

### MATH 213 - Homework #3 (Due 2/03)

1. Solve the following linear differential equation:

$$x' = -2tx + 2t^3, \quad x(0) = -1.$$

Check your answer using the *dsolve* command in MATLAB.

2. A body cools in 10 min from 100°C to 60°C when the environment is at 20°C. How long does it take to cool to 25°C?
3. A 200-gal tank is filled with 100 gal of pure water. Salt-water solution containing 0.5 lb/gal salt enters the tank at a rate of 4 gal/min. The solution leaves the tank at a rate of 2gal/min. What is the salt content (lb) in the tank at the precise moment that the tank is full of salt-water solution?
4. Consider the dimensionless differential equation modelling a spruce budworm population:

$$x' = rx(1 - x/k) - \frac{x^2}{1 + x^2}.$$

- (a) Let  $k = 20$ . Perform a parameter analysis (in terms of  $r$ ) for the long-term population behavior.
  - (b) Let  $r = 1/2$ . Perform a parameter analysis (in terms of  $k$ ) for the long-term population behavior.
5. Problem #3, page 257 (qualitative analysis).
  6. Problem #6, page 258.