

1

The hydrocarbons in crude oil can be separated into useful fractions.

Fraction	Boiling point in °C	Carbon chain length	Relative % in crude oil	Relative % demand
Naphtha	20–180	5–9	10	20
Gasoline (petrol)	20–200	5–10	10	20
Kerosene (paraffin)	180–260	10–16	15	23
Diesel	260–340	14–20	20	25
Fuel oil	370–600	20–70	45	12

(a) Why does gasoline (petrol) have a lower boiling point than fuel oil?

.....

(1)

(b) Suggest why gasoline (petrol) costs more than fuel oil.

.....

(2)

(c) Describe how fuel oil can be changed into gasoline (petrol).

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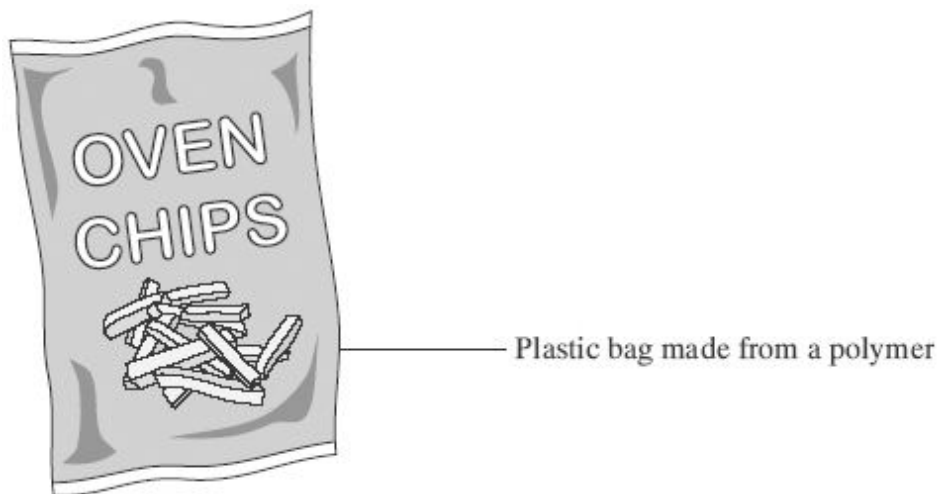
(2)

(Total 5 marks)

2

Polymers are used to make many materials that people need.

- (a) Plastic bags are used to carry, protect and store food. Plastic bags are made from polymers.



- (i) Ethene is the small molecule (the monomer) used to make the polymer for this plastic bag.

Name the polymer that is made from ethene.

.....

(1)

- (ii) Use the correct word from the box to complete the sentence about ethene.

condensing	corroding	cracking
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Ethene is made by breaking down large hydrocarbon molecules into smaller hydrocarbon molecules by a process called

(1)

- (iii) The hydrocarbon ethene has the formula C_2H_4

Complete the sentence about ethene.

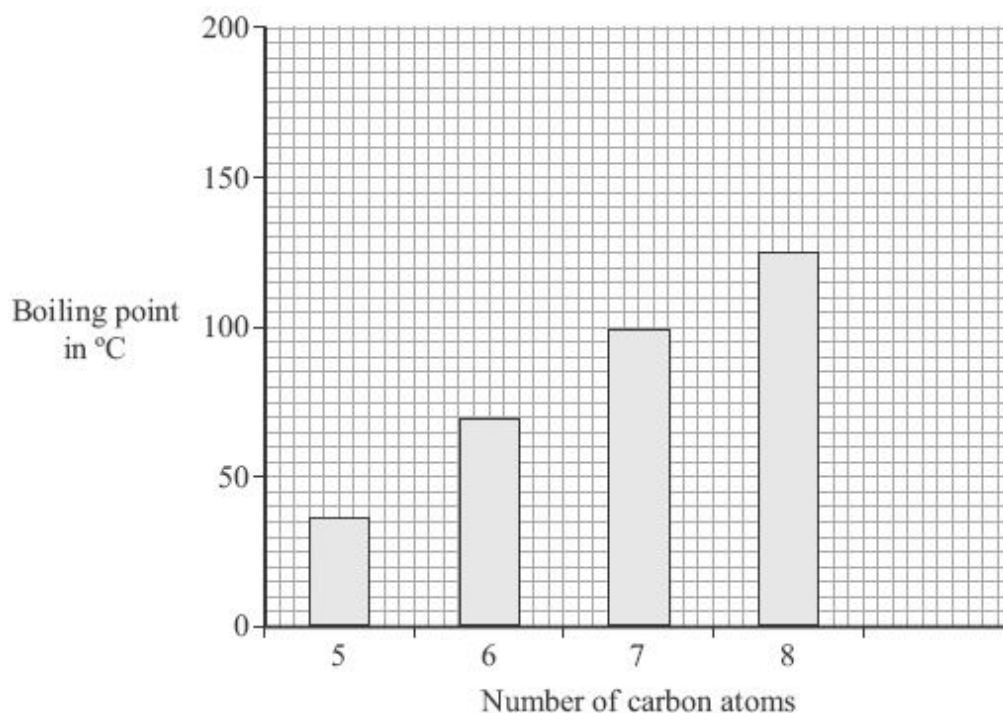
Ethene is a hydrocarbon made up of carbon and atoms.

(1)

- (b) The hydrocarbons used to make ethene come from crude oil. The properties of hydrocarbons are linked to the number of carbon atoms in their molecules.

Number of carbon atoms	5	6	7	8	9
Boiling point in °C	36	69	99	125	151

(i) Use the data in the table to complete the bar chart.



(2)

(ii) What happens to the boiling point of a hydrocarbon as the number of carbon atoms increases?

.....

(1)

(iii) All the hydrocarbons in the table are found in petrol. Petrol is one of the fractions separated from crude oil.

Describe how the fractions are separated from crude oil.

.....

(2)

(c) Most plastic bags that are made of hydrocarbons are not biodegradable.

Used plastic bags can be:

- dumped into large holes, which is called landfill
- burned to give out heat energy, which would produce large amounts of gases.

Would burning used plastic bags be better for the environment than dumping them in landfill?

Explain your answer.

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(2)
(Total 10 marks)

3

Crude oil is a mixture of mostly alkanes.

(a) Crude oil is separated into useful fractions by fractional distillation.

(i) Describe and explain how the mixture of alkanes is separated by fractional distillation.

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(3)

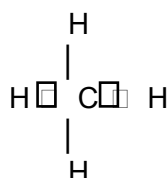
(ii) The table gives the name and formula for each of the first three alkanes.

Complete the table to show the formula of butane.

Name of alkane	Formula
Methane	CH ₄
Ethane	C ₂ H ₆
Propane	C ₃ H ₈
Butane	

(1)

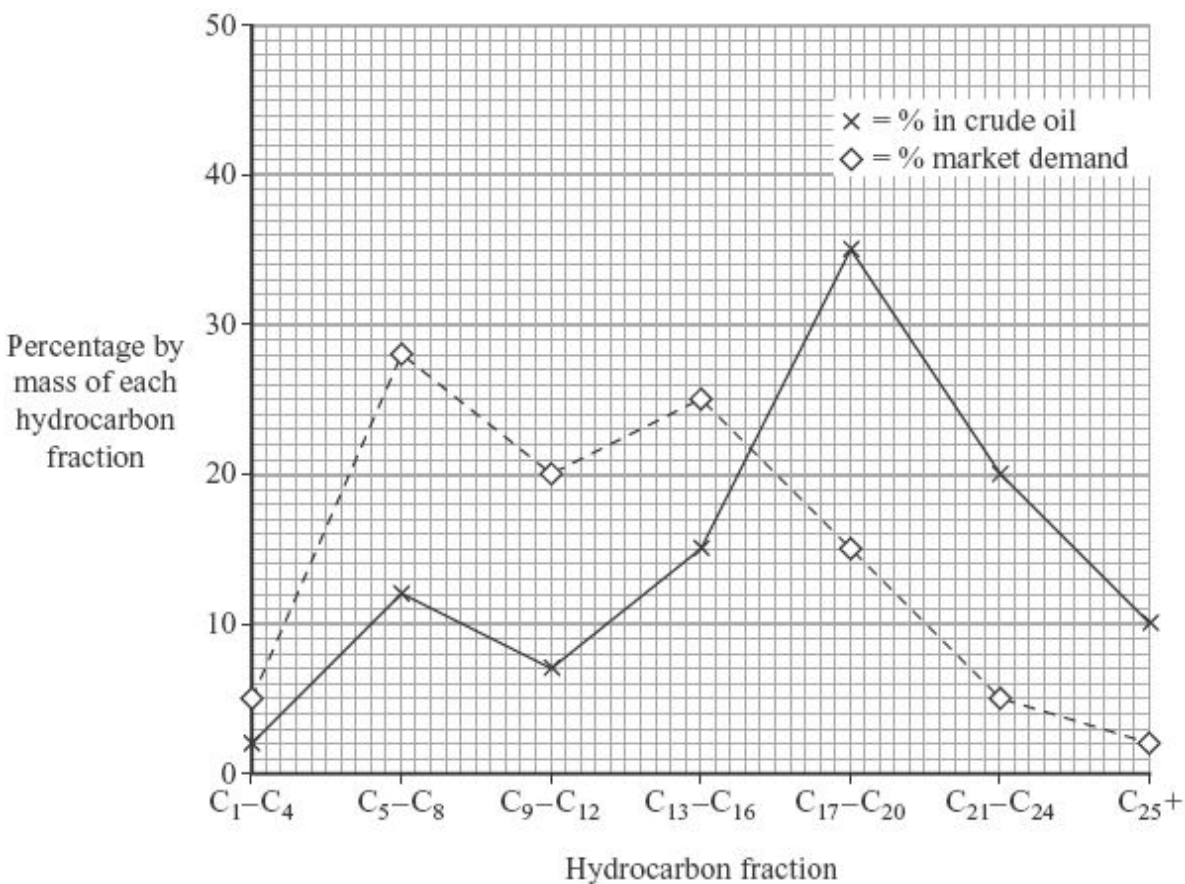
(b) The structural formula of methane, CH₄, is:



Draw the structural formula of propane, C₃H₈

(1)

- (c) The relative amounts of and the market demand for some hydrocarbons from the fractional distillation of crude oil are shown in the graph.



- (i) Why is the market demand for the C₅ – C₈ fraction higher than the market demand for the C₂₁ – C₂₄ fraction?

.....

(1)

- (ii) Cracking is used to break down large hydrocarbon molecules into smaller hydrocarbon molecules.

Complete the symbol equation by writing in the formula of the other hydrocarbon.



(1)

(iii) The C₅ – C₈ fraction has low supply and high market demand.

Suggest **three** ways in which the oil industry could overcome this problem.

1

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(3)
(Total 10 marks)

4

Crude oil is a natural resource from which useful fuels can be separated.

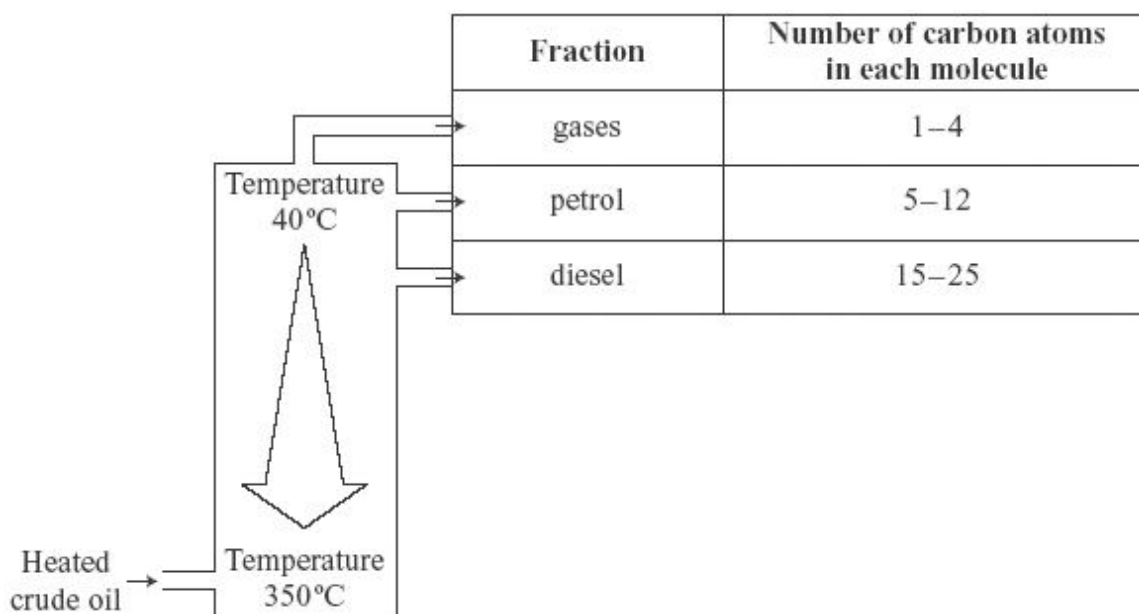
(a) Crude oil is a mixture of hydrocarbons.

Complete the sentence about a hydrocarbon molecule.

A hydrocarbon molecule is made up of and carbon atoms only.

(1)

(b) Many fuels come from crude oil. Some of these fuels are shown in the diagram.



Suggest **two** properties of these fuels that allow them to be separated from crude oil.

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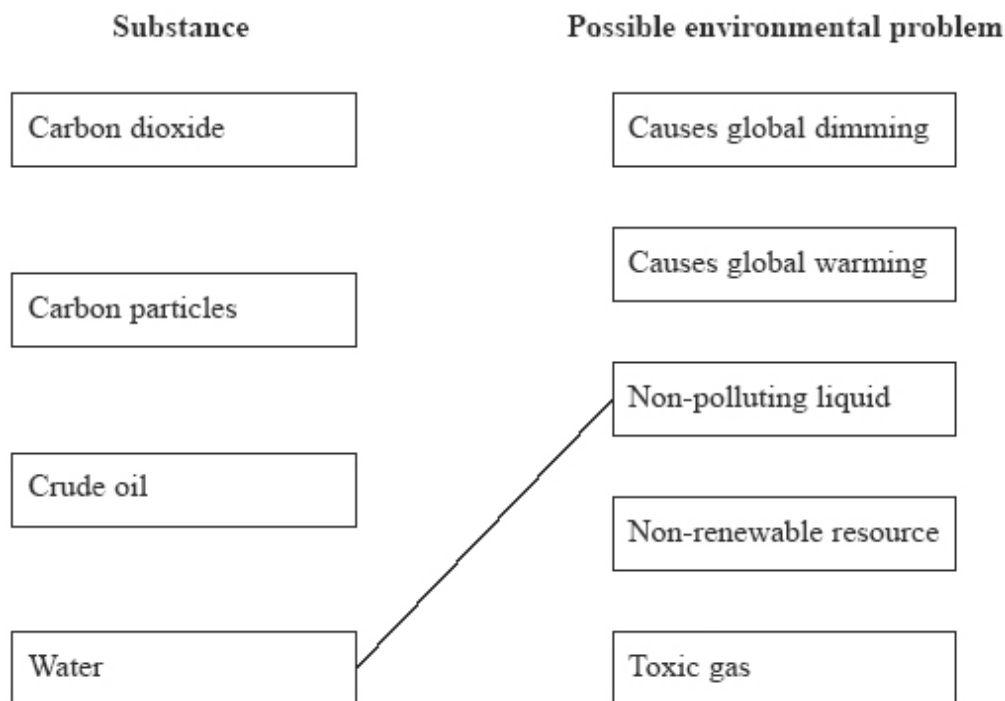
(2)

(c) Fuels from crude oil burn to provide heat energy.

When a fuel burns, it combines with oxygen in the air and produces carbon dioxide and water. When there is not enough oxygen, the fuel burns and also produces carbon monoxide and carbon particles.

Draw a straight line from each substance that links it to a possible environmental problem.

One has been done for you.



(3)
(Total 6 marks)

5

Known crude oil reserves are being used up rapidly. Crude oil is used to produce many useful fuels, such as petrol. One way to conserve crude oil reserves would be to increase the production of bio-fuels.

(a) Ethanol can be produced for use as a bio-fuel. Cars can be powered by ethanol or ethanol–petrol mixtures.

Sugar cane can be fermented to give a mixture of water (boiling point 100 °C) and ethanol (boiling point 78 °C).

(i) How can ethanol be separated from water?

.....

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(1)

- (c) As explained in parts (a) and (b), ethanol can be made using either sugar or alkanes as the starting material.

Evaluate the advantages and disadvantages of using these two starting materials to produce ethanol.

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(4)
(Total 10 marks)

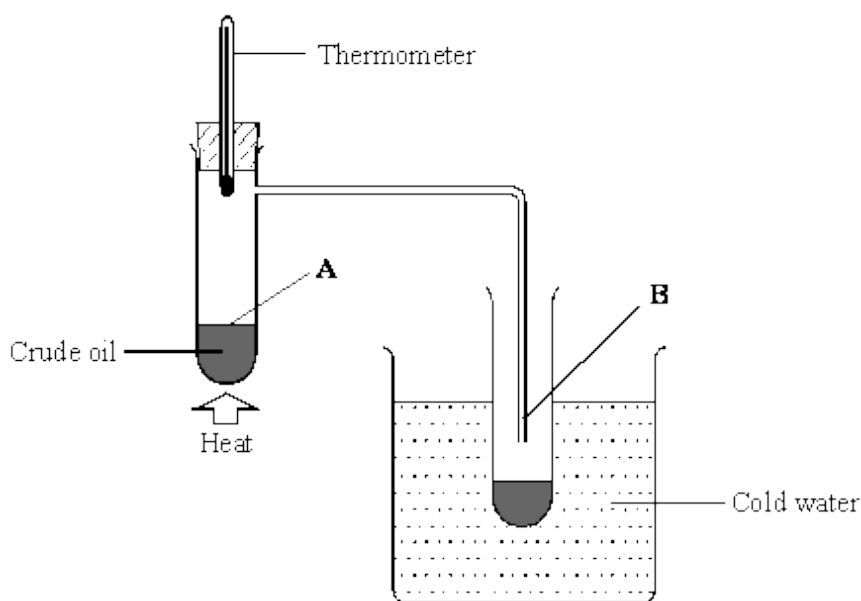
6

- (a) Complete this sentence about crude oil.

Crude oil is mainly a mixture of compounds called which contain carbon and hydrogen only.

(1)

- (b) The diagram shows a laboratory experiment used to separate crude oil.



Complete each sentence by choosing the correct words from the box.

condensation	distillation	evaporation
melting	sublimation	

The main process taking place at **A** is

The main process taking place at **B** is

This method of separating crude oil is called

(3)

- (c) Complete this sentence by crossing out the word in each box that is wrong. The first one has been done for you.

This method of separating crude oil works because the smaller
~~larger~~ the molecules are,

the higher
lower their boiling point and the more
less volatile they are.

(1)

(Total 5 marks)

7

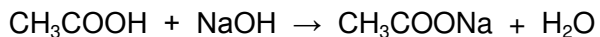
- (a) This label has been taken from a bottle of vinegar.



Vinegar is used for seasoning foods. It is a solution of ethanoic acid in water.

In an experiment, it was found that the ethanoic acid present in a 15.000 cm³ sample of vinegar was neutralised by 45.000 cm³ of sodium hydroxide solution, of concentration 0.20 moles per cubic decimetre (moles per litre).

The equation which represents this reaction is



Calculate the concentration of the ethanoic acid in this vinegar:

- (i) in moles per cubic decimetre (moles per litre);

.....

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Concentration = moles per cubic decimetre

(2)

- (ii) in grams per cubic decimetre (grams per litre).

Relative atomic masses: H = 1; C = 12; O = 16.

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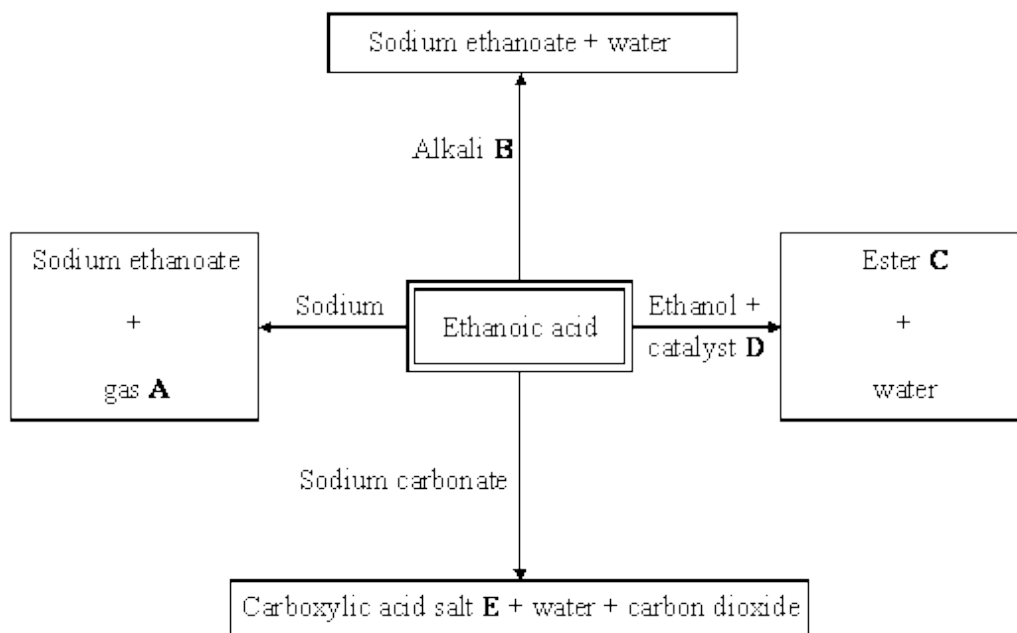
.....

.....

Concentration = grams per cubic decimetre

(2)

(b) The flow diagram shows some reactions of ethanoic acid.



Give the name of:

(i) gas **A**,

.....

(1)

(ii) alkali **B**,

.....

(1)

(iii) ester **C**,

.....

(1)

(iv) catalyst **D**,

.....

(1)

(v) carboxylic acid salt **E**.

.....

(1)

(Total 9 marks)

8

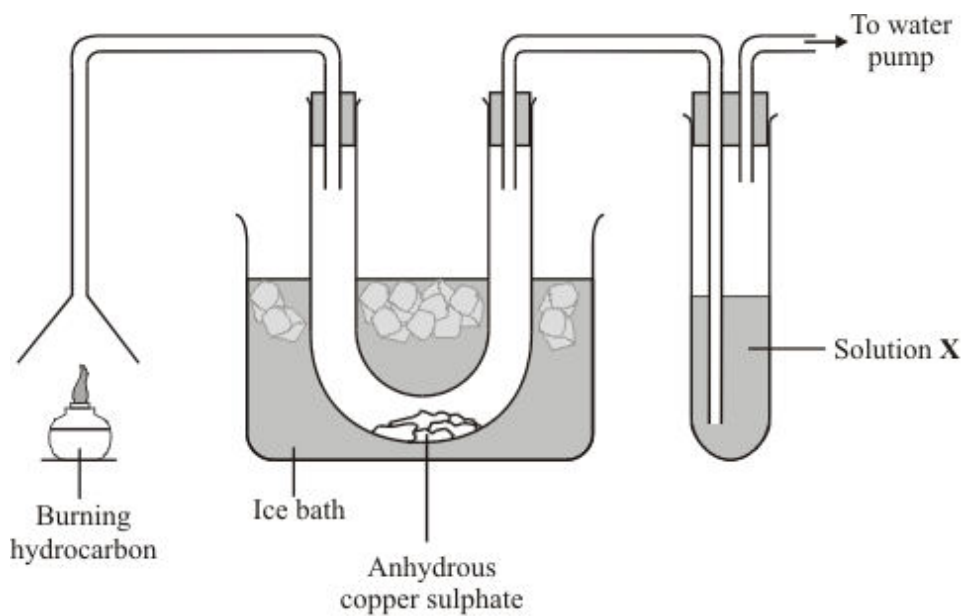
Petrol is a hydrocarbon fuel.

(a) Complete this sentence.

Hydrocarbons are compounds which are made from the elements
and only.

(2)

(b) This apparatus was used to study the combustion of a hydrocarbon fuel.



(i) Name the substance which changed the anhydrous copper sulphate from white to blue.

.....

(1)

(ii) Carbon dioxide is also produced when the hydrocarbon fuel is burned.
Name the solution, labelled X on the diagram, which tests for carbon dioxide.

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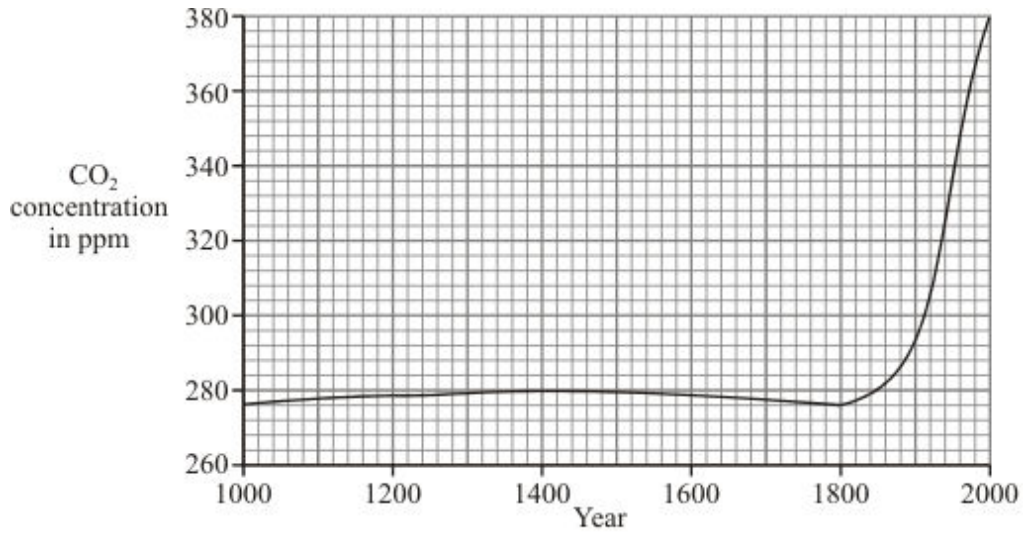
(1)

(iii) Complete this sentence.

Carbon dioxide turns solution X

(1)

- (c) The graph shows how the concentration of carbon dioxide in the air has varied since the year 1000.



- (i) Describe the changes in the concentration of carbon dioxide in the air since the year 1000.

