(1 pt) 0. Follow the instructions on this exam and any additional instructions given during the exam.

(6 pt) 1. Give an explicit solution to the differential equation: \( ty' - y = t^2 e^t, \quad t > 0. \)
(6 pt) 2. (a) Find the general solution to the autonomous differential equation $\frac{dy}{dt} = y^2 - 1$. You may use the fact that $\frac{1}{y^2 - 1} = \frac{1/2}{y-1} - \frac{1/2}{y+1}$, and leave your answer in implicit form.

(b) Use a phase line/phase diagram to compute $\lim_{t \to \infty} \phi(t)$ for the solution $\phi$ to the initial value problem $\frac{dy}{dt} = y^2 - 1, \quad y(0) = 3$
(6 pt) 3. Use the integrating factor $\mu(x, y) = 2y$ to solve the IVP. Leave your answer in implicit form.
\[
\frac{x^3}{2y} + ye^x + (1 + 2e^x) \frac{dy}{dx} = 0, \quad y(0) = 1.
\]
(6 pt) 4. Solve the initial value problem: \( y'' - y' + y = 0 \), \( y(0) = 1 \), \( y'(0) = 3 \).