#ชุดที่ 1

Name- Surname....................................Student Code........................

Prince of Songkla University
Faculty of Engineering

Final Examination: 1st Semester
Date: 8th December 2014
Subject: 231-436 Com App for Chem Eng

Academic Year: 2014
Time: 9.00 – 12.00
Room: Com 1

ทุจริตในการสอบ โทษขั้นต่ำ คือ ปรับตกในรายวิชาที่ทุจริต และพักการเรียน 1 ภาคการศึกษา

- อนุญาตให้นำเอกสาร และตำรา เข้าห้องสอบได้
- ห้ามนำโทรศัพท์มือถือ เครื่องคิดเลข คอมพิวเตอร์โน้ตบุ๊ก ทุกรุ่นเข้าห้องสอบ
- ห้ามหยิบยืมเอกสาร ห้ามติดต่อสื่อสาร กับผู้ร่วมสอบ
- เขียนชื่อ และรหัสทุกหน้า
- กรณีกระดาษคำตอบไม่พอให้ใช้ด้านหลังได้
- ใช้ดินสอทำข้อสอบได้
- ข้อสอบมีทั้งหมด 2 ข้อ (9 หน้า รวมปก)

ข้อ	**คะแนนเต็ม**	**คะแนนที่ได้**
1(a)	20	
1(b)	20	
2(a)	10	
2(b)	15	
2(c)	15	
รวม	80	

รศ.ดร. ลือพงศ์ แก้วศรีจันทร์
ผู้ออกข้อสอบ

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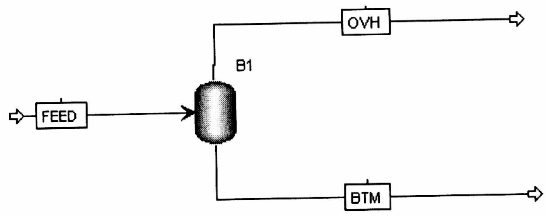
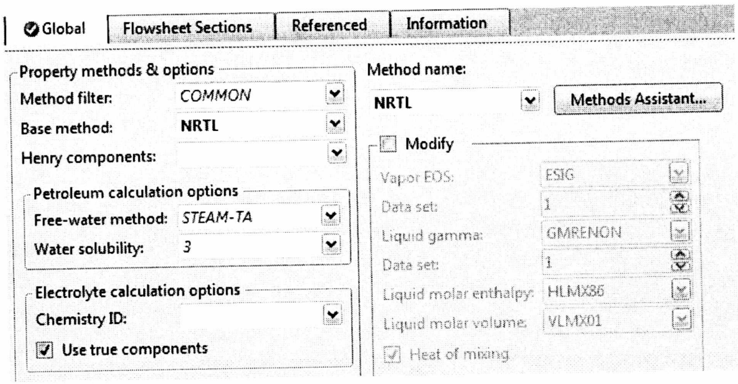
1. (40 points): Mixed gas stream of hydrogen, nitrogen and hydrocarbons is fed to a flash vessel in order to obtain vapor and liquid phases which came out into OVH and BTM streams, respectively.



Note: Before running Sensitivity, Set temperature and pressure of B1 to be 5 °F and 20 atm, respectively.

Feed stream conditions and thermodynamic package entirely used are listed below:

	Molar flow rate (lbmol/hr)	Alias formula
Hydrogen	25	C2
Nitrogen	13	N2
Methane	40	CH4
Cyclohexane	1.24	C6H12-1
Benzene	0.003	C6H6
	Temp (°F)	420
	Pressure (atm)	20



Flash vessel (B1) is selected from Model Palette of **Separators** (Flash2)

(a) You have to use model analysis tools for the sensitivity for varying FLASH tank temperature in order to find (1) molar flow rate (in lbmol/ hr) of overhead stream (OVH) (2) mass fraction of cyclohexane in OVH and (3) mass fraction of methane in BTM. *(Set pressure of B1 to be 20 atm during sensitivity operation)*

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Explain your variables used in sensitivity analysis

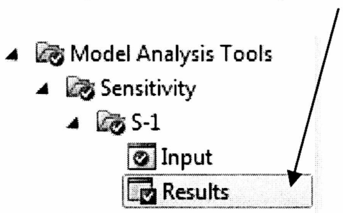
Define (5 points)

Flowsheet variable	Definition (as shown in your simulation)

Vary (5 points)

Manipulated variable	Value of manipulated variable
	Overall range Lower ☐ Upper ☐ **#points = 4**

Show your sensitivity results (10 points)



Point #	Manipulated	molar flow rate	mass fraction	mass fraction
variable				
1				
2				
3				
4				

