1. Solve initial value problem $ty' + 2y = e^{-t}$, $y(-1) = 0$, and state on which interval the solution is valid.

2. Solve $y' = (2x + \sin x)y^2 + (2x + \sin x)$, $y(0) = 0$. 
3. Solve \( \frac{dy}{dx} = -\frac{2xy + 1}{x^2 + 2y} \), \( y(1) = 2 \).

4. Solve the equation \( \frac{dy}{dx} = \frac{y^2 + 4xy}{x^2} \) by changing variables.
5. A large tank contains 100 gallons of water and 50 oz of salt. Water containing a salt concentration of 0.5 oz/gal flows into the tank at a rate of 4 gal/min, and the well-stirred mixture in the tank flows out at the rate $3 + \sin t$ gal/min. If $Q(t)$ is the amount of salt in the tank at any time $t$. Set up the different equation that determines $Q(t)$.

6. Do either (a) or (b). Circle the one that you want to be graded. If you do both, better one will be graded

(a) Solve the Bernoulli equation $xy' - y = x^4y^{-1}$, $y(1) = 1$.

(b) Find the equilibrium solutions to the equation $x' = (x - 1)^2(x^2 - 4)$, then use a phase diagram to classify them as stable/unstable/semistale solutions.