SUMMER-17 EXAMINATION

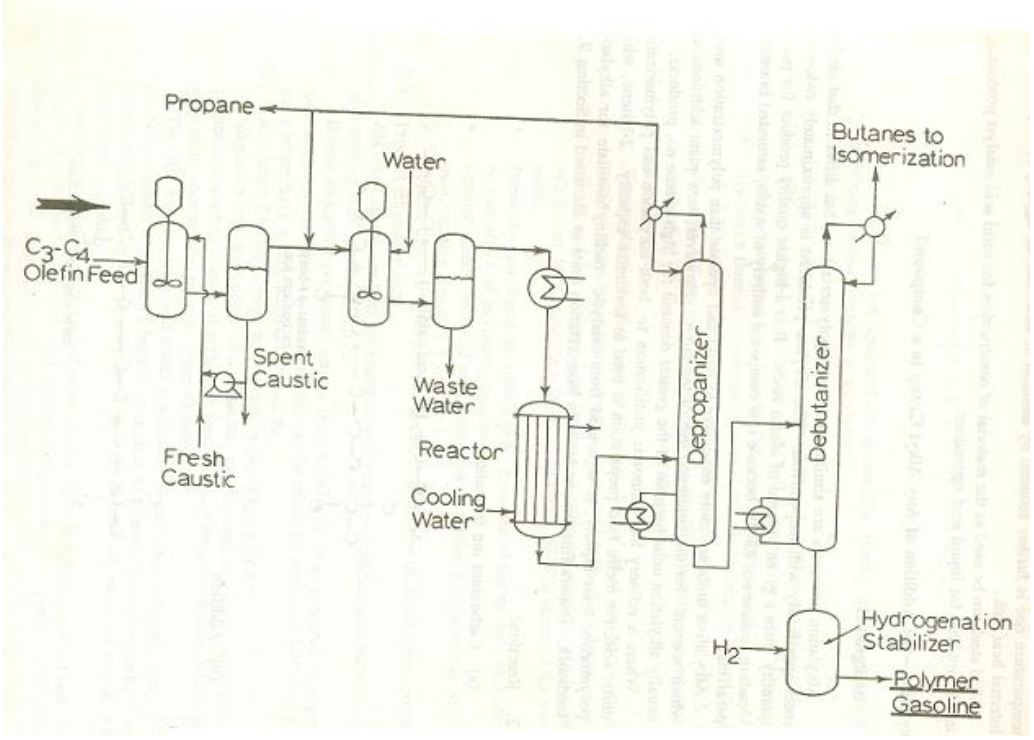
Model Answer

Important Instructions to examiners:

1) The answers should be examined by key words and not as word-to-word as given in the model answer scheme.
2) The model answer and the answer written by candidate may vary but the examiner may try to assess the understanding level of the candidate.
3) The language errors such as grammatical, spelling errors should not be given more Importance (Not applicable for subject English and Communication Skills.
4) While assessing figures, examiner may give credit for principal components indicated in the figure. The figures drawn by candidate and model answer may vary. The examiner may give credit for any equivalent figure drawn.
5) Credits may be given step wise for numerical problems. In some cases, the assumed constant values may vary and there may be some difference in the candidate's answers and model answer.
6) In case of some questions credit may be given by judgement on part of examiner of relevant answer based on candidate's understanding.
7) For programming language papers, credit may be given to any other program based on equivalent concept.

<table>
<tr><th>Q No.</th><th>Answer</th><th>Marks</th></tr>
<tr><td>1</td><td>Attempt any FIVE of the following</td><td>20</td></tr>
<tr><td>1-a</td><td>Four Indian refineries with their location and capacity.
<table>
<tr><th>Name</th><th>Location</th><th>Capacity (MMTPA)</th></tr>
<tr><td>Reliance petroleum Ltd</td><td>Jamnagar</td><td>33</td></tr>
<tr><td>Indian Oil Corporation Limited</td><td>Koyali in Gujarat</td><td>13.7</td></tr>
<tr><td>Manglore Refinery and Petrochemicals Ltd</td><td>Manglore in Karnataka</td><td>9.69</td></tr>
<tr><td>Chennai Petroleum Corporation Ltd</td><td>Manali</td><td>9.5</td></tr>
<tr><td>Indian Oil Corporation Limited.</td><td>Mathura in Uttar Pradesh</td><td>8.0</td></tr>
<tr><td>Cochin Refineries Ltd.</td><td>Cochin , Kerala.</td><td>7.5</td></tr>
<tr><td>Hindustan Petroleum Corporation Ltd.</td><td>Visakhapattanam in Andhra Pradesh</td><td>7.5</td></tr>
<tr><td>Bharat Petroleum Corporation Ltd.</td><td>Mumbai.</td><td>6.9</td></tr>
<tr><td>Indian Oil Corporation Limited</td><td>Panipat in Haryana</td><td>6.0</td></tr>
<tr><td>Indian Oil Corporation Limited</td><td>Barauni in Bihar</td><td>6.0</td></tr>
<tr><td>Hindustan Petroleum Corporation Ltd.</td><td>Mumbai</td><td>5.5</td></tr>
</table>
Note:
Any other Indian refineries should be given due consideration</td><td>1 mark each for any four</td></tr>
<tr><td>1-b</td><td>Test properties for gasoline
1. ASTM distillation: specifies the evaporation characteristics of gasoline</td><td>½ mark each for</td></tr>
</table>

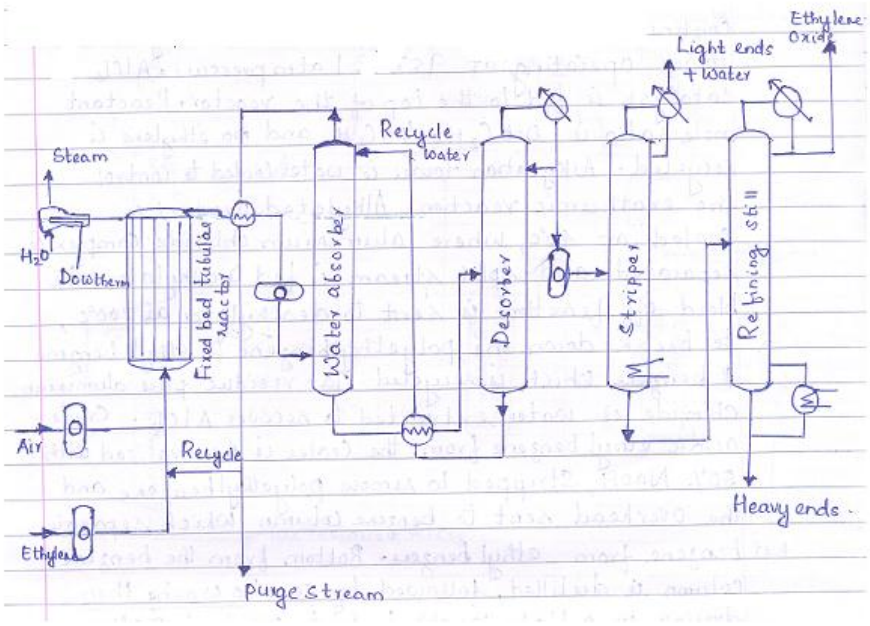
	which gives an idea of the flash point 2. Reid vapour pressure (volatility tests): volatility tests are intended for smooth performance of engine under all weather. 3. Octane number: It is used for measuring the anti knocking qualities of gasoline 4. Gum content: specifies the oxidation stability of gasoline 5. Sulfur content **Test properties for diesel** 1. Pour point 2. Aniline point-Diesel index (Cetane number) 3. Flash point 4. Calorific value 5. Viscosity.	naming any four ½ mark each for naming any four
1-c	Flow sheet for polymerization process	4

