This quiz covers: through Chapter 2.3

Directions: Complete all question and **show all applicable work.** Partial credit will be given. Please feel free to consult your text, notes and the online direction field solver as you see fit. Please do not discuss with other people (except the professor) or use the internet at large (including Wolfram Alpha). Each part is worth 5 points.

DUE: Wednesday 2/8 at beginning of class.

Wells College installed a 500-liter fish tank in the cafeteria. In the spirit of *National Wear Red Day* (this Friday!) the tank is dyed with 100 grams of red food coloring at midnight on Thursday night. Except the constant running into walls, the food coloring has little effect on the fish. The plants will die from reduced light penetration after four days. An acceptable level of dye is 0.5 grams. To clear the water, two filters can be attached. Filter A can filter 250 gallons of water each hour, reducing the amount of dye at a continuous rate of 4% per hour. Filter B can filter out 0.75 grams per hour, regardless of how much dye is in the tank.
Assume at all times the tank is well mixed. Further assume that the filter begins filtering the moment dye enters the water.

1. Setup a differential equation that models the system assuming only Filter A is attached.
2. Provide a direction field for the given differential equation and draw/label the solution of interest.
3. Create a model (solve DE from Part 1) that gives the amount of dye in the tank at any given time assuming only Filter A is attached.
4. Setup a differential equation that models the system assuming both Filter A and B are attached.
5. Provide a direction field for the given differential equation and label the solution of interest.
6. Create a model that gives the amount of dye in the tank at any given time assuming both Filter A and B are attached.
7. Which filter(s) should be attached? Explain. (hint: you need to model Filter B only to get a full conclusion)
8. Does your selection ensure that the fish and plants survive? When does the amount of dye drop below the threshold?
9. Is it a good model for this problem? Describe any issues that your model overlooks or assumes? What decision criterion must you base your decision upon? (Hint: Fish safety, Plant safety, Electricity Usage, Dye lasts too long/not long enough, etc.)
10. (BONUS 5pt.) It seems illogical to add dye and immediately begin filtering. More likely, it seems that there should be a window where the dye is left alone without filtering. Is there a logical comprimise here? Explain.