

**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 4<sup>th</sup> decimal place and you may need computational aids in finding some of the intervals of validity.

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

$$2. \ y' = y(5x^2 - 7x) \quad y(0) = e^9 \quad \text{You may assume } y > 0 \text{ for this problem.}$$

3. Solve the following differential equation and determine the minimum value(s) of the solution. Any approximate answers must be to at least the 4<sup>th</sup> 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 4<sup>th</sup> 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  $t \rightarrow \infty$ ) 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 contaminate in the inflow is reduced to 2 grams/liter and the flow rate is increased to 6 liters/hr while the outgoing water is continues to flow out at 6 liters/hr.

How much of the contaminate 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 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.