



SUMMER – 2022 EXAMINATION

Subject Name: Technology of Organic Chemicals

Model Answer

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 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.
- 8) As per the policy decision of Maharashtra State Government, teaching in English/Marathi and Bilingual (English + Marathi) medium is introduced at first year of AICTE diploma Programme from academic year 2021-2022. Hence if the students in first year (first and second semesters) write answers in Marathi or bilingual language (English +Marathi), the Examiner shall consider the same and assess the answer based on matching of concepts with model answer.

Q. No.	Sub Q. N.	Answer	Marking Scheme
1	a	Raw Material for Ethanol Production <ul style="list-style-type: none">• Molasses• Corn	1 mark each
1	b	Application of acetaldehyde (any 2) For the production of <ul style="list-style-type: none">• Acetic Acid/Acetic anhydride• Acetate esters• Pentaerythritol• Pyridine and pyridine bases• Peracetic acid• 1,3-Butylene glycol	1 mark each for any two
1	c	Catalyst for hydrogenation of oil Nickel	2 marks
1	d	Applications of polyester Industrial polyester fibers, yarns and ropes are used in car tire reinforcements, fabrics for conveyor belts, safety belts, coated fabrics and plastic reinforcements with high-energy	1 mark each for any two



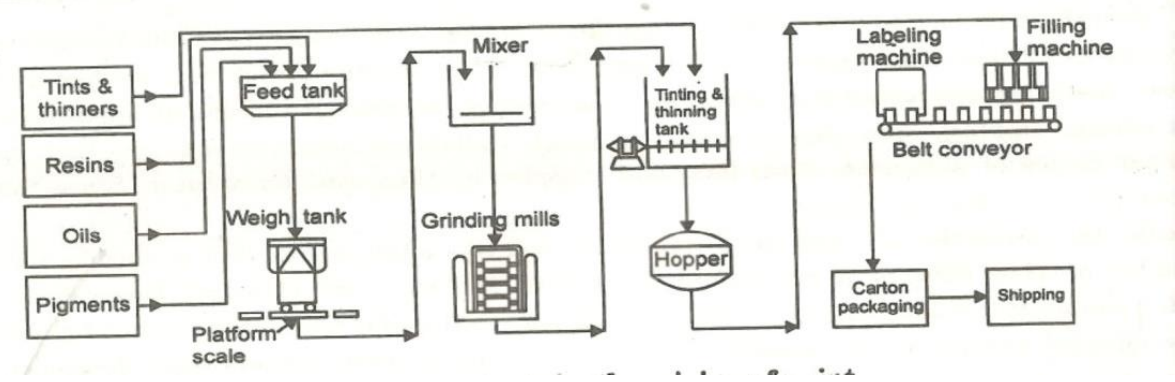
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		absorption.	
1	e	Types of Papers(any 4) Printing Paper:- To use in office printing ,Xeroxing Wrapping Paper:- To make bags, cartoon wrapping Book paper:- To make text books, handbooks Tissue Paper:- to make cigarette, toilet paper, napkin papers Groundwood printing paper:- To make catalogue, newsprint, poster Paperboard:- boxes, cartoons	1/2 mark each
1	f	Processes used for manufacturing of polyethylene(any 2) <ul style="list-style-type: none">• High pressure process• Ziegler process• Low pressure process	1 mark each
1	g	Raw material for Raschig process <ul style="list-style-type: none">• Benzene• Hydrochloric acid• Oxygen	2 marks
2	a	Block Diagram -Manufacturing of paint  <p>The diagram illustrates the manufacturing process of paint. It starts with four input boxes: 'Tints & thinners', 'Resins', 'Oils', and 'Pigments'. These are fed into a 'Weigh tank' which sits on a 'Platform scale'. The output of the weigh tank goes to a 'Feed tank'. From the feed tank, the material is sent to a 'Mixer'. The mixer's output goes to 'Grinding mills'. The output of the grinding mills goes to a 'Tinting & thinning tank'. The output of the tinting tank goes to a 'Hopper'. The output of the hopper goes to a 'Filling machine'. The output of the filling machine goes to a 'Labeling machine'. The output of the labeling machine goes to a 'Belt conveyor'. The output of the belt conveyor goes to 'Carton packaging', which then leads to 'Shipping'.</p>	2 marks
		<p>1) Decorative and building paints Application- Flat wall paint, interior, Floor paints, heat and fire resisting</p> <p>2) Industrial and marine paints Application- ship paints, anti-fouling paints, urethane</p>	2 marks