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(3)

- (ii) Suggest why the concentration of carbon dioxide in the air has changed since the year 1800.

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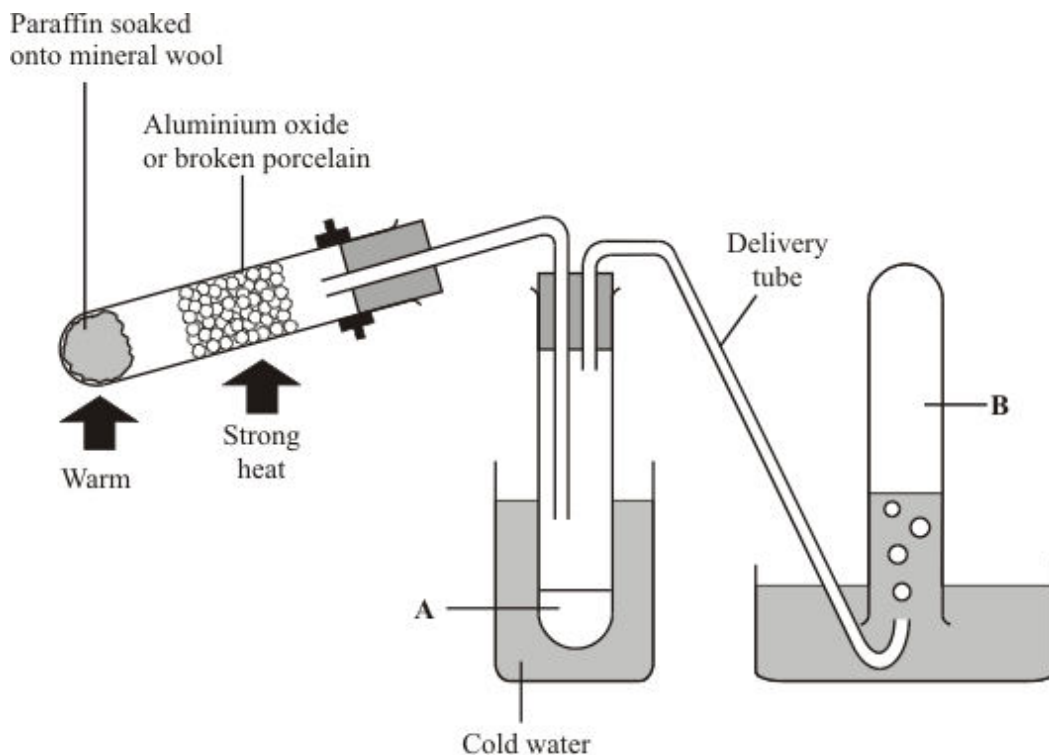
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(1)

(Total 9 marks)

9

The diagram shows an apparatus that can be used to carry out cracking reactions in a laboratory.



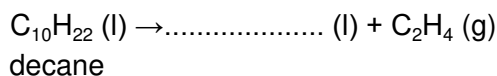
- (a) Why is aluminium oxide or broken porcelain used?

.....

(1)

- (b) Paraffin contains decane. The cracking of decane can be represented by the equation below. A decane molecule is split into two smaller molecules.

Complete the equation by adding the formula of the other product.



(1)

- (c) Would you expect C_2H_4 molecules to collect at position A or B shown on the diagram?

Position

Explain your answer.

.....

(1)

(d) Cracking reactions involve *thermal decomposition*.

What is meant by thermal decomposition?

.....
.....
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(2)

(e) Explain, as fully as you can, why cracking is used in the oil industry.

To gain full marks in this question you should write your ideas in good English. Put them into a sensible order and use the correct scientific words.

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(3)

(f) The cracking reaction produces a mixture of products. The mixture contains hydrocarbons with different boiling points.

Suggest a method of separating this mixture.

.....
.....

(1)

(Total 9 marks)

10

The table gives some data about four fuels, **A**, **B**, **C** and **D**.

Fuel	Cost in pence per 100 g	Energy in kJ per 100 g	Energy per penny in kJ	Gas (✓) formed on burning		
				Carbon dioxide	Sulphur dioxide	Water vapour
A	6.0	4 800	800	✓		✓
B	4.0	1 200	300	✓		✓
C	3.5	2 800	800	✓	✓	✓
D	18.0	14 400	800			✓

A student was asked to use the data in the table to compare these four fuels, and then place the fuels in an order.

The order that the student chose was:



Use the information in the table to suggest reasons why the student chose this order.

To gain full marks in this question you should write down your ideas in good English. Put them into a sensible order and use the correct scientific words.

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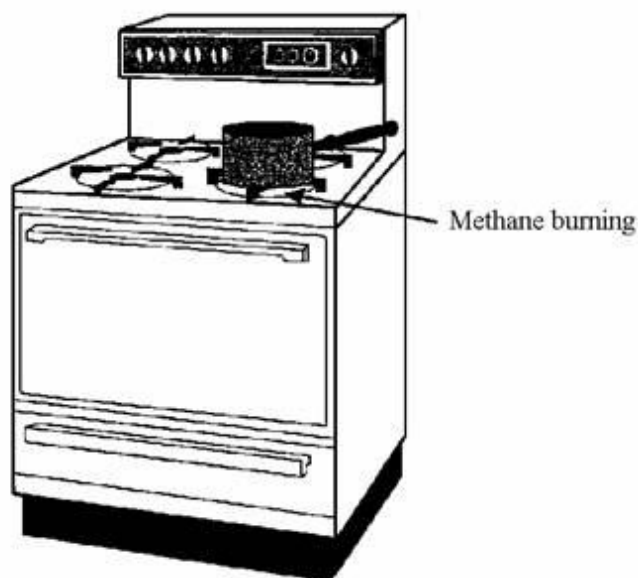
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(Total 4 marks)

11

Some gas cookers burn natural gas, methane. Methane, CH_4 , is a *hydrocarbon*.



(a) What is meant by *hydrocarbon*?

.....

(2)

(b) When methane burns there must be a good supply of air.

(i) Complete the word equation by choosing the correct **two** chemicals from the box.

carbon dioxide	hydrogen	oxygen	water
----------------	----------	--------	-------

methane + oxygen \rightarrow +

(2)

(ii) Without a good supply of air, carbon monoxide is formed. Why is carbon monoxide a dangerous gas?

.....

(1)

(Total 5 marks)

12

(a) Alkenes can be made by cracking large alkane molecules.

(i) Explain how the cracking process is carried out.

.....

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.....

(2)

(ii) Give a chemical test which would show the difference between an alkene and an alkane.

Test

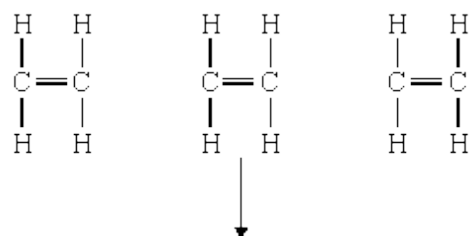
Result of test

.....

(2)

(b) Alkenes, such as ethene, can be made into polymers.

(i) Complete the following to show how the ethene molecules bond to form part of a polymer.



(1)

(ii) Name the polymer formed from ethene.

.....

(1)

(iii) Explain **one** important problem caused by the everyday use of this polymer.

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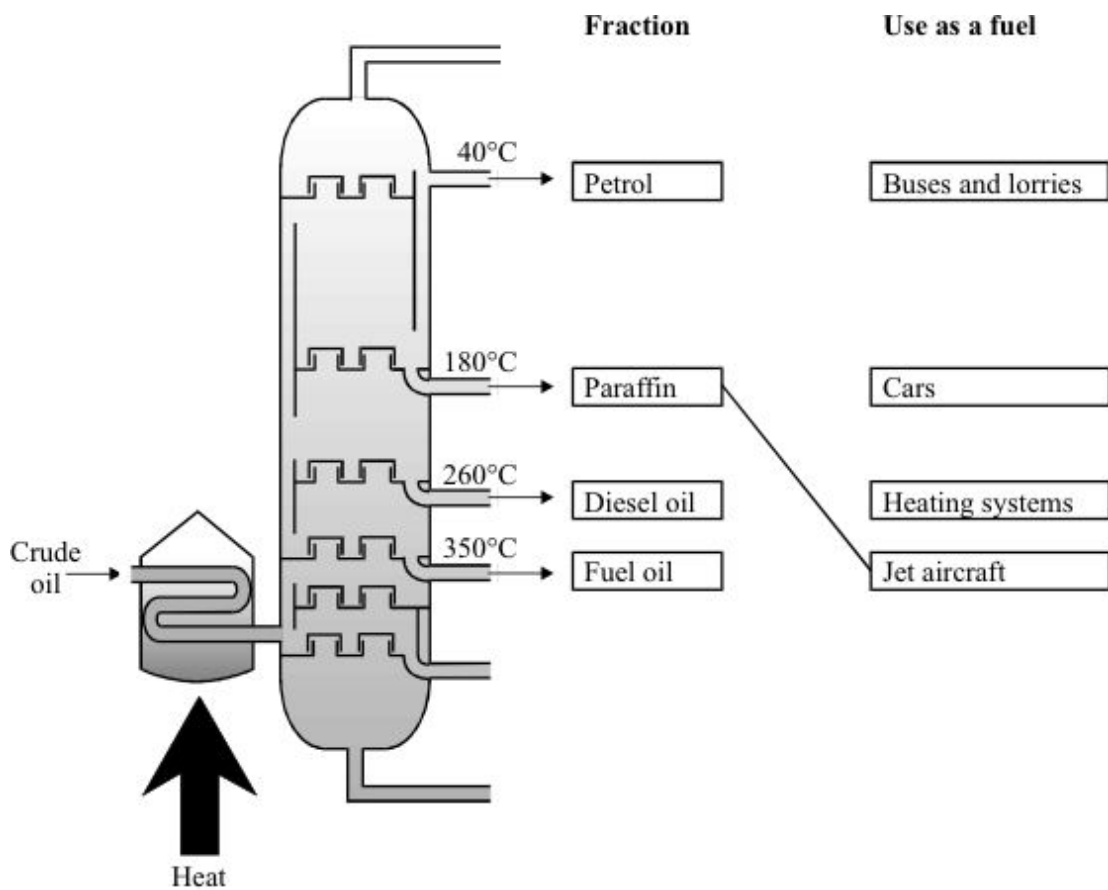
.....

(2)
(Total 8 marks)

13

Fractional distillation is used to separate fractions in the crude oil mixture.

(a) Draw a line to join each fraction to its use as a fuel. One line has been drawn for you.



(2)

(b) (i) Why does petrol separate from the other fractions in the crude oil mixture?

.....

.....

(1)

(c) The hydrocarbon **X** is used to make poly(ethene).

(i) What is the name of **X**?

.....

(1)

(ii) What is the name of the process in which **X** is changed into poly(ethene)?

.....

(1)

(Total 5 marks)

15

The table shows some information about alkanes.

Name	Formula	Relative formula mass	Boiling point in °C
methane	CH ₄	16	-160
ethane	C ₂ H ₆	30	-90
propane		44	-40
butane	C ₄ H ₁₀	58	
pentane	C ₅ H ₁₂	72	36
hexane	C ₆ H ₁₄	86	68

(a) Give the formula of propane.

.....

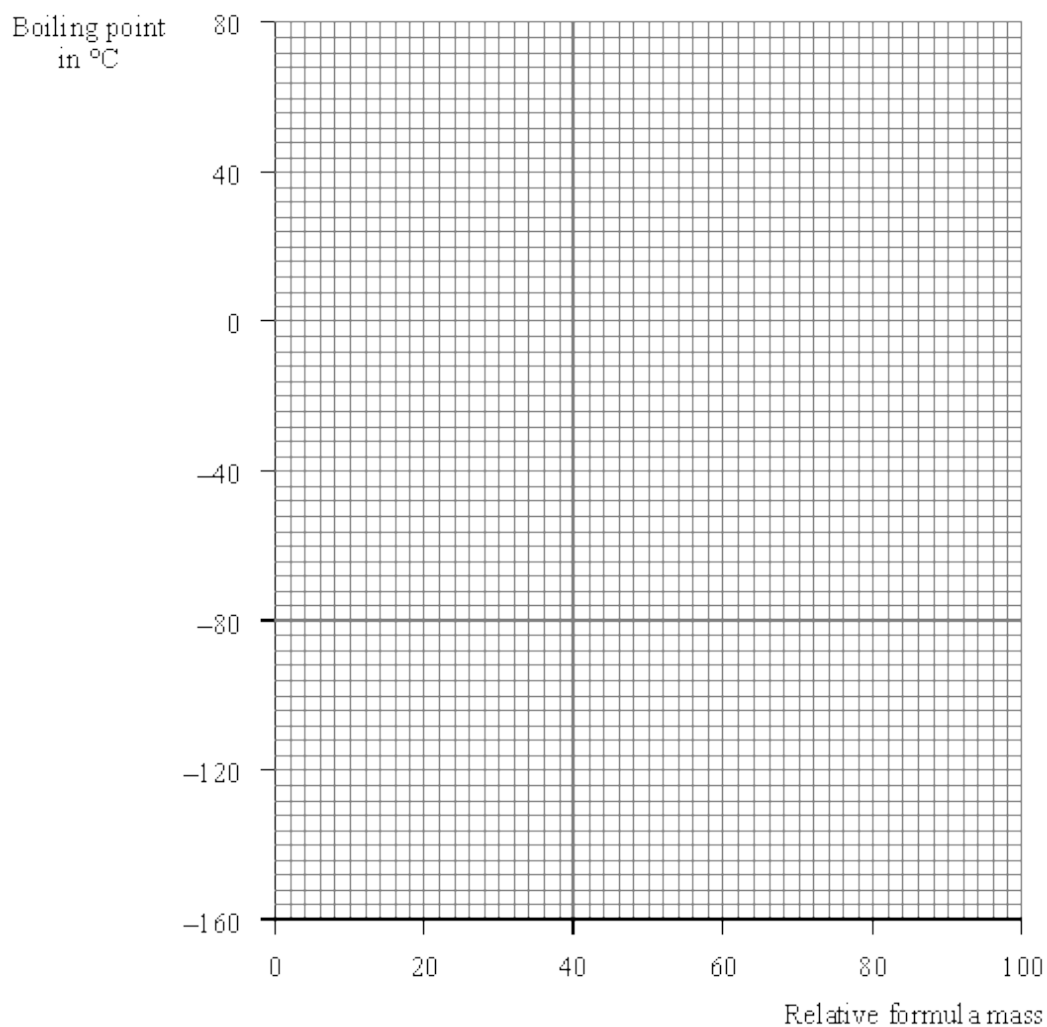
(1)

(b) (i) What happens to the boiling points of the alkanes as the relative formula mass increases?

