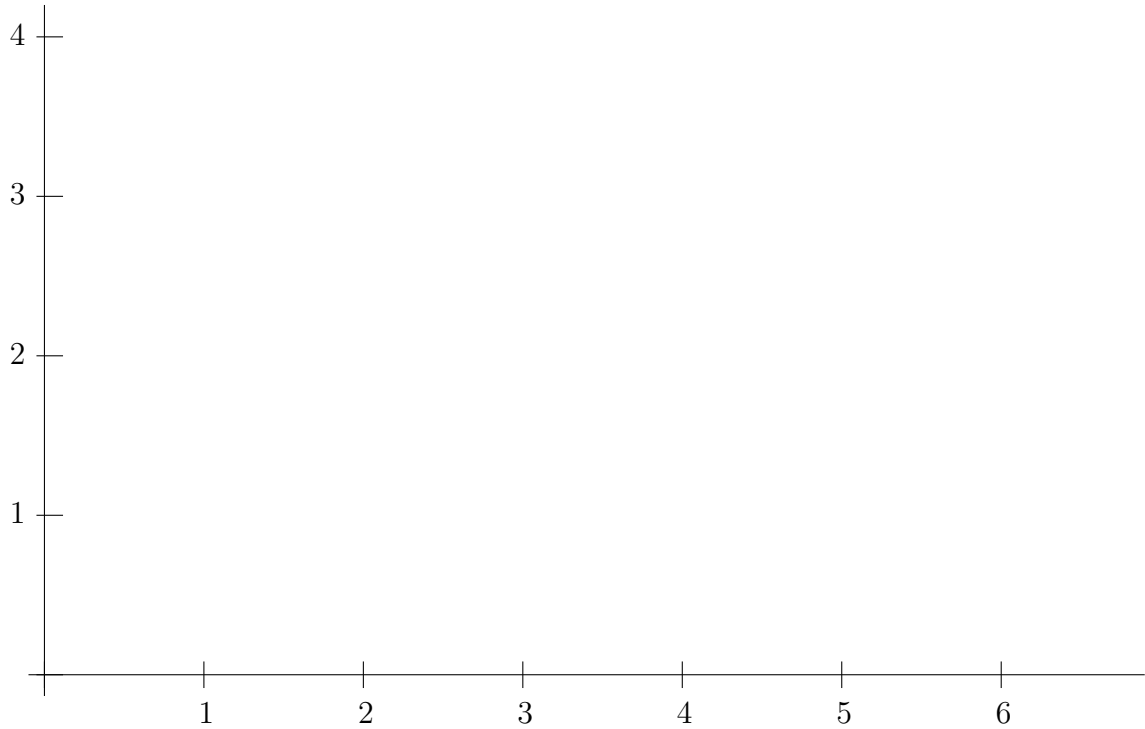


(1) Two non-negative populations  $x(t)$ ,  $y(t)$  satisfy  $\begin{cases} x' = x(6 - x - 2y) \\ y' = y(4 - x - y) \end{cases}$  for  $x \geq 0, y \geq 0$ .

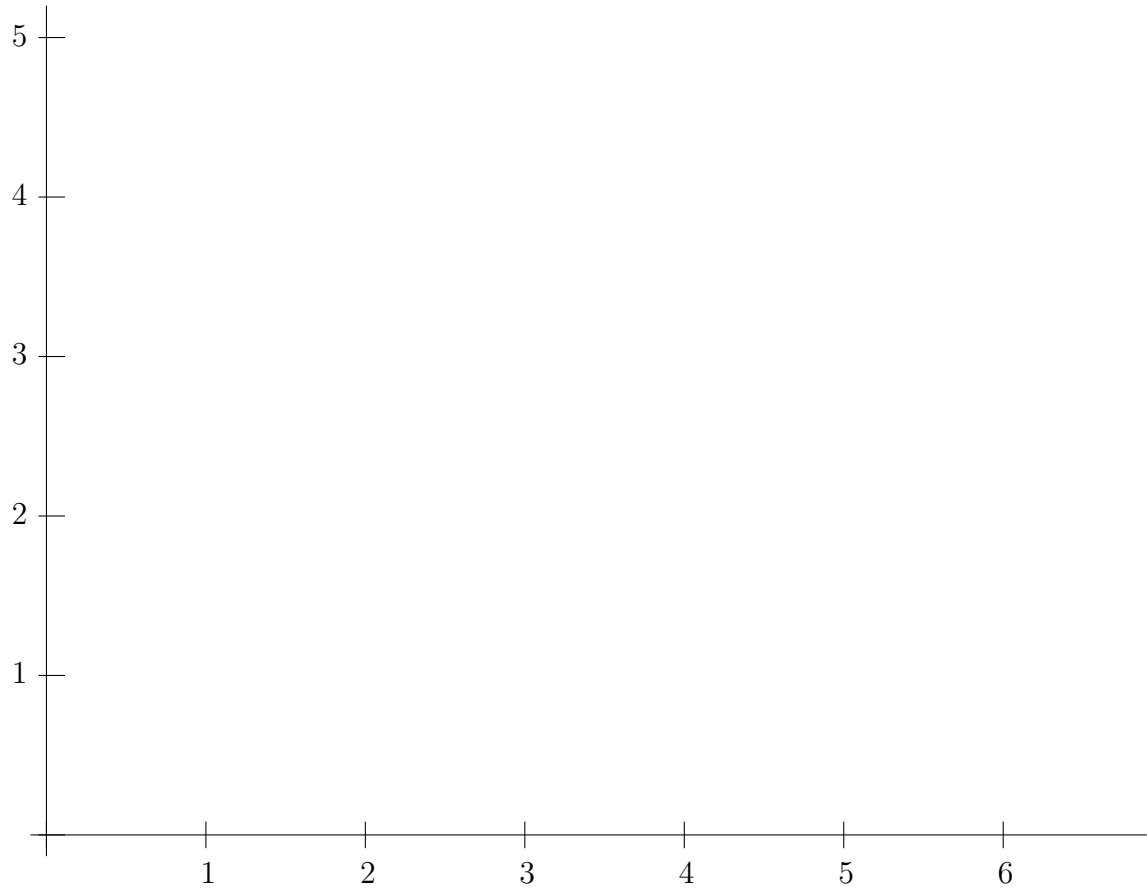
(1a) The lines  $x + y = 4$  and  $x + 2y = 6$  separate the positive quadrant into four regions. In each of the four regions, sketch a vector of the direction field.



(1b) Find all the critical points of the system (1), and plot them in the figure. There is one critical point with  $x > 0$  and  $y > 0$ . What is the type and stability of this point?

(2) Two non-negative populations  $x(t)$ ,  $y(t)$  satisfy  $\begin{cases} x' = x(-2 + y) \\ y' = y(5 - x - y) \end{cases}$

(2a) The lines  $y = 2$  and  $x + y = 5$  separate the positive quadrant into four regions. In each of the four regions, sketch a vector of the direction field.



(2b) The critical points are  $(0,0)$ ,  $(0,5)$ ,  $(3,2)$ . What is the type and stability of the point  $(3,2)$ ?

(2c) Sketch the trajectory that starts at  $(1,2)$ .