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(b) You have to use model analysis tools for optimization (without constraints) in order to **minimize** the objective function of **{mass flowrate of cyclohexane in OVH stream+ mass flowrate of methane in BTM stream}.** In this case set *temperature of B1 to be 6 °F.*

Express your variables used in optimization analysis

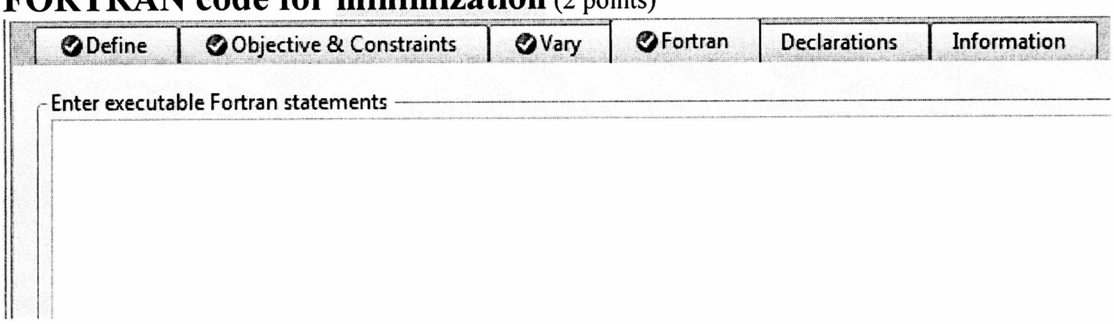
Define (4 points)

Flowsheet variable	Definition (as shown in your simulation)

Vary (4 points)

Manipulated variable	Manipulated variable limits
	Lower [ ] Upper [ ]

FORTRAN code for minimization (2 points)



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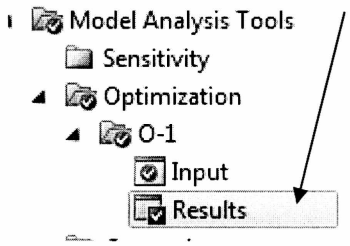
Show your optimization results (10 points)



Results | Status

Variable results

Variable	Initial value	Final value	Units

Show your stream results after successful optimization

Display: All streams Format: CHEM_E Stream Table Copy All

	BTM	FEED	OVH
Temperature F			
Pressure psia			
Vapor Frac			
Mole Flow lbmol/hr			
Mass Flow lb/hr			
Volume Flow cuft/hr			

Display: All streams Format: CHEM_E Stream Table Copy All

	BTM	FEED	OVH
Mole Flow lbmol/hr			
HYDROGEN		25	
NITROGEN		13	
METHANE		40	
CYCLOHEX		1.24	
BENZENE		0.003	

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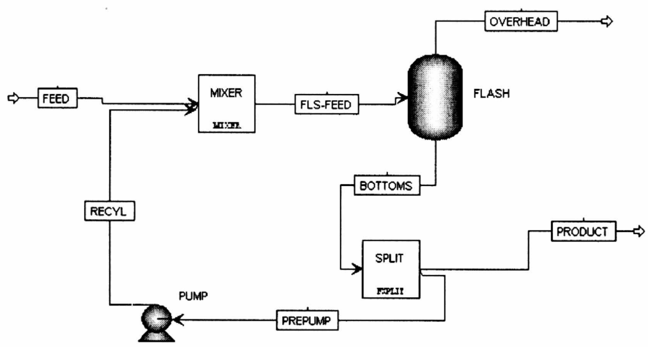
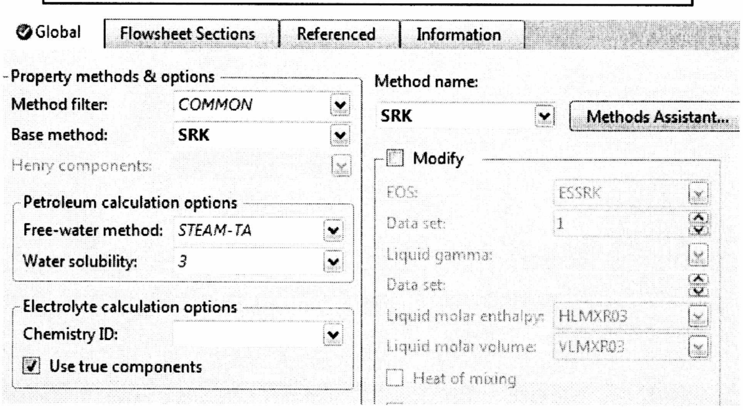
2. (40 points) Considering a flash vessel of hydrocarbon separation; the feed stream contains methane, ethane, propane, n-butane, 1-butene and Hexachloro-1,3 butadiene; the feed rate of each component is 50, 100, 700, 870, 1176 and 5,130 lbm / h, respectively. Previous entering to the flash tank, the mixture of feed stream is mixed with the RECYL stream to form FLS-FEED stream via a Mixer unit as shown below. The BOTTOMS stream of the FLASH tank is separated onto two streams (PRODUCT and RECYL) via a splitter FSplit unit.



