Charles Darwin University

Final Examination

Family Name						
Given Name/s						
Student Number						
Teaching Period	Semester 1, 2019					

ENG444 – Hydrocarbon Processing	DURATION	
	Reading Time:	10 minutes
	Writing Time:	180 minutes

INSTRUCTIONS TO CANDIDATES

There are 4 questions in this exam.
The maximum number of marks is 100.

EXAM CONDITIONS

You may begin writing from the commencement of the examination session. The reading time indicated above is provided as a guide only.

This is a RESTRICTED OPEN BOOK examination

Any non-programmable calculator is permitted

One A4 sheet of handwritten double-sided notes permitted

No dictionaries are permitted

ADDITIONAL AUTHORISED MATERIALS	EXAMINATION MATERIALS TO BE SUPPLIED
No additional printed material is permitted	1 x 16 Page Book 1 x Scrap Paper

THIS EXAMINATION IS PRINTED DOUBLE-SIDED.

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Question 1 (Reservoir Fluid)

Phase diagrams of 4 types of reservoir fluid ***(1)***, ***(2)***, ***(3)*** and ***(4)*** are given in ***Figure Q1,*** where T_{res} is the common reservoir temperature and ***C1***, ***C2***, ***C3***, ***C4*** are critical points of the fluids.

a) Identify and briefly describe the characteristics of the 4 reservoir fluids.

(Marks: 10)

b) Explain what happens during the production of reservoir fluid ***(4)***.

(Marks: 10)

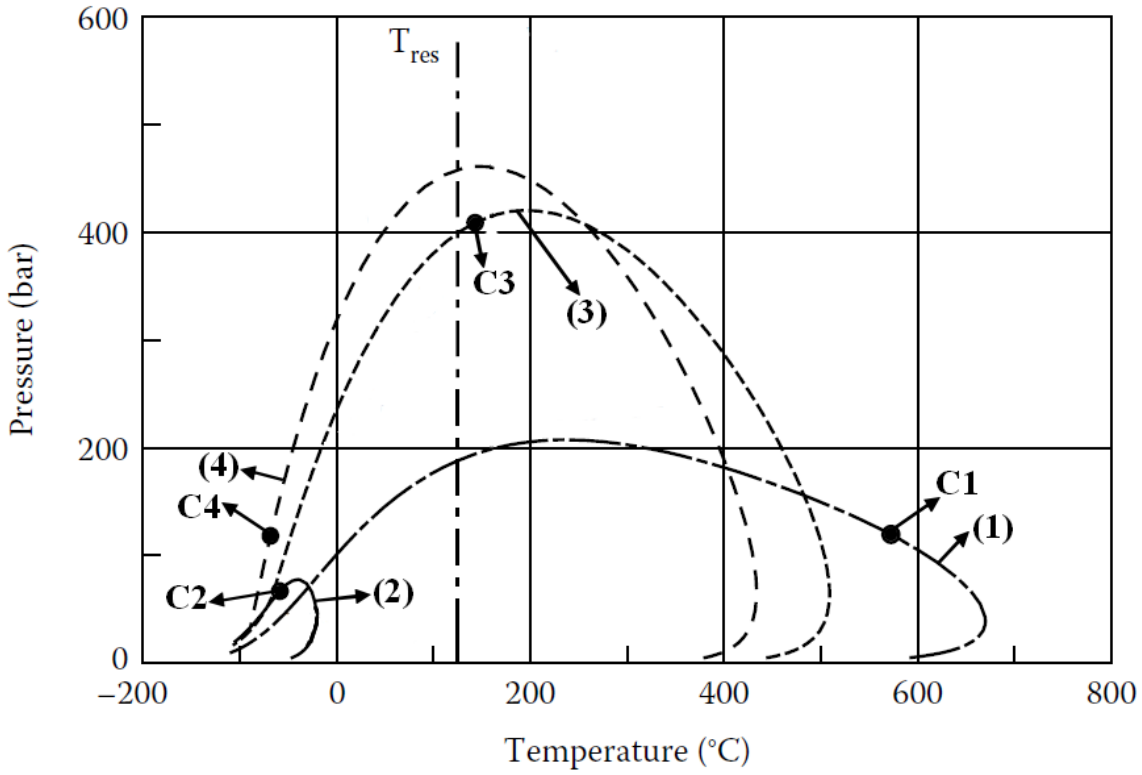

Fig. Q1. *Phase diagrams of reservoir fluids. (taken from Phase Behavior of Petroleum Reservoir Fluids, 2nd Edition, K S Pedersen et. al., CRC Press, 2015.)*

Question 2 (Refining Processes)

a) Describe briefly all the hydrogen-consuming processes in a refinery.

