

Organic Chemistry 2

Name: _____

Class: _____

Date: _____

Time: **51 minutes**

Marks: **51 marks**

Comments:

1.

Crude oil is a mixture of alkanes from which useful fuel fractions can be obtained.

Fraction	A hydrocarbon in this fraction	Boiling point of alkane in °C
petroleum gases	Propane	-42
petrol (gasoline)	Octane	+126
paraffin (kerosene)	Dodecane	+216
diesel	Eicosane	+344

- (a) (i) Suggest the lowest temperature to which crude oil needs to be heated to vaporise all of these fuel fractions.

Temperature _____ °C

(1)

- (ii) Dodecane boils at +216 °C. At what temperature will dodecane gas condense to liquid?

Temperature _____ °C

(1)

- (iii) Describe what happens in a fractionating column that allows these fractions to be collected.

(3)

- (b) Propane is a fuel because it burns in air releasing heat energy.

- (i) Complete the balancing of the two chemical equations for propane burning in air.



(2)

(ii) The products of the two chemical reactions in (b)(i) are different.

Explain why.

(2)

(Total 9 marks)

2.

A burning torch is carried by a runner.

The fuel in the torch is a mixture of propane and butane.

Propane and butane are alkanes.

Alkanes have the general formula C_nH_{2n+2}



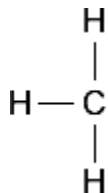
(a) Propane has 3 carbon atoms.

What is the formula of propane?

(1)

- (b) Butane has the formula C_4H_{10}

Complete the displayed (structural) formula for one molecule of butane.



(1)

- (c) Complete the word equation for the complete combustion of butane.

butane + oxygen \rightarrow _____ + _____

(1)

- (d) In earlier designs of the torch, propene (C_3H_6) was used as the fuel.

Smoke is produced when propene is burned.

Explain why smoke is produced.

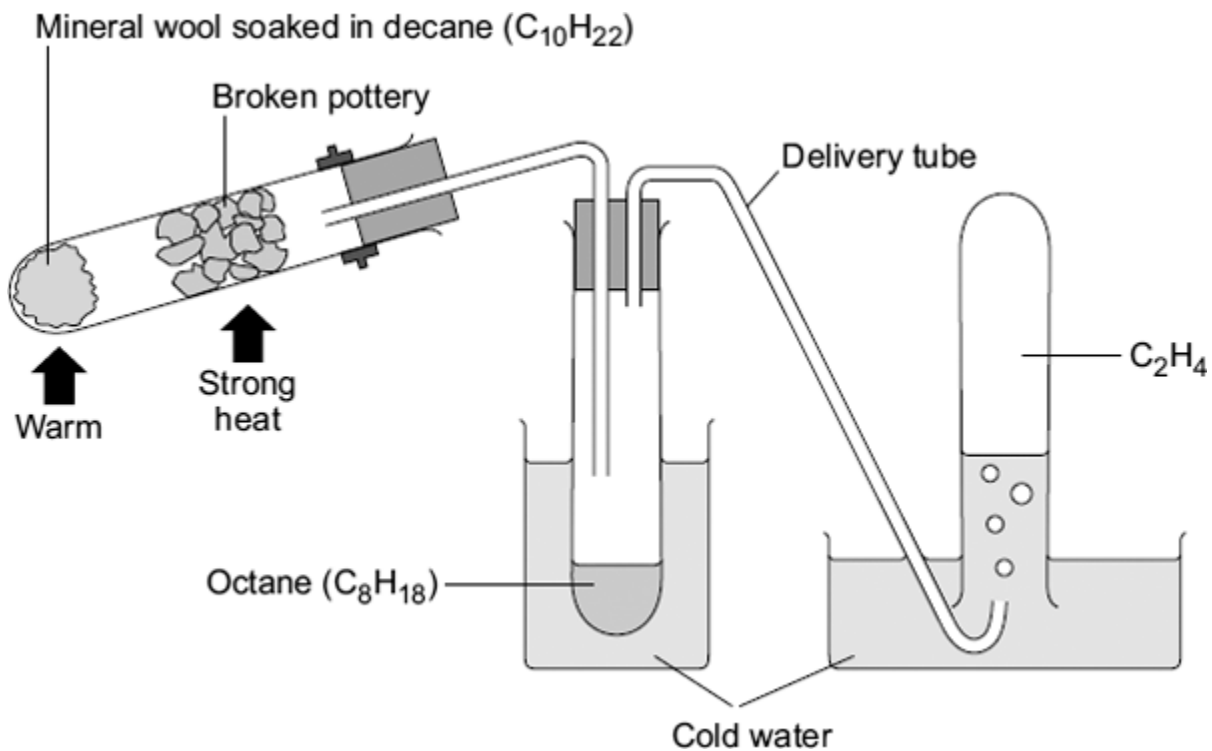
(2)

(Total 5 marks)

3.

