

1. Give qualitative analysis of the following autonomous differential equations. That is, determine the equilibrium solutions, classify each as stable, unstable, or semistable, and sketch the solutions. Include a phase line.

(a) $\frac{dy}{dt} = y^2(y^2 - 1)$

(b) $\frac{dy}{dt} = y^2(1 - y)^2$

(c) $\frac{dy}{dt} = \sin y$

2. Determine whether the following equations are exact. If exact, find the solution.

(a) $(2x + 3) + (2y - 2)y' = 0$

(b) $(2x + 4y) + (2x - 2y)y' = 0$

(c) $(2xy^2 + 2y) + (2x^2y + 2x)y' = 0$

(d) $y' = -\frac{ax+by}{bx+cy}$ where a , b , and c are constants.