Separable Differential Equations
For problems 1 & 2 find the solution to the given IVP and determine the interval of validity for the solution. Any approximate answers must be to at least the 4th decimal place and you may need computational aids in finding some of the intervals of validity.

1. \( y' = \frac{(3+y)^2}{1+x} \) \( y(0) = 12 \)

2. \( y' = y \left( 5x^2 - 7x \right) \) \( y(0) = e^0 \) You may assume \( y > 0 \) for this problem.

3. Solve the following differential equation and determine the minimum value(s) of the solution. Any approximate answers must be to at least the 4th decimal place.

\[ y' = \frac{4 - 2x}{7 + 4y} \quad y(2) = -6 \]

Modeling, Part I
For problems 4 & 5 you MUST set up and solve the appropriate IVP(s) in order to receive any credit for the problem. Any decimals must be to at least the 4th decimal place.

4. A 600 gallon tank contains 400 gallons of water with 60 ounces of salt dissolved in it. Water with a salt concentration of \( c(t) = 5 + 10e^{-\frac{t}{200}} \) ounces/gal is flowing into the tank at a rate of 4 gallons/min and a well mixed solution flows out at a rate of 4 gallons/min. If left to forever, what would be the equilibrium (i.e. what would be the amount of salt in the tank as \( t \to \infty \)) amount of salt in the water?

5. A 800 liter tank initially contains 600 liters of water with 150 grams of contamination in the water. Contaminated water with a concentration of 5 grams/liter flows into the tank at a rate of 4 liters/hr and a well mixed solution flows out at a rate of 6 liters/hr. This will continue until there is 600 grams of contamination in the tank. At that point in time concentration of the contaminant in the inflow is reduced to 2 grams/liter and the flow rate is increased to 6 liters/hr while the outgoing water continues to flow out at 6 liters/hr.

How much of the contaminant is in the tank 50 hours after concentration of the inflow is changed?

6. Take the same situation from #5 and after that 50 hours the contaminated inflow is turned off and pure water now flows into the tank at a rate of 10 liters/hr and the outflow is increased to 8 liters/hr. Set up, but do not solve, an IVP for this new situation.