Name: _____

Directions: Show all work. No credit for answers without work.

1. [**3 points**] Solve the following initial value problem: $\frac{dx}{dt} = 7x(x-13)$, and $x(0) = 17$.

2. [**2 points**] Recall the logistic differential equation $\frac{dx}{dt} = kx(M-x)$. A population of cows satisfying the logistic equation initially has 4000 members and is growing at a rate of 3 cows per day. The environment can support a population of 10,000 cows.

   (a) Solve for k in the logistic differential equation.

   (b) Explicitly give the formula for $x(t)$.

3. [**3 points**] Find the equilibrium solutions to $\dfrac{dx}{dt} = x(x^2 - 4)$. Use a phase diagram to classify each equilibrium solution as stable, semi-stable, or unstable.

4. [**2 points**] Give the bifurcation diagram for the differential equation $\dfrac{dx}{dt} = x + kx^3$; this is the plot of all points (k, c) such that $x = c$ is an equilibrium solution to $\dfrac{dx}{dt} = x + kx^3$.