ชื่อ-สกุล.....รหัส.....

มหาวิทยาลัยสงขลานครินทร์

คณะวิศวกรรมศาสตร์

ข้อสอบกลางภาค: ภาคการศึกษาที่ 1 ปีการศึกษา: 2550

วันที่สอบ: 2 สิงหาคม 2550 เวลา: 13.30 - 16.30 น.

วิชา: 230 –351 การประยุกต์คอมพิวเตอร์สำหรับวิศวกรเคมี ห้องสอบ: R300

ทุจริตในการสอบ โทษขั้นต่ำ คือ ปรับตกในรายวิชาที่ทุจริต และพักการเรียน 1 ภาคการศึกษา

- อนุญาตให้นำเอกสารทุกชนิดเข้าห้องสอบได้
- อนุญาตให้นำแผ่นข้อมูลเข้าห้องสอบได้
- ไม่อนุญาตให้นำเครื่องคำนวณใดๆ เข้าห้องสอบ
- ห้ามหยิบยืมเอกสารและแผ่นข้อมูล
- เขียนชื่อ และรหัสทุกหน้า (ข้อสอบทั้งหมดมี 6 หน้า รวมปก)

ข้อ	คะแนนเต็ม	คะแนนที่ได้
1	35	
2	35	
3	35	
4	35	
รวม	140	

ผศ. ดร. ลือพงศ์ แก้วศรีจันทร์

ผู้ออกข้อสอบ

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1. (35 points) Calculate the terminal velocity of coal ρ_P = 1,200 kg/m^3 , Dp = 3.3 millimeter falling in water at 27 °C in a centrifuge separator where the acceleration (a) is 30,000g. Additional information and data are as followed.

a. viscosity and density water at 27 °C ($\mu = 0.86x10^{-3}$ kg/(m s), $\rho = 997$ kg/m^3)

b. assuming that the coal particles are spherical, a force balance on a particle yields

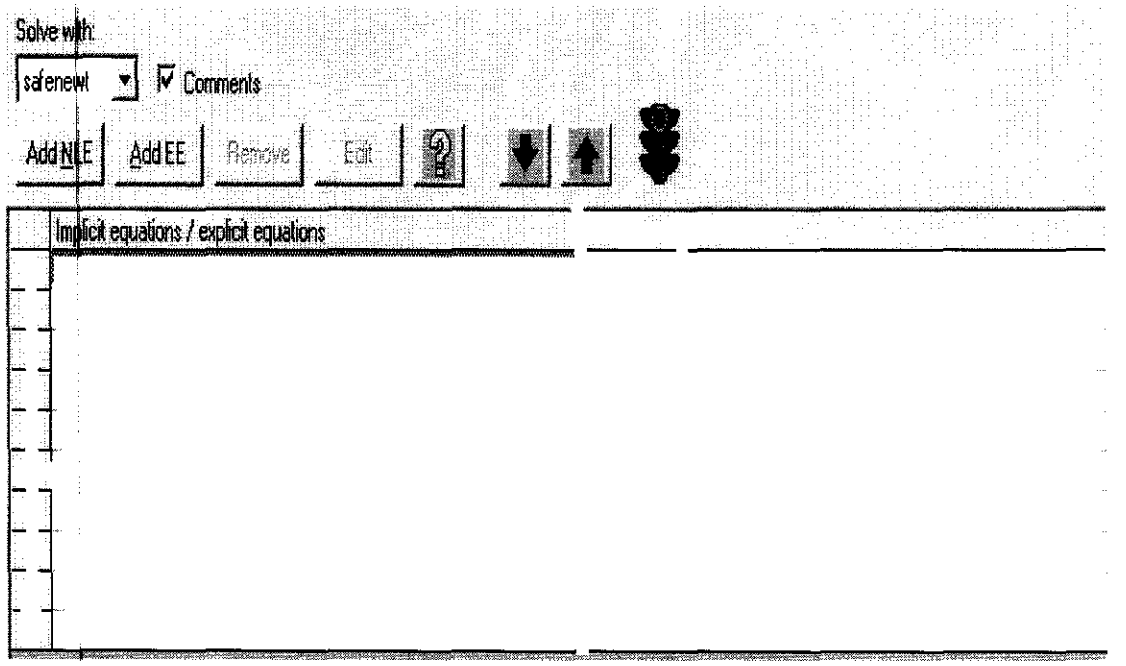
$$v_t = \sqrt{\frac{4a(\rho_P - \rho)D_P}{3C_D\rho}}$$

