1. Consider the equation \( y'' + y' = 2y \). For what \( a \) is \( e^{ay} \) a solution? Find a solution \( y_0 \) to \( y''' + y'' = 2y'' \) with exponential growth as \( x \to -\infty \) and \( \lim_{x \to -\infty} y_0(x)/x = 1 \).

2. Suppose that if \( y_0 \) is a solution to \( y'' + y' - 2y = F(x) \) on all of \((-\infty, \infty)\), then there is another solution \( y_1 \) to the same equation with \( |y_1(x) - y_0(x)| \to 0 \) as \( x \to \infty \).

3. Show that \( y = e^x \) and \( y = \cos x \) cannot be solutions of the same first-order equation \( y' = f(x, y) \) on any interval containing the origin.

4. Solve \( ydx + 3xdy = 14y^4dy \).

5. Suppose that a trajectory of \((3x^2 - y)dx + (3y^2 - x)dy = 0\) contains the point \((1, 1)\). Show that it also contains the points \((1, -1), (-1, 1), (0, 1), (1, 0)\).

6. (Birkhoff-Rota: p. 6, #7) Show that solutions of \( y' = g(y) \) are convex up or convex down for given \( y \) according as \( |g| \) is an increasing or decreasing function there.