



WINTER-19 EXAMINATION

Model Answer

Subject Name: Technology of organic chemicals

Subject Code:

22410

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 judgment 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.

Q. No	Sub Q. N.	Answer	Marking Scheme
1.		Attempt any Five of the following	10
	a)	Enzymes used in alcohol manufacturing <ul style="list-style-type: none">• Diastase• Zymase	1 mark each
	b)	Applications of butanol (any two) <ul style="list-style-type: none">• As a fuel• As a solvent• For production of ether• Plasticizer• Butyl acrylate• N butyl acetate• Glycols	1 mark each for any two
	c)	Solvent used for oil extraction <ul style="list-style-type: none">• Hexane• Petroleum ether	1 mark each for any two



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		<ul style="list-style-type: none">• Benzene	
d)	Raw Material for PVC <ul style="list-style-type: none">• Acetylene• Hydrochloric Acid OR <ul style="list-style-type: none">• Ethane• Chlorine	1 mark each	
e)	Methods for production of pulp <ul style="list-style-type: none">• Mechanical• Chemical• Semi chemical	1 mark each for any 2	
f)	Application of Polyester (any two) <ul style="list-style-type: none">• Textile• fishing nets• filter cloth• Conveyor belt	1 mark each for any 2	
g)	Alkylation process <p>Alkylation is the transfer of an alkyl group from one molecule to another. The alkyl group may be transferred as an alkyl carbocation, a free radical, a carbanion or a carbene. Alkylation is the process of producing gasoline range material light olefins (primarily propylene and butylene) with isobutane in the presence of a highly acidic catalyst, either sulfuric acid or hydrofluoric acid.</p>	2	
2.	Attempt any THREE of the following	12	
a)	PFD for manufacturing of polyethylene	4	

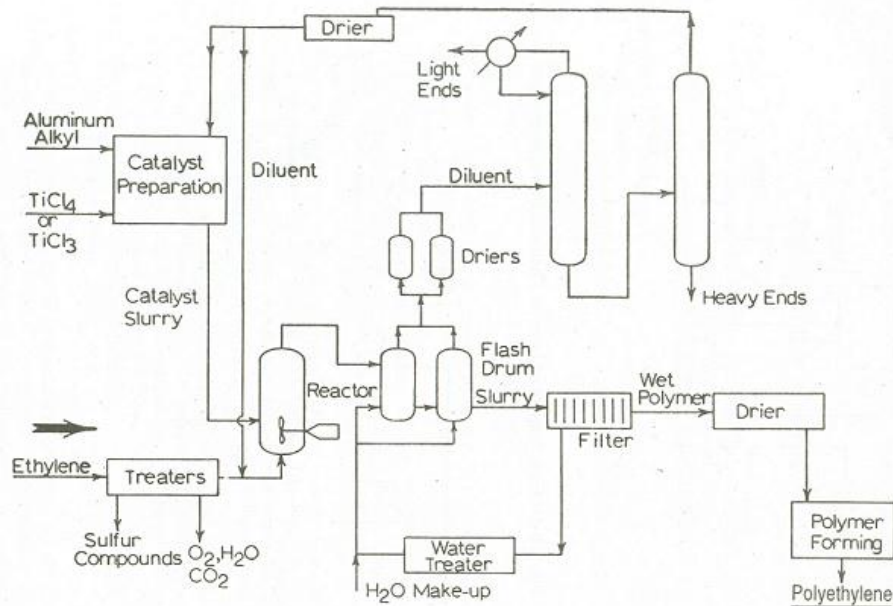
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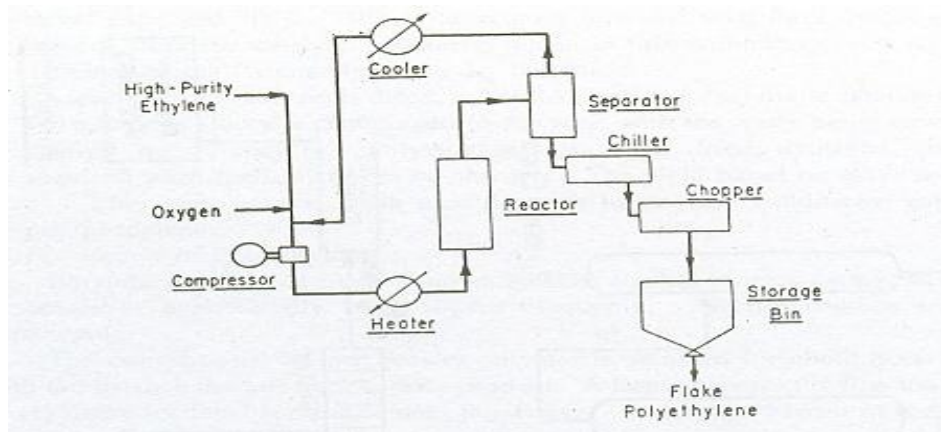
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OR

