1. (84 pts) Solve each of the following differential equations. If no initial conditions are given, find the general solution. You may find the following integral useful

\[ \int x^n e^{ax} dx = \frac{x^n e^{ax}}{a} - \int \frac{n x^{n-1} e^{ax}}{a} dx. \]

(a) \( x \, dx + 2y e^{-x} \, dy = 0, \quad y(0) = 2. \)

(b) \( x \, dt = (3x^2 - t) \, dx. \)

(c) \( ye^x \, dx + (y + e^x) \, dy = 0. \)

(d) \( dy = 2xy^2 \, dx, \quad y(0) = 0. \)

(e) \( y'' - 4y' - 5y = 0. \)

(f) \( y'' - 4y' + 5y = 0, \quad y(0) = 0, \quad y'(0) = 1. \)

2. (16 pts) This problem deals with the differential equation

\[ y' = y - y^3. \]

(a) What are its equilibrium points?

(b) Which equilibrium points are stable and which are unstable?

(c) If \( y(0) = 1/2, \) what is \( \lim_{t \to \infty} y(t)? \) Give a reason for your answer.