PETROCHEMICALS

Distillation

1 Why is distillation important in the petrochemical industry following the Fischer-Tropsch reaction?

_____

_____

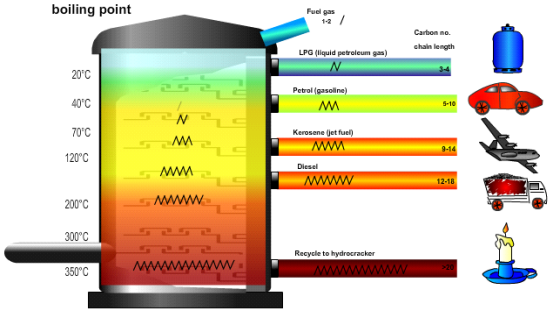
_____

2 Complete the explanation by filling the gaps or choosing from the options. Do this before, or after, but not during, watching the animations. Mark during re-watching.

Separation of Fischer-Tropsch products

Distillation is the main process used to separate Fischer-Tropsch (FT) products

Aim of distillation: to separate a mixture of chemical molecules by using differences in boiling point



Distillation is the separation of a mixture into its components by using their differences in _____ points. Boiling point is the _____ at which a substance boils. This is also the temperature at which it [freezes/melts/condenses/sublimes]. During condensation, a substance changes from _____ to _____. Long-chained hydrocarbons condense at [higher/lower] temperatures than short-chained hydrocarbons.

A distillation column has different temperatures throughout its height. At the bottom it is very [cold/hot]. It gets cooler and cooler [higher up/lower down]. The hydrocarbon mixture formed by the Fischer-Tropsch process is heated to over 350°C, making all its components vaporise, that is, turn to _____. This hot mixture is fed into the bottom of the _____ column. Even though the temperature at the bottom of the column is hot, it is not hot enough to keep the [shortest/longest]-chained hydrocarbons in the gaseous phase. They_____and sink to the bottom. These hydrocarbons have more than 20 carbon atoms per molecule. They are then led off. They may be used, for example in _____, or they may be sent back to the _____ to be split into shorter chains.

The [shorter/longer] hydrocarbons, still in the _____ phase, rise. As they do so they come to cooler parts of the distillation column. At about 200°C, _____ condenses, and is led off. _____ is made of a mixture of hydrocarbons having from 12 to 18 carbon atoms per molecule. It is used in some vehicles. At about 120°C, kerosene condenses. Kerosene is used as _____ fuel. Kerosene is a mixture of hydrocarbons having 9 to 14 carbon atoms per molecule. At 40°C, _____, also called gasoline, condenses. It is made of a mixture of hydrocarbons having from 5 to 10 carbon atoms per molecule. This is used to power many vehicles. At 20°C_____ (LPG) condenses. LPG is often sold in gas bottles and might be used in gas heaters or stoves. It contains very [short/long] hydrocarbon chains which have only 3 or 4 carbon atoms per molecule. Even smaller molecules, consisting of only 1 or 2 carbon atoms per molecule, form _____. This exits at the top of the distillation column, still in the _____ phase.

So by cooling the heated hydrocarbon mixture to different _____, it is separated into its components as each component _____ at a different temperature, and therefore a different _____, in the distillation column. A similar process is used in the separation of crude oil into its components. The temperatures used and products formed would, however, differ slightly from those given here.

Hydrocracker

3 What is the purpose of the hydrocracker? _____

_____

4 Which chemical, in the presence of a catalyst, cracks the chains? _____

Methane, Ethane, Ethene, Wax

5 Give the formulae of:
a. Methane _____ b. Ethane _____ c. Ethene _____

6 Tick the relevant blocks in this table to show the classification of these chemicals.

Chemical	Hydrocarbon?	Alkane?	Alkene?	Polymer?
Methane				
Ethane				
Ethene				
Wax		✓	✓	

General

7 Link each element from Column A with its corresponding element in Column B.
Write the letter from A next to each item in B in the last column.

Column A	Column B	A
a hydrocarbons	bonds break	_____
b alkanes	a single unit	_____
c alkenes	energy needed to start a reaction	_____
d adsorbed	consists of a long chain of repeated units	_____
e dissociate	consist of only hydrogen and carbon atoms bonded together	_____
f intramolecular	the process by which monomers bond with one another	_____
g polymer	attaches to	_____
h monomer	hydrocarbons with only single bonds	_____
i polymerisation	between two atoms within a molecule	_____
j catalyst	hydrocarbons with a double bond in them	_____
k activation energy	a chemical which speeds up a reaction without itself being permanently changed by the reaction	_____

Catalysts

8 Complete the explanation by filling the gaps or choosing from the options. Do this before, or after, but not during, watching the animations. Mark during re-watching.

A catalyst speeds up a reaction without itself being permanently _____ by the reaction. It serves as a _____ site for a reaction to take place. Reactants are _____ onto a catalyst surface. They then _____, breaking into their component atoms as their [inter/intra]molecular bonds break. The loosened [molecules/atoms] can then bond with other atoms to form a [reactant/product]. The catalyst allows this reaction to occur more easily than if it wasn't there. Reactants can only bond with one another if they can hit against one another with enough _____ and the right _____ to stay together. We say they need _____ energy in order to start them reacting. But if a catalyst holds the reactants in place to make reacting easier, the reactants need [more/less] energy to get to react. In other words, a catalyst [reduces/increases] the_____ energy needed to cause a reaction. Because of this, the reaction will occur more [slowly/quickly] with a catalyst than without one.