Hydrocarbons are cracked to produce smaller molecules.

The diagram shows an experiment to demonstrate cracking.



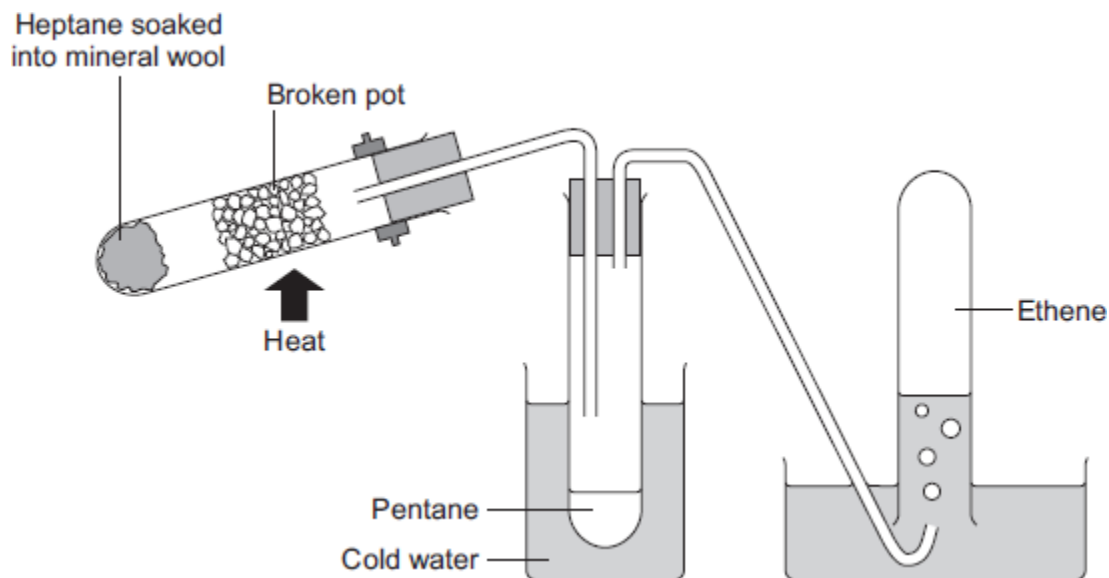
Describe the process of cracking shown in the diagram.

(Total 4 marks)

4.

In the laboratory, ethene can be made when heptane vapour is passed over a hot catalyst.

Heptane is an alkane.



- (a) (i) Draw a ring around the correct answer to complete the sentence.

The process used to make ethene is called

combustion.
cracking.
fermentation.

(1)

- (ii) Why does pentane collect in the test tube surrounded by cold water?

(1)

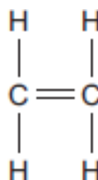
- (iii) Complete the sentences using words from the labels on the diagram.

The name of the alkane that decomposes is _____.

The name of the catalyst is _____.

(2)

(b) The displayed (structural) formula of ethene is:



Ethene is added to bromine water.

What colour change will be seen when ethene is added to bromine water?

(2)

(c) Name the polymer made from ethene.

(1)

(Total 7 marks)

5.

Fire dancers use firesticks to make flame patterns.



One end of the firestick is soaked in kerosene.
The kerosene is lit and burns with a yellow flame.