		
1-d	**(i) Reactions involved in the manufacture of methanol with standard conditions:** Methanol is produced by catalytic hydrogenation of CO Main reaction: $CO + 2H_2 \rightarrow CH_3OH$ Side reactions: $CO + 3H_2 \rightarrow CH_4 + H_2O$ $2CO + 2H_2 \rightarrow CH_4 + CO_2$ $xCO + y\ H_2 \rightarrow$ high molecular weight alcohols and hydro carbons Temperature : 300^0C Pressure: 200-300 atm Catalyst: Mixed catalyst of Zn, Cr, Mn Or Al oxides **(ii) Reactions involved in the manufacture of Formaldehyde with standard conditions:** i. oxidation	1 1

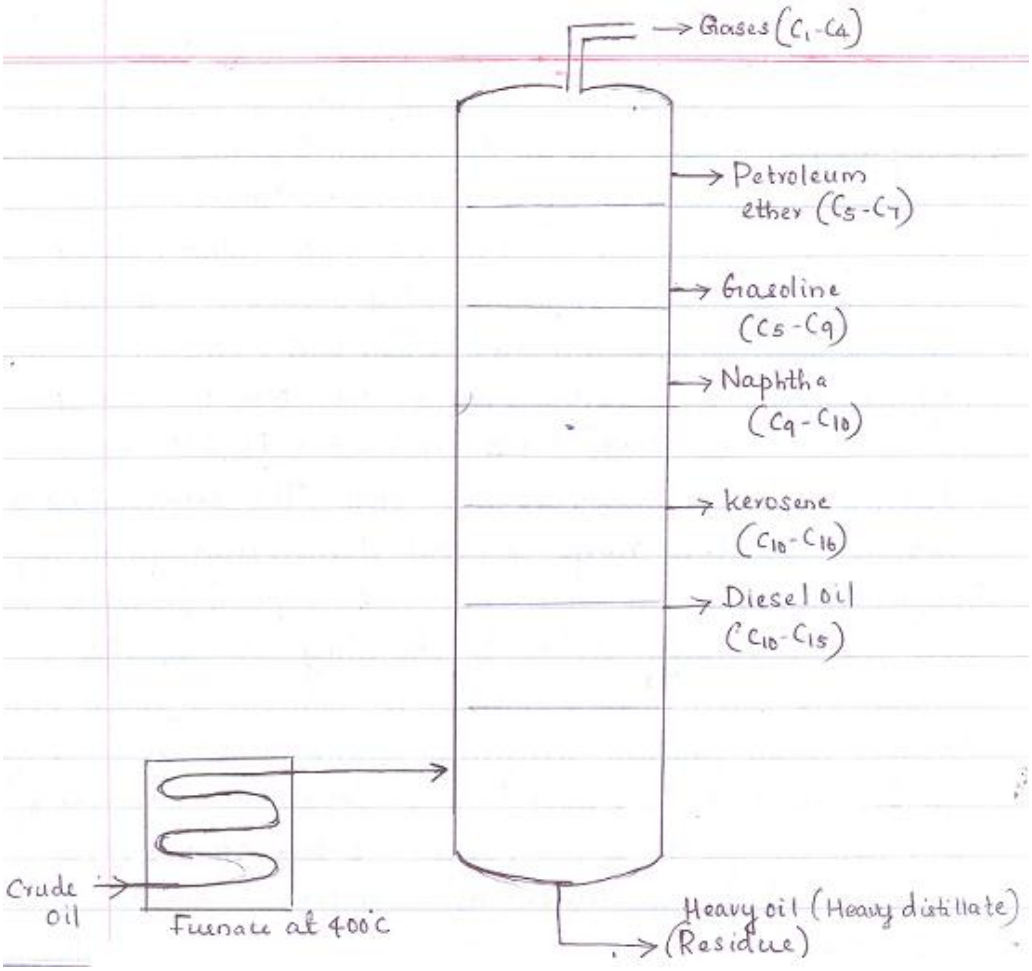
<table>
<tr><td></td><td>$CH_3OH + 1/2\ O_2 \rightarrow HCHO + H_2O$
ii. Pyrolysis
$CH_3OH \rightarrow HCHO + H_2$
iii. Side reaction
$CH_3OH + 3/2\ O_2 \rightarrow 2H_2O + CO_2$
Temperature: 450-550^{0}C
Pressure: 1.2atm
Catalyst: Ag or Cu gauze or their oxides.</td><td>1

1</td></tr>
<tr><td>1-e</td><td>Fractions obtained from crude oil with their boiling point range
<table>
<tr><th>Fractions</th><th>Boiling point range</th></tr>
<tr><td>1. Uncondensed gases</td><td>< 30^{o}C</td></tr>
<tr><td>2. Petroleum ether</td><td>30-70^{o}C</td></tr>
<tr><td>3.Gasoline or petrol or motor spirit</td><td>40-120^{o}C</td></tr>
<tr><td>4. Naphtha</td><td>120-180^{o}C</td></tr>
<tr><td>5. Kerosene oil</td><td>180-250^{o}C</td></tr>
<tr><td>6. Diesel oil</td><td>250-320^{o}C</td></tr>
<tr><td>7.Heavy oil
On vacuum distillation of heavy oil gives lubricating oil, petroleum jelly, greases, paraffin wax etc.</td><td>320-400^{o}C</td></tr>
<tr><td>8.Residue</td><td>> 400^{o}C</td></tr>
</table></td><td>1 mark each for any four</td></tr>
</table>

1-f	**Waste water treatment in petroleum and petrochemical industry.** **Four process of waste water treatment:** i. Primary treatment ii. Secondary treatment iii. Tertiary treatment iv. pretreatment **Primary treatment:** This treatment consists of oil removal in two stages by physical methods. The first stage of oil removal is done in smallponds or basin where major portion of the oil is removed by using baffles, floatation and skimming methods. The second stage of oil removal is mainly by API separator or other gravity separator. **Secondary treatment**: This includes chemical method and biological method. The main purpose of chemical method is to remove emulsified oil with addition of flocculating agents and also to remove suspended solids and toxic substances thereby conditioning the effluent for further treatment by biological methods. Biological treatment aims at the removal of all oxidisable and organic matter from the waste water. **Tertiary treatment:** This treatment removes specific pollutants to meet regulatory discharge requirement. This includes chlorination, ion exchange, reverse osmosis, activated carbon etc. **Pretreatment:** It is done to remove water from the used oil. Water plus used oil is placed in large settling tanks which separates oil and water. It involves following steps-a. Filtering & demineralization b. Propane Deasphalting process & c. Distillation.	1 mark each
1-g	**Manufacture of ethylene oxide**	

	Flow sheet  **Description:** Ethylene of 95-98% purity and air are compressed separately, mixed together to give 3-10% ethylene by volume and passed over catalyst (silver oxide on alumina) in a fixed bed tubular reactor. Ethylene dichloride is added to suppress the side reactions. Reaction is exothermic. Heat transfer salt or Dowtherm is passed around the tubes to maintain the temperature to 250-300^{0}C. Effluent gases from the reactor are water washed under pressure. The absorbed ethylene oxide is sent to a packed bed desorber tower and taken as overhead. It still contain large amount of water vapour plus some impurities. This stream is compressed to 4-5 atm, steam stripped to remove dissolved gases and fractionated twice to remove light ends, water and high boiling polymers.	2 2
2	**Attempt any FOUR of the following**	**16**
2-a	**Carbon range of fractions obtained from fractionation of crude oil** **fraction** | **Carbon atom**	1 mark each for any four