.....

(1)

(ii) Draw a graph. Plot the points and draw a best fit line.



(3)

(iii) What is the boiling point of butane?

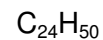
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(1)

(iv) Show clearly on the graph how you found the boiling point of butane.

(1)

(c) Circle which of the following is **not** an alkane.

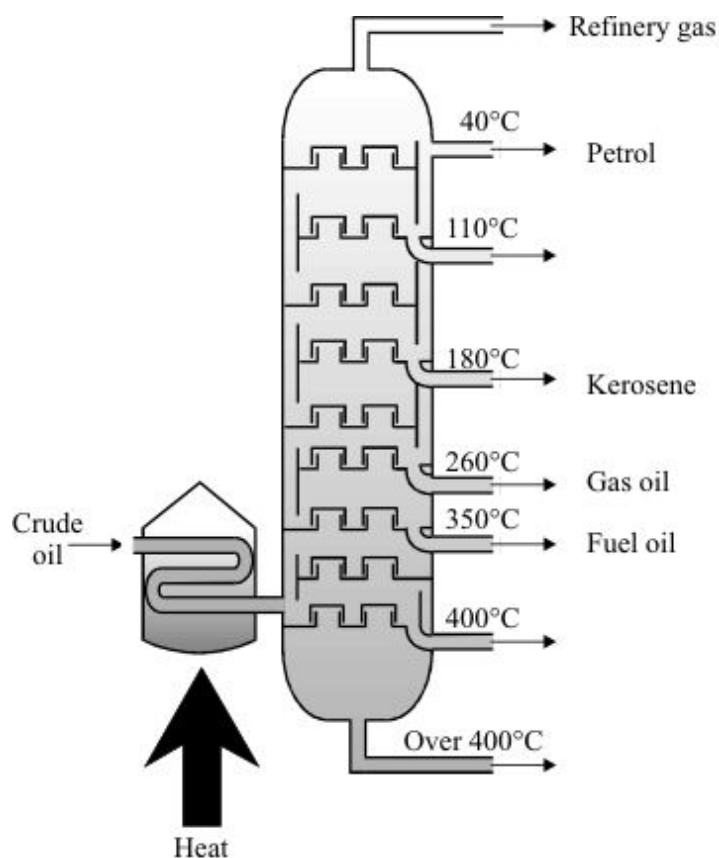


(1)

(Total 8 marks)

16

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)**17**

One reason the oil industry is important is that it uses crude oil to produce many of the plastic materials we use in everyday life.

- (a) The first stage in the formation of a plastic material is called cracking. Butane (C_4H_{10}), a hydrocarbon in crude oil, can be cracked to produce two different hydrocarbons, ethane (C_2H_6) and ethene (C_2H_4)

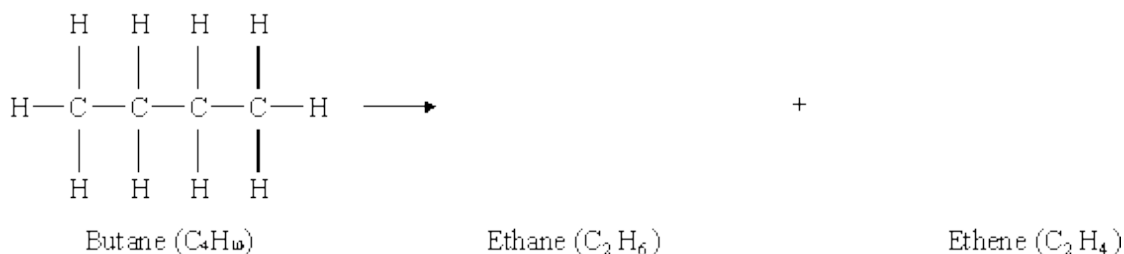
- (i) For cracking to happen what needs to be done to the hydrocarbon?

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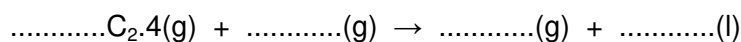
(2)

- (ii) Complete the equation for the cracking of butane using displayed formulae.



(2)

- (iii) Complete the balanced chemical equation for the complete combustion of ethane in oxygen.



(3)

- (b) The second stage is the formation of the plastic material by polymerisation.

Describe how ethene (C_2H_4) forms poly(ethene). You do not need to give the reaction conditions or the names of catalysts.

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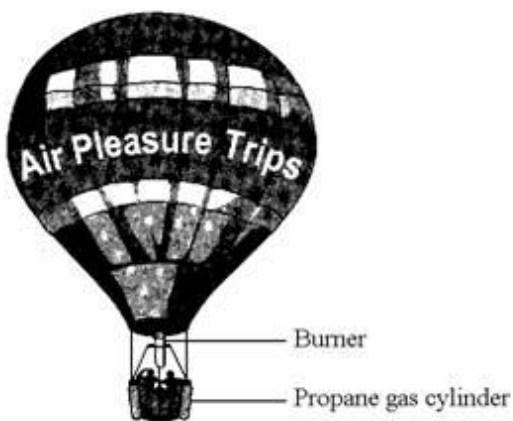
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(3)
(Total 10 marks)

18

Hot air balloons are used mainly for pleasure trips.



- (a) Air is a mixture of gases. Complete the table. (Carbon dioxide has been done for you.)

Gas	Chemical formula	% in air
nitrogen		78
oxygen	O_2	
argon		0.9
carbon dioxide	CO_2	0.03

(3)

(b) The air in the balloon is heated using a propane burner. Propane, C_3H_8 , is a *hydrocarbon* that burns in air forming carbon dioxide, CO_2 , and water, H_2O .

(i) What does *hydrocarbon* mean?

.....
.....

(1)

(ii) Which gas, in the air, reacts with propane when it burns?

.....

(1)

(iii) What type of chemical reaction happens when a hydrocarbon burns?

.....

(1)

(iv) The formation of more carbon dioxide causes global problems. Explain why.

.....
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(2)

(Total 8 marks)

19

This question is about hydrocarbons.

(a) Use **two** of the words in the box to complete the sentence.

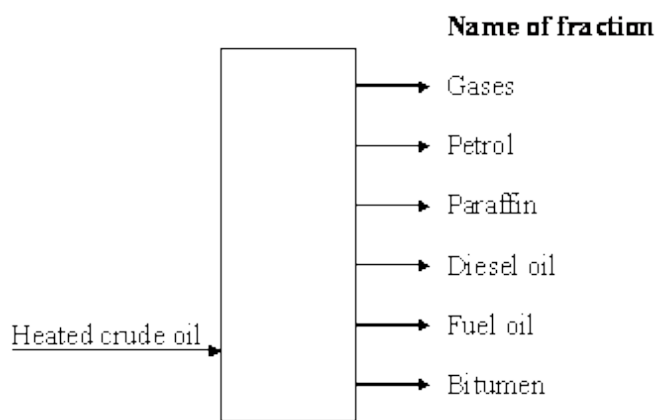
air finite organic renewable sediment water

Crude oil is a mixture of hydrocarbons. It was formed from

..... materials that were trapped in
..... over a very long period of time.

(2)

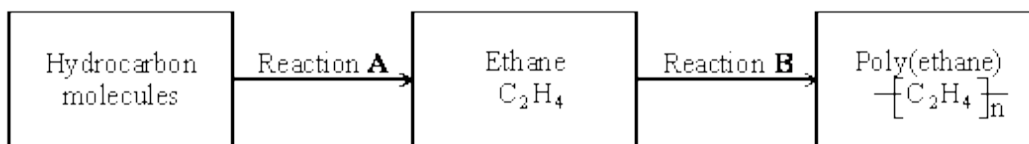
- (b) Petrol is separated from crude oil by fractional distillation.



- (i) Which fraction has the lowest boiling point?

 (1)
- (ii) Which fraction has the highest density?

 (1)
- (c) Some of the fractions containing larger hydrocarbon molecules are used to make plastics, such as poly(ethene).



- (i) What type of chemical change is Reaction **A**?

 (1)

- (ii) Explain what happens in Reaction **B**.

 (2)

(d) Natural gas contains the hydrocarbon called methane. Some water heaters use methane as a fuel. People could die from breathing the fumes produced by heaters that have not been checked and serviced. Explain how these fumes are produced and why they are dangerous.

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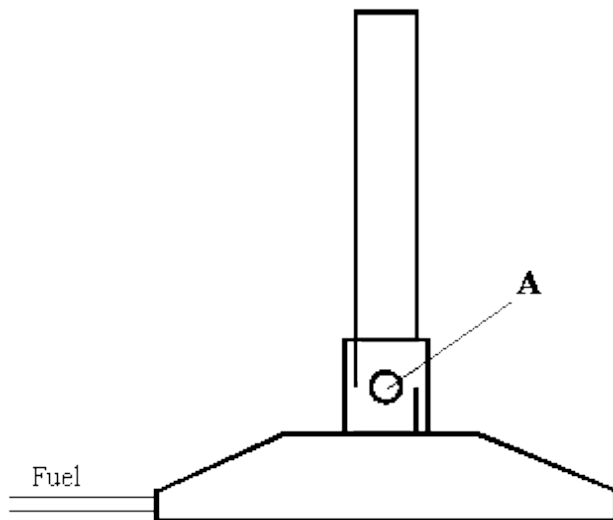
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(3)
(Total 10 marks)

20

The diagram below shows a bunsen burner.



Use words from the list to complete the passage about the Bunsen burner. You may use each word once, more than once or not at all.

- | | |
|-------------------|-------------------|
| air | methane |
| argon | mechanical energy |
| carbon dioxide | nitrogen |
| chemical | physical |
| electrical energy | potential energy |
| heat | oxygen |
| kinetic energy | water vapour |

In the Bunsen burner the fuel is mixed with

which enters through the hole labelled A.

When the fuel burns it reacts with the gas called

and energy is given out as

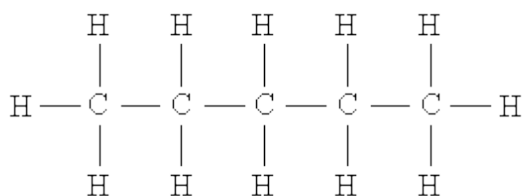
The fuel used in the Bunsen burner contains carbon and hydrogen which are changed during burning into and

Burning is an example of a change because new substances are formed.

(Total 6 marks)

21

Crude oil is a mixture of a large number of compounds most of which are hydrocarbons such as the molecule shown below.



(a) What is a hydrocarbon?

.....

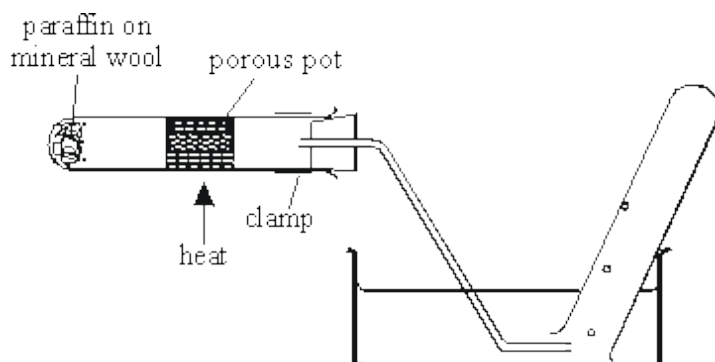
(1)

(b) What is the chemical formula of the molecule shown above?

.....

(1)

- (e) The cracking of large molecules obtained from crude oil is one of the important processes in an oil refinery. Cracking involves the thermal decomposition of large molecules. The diagram below shows an apparatus that can be used to demonstrate cracking in the laboratory. The porous pot acts as a catalyst in the reaction.



- (i) What happens during thermal decomposition?

.....

.....

.....

(2)

- (ii) What effect does the porous pot catalyst have on the reaction?

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.....

(1)

- (iii) Complete the equation below for the cracking of the molecule. $C_{20}H_{42}$.

