ชื่อ-สกุล...รหัส..

มหาวิทยาลัยสงขลานครินทร์

คณะวิศวกรรมศาสตร์

ข้อสอบกลางภาค: ภาคการศึกษาที่ 1 ปีการศึกษา: 2553
วันที่สอบ: 3 สิงหาคม 2553 เวลา: 9.00-12.00
วิชา: 230 –466 การประยุกต์คอมพิวเตอร์สำหรับวิศวกรเคมี ห้องสอบ: com 1

ทุจริตในการสอบ โทษขั้นต่ำ คือ ปรับตกในรายวิชาที่ทุจริต และพักการเรียน 1 ภาคการศึกษา

- อนุญาตให้นำเอกสารทุกชนิดเข้าห้องสอบได้
- อนุญาตให้นำแผ่นข้อมูลเข้าห้องสอบได้
- ไม่อนุญาตให้นำเครื่องคำนวณใดๆ เข้าห้องสอบ
- ห้ามหยิบยืมเอกสารและแผ่นข้อมูล
- เขียนชื่อ และรหัสทุกหน้า (ข้อสอบทั้งหมดมี 8 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) There are 4 species of animals collected by one of senior chemical engineering students. Those animals are:

   Peacocks (2 legs, 2 wings, 1 head and 1 tail)

   Spiders (8 legs, 0 wing, 1 head and 0 tail)

   Dragonflies (6 legs, 4 wings, 1 head and 1 tail)

   Cats (4 legs, 0 wing, 1 head and 1 tail)

   If all of animals are counted for 264 legs, 92 wings, 47 heads and 32 tails. Calculate the numbers of each animal.

   1.1 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						

   1.2 Show the results after calculate in 1.1

   Numbers of peacocks =

   Numbers of spiders =

   Numbers of dragonflies =

   Numbers of cats =

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2. (35 points) Heat transfer by radiation between black bodies: A spherical 1.0 ft in diameter (D) is placed in a completely closed box. The temperature of the sphere is maintained at 1000°F (T_2), and the inside surface of the box is kept at 400°F (T_1). Assuming the sphere and the inside surface of the box are black bodies, calculate the radiation heat loss from the sphere (q) to the box in Btu per hour. Hint: given the emission equation and conditions as follows,

$$q = 0.173A[(T_2/100)^4 - (T_1/100)^4]F_{AE}$$

$q =$ Radiation heat loss [$\equiv$] Btu per hour

$A =$ Surface area of the sphere $\text{ft}^2 = \pi D^2$

$T_1, T_2 =$ Temperature [$\equiv$] Rankin

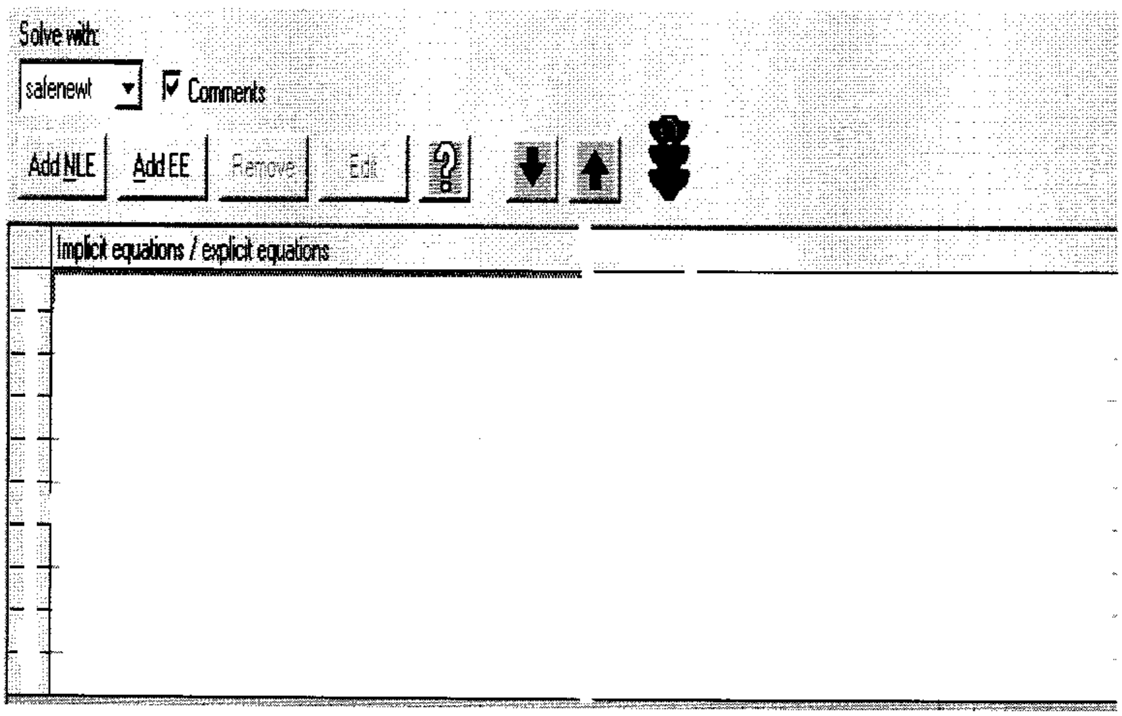
$F_{AE} =$ Correction factor:

$F_{AE} = 0.70$ when $q \le 13{,}000$

$F_{AE} = 0.85$ when $q \le 23{,}000$

$F_{AE} = 1.0$ when $q > 23{,}000$

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



Fill in the following results

	Unit
A =	
q =	
F_{AE} =	

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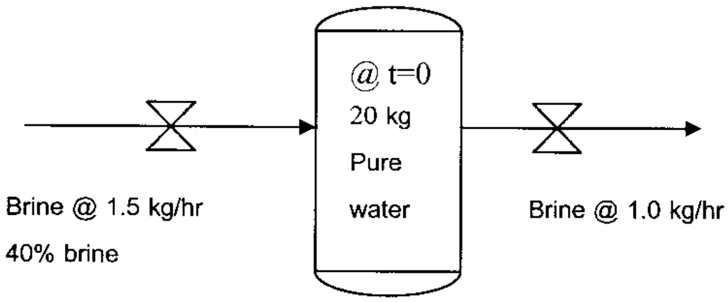
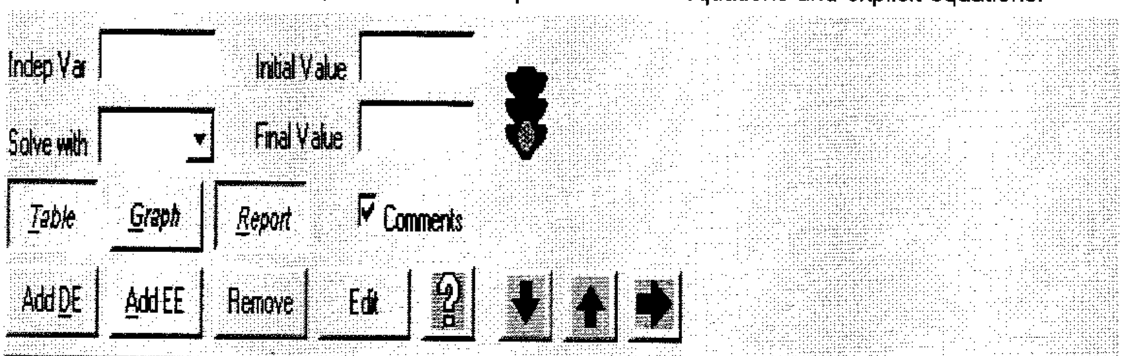
3. (35 points) A well-mixed tank of initially 20 kg of pure water needs to mix with brine solution. At time zero a brine solution (40 % salt by weight) is being filled with an inlet flow of 1.5 kg/hr at the same time the outlet flow of the brine solution from the tank is 1.0 kg/h. (1) What is the total weight and concentration of the brine in the tank after the opening of the valves for 20 hours? (2) At what time the weight per cent brine in the tank reach 25%? Assume that the tank's volume is large enough to reach overflow condition.