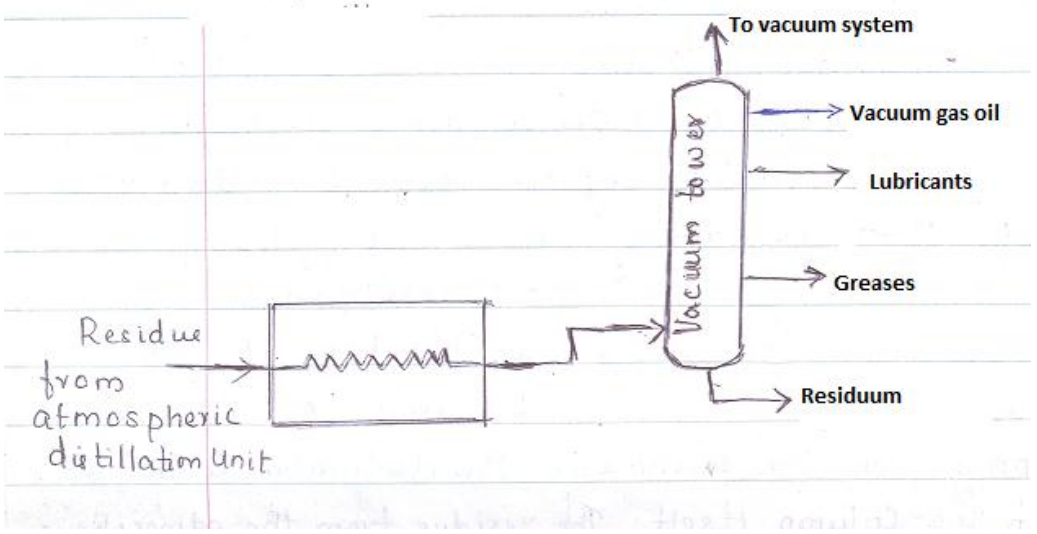
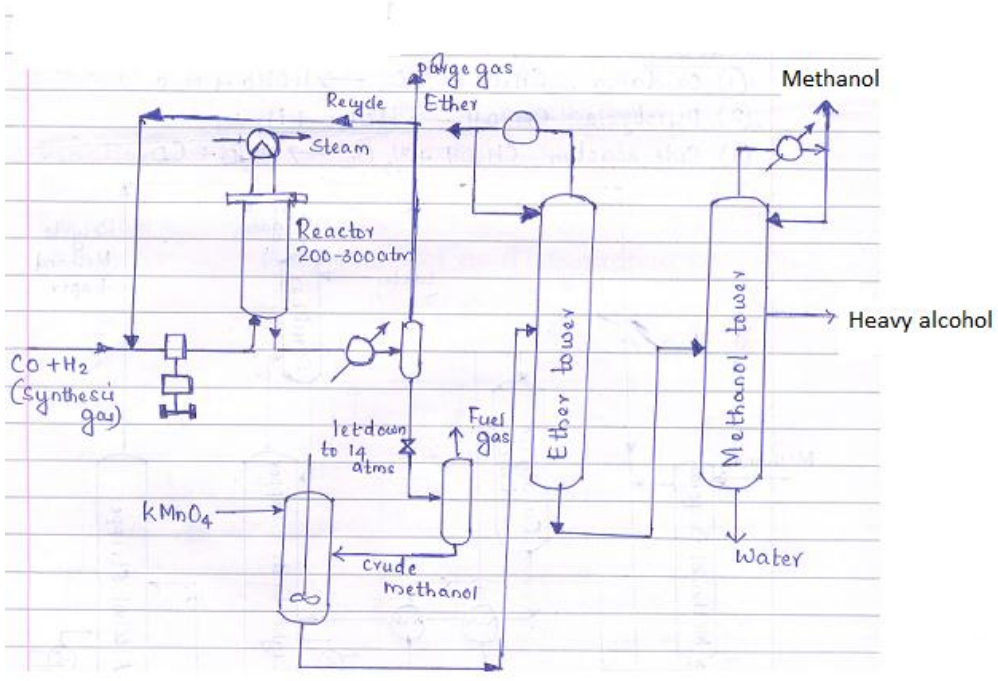
		Gases | 1-4 Gasoline | 5-12 Naphtha | 8-12 Kerosene and jet fuel | 11-13 Diesel and fuel oil | 13-17 Atmospheric. Gas oil | ---- Heavy fuel oil | 20-45 Atmospheric distillation residue | Over 30 Vacuum distillation residue | Over 60		
2-b	**Refining process.** Refining of crude takes place in two stages- first stage (Atmospheric distillation) and second stage (vacuum distillation.) Atmospheric distillation: Crude oil is preheated to 300-350^{0}C in a tubular furnace. Hot vapours plus liquid are passed through a tall fractionating column.It consists of a number of horizontal bubble cap trays, which provide intimate contact between escaping vapours and downcoming liquid. Separation of various fractions is based on the fact that hydrocarbons of crude oil boil at different temperatures.			2



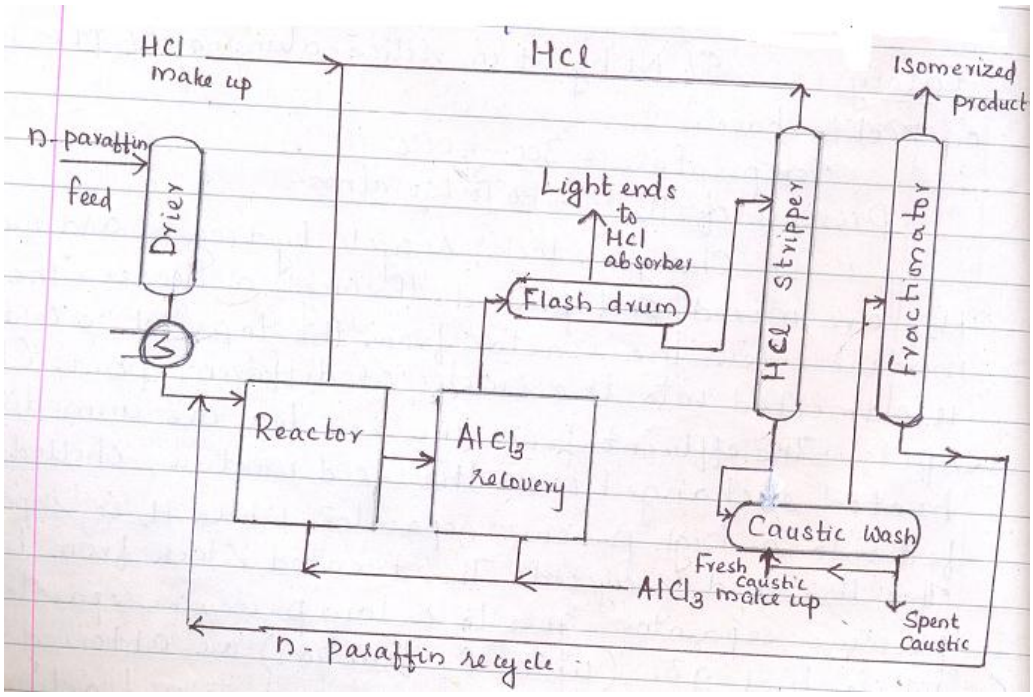
Vacuum distillation:

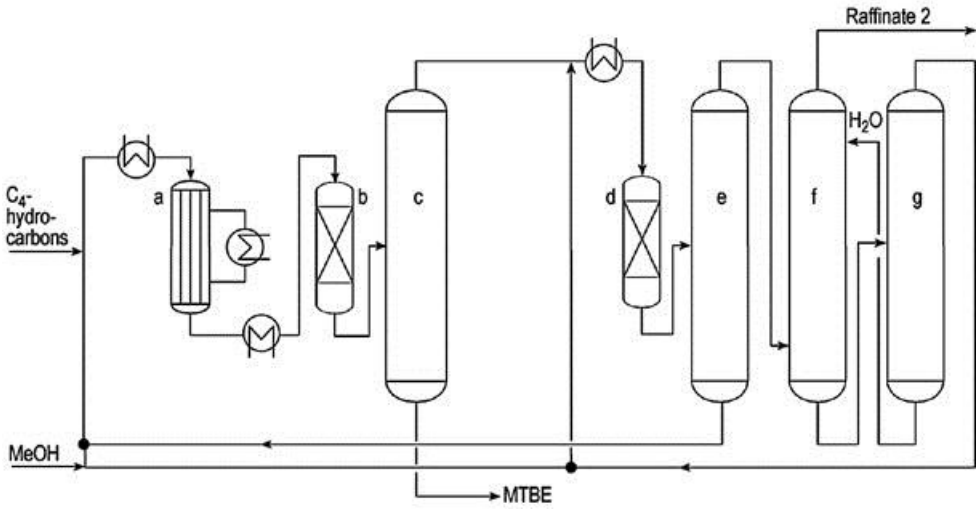
The residue from the atmospheric distillation column is send to vacuum distillation unit where absolute pressure is maintained at 10 to 40mm of Hg using multiple stages of steam jet ejectors. Vacuum columns have large diameters. They use distillation trays only when products have to be withdrawn from sides. Often packing materials like structured sheet metal or randomly packed Raschig rings are used because packings has low pressure drop than distillation trays. The bottoms of vacuum distillation column is known as Goudron or residuum.

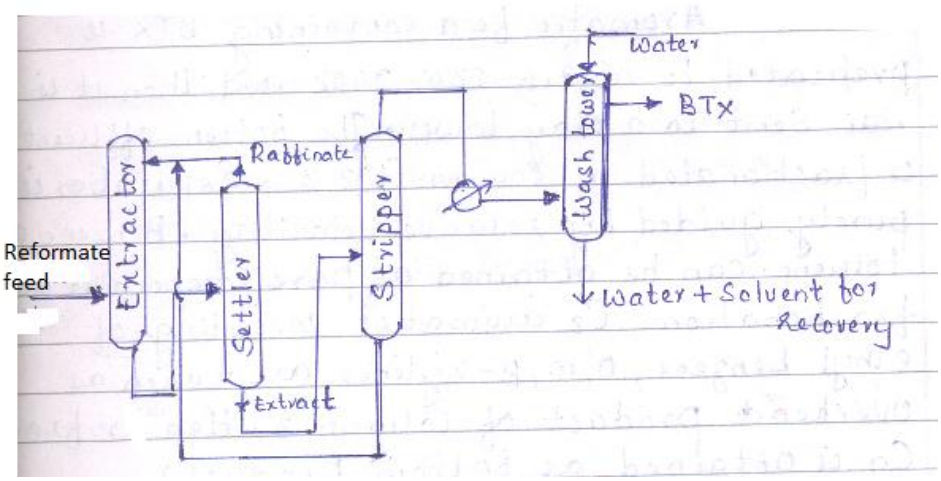
2

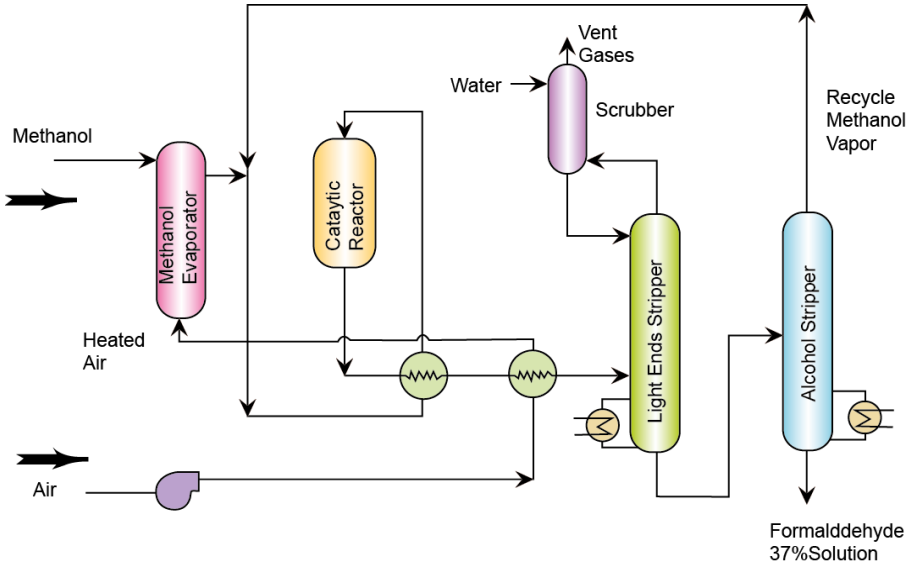
		
2-c	**Methanol:** **Flow sheet**  **Description:** Hydrogen and carbon monoxide in the mole ratio of 2.25 is compressed to 200-	2

	300 atm, mixed with recycle gas and fed to a high pressure converter. Internal preheating is done to maintain the temperature of 300-375^{0}C. Reactor is copper lined steel vessel and contains mixed catalyst of Zn, Cr, Mn Or Al oxides. Exit gases are cooled by heat exchange with reactants, then with water.The methanol condenses under full operating pressure to maximize yield. Liquid methanol is depressurized, purified by potassium permanganatr to remove traces of ketones, aldehydes and other impurities, sent to a stripper to remove light ends such as dimethyl ether and to fractionators to separate methanol from high moiecular weight compounds.	2
2-d	**Octane number:** Octane number is defined as the percentage volume of isooctane in a mixture of isooctane and – heptanes that gives the same knocking characteristics as the fuel under consideration **Cetane number:** It is defined as the percentage volume of n-cetane in a mixture of n-cetane and heptamethyl nonane that gives the same ignition delay as the fuel under consideration.	2 2
2-e	**Chemicals derived from C1 hydrocarbon with application:** 1. Methanol – in the production of formaldehyde, drugs, pesticides,chemicals such as acetic acid, methyl amines, esters,component of gasoline-alcohol mixture for petrol engine (any one) 2. Formaldehyde – In the manufacture of phenolic, urea and melamine resins,in the manufacture of methylene diisosyanate, 1,4butandiol (any one) 3. Chloromethane-– in the production of silicons, tetramethyl lead, synthetic rubber, herbicides, amines(any one) 4. Methylene dichloride – Good paint removal solvent, good propellant for aerosols(any one) ***(Due consideration should be given for any other chemical derived from C1***	1 mark each

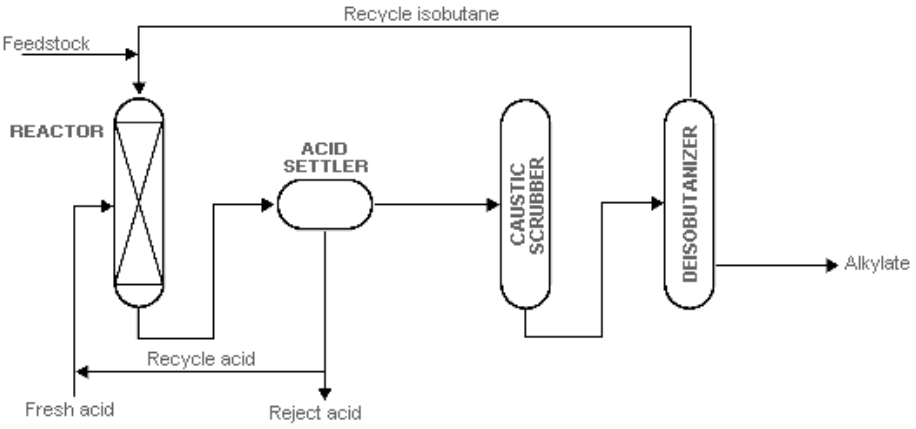
	hydrocarbon)	
2-f	**Isomerization process:** 	4
3	**Attempt any FOUR of the following**	**16**
3-a	**Flow sheet of MTBE**	

