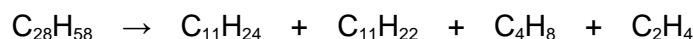


Organic Chemistry Part 2

Q1.

Ethene is used as a starting material for the production of many other substances, including ethanol.

- (a) Ethene is produced when hydrocarbons are cracked. To do this hydrocarbons are heated to vaporise them. The vapours are then passed over a hot catalyst. The symbol equation shows the reaction for one hydrocarbon.



- (i) One of the products is a different type of hydrocarbon to the other products.

Complete the sentences.

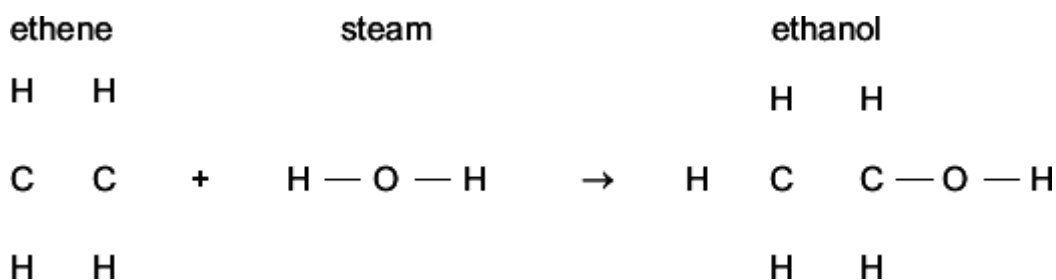
The formula of the product that is a different type of hydrocarbon is

The chemical structure of this product is different to the other products because

(2)

- (ii) Ethanol is produced when ethene reacts with steam in the presence of a hot catalyst.

Draw the missing bonds to complete the displayed structures in the equation.



(2)

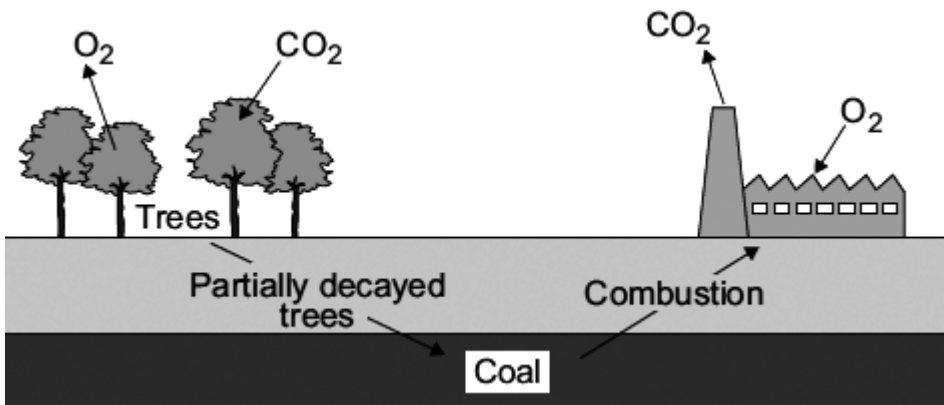
- (b) *In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.*

In 1970, the Brazilian Government had stated that all petrol must contain more than 25% ethanol. The reasons for this statement in 1970 were:

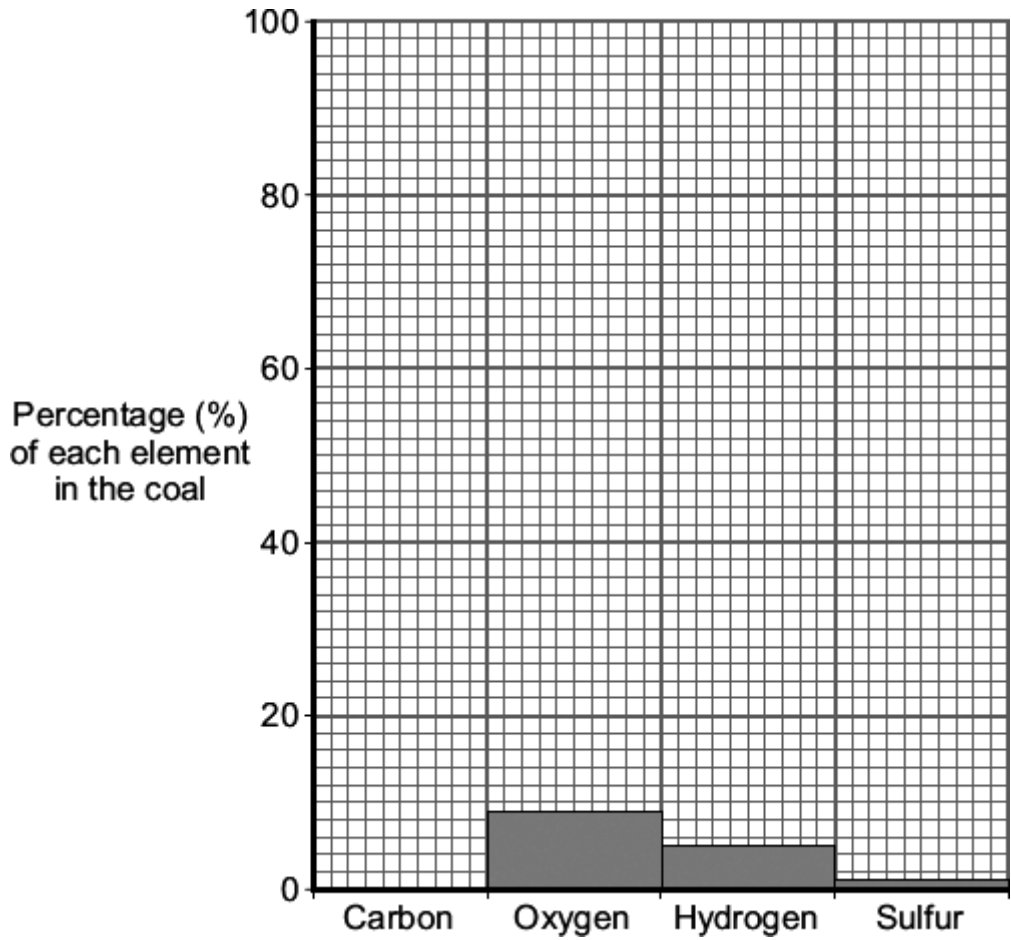
- the oilfields in Brazil at that time only supplied 20% of the crude oil needed to make petrol
- Brazil has a climate suitable for growing sugar cane.

To produce ethanol the sugar cane plants are crushed and soaked in water for one

and trees died they were covered by sand and slowly decayed to form coal.



(a) The bar chart shows the percentage of some of the elements in this coal.



(i) This coal contains 85 % carbon. Draw the bar for carbon on the chart.

(1)

(ii) Coal is burned in the atmosphere to release energy. Two of the products of burning coal are shown.

Draw **one** line from each product to its environmental impact.

Product

Environmental impact

Sulfur dioxide

Acid rain

Global dimming

Carbon particles

Global warming

(2)

(b) Use the information above and your knowledge and understanding to answer these questions.

(i) How did the formation of coal decrease the amount of carbon dioxide in the Earth's early atmosphere?

(1)

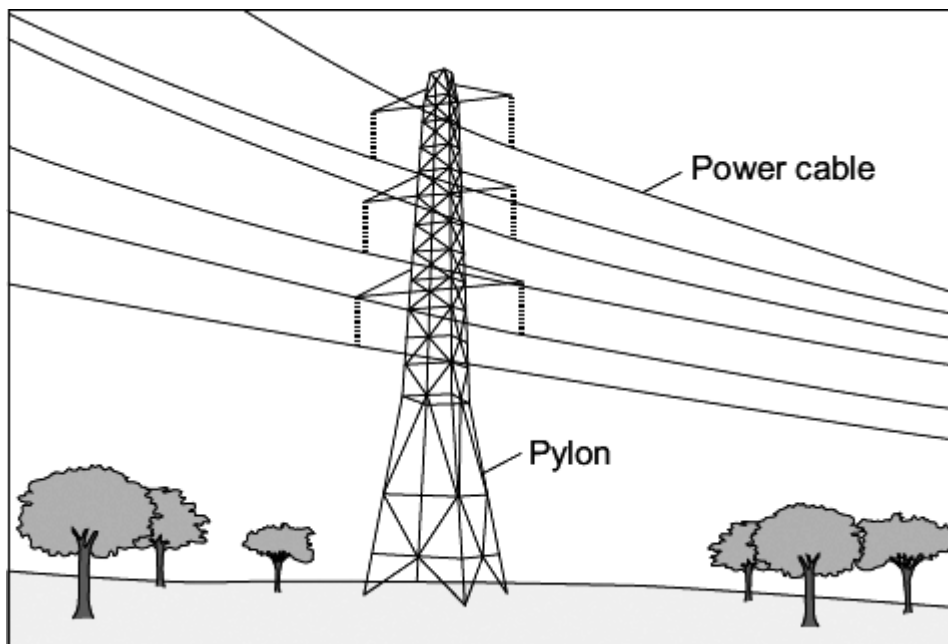
(ii) How does burning coal affect the amount of carbon dioxide in the Earth's atmosphere?
Explain your answer.

(2)

(Total 6 marks)

Q3.

Metals are used in the manufacture of pylons and overhead power cables.



(a) Suggest **one** reason why iron (steel) is used to make pylons.

(1)

(b) The table shows some of the properties of two metals.

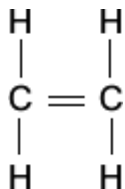
Metal	Density in g per cm ³	Melting point in °C	Percentage(%) relative electrical conductivity	Percentage(%) abundance in Earth's crust
copper	8.92	1083	100	0.007
aluminium	2.70	660	60	8.1

Use the information in the table to suggest why aluminium and **not** copper is used to conduct electricity in overhead power cables.

(2)

(c) A polymer can be used to cover and insulate power cables.

The polymer is made from the alkene:



Draw a ring around the correct answer to complete each of the sentences.

(i) The chemical formula of this alkene is

CH
CH ₄
C ₂ H ₄

(1)

(ii) The two lines between the carbon atoms are called a

double bond.
nucleus.
single bond.

(1)

(iii) The name of the polymer formed when many of these alkene molecules join

together is

poly(ethene).
poly(ethenol).
poly(propene).

(1)

(Total 6 marks)

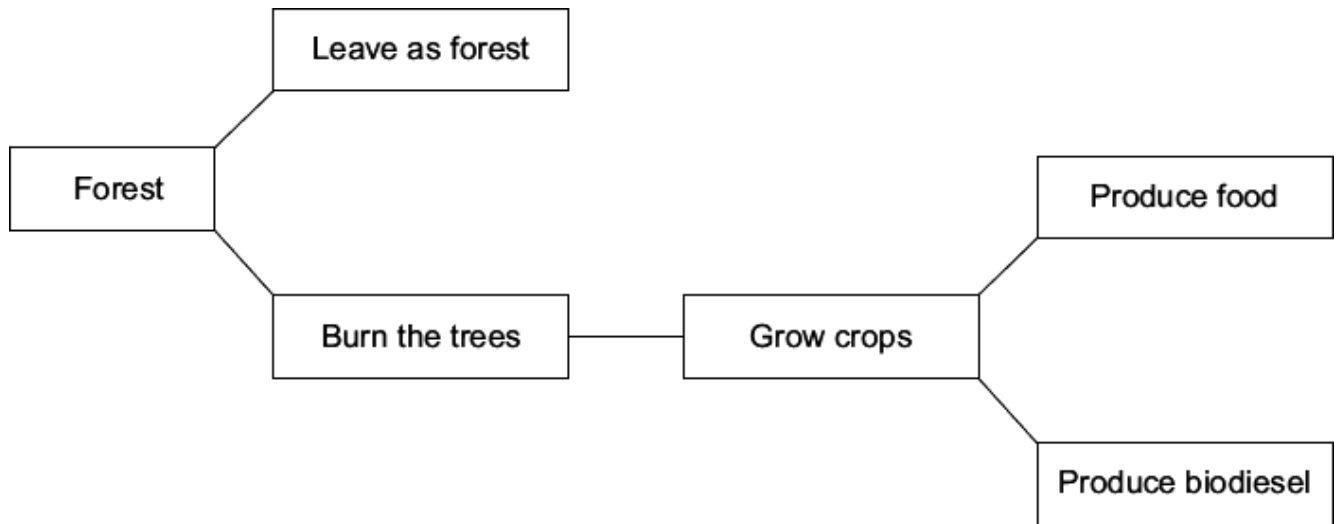
Q4.

Petroleum diesel is a fuel made from crude oil.

Biodiesel is a fuel made from vegetable oils.

To make biodiesel, large areas of land are needed to grow crops from which the vegetable oils are extracted.

Large areas of forest are cleared by burning the trees to provide more land for growing these crops.



(a) Use this information and your knowledge and understanding to answer these questions.

(i) Carbon neutral means that there is no increase in the amount of carbon dioxide in the atmosphere.

Suggest why adverts claim that using biodiesel is carbon neutral.

(2)

(ii) Explain why clearing large areas of forest has an environmental impact on the atmosphere.

(2)

(b) Why is there an increasing demand for biodiesel?

(1)

(c) Suggest why producing biodiesel from crops:

(i) causes ethical concerns

(1)

(ii) causes economic concerns.

(1)

(Total 7 marks)

Q5.

About 3000 million years ago, carbon dioxide was one of the main gases in the Earth's atmosphere.

About 400 million years ago, plants and trees grew on most of the land. When the plants and trees died they were covered by sand and slowly decayed to form coal.

(a) Describe and explain how the composition of the Earth's atmosphere was changed by the formation of coal.

(3)

(b) Today, coal is burned in power stations to release the energy needed by industry. Carbon dioxide, water and sulfur dioxide are produced when this coal is burned.

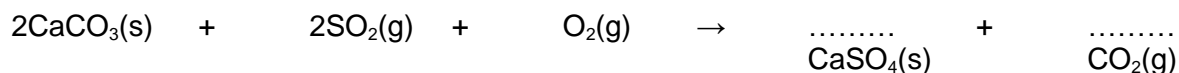
Name **three** elements that are in this coal.

(2)

(c) In some power stations coal is mixed with calcium carbonate (limestone). The mixture is crushed before it is burned.

- (i) Many chemical reactions happen when this mixture is burned. The chemical equation represents one of these reactions.

Balance the chemical equation.



(1)

- (ii) Explain how the use of calcium carbonate in the mixture:

increases atmospheric pollution

decreases atmospheric pollution.

(4)

(Total 10 marks)

Q6.

Ethanol (C₂H₅OH) can be made from ethene or from sugar.

- (a) Complete the table which shows the number of atoms of each element in the formula of ethanol.

