

King Saud University  
College of Engineering  
Chemical Engineering Dept.

**CHE401: Exam 1**

**Problem #1**

A gaseous mixture has the following composition (in mole percent): methane 20%,  $C_2H_4$ , 30%,  $N_2$  50%. at 90 atm pressure and  $100^\circ C$ . Using appropriate initial guess, show two iterations of Newton method to calculate the molar volume of this gas using the Van der Waals' equation using averaged constants:

$$V^3 - \left(b + \frac{RT}{P}\right)V^2 + \frac{a}{P}V - \frac{ab}{P} = 0$$

Additional data needed are:

$a$  (atm)( $cm^3/mol$ )<sup>2</sup> for  $CH_4$  is  $2.25 \times 10^6$ ,  $C_2H_4$  is  $4.48 \times 10^6$ ,  $N_2$  is  $1.35 \times 10^6$ .

$b$  ( $cm^3/mol$ ) :  $CH_4$  is 42.8,  $C_2H_4$  is 57.2,  $N_2$  is 38.6.

$R = 82.1$  atm  $cm^3/mole$  K.

**Problem#2**

(a) Using our own value for the step size, show two cycles of explicit Euler method for solving the following first-order differential equation:

$$\frac{dx}{dt} = \frac{1}{10}(45 - 12x), \quad x(0) = 200$$

(b) show two cycles of implicit Euler method: