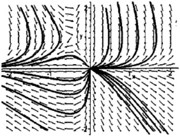
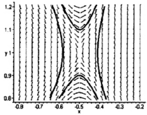
9.2

5(a). The critical points are given by the solution set of the equations
$$x(1-y)=0$$
$$y(1+2x)=0\,.$$
Clearly, $(0\,,0)$ is a solution. If $x \neq 0$, then $y=1$ and $x=-1/2$. Hence the critical points are $(0\,,0)$ and $(-1/2\,,1)$.

(b).



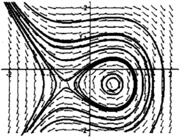
(c). Based on the phase portrait, all trajectories starting near the origin *diverge*. Hence the critical point $(0\,,0)$ is *unstable*. Examining the phase curves near the critical point $(-1/2\,,1)$,



the equilibrium point has the properties of a *saddle*, and hence it is *unstable*.

6(a). The critical points are solutions of the equations
$$1+2y=0$$
$$1-3x^2=0\,.$$
There are two equilibrium points, $\left(-1/\sqrt{3}\,,-1/2\right)$ and $\left(1/\sqrt{3}\,,-1/2\right)$.

(b).



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(c). Locally, the trajectories near the point $\left(-1/\sqrt{3}\,,-1/2\right)$ resemble the behavior near a *saddle*. Hence the critical point is *unstable*. Near the point $\left(1/\sqrt{3}\,,-1/2\right)$, the solutions are *periodic*. Therefore the second critical point is *stable*.

8(a). The critical points are solutions of the equations
$$-(x-y)(1-x-y)=0$$
$$x(2+y)=0\,.$$
If $x=y$, then $x=y=0$ or $x=y=-2$. If $x=1-y$, then $x=0$ and $y=1$, or $x=3$ and $y=-2$. It follows that the critical points are $(0,0),(-2,-2),(3,-2),(0,1)$.