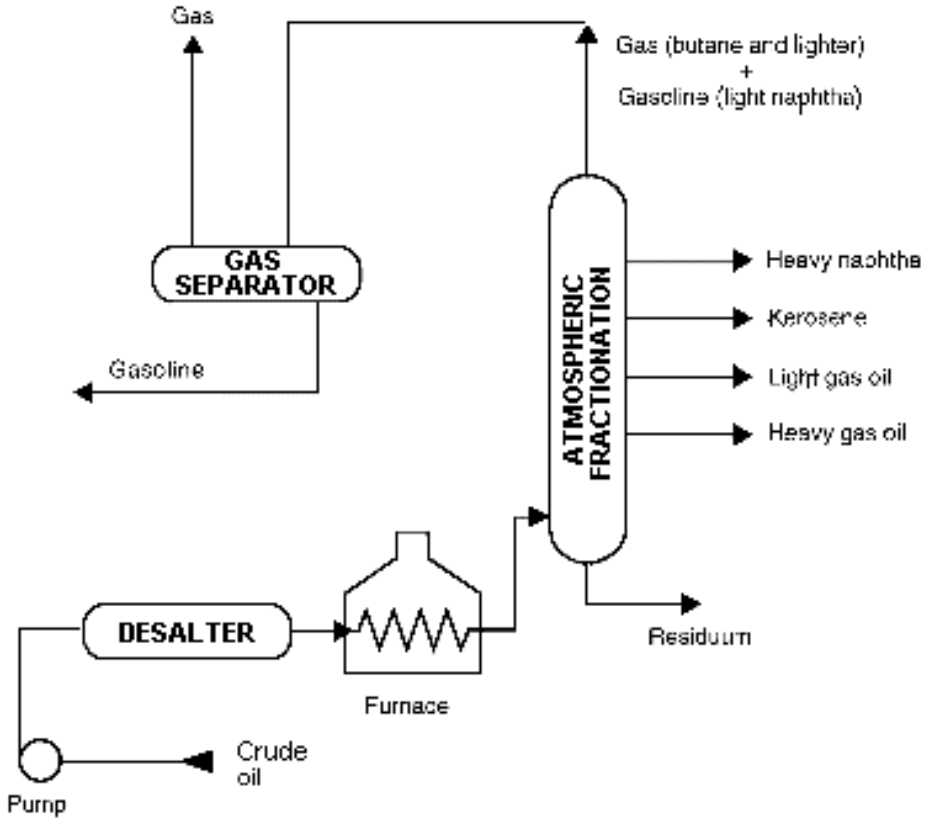
	 Figure : Two-stage Oxeno-MTBE-Process First stage: a) Multi tubular reactor; b) Adiabatic reactor; c) First C4 distillation tower (debutanizer) Second stage d) Secondary adiabatic reactor e) Second C4 distillation tower for Methanol recovery f) Methanol extraction g) Methanol tower	4
3-b	**Udex process** Extractor consists of packed or plate column, where the feed is introduced at the bottom and the solvent is fed counter current to feed. The temperature is kept around 40-50^{o}C. Extract is the desirable product. Extract and raffinate are settled in a settling column. Most of the raffinate is send to the extractor as reflux. Rich extract from the bottom of the column goes to a stripper, where solvent and aromatics are separated. Aromatics still contain some solvent as impurity which is removed by washing with water in a wash column.BTX is obtained as top product from the washer. Non aromatics raffinate can be easily purified by washing with water alone.	4

		
3-c	**Test properties:** **(i) Gasoline:** 1. ASTM distillation: specifies the evaporation characteristics of gasoline which gives an idea of the flash point 2. Reid vapour pressure (volatility tests): volatility tests are intended for smooth performance of engine under all weather. 3. Octane number: It is used for measuring the anti knocking qualities of gasoline 4. Gum content: specifies the oxidation stability of gasoline 5. Sulfur content **(ii)Kerosine** 1. Flash point and fire point 2. Smoke point(Burning quality) 3. Volatility 4. Sulfur content 5. Aniline point **(iii)Diesel**	½ mark each for any 2 ½ mark each for any 2

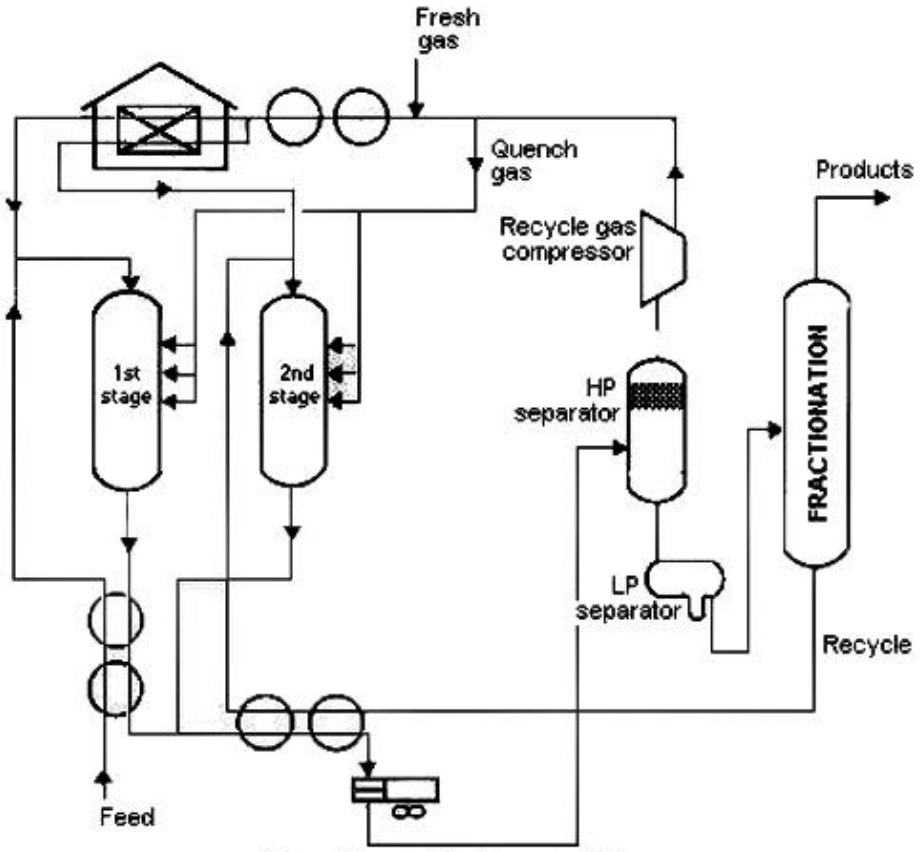
	1. Pour point 2. Aniline point-Diesel index (Cetane number) 3. Flash point 4. Calorific value 5. Viscosity. **(iv)Lubricating oil** 1. Flash point 2. Pour point 3. Viscosity and viscosity index 4. Oxidation stability 5. Carbon residue	½ mark each for any 2 ½ mark each for any 2
3-d	**Formaldehyde** **Flow sheet**  **Description:** **Reactions:** oxidation $CH_3OH + 1/2\ O_2 \rightarrow HCHO + H_2O$	2

