

BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE, PILANI

First Semester 2022-2023 (27/12/2022)

Comprehensive Examination (**PART A-Closed book-45 marks, suggested time 130 min**)

Course No. : CHE F422

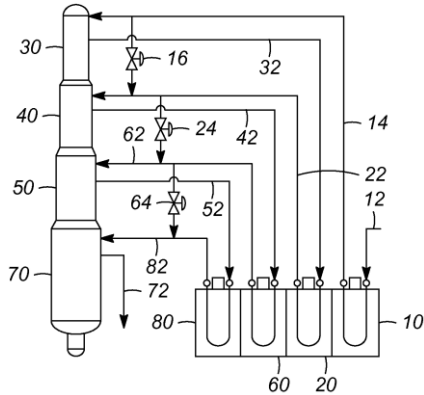
Total time: 180 min

Course Title: PRT

Total Marks: 60

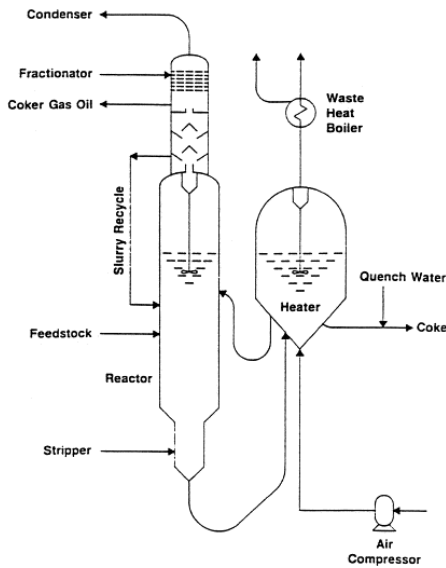
Instructions: *Number each main question correctly and also start each new main answer on a fresh page.*
Part B (open book) answer booklet may only be taken once part A answer booklet is submitted.
Time distribution for Part A and B is up to the student.

Q1. The following image below of a patent is representative of the main units of a refinery flowsheet. Answer the related questions:



- Name the flowsheet/ process and give its purpose
 - List operating T, P, catalyst and feed for the unit
 - With examples describe two categories of reaction that are desirable
 - Is there another unit for same process? What advantage does this one have if any?
 - Reason out possibly why reactors are designed progressively larger
- [1+4+1+2+2=10]**

Q2. Carefully observe the figure below:



- Give the exact industrial name of the flowsheet (Figure below)
 - Describe what is happening in the flowsheet (the process by which product is being formed) and the *form* of the final product formed?
 - Name the *alternative* industrial process for this product and draw the flowsheet for that (all main units and correct interconnections are required).
 - Name the **end uses** of the product- must be specific.
- [2+2+4+2=10]**

Q3. (a) In one of our government owned Refineries, a newly bid crude oil deal, was successfully completed. Before sending the 'new' crude out for the planned electric dehydration operation however, the research lab engineer decided to do a simple mixing test with 500ml water and 500ml crude. A very low rpm mixer with rotation elements that imparted shear force more or less evenly in all directions was used for dispersion of water within the crude layer. After mixing and sitting the mixture for the prescribed time, the engineer observed an unusually thick interface/layer between the brine and oil layers, which clearly had a different appearance. **What implications, if any, does this have for the subsequent planned operation?** Analyse and give reasoned justification [4]

(b) the following two equipment of furnaces (Figures below) of similar size and volume but different design, are being considered by a refinery. The refinery is about to go through an adjustment. Their upcoming feedstock is heavy crude of AIP=15 (they usually processed crude of API=60), and their plan is to reduce the unit daily turn-out capacity by 35% compared to what they processed in the past (Assume plant will run for almost same hours/day). With these considerations, which design might be a better design to purchase, or were both equally appropriate technically? Justify technically and in detail [3]

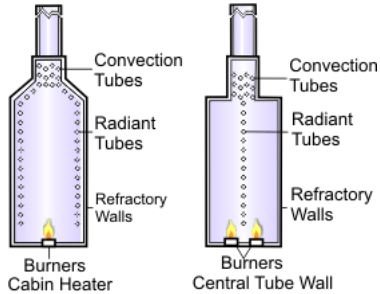


Figure: Furnaces

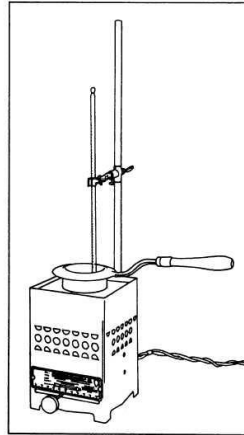


Figure: Test 1

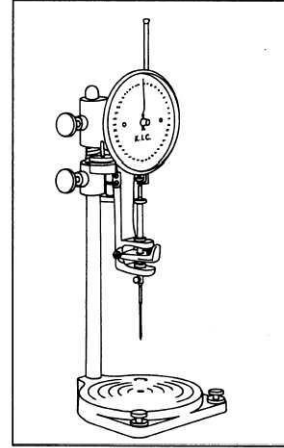


Figure: Test 2

(c) Give the complete name of Test 1 and Test 2 from the schematic of the test set-up for crude fractions, and briefly describe purpose of each test. [3]

Q5. Give only the definition and significance of these properties: (a) Cloud point (b) Aniline point (c) Cetane number. **Only state the purpose and draw** a very basic schematic of set-up for (a) Reid vapor pressure test; and (b) Conradson carbon residue test [6 +4]

Q6. What is the difference on the basis provided in brackets? Go directly to the point (1×5)

- 1) Sweet crude, High sulfur crude (**definition**)
- 2) Shield, Basin (**geological structure**)
- 3) Oil Window, Oil peak (**evidence for these theories**)
- 4) Correlation index, UOP characterization factor (**suitability for aromatic heavy crude**)
- 5) Straight chain paraffins, Branched chain paraffins (**Octane Number**)

*****End of PartA*****

(PART B-Open book-15 marks, suggested time 50 min)

Instructions: *Write all the steps of the solution procedure and quote all data sources. Show at least one sample calculation for each column data.*

Characterize the following crude of 32.1°API by calculating and plotting only **mid-volume % Vs API** and **vol% Vs wt%** graphs [10+5]. Take cut fractions of 200°F as IBP-200, 200-400,... 800-FBP. Quote data sources and show at least one sample calculation. Marks will be given only for accurate values of the given problem and correct graphs.

Vol. %	0	5	10	20	30	40	50	60	70	80	90	99
TBP, ° F	-100	-40	20	120	190	250	310	380	450	550	700	900

*****End of Part B*****