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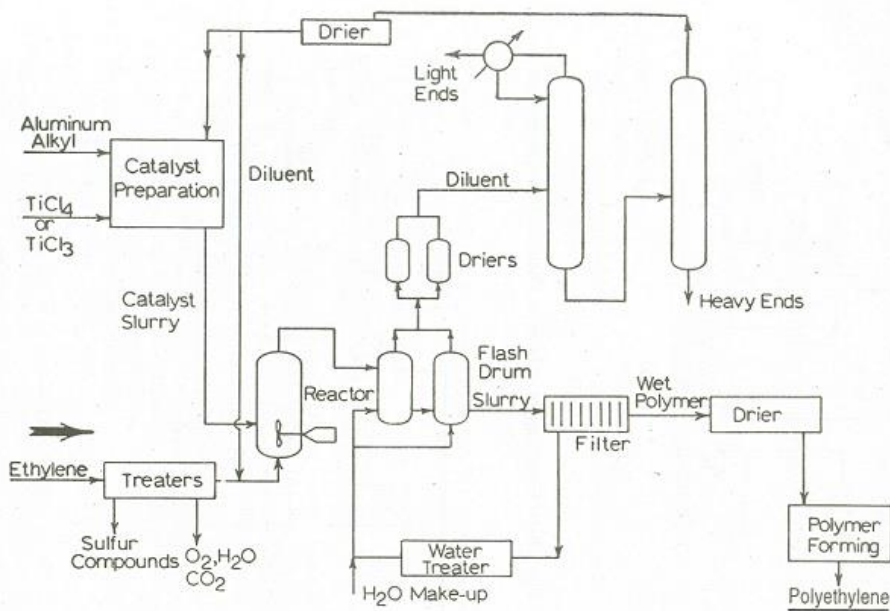
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oils

2 b PFD for manufacturing of polyethylene

4 marks



OR

Polyethylene by High Pressure Process



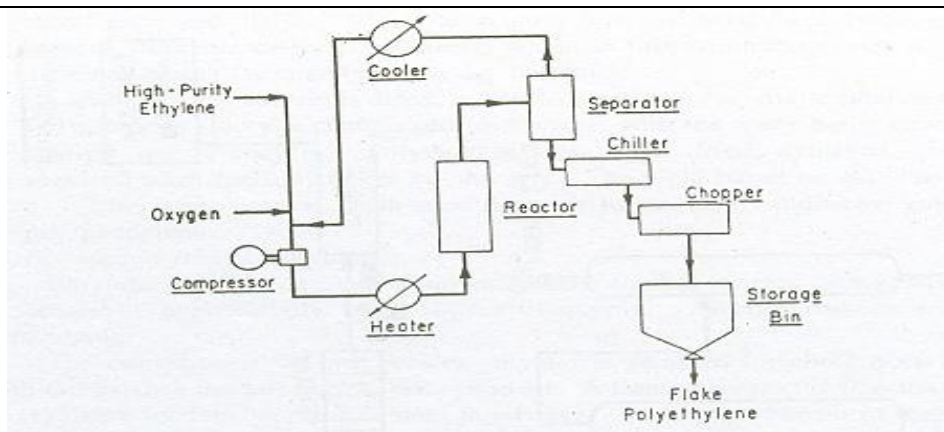
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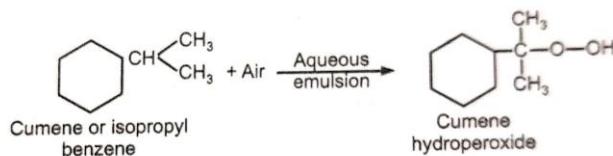
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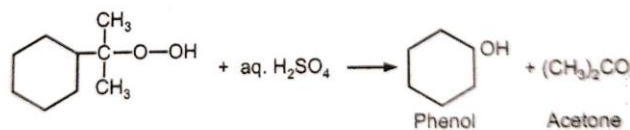
2 c Reactions involved in manufacturing of Phenol from Cumene