Use the Chemistry Data Sheet to help you to complete the table.

Element	Symbol	Number of atoms in the formula C ₂ H ₅ OH
Carbon	C	2
Hydrogen	H	_____
_____	O	1

(2)

- (b) Ethene (C₂H₄) is produced when hydrocarbons are cracked.

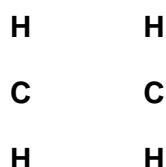
- (i) Tick (✓) **two** conditions needed to crack a hydrocarbon.

Condition	Tick (✓)

The presence of an emulsifier.	
Heating the hydrocarbon to a high temperature.	
Adding oxygen to the hydrocarbon.	
The presence of a catalyst.	

(2)

(ii) Draw the missing bonds to complete the displayed structure of ethene.



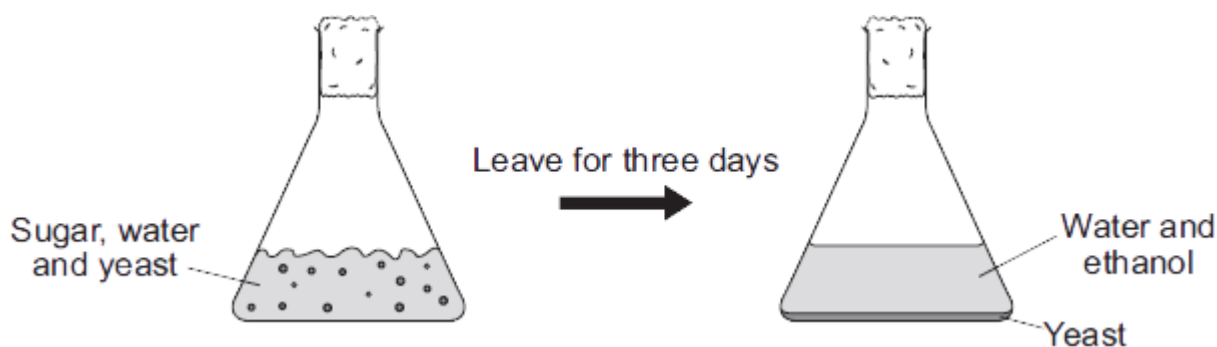
(1)

(iii) Name the substance added to ethene (C_2H_4) to produce ethanol ($\text{C}_2\text{H}_5\text{OH}$).

(1)

(c) The diagram shows how a solution of ethanol is made from sugar dissolved in water.

The boiling point of ethanol is 78°C and the boiling point of water is 100°C .



(i) Name the gas produced during this reaction.

(1)

(ii) What are the main steps needed to obtain pure ethanol from the mixture produced after three days?

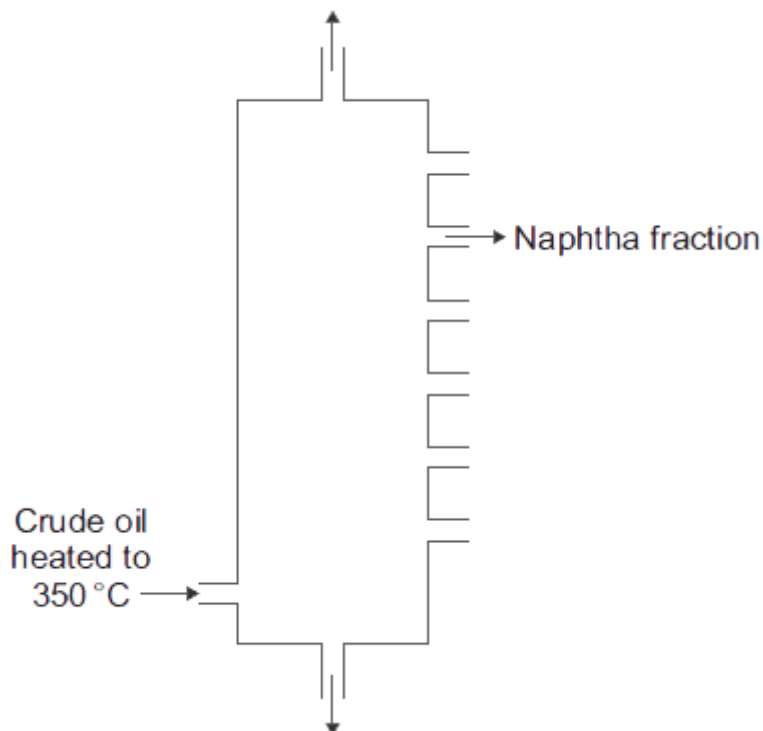
(2)

(Total 9 marks)

Q7.

Crude oil is used to produce poly(ethene).

- (a) Fractional distillation is used to separate crude oil into fractions.



- (i) Write a number, **2**, **3**, **4** or **5**, next to each stage so that the description of fractional distillation is in the correct order. Numbers **1** and **6** have been done for you.

Number	Stage
1	The crude oil is heated to 350 °C.
	When a fraction in the vapours cools to its boiling point, the fraction condenses.
	Any liquids flow down to the bottom of the column and the hot vapours rise up the column.
6	The condensed fraction is separated and flows out through a pipe.
	When the hot vapours rise up the column, the vapours cool.
	Most of the compounds in the crude oil evaporate.

(2)

- (ii) The naphtha fraction is cracked to produce ethene (C_2H_4). Ethene is used to make the polymer called poly(ethene).

Name **two** substances produced when poly(ethene) burns in air.

1. _____
2. _____

(b) *In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.*

Each year in the UK, billions of plastic bags are given free to shoppers. These bags are made from poly(ethene) and are often used only once. After being used many of these plastic bags are either thrown away as litter or buried in landfill sites.

In 2006 over 10 billion of these plastic bags were given free to shoppers. In 2009 the number of plastic bags given to shoppers had decreased to 6.1 billion. One reason for the decrease was because some supermarkets made people pay for their plastic bags.

From 2011 a new type of plastic shopping bag made mainly from poly(ethene) had a use-by date of only one year printed on the bag.

Use the information above and your knowledge and understanding to describe advantages and disadvantages of using plastic shopping bags made from poly(ethene).

(6)
(Total 10 marks)

Q8.

Ethanol (C₂H₅OH) is produced from ethene or from sugar cane.

The two different methods to produce ethanol are summarised in the table.

Ethanol from sugar cane is a batch	Ethanol from crude oil is a
------------------------------------	-----------------------------

(5)
(Total 8 marks)

Q9.

The plastic used for shopping bags is made from crude oil.



(a) Complete each sentence.

(i) The compounds of hydrogen and carbon
in crude oil are called _____

(1)

(ii) Crude oil is separated into fractions, such as naphtha, using
fractional _____

(1)

(b) Plastics are made from alkenes.
The alkenes are made from naphtha.

Draw a ring around the correct answer to complete each sentence.

(i) First the liquid naphtha is made into a gas. This process is
called

distilling.
filtering.
vaporising.

(1)

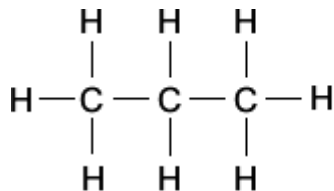
(ii) The naphtha gas is then passed over a hot catalyst.

This process is called

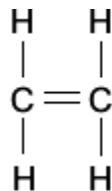
boiling.
bonding.
cracking.

(1)

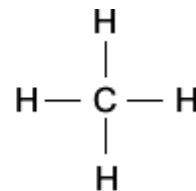
(c) The displayed formulas of three molecules are:



Molecule A



Molecule B



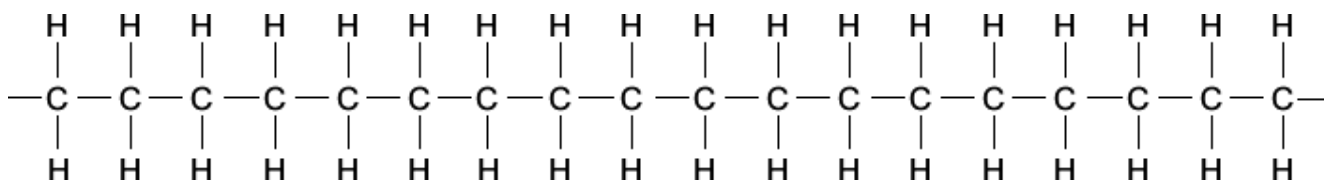
Molecule C

Which molecule, **A**, **B** or **C**, is an alkene?

(1)

- (d) The plastic for the bag is made when many alkene molecules are joined together to make the polymer called poly(ethene).

Part of a very large poly(ethene) molecule is shown below.



After plastic bags have been used for shopping, the bags can be reused, recycled, buried in landfill sites or burned.

- (i) Reusing and recycling used plastic bags is good for the environment because this conserves crude oil.

Tick (✓) another reason why recycling used plastic bags is good for the environment.

Reason	Tick (✓)
energy is used to transport and melt the used plastic bags	
new plastic products are made from the used plastic bags	
new plastic bags made from crude oil are cheap to produce	

(1)

- (ii) Complete the sentence.

One reason why burying used plastic bags in landfill sites is not good for the environment is that poly(ethene) _____

(1)

- (iii) Some statements about burning used plastic bags are given below.

Tick (✓) **one** advantage and tick (✓) **one** disadvantage of burning used

plastic bags.

	Advantage Tick (✓)	Disadvantage Tick (✓)
new plastic bags can be produced		
carbon dioxide is produced		
water is one of the products		
energy is released		

(2)

(Total 9 marks)

Q10.

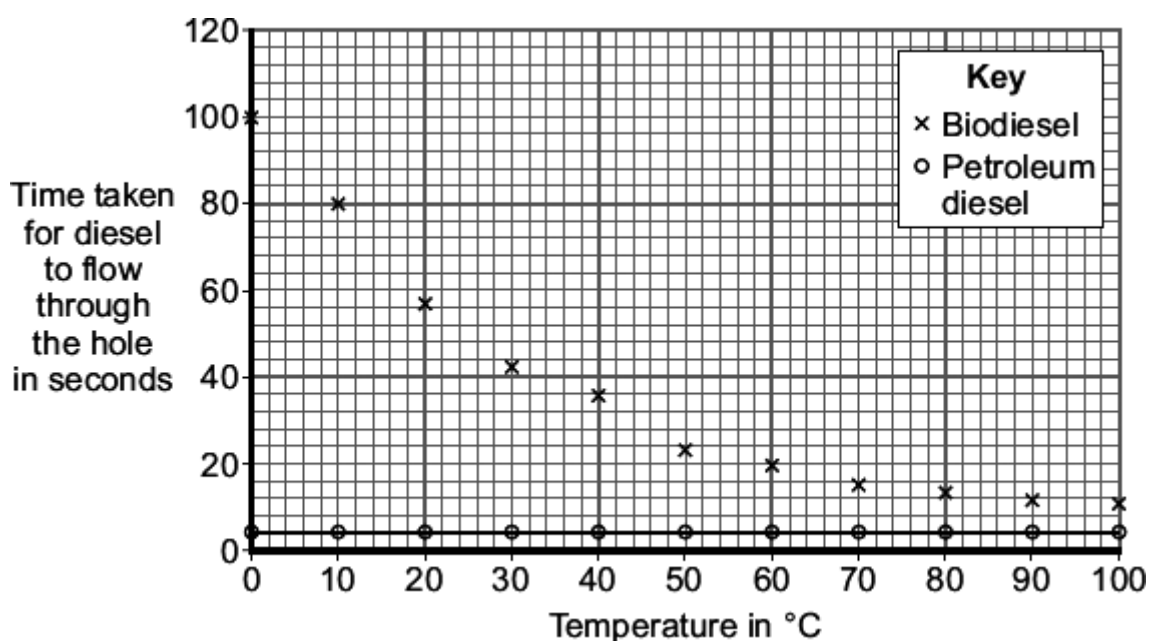
There are two main types of diesel fuel used for cars:

- biodiesel, made from vegetable oils
- petroleum diesel, made from crude oil.

(a) A scientist compared the viscosity of biodiesel with petroleum diesel at different temperatures.

The scientist measured the time for the same volume of diesel to flow through a small hole in a cup.

The scientist's results are plotted on the grid.



(i) Draw a line of best fit for the biodiesel results.

(1)

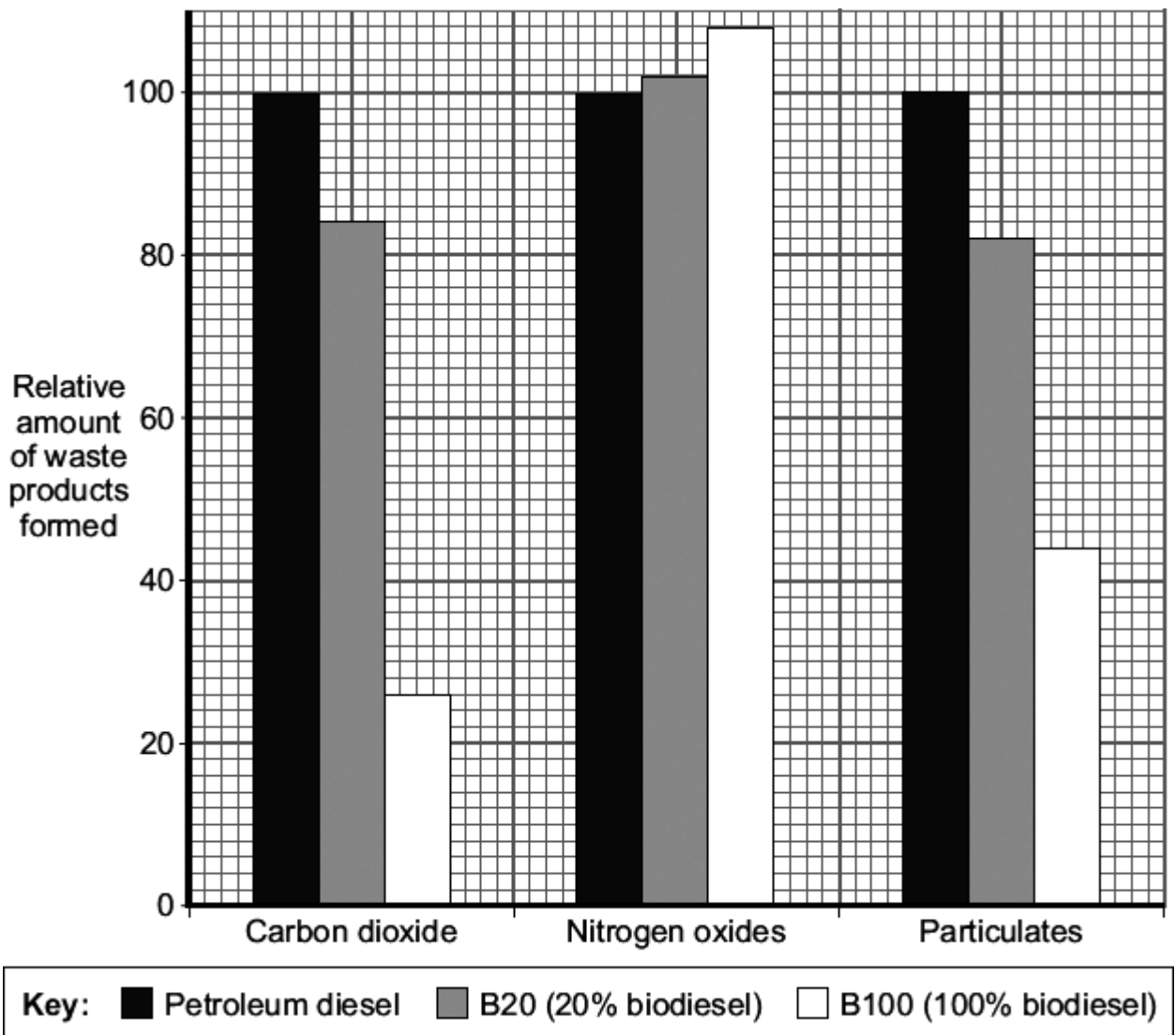
(ii) What conclusions can the scientist make about the viscosity of biodiesel compared with the viscosity of petroleum diesel at different temperatures?