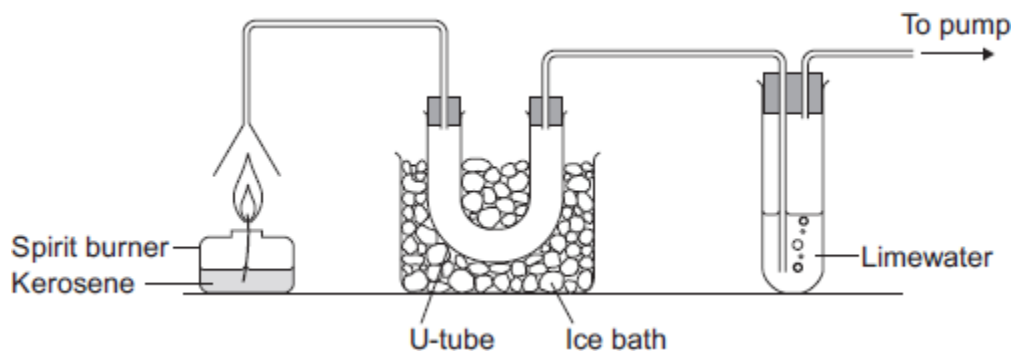
(a) Kerosene is a mixture of hydrocarbons.

Which elements are present in a hydrocarbon?

(1)

(b) A student investigated the products formed when kerosene burned.

The diagram shows the apparatus the student used.



Describe and explain the observations you would expect the student to make.

(4)

(Total 5 marks)

6.

The table below shows information about the fractions obtained when crude oil is distilled.

Fraction	Supply from distillation as percentage (%) of crude oil input	Demand by consumers as percentage (%) of crude oil input	Number of carbon atoms in hydrocarbon chain
LPG	2	6	C ₁ – C ₄
Petrol	14	27	C ₅ – C ₁₀
Kerosene	13	8	C ₁₁ – C ₁₅
Diesel	21	21	C ₁₆ – C ₁₉

(a) Some petrol is produced by cracking.

(i) Why is it necessary to produce some petrol by cracking?

(1)

(ii) Which fraction is the most suitable to be cracked to produce petrol?

Draw a ring around the correct answer.

diesel

kerosene

LPG

(1)

(iii) Give **two** reasons why the fraction you chose in part (ii) is cracked to produce petrol.

(2)

(b) Describe the process used to crack hydrocarbons.

(2)

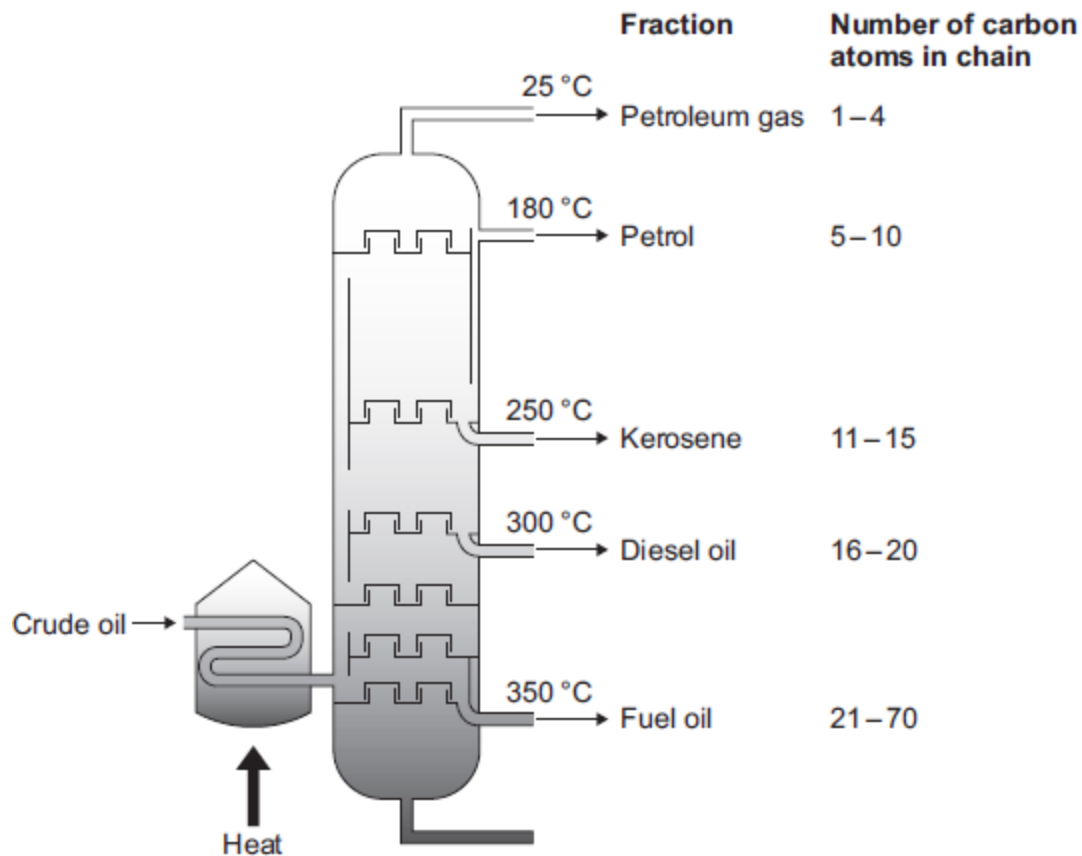
(Total 6 marks)

7.