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.



	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			

3.1 What is the total weight and concentration of the brine in the tank after the opening of the valves for 20 hours?

Ans.

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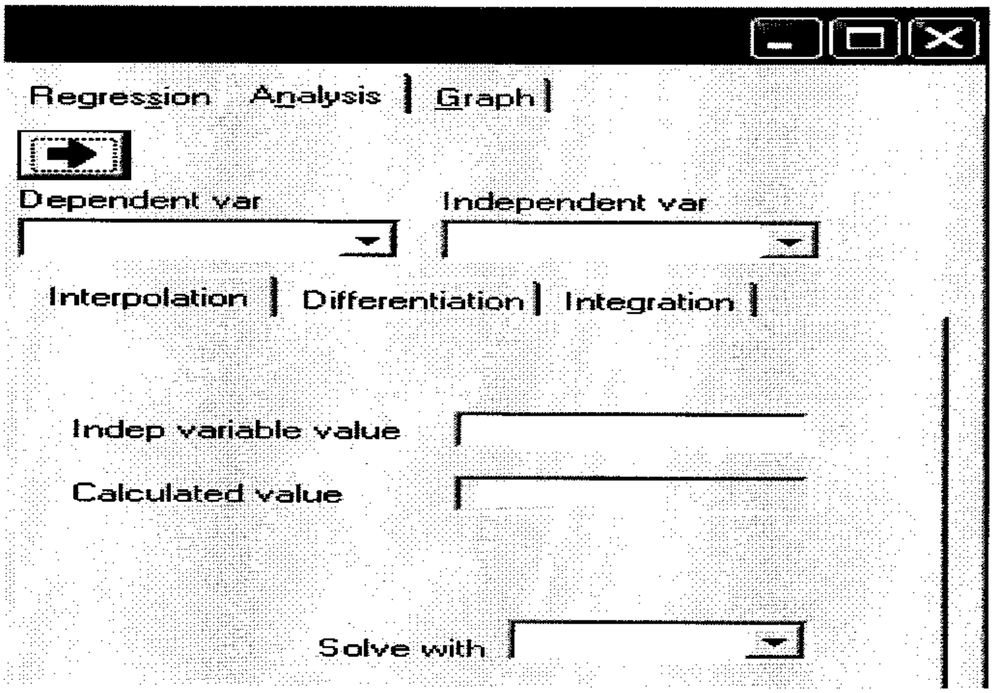
3.2 Calculate the time that the weight per cent brine in the tank is 25% by mean of the following window.



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4. (35 points) A vapor liquid equilibrium data of methanol (1) - water (2) at a total pressure of 760 mmHg is illustrated as follows:

x_1	y_1	$T(^oC)$	P_{tot} (mmHg)
0.04	0.230	93.5	760
0.10	0.418	87.7	760
0.20	0.579	81.7	760
0.40	0.729	75.3	760
0.60	0.825	71.2	760
0.80	0.915	67.6	760
0.90	0.958	66.0	760
0.95	0.979	65.0	760

Calculate parameters in Wilson's activity coefficient model by nonlinear regression method.

Given:

a) Vapor pressures of methanol and water are accorded to Antoine equations:

$\log_{10}(P^v, mmHg) = A - B/(t(celsius) + C)$

component	A_i	B_i	C_i
Methanol	8.07246	1574.99	238.86
Water	7.96681	1668.21	228.0

b) Wilson activity coefficient model for non-ideality in liquid phase

$$\ln\gamma_1 = -\ln(x_1 + \Lambda_{12}x_2) + x_2\left[\frac{\Lambda_{12}}{x_1 + \Lambda_{12}x_2} - \frac{\Lambda_{21}}{\Lambda_{21}x_1 + x_2}\right]$$

$$\ln\gamma_2 = -\ln(x_2 + \Lambda_{21}x_1) - x_1\left[\frac{\Lambda_{12}}{x_1 + \Lambda_{12}x_2} - \frac{\Lambda_{21}}{\Lambda_{21}x_1 + x_2}\right]$$

c) Ideal gas behavior in vapor phase (fugacity coefficients are equal to 1)

$$p_1 = y_1P_{tot} = x_1\gamma_1P_1^S \leftrightarrow \gamma_1 = \frac{y_1P_{tot}}{x_1P_1^S}$$

$$p_2 = y_2P_{tot} = x_2\gamma_2P_2^S \leftrightarrow \gamma_1 = \frac{y_2P_{tot}}{x_2P_2^S}$$