(2)

- (iii) Biodiesel may be less suitable than petroleum diesel as a fuel for cars. Use these results to suggest **one** reason why.

(1)

- (b) Biodiesel can be mixed with petroleum diesel to make a fuel for cars. In a car engine, the diesel fuel burns in air. The waste products leave the car engine through the car exhaust system. The bar chart compares the relative amounts of waste products made when three different types of diesel fuel burn in a car engine.



Nitrogen oxides and sulfur dioxide cause a similar environmental impact.

- (i) What environmental impact do particulates from car exhaust systems cause?

(1)

- (ii) What is the percentage reduction in particulates when using B100 instead of petroleum diesel?

_____ >

(1)

- (iii) Replacing petroleum diesel with biodiesel increases one type of environmental pollution.

Use the bar chart and the information given to explain why.

(2)

- (iv) A carbon neutral fuel does **not** add extra carbon dioxide to the atmosphere.

Is biodiesel a carbon neutral fuel?

Use the bar chart and your knowledge to explain your answer.

(2)

(Total 10 marks)

Q11.

Read the article and then answer the questions.

Supermarkets launch eco-friendly plastic milk bags. Could this be the end of the milk bottle?



Milk bottles are made from glass or from plastic.

Glass milk bottles contain 0.5 litres of milk. When the milk is used up the empty bottles are returned to be re-used. Glass milk bottles are re-used 24 times on average. The glass to make new milk bottles is produced when a mixture of sand, limestone, soda and recycled glass is heated to about 1600 °C in a furnace. There are almost unlimited amounts of the raw materials needed to produce this glass. About 35% of used glass is recycled.

The most common plastic milk bottles contain 2 litres of milk. When the milk is used up the empty bottles are discarded as waste. The plastic used to make these milk bottles is poly(ethene). Poly(ethene) is produced from crude oil by first using fractional distillation, then cracking the naphtha fraction and finally polymerising the ethene. About 5% of used poly(ethene) is recycled.

The new plastic milk bags contain 2 litres of milk. The milk bags are also made from poly(ethene). A milk bag uses 75% less poly(ethene) than is used to make the poly(ethene) milk bottles. When the milk is used up the empty bags are discarded as waste.

- (a) Describe what happens in fractional distillation so that fractions, such as naphtha, are separated from crude oil.

(3)

- (b) Supermarkets claim that using milk bags instead of milk bottles would have less environmental impact.

Do you agree with this claim?

Use the information in the article and your knowledge and understanding to make appropriate comparisons to justify your answer.

(4)
(Total 7 marks)

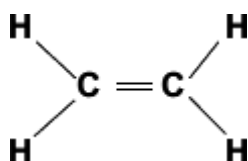
Q12.

Supermarkets in the UK have been advised by the Government to stop giving plastic bags to customers.

Plastic bags are made from a polymer.

The polymer is made from ethene.

The structural formula of ethene is shown.



Ethene is made by cracking hydrocarbons.

These hydrocarbons come from crude oil.

(a) Complete these sentences about ethene.

(i) Ethene is a hydrocarbon because it contains only _____ and

(2)

(ii) Ethene is unsaturated because it has a _____ bond.

(1)

(b) Tick (✓) the name of the polymer formed when many ethene molecules join together.

Name of polymer	Tick (✓)
poly(chloroprene)	
poly(ethene)	
poly(propene)	

(1)

(c) Suggest **two** reasons why supermarkets should stop giving plastic bags to customers.

1. _____

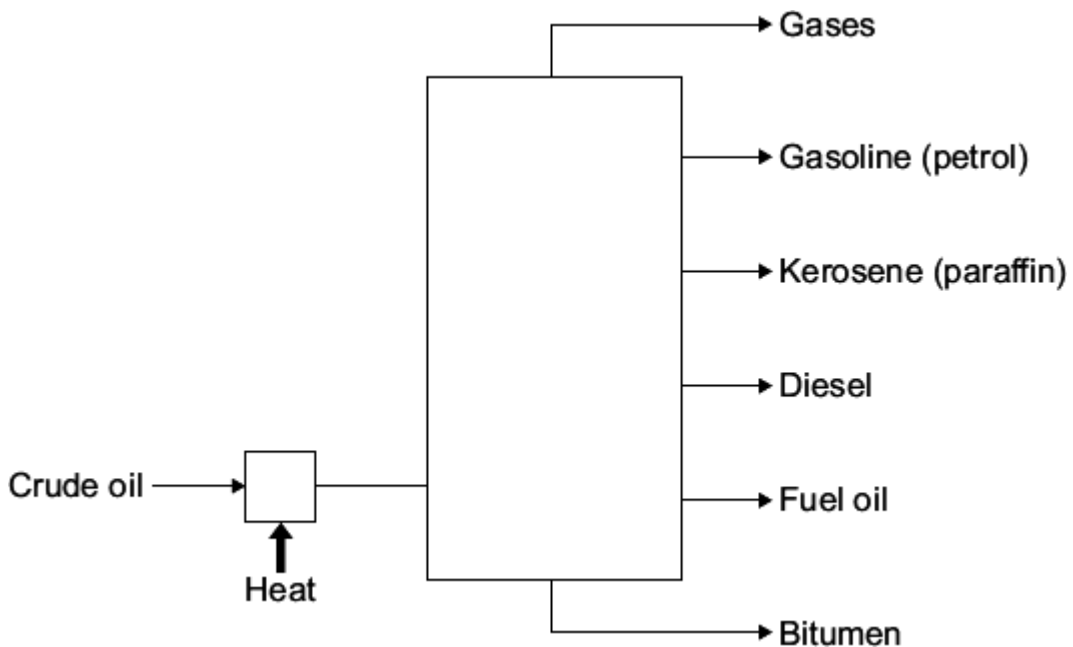
2. _____

(2)
(Total 6 marks)

Q13.

Crude oil is used to produce many useful materials.

(a) The diagram shows some of the fractions produced from crude oil by fractional distillation.



Use the diagram to help you to explain how crude oil is separated into fractions.

You should use the words evaporated and condensed in your answer.

(3)

- (b) The table shows some information about four of the fractions from crude oil that are used as fuels.

Fraction	Boiling point in °C	Number of carbon atoms found in the molecules
Gasoline (petrol)	20 - 200	5 - 10
Kerosene (paraffin)	180 - 260	10 - 16
Diesel	260 - 340	14 - 20
Fuel oil	370 - 600	20 - 70

Use the information in the table to help you to answer these questions.

- (i) How can you tell that each of the fractions is a mixture?

(1)

- (ii) How does the number of carbon atoms in a molecule affect its boiling point?

(1)

- (c) Fuels are substances that release energy.

- (i) Name the reaction that releases energy from a fuel such as gasoline (petrol).

(1)

- (ii) Describe how fuel oil is broken down into smaller, more useful molecules such as gasoline (petrol).

(2)

(Total 8 marks)

Q14.

Supermarkets in the UK have been advised by the Government to stop giving plastic bags to customers. The Government states that this is because plastic bags use up resources that are not renewable and that the manufacture of plastic bags produces carbon dioxide. Most of these plastic bags are made from poly(ethene). The table shows methods to deal

with large numbers of used plastic bags.

Method	Description of what happens to the plastic bag
Reused	used again by the customer
Recycled	collected, transported, washed and melted to make new plastic items
Burned	collected, transported and burnt to release heat energy
Dumped	mixed with other household waste, collected, transported and disposed of at a landfill site

Use the information and your knowledge and understanding to briefly give **one advantage and one disadvantage** for each of these methods.

Reused _____

Recycled _____

Burned _____

Dumped _____

(4)

(Total 4 marks)

Q15.

This information about diesel was printed in a magazine.

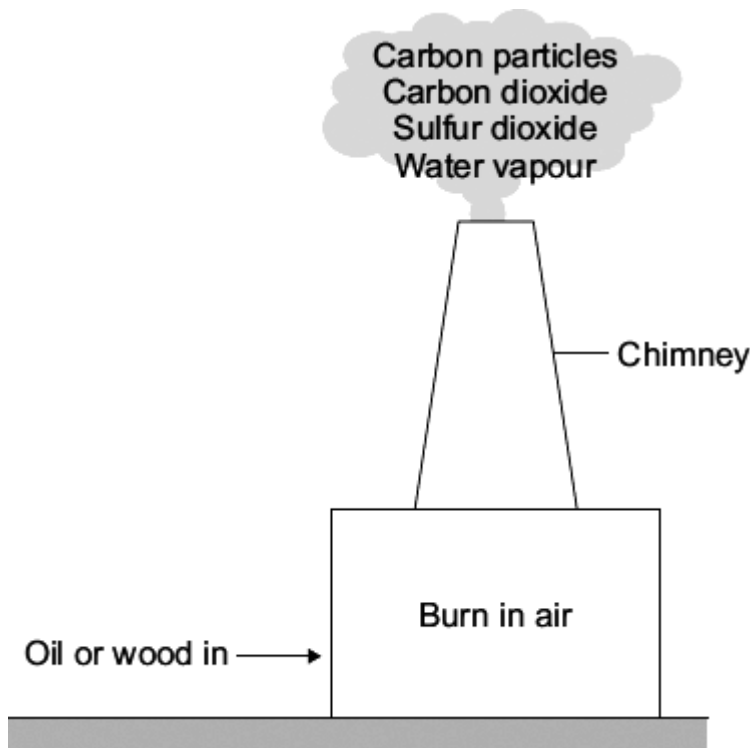
Almost all of the crops that we eat can be converted into fuel for cars.

Vegetable oils can be used as biodiesel. Diesel from crude oil is called fossil diesel.

When either biodiesel or fossil diesel burn they both produce similar amounts of carbon dioxide.

Both types of diesel produce carbon monoxide. However, biodiesel produces fewer carbon particles and less sulfur dioxide.

(a) Carbon monoxide can be produced when diesel burns in a car engine. Explain how.



(a) Which **one** of the emissions from the chimney can cause acid rain?

(1)

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

Carbon particles in the Earth's atmosphere cause

- | |
|---|
| <p>acid rain.</p> <p>global dimming.</p> <p>global warming.</p> |
|---|

(1)

(c) Which gas in the air is needed for oil or wood to burn?

(1)

(d) Suggest why there will be **fewer** power stations burning oil in the future.

(1)

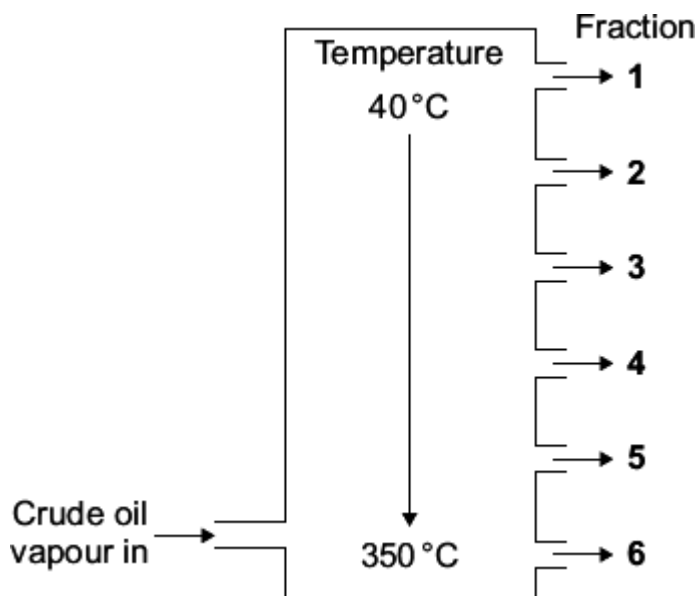
(e) Some power stations burn wood.
The wood comes from trees grown in forests.

Suggest why burning wood in power stations is said to be 'carbon-neutral'.

(2)
(Total 6 marks)

Q17.

Crude oil is a mixture of hydrocarbons.
Crude oil can be separated into fractions.



(a) (i) Complete the sentence.

The process used to separate the crude oil into fractions is called
fractional _____.

(1)

(ii) Why do the fractions separate at different temperatures?

(1)

(b) Tick (✓) **two** properties of fraction 6.

Property	Tick (✓)
contains hydrocarbons	
has a small number of carbon atoms in each molecule	
is easy to ignite	
has a high boiling point	

(2)

- (c) Fraction 1 contains hydrocarbons called alkanes.
The general formula of an alkane is: C_nH_{2n+2}

What is the formula of the alkane that has 5 carbon atoms in each molecule?

Draw a ring around the correct answer.



(1)

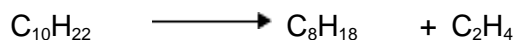
(Total 5 marks)

Q18.

The raw materials used to make the polymer polyvinyl chloride (PVC) are crude oil and sea salt (sodium chloride).

- (a) There are three main stages in the production of PVC.

- (i) **Stage 1** Cracking of hydrocarbons from crude oil produces ethene, C_2H_4

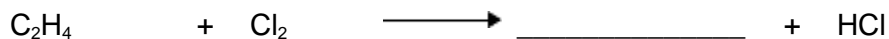


How are hydrocarbons cracked?

(2)

- (ii) **Stage 2** Electrolysis of sodium chloride solution produces chlorine.
Ethene from **Stage 1** is then reacted with this chlorine.
One of the hydrogen atoms in each ethene molecule is replaced by a chlorine atom to produce vinyl chloride.

