

## Lab 7.

### Mixture Problem.

This lab deals with a certain kind of mixture problem, namely a batch reactor. In this situation we have a holding tank with a mixture which contains two chemicals  $A$  and  $B$ . A reaction is taking place whereby  $A \rightarrow B$  by what is thought to be a second-order rate law, that is to say

$$\frac{dC_A}{dt} = -kC_A^2,$$

where  $C_A$  is the concentration of the chemical  $A$  measured, say, in kilograms of  $A$  per cubic meter, and  $k$  is a constant. To test whether the reaction is a second-order one the following measurements are taken:

$t(\text{min})$	5	10	20	30	90
$C_A (\text{kg/m}^3)$	2.1	1.5	1.1	0.52	0.33

(a) Solve the differential equation above and show that the solution can be written in the form:

$$\frac{1}{C_A} = \frac{1}{C_A(0)} + kt.$$

(b) Use Maple V and the given data and a straight-line plot to determine whether the reaction indeed follows a second-order rate law. (If the plot that is supposed to be linear actually is, the rate law works.) If it does, use the slope and intercept of the line to estimate the rate constant  $k$  and the initial concentration.

(c) Now use your expression for the concentration and Maple V to plot  $C_A(t)$  for values of time from 0 to 90 and compare your results with the ones in the table.