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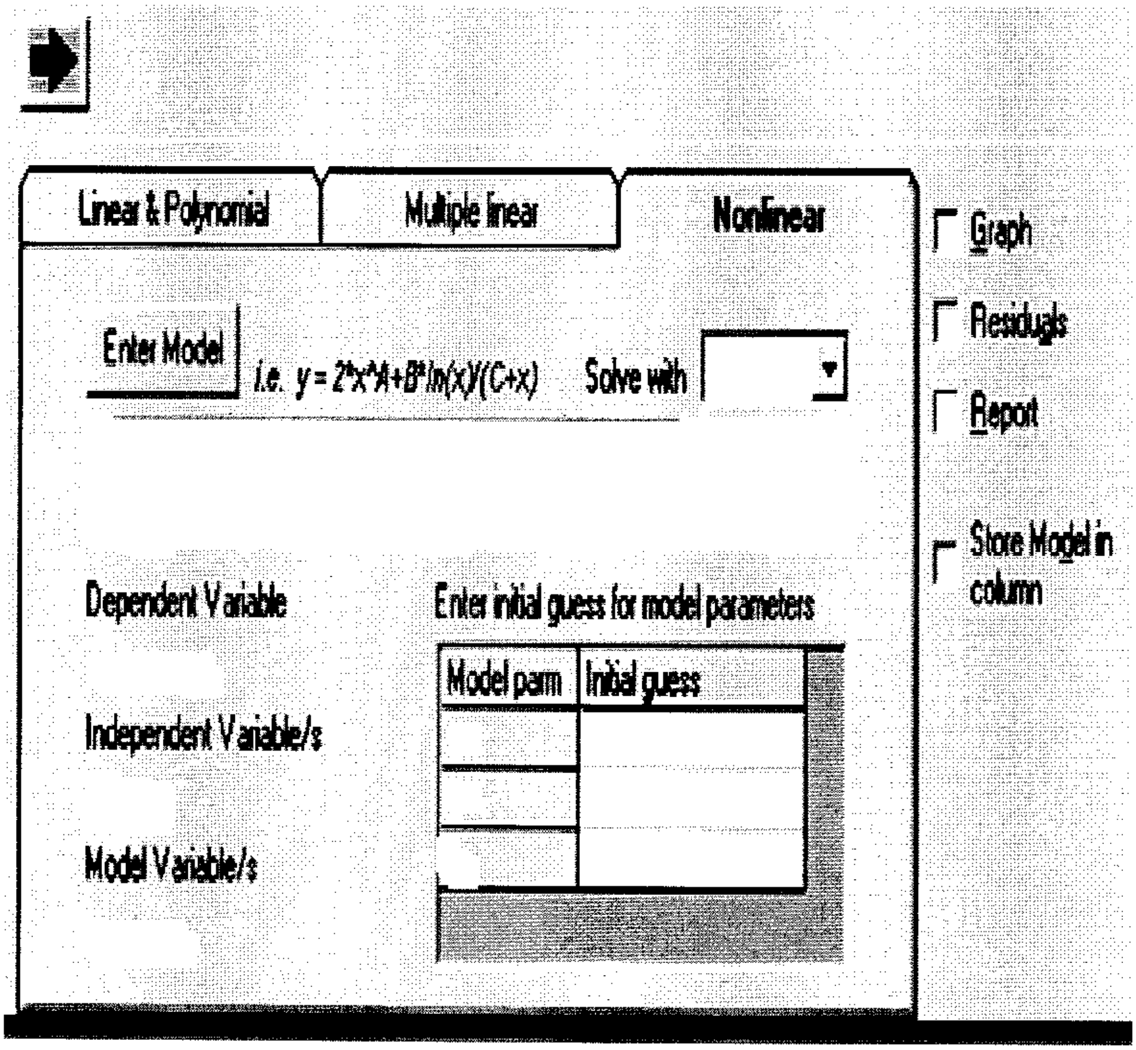
4.1 Fill in data of spreadsheet prepared for nonlinear regression