Polyethylene by High Pressure Process



b) **Difference between varnish and lacquer**

Varnish	Lacquer
Varnish is a homogenous colloidal dispersion solution of resin in oils or thinner or both.	Lacquers are dispersion of cellulose or other cellulose derivatives, resins and plasticizers in solvents

1 mark each for any 4 points

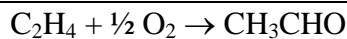
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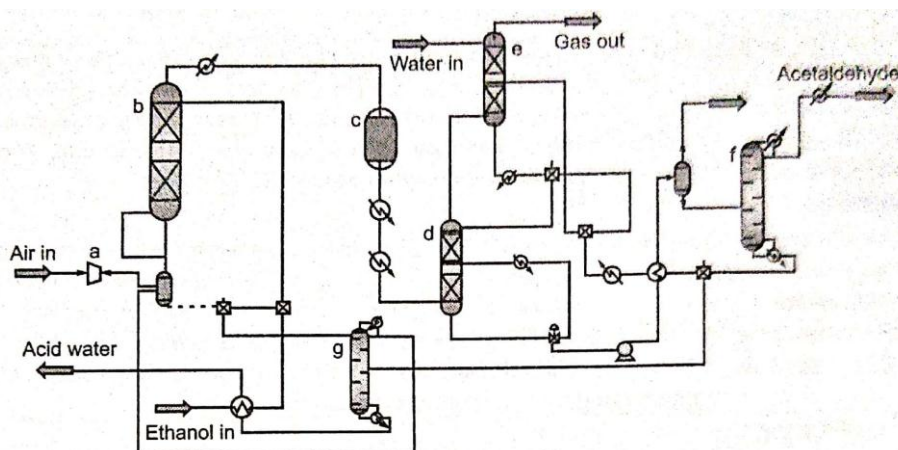
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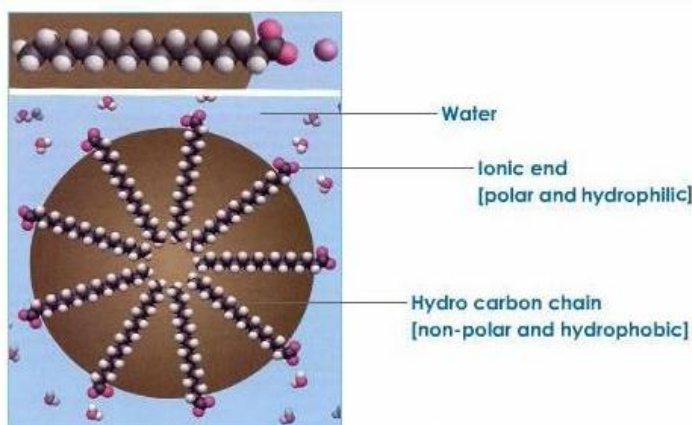


The process is operated at pressure below 50 atmosphere and at temperature of 50 to 100 °C. Typical reaction time ranges from 6 to 40 minutes.