Where v_t [m/s], g [m/s^2], ρ_P [kg/m^3], D_P [m] and C_D [dimensionless coefficient], g [9.81m/s^2] : C_D = 24/Re for Re<0.1, C_D =(24/Re)(1+0.14$Re^{0.7}$) for 0.1≤Re≤1000, C_D = 0.44 for 1,000 ≤Re ≤35,000 and C_D= 0.19 - 8.0 x10^4/Re for 35,000< Re

Calculate density, viscosity, acceleration in SI unit and also give symbols that you are going to use in the program:

	Symbol	Value	Unit
density of fluid			
density of coal			
viscosity			
acceleration			

Use Polymath to calculate the velocity by filling in the following window:



Fill in the following results

	value	Unit		value	Unit		value	Unit
Re			C_D			v_t		

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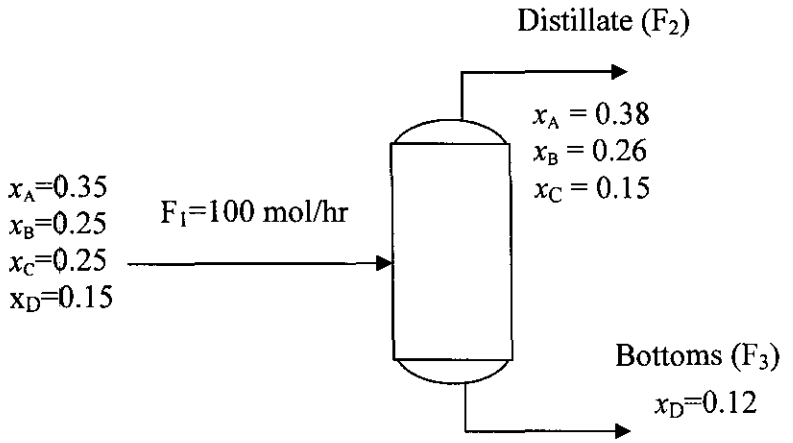
2. (35 points) A four-component mixture is partially separated in a distillation tower. Component A is the most volatile, and component D is the least volatile. Calculate the steady-flow rates of distillate (F_2) and bottoms (F_3) for the conditions shown below.



2.1 Fill in the following window for (a) Number of linear equation and (b) x1, x2, x3, ...and beta for each row of the linear equation.