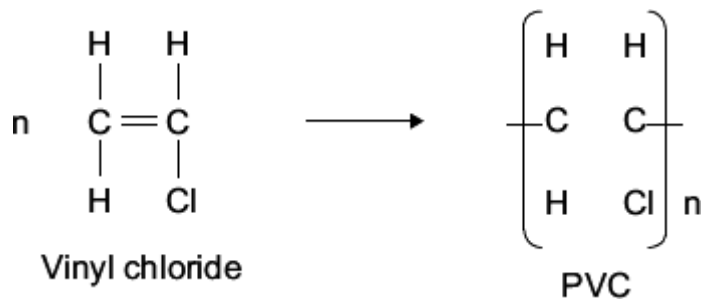
Complete the chemical equation by writing in the formula of the product vinyl chloride.



(1)

- (iii) **Stage 3** Polymerisation of vinyl chloride produces polyvinyl chloride (PVC).

Complete the chemical equation by drawing in the missing bonds of the product, PVC.

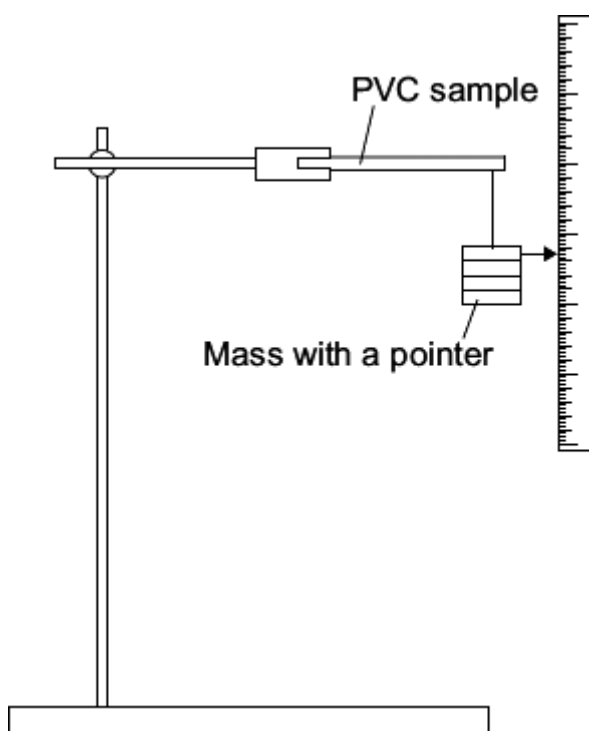


(1)

- (b) Unplasticised polyvinyl chloride (uPVC) is used to make door and window frames. PVC with a plasticiser added is used to make cling film for wrapping food. A plasticiser is a chemical compound.

A student investigated how the percentage of plasticiser added to PVC affected its flexibility.

The student measured the bending of PVC samples when a mass was added.



The student's results are shown in the table.

Sample of PVC	Percentage (%) of plasticiser added	Bending of PVC sample in mm				
		Test 1	Test 2	Test 3	Test 4	Mean
A	0	2	3	3	4	3
B	5	22	15	23	24	
C	10	27	27	29	29	28
D	15	34	35	35	36	35

- (i) Each PVC sample should be the same size to make it a fair test.
Explain why.

(1)

- (ii) The student repeated the test four times for each sample.
Explain why.

(1)

- (iii) Calculate the mean value for sample **B**.

(2)

- (iv) Each of the samples bent the most in test **4**.
Suggest a possible reason for this.

(1)

- (c) Suggest why unplasticised polyvinyl chloride (uPVC) is used to make door and window frames.

(1)

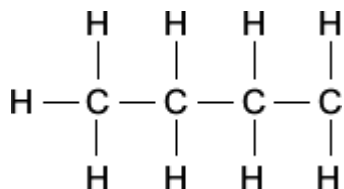
(Total 10 marks)

Q19.

Crude oil is a mixture of hydrocarbons. Most of these hydrocarbons are alkanes.

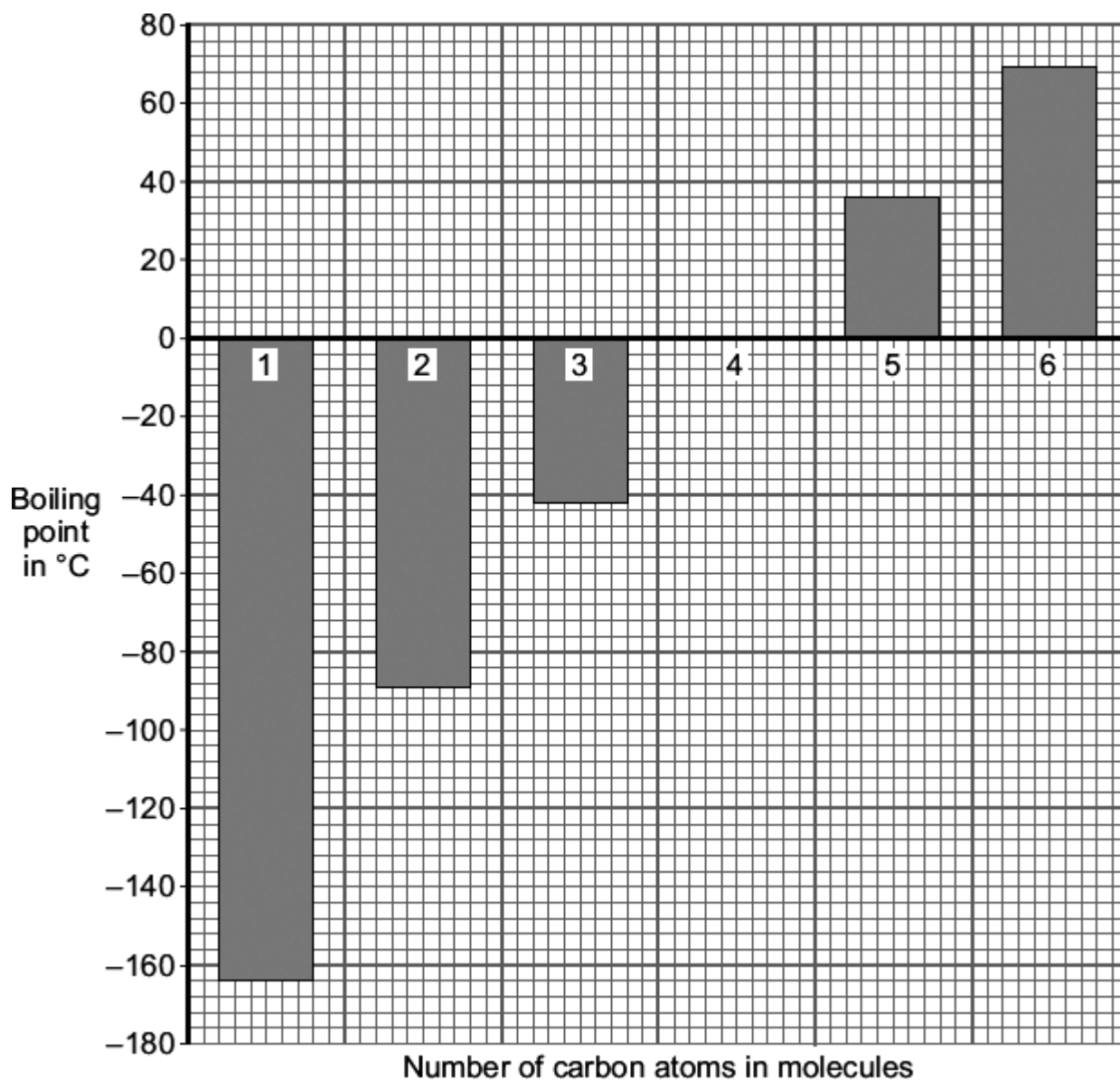
- (a) The general formula of an alkane is C_nH_{2n+2}

Complete the structural formula for the alkane that has **six** carbon atoms in its molecules.



(1)

- (b) The boiling points of alkanes are linked to the number of carbon atoms in their molecules.



- (i) Describe the link between the number of carbon atoms in an alkane molecule and its boiling point.

(1)

- (ii) Suggest **two** reasons why all of the alkanes in the bar chart are better fuels than the alkane with the formula $C_{30}H_{62}$

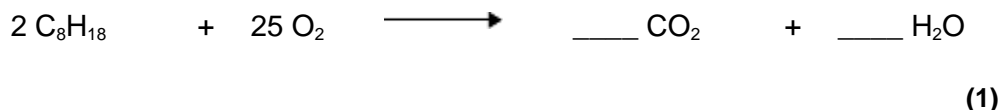
1. _____

2. _____

(2)

- (c) During the last 200 million years the carbon cycle has maintained the percentage of carbon dioxide in the atmosphere at about 0.03 %.
Over the last 100 years the percentage of carbon dioxide in the atmosphere has increased to about 0.04 %.
Most of this increase is caused by burning fossil fuels to heat buildings, to generate electricity and to power our transport.
Fossil fuels contain carbon that has been locked up for millions of years.

- (i) Burning fossil fuels, such as petrol, releases this locked up carbon. Balance the chemical equation for the combustion of one of the alkanes in petrol.



- (ii) Where did the carbon that is locked up in fossil fuels come from?

(1)

- (iii) The burning of fossil fuels has caused the percentage of carbon dioxide in the atmosphere to increase to above 0.03 %.
Explain why.

(2)

(Total 8 marks)

Q20.

Petroleum diesel is produced from crude oil.

Most vehicles that use petroleum diesel as fuel can also use biodiesel or a mixture of these two fuels. In the UK (in 2010) there must be 5 % biodiesel in all petroleum diesel fuel.

Biodiesel is produced from plant oils such as soya. The crops used to produce biodiesel can also be used to feed humans. The benefit that biodiesel is 'carbon neutral' is outweighed by the increasing demand for crops. This increasing demand is causing forests to be burnt to provide land for crops to produce biodiesel. Only a huge fall in the price of petroleum diesel would halt the increasing use of biodiesel.

The graph shows the average percentage change in exhaust emissions from vehicles using different mixtures of petroleum diesel and biodiesel.

Q21.

Natural gas is mainly a hydrocarbon called methane.

- (a) Use **one** word from the box to complete the sentence.

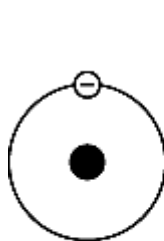
compounds	elements	molecules
------------------	-----------------	------------------

Hydrocarbons contain hydrogen and carbon only.

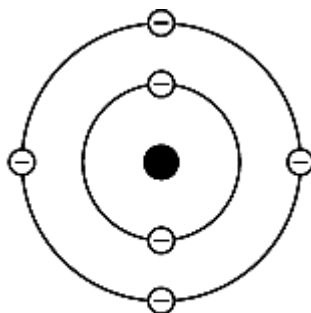
Hydrogen and carbon are _____.

(1)

- (b) The diagrams represent atoms of hydrogen and carbon.



Hydrogen



Carbon

Draw a ring around the correct answer to complete the sentences.

- (i) The centre of each atom is called the

bond.
nucleus.
symbol.

(1)

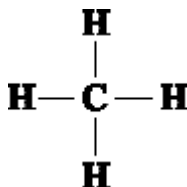
- (ii) The hydrogen atom has one electron and the carbon atom has

three
four
six

electrons.

(1)

- (c) A molecule of methane can be represented as



Draw a ring around the correct answer to complete the sentences.

(i) The formula of methane is

- CH
- CH₄
- C₄H₄

(1)

(ii) The line between C—H is called a

- bond.
- molecule.
- nucleus.

(1)

(d) Methane burns to produce carbon dioxide (CO₂) and water (H₂O).

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

When methane burns it reacts with

- carbon.
- nitrogen.
- oxygen.

(1)

(ii) Hydrogen (H₂) can be used as a fuel.

Suggest why burning hydrogen would be less harmful to the environment than burning methane.

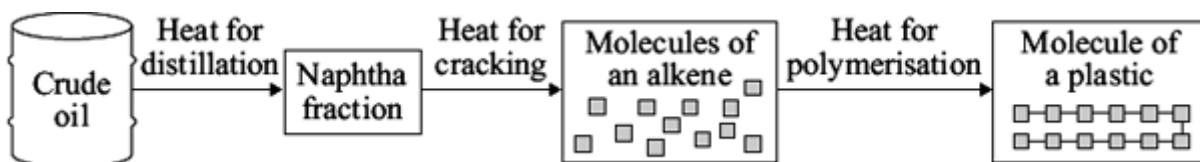
(1)

(Total 7 marks)

Q22.

Crude oil is used to make plastics.

(a) To make a plastic from crude oil involves many processes.



(i) How do alkene molecules form a molecule of a plastic?

(1)

(ii) Suggest **one** of the main costs of making a plastic from crude oil.

(1)

(iii) Suggest **two** problems caused by the disposal of plastics in landfill sites.

1. _____

2. _____

(2)

(b) Some companies are using bio-plastics made from plants such as corn. Less fossil fuel is used to make bio-plastics than is used to make plastics from crude oil.

Plastics made from plants would be more environmentally friendly than plastics made from crude oil.

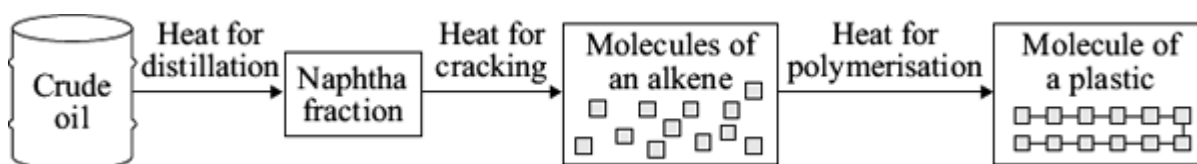
Explain why.

(2)

(Total 6 marks)

Q23.

To make a plastic, such as poly(ethene), from crude oil involves many processes.

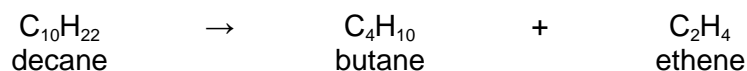


(a) Describe how crude oil is separated into fractions.

(2)

(b) Ethene is produced by cracking the hydrocarbons in the naphtha fraction.

(i) Balance the symbol equation for this reaction.



(1)

(ii) Describe how cracking is carried out.

(2)

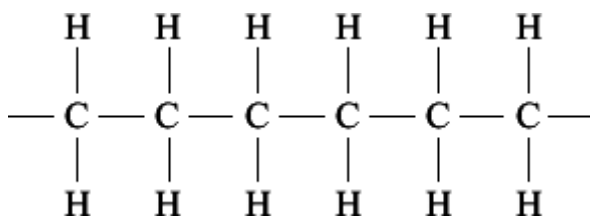
(c) Alkanes, such as butane (C_4H_{10}), do **not** form polymers.

