Problem Set PS07

ISSUED: 3/15/01 **Due: 3/22/01**

Prof. Darin J. Ulness Name ____________________

Instructions. Complete all questions before class on the due date. You are encouraged to work together. Be sure to struggle with the problem before seeking help. Many of the exercises are very similar to problems in the book. Understanding the solution to these problems will be helpful in completing the assigned exercises.

Mathematical Exercises

1. We will run into a number of simple differential equation and it will be nice to be able to solve them in our heads. Many relations we will see during derivations will be what are called first order ordinary differential equations. (The rate laws of kinetics were of this type.) "First order" means that only a first derivative appears in the differential equation, "ordinary" means we are worried about only one independent variable. A common type first order differential equation is of the form

$$\frac{df}{dx} = P(x)Q(f),$$

where $P(x)$ is any function of x and $Q(f)$ is an explicit function of f. Equations of this type may be solved using a technique called separation of variables (n.b., this is not at all related to the separation of variables technique for solving partial differential equations like the Schrödinger for a particle in a 3D box). The procedure goes as follows. The dx is moved to the right hand side of the differential equation and $Q(f)$ to the left hand side,

$$\frac{df}{Q(f)} = P(x)dx,$$

then each side is integrated

$$\int \frac{df}{Q(f)} = \int P(x)dx.$$

This solves the differential equation (provide you can do the integrals). Note that the constant of integration associated with the f integration is combined with the constant of integration of the x integration. This constant can be determined if some other piece if information is know; that is, if we are given an initial condition or boundary condition. Use this technique to solve the following differential equations

   (a) $\frac{df}{dx} = c,\ f(x=0) = 1$

   (b) $\frac{df}{dx} = -cx,\ f(x=0) = 1$

   (c) $\frac{df}{dx} = \sin x,\ f(x=0) = 1$

   (d) $\frac{df}{dx} = f,\ f(x=0) = 1$

   (e) $\frac{df}{dx} = fx,\ f(x=0) = 1$

Exercises

2. Work the following problems from Laidler and Meiser

    - 9.1
    - 9.2
    - 9.5
    - 9.10
    - 9.13
    - 9.14
    - 9.21
    - 9.30
    - 9.31
    - 9.32
    - 9.39
    - 9.56
    - 9.57