Part 1

1.7, Problem 10

For

$$\frac{dy}{dt} = e^{-y^2} + \alpha,$$

there are zero equilibrium solutions for $\alpha \geqslant 0$ and $\alpha < -1$, while there are two equilibrium solutions for $\alpha \in (-1, 0)$ and one equilibrium solution for $\alpha = -1$.

1.7, Problem 13

(a) This is a graph of (iii), as (iii) decomposes into $y(A - y^2)$, meaning 0 is always an equilibrium solution, as well as the map $A = y^2$.

(b) This is a graph of (v), as $y^2 - A = 0$ when $A = y^2$, so it yields a source when $y > 0$ and a sink when $y < 0$.

(c) This is a graph of (iv) as it is the opposite sign of (v).

(d) This is a graph of (iv), as (iv) decomposes into $(A - y)\,y$, meaning 0 is always an equilibrium solution, as well as some linear factor.

Chapter 1 Review, Problem 3

There are no equilibrium solutions for $\frac{dy}{dt} = t^2(t^2 + 1)$

Chapter 1 Review, Problem 4

One of the solutions to $\frac{dy}{dt} = -\left|\sin^5 y\right|$ is the equilibrium solution $y = 0$.

Chapter 1 Review, Problem 10

The bifurcation occurs at $a = -4$, where there is one equilibrium solution, with zero equilibrium solutions on either side of $a = -4$.

Chapter 1 Review, Problem 11

Chapter 1 Review, Problem 12

Chapter 1 Review, Problem 13

Chapter 1 Review, Problem 14

Chapter 1 Review, Problem 49

Chapter 1 Review, Problem 52