Directions:

- Work should be done neatly and on separate paper.
- Enough work must be shown so that the steps you are taking is clear.

1. In dealing with an infestation of cockroaches you find that the growth rate is 5% weekly. Suppose there were 200 cockroaches initially and you manage to kill eight each week.
   
   (a) Solve the corresponding differential equation to find the number of cockroaches at time $t$.
   (b) Show algebraically that you will not kill off the infestation.
   (c) How many cockroaches must you kill weekly in order to eliminate the infestation after ten weeks?

2. A 1000L tank initially contains 700L of freshwater. Sugar water with a concentration of 0.1kg/L is pumped in at 30L/min while the tank is being emptied of the mixture at 20L/min.
   
   (a) Solve the corresponding differential equation to find the amount of sugar in the tank at time $t$.
   (b) How long will it be until the tank overflows?
   (c) At that point how much sugar will be in the tank?

3. Suppose a skydiver has a drag coefficient is 0.0025m$^{-1}$.
   
   (a) What is her terminal velocity?
   (b) Solve the corresponding differential equation to find her velocity at time $t$.
   (c) If her initial height is 3000m find her height at any time $t$ and calculate how long it will take her to reach the ground.

4. If the terminal velocity of a skydiver needs to be 50m/s what would the drag coefficient need to be?