1. The purposes of catalytic reforming process are to improve the octane number of the feedstock, especially of heavy naphtha and reducing antiknock quality of naphtha.
2. Naphtha hydro-treatment is an important step in the catalytic reforming process for the removal of the various catalyst poisons.
3. It is important to remove C6 from the reformer feed because it will form benzene, which is considered carcinogenic upon combustion.
4. The main uses of petroleum coke are Fuel, Manufacture of anodes for electrolytic cells, Direct use as a chemical carbon source for the manufacture of elemental phosphorus, calcium carbide, Manufacture of electrodes for use in electric furnace, Manufacture of graphite
5. Typical catalysts that are used in catalytic reforming are mono-metallic, bimetallic or tri-metallic catalysts supported on aluminum, such as platinum (Pt/Al2O3), Platinum-Iridium (Pt-Ir/Al2O3) or Platinum-Iridium-Tin (Pt-Ir-Sn/Al2O3) respectively.
6. Coking is thermal cracking under severe conditions to allow to the breaking of the hydrocarbons completely to give carbon (coke).
7. The alkylation is used for the reaction of a low molecular weight oleﬁn with an iso-parafﬁn to form higher molecular weight iso-parafﬁns.
8. Naphthene compounds have a lower octane number than n-paraffin compounds.
9. The hydrotreated naphtha (HTN) is fractionated into light naphtha (LN), which is mainly C5-C6 , and heavy naphtha (HN) which is mainly C7-C10 hydrocarbons.
10. There are two types of isomerization catalysts, which are the standard Pt/ chlorinated alumina and Pt/zeolite catalyst.
11. Naphtha cracking is important steps in the catalytic reforming process for removal of the various catalyst poisons.

* Types of Thermal Cracking are Delayed coking, Visbreaking, and Flexi-coking:

The starting material used for the production of petrochemicals is called feedstock

There are two common feedstocks for the manufacture of petrochemicals; these are: **Natural gas** and **Naphtha and reformed naphtha**

Primary petrochemicals are divided into three groups, depending on their chemical structure:

**Olefins:** include ethylene, propylene, and butadiene.

**Aromatic petrochemicals:** include benzene, toluene, and xylenes.

**Synthesis gas** (SynGas): is a mixture of carbon monoxide and hydrogen, and is used to make the petrochemicals ammonia and methanol.

The finished products of benzene in petroleum processing are ………………………., ……………………, and ……………………………

Chemical compounds added in high concentrations (typically >1%) at the refinery are called blending components, and compounds added in lower concentrations (typically <1%) at the refineries are called refinery (functional) additives.

………………………………………….. is an example of the **Viscosity Improver additive in lubricant oil.**

Write three finished products in petroleum processing the following Primary petrochemicals

* Benzene
* Xylene
* Methanol from syngas
* Ammonia
* Butadiene
* **Butylene**

Scheme

Fluid Catalytic Cracking Process

Catalytic Hydrocracking Process

Catalytic Reforming Process

Flowsheet of Isomerization of n-paraffin

Hydrotreating Process

Acetone from Propylene



Reactions

Fluid Catalytic Cracking Reactions

Catalytic Hydrocracking Reactions

Coke formation

Catalytic Reforming Reactions

Reforming Reaction Network

Alkylation Reactions

Hydrotreating Reactions

**Catalysts**

Fluid Catalytic Cracking Catalyst

* Acid-treated natural aluminosilicates.
* Amorphous synthetic silica-alumina combinations.
* Crystalline synthetic silica-alumina catalysts (zeolites).

Most catalysts used today are either type 3 or mixtures of types 2 and 3 catalysts.

Catalytic Hydrocracking Catalysts

* Most of the hydrocracking catalysts consist of a crystalline mixture of silica-alumina.
* The silica-alumina part provides cracking activity.
* While rare earth metals promote hydrogenation.
* Catalytic Reforming (Catalyst Types)
* Typical catalysts that are used in catalytic reforming are mono-metallic, bimetallic or tri-metallic catalysts supported on aluminum, such as platinum (Pt/Al2O3), Platinum-Iridium (Pt-Ir/Al2O3) or Platinum-Iridium-Tin (Pt-Ir-Sn/Al2O3) respectively.
* Isomerization Catalysts

There are two types of isomerization catalysts:

* The standard Pt/ chlorinated alumina with high chlorine content, which is considered quite active
* The Pt/zeolite catalyst.
* This bi-functional nature catalyst consists of highly chlorinated alumina responsible for the acidic function of the catalyst.
* Platinum is deposited (0.3–0.5 wt%) on the alumina matrix.

Alkylation Reactions

**Polymerisation Reactions**

**Describe**

Describe the advantages of hydrocracking a

**Removal of components, which have undesirable characteristics:**

* Describe **Synthesis gas**

1. **2. Primary petrochemicals (First generation)**

Primary petrochemicals are divided into three groups, depending on their chemical structure:

1. **Olefins:** include ethylene, propylene, and butadiene.
2. **Aromatic petrochemicals:** include benzene, toluene, and xylenes.
3. **Synthesis gas** (SynGas): is a mixture of carbon monoxide and hydrogen, and is used to make the petrochemicals ammonia and methanol.

benzene, toluene, and xylene to finish products

Types of polyethylene

**Steam Cracking**

**Synthesis of polyethylene terephthalate (PET) from p-xyelene**

**Synthesis of polyurethane from Toluene diisocyanate (TDI)**

**Synthesis of Nylon-6 from cyclohexane**

**Synthesis of Nylon 6-6 from cyclohexane**

**Synthesis of phenolic resin from benzene**

**Polystyrene**

Define additives with mentioning their properties then write an example of the following additives