Many fuels are produced from crude oil.

(a) Crude oil is separated into fractions by distillation in a fractionating column.

A fractionating column is shown below.



(i) Describe how crude oil is separated into fractions by fractional distillation.

(3)

- (ii) Some properties of hydrocarbons change as the size of the molecules increases.

Describe the trends in boiling point and viscosity as the number of carbon atoms in the molecule increases.

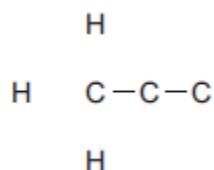
Boiling point _____

Viscosity _____

(2)

- (b) LPG (liquefied petroleum gas) is a fuel. LPG contains propane (C₃H₈).

- (i) Complete the displayed (structural) formula for propane.



(1)

- (ii) Burning fuels releases energy. Name **two** products formed when LPG is burnt.

(2)

- (iii) Some cars are now designed to use LPG as a fuel. LPG is about 50p per litre cheaper than petrol.

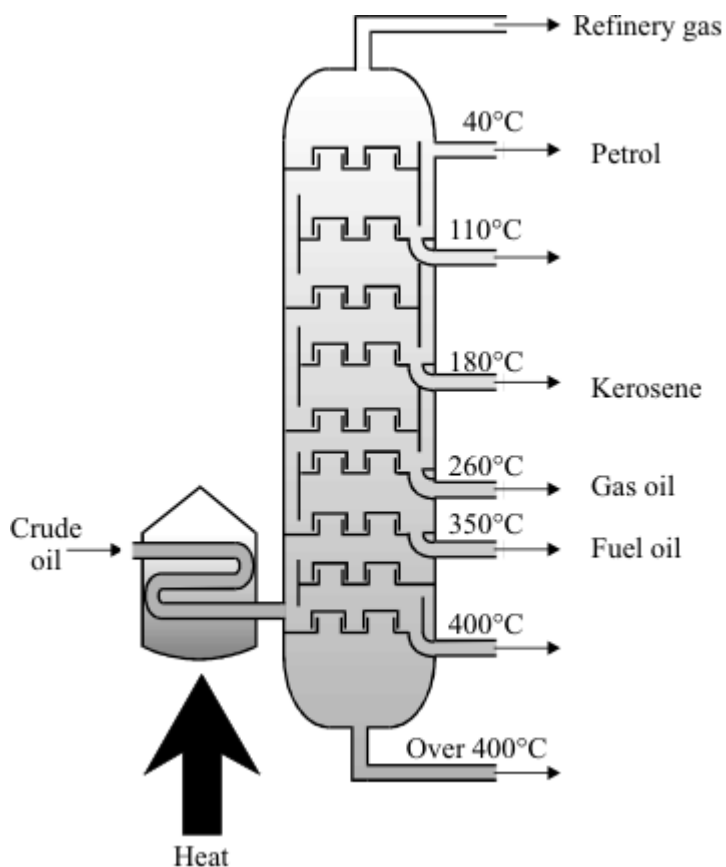
Suggest **one** reason why most car owners use cars designed to use petrol and not LPG as a fuel.

(1)

(Total 9 marks)

8.

To make crude oil more useful it is separated into different fractions.



(a) Complete the gaps in the following sentences.

Crude oil is separated into different fractions by a process called _____
_____. Each fraction has a different _____.

(2)

(b) Each fraction is a mixture of compounds. Most of these compounds are hydrocarbons, made up of the elements hydrogen and carbon.

(i) Explain the difference between a mixture and a compound.

(2)

(ii) Explain the difference between a compound and an element.

(2)

(Total 6 marks)

Mark schemes

1.

- (a) (i) 344 – 350(°C) 1
- (ii) 216(°C) 1
- (iii) the vapours / gases cool as they rise up the fractionating column 1
- which causes the vapours / gases to condense 1
- at different temperatures or into fractions that have different boiling points 1
- (b) (i) $10 \longrightarrow 6 + 8$ 1
- $7 \longrightarrow 6 + 8$ 1
- (ii) first reaction is complete combustion 1
accept first reaction has excess/enough oxygen
- second reaction is incomplete combustion 1
accept second reaction has limited oxygen

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2.