x_1	y_1	$T(^\circ C)$	P_{tot}							
0.04	0.230	93.5	760							
0.10	0.418	87.7	760							
0.20	0.579	81.7	760							
0.40	0.729	75.3	760							
0.60	0.825	71.2	760							
0.80	0.915	67.6	760							
0.90	0.958	66.0	760							
0.95	0.979	65.0	760							

4.2 Enter the model to fit the Wilson's activity coefficient parameters



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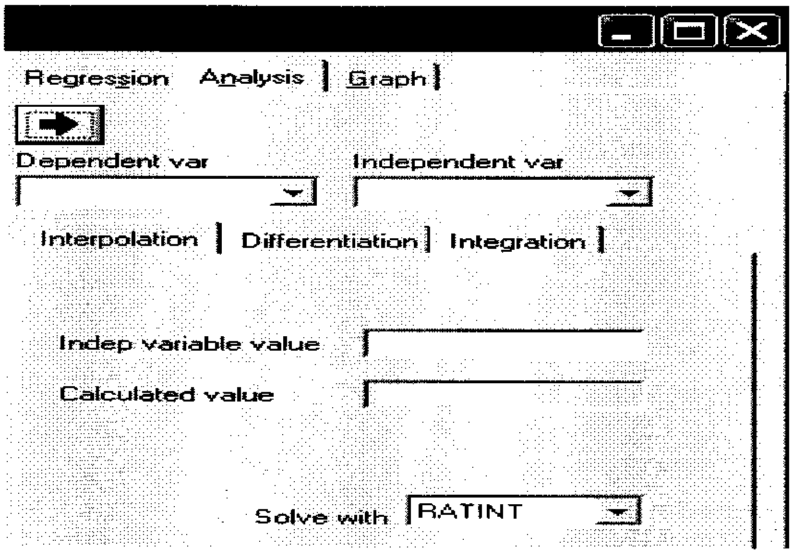
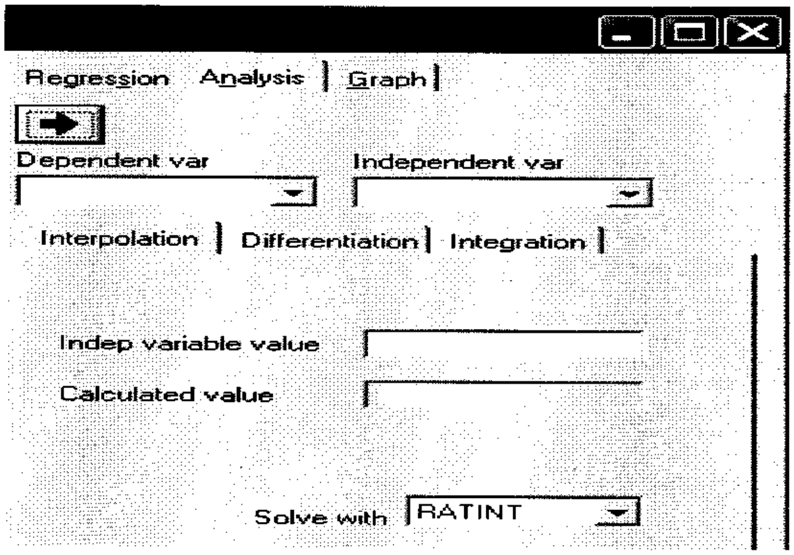
4.3 Calculate γ_1 and γ_2 at x_1 = 0.75 and P_{tot} = 760 mmHg





4.4 Show your results of, Λ_{12}, Λ_{21} and R^2 after regression

	value
Λ_{12}	
Λ_{21}	
R^2 (not the Gas constant)	