

ชื่อ-สกุล.....รหัส.....

มหาวิทยาลัยสงขลานครินทร์
คณะวิศวกรรมศาสตร์

ข้อสอบกลางภาค: ภาคการศึกษาที่ 1

ปีการศึกษา: 2549

วันที่สอบ: 4 สิงหาคม 2549

เวลา: 9.00-12.00

วิชา: 230-351 การประยุกต์คอมพิวเตอร์สำหรับวิศวกรเคมี

ห้องสอบ: R300

ทฤษฎีในการสอบ โทษขั้นต่ำ คือ ปรับตกในรายวิชาที่ทุจริต และพักการเรียน 1 ภาคการศึกษา

- อนุญาตให้นำเอกสารทุกชนิดเข้าห้องสอบได้
- อนุญาตให้นำแผ่นข้อมูลเข้าห้องสอบได้
- ไม่อนุญาตให้นำเครื่องคำนวณใดๆ เข้าห้องสอบ
- ห้ามหยิบยืมเอกสารและแผ่นข้อมูล
- เขียนชื่อ และรหัสทุกหน้า

ข้อสอบที่ 11 66 คะแนน 4 ข้อ

ข้อ	คะแนนเต็ม	คะแนนที่ได้
1	35	
2	35	
3	40	
4	40	
รวม	150	

ผศ. ดร. ลือพงศ์ แก้วศรีจันทร์

ผู้ออกข้อสอบ

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1. (35 points) High pressure is needed to compress carbon dioxide gas to density of 0.08 g/cm³ at 0°C. The Redlich-Kwong EOS equation was selected to calculate the pressure:

$$\left[P + \frac{a}{T^{1/2}v(v+b)} \right] (v-b) = RT$$

$$a = \frac{0.4278R^2T_C^{2.5}}{P_C}$$

$$b = \frac{0.0867RT_C}{P_C}$$

$$P_C = 72.9 \text{ atm}$$

$$T_C = 304.2 \text{ K}$$

Note: MW of CO₂ is 44 and unit of v is cm³/mole, P in atm and T is in Kelvin.

1.1 Fill in the blank for the following table:

	Value	Unit
R		
a		
b		
P		

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1.2 Use Polymath to calculate the pressure by filling in the following window:

POLYMATH 5.1 - [Nonlinear Equations Solver]

File Edit Program Window Examples Help

Open Save LEQ NLE DEQ REG Calculate Units Const Setup

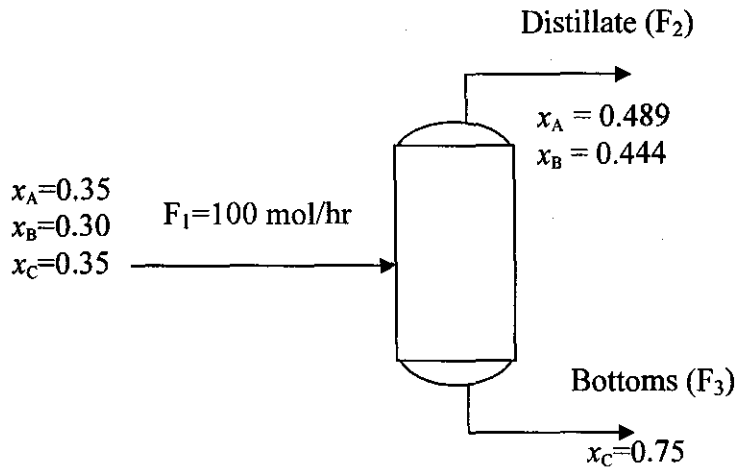
Solve with: salenewt Comments

Add NLE Add EE Remove Edit ? ↓ ↑

	Implicit equations / explicit equations	Initial guess	Comments
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			

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2. (35 points) A three-component mixture is partially separated in a distillation tower. Component A is the most volatile, and component C 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) x_1 , x_2 , x_3 , ...and beta for each row of the linear equation.

