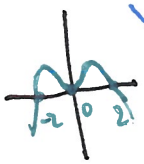
$\frac{dy}{dt} = -(y-1)^2$



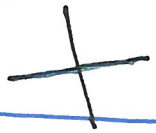
$\frac{dy}{dt} = y^2(y-2)^2(y+2)^2$

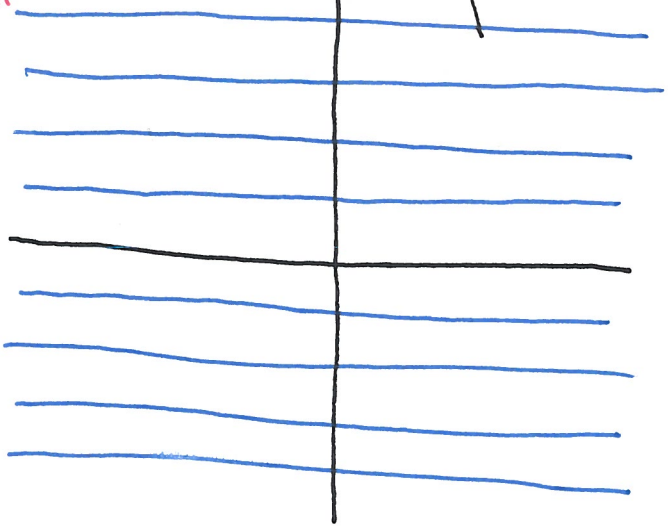


$\frac{dy}{dt} = y^2(y-2)(y+2)$



$\frac{dy}{dt} = 0$





$\frac{dy}{dt} = (y-2)^2 + 1$