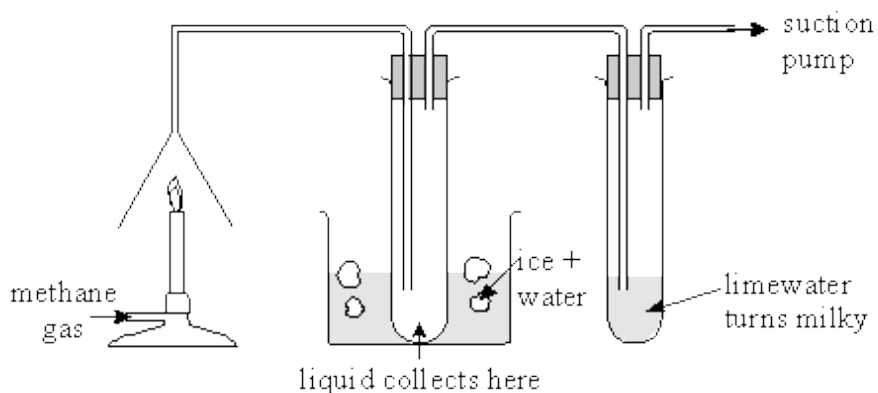


(1)

(Total 6 marks)

22

Methane CH_4 contains the elements carbon and hydrogen only. A student wanted to find out which new substances are produced when methane is burned. The student set up the apparatus shown below.



- (a) Which gas in the air reacts with methane when it burns?

.....

(1)

- (b) Name the liquid collected.

.....

(1)

- (c) Name the gas which turns limewater milky.

.....

(1)

- (d) When methane burns an exothermic reaction takes place. What is meant by an exothermic reaction?

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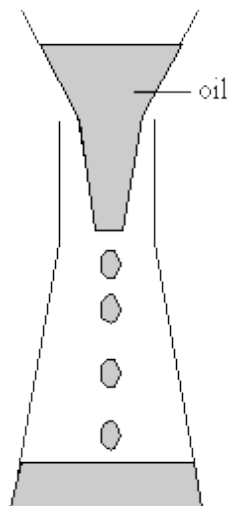
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(2)

(Total 5 marks)

23

A teacher carried out an experiment to study car engine oil. The experiment was carried out in a fume cupboard and the teacher wore plastic gloves. The oil was poured through a funnel. The time taken for all the oil to go through the funnel was measured. The experiment was repeated with the oil at different temperatures.



(a) What **two** safety precautions were taken in the experiment?

1

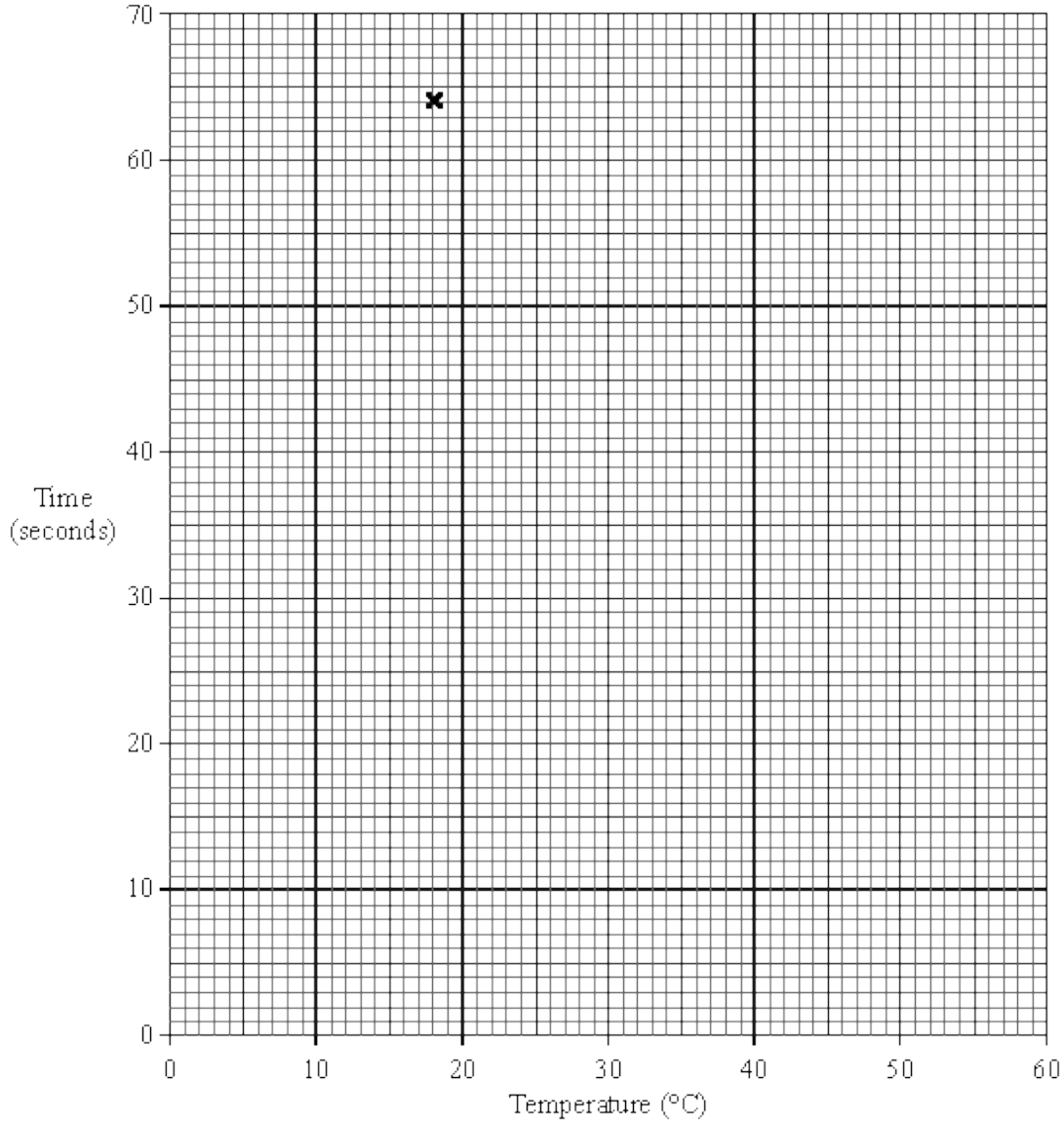
2

(1)

(b) The results of the experiment are shown in the table below.

TEMPERATURE (°C)	TIME (seconds)
18	64
25	43
32	28
42	19
52	15

- (i) Plot the results on the graph paper. One of the results has been plotted for you. Join the points in a smooth curve.



(3)

- (ii) Use your graph to find the time it would take the oil to travel through the funnel at 37 °C.

Time = seconds

(1)

- (iii) How does the time taken for the oil to go through the funnel change when the temperature is increased?

.....
.....

(1)

(c) An engine oil must be viscous enough to stop the metal parts of the engine from rubbing against each other. It must not be too viscous or the parts cannot move freely.

(i) Complete the sentences below.

The more viscous a liquid is, the less easily it

As the liquid gets hotter it gets viscous.

(2)

(ii) Why should the oil in a car engine **not** be allowed to get too hot?

.....
.....
.....

(1)

(Total 9 marks)

24

Crude oil is a mixture of many *saturated hydrocarbons*. They can be separated into *fractions* by the process of fractional distillation.

State what is meant by:

(i) *hydrocarbon*.

.....

(2)

(ii) *saturated*.

.....

(1)

(iii) *fraction*.

.....

(1)

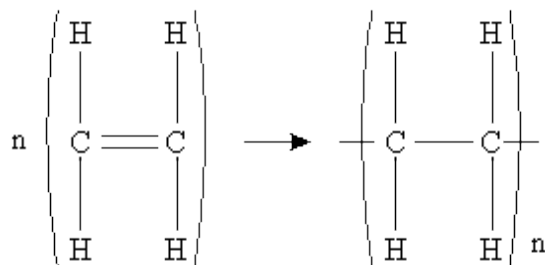
(Total 4 marks)

25

Propane and ethene are both important hydrocarbons.

	propane	ethene
formula	C_3H_8	
structure		$ \begin{array}{c} \text{H} \quad \quad \text{H} \\ \diagdown \quad \diagup \\ \text{C} = \text{C} \\ \diagup \quad \diagdown \\ \text{H} \quad \quad \text{H} \end{array} $

- (a) **Complete the table** by adding the formula of the ethene molecule and the structure of the propane molecule. (2)
- (c) Ethene can be changed into a plastic. The equation shown below represents the reaction in which ethene is polymerised.



- (i) What is the name of the plastic formed in this reaction?

.....

(1)

- (ii) What type of polymerisation reaction is shown in the equation?

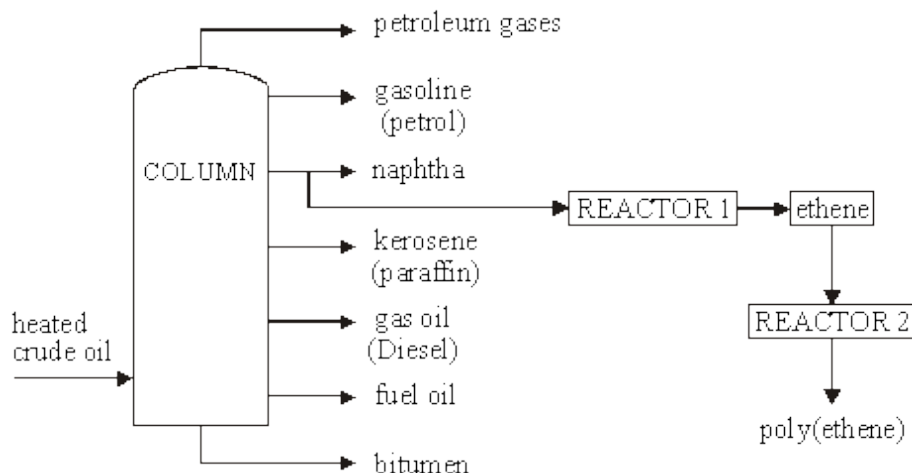
.....

(1)

(Total 4 marks)

28

Crude oil is a mixture of many compounds. The diagram below shows some of the processes that take place in a petrochemical plant.



(a) Name the process which takes place in the COLUMN.

.....

(1)

(b) Name the type of reactions which take place in:

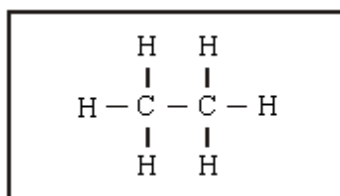
(i) REACTOR 1

(ii) REACTOR 2

(2)

(c) The petroleum gases contain ethane, C_2H_6 and propane, C_3H_8 .

The structure of a molecule of ethane can be represented as:



ethane

Draw the structure of a molecule of propane in the space below.



propane

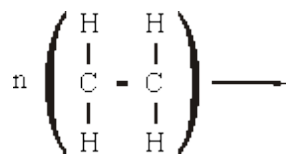
(1)

(d) Ethane and propane are said to be *saturated* hydrocarbons.
What does *saturated* mean when used to describe hydrocarbons?

(1)

- (e) Many molecules of ethene join together to form poly(ethene) in REACTOR 2.

Complete the diagram below to show the formation of poly(ethene).



(2)
(Total 7 marks)

29

- (a) Crude oil is a mixture of many compounds. Most of the compounds consist of molecules made only of carbon and hydrogen. Choose **one** word from the list below to complete the sentence.

carbohydrates carbonates hydrocarbons hydrogencarbonates

Compounds made only of carbon and hydrogen are called

(1)

- (b) The fractions contain molecules with similar numbers of carbon atoms. The main fractions are shown in the table below.

NAME OF FRACTION	NUMBER OF CARBON ATOMS IN MOLECULES
petroleum gases	1 to 4
gasoline	4 to 12
naphtha	7 to 14
kerosene	11 to 15
diesel oil	14 to 19
lubricating oil	18 to 30
residue	more than 30

Naphtha burns more easily than diesel oil.
Explain why.

.....

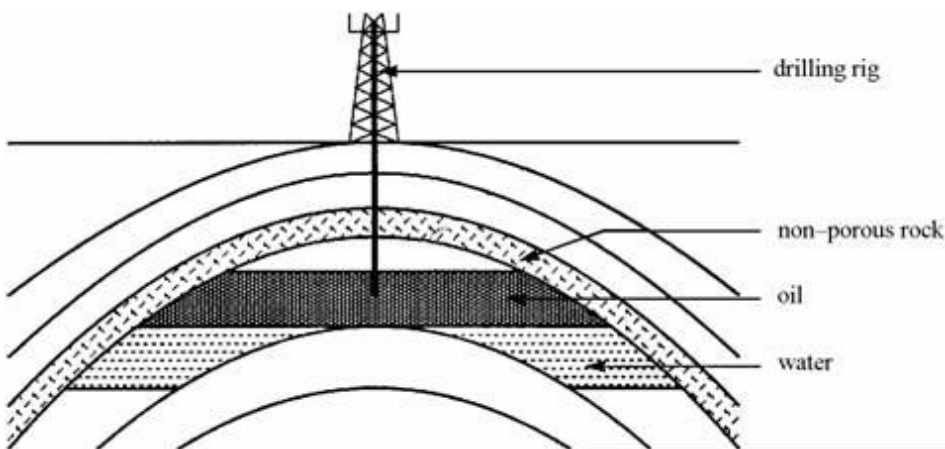
.....

.....

(1)
(Total 2 marks)

30

Crude oil is obtained by drilling into the Earth's crust. The diagram shows a section through the Earth's crust to show how this is done.