POLYMATH 5.1

File Edit Program Window Help

Open Save LEQ NLE DEQ REG Calculate U

Linear Equations Solver

Number of linear equations

Matrix of Coefficients and beta vector of constants

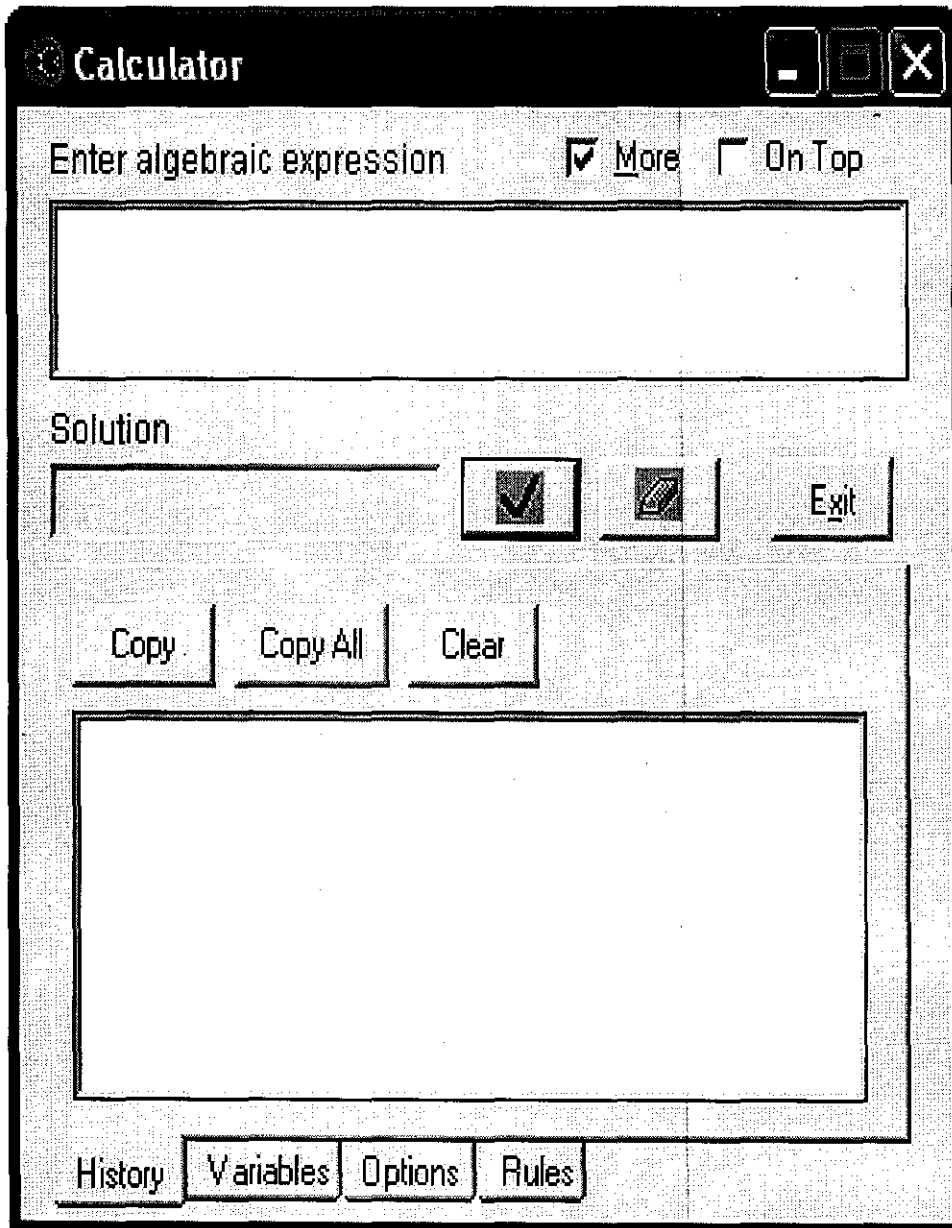
	x_1	x_2	x_3	x_4	x_5	beta
1						
2						
3						
4						
5						

