Math 225 – Quiz #4: First-Order Applications

Clearly and neatly show all work for each problem. Solutions with no work will receive no credit.

1. A small metal bar, whose initial temperature is 20°C, is dropped into a container of boiling water. How long will it take the bar to reach 90°C if its temperature increases 2° in 1 second? How long will it take the bar to reach 98°C?

2. A large tank is partially filled with 100 gallons of fluid in which 10 pounds of salt is dissolved. Brine containing half a pound of salt per gallon is pumped into the tank at a rate of 6 gal/min. The well-mixed solution is then pumped out at a rate of 4 gal/min. Find the number of pounds of salt in the tank after 30 minutes. If the tank holds 200 gallons, when will the tank overflow? What will be the number of pounds of salt in the tank at the instant that it overflows? If the flow in and flow out continue at their rates, devise a method for determining the number of pounds of salt in the tank after 2 hours.

3. Two chemicals, A and B, are combined to form a chemical C. The rate of the reaction is proportional to the product of the instantaneous amounts of A and B not converted to chemical C. Initially there are 40 grams of A and 50 grams of B, and for each gram of B, 2 grams of A is used. It is observed that 10 grams of C is formed in 5 minutes. How much is formed in 20 minutes? What is the limiting amount of C after a long time? How much of chemical A and B remains after a long time?