Alkenes, such as ethene (C_2H_4), do form polymers.

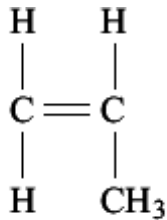
Explain these statements.

(2)

(d) Ethene molecules form the polymer poly(ethene). One molecule in poly(ethene) will contain thousands of carbon atoms. The diagram represents part of a poly(ethene) molecule.



Propene molecules form the polymer poly(propene).



Propene molecule

Draw a diagram to represent part of a poly(propene) molecule.

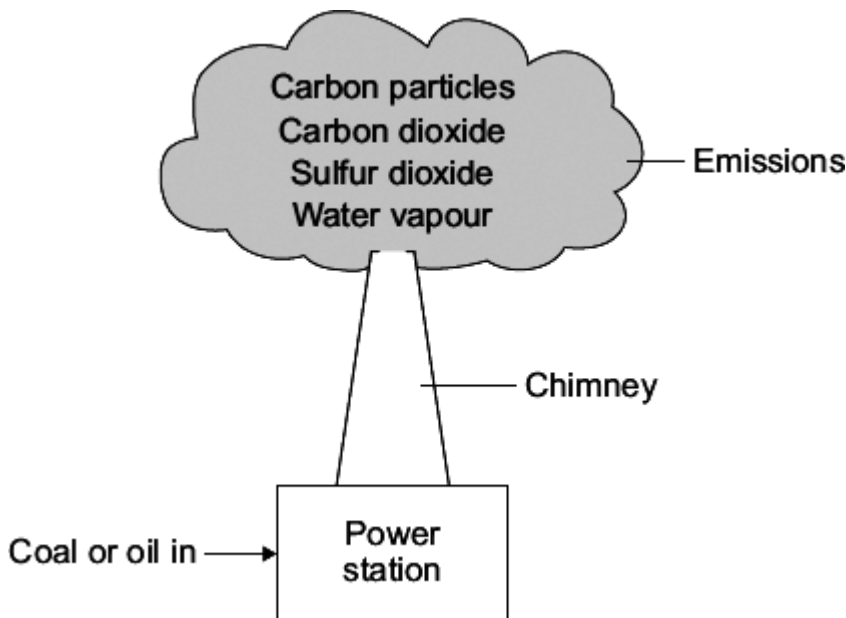
(2)

(Total 9 marks)

Q24.

In the future more coal-fired and fewer oil-fired power stations will be used to generate electricity.

When coal and oil are burned they produce the same types of emissions which can cause environmental problems.



- (a) Emissions from the chimney can cause acid rain, global dimming and global warming. Draw **one** straight line from each possible environmental problem to the emission that causes it.

Possible environmental problem

Emission that causes it

acid rain

carbon particles

global warming

carbon dioxide

global dimming

sulfur dioxide

water vapour

(3)

(b) Draw a ring around the correct word in the box to complete each sentence.

(i) Incomplete combustion of coal or oil is caused by too little

carbon dioxide.
nitrogen.
oxygen.

(1)

(ii) A gas formed by the incomplete combustion of coal or oil is

carbon
monoxide.
hydrogen.
oxygen.

(1)

(c) The table shows the world production for both coal and oil in 2000.

The world production figures after 2000 are predicted.

Year	World production of coal (billions of tonnes per year)	World production of oil (billions of barrels per year)
2000	3.5	12.5
2050	4.5	5.6
2100	5.0	1.7
2150	5.5	0.5
2200	6.0	0.0

(i) How is the world production of oil predicted to change from 2000 to 2200?

(1)

(ii) Suggest **two** reasons why the world production of coal is predicted to increase.

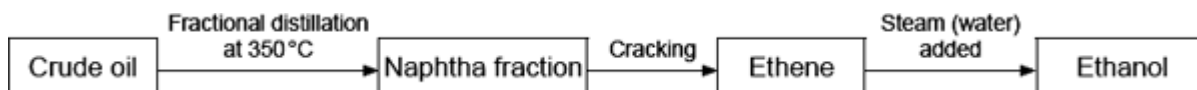
1. _____

2. _____

Q25.

Petrol sold in most countries now contains at least 5% ethanol.
The production of ethanol, for use as a fuel, is being increased.

The flow diagram shows how ethanol can be produced from crude oil.

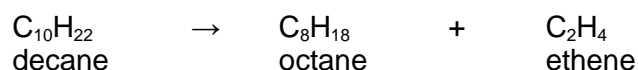


- (a) Why does crude oil need to be fractionally distilled?

(1)

- (b) Hydrocarbons, such as decane, in the naphtha fraction are cracked to produce ethene.

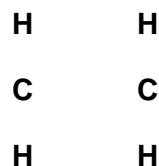
The balanced chemical equation shows the cracking of decane.



- (i) Describe how cracking is done.

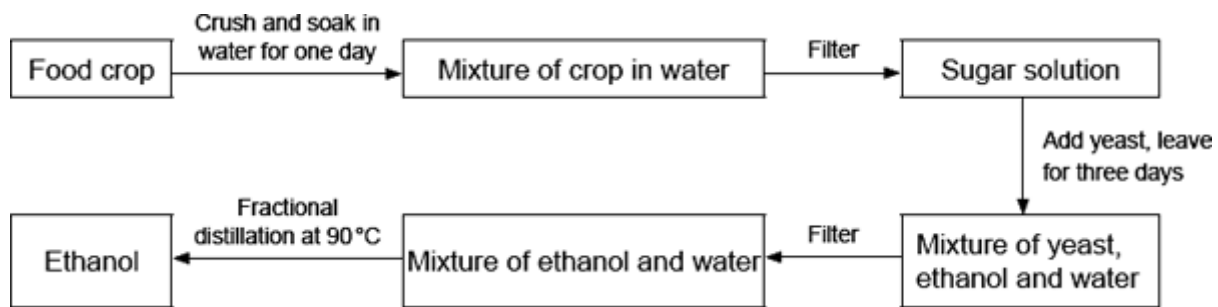
(2)

- (ii) Complete the structural formula of ethene by drawing lines to represent each covalent bond.



(1)

- (c) The flow diagram below shows how ethanol, for use as a fuel, can also be produced from food crops.



Use the information in the two flow diagrams and your own knowledge and understanding to evaluate whether more of this ethanol should be produced from food crops or from crude oil.

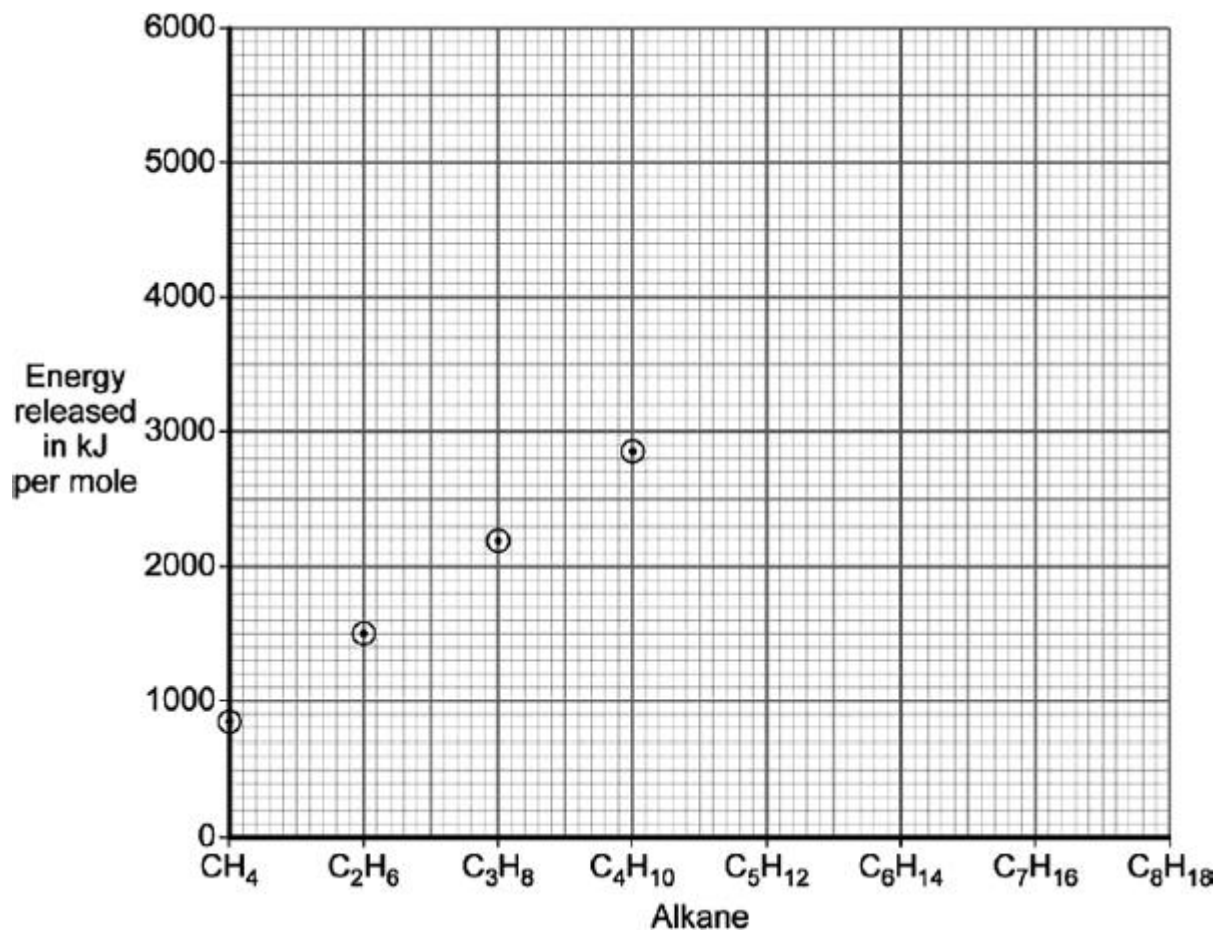
Remember to give a conclusion to your evaluation.

(5)
(Total 9 marks)

Q26.

- (a) Alkanes are important hydrocarbon fuels. They have the general formula C_nH_{2n+2}

The points on the graph show the amount of energy released when 1 mole of methane (CH_4), ethane (C_2H_6), propane (C_3H_8) and butane (C_4H_{10}) are burned separately.



- (i) Draw a line through the points and extend your line to the right-hand edge of the graph.

(1)

- (ii) Use the graph to estimate the amount of energy released when 1 mole of octane (C₈H₁₈) is burned.

Energy released = _____ kJ

(1)

- (iii) Suggest why we can make a good estimate for the energy released by 1 mole of pentane (C₅H₁₂).

(1)

- (iv) A student noticed that octane (C₈H₁₈) has twice as many carbon atoms as butane (C₄H₁₀), and made the following prediction:

“When burned, 1 mole of octane releases twice as much energy as 1 mole of butane.”

Use the graph to decide if the student’s prediction is correct. You **must** show your working to gain credit.

(2)

(b) Some information about four fuels is given in the table.

Fuel	Type	Heat released in kJ per g	Combustion products			Type of flame
			CO ₂	SO ₂	H ₂ O	
Bio-ethanol	Renewable	29	✓		✓	Not smoky
Coal	Non-renewable	31	✓	✓	✓	Smoky
Hydrogen	Renewable	142			✓	Not smoky
Natural gas	Non-renewable	56	✓		✓	Not smoky

From this information a student made two conclusions.

For each conclusion, state if it is correct **and** explain your answer.

(i) "Renewable fuels release more heat per gram than non-renewable fuels."

(2)

(ii) "Non-renewable fuels are better for the environment than renewable fuels."

(2)

(Total 9 marks)

Q27.

Water sold in plastic bottles has a high 'carbon cost'.

The 'carbon cost' depends on the amount of carbon dioxide emitted in making and transporting the product.

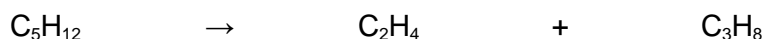
The more carbon dioxide emitted, the higher the 'carbon cost'.

- (a) Plastic water bottles are made from a polymer.
The polymer is made from ethene.
Ethene is made by cracking hydrocarbons.

(i) Name the polymer made from ethene.

(1)

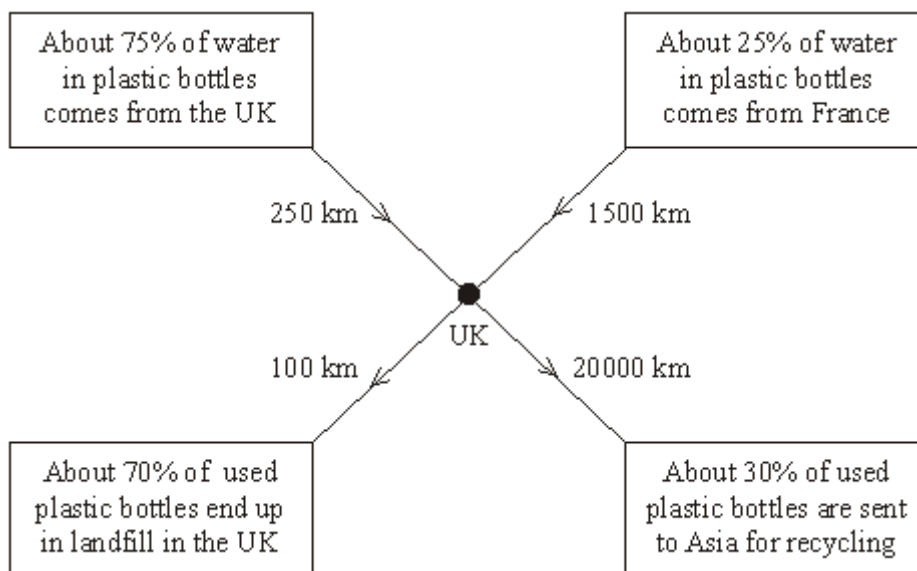
(ii) Ethene can be made by cracking the hydrocarbon pentane, C_5H_{12} .



Explain why there is a 'carbon cost' for the process of cracking a hydrocarbon.

(2)

- (b) The diagram shows information about water sold in plastic bottles in the UK.
The diagram also shows the average distances that water and plastic bottles are transported.