2.2 Show the results after calculate in 2.1

$$F_2 = \text{mol/h}$$
$$F_3 = \text{mol/h}$$

2.3 Calculate x_A and x_B in F_3 by calculator

$$x_A =$$
$$x_B =$$

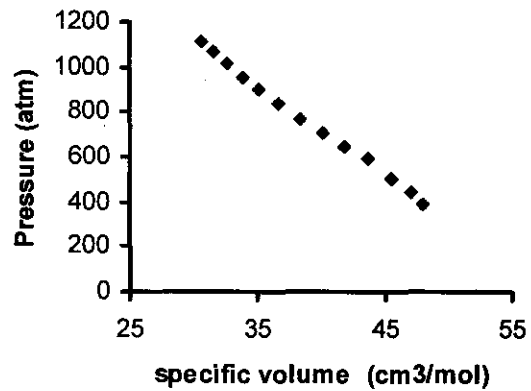


3. (40 points) Experimental measurements of the density of benzene vapor at 563.15 K are given in the table and the figure below. Notice that the function

$P = P(v)$ is nonlinear. Using the virial equation of state: $\frac{Pv}{RT} = 1 + \frac{B}{v} + \frac{C}{v^2}$, determine parameter B and C by multiple linear regression method.

P (atm)	v (cm ³ /mole)
30.64	1114
31.60	1067
32.60	1013
33.89	956
35.17	900
36.63	842
38.39	771
40.04	707
41.79	646
43.59	591
45.48	506
47.07	443
48.07	386

P-V data of benzene at 563.15 K



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3.1 Calculate RT for this problem

	value	Unit
R		
$R*T$		

3.2 Name column 3, 4, 5...and fill in the values of row 07 (at 38.39 atm and 771 cm³/mol) for each column (only three digits needed).

R007 : C005 =

	P atm	v cm3 m					C08	C09
01	30.64	1114						
02	31.60	1067						
03	32.60	1013						
04	33.89	956						
05	35.17	900						
06	36.63	842						
07	38.39	771						
08	40.04	707						
09	41.79	646						
10	43.59	591						
11	45.48	506						
12	47.07	443						
13	48.07	386						
14								