3 marks

(a) Peroxidation :



(b) Hydrolysis :



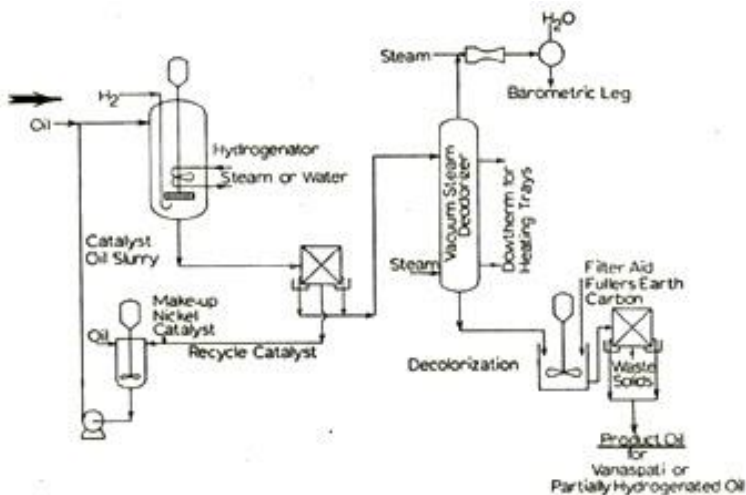
Raw Material

Cumene and Air (Oxygen)

1 mark

2 d Hydrogenation of Oil

2 marks





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The dry pure oil and nickel catalyst is taken in an iron cylinder. The cylinder has two inlets & outlets. One inlet is used for the introduction of oil & the other to introduce dry hydrogen. Unused hydrogen is removed through the upper outlet, while lower outlet is used to take the hydrogenated oil. The cylinder is provided with stirrer inside it. The temp. is regulated between 140°C-180°C. From the second inlet, pure hydrogen gas is well mixed with the oil. In the cylinder oil & dry hydrogen gas are well mixed with mechanical stirrer.

After certain time a sample of hydrogenated oil is taken through outlet is situated at the bottom of the cylinder. The iodine value of the hydrogenated oil is determined. If it is 60, the process of hydrogenation is stopped. And all the hydrogenated oil is taken out. It is passed through cooler then filter pressed to remove nickel particles.

2 marks

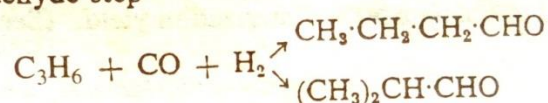
3 a **Butanol production by OXO process**

Raw materials for butanol

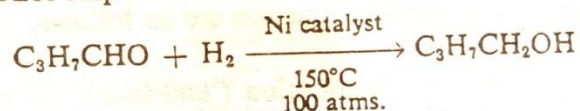
Propylene, Hydrogen, Synthesis gas

Reaction

(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 butanaldehyde from demerisation reactor is continuously hydrogenated using a fixed bed nickel

