## Mathematics 172 Homework

The solution for these problems are after the last problem. 1. For the system of differential equations

$$\frac{dx}{dt} = .4x \left(\frac{100 - x - .4y}{100}\right)$$
$$\frac{dy}{dt} = .6x \left(\frac{200 - x - .8y}{200}\right)$$

draw the phase plane (which for us is just a fancy term for the first quadrant of the x-y plane) showing

(a) The lines where  $\frac{dx}{dt} = 0$ , (b) The lines where  $\frac{dy}{dt} = 0$ ,

(c) The coordinates of all the equilibrium points in the first quadrant.2. For the system of differential equations

$$\frac{dx}{dt} = .23x \left(\frac{100 - x - 1.5y}{100}\right) \\ \frac{dy}{dt} = .07x \left(\frac{150 - x - 4y}{150}\right)$$

draw the phase plane showing

(a) The lines where  $\frac{dx}{dt} = 0$ , (b) The lines where  $\frac{dy}{dt} = 0$ ,

(c) The coordinates of all the equilibrium points in the first quadrant.3. For the system of differential equations

$$\frac{dx}{dt} = .15x \left(\frac{300 - x - .7y}{300}\right)$$
$$\frac{dy}{dt} = .2x \left(\frac{250 - x - 4y}{250}\right)$$

draw the phase plane showing

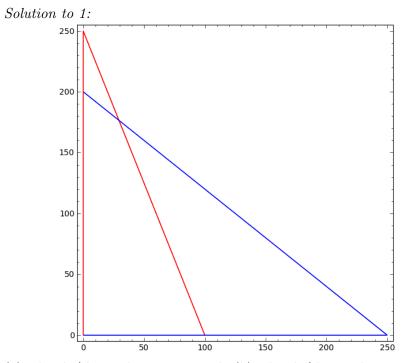
(a) The lines where  $\frac{dx}{dt} = 0$ , (b) The lines where  $\frac{dy}{dt} = 0$ ,

(c) The coordinates of all the equilibrium points in the first quadrant.

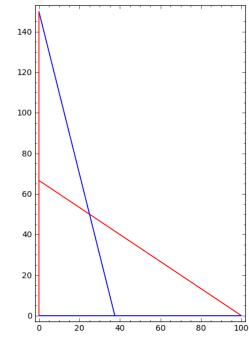
4. For the system of differential equations

$$\frac{dx}{dt} = .14x \left(\frac{100 - x - 3y}{100}\right)$$
$$\frac{dy}{dt} = .3x \left(\frac{80 - x - .4y}{80}\right)$$

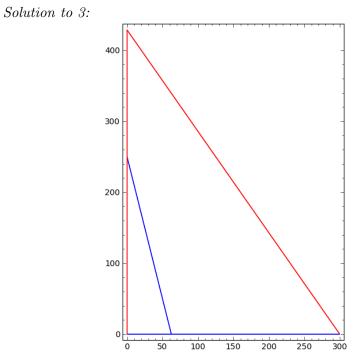
- draw the phase plane showing (a) The lines where  $\frac{dx}{dt} = 0$ , (b) The lines where  $\frac{dy}{dt} = 0$ ,
  - (c) The coordinates of all the equilibrium points in the first quadrant.



(a) The dx/dt = 0 lines are in red. (b) The dy/dx = 0 lines are in blue. The equilibrium points are (0,0), (100,0), (0,200), and (29.41,176.5). Solution to 2:

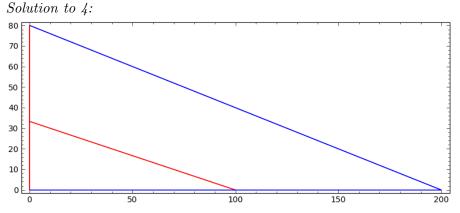


(a) The dx/dt = 0 lines are in red. (b) The dy/dx = 0 lines are in blue. The equilibrium points are (0,0), (100,0), (0,150), and (25.00,50.00).



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(a) The dx/dt = 0 lines are in red. (b) The dy/dx = 0 lines are in blue. The equilibrium points are (0,0), (300,0), and (0,250).



(a) The dx/dt = 0 lines are in red. (b) The dy/dx = 0 lines are in blue. The equilibrium points are (0,0),(100,0), and (0,80).