2

b) **Cleansing action of soap:**



The dirt on skin or cloth sticks due to greasy matter. When rubbed with soap solution, it is easily washed away. Soap molecule has a polar end (-COO-Na⁺) and a non polar end (a long carbon chain of 12 to 18 carbons). The polar end is water soluble while the non polar end is oil soluble. Normally oil droplets in contact with water tend to coalesce to form oil layer and aqueous layer. The non polar ends of soap molecules dissolve in the oil droplet leaving the carboxyl ate ends projecting into the surrounding water. Due to the presence of negatively charged carboxylic groups, each of the oil droplets surrounded by an ionic

1

3



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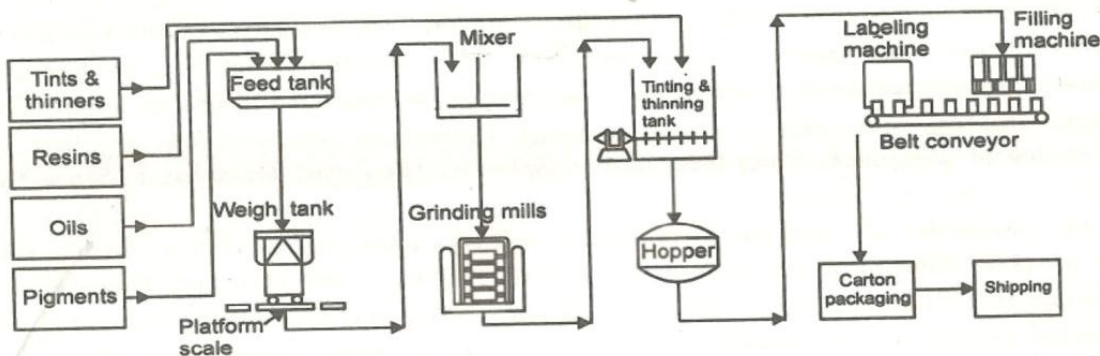
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atmosphere. Oil droplets do not coalesce due to the repulsion between similar charges thus stable emulsion of oil in water is formed. In this way soap cleans by emulsifying the fat or grease containing dirt.

c) **Manufacturing of paint**



The weighing assembling, and mixing of the pigments and vehicles takes place on the top floor. The mixer may be similar to large dough kneader with sigma blades. The batch masses are conveyed to the floor below, where grinding & further mixing takes place. A variety of grinding mills are used.

After mixing, the paint is transferred to the next to the next lower floor, where it is thinned & tinted in agitated tanks, which may hold batches of several thousand litres. The liquid paint is strained into a transfer tank or directly into the hopper of the filling machine on the floor below, centrifuges, screens or press. Filters are used remove non dispersed pigments. The paint is poured into cans or drums, labelled, packed & moved to storage each step being completely automatic.

d) **Recovery of Chemicals from black liquor**

Black liquor from the blow tank contains 98-99% of the digestion chemicals which must be recovered to avoid water and air pollution problem. It is carried out as follows

Multiple effect evaporation using 5-6 stages of calendria equipment followed by disc evaporators concentrates the liquor from 15-18% solids to the point where combustion can be sustained in a smelting waste heat boiler. This concentration is around 60% solids. Organic carbon burns in the smelting furnace, supplying the necessary heat and CO₂ to produce an inorganic molten slag or smelt. Make up alkali is supplied via Na₂SO₄.