1 marks

1 mark

2 marks



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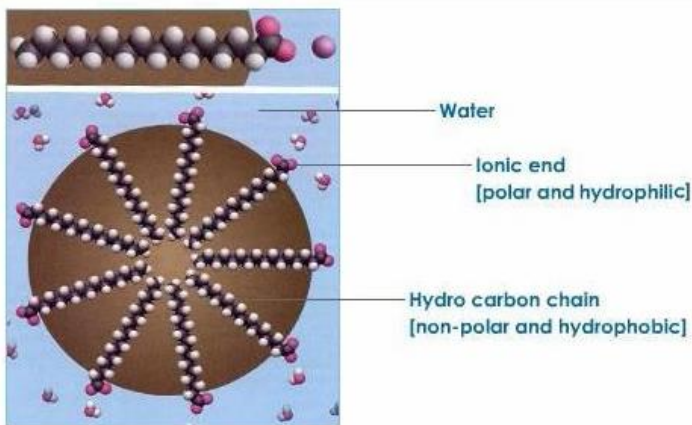
catalyst at 100 atm and 150 degC The resulting butanol are fed to a distillation column comprising of several fractionating column in series Light and heavy ends are obtained in addition to the product alcohol.

3 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 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.

3 marks

1 mark



3 c **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
Solvent used-Oil	Solvent used – Ether, alcohol, ketones

1 mark each for any 4 points



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		Manufacturing- Cooking	Manufacturing - Mixing	
		Mode of drying – Oxidation or polymerisation	Mode of drying - Evaporation	
3	d	Production of paper from pulp Conversion of fibre suspension into paper sheet incorporates three principal steps. i) Forming wet-web : A wet sheet is formed by running 99.5% water-fibre slurry evenly into a moving endless belt of wire cloth at speed of 50 m/min for a fine paper to 500 m/min for newsprint. Water drain by gravity , apart is next removed by a pressure roll and then by suction roll. The screen also has a side wise shaking motion to give better interlocking of fibre on the mat. The water collected in this section of machine is called white water and is reused to obtain maximum recovery of fibre. ii) Pressing the wet sheet : The wet paper wheet containing about 80% water is fed via felt roll to the press section where water is removed by mild pressure to reduce content to 60-65% water. Bond or water mark, if needed is formed on sheet during pressing. iii) Drying of sheet : The sheet from the press section has sufficient strength to carry its own weight as it passed through smoothing rolls, then a series of steam heated metal cylinders where heat and moisture are transferred to a felting or canvas belt running on top of the paper. As the sheet leaves the east drying roll with 5-6% water, it passes through final series of pressure or calendaring rolls to produce a smooth well-finished paper. It is wound on large roll and transferred to finishing department where it may be cut, coated and packaged.		4 marks
4	a	Soap by continuous process		2 marks



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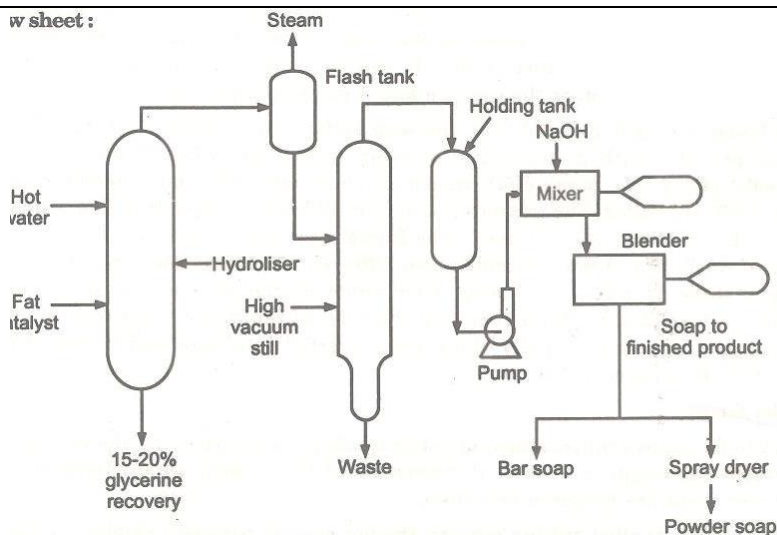
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Worksheet :



2marks

Glycerides plus catalyst are added at the bottom of the hydrolysis tower where high pressure water at 230-250°C is passed countercurrently to the glycerides. And triglycerides are broken into fatty acid and glycerin with a 15-20% glycerin solution being removed from bottom of the tower. The fatty acid is passed overhead to a flash tank to remove excess steam. The crude fatty acid are vacuum distilled and the condensate in the distillate receiver is either available as a marketable product or for soap mfg.