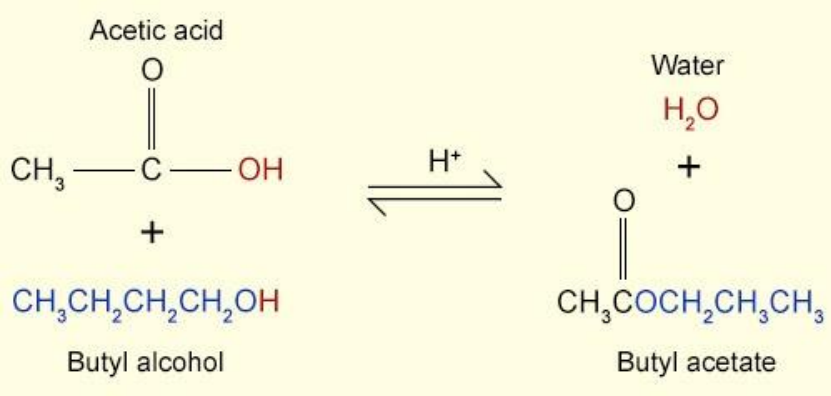
	ii. Pyrolysis $CH_3OH \rightarrow HCHO + H_2$ iii. Side reaction $CH_3OH + 3/2\ O_2 \rightarrow 2H_2O + CO_2$ Temperature: 450-550^{0}C Pressure: 1.2atm Catalyst: Ag or Cu gauze or their oxides. Air is sent for pre-heating using reactor outlet product. Eventually heated air and methanol are fed to a methanol evaporator unit. The feed ratio is about 30 – 50 % for CH_3OH: O_2. After reaction, the product is a vapour mixture with temperature 450 – 900°C. The product gas is cooled and then fed to the absorption tower. From the absorber, HCHO + methanol rich water stream is obtained as the bottom product. The stream is sent to a light end stripper eventually to remove any light end compounds that got absorbed in the stream. The light end stripper bottom product is fed to a distillation tower that produces methanol vapour as the top product and 37% formaldehyde as the bottom product.	2
3-e	**Alkylation** **Description** In cascade type sulfuric acid (H_2SO_4) alkylation units, the feedstock (propylene, butylenes and fresh isobutane) enters the reactor and contacts the concentrated sulfuric acid catalyst (in concentrations of 85% to 95% for good operation and to minimize corrosion). The reactor is divided into zones, with olefins fed through distributors to each zone, and the sulfuric acid and isobutanes flowing over baffles from zone to zone. The reactor effluent is separated into hydrocarbon and acid phases in a settler, and the acid is returned to the reactor.	2

	The hydrocarbon phase is hot-water washed with caustic for pH control before being successively depropanized, deisobutanized, and debutanized. The alkylate obtained from the deisobutanizer can then go directly to motor-fuel blending or be rerun to produce aviation-grade blending stock. The isobutane is recycled to the feed. **Flow Sheet**  	2
3-f	**Global crude oil producers** 1. Kuwait 2. Brazil 3. Mexico 4. United Arab Emirates 5. Canada 6. Iran 7. China 8. Russia 9. Saudi Arabia	½ mark each for any 8

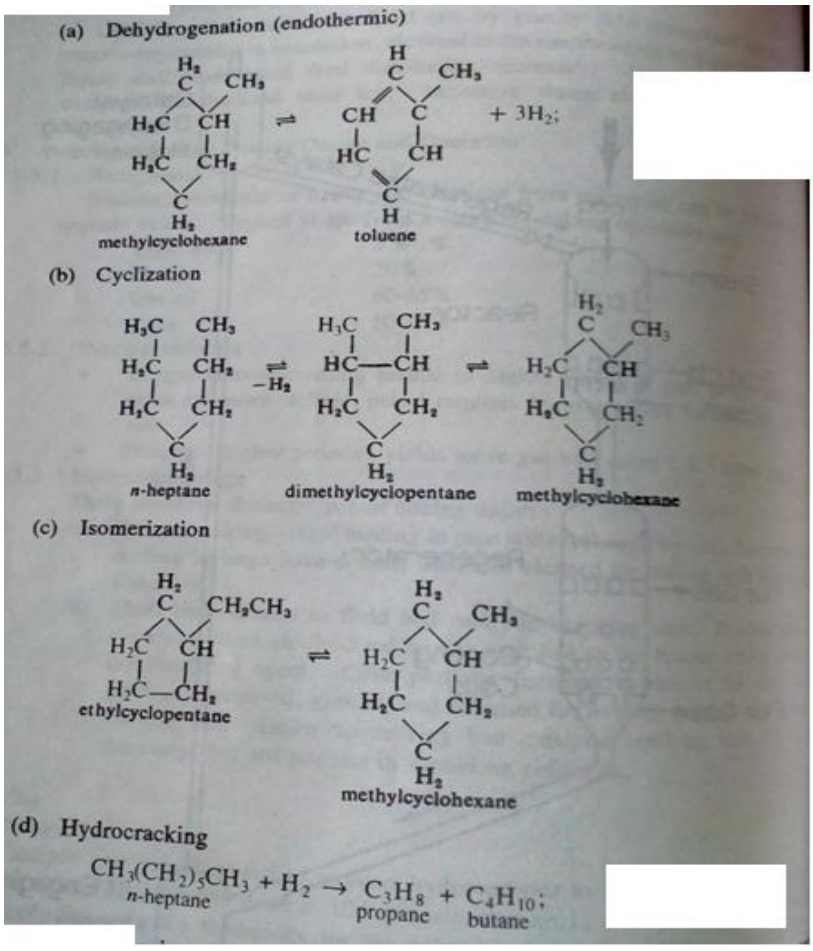
	10. United States 11. Venezuela	
4	**Attempt any four of the following**	**16**
4-a	**Atmospheric distillation** **Diagram**  **Explanation:** At the refinery, the desalted crude feedstock is preheated using recovered process heat. The feedstock then flows to a direct-fired crude charge heater where it is fed into the vertical distillation column just above the bottom, at pressures slightly above atmospheric and at temperatures ranging from 650° to 700° F .All but the heaviest fractions flash into vapor. Heavy fuel oil or asphalt	2 2

	residue is taken from the bottom. At successively higher points on the tower, the various major products including lubricating oil, heating oil, kerosene, gasoline, and uncondensed gases (which condense at lower temperatures) are drawn off. The fractionating tower, a steel cylinder about 120 feet high, contains horizontal steel trays for separating and collecting the liquids. At each tray, vapors from below enter perforations and bubble caps. They permit the vapors to bubble through the liquid on the tray, causing some condensation at the temperature of that tray. An overflow pipe drains the condensed liquids from each tray back to the tray below, where the higher temperature causes re-evaporation.	
4-b	**Hydrocracking** **Description** Hydrocracking is a two-stage process combining catalytic cracking and hydrogenation, wherein heavier feed stocks are cracked in the presence of hydrogen to produce more desirable products. Charge stock, recycle hydrogen and make up hydrogen are mixed and passed through a heater. The mixture enters the reactor from the top while cold hydrogen is admitted in to the reactor at different points. The effluent from the reactor is immediately heat exchanged with the feed mixture, chilled and fed in to a high pressure separator where hydrogen is separated and recycled. The treated stock from high pressure separator goes to low pressure separator where fuel gas are obtained. Liquid fractions from the bottom are sent to fractionators where distillates are separated and heavy oil from the bottom is recycled. **Flow Sheet**	2