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		The molten smelt falls into a dissolver where it connects cold H ₂ O to yield green liquor solution. The insoluble impurities, such as unburned carbon, are settled out and the clear liquor causticized by adding lime. Filtration removes the calcium carbonate sludge while the filtrate (white liquor) is returned to the digester. The carbonate sludge is calcinated to lime for recycle.													
4.		Attempt any THREE of the following	12												
a)	Difference between Soaps and Detergents : <table border="1"><thead><tr><th>Soaps</th><th>Detergents</th></tr></thead><tbody><tr><td>1. Are sodium (Na) or potassium (K) salts of long chain fatty acids.</td><td>1. Are salts of organic derivatives of sulphuric acid.</td></tr><tr><td>2. Soluble in Water.</td><td>2. More soluble in water.</td></tr><tr><td>3. Are not satisfactory with hard water because they form scum.</td><td>3. Form no scum with hard water because corresponding Ca and Mg salts are soluble.</td></tr><tr><td>4. Yield alkaline solution because salts of weak acid.</td><td>4. Yields neutral solution because they are salts of strong acids.</td></tr><tr><td>5. Cannot be used for any pH.</td><td>5. Can be used for any pH.</td></tr></tbody></table>		Soaps	Detergents	1. Are sodium (Na) or potassium (K) salts of long chain fatty acids.	1. Are salts of organic derivatives of sulphuric acid.	2. Soluble in Water.	2. More soluble in water.	3. Are not satisfactory with hard water because they form scum.	3. Form no scum with hard water because corresponding Ca and Mg salts are soluble.	4. Yield alkaline solution because salts of weak acid.	4. Yields neutral solution because they are salts of strong acids.	5. Cannot be used for any pH.	5. Can be used for any pH.	1 marks each for any 4 points
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b)	Constituents of paint Pigments: - It is finely divided solids generally made up metal oxides .It is used to give color to paint. Drying oil: - These are unsaturated oils. It is used to form protective film and give gloss. Thinners or solvent: - It is alcohols or turpentine. is used to dissolve polymers in paint and to disperse pigments (emulsion formation).It adjust viscosity, form thin film. Plasticizer: - These are polymers. Used to impart elasticity to paint.		1 mark each												
c)	Ziegler Process to produce polyethylene High purity ethylene is prepared by desulphurization and removal of light ends, The ethylene is further treated to remove traces of oxygen and its compounds which can possibly deactivate the catalyst. The ethylene is first pumped into a reactor where it is mixed with catalyst diluents stream.		4												

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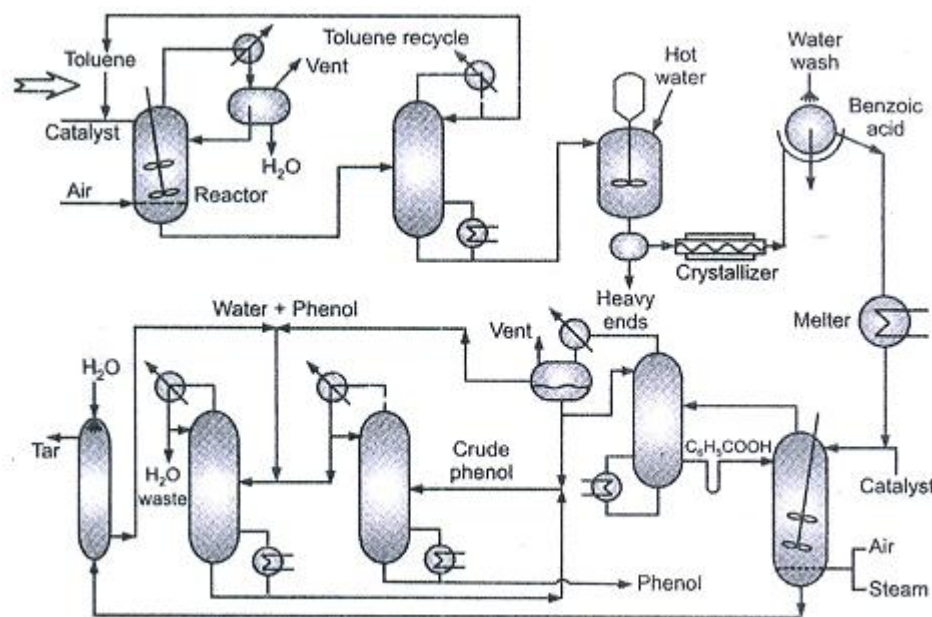
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The optimum temperature and pressure maintained should be 70 °C and 7 atms gage. The effluent stream then follows across a series of flash drums in order to remove the solvent from the catalyst. The residual catalyst at this point is removed by adding water. The flashed solvent is thereafter recycled to the catalyst make-up unit after appropriate drying and redistillation. The slurry which results is then centrifuged to remove the water, and the water is treated to remove the catalyst before recycle. The final products of polyethylene solids are then dried, extruded and given the required final forms.