Caustic soda is added to fatty acid in a continuous high speed mixture and the saponification is completed in a slow speed blender where other ingredients are added if desired. Soap from the blender may be pumped through heated lines to bar soap or flake or spray drying equipments followed by packing operations.

4

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

4

c

Reactions involved in polyester manufacturing

4 marks

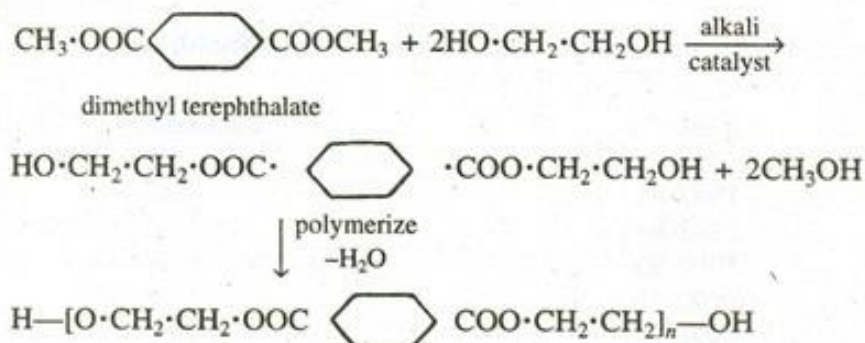
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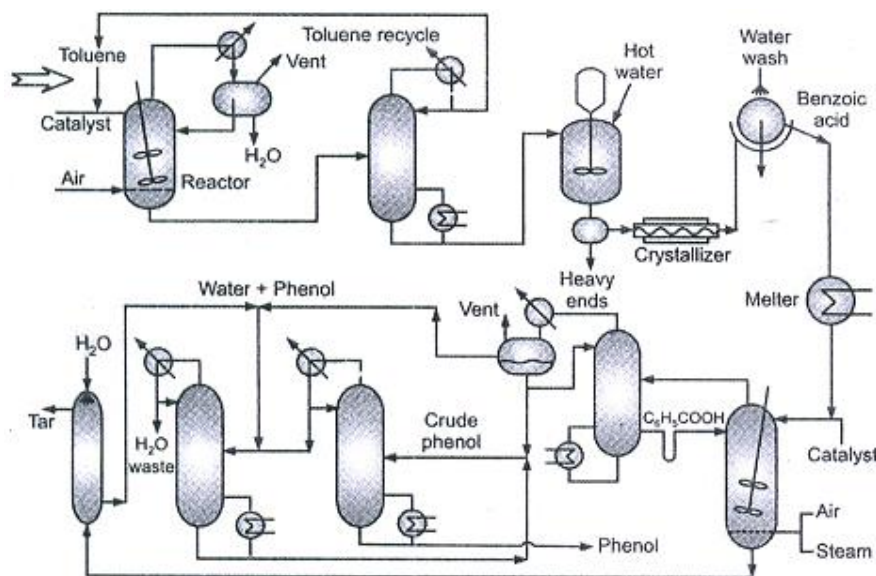
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4

d

Phenol by toluene oxidation



4 marks

4

e

Manufacturing of Phenol by Raschig process

Process description: the Raschig process has two vapour-phase catalyst stages. Purified benzene is fed to a heater, packed reactor containing ferric chloride & cupric chloride catalyst. Chlorination with HCl-O₂ at 220⁰C occurs with a short residence time to produce 10-20% conversion of benzene. Fractionation separates unreacted benzene from chlorobenzene & polychlorobenzene. The crude chlorobenzene is scrubbed with phenol, water washed & sent to the second catalytic stage. Here it is hydrolyzed in a tubular high temp furnace with either SiO₂ or Ca₃(PO₄)₂ as the catalyst. Phenol from the hydrolyzer is washed with water, then extracted by benzene & finally purified by two stage distillation. HCl vapours from the high temp catalytic hydrolyzer is recycled to the hydrochlorination stage

