FRACTIONAL DISTILLATION AND CRACKING – TEST 1

QUESTION 1
The boiling temperature of hydrocarbons making up crude oil depends on the strength of intermolecular forces known as:

A Hydrogen bonding.
B Dipole-dipole interactions.
C Dispersion forces.
D Intermolecular forces.

QUESTION 2
The boiling temperature of alkanes increases with:

A Increasing molecular mass.
B Decreasing molecular mass.
C Increasing atomic mass.
D Decreasing atomic mass.

QUESTION 3
The role of bubble caps in a fractionating tower is to:

A Speed up condensation of gases.
B Prevent condensation of gases.
C Force gases into contact with condensed liquid hydrocarbon.
D Facilitate upward movement of gases.

QUESTION 4
Consider the two following hydrocarbons: C_6H_{14} and $C_{20}H_{42}$.
Which of the following statements about these two hydrocarbons is incorrect?

A Both hydrocarbons are alkanes.
B $C_{20}H_{42}$ has a higher boiling temperature than C_6H_{14}.
C C_6H_{14} will condense nearer to the top of the fractionating tower than $C_{20}H_{44}$.
D Both hydrocarbons are alkenes.

QUESTION 5
Fractional distillation of crude oil produces a number of different fractions. Which of the following properties apply to a fraction containing large molecules?

A High viscosity and low flammability
B Low viscosity and high flammability
C High viscosity and high flammability
D Low viscosity and low flammability

QUESTION 6
State a property of the molecules in petroleum which allows the mixture to be separated into fractions.

Solution

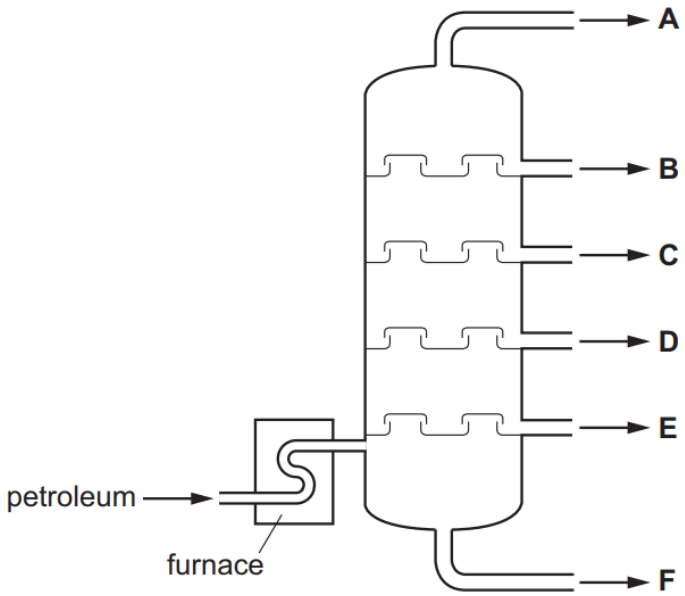
QUESTION 7
Describe how the number of carbon atoms affects the boiling range.

Solution

QUESTION 8
Describe how fractional distillation is used to separate petroleum into fractions.

Solution

QUESTION 9
Petroleum can be separated into different fractions by fractional distillation.
The diagram below shows a fractionating column. The fractions are shown by letters.



(a) Identify the fraction with the shortest chain length.

(b) Identify the fraction that is most viscous.

(c) Identify the fraction that is most volatile.

(d) Identify the fraction with the highest boiling point.

QUESTION 10
Chemists take the longer chained hydrocarbon molecules from crude oil and break them down in to shorter chained molecules.

(a) What name is given to this process?

(b) Complete the below equation to show the products formed when dodecane is subjected to this process.

$C_{12}H_{26} \rightarrow C_4H_{10} +$

(c) State two conditions that are required for this process to occur.

QUESTION 11
Consider the following reaction: $C_8H_{18} \xrightarrow{\text{Process X}} Ethene + Compound\ Y$
Which option correctly identifies Process X and Compound Y?

	Process X	Compound Y
A	Cracking	Hexane
B	Cracking	Hexene
C	Distillation	Hexane
D	Distillation	Hexene

QUESTION 12
The catalytic cracking of $C_{25}H_{52}$ under a particular set of conditions produces hexane, hexene and another alkene. Write a balanced equation for the reaction.

Solution

QUESTION 13
Thermal cracking of ethane is carried out at a temperature of about 800^0C and the heat of reaction is +138 KJ mol^{-1}.

(a) State the main purpose for cracking a light molecule such as ethane.

(b) Write a balanced equation for the reaction.

(c) What is the advantage of carrying out the reaction at high temperatures?

(d) The reaction is also carried out at a pressure of less than one atmosphere. Suggest a reason for this.

QUESTION 14
In a thermal cracking reaction, both methane and ethene were produced.

(a) Which hydrocarbon was cracked?
(b) Write a balanced equation for the reaction.

Solution

QUESTION 15
Compare the processes of catalytic cracking and thermal cracking in terms of:

(a) Operating conditions.
(b) Products obtained.

Solution

SOLUTIONS

QUESTION 1 Answer is C

QUESTION 2 Answer is A

QUESTION 3 Answer is C

QUESTION 4 Answer is D

QUESTION 5 Answer is A

QUESTION 6 Boiling point

QUESTION 7

The greater the number of carbon atoms, the higher the values of the boiling range.

QUESTION 8

- Petroleum vaporised (in furnace);
- Column is hot at the bottom and cool at the top;
- Smaller / lighter molecules move higher up the column;
- Fractions with lower boiling points move further up column;
- Smaller / lighter molecules have lower boiling points;
- Fractions condense when the temperature in the column falls below the (average) boiling point of the fraction.

QUESTION 9

(a) A
(b) F
(c) A
(d) F

QUESTION 10

(a) Cracking

(b) $C_{12}H_{26} \rightarrow C_4H_{10} + C_6H_{12} + C_2H_4$

(c) High temperatures and a catalyst.

QUESTION 11 Answer is A

QUESTION 12

The equation for the reaction is: $C_{25}H_{52}(g) \rightarrow C_6H_{14}(g) + C_6H_{12}(g) + C_{13}H_{26}(g)$

QUESTION 13

(a) Ethane is cracked to produce ethene.

(b) $C_2H_6(g) \rightarrow C_2H_4(g) + H_2(g)$

(c) Since the forward reaction is endothermic, a high temperature would push the equilibrium further to the right or product side, increasing the yield of ethene.

(d) A low pressure would also push the equilibrium to the right or product side and increase ethene yield. This occurs because the product side of this reaction has a greater number of particles than the reactant side.

QUESTION 14

A Propane was cracked.

B $C_3H_8(g) \rightarrow C_2H_4(g) + CH_4(g)$

QUESTION 15

(a) Catalytic cracking operates at lower temperatures (400-500^{0}C) and uses a catalyst to increase the rate of reaction. Thermal cracking operates at around 800^{0}C and uses no catalyst to speed up the rate of reaction.

(b) The main purpose of thermal cracking is to produce important unsaturated molecules such as ethene and propene. Light alkanes such as ethane and propane are used as reactants. Catalytic cracking is mainly used to decompose heavy oil fractions into more useful lighter fractions.