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Family Name					
Given Name/s					
Student Number					
Teaching Period	Semester 1, 2018				

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 40.		
EXAM CONDITIONS		
<u>You may begin writing from the commencement of the examination session.</u> 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	

**THIS EXAMINATION IS PRINTED
DOUBLE-SIDED.**

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Question 1 (Reservoir Fluid)

Phase diagram of a reservoir fluid is given in *Figure Q1*. The reservoir's initial conditions are defined as point (A).

- a) What is the type of the reservoir shown in the figure?
- b) List some typical characteristics of this reservoir fluid.
- c) On the phase diagram, identify the region, where retrograde condensation may occur during the depletion of the reservoir.

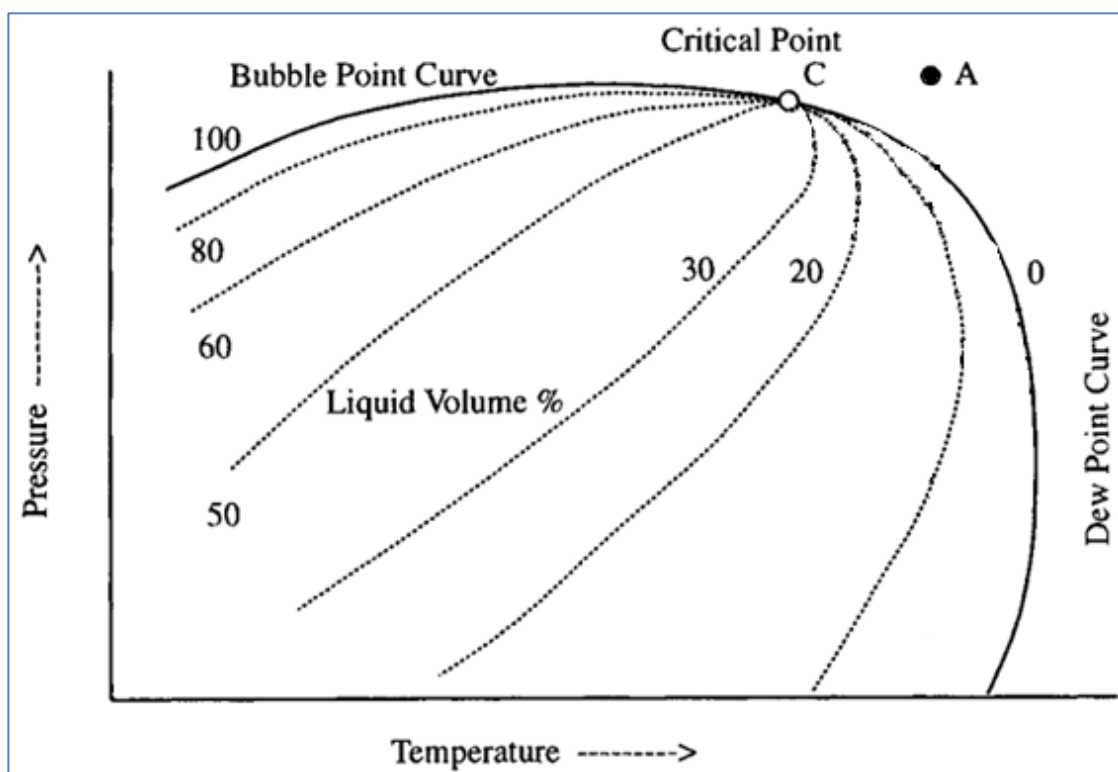


Fig. Q1. Phase diagram of a reservoir fluid. (taken from Phase Behavior of Petroleum Reservoir Fluids, 2nd Edition, K S Pedersen et. al., CRC Press, 2015.)

(Marks: 8)

Question 2 (Refining Processes)

- What is the role of the Fluid Catalytic Cracking (FCC) unit in a refinery?
- What are the main chemical reactions occurring in a FCC unit?
- What are possible feeds for the FCC unit?
- Draw a block diagram of the common FCC process and describe it. What is the most important feature of FCC process?
- Figure Q2** below shows the simplified block diagram of an atmospheric distillation unit (ADU) in a refinery. The refinery aims to produce as much 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.