	x1	x2	x3	x4	x5	beta
1						
2						
3						
4						
5						

2.2 Show the results after calculate in 2.1

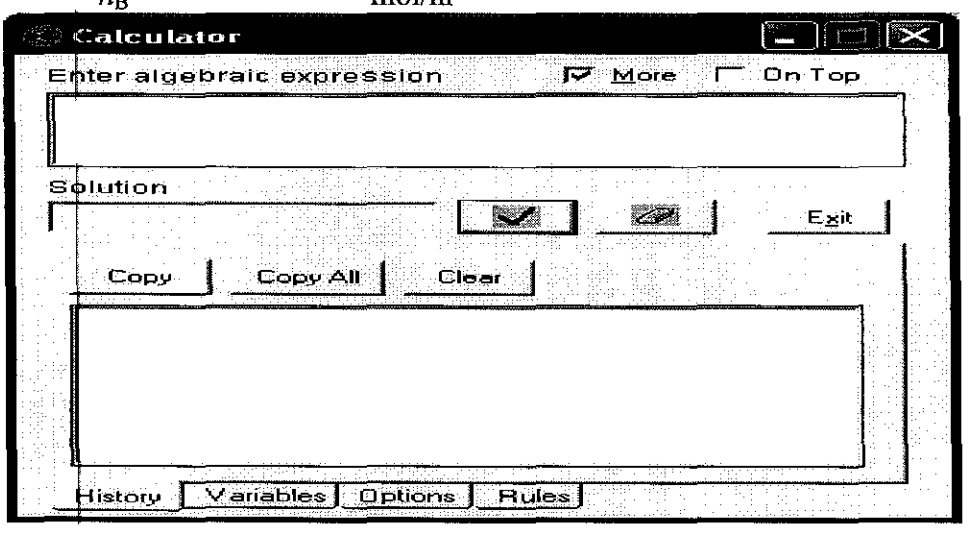
F_2 = mol/h

F_3 = mol/h

2.3 Calculate molar flow rate of A (n_A), B (n_B) and C (n_C) in in F_3 by calculator

n_A = mol/hr, n_C = mol/hr

n_B = mol/hr



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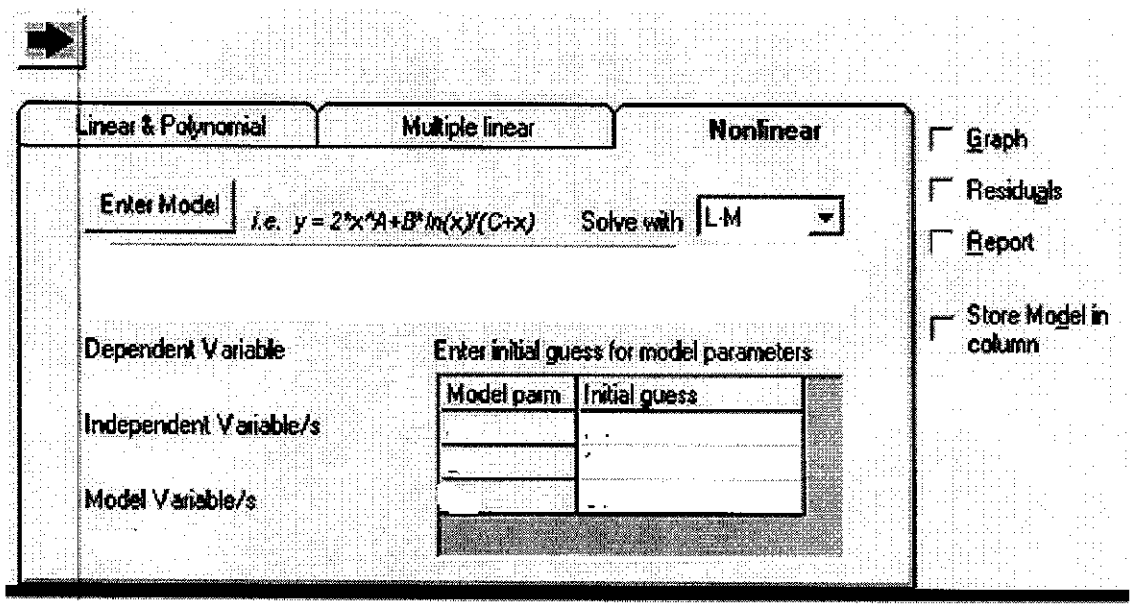
3. (35 points) Experimental measurements of the molar volume of gas A at 400 K are given in the table below. Notice that the function $P = P(v)$ is nonlinear. Using the R-K equation of state: $P = \frac{RT}{(v-b)} - \frac{a}{T^{1/2}(v)(v+b)}$, set $a = 2000$ and T in Kelvin. **Determine parameter *b* by nonlinear regression method.**

P (atm)	*v* (cm^3/mole)	*P* (atm)	*v* (cm^3/mole)
37	900	88	450
43	850	99	400
46	800	120	350
47	750	143	300
52	700	186	250
54	650	263	200
63	600	442	150
71	550	1370	100
78	500		

