Mathematics 172

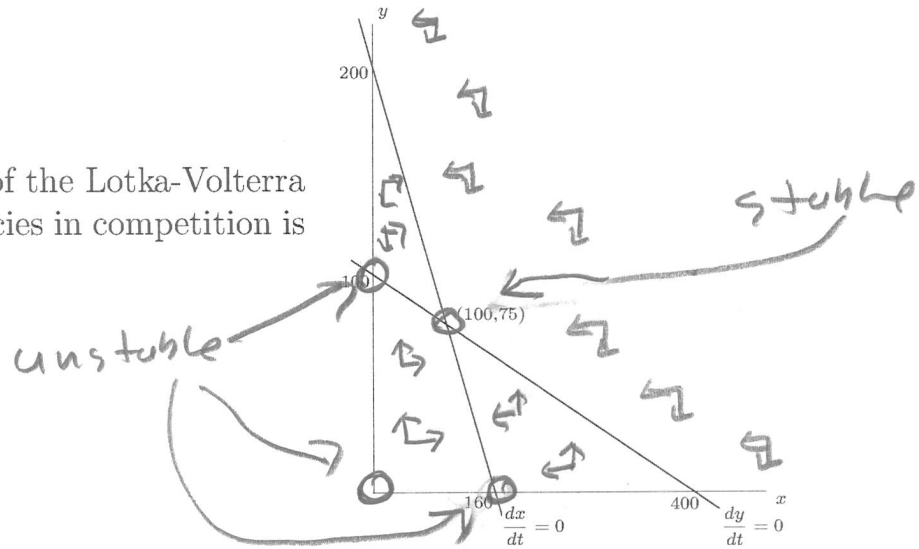## You must show your work to get full credit.

The phase diagram of the Lotka-Volterra equations of two species in competition is shown at the right.

1. Label all the equilibrium points with a small circle O.

2. Draw in arrows that shows the direction that points in the phase space are moving.

3. Use your answer to (b) to label all the equilibrium points as being either stable or unstable?

4. If $x(0) = 200$ and $y(0) = 15$ estimate $x(100)$ and $y(100)$.

$x(100) \approx$ _____100_____ $y(100) \approx$ ___75___

5. If $x(0) = 10$ and $y(0) = 120$ estimate $x(100)$ and $y(100)$.

$x(100) \approx$ _____100_____ $y(100) \approx$ ___75___

6. If $x(0) = 0$ and $y(0) = 200$ estimate $x(100)$ and $y(100)$.
(stays on y axis)

$x(100) \approx$ _____0_____ $y(100) \approx$ ___100___

7. If $x(0) = 200$ and $y(0) = 0$ estimate $x(100)$ and $y(100)$.
stays on x-axis

$x(100) \approx$ _____160_____ $y(100) \approx$ ___O___

8. Describe the long term behavior of the competition. That is competitive exclusion, competitive coexistence, species x dominates, or species y dominates (**circle one**).