

**PETROLEUM REFINERY ENGINEERING  
(CHEN 4132)**

**Time Allotted : 3 hrs**

**Full Marks : 70**

*Figures out of the right margin indicate full marks.*

*Candidates are required to answer Group A and  
any 5 (five) from Group B to E, taking at least one from each group.*

*Candidates are required to give answer in their own words as far as practicable.*

**Group - A  
(Multiple Choice Type Questions)**

1. Choose the correct alternative for the following: **10 × 1 = 10**
- (i) ASTM D158 corresponds to the distillation standard for  
(a) Kerosene (b) Diesel  
(c) Naphtha (d) LPG
  - (ii) Acceleration properties of an IC engine can be gauged from \_\_\_\_ during ASTM distillation  
(a) T<sub>50</sub> (b) T<sub>20</sub> (c) T<sub>30</sub> (d) T<sub>10</sub>
  - (iii) During gasoline blending the two major properties of gasoline which are improved are  
(a) Reid vapour pressure and octane number  
(b) Reid vapour pressure and viscosity index  
(c) Pour point and viscosity index  
(d) Pour point and smoke point
  - (iv) During lead doctoring of gasoline, the gasoline stream contains  
(a) sulphur (b) disulfide (c) sulphide (d) sulphur dioxide
  - (v) The catalyst used in hydrotreating is  
(a) cobalt-molybdenum sulphide on alumina support  
(b) zeolite  
(c) silica-alumina with rare earths  
(d) natural aluminosilicates
  - (vi) In the radiant section of a pipe-still furnace, the tube spacing can be kept as \_\_\_\_ times the tube O.D.  
(a) 1 (b) 5 (c) 0.5 (d) 3
  - (vii) For production of polymer gasoline, the most widely used catalyst is  
(a) HF (b) H<sub>3</sub>PO<sub>4</sub> (c) H<sub>2</sub>SO<sub>4</sub> (d) Zeolite

- (viii) R.O.N. is determined in a CFR engine running at \_\_\_\_\_ rpm.  
(a) 600                      (b) 500                      (c) 900                      (d) 300
- (ix) For solvent dewaxing, \_\_\_\_\_ is one of the main solvents.  
(a) MEK                      (b) NMP                      (c) Furfural                      (d) Acetone
- (x) Methyl cyclopentadienyl manganese tricarbonyl is used for  
(a) decreasing pour point                      (b) increasing flash point  
(c) improving anti-knock property                      (d) increasing cetane number.

**Group- B**

2. (a) A particular crude oil sample has a molecular weight of 150 and a specific gravity of 1.125 at 15°C. Determine the base of the crude oil.  
[[CO1](Apply/IOCQ)]
- (b) What is the utility of the copper strip corrosion test? [[CO1](Understand/LOCQ)]
- (c) The lighter fraction of a particular crude oil sample boils at 266°C at normal atmospheric pressure, while the heavier fraction boils at 290°C at a vacuum of 1.58 inch Hg. The specific gravity of the former fraction at 15°C is 1.127 and that of the latter fraction is 1.14. Identify the base of the crude oil sample.  
[[CO1](Evaluate/HOCQ)]  
**3 + 4 + 5 = 12**
3. (a) Why pump-around refluxes are drawn from the heavy naphtha, kerosene and diesel trays and not from LPG/light naphtha trays? [[CO1,2,3](Evaluate/HOCQ)]
- (b) What is the operating principle behind electrical desalting of crude oil?  
[[CO1,3](Understand/LOCQ)]
- (c) Explain why atmospheric distillation of crude oil is carried out at a pressure slightly more than atmospheric. [[CO1,3](Analyze/IOCQ)]  
**5 + 4 + 3 = 12**

**Group - C**

4. (a) Describe the delayed coking operation with a flow diagram.  
[[CO2] (Understand/LOCQ)]
- (b) Suggest suitable design modifications that can be made in existing FCC units for obtaining improved gasoline yield and catalytic activity.  
[[CO2,CO3] (Evaluate/HOCQ)]
- (c) Discuss the important reactions taking place in a catalytic reforming unit and identify the desirable reactions. Analyze the effect of different operating parameters on the desirable reactions. [[CO2](Analyze/IOCQ)]  
**4 + 4 + (2 + 2) = 12**
5. (a) “Visbreaking is a type of thermal cracking operation”. Justify the claim.  
[[CO2] (Evaluate/HOCQ)]

- (b) Comment on the effect of operating parameters on the conversion and yield of desirable products in fluidised bed catalytic cracking. [(CO2) (Analyze/IOCQ)]
- (c) "Catalytic cracking proceeds via carbonium ion mechanism while thermal cracking proceeds via free radical mechanism". Comment on the validity of the statement. [(CO1)(Analyze/IOCQ)]

**5 + 4 + 3 = 12**

**Group - D**

6. (a) Discuss the important reactions taking place in a hydrocracking unit and identify the desirable reactions. [(CO4) (Remember/LOCQ)]
- (b) "Feed preparation is an essential step in hydrocracking". Justify. [(CO2) (Analyze/LOCQ)]
- (c) "Ebullated bed reactors provide advantages over expanded bed hydrocracking process". Comment on the claim. [(CO2)(Analyze/IOCQ)]

**4 + 4 + 4 = 12**

7. (a) What are the top and bottom products from the de-isobutanizer in the HF alkylation process? [(CO3)(Analyze/IOCQ)]
- (b) What preventive measures are installed so as to not let the acid concentration drop in the alkylation reactor? [(CO3)(Analyze/IOCQ)]
- (c) What are the main reactions taking place during polymerization of propane and butane? [(CO1)(Remember/LOCQ)]

**4 + 4 + 4 = 12**

**Group - E**

8. (a) What is the utility of dewaxing in LOBS production? What is catalytic isodewaxing? [(CO1,3)(Understand/LOCQ)]
- (b) Why is the removal of aromatics necessary for LOBS production? [(CO1,3)(Understand/LOCQ)]
- (c) What are the principal feedstocks for LOBS production? [(CO1)(Remember/LOCQ)]

**(2 + 2) + 4 + 4 = 12**

9. (a) Explain the motive for the modern trend of refinery-petrochemicals integration. [(CO3, CO4)(Evaluate/HOCQ)]
- (b) What are the feedstocks for the production of 3<sup>rd</sup> generation biofuels? Give some examples of such fuels. [(CO4)(Remember/LOCQ)]

**6 + (3 + 3) = 12**

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	43.75%	30.21%	26.04%

**Course Outcome (CO):**

After the completion of the course students will be able to

C01: Understand oil refining process

C02: Categorize associated downstream processing technologies, operations and economics

C03: Grasp the principles for improving refinery economics

C04: Develop the essential knowledge and skills required to work as an engineer in the oil, gas and petrochemical sectors

\*LOCQ: Lower Order Cognitive Question; IOCQ: Intermediate Order Cognitive Question; HOCQ: Higher Order Cognitive Question

Department & Section	Submission Link
CHE	<a href="https://classroom.google.com/c/NDAwOTA2MDQ2NjMy/a/NDYzODUyMDA1NjQw/details">https://classroom.google.com/c/NDAwOTA2MDQ2NjMy/a/NDYzODUyMDA1NjQw/details</a>