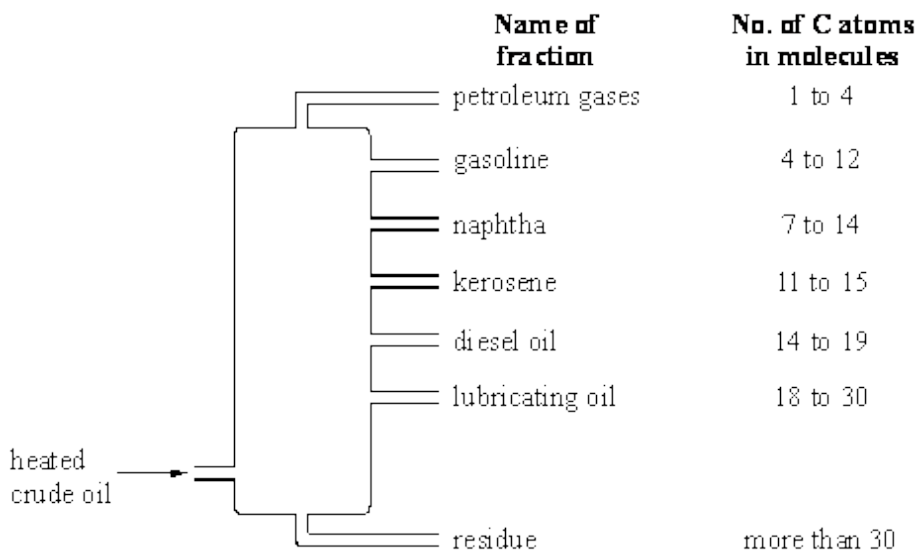


(a) Crude oil contains many hydrocarbons. Which elements do hydrocarbons contain?

.....

(1)

(b) The crude oil is separated by fractional distillation. The diagram shows a column used for this.



(i) Explain, as fully as you can, how fractional distillation works.

.....

.....

.....

.....

.....

(3)

- (ii) Naphtha burns more easily than diesel oil. Explain why.

.....

.....

.....

(1)

- (iii) Naphtha contains a saturated hydrocarbon with the formula $C_{16}H_{34}$.
Draw the structural formula of this compound.

(2)

(Total 7 marks)

31

Crude oil contains many different hydrocarbons.

- (i) Which formula in the list represents a hydrocarbon?
Draw a **ring** around the correct formula.

CO_2 $C_6H_{12}O_6$ C_8H_{18} H_2O

(1)

- (ii) Which word from the list below best describes crude oil?
Draw a **ring** around the correct word.

alloy **compound** **element** **mixture**

(1)

- (iii) Choose, from the list below, words to complete the passage about the separation of the hydrocarbons in crude oil by fractional distillation.

atoms burned condensed evaporated filtered
fractions ions molecules neutralised


During fractional distillation the many hydrocarbons in crude oil are separated into each of which contains with a similar number of carbon

To do this the oil is first and then at a number of different temperatures.

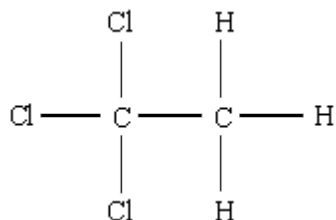
(5)
(Total 7 marks)

32

The label has been taken from a tube of *Humbrol Polystyrene Cement*, a glue used in model making.

HUMBROL	
Polystyrene Cement	
 HARMFUL	<p>Paint product contains 1,1,1 TRICHLOROETHANE</p> <ul style="list-style-type: none"> • Keep container tightly closed. <p>Harmful by inhalation, in contact with skin and if swallowed. Avoid contact with eyes. Keep out of reach of children.</p>
<p>• For use on all polystyrene plastic except expanded or foam. Specially recommended for plastic kits. Thinly coat each surface, press together. To remove cement from fabrics use Humbrol Universal Cleaner.</p>	
HUMBROL LTD., HULL, ENGLAND.	

- (a) The solvent used is 1,1,1-trichloroethane. The structural formula of this molecule is:



- (i) What do the lines between the atoms represent?

.....

(1)

- (ii) State whether 1,1,1-trichloroethane is saturated or unsaturated. Give **one** reason for your answer.

.....

(1)

- (iii) 1,1,1-trichloroethane is being replaced in favour of a 'better' solvent. Use information on the label to help you to suggest why.

.....

(1)

- (b) Polystyrene is a plastic. Plastics are polymers which are made by the process of polymerisation.

- (i) What is meant by polymerisation?

.....

(2)

- (ii) The table gives information about monomers and the polymers made from them. Complete the table.

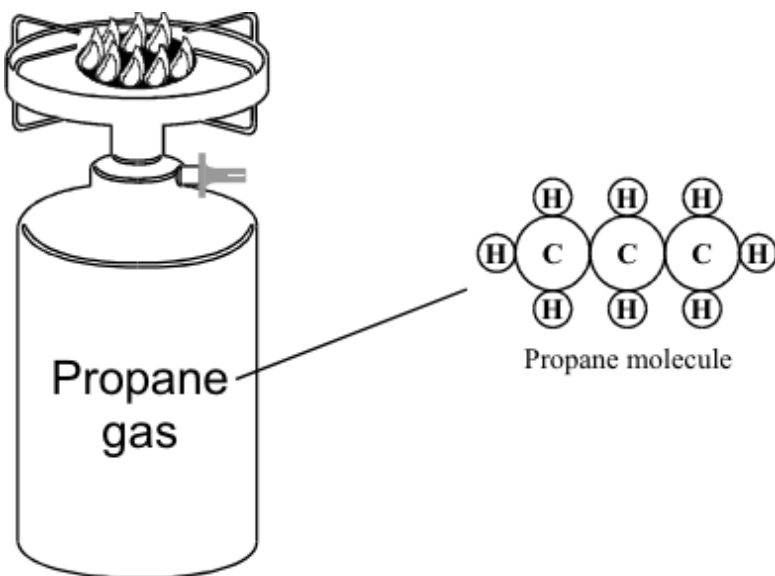
MONOMER		POLYMER	
name	formula	name	formula
ethene	$\begin{array}{c} \text{H} & & \text{H} \\ & \diagdown & / \\ & \text{C} = \text{C} \\ & / & \diagdown \\ \text{H} & & \text{H} \end{array}$		$\left(\begin{array}{cc} \text{H} & \text{H} \\ & \\ -\text{C} & - & \text{C}- \\ & \\ \text{H} & \text{H} \end{array} \right)_n$
styrene		polystyrene	$\left(\begin{array}{cc} \text{H} & \text{H} \\ & \\ -\text{C} & - & \text{C}- \\ & \\ \text{H} & \text{C}_6\text{H}_5 \end{array} \right)_n$
chloroethene	$\begin{array}{c} \text{H} & & \text{H} \\ & \diagdown & / \\ & \text{C} = \text{C} \\ & / & \diagdown \\ \text{H} & & \text{Cl} \end{array}$	poly(chloroethene)	

(3)

(Total 8 marks)

33

Propane has a small, hydrocarbon molecule, so it is used as a fuel.



(a) Complete the sentences by choosing the correct words from the box.

carbohydrate	high	hydrogen
hydroxide	low	volatile

Propane is a hydrocarbon with a boiling point. Propane is a hydrocarbon because it is made of and carbon only.

(2)

(b) Describe, in as much detail as you can, what happens when propane burns.

.....

.....

.....

.....

.....

.....

(3)
(Total 5 marks)

35

Crude oil is separated into fractions by fractional distillation.

The table gives information about some of the fractions.

Fraction	Boiling point range in °C	Number of carbon atoms per molecule
Gas	Below 20	1 – 4
Petrol	20 – 100	5 – 10
Paraffin	100 – 250	11 – 15
Diesel	250 – 350	16 – 20
Lubricant	350 – 500	21 – 35
Bitumen	Above 500	Above 35

- (a) What is the relationship between the boiling point of a fraction and the number of carbon atoms in its molecules?

.....

(1)

- (b) Give **one** further difference, other than boiling point, between diesel and paraffin that also depends on the number of carbon atoms in their molecules.

.....

(1)

- (c) All the fractions contain hydrocarbons.

Name the **two** elements in a hydrocarbon.

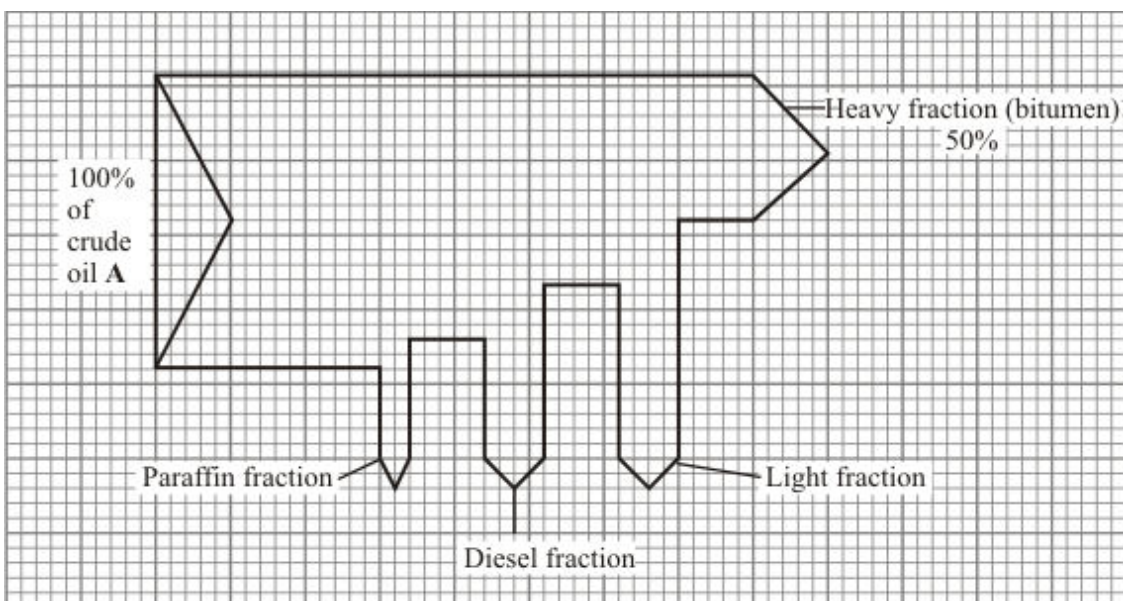
..... and

(1)

(Total 3 marks)

36

The diagrams show the percentages of the four main fractions produced from two samples of crude oil, A and B.



- (a) The light fraction contains hydrocarbons used for the manufacture of useful chemicals such as polymers. Which one of the samples, A or B, would be more useful for the manufacture of polymers? Explain your answer.

.....

.....

.....

.....

.....

.....

(2)

- (b) Heptane (C_7H_{16}), is one of the hydrocarbons used for the manufacture of poly(ethene). The first stage of the process is the production of ethene and another hydrocarbon from heptane.



- (i) In the box, draw the structural formula of the other hydrocarbon produced.

(1)

(ii) Describe how the reaction is carried out.

.....

.....

.....

.....

.....

.....

(2)
(Total 5 marks)

37

(a) Some hydrocarbons are used as fuels in power stations.

The table gives the boiling points of four hydrocarbons.

Hydrocarbon	Boiling point in °C
W	165
X	-160
Y	-40
Z	180

(i) Which of these hydrocarbons are gases at room temperature (20 °C)?

.....

(1)

(ii) Which of these hydrocarbons has the largest molecules?

.....

(1)

(iii) Which of these hydrocarbons ignites most easily?

.....

(1)

- (b) Some hydrocarbons are used to produce polymers.

Which type of hydrocarbons can be converted into polymers?

.....

(1)

(Total 4 marks)

38

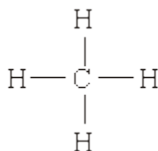
- (a) A piece of lithium is placed on the surface of some water in a beaker.
Hydrogen is given off.
Lithium hydroxide is also formed.

Write a word equation for this reaction.

.....

(2)

- (b) The diagram shows the structure of a molecule of methane.



Write down everything that this diagram tells you about a methane molecule.

To gain full marks in this question you should write your ideas in good English. Put them into a sensible order and use the correct scientific words.

.....

.....

.....

.....

.....

.....

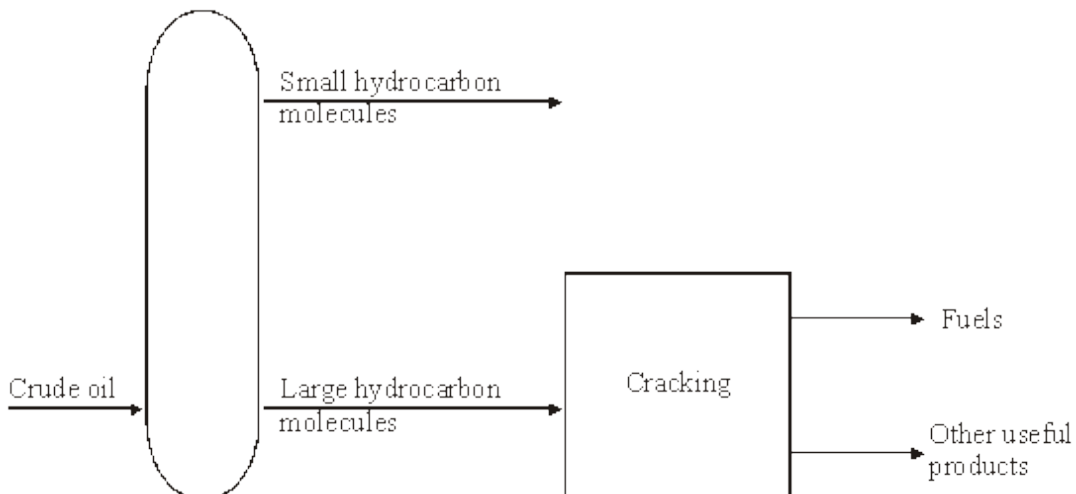
.....