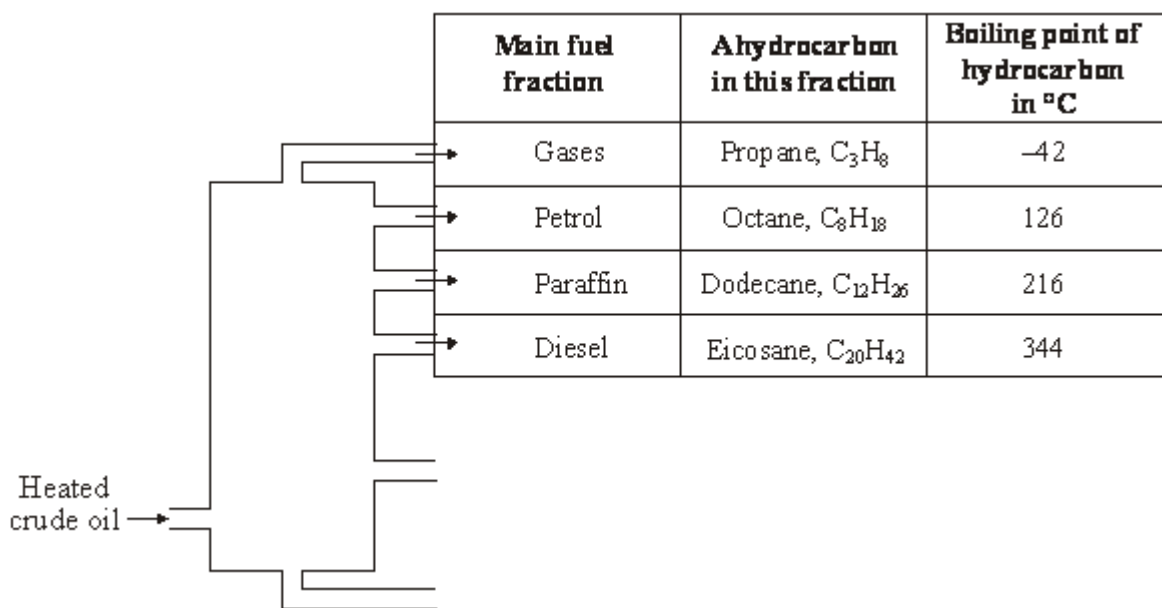
Suggest how the high 'carbon cost' of water sold in plastic bottles could be reduced.

(3)
(Total 6 marks)

Q28.

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

- (a) The name of the main fuel fractions and one of the hydrocarbons in each fraction are shown in the table.



- (i) How does the number of carbon atoms in a hydrocarbon affect its boiling point?

(1)

- (ii) Suggest the lowest temperature to which crude oil needs to be heated to vaporize all the hydrocarbons in the table.

Temperature = _____ °C

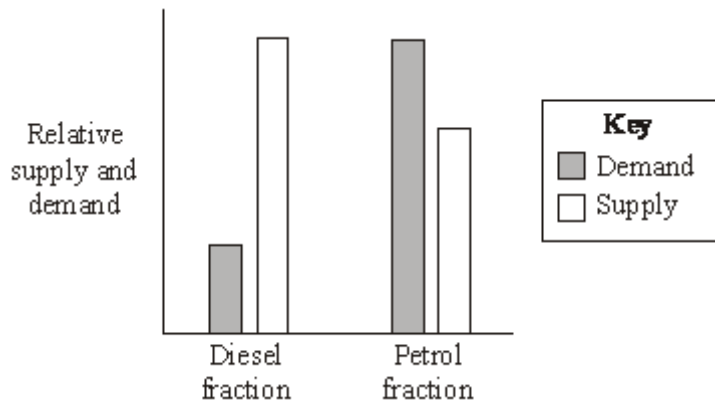
(1)

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

Temperature = _____ °C

(1)

- (b) The bar chart shows the relative supply and demand for the petrol and diesel fractions.



- (i) How does the relative supply and demand for petrol and diesel fractions cause problems for an oil company?

(2)

- (ii) Suggest **one** way an oil company could solve these problems.

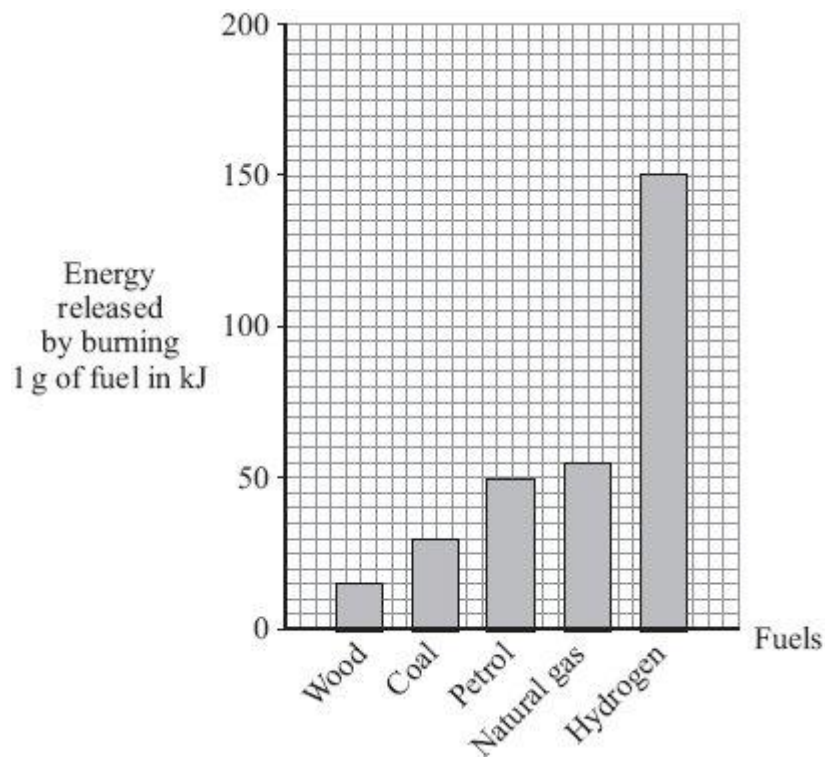
(1)

(Total 6 marks)

Q29.

Energy is released by burning fuels.

- (a) The bar chart shows the energy in kilojoules, kJ, released by burning 1 g of five different fuels.



(i) Which fuel releases the least energy from 1 g?

(1)

(ii) How much energy is released by burning 1 g of coal?

Energy = _____ kJ

(1)

(iii) Coal burns in oxygen and produces the gases shown in the table.

Name	Formula
Carbon dioxide	CO ₂
Water vapour	H ₂ O
Sulfur dioxide	SO ₂

Use information from the table to name **one** element that is in coal.

(1)

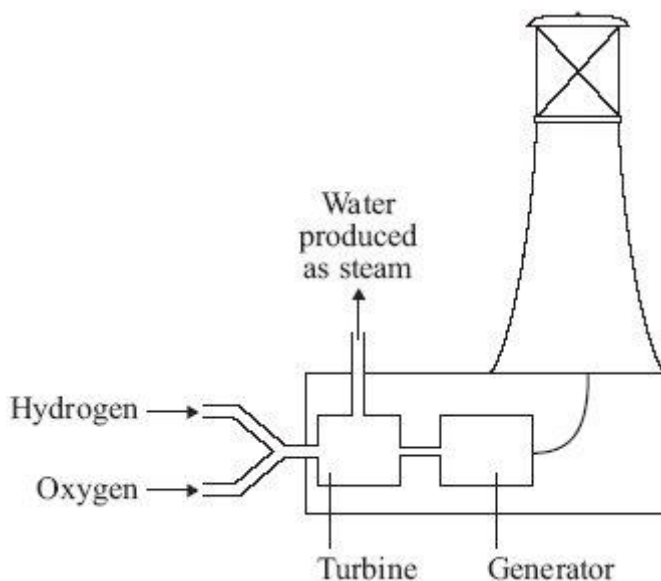
(iv) Use information from the bar chart to calculate the mass of petrol that will release the same amount of energy as 1 g of hydrogen.

Mass = _____ g

(1)

- (b) Hydrogen can be made from fossil fuels.
Hydrogen burns rapidly in oxygen to produce water only.

A lighthouse uses electricity generated by burning hydrogen.



- (i) Use information from the bar chart and the diagram above to suggest **two** advantages of using hydrogen as a fuel.

1. _____

2. _____

(2)

- (ii) Suggest **one** disadvantage of using hydrogen.

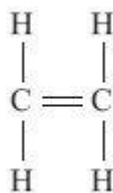
(1)

(Total 7 marks)

Q30.

Crude oil is used to make useful substances such as alkenes and plastics.

- (a) The alkene shown is ethene.



- (i) Tick (✓) the correct formula for ethene.

Formula	(✓)
---------	-----

CH ₄	
C ₂ H ₄	
C ₂ H ₆	

(1)

- (ii) Tick (✓) the name of the plastic formed when many ethene molecules join together.

Name of plastic	(✓)
Poly(ethene)	
Poly(ethanol)	
Poly(propene)	

(1)

- (b) Read the article about plastics and then answer the questions.

THE PROBLEM WITH PLASTIC WASTE

The UK produces about 3 million tonnes of plastics from crude oil every year.

Most of the litter found on UK beaches is plastic waste.

80% of the plastics produced end up in landfill sites.

The UK recycles only 7% of plastic waste.

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

Litter that is plastic waste needs to be removed from beaches

because it

decomposes
is flammable
is not biodegradable

.

(1)

- (ii) Suggest a problem caused by 80% of the plastics going to landfill sites.

(1)

- (iii) The UK government has set a target to recycle 30% of plastic waste.

How are resources saved by recycling more plastics?

(1)
(Total 5 marks)

Q31.

(a) PEX is a material that is used as an alternative to copper for hot water pipes. PEX is made from poly(ethene).

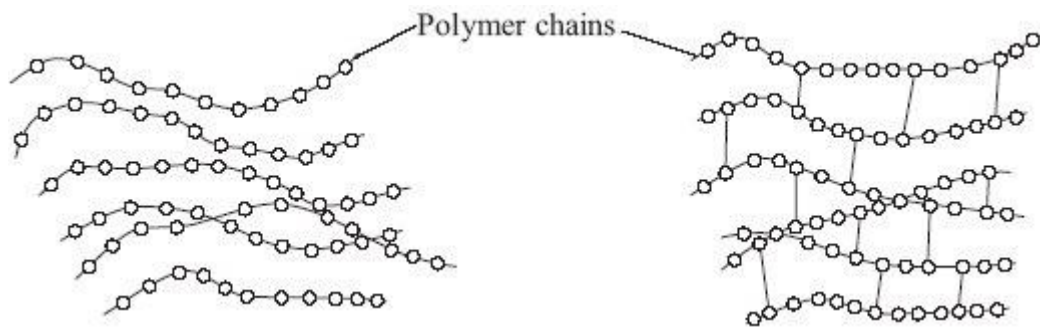
(i) Describe how ethene forms poly(ethene).

(2)

(ii) PEX is a shape memory polymer. What property does a shape memory polymer have?

(1)

(iii) The simplified structures of poly(ethene) and PEX are shown.



Poly(ethene)

PEX

Poly(ethene) is a thermoplastic that softens easily when heated.

Suggest and explain how the structure of PEX changes this property.

(3)

- (b) Copper was considered to be the most suitable material to use for hot water pipes. PEX is now used as an alternative material for hot water pipes.

Copper is extracted from its ore by a series of processes.

- 1 The low-grade ore is powdered and concentrated.
- 2 Smelting is carried out in an oxygen flash furnace. This furnace is heated to 1100 °C using a hydrocarbon fuel. The copper ore is blown into the furnace with air, producing impure, molten copper.
- 3 Oxygen is blown into the impure, molten copper to remove any sulfur. The copper is cast into rectangular slabs.
- 4 The final purification of copper is done by electrolysis.

PEX is made from crude oil by a series of processes.

- 1 Fractional distillation
- 2 Cracking
- 3 Polymerisation
- 4 Conversion of poly(ethene) into PEX

Suggest the possible environmental advantages of using PEX instead of copper for hot water pipes.

(4)

(Total 10 marks)

Q32.

Chlorine and bromine are important Group 7 elements.

- (a) Explain why chlorine is added to drinking water.

(1)

- (b) Describe what you would **see** when bromine water is added to an unsaturated organic compound.

(1)

(c) Bromine can be extracted from seawater. The dissolved bromide ions are reacted with chlorine. Bromine and chloride ions are formed.

(i) Complete and balance the equation below, which represents the reaction between chlorine and bromide ions.



(1)

(ii) Describe what you **see** when chlorine is added to a solution containing bromide ions.

(1)

(d) In terms of electronic structure:

(i) state why bromine and chlorine are both in Group 7

(1)

(ii) explain why bromine is less reactive than chlorine.

(3)

(e) What is the result of adding acidified silver nitrate solution to a solution containing:

(i) chloride ions

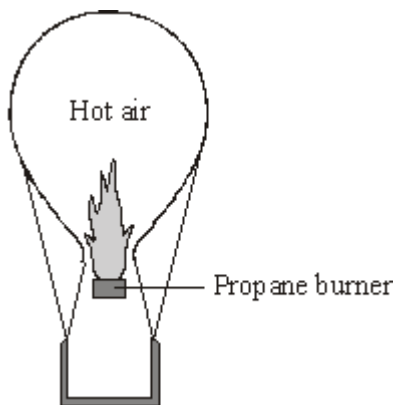
(1)

(ii) bromide ions?

(1)

(Total 10 marks)

Hot air balloons burn hydrocarbons to heat the air.



- (a) The hot air contains these gases: nitrogen, N_2
 oxygen, O_2
 argon, Ar
 carbon dioxide, CO_2
 water vapour, H_2O

- (i) Argon is an *element*.

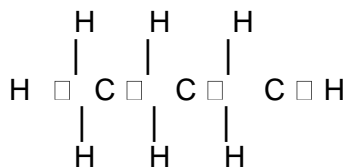
What is an *element*?

(1)

- (ii) Name **one** other gas in the hot air that is also an element.

(1)

- (b) Propane, C_3H_8 , can be represented as:



Use the correct words from the box to complete the sentences.

bond	carbon	compound	element	mixture
-------------	---------------	-----------------	----------------	----------------

- (i) Propane is a _____ and is made up of atoms of hydrogen and _____

(2)

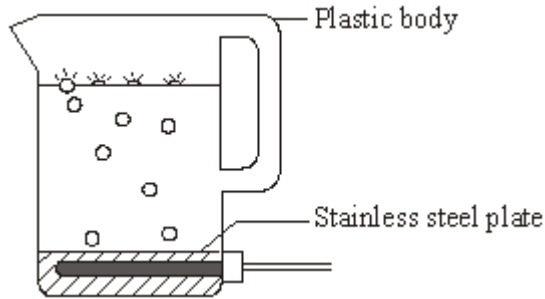
- (ii) Each line between the atoms in propane represents a chemical _____

(1)

(Total 5 marks)

Q34.