4 marks



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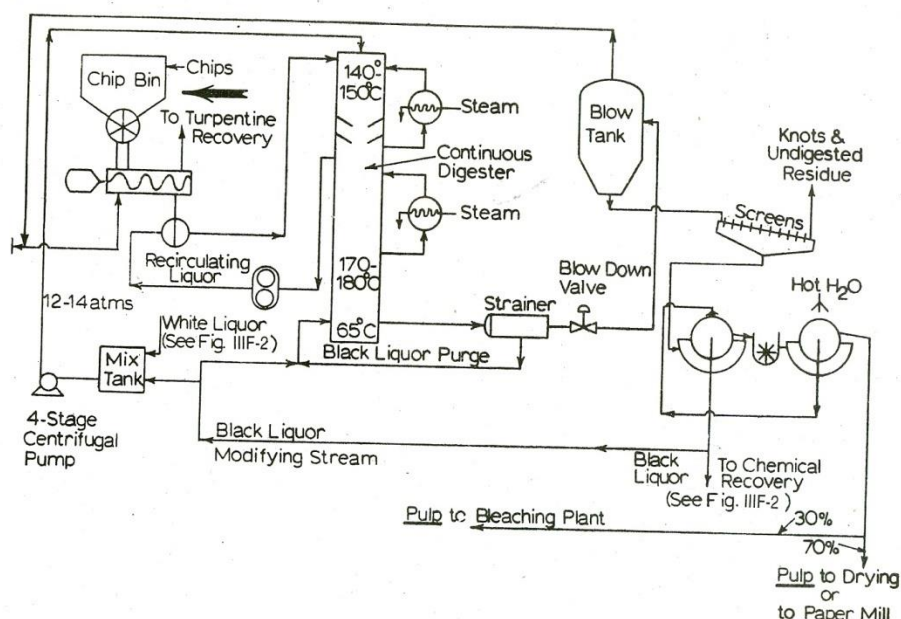
5

a

Manufacturing of pulp by Kraft process with neat flow diagram:

The wooden chips are metered via star valve to a deaerator preheater. After several minutes, the chips are discharged through a rotating tapered plug into the lift line where recirculating digestion liquor at 12 atms. Transfers chips to the upper soaking zone of the 25-30m tall digester tower. Chips flow down past a series of circumferential screen plates. Cooking liquor is withdrawn as side streams and circulated through external heat exchangers to reheat and control the digestion temp. within the tower. The digestion time and temp. is adjusted so that max lignin removal is accomplished with a minimum cellulose hydrolysis and consequent loss of bulk yield. The digested chips are cooled at the base of tower by injection of cold black liquor. This is to avoid mechanical weakening of fibers from steam explosion of hot liquor when passed through a blow down valve. The pulp liquor slurry is passed through the valve to a blow tank where residual heat is recovered in the form of steam. which passes overhead with turpentine vap. To the chip preheater. The pulp is filtered to separate black liquor and screened to remove wood knots and other undigested residue

3 marks



3 marks

5

b

Manufacturing of acetaldehyde with neat flow diagram:



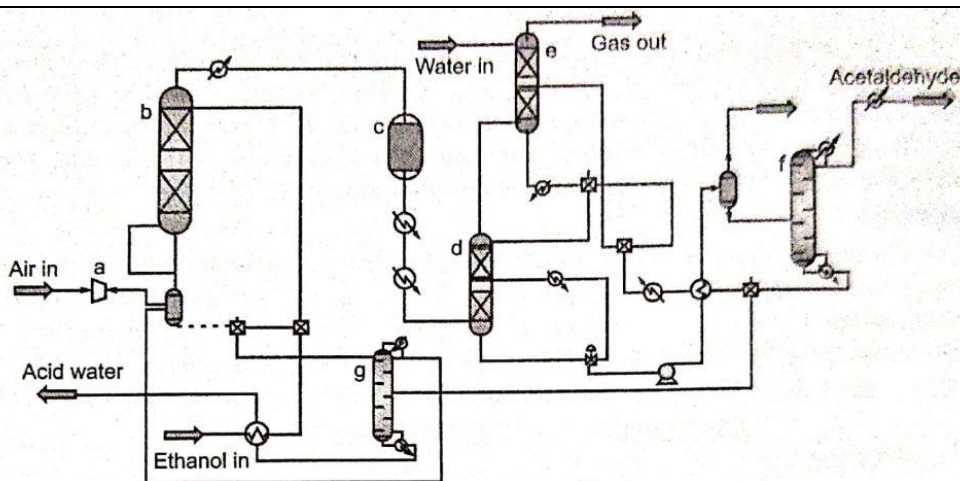
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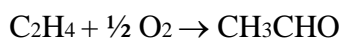
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3 Marks

3 Marks

The process operates in the presence of an aqueous liquid copper salt catalyst, promoted by a metal such as palladium. As follows



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.

5

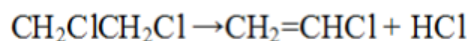
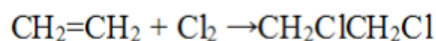
c

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

a

Manufacturing of ethyl alcohol using corn :

(Reactions are not compulsory. If Students writes reactions then allot 2 Marks and 1 mark for description. Otherwise all three marks for description)

3 marks



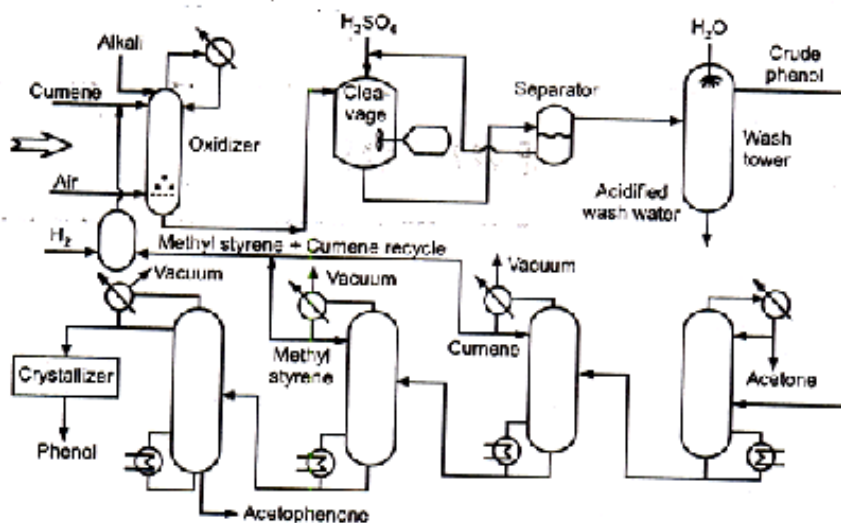
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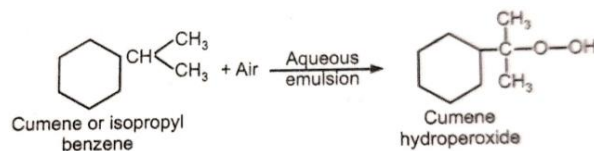
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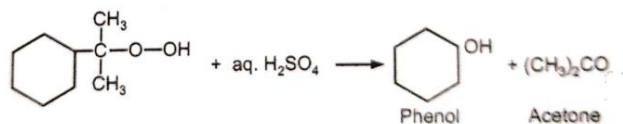
3 marks

Reactions involved in manufacturing of Phenol from Cumene

(a) Peroxidation :



(b) Hydrolysis :



3 marks