(4)

(Total 6 marks)

39

Crude oil is a mixture of hydrocarbons. These hydrocarbons can be separated and some of them can be used to make other useful products.



(a) Complete the sentence.

Hydrocarbons are made up of atoms and atoms.

(2)

(b) How are the small and large hydrocarbon molecules in crude oil separated?

.....
.....
.....
.....

(2)

(c) The diagram shows that one useful product of cracking is fuels. Name **one** of the other useful products.

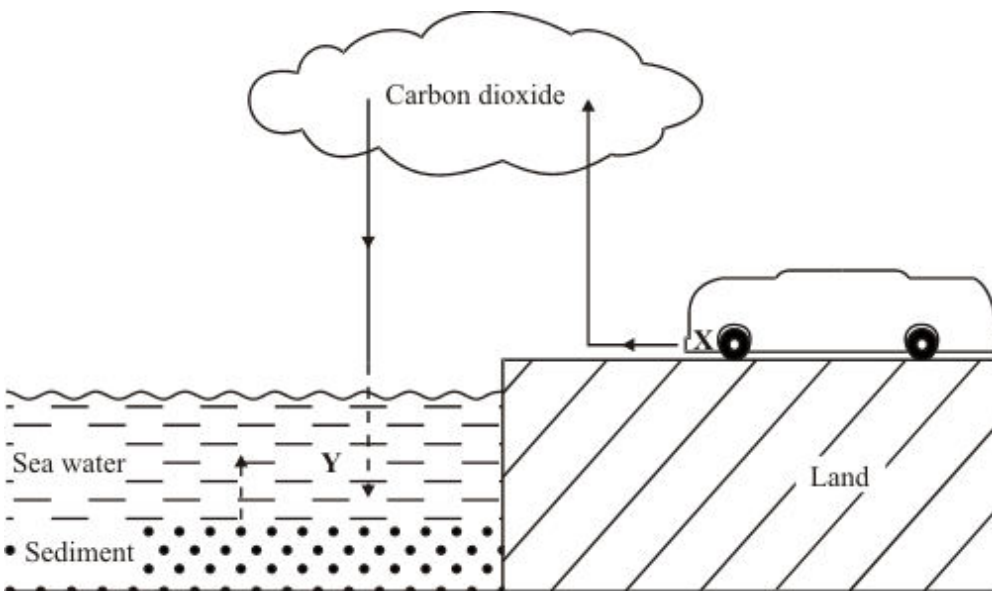
.....

(1)

(Total 5 marks)

40

The amount of carbon dioxide in the atmosphere is increased by reactions that occur in internal combustion engines (X) and is decreased by reactions in sea water (Y).



Describe, in as much detail as you can, the reactions which take place at X and Y.

(a) X

.....

.....

.....

(2)

(b) Y

.....

.....

.....

(3)

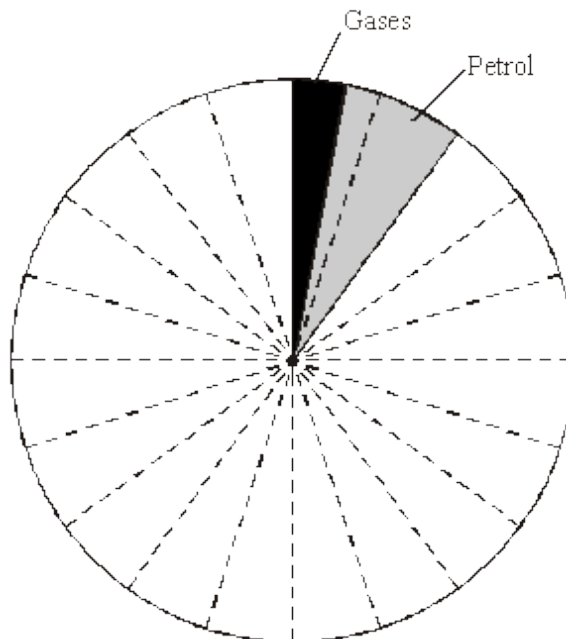
(Total 5 marks)

41

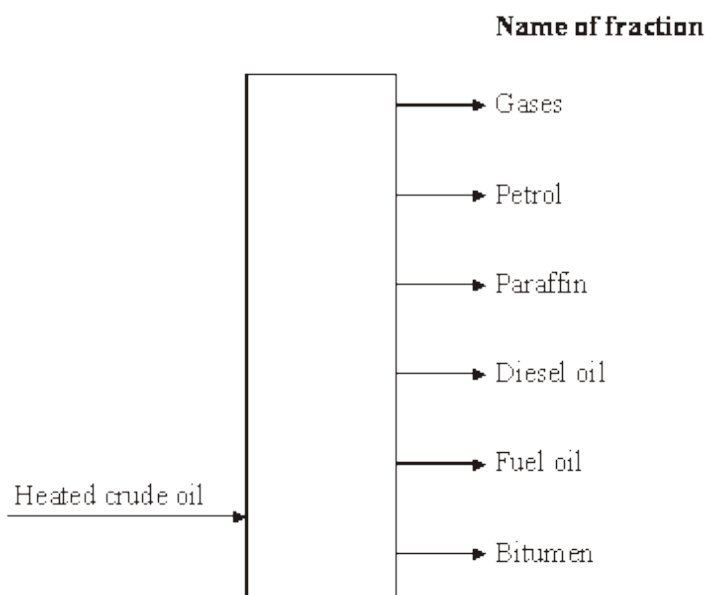
The table shows the composition of some crude oil.

Fraction	Percentage in crude oil
Gases	3
Petrol	7
Naphtha	10
Kerosine	15
Gas oil	20
Fuel oil	45

- (a) Complete the pie chart for the composition of this crude oil. Remember to label the chart.

**(3)**

- (b) The diagram shows the process of separating a different sample of crude oil into fractions.



- (i) What is the name given to this process?

.....

(1)

- (ii) Which fraction has the lowest boiling point?

.....

(1)

- (iii) Which fraction is the least volatile?

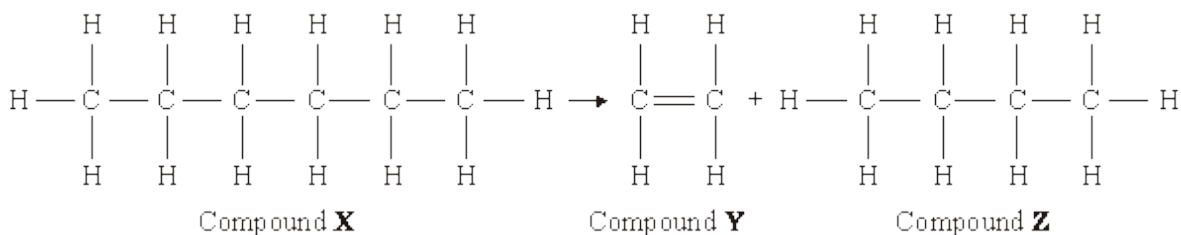
.....

(1)

(Total 6 marks)

42

The diagram shows a reaction which takes place in an oil refinery.



- (a) **X**, **Y** and **Z** are all examples of which type of compound?

.....

(1)

- (b) What type of chemical reaction takes place when compound **X** is converted into compounds **Y** and **Z**?

.....

(1)

- (c) Compounds **Y** and **Z** are both useful substances.

Compound **Y** is unsaturated. Compound **Z** is saturated.

- (i) Suggest **one** use for compound **Y**.

.....

(1)

- (ii) Suggest **one** use for compound **Z**.

.....

(1)

(Total 4 marks)

43

Crude oil and natural gas are mixtures of hydrocarbons. They are obtained from wells drilled into rocks where they are trapped.

- (a) (i) What is the name of the process used to separate the different hydrocarbons in crude oil?

.....

(1)

- (ii) Methane is one of the gases obtained when crude oil is separated.

Give the name of another hydrocarbon gas obtained from this process.

.....

(1)

- (b) A fuel used in gas cookers is natural gas. It is mainly methane, CH_4 .

- (i) Complete the word equation for the complete combustion of methane.

methane + oxygen \rightarrow +

(2)

- (ii) What different gas is produced by the incomplete combustion of methane?

.....

(1)

(Total 5 marks)

44

The table shows some of the products which are obtained from the fractional distillation of crude oil.

Fraction	Nature of products
A	a mixture of gases
B	a mixture of low boiling point liquids
C	a mixture of high boiling point, yellow liquids

- (a) For each of the fractions **A–C** give the name of an organic substance which could be part of the fraction and state a use for it.

A

Use

(2)

B

Use

(2)

C

Use

(2)

- (b) When burned in excess air, all the substances in fractions **A–C** form the same two compounds.

Give the **formulae** of these two compounds.

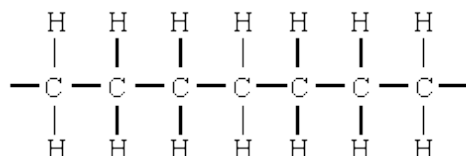
..... and

(1)

(Total 7 marks)

45

Poly(ethene) is a long-chain saturated hydrocarbon. The formula for part of the polymer chain is:



(a) Write the structural formula of the small molecule from which poly(ethene) is made.

(2)

(b) Saturated hydrocarbons, such as propane, are fuels.

Write a balanced equation for the complete combustion of propane, C_3H_8 .

..... + \rightarrow +

(3)

(Total 5 marks)

46

Wax is a fuel.

A young child watched a candle burning and wondered where the wax had gone.



(a) Complete the sentence below.

When wax burns, energy is released as

(1)

(b) Why does the wax disappear as it burns?

.....

(1)

(Total 2 marks)

47 Petrol burns in oxygen from the air in a car engine.

Two of the gases in the exhaust fumes are carbon dioxide and water vapour.

This indicates that petrol contains the elements and

.....

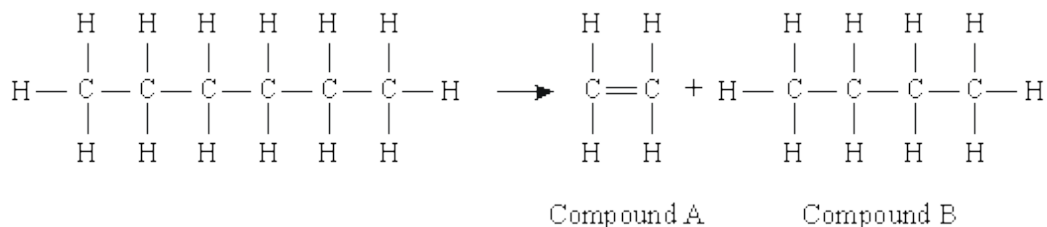
(Total 2 marks)

48 In a car engine petrol burns in oxygen from the air. Two of the gases in the exhaust fumes are carbon dioxide and water vapour.

This indicates that petrol contains the elements and

(Total 2 marks)

49 The equation below shows the cracking of a hydrocarbon compound into two different compounds, A and B.



(a) State **two** differences between the structures of compounds A and B.

.....

(2)

(b) Why is compound A useful in industry?

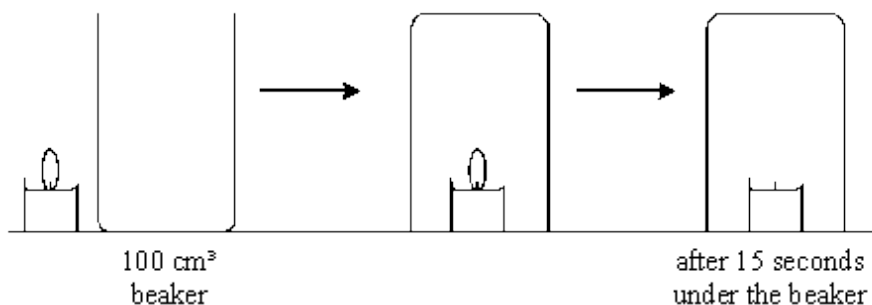
.....

(1)

(Total 3 marks)

50

This experiment shows a candle burning then going out.



(a) Choose words from this list to complete the sentences in parts (i) and (ii) below.

air carbon dioxide hydrogen nitrogen oxygen

(i) When the candle wax is burning it is reacting with from the

(2)

(ii) One product of the reaction is

(1)

(b) Complete the following sentence.

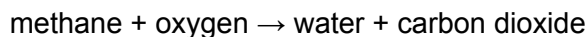
In another experiment a 200 cm³ beaker is used. The candle will then burn for about seconds.

(1)

(Total 4 marks)

51

Here is the word equation for a chemical reaction.



Write down everything that the word equation tells you about the reaction.

.....

.....

.....

.....

.....

.....

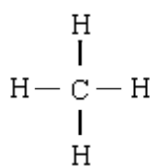
.....