d) **PFD- Phenol manufacturing by toluene oxidation**



Flow sheet for manufacturing of Phenol from Toluene oxidation

e) **Uses of phenol**

for production of

1. Phenol formaldehyde
2. epoxy resins
3. herbicides,
4. insecticide
5. In pharmaceutical industry

Properties of phenol

1 mark
each for
any 2

1 mark
each for



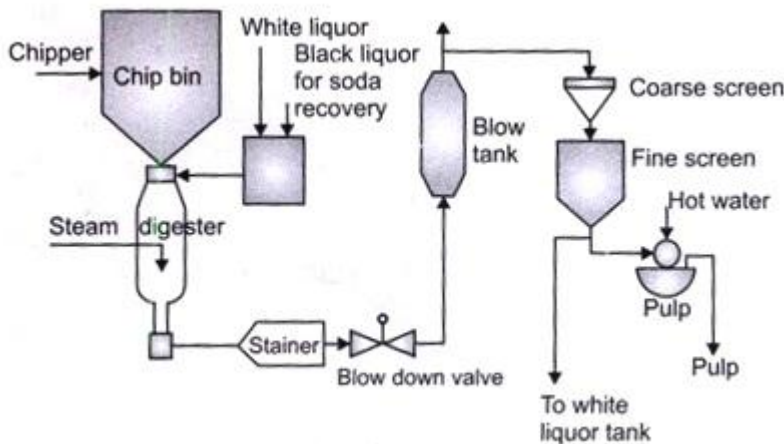
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	<p>1. Molecular wt =94.11 2. MP = 42oC 3. BP =181.4oC 4. Density @25oC = 1.07 5. Appreciably soluble in water 6. Toxic in nature</p>	any 2
5.	Attempt any TWO of the following	12
a)	<p>Recycling of Paper Recycling of paper is useful to recover the fibers from used papers otherwise we have to produce fiber from wood. It also saves energy required to produce virgin fiber. This way we can save the trees. Saving trees can contribute to reduce carbon dioxide also.</p> <p>PFD of Kraft Process</p>  <p>The diagram illustrates the Kraft process for paper production. It starts with a Chipper feeding into a Chip bin. The chips go to a digester where steam is added. White liquor and black liquor for soda recovery are also added. The output goes to a stainer, then through a blow down valve to a blow tank. From the blow tank, the pulp goes through a coarse screen and a fine screen. Hot water is added to the pulp. The final pulp is collected, and some liquor is recycled back to the white liquor tank.</p>	<p>2</p> <p>4</p>
b)	<p>Ethyl alcohol from corn</p> <p>Reactions:</p> $2 (C_6H_{10}O_5)_n + n H_2O \xrightarrow{\text{Diastase}} n C_{12}H_{22}O_{11}$ $C_{12}H_{22}O_{11} + H_2O \xrightarrow{\text{Maltase}} 2 C_6H_{12}O_6$ <p>Fermentation reaction</p> $C_6H_{12}O_6 \xrightarrow{\text{Zymase}} C_2H_5OH + 2 CO_2$	2



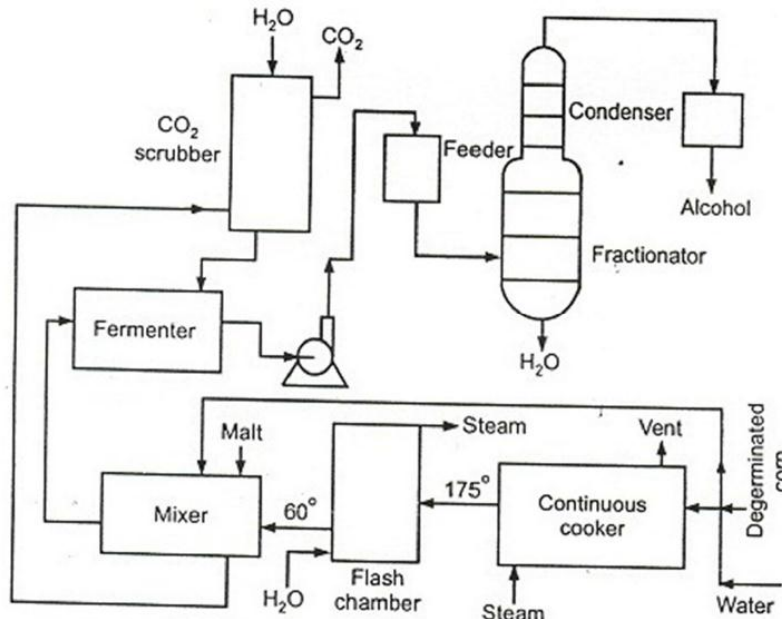
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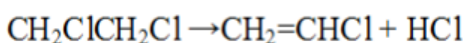
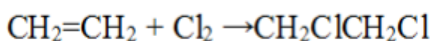
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c) **Condensation polymerization:** In this a new bond is formed between the monomers by elimination of small molecules like water under suitable conditions of temperature and pressure. Ex. Production of phenol formaldehyde from phenol and formaldehyde monomers with condensation of water.