Plastics are used to make many everyday items, such as the body of the kettle.



(a) Complete the sentences by drawing a ring around the correct words.

(i) The plastic is made from many small molecules called

- | |
|-----------|
| catalysts |
| monomers |
| polymers |

(1)

(ii) Propene is produced by cracking some of the fractions that are

separated from

- | |
|------------|
| crude oil |
| limestone |
| metal ores |

(1)

(b) After a few years the kettle no longer worked.

- Some parts of the kettle are made of plastic.
- Some parts of the kettle are made of stainless steel.
- The owner of the kettle disposed of it in a landfill site.

Consider these statements.

Suggest **three** reasons why the kettle should **not** be disposed of in a landfill site.

1. _____

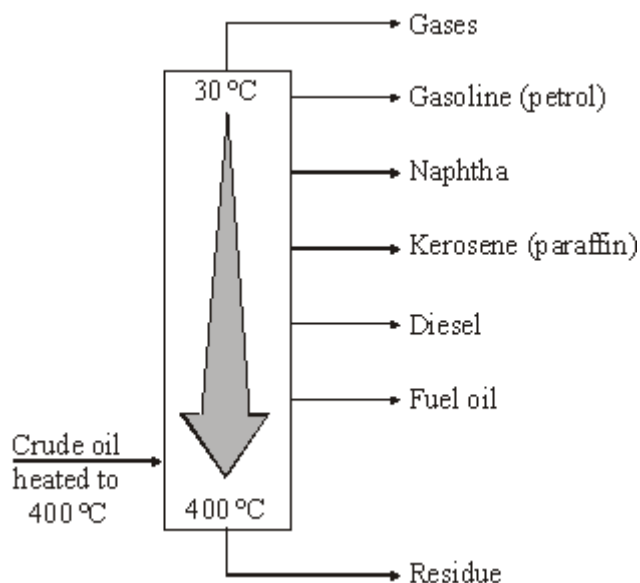
2. _____

3. _____

(3)

Q35.

Crude oil is the source of many useful materials. Crude oil is separated into fractions by fractional distillation.

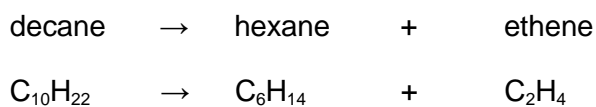


(a) Describe how the naphtha fraction separates from the other fractions.

(2)

(b) The naphtha fraction is often used to make other useful materials. This involves the cracking of hydrocarbons in the naphtha fraction.

For example:



(i) Balance the symbol equation given above.

(1)

(ii) Describe how cracking is carried out.

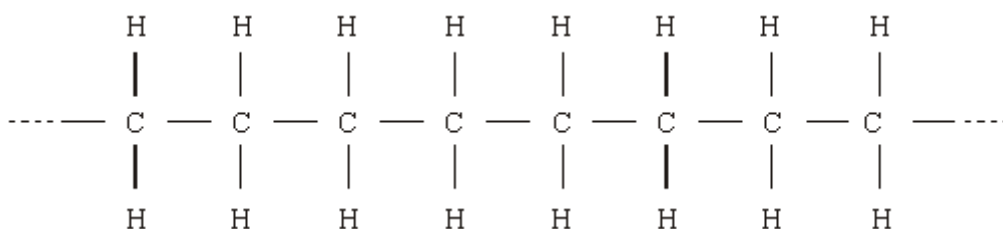
(2)

(iii) Why does ethene have different chemical properties from decane and

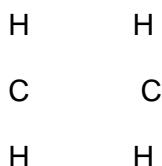
hexane?

(2)

- (c) Ethene is used as the starting material for many polymers. The most common polymer is poly(ethene). One hydrocarbon molecule in poly(ethene) will contain thousands of carbon atoms.



Complete the diagram to show the bonds in ethene.



(1)

- (d) Read the following information.

Landfill, Incineration, Recycling and Re-use of Poly(ethene)

People could be encouraged to re-use their poly(ethene) bags and containers.

Recycling poly(ethene) saves raw materials and energy needed to make new plastic. When polymers are recycled the plastics must be collected, transported, sorted into different types by hand and washed. This requires the use of fossil fuels and is expensive.

Poly(ethene) can be burnt in an incinerator with other household waste. The heat released could be used to make steam to drive an electric generator. Surplus heat could be used to heat greenhouses used for growing vegetables. Incineration at too low a temperature can produce harmful substances. The residue (ash) has to go to landfill.

Landfill is probably the easiest way to dispose of polymers and it is cheap.

Polymers are often mixed in with other household rubbish. Household waste does not get sorted into different materials because it is disposed of in the same hole in the ground. When the hole is eventually full, the waste is covered by a layer of soil to stop it smelling. The waste gets compressed under its own weight. Most polymers, such as poly(ethene), are not biodegradable so will remain in the ground forever.

You are asked to decide which option for the disposal of poly(ethene) will be put forward in your area. You decide that recycling is the best option.

Suggest **one** economic argument and **one** environmental argument that will be made against recycling.

For each argument made, how will you persuade those making the argument to accept your option?

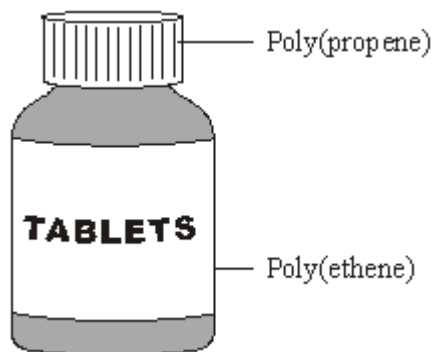
(You must use only one sentence for each argument made against your decision and only one sentence for your response to it.)

(4)

(Total 12 marks)

Q36.

Tablet containers are often made from two different polymers.



(a) Ethene, C_2H_4 , and propene, C_3H_6 , can be made from crude oil.

(i) Complete the following sentence.

Ethene and propene are called hydrocarbons because they are made up of

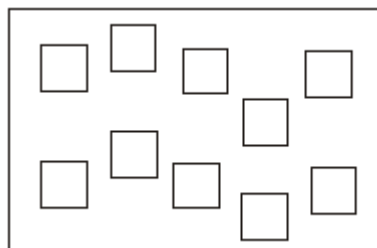
carbon and _____ atoms only.

(1)

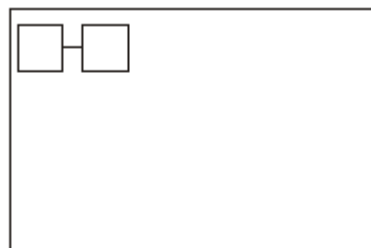
- (ii) Ethene molecules are used to form poly(ethene) molecules.

Complete the diagram to show the poly(ethene) molecule.

Ethene molecules



Poly(ethene) molecule



(2)

- (b) The tablet containers could be disposed of in a landfill site or could be recycled.

- (i) Suggest **two** reasons why disposing of the tablet containers in a landfill site could cause problems.

1. _____

2. _____

(2)

- (ii) Suggest **one** reason why recycling the tablet containers would be difficult.

(1)

(Total 6 marks)

Q37.

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).

(2)

(Total 5 marks)

Q38.

Scientists study the atmosphere on planets and moons in the Solar System to understand how the Earth's atmosphere has changed.

(a) Millions of years ago the Earth's atmosphere was probably just like that of Mars today.

The table shows data about the atmospheres of Mars and Earth as they are now.

Mars		Earth	
nitrogen	3%	nitrogen	78%
oxygen	trace	oxygen	21%
water	trace	water	trace
carbon dioxide	95%	carbon dioxide	trace
Average surface temperature $-23\text{ }^{\circ}\text{C}$		Average surface temperature $15\text{ }^{\circ}\text{C}$	

Suggest what has caused the main gases in the Earth's atmosphere of millions of years ago to change to the present-day atmosphere.

(2)

- (b) Titan is the largest moon of the planet Saturn. It has an atmosphere that, like the Earth's, contains mainly nitrogen. Methane is the other main gas.

Main gases in Titan's atmosphere	Percentage (%)	Boiling point in °C
Nitrogen	95	-196
Methane	5	-164
Average surface temperature -178 °C		

When it rains on Titan, it rains methane! Explain why.

(2)

- (c) Ultraviolet radiation from the Sun produces simple alkenes, such as ethene and propene, from methane in Titan's atmosphere.

- (i) Draw the structure of propene, C_3H_6 , to show the covalent bonds.

(1)

- (ii) Explain how propene molecules form a polymer. You should name the polymer formed.

Q39.

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.



Plastic bag made from a polymer

- (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
-------------------	------------------	-----------------

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.

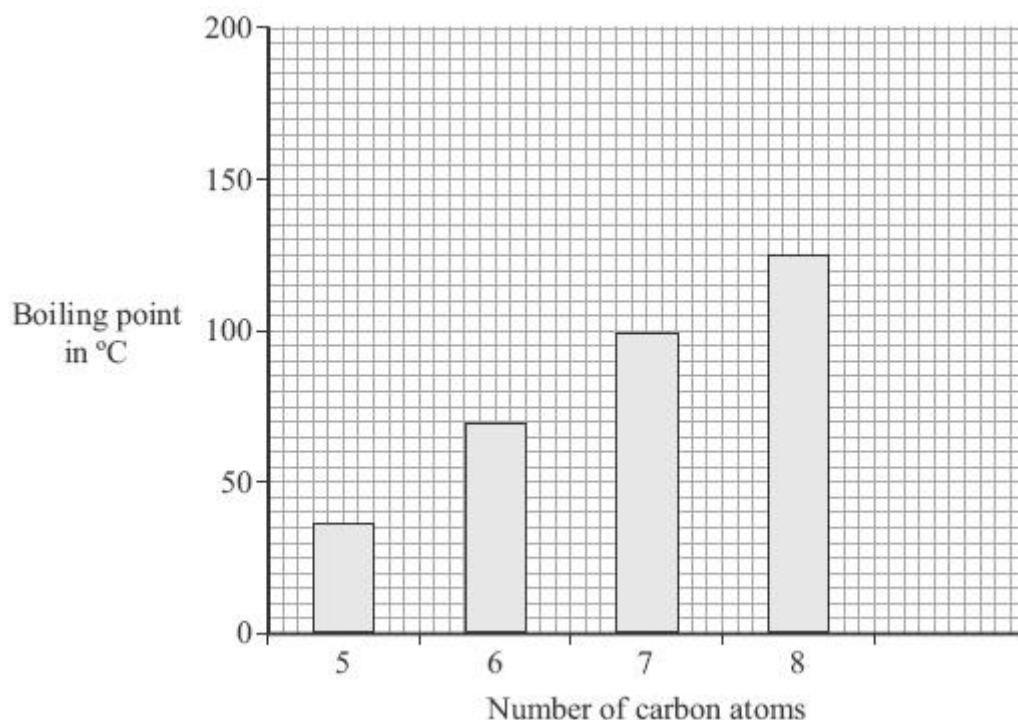
Ethene is a hydrocarbon made up of carbon and _____ atoms.

(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.

(2)
(Total 10 marks)

Q40.

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.

(3)

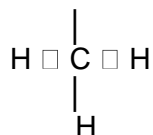
- (ii) The table gives the name and formula for each of the first three alkanes. Complete the table to show the formula of butane.

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:

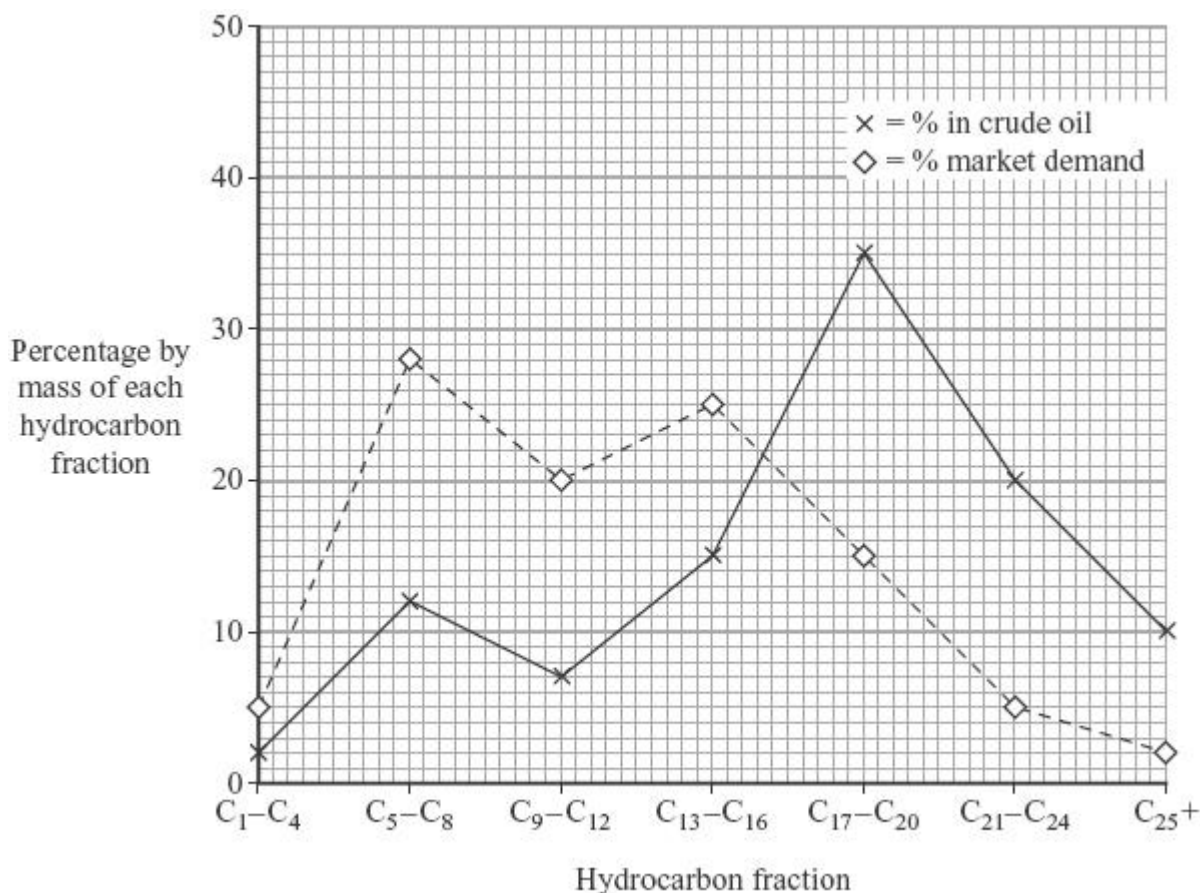
H



Draw the structural formula of propane, C_3H_8

(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 $\text{C}_5 - \text{C}_8$ fraction higher than the market demand for the $\text{C}_{21} - \text{C}_{24}$ 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 $\text{C}_5 - \text{C}_8$ fraction has low supply and high market demand.