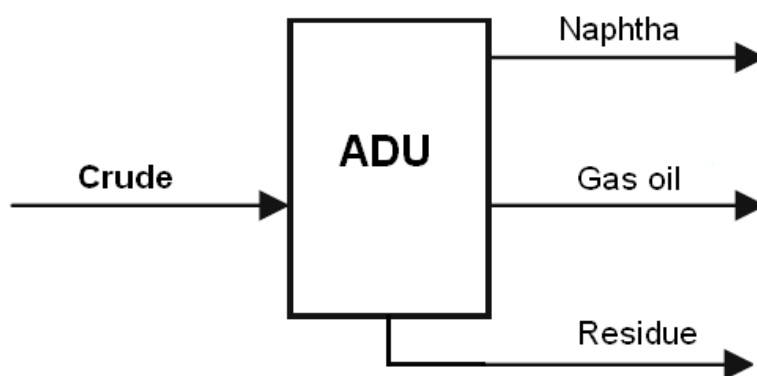


Fig. Q2. Existing ADU in a refinery.

(Marks: 12)

Question 3 (Gas Mixture Separation)

Table Q3 shows the composition of gas product stream of a FCC unit. Ethylene and propylene are desired products, which must be separated from the FCC gas stream. Your task is to propose an optimal separation sequence to produce these two desired products, employing simple heuristics. Explain and draw a simple block diagram for your proposal.

Table Q3. Composition of FCC gas product.

Component	Boiling point (°C)	mol%
Hydrogen (H ₂)	-253	18
Methane (C ₁)	-164	15
Ethane (C _{2-p})	-88	15
Ethylene (C _{2-o})	-104	24
Propane (C _{3-p})	-42	6
Propylene (C _{3-o})	-48	14
Heavier components (C ₄₊)	-1	8

(Marks: 10)

Question 4 (HAZOP study)

Figure Q4 describes a heating process, where flammable, volatile solvents are heated by steam. The temperature of the outlet solvent stream is measured by a thermocouple, and a controller valve adjusts the amount of steam to the heat exchanger to achieve the desired temperature.

- Identify the study nodes of the heating process.
- Perform a HAZOP study for the study node “hot solvent line from heat exchanger”, using two process parameters: flow and temperature.

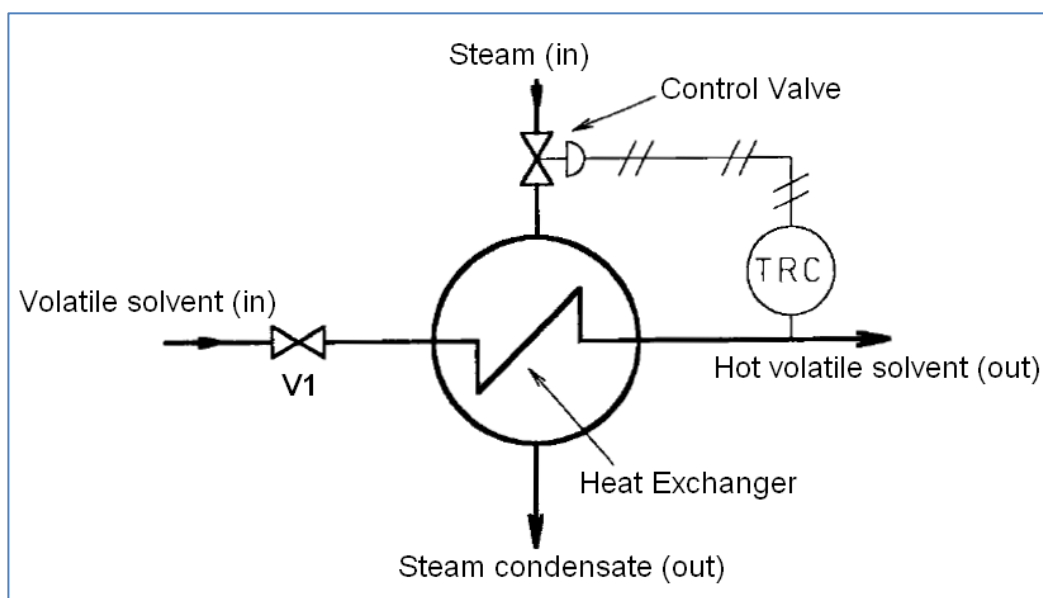


Fig. Q4. Volatile solvent heating process.

(Marks: 10)