Addition polymerization : In this a new bond is formed between the monomers by elimination of small molecules like water under suitable conditions of temperature and pressure

Ex. Polyethylene is produced by the addition polymerization of ethylene monomers.

Monomer of vinyl chloride



2

2

2

6. **Attempt any TWO of the following**

12

a) **Butanol production by OXO process**

Raw materials for butanol

Propylene, Hydrogen, Synthesis gas

Reaction

3

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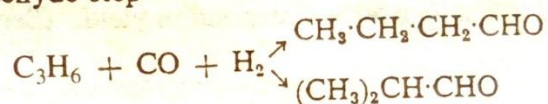
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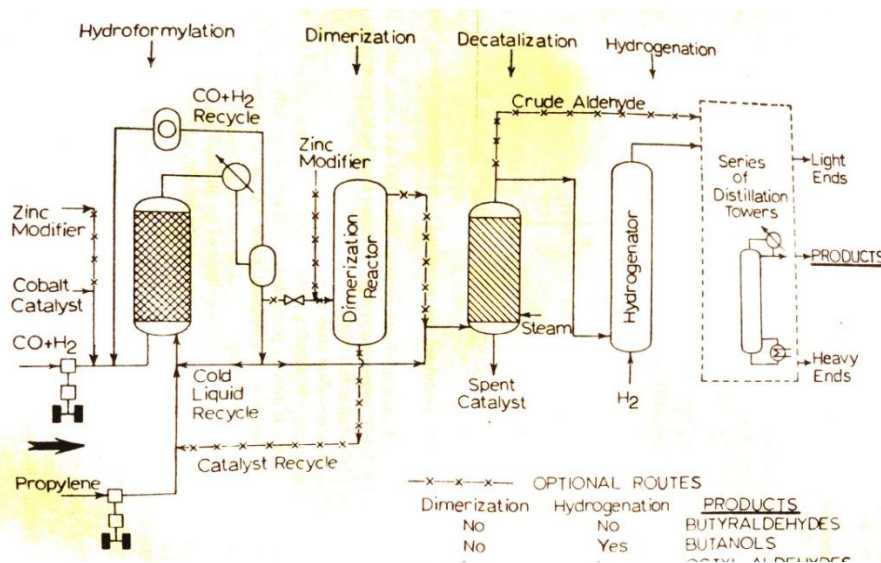
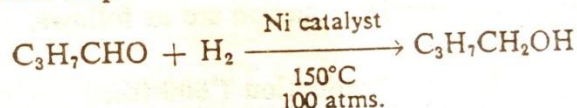
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(a) Aldehyde step



(b) Alcohol step



Process description:

Propylene is compressed at 150 atm and cobalt naphthanate added to give 0.5 to 1 % CO in sol. This stream is passed concurrently with CO+H₂ stream through a packed bed tower. The tower contains a porous carrier with 2 % metallic cobalt deposited. The reaction is highly exothermic and temperature of 170 deg C is controlled by recycle of a portion of prod stream after cooling. The product liquid fraction is mixed with steam at 180 deg C and a relatively low pressure of 20 atm. To decompose cobalt carbonyl and naphthanate depositing cobalt on porous carrier as oxides.