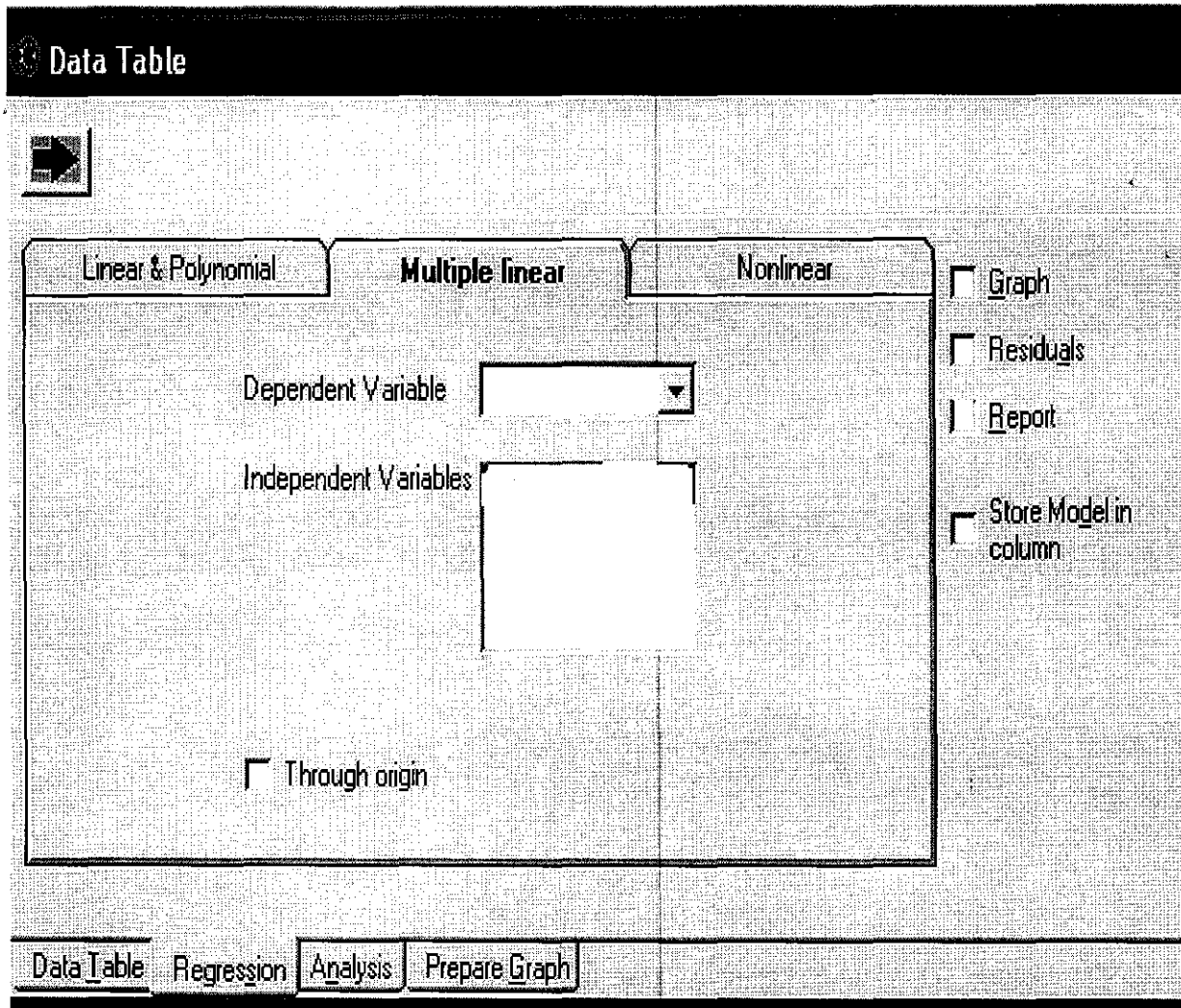
Data Table | Regression | Analysis | Prepare Graph

3.2 Show mathematical formula used for each column

Column	Name	mathematical formula
03		
04		
05		
06		
07		

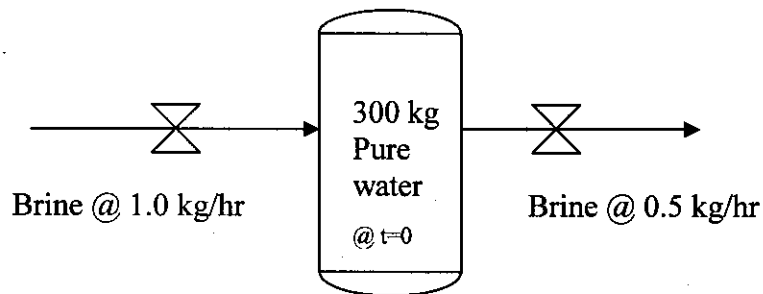
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3.3 Show the window of multiple linear regression and selected independent variable and dependent variable.



3.4 Show your results of B , C and R^2 after regression

4. (40 points) A well-mixed tank of initially 300 kg of pure water needs to be replaced with brine solution. At time zero a brine solution (20 % 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 0.5 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%? *Assume no overflow from the tank since the volume of the tank is very large.*



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

4.1 Fill the blanks of **Initial** value, **Final** value and put **Differential** equations and **Explicit** equations (do not forget comments!)

Ordinary Differential Equations Solver

Indep Var: Initial Value:

Solve with: RKF45 Final Value:

Table Graph Report Comments

	Differential equations / explicit equations	Initial value	Comments
1			total mass in cylinder
2			Total salt in cylinder
3			percent of salt in cylinder
4			
5			
6			
7			
8			
9			

Differential Equations: 2 Auxiliary Equations: 1

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

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