(Total 4 marks)

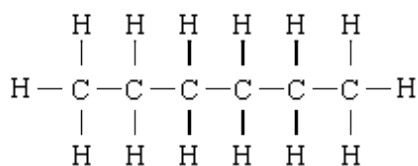
52

The structural formulae of two saturated hydrocarbons are shown below.

compound A



compound B



Describe **two** ways in which they will differ in their physical properties.

1

.....

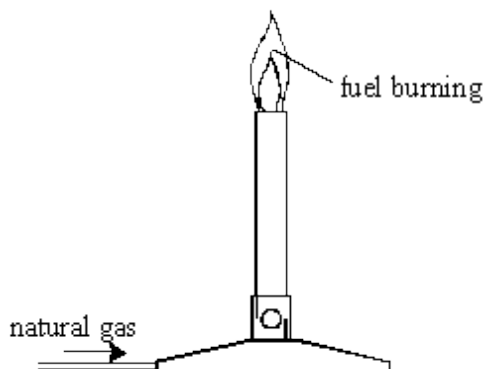
2

.....

(Total 2 marks)

53

Natural gas is a fuel.



(a) Complete these sentences.

When the fuel burns completely, we cannot see the new substances produced because they are mainly colourless

The energy of the fuel is released as

(3)

(b) Choose words from this list to complete the sentence below.

- carbon carbon dioxide hydrogen nitrogen
 oxygen sulphur dioxide water vapour

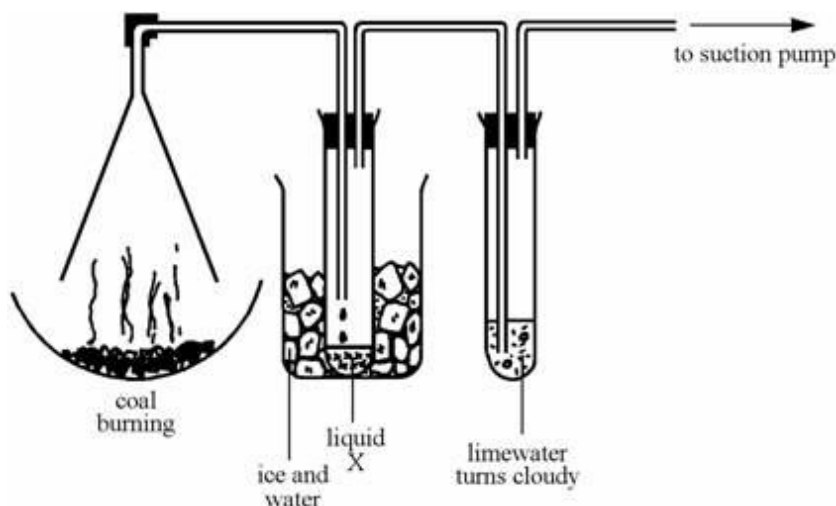
Three gases which can be produced when fuels burn are:

1.
2.
3.

(3)
(Total 6 marks)

54

The gases produced when coal burns are cooled by ice and then bubbled through limewater.



(a) Complete these sentences.

- (i) The coal is reacting with when it burns.
- (ii) During burning, elements in the coal are converted to compounds called

(2)

(b) Choose words from this list to complete the sentences.

- carbon carbon dioxide sulphur sulphur dioxide**
sodium water

- (i) Liquid X is a compound made from hydrogen and oxygen.
 It is called

(ii) Sulphur dioxide is an acidic gas. It is given off when coal burns, because coal contains the element

(iii) Most fuels are compounds of hydrogen and

(3)

(c) Burning coal is an exothermic reaction.

Explain what "exothermic" means.

.....

(1)

(d) (i) Which gas turns limewater cloudy?

.....

(ii) Which element in the coal is oxidised to form this gas?

.....

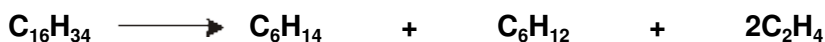
(2)

(Total 8 marks)

55

(a) The hydrocarbon $C_{16}H_{34}$ was heated strongly in the absence of air.

This is one of the reactions which took place:



This type of reaction is carried out because there is a greater demand for the products than for the original hydrocarbon.

Suggest **two** reasons for this.

1

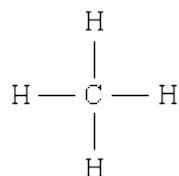
.....

2

.....

(2)

(b) A molecule of the compound methane, CH_4 , can be shown like this:

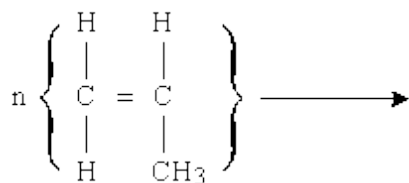


Draw a molecule of the compound ethene, C₂H₄.

(2)

(c) Small molecules of substances called monomers can be joined together in polymerisation, eg. ethene poly \longrightarrow (ethene).

(i) Complete the equation below to show formation of the polymer from the monomer propene.



(1)

(ii) Suggest the name of the polymer formed.

.....

(1)

(Total 6 marks)

56

Choose words from this list to complete the sentences,

ammonia**carbon dioxide****hydrogen****nitrogen****electrical****heat****solar****sound**

(a) In air, the two most common gases are oxygen and

(b) When natural gas burns, energy is released mainly as

(c) When natural gas burns, a gas is produced which turns limewater milky.

The gas is

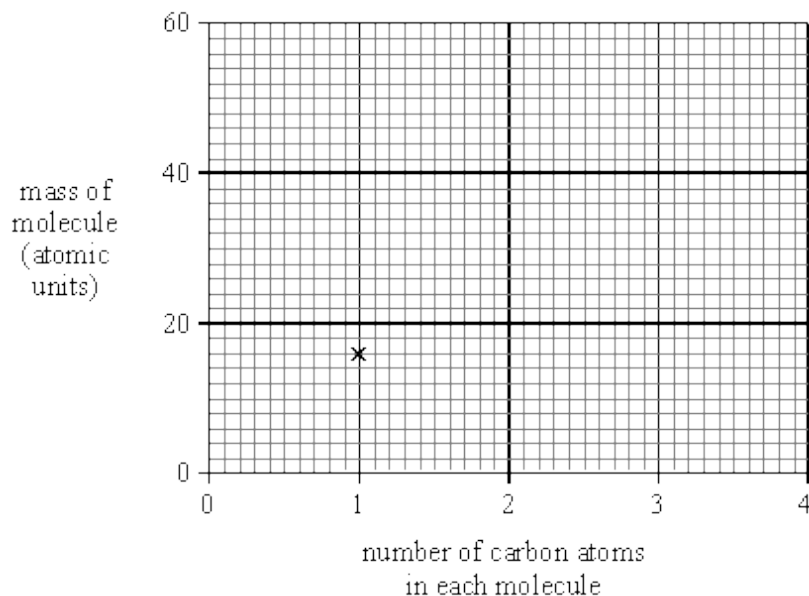
(Total 3 marks)

57

The table gives some information about a family of molecules in crude oil.

NUMBER OF CARBON ATOMS IN MOLECULE	MASS OF MOLECULE (atomic units)
1	16
2	30
4	58

(a) Show information from the table in the most appropriate way on the grid.



(3)

(b) What is the mass of a molecule with three carbon atoms?

.....

(1)

(c) The other atoms in each molecule are all hydrogen atoms.
What family of substances do all the molecules belong to?

.....

(1)

- (d) The mass of a carbon atom is 12 atomic units.
The mass of a hydrogen atom is 1 atomic unit.

So the molecule with one carbon atom has four hydrogen atoms.
Its formula is CH_4 .

Write down the formula:

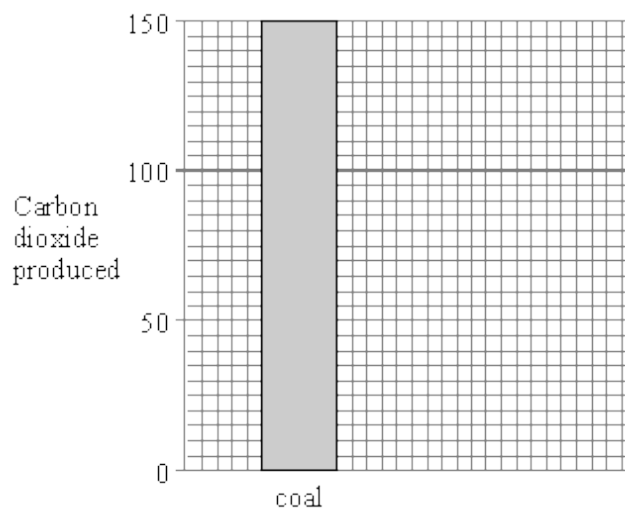
- (i) of the molecule with two carbon atoms
- (ii) of a molecule from the same family with five carbon atoms

(2)
(Total 7 marks)

58

The table shows how much carbon dioxide is produced when you transfer the same amount of energy by burning coal, gas and oil.

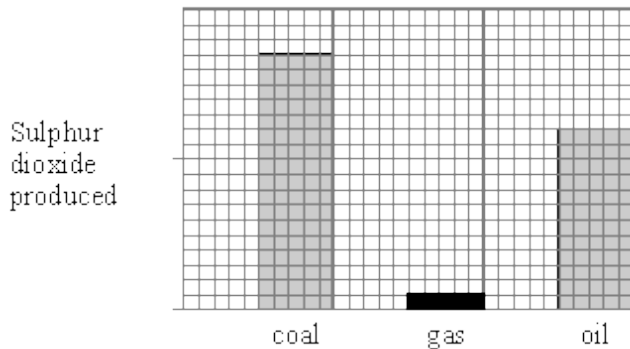
	Carbon dioxide (based on oil = 100)
coal	150
gas	75
oil	100



- (a) Use the information from the table to complete the bar-chart.

(3)

- (b) The second bar-chart shows how much sulphur dioxide is produced by burning the same three fuels.



Compare the amount of sulphur produced by burning gas with the amount produced by burning coal.

.....
.....

(2)

- (c) (i) Coal and oil produce carbon dioxide and sulphur dioxide when they burn. What elements must they contain?

.....
.....

(2)

- (ii) Burning fuels also produce nitrogen oxides, even though the fuels contain no nitrogen. Explain why this happens.

.....
.....

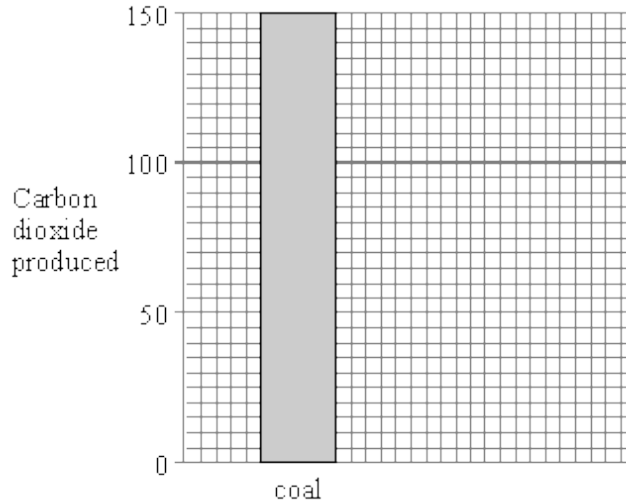
(2)

(Total 9 marks)

59

The table shows how much carbon dioxide is produced when you transfer the same amount of energy by burning coal, gas and oil.

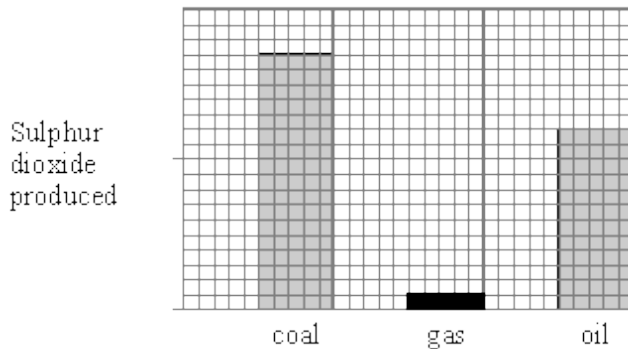
	Carbon dioxide (based on oil = 100)
coal	150
gas	75
oil	100



(a) Use the information from the table to complete the bar-chart.

(2)

(b) The second bar-chart shows how much sulphur dioxide is produced by burning the same three fuels.



Compare the amount of sulphur produced by burning gas with the amount produced by burning coal.

.....

(1)

(c) Burning fuels also produces nitrogen oxides, even though the fuels contain no nitrogen. Explain why this happens.

.....

(2)

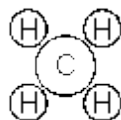
- (d) When you release the same amount of energy from coal, gas and oil, different amounts of carbon dioxide are produced.

Use the information below to explain why.

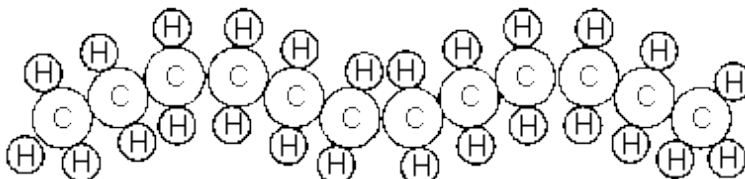
Coal is mainly carbon



North Sea gas is mainly methane



Oil is made from molecules similar to the one shown



(3)

- (e) What other element do coal and oil usually contain?

.....

(1)

(Total 9 marks)