(Marks: 5)

b) Which process could be used to produce hydrogen for hydrogen-consuming processes in a refinery? Draw a block diagram for that process and describe it.

(Marks: 10)

c) How is gasoline produced in a refinery?

(Marks: 5)

d) ***Figure Q2*** below shows the simplified block diagram of an atmospheric distillation unit (ADU) in a refinery. The refinery aims to produce as much clean gasoline as possible. What are other processing units required to achieve this aim? Give your explanations and complete the block diagram for the proposed configuration of the refinery.

(Marks: 10)

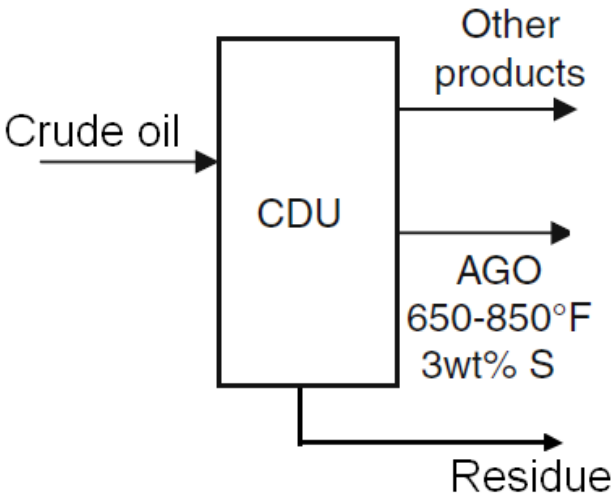

Fig. Q2. *Existing ADU in a refinery.*

Question 3 (Hydrocarbon Mixture Separation)

Table Q3 shows the composition of a hydrocarbon stream containing 5 components. We wish to separate this mixture into 5 individual components, using simple distillation columns.

a) List all possible separation sequences for this task.

(Marks: 8)

b) Employing simple heuristics, propose the optimal sequence for the separation of this mixture. Explain and draw a simple block diagram for your proposal.

(Marks: 12)

Table Q3. Composition of a hydrocarbon stream.

Component	Boiling point (°C)	Relative volatility *(compared to the heaviest component)*	Molar flow rate (mol/s)
A	106	4.3	1
B	117	4	0.5
C	120	3	1
D	132	2	7
E	151	1	10

Question 4 (HAZOP study)

Figure Q4 describes a shell and tube heat exchanger.

a) Perform a HAZOP study for this heat exchanger

(Marks: 20)

b) Recommend possible modifications to improve the safety of the process.

(Marks: 10)

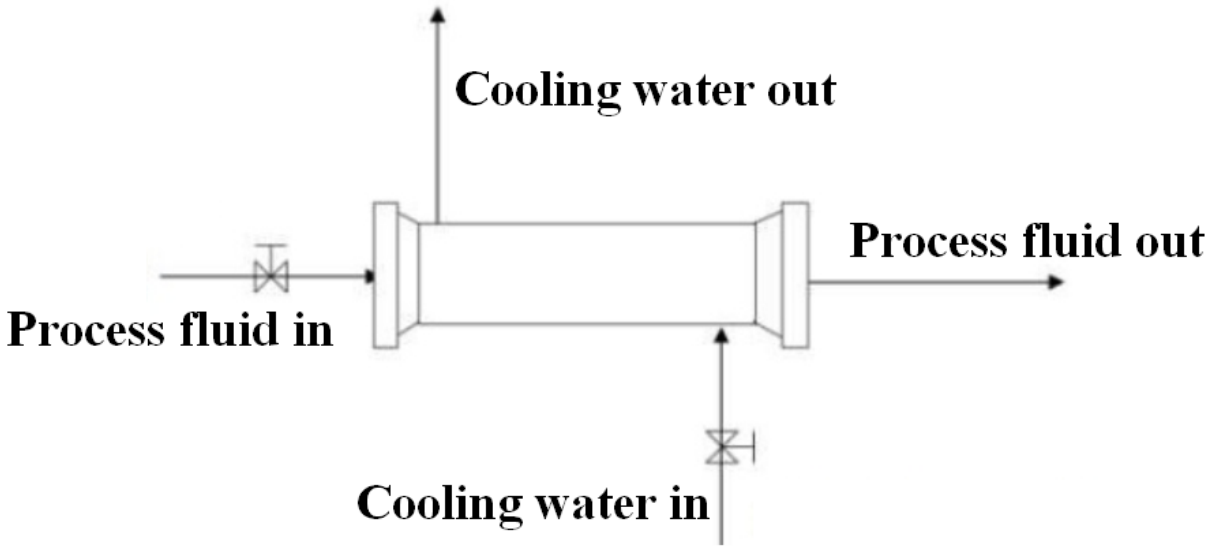

Fig. Q4. A shell and tube heat exchanger.