3.1 Calculate RT for this problem

	value	Unit
R		
R*T		

3.2 Show the window of the nonlinear regression and fill the nonlinear model, selected independent variable(s) , dependent variable, model variables, and initial guess of the model parameters



3.3 Show your results of b and R^2 after regression

	value	Unit
b		
R^2 (not the Gas constant)		

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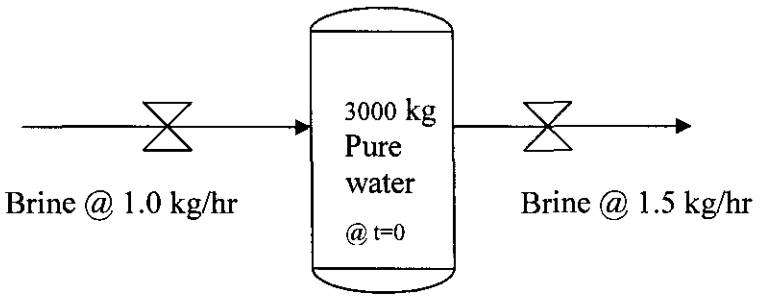
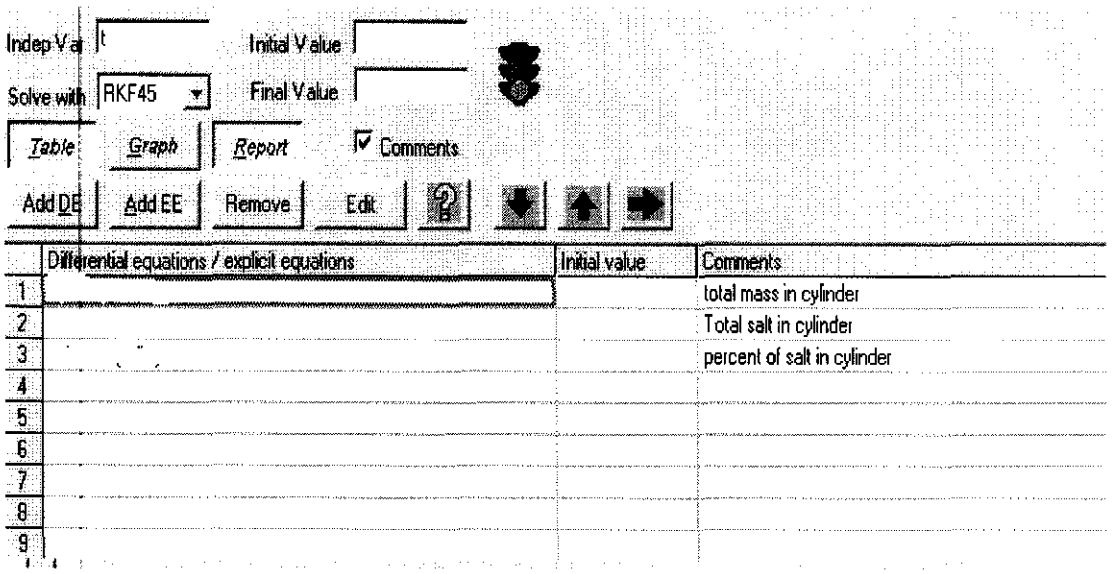
4. (35 points) A well-mixed tank of initially 3000 kg of pure water needs to mix with brine solution. At time zero a brine solution (40 % salt by weight) is being filled with an inlet flow of 1 kg/hr at the same time the outlet flow of the brine solution from the tank is 1.5 kg/h. (1) What is the total weight and concentration of the brine in the tank after the opening of the valves for 18 hours? (2) At what time the weight per cent brine in the tank reach 5%?



Note: At t=0, there is no brine in the tank,
Two valves opened at time zero

Fill the blanks of Initial value, Final value and put Differential equations and Explicit equations.



4.1 What is the total weight and concentration of the brine in the tank after the opening of the valves for 18 hours?

Ans.

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4.2 Calculate the time that the weight per cent brine in the tank is 5% by mean of the following window.