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

1. _____

2. _____

3. _____

(3)
(Total 10 marks)

Q41.

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

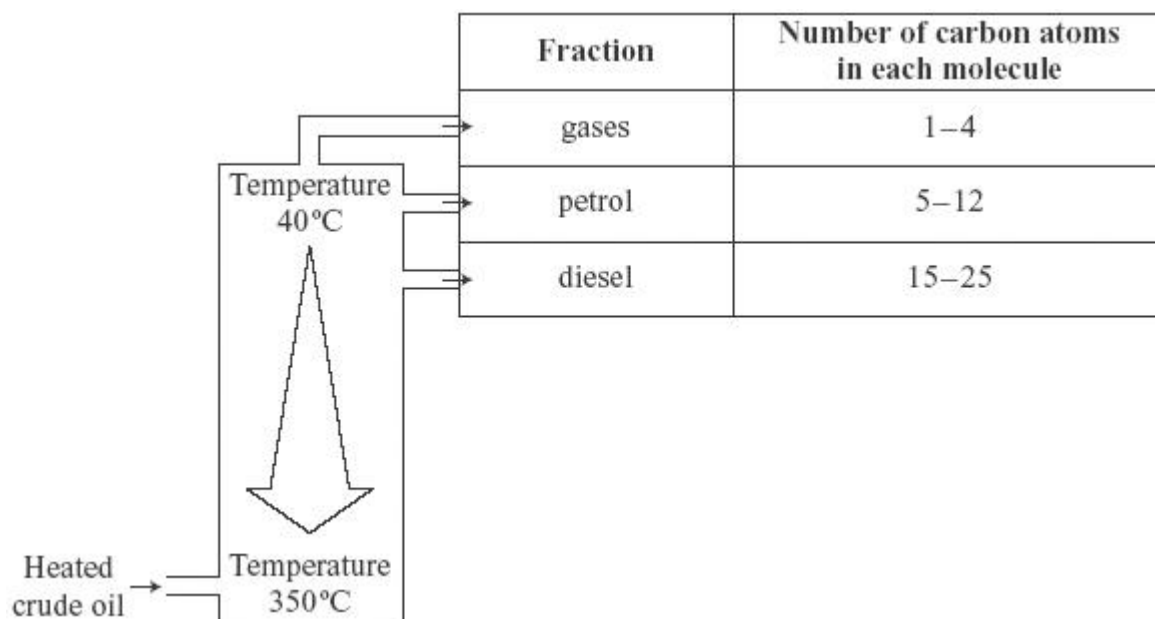
- (a) Crude oil is a mixture of hydrocarbons.

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.

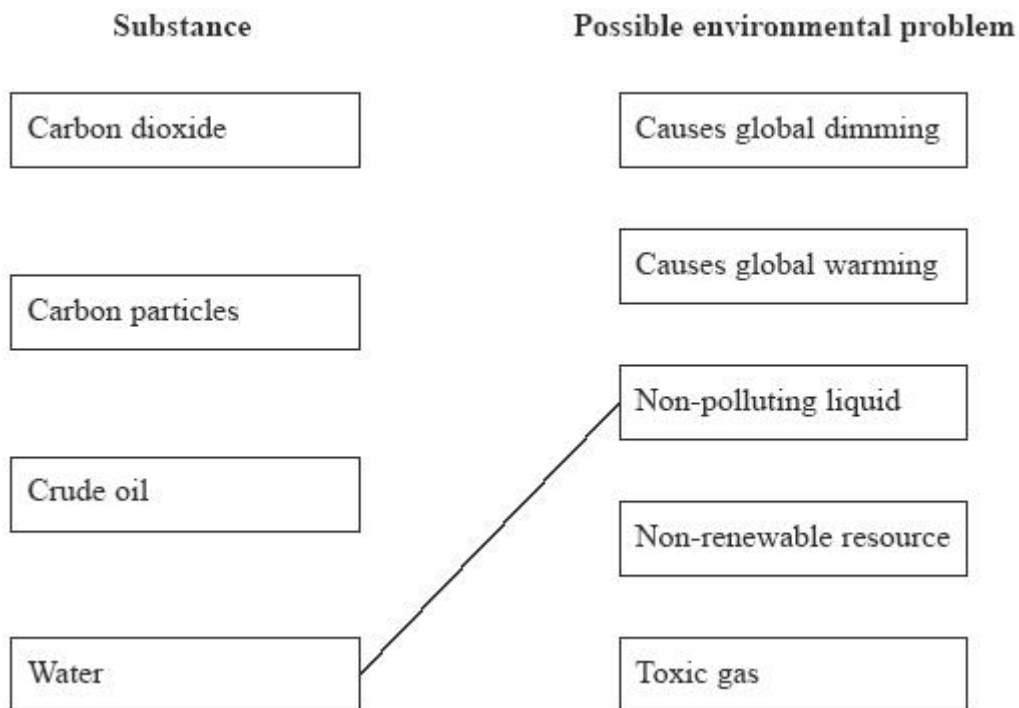
(2)

- (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)

Q42.

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?

(1)

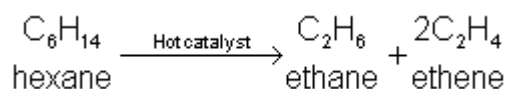
- (ii) Ethanol, C_2H_5OH , burns to release heat energy.

Complete the balanced symbol equation by writing in the formulae of the two products.



(2)

- (b) The cost of producing a bio-fuel, such as ethanol, by fermentation, is at least three times higher than the production cost of petrol. It costs less to produce ethanol from alkanes. In the production, the vapour of an alkane is passed over a hot catalyst.



Ethene is then converted into ethanol.

- (i) What has happened to the hexane to produce ethene?

(1)

- (ii) Complete the structural formula for ethene, C₂H₄.



(1)

- (iii) Name the compound that is added to ethene to produce ethanol, C₂H₅OH.

(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.

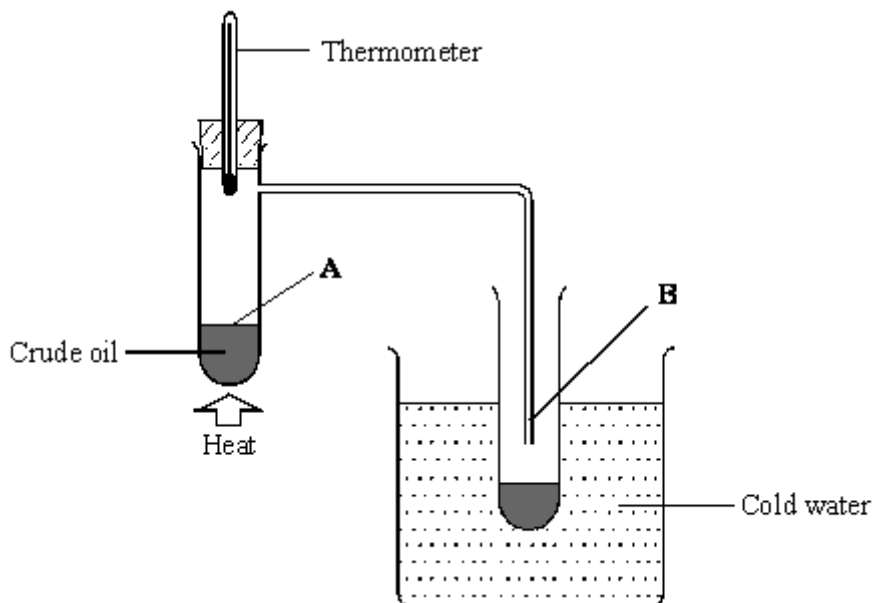
Q43.

- (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

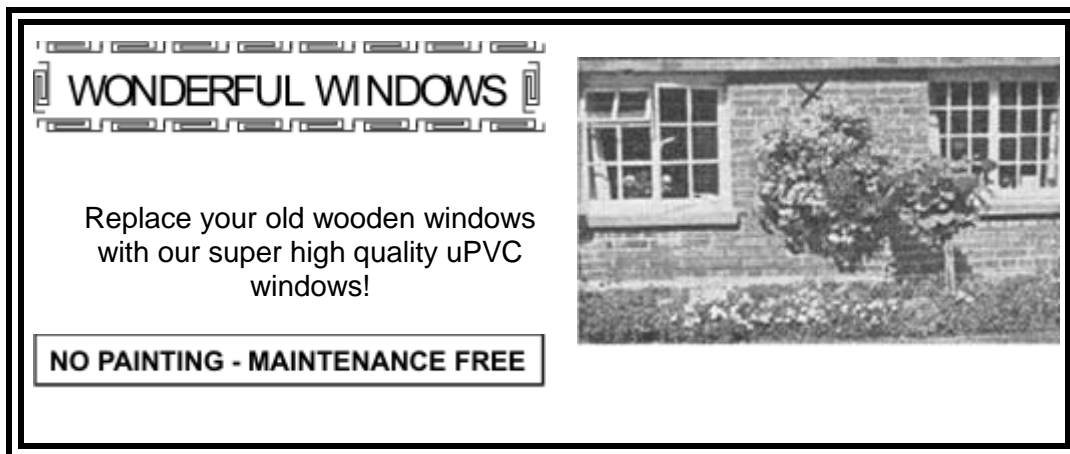
 their boiling point and the

more
less

 volatile they are.

Q44.

Modern window frames are often made from uPVC which contains the plastic poly(chloroethene).



- (a) State why plastic window frames need no painting or maintenance.

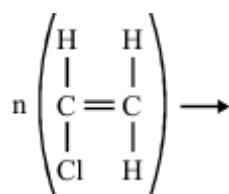
(1)

- (b) Poly(chloroethene) is a polymer formed by the *addition polymerisation* of chloroethene.

- (i) Chloroethene is an unsaturated molecule. Why is this molecule said to be unsaturated?

(1)

- (ii) Complete the diagram to represent how poly(chloroethene) is formed from chloroethene.



(3)

- (iii) Explain what is meant by the term *polymerisation*.

(2)

(iv) Why is this an *addition polymerisation*?

(1)

(Total 8 marks)

Q45.

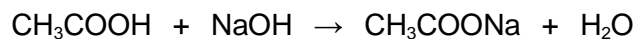
(a) This label has been taken from a bottle of vinegar.



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);

Concentration = _____ moles per cubic decimetre

(2)

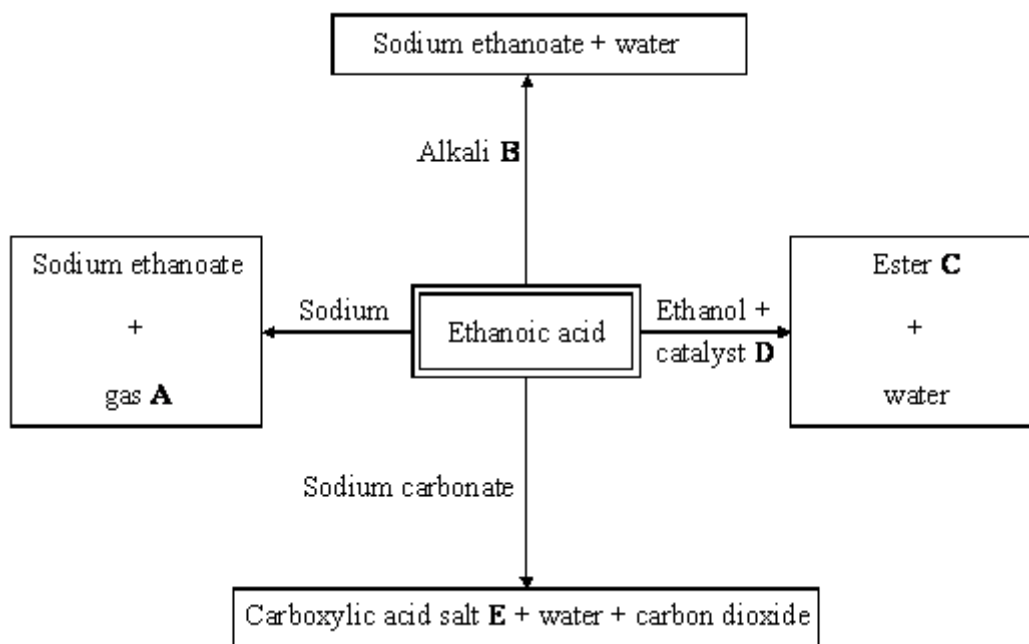
(ii) in grams per cubic decimetre (grams per litre).

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

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)

Q46.

Petrol is a hydrocarbon fuel.

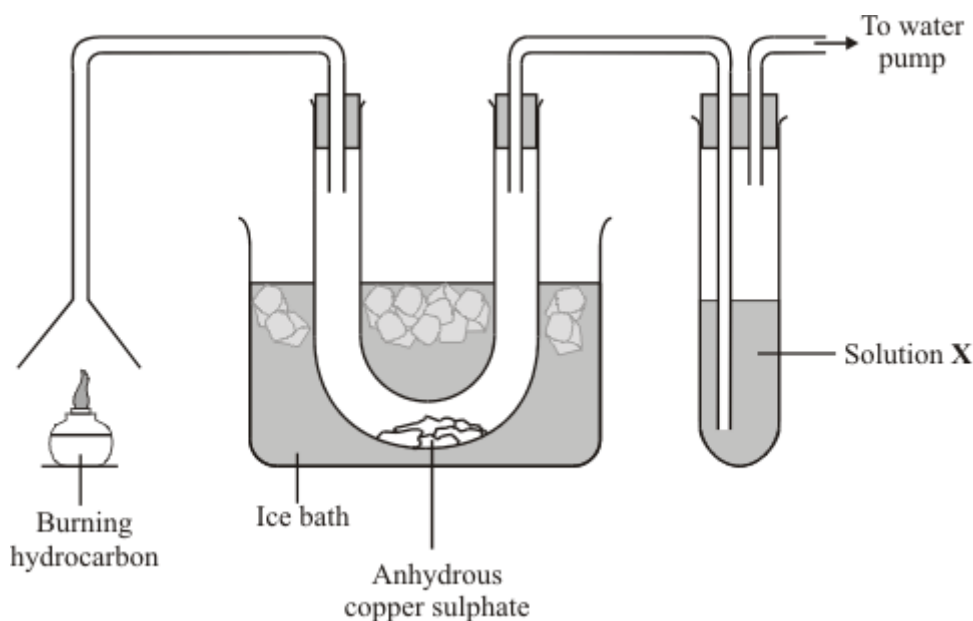
- (a) Complete this sentence.

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.