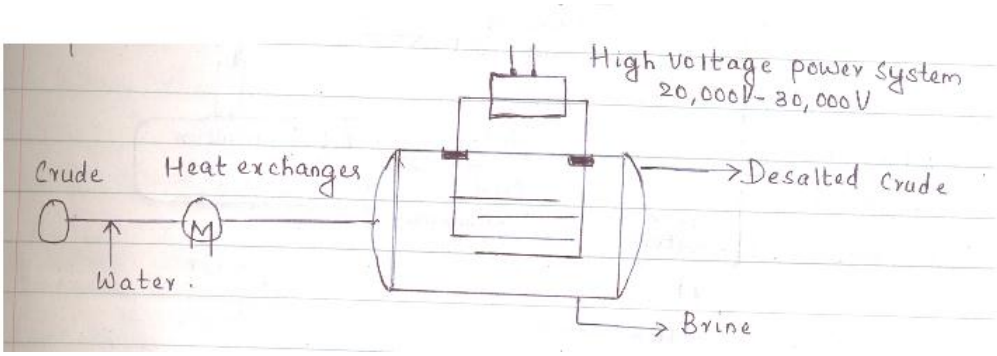
	 Two Stage Hydrocracking	2
4-c	**Petrochemicals derived from C2 hydrocarbon** 1. Ethylene - the simplest olefin; used as a chemical feed stock and ripening stimulant 2. Tetrachloroethylene - also called perchloroethylene; used as a dry cleaning solvent and degreaser 3. Vinyl Chloride: used to make polyvinyl chloride (PVC) 4. Acetylene: used as a fuel and a chemical building block 5. Ethanol: Solvent in the manufacture of varnishes, in medicines and drugs, as a disinfectant, antidote to methanol poisoning 6. Ethylene oxide: used in the production of ethylene glycol, detergents,	½ mark each for naming any 4 and ½ mark each for writing any one application

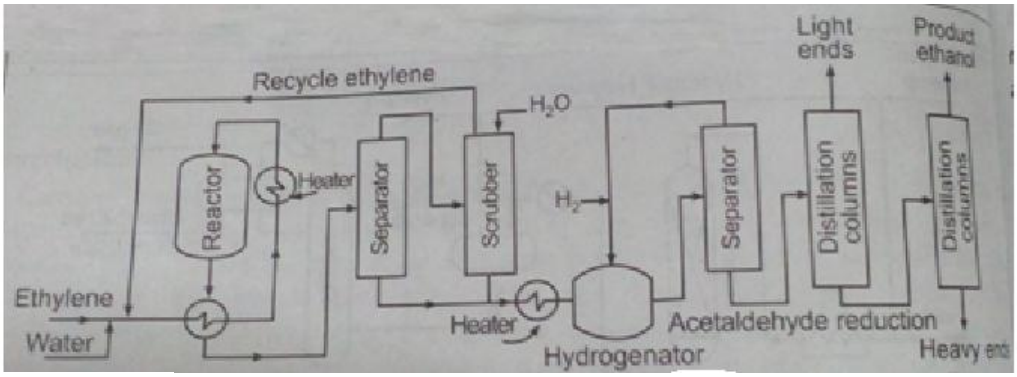
	ethanol amines,glycol ethers 7. Styrene: in the manufacture of polystyrene, styrene butadiene rubber, styrene acrylonitrile, polyester resins	
4-d	**Chemical reactions involved in the manufacture of** **(i) Butadiene** Main reaction: : n-Butane → Butadiene + Hydrogen. $C_4H_{10} \rightarrow CH_2=CH-CH=CH_2 + 2H_2$ Side reaction: n-Butane→ n-Butylene + Hydrogen. $C_4H_{10} \rightarrow: C_4H_8 + H_2$ (ii) **Butyl acetate**  	2 2
4-e	**Definition** **(i) Thermal cracking** It is a process that breaks or cracks the heavier, higher boiling-point petroleum fractions into more valuable products such as gasoline, fuel oil, and gas oils with the application of high temperature and pressure. Eg Cracks large hydrocarbon molecules to lighter hydrocarbons like LPG and gasoline **(ii) Catalytic cracking**	2

	Catalytic cracking breaks complex hydrocarbons into simpler molecules with the help of a catalyst(under less severe temperature compared to thermal cracking) in order to increase the quality and quantity of lighter, more desirable products and decrease the amount of residuals. This process rearranges the molecular structure of hydrocarbon compounds to convert heavy hydrocarbon feedstock into lighter fractions such as kerosene, gasoline, LPG, heating oil, and petrochemical feedstock. Eg Cracks heavy gas oil into gasoline of high octane number	**2**
4-f	**Composition of petroleum** Hydrocarbons in crude oil: There are four main types of hydrocarbons found in crude oil. 1. paraffins (15-60%) 2. naphthenes (30-60%) 3. aromatics (3-30%) 4. asphaltics (remainder) Elemental composition of petroleum 1. Carbon - 83 to 87% 2. Hydrogen - 10 to 14% 3. Nitrogen - 0.1 to 2% 4. Oxygen - 0.05 to 1.5% 5. Sulfur - 0.05 to 6.0% 6. Metals - < 0.1%	2 2
5	**Attempt any FOUR of the following**	**16**
5-a	**Uses of (any two)** **(i) MTBE:** -fuel component in fuel for gasoline engines, reaction medium & extraction solvent to replace aromatics	2 marks each

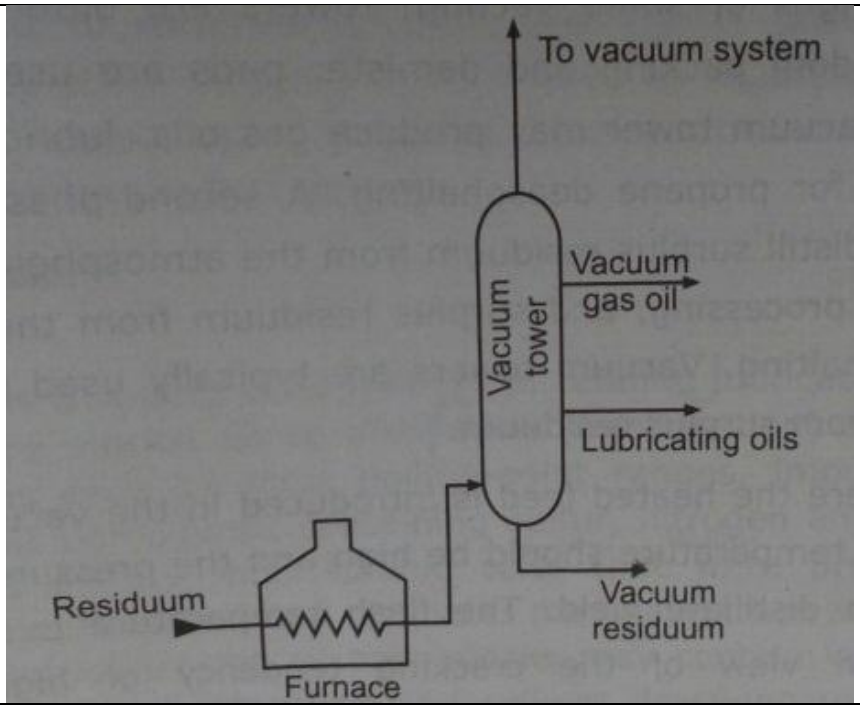
	(ii) **Styrene**: in the manufacture of polystyrene, styrene butadiene rubber, styrene acrylonitrile, polyester resins **(iii)** **Ethanol:** solvent for paints, manufacturing of chloroform, acetaldehyde, Solvent in the manufacture of varnishes, in medicines and drugs, as a disinfectant, antidote to methanol poisoning	
5-b	**Four chemical reaction involved in reforming process with standard conditions**  Catalyst: Platinum	1 mark each