This cobalt is dissolved periodically in an acid wash and converted in naphthanate for reuse. Crude butaraldehyde from demerisation reactor is continuously hydrogenated using a fixed bed nickel catalyst at 100 atm and 150 degC. The resulting butanol are fed to a distillation column comprising of several fractionating column in series. Light and heavy ends are



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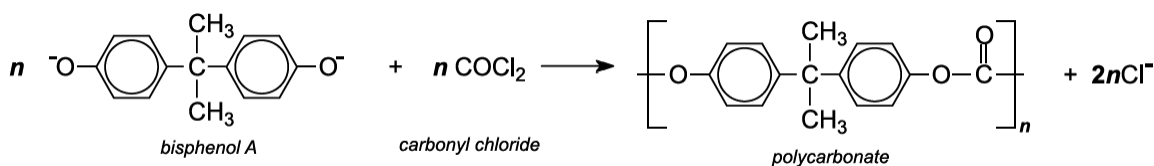
obtained in addition to the product alcohol.

b) **Applications of Polycarbonate**

- plastic lenses in eyewear
- power distribution (covers and housings)
- connectors
- electrical household appliances
- mobile phones
- electrical chargers
- lighting
- battery boxes automotive lighting
- head lamp lenses
- dashboards
- interior cladding
- exterior parts (bumpers, bodypanels) power tools
- baby bottles
- water dispensers
- garden equipment
- furniture (office & institutional)
- sporting goods
- medical applications

1 mark
each for
any 4

Reaction



2

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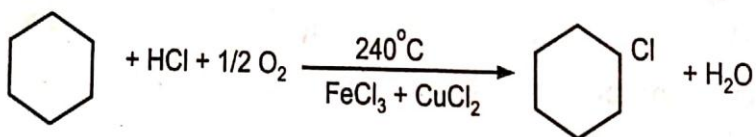
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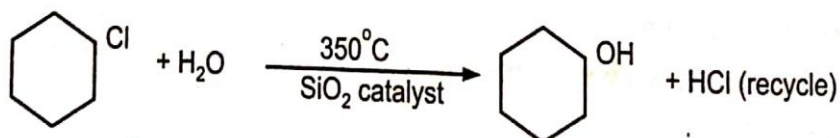
c) Manufacturing of Phenol by Raschig process

2

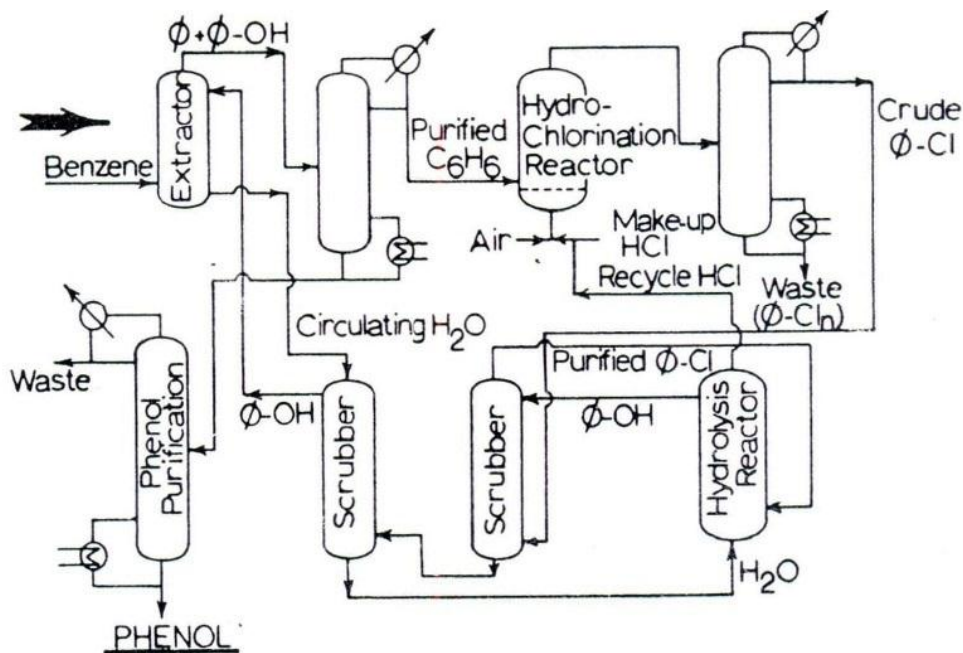
(a) Hydrochlorination :



(b) Hydrolysis :



PFD of the process



4