Feed stream, FLASH tank conditions, Pump specification and thermodynamic package entirely used are listed below:

FEED stream	Mas flow rate (lbm/hr)	Alias formula
Methane	50	CH4
Ethane	100	C2H6
Propane	700	C3H8
n-Butane	870	C4H10-1
i-Butene	1176	C4H8-1
HEXACHLORO-1,3 Butadiene	5130	C4CL6
	Temp (°F)	85
	Pressure (psia)	50

FLASH tank conditions: 41°F and 25 psia



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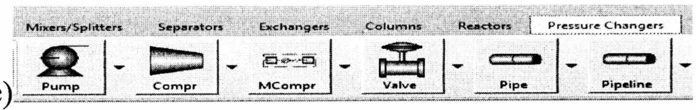
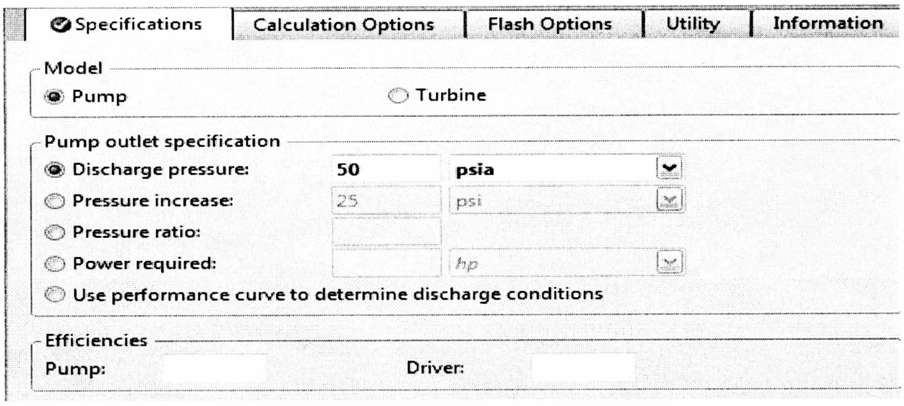
(model palette)





(a) (10 points) Fill in the blanks for the stream results after simulation in case of percent recycle of the bottom is equal to 35. (35 % recycle)

Format selected

Display: All streams Format: CHEM_E Stream Table Copy All

	BOTTOMS	FEED	FLS-FEED	OVERHEAD	PRODUCT	RECYL
Temperature F						
Pressure psia						
Vapor Frac						
Mole Flow lbmol/hr						
Mass Flow lb/hr						

	BOTTOMS	FEED	FLS-FEED	OVERHEAD
Mole Flow lbmol/hr				
METHANE				
ETHANE				
PROPANE				
N-BUTANE				
1-BUTENE				
1,3BUTAD				

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(b) Using 'Flowsheeting options' for 'Design Spec' to get mass fraction of Hexachloro 1,3-Butadiene in stream 'OVERHEAD' equal to 0.0007 by varying temperature of the FLASH tank.

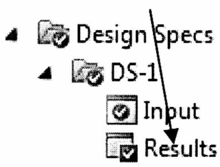
Express your simulation by writing down variables and their definitions on the following windows.

a) Define (4 points)

b) Spec (4 points)

c) Vary (4 points)

d) Click Results after successful simulating(2 points)



Fill all design spec results in the following window:

Results | Status

Variable results

Variable	Initial value	Final value	Units

e) Ans. Temperature = ☐ °F(1 points)

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(c) Using 'Flowsheeting options' for 'Design Spec' to get molar flow of iso-butene in the stream 'OVERHEAD' equal to 5.0 lbmol/h by varying pressure of the FLASH tank.

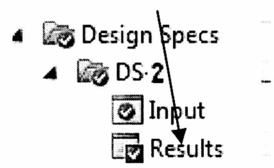
Express your simulation by writing down variables and their definitions on the following windows.

a) Define (4 points)

b) Spec (4 points)

c) Vary (4 points)

d) Click Results after successful simulating (2 points)



Fill all design spec results in the following window:

Results | Status

Variable results

Variable	Initial value	Final value	Units

e) Ans. Pressure = ☐ Psia (1 points)