	Pressure: 15-50 atms Temperature: 470-525^{0}C	
5-c	**Petrochemicals manufactured from benzene, toluene and xylene** **Benzene**- styrene,phenol,cychlohexane,cumene,acetone,aniline ethyl benzene,bisphenol,nylon 6,6 **Toluene** - benzene, toluenediisocynate, nylon,caprolactum, phenol, benzyl chloride **Xylene**-blending fuel, phthalicanhydride, isophthalic acid which is competitive with phthalic acid for reinforced plastics &plasticizers, dimethyl terephthalate used in polysterfibre& films	4
5-d	**Fractions belonging to the following list of test properties:** **(i) Octane number:** gasoline **(ii) Aniline point:** diesel, kerosene (any one) **(iii) Smoke point:** kerosene **(iv) Cetane number:** diesel	1 mark each
5-e	**Uses** (i) **Formaldehyde:** In the manufacture of melamine resins, urea resins, phenolic resins **(ii) Ethylene oxide :** In the manufacture of ethylene glycol, nonionic detergents, ethanolamines **(iii) Acetaldehyde:** In the manufacture of acetic acid, acetic anhydride **(iv) Butadiene:** used in wide variety of synthetic rubbers & polymer resins.	½ mark each for any 2 uses ½ mark each for any 2 uses ½ mark each for any 2 uses ½ mark each for any 2 uses
5-f	**Four methods for dehydration and desaltification** 1. Chemical treatment	

	2. Gravity settling 3. Centrifugal separation 4. Electric desalter 5. Electrostaticseparation 6. using hot water as extracting agent 7. less common process involves filtering heated crude using diatomaceous earth **Electric desalting:** The feedstock crude is heated between 150^0 & 350^0F to reduce viscosity & surface tension for easier mixing & separation of the water. The principle of operation is that under a charged electric field, the polar molecules orient. A potential of 20,000-30,000 volts is applied between electrodes through which crude is passed. Water present in the form of emulsion also coalesces and agglomerates into a stream entrapping all the salts in the process. Brine collects at the bottom of the desalter, while crude floats above and forms a separate stream.  ***(Due consideration should be given for any other method)***	½ mark each for any 4 methods 2
6	**Attempt any FOUR of the following**	**16**
6-a	**Safety measures followed in petrochemical industry** 1. Personal – Hearing protection, respiratoryprotection, safety glasses 2. Vehicles – Vehicle entry is by permit only & keys are to be left in park	1 mark each for any 4

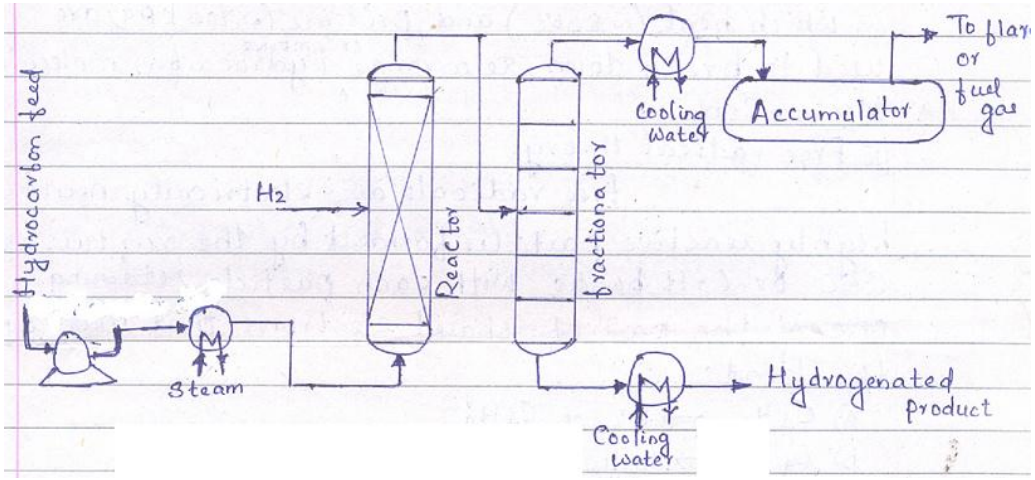
	vehicles 3. Special authorization permits – For excavation, temporary electrical facilities 4. Electrical precautions –All electrical tools, cords& equipments must be grounded or double insulated. 5. Emergency warning system & procedure –When an alarm sounds, secure all equipments & shut down all machines. 6. To establish a system to identify & manage all hazardous chemicals in the factory thorough the provision of material safety data sheets & procedures for proper use, storage, handling & movement of the hazardous chemicals internal & external safety audit should be done. 7. Proper plant maintenance, Piping connected to a work area from vessels, pumps & other sources is isolated with a solid plate prior to the start of work. 8. Sewer cover must be in good condition with no openings for vapour flow.	points
6-b	**Hydration process** **Flow sheet**  **Explanation:** Hydration reaction is addition of water .Synthetic ethyl alcohol is made by	2

	hydration of ethylene. CH2=CH2+H2O---------→C2H5OH The catalyst use is H_3PO_4. Temp.-300 ^{0}c Pressure: 6.8MPa Ethylene & water are combined with a recycle steam in the ratio ethylene to water 1/0.6, furnace heats the mixture to 300^0c, & the gases reacts over the catalyst .Unreacted reagents are separated & recirculated, Byproduct acetaldehyde is hydrogenated over a catalyst to form more alcohol.	2
6-c	**Uses** **(i) Kerosene:** illuminant, fuel for stoves **(ii) Diesel :** in many installations for generating electricity, diesel engine fuel, carbureting of water gas **(iii)Lubricating oil :** for lubrication in machines **(iv)Gasoline:** As a motor fuel for IC engines, solvent for dry cleaning	1 mark each for any 1 1 mark each for any 1 1 mark each for any 1 1 mark each for any 1
6-d	**Diagram of vacuum distillation unit**	4



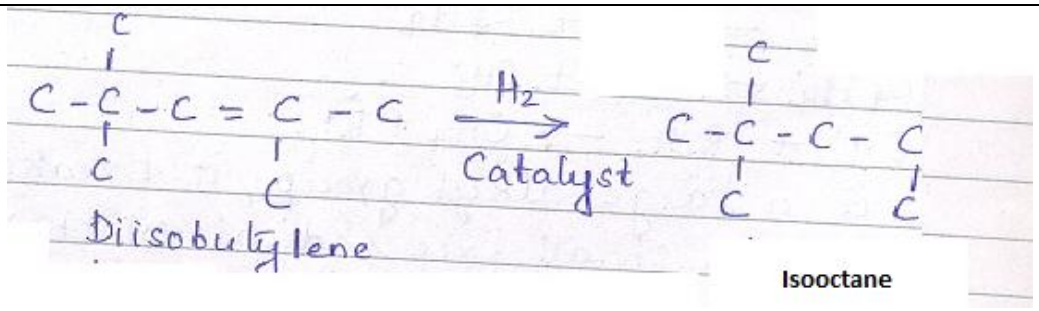
6-e **Hydrogenation process:**

Flow sheet



Description: It is the addition of hydrogen to an olefin

2

	 Hydrogen and hydrocarbon feed flows concurrently in a fixed bed reactor. Intimate mixing of hydrogen and reactants in the reactor bed is essential to make the best use of palladium catalyst. Poor hydrogen distribution results to inadequate diolefin hydrogenation. Additional equipment for high temperature hydrogen stripping is required for removal of polymer in order to extend the useful life of catalyst.	2
6-f	**Physical properties of** **(i) Methanol:** M.P.-97.8^{0}C,B.P-64.7^{0}C,molecular wt-32.04,density-0.788 g /cc at 20^{0}C **(ii) Formaldehyde:** soluble in water, alcohol and polar solvents, M.P.-118^{0}C, B.P.-19^{0}C **(iii) Ethanol:** B.P.-78.3^{0}C,M.P.—112^{0}C, Flash point- 21^{0}C **(iv) Propylene oxide :** -molecular weight-58.08, B.P.-33.9^{0}C, density -0.831g /cc	1/2 mark each 1/2 mark each 1/2 mark each 1/2 mark each