- (a) C_3H_8 1
allow H_8C_3
C and H must be upper case 3 and 8 should be subscript
*do **not** accept superscript 3 or 8*
- (b)
- $$\begin{array}{ccccccc} & H & H & H & H & & \\ & | & | & | & | & & \\ H & - C & - C & - C & - C & - H & \\ & | & | & | & | & & \\ & H & H & H & H & & \end{array}$$
- all bonds must be shown*
all letters must be upper case
ignore circles around letters
*do **not** allow double bonds* 1

- (c) carbon dioxide + water
answers can be in either order
accept carbon dioxide as CO₂ and water as H₂O
numbers in formulae must be subscript 1
- (d) (smoke is) carbon
ignore soot 1
- (formed by) incomplete combustion
accept insufficient oxygen 1

[5]

3.

any **four** from:

- decane evaporates / vaporises
- broken pottery acts as catalyst
- (decane) is split / cracked
allow chains broken
allow large molecules into small molecules
- thermal decomposition
- into octane / alkane
- and an alkene / ethene / C₂H₄

4

[4]

4.

- (a) (i) cracking 1
- (ii) (pentane) condenses
accept (pentane) liquefies / becomes liquid 1
- (iii) heptane
must be in correct order
*do **not** accept heptene* 1
- broken pot 1
- (b) (bromine water) turns from orange
allow brown 1
- to colourless
accept is decolourised ignore clear 1

- (c) poly(ethene)
ignore plastic
allow polyethene
accept polythene
*do **not** allow poly(ethane) or polyethane*

1

[7]

5.

- (a) hydrogen **and** carbon
both elements in either order needed for mark
any additional elements negates the mark

1

- (b) colourless liquid / condensation in U tube
ignore ice melts

1

(because) water produced

1

lime water goes cloudy

1

(because) carbon dioxide produced

1

[5]

6.

- (a) (i) demand (for petrol) is greater than supply
ignore reference to figures unless qualified

1

(ii) kerosene

1

(iii) supply (of kerosene) is greater than demand

1

contains larger molecules (which can be split into smaller molecules)

1

- (b) heat to vaporise (hydrocarbons)

1

(then pass the vapours over a) hot catalyst

allow zeolites / aluminium oxide for catalyst

accept as an alternative approach:

mix (the vapours) with steam (1 mark)

(then) heat to a (very) high temperature. (1 mark)

1

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7.	<p>(a) (i) any three from:</p> <ul style="list-style-type: none"> • (crude) oil is heated • (crude) oil evaporates • vapour condenses <i>allow fractions condense</i> • at different temperatures. <i>allow the fractions have different boiling points</i> 	3
	<p>(ii) (as number of carbon atoms increases) (Boiling point) increases</p> <p>(Viscosity) increases</p>	1 1
	<p>(b) (i)</p> <div style="text-align: center; margin: 10px 0;"> $\begin{array}{ccccccc} & \text{H} & & \text{H} & & \text{H} & \\ & & & & & & \\ \text{H} & - \text{C} & - & \text{C} & - & \text{C} & - \text{H} \\ & & & & & & \\ & \text{H} & & \text{H} & & \text{H} & \end{array}$ </div>	1
	<p>(ii) any two from:</p> <ul style="list-style-type: none"> • carbon dioxide <i>allow CO₂</i> • water <i>allow H₂O</i> <i>allow water vapour</i> • carbon monoxide <i>allow CO</i> • carbon. <i>allow soot</i> 	2
	<p>(iii) any one from:</p> <ul style="list-style-type: none"> • lack of availability of LPG • cars need to be modified. <i>allow LPG cars are more expensive</i> 	1
[9]		
8.	<p>(a) fractional distillation</p>	1
	<p>boiling point or use</p>	1

(b) (i) mixture: compounds **or** elements **or** substances together but not chemically combined

ignore references to separation

1

compound: (different) elements **or** different atoms together and chemically combined

ignore references to separation

1

(ii) element: contains only one type of atom

accept made of atoms which contain the same number of protons

1

compound: contains different types of atom chemically combined

'chemically combined' not needed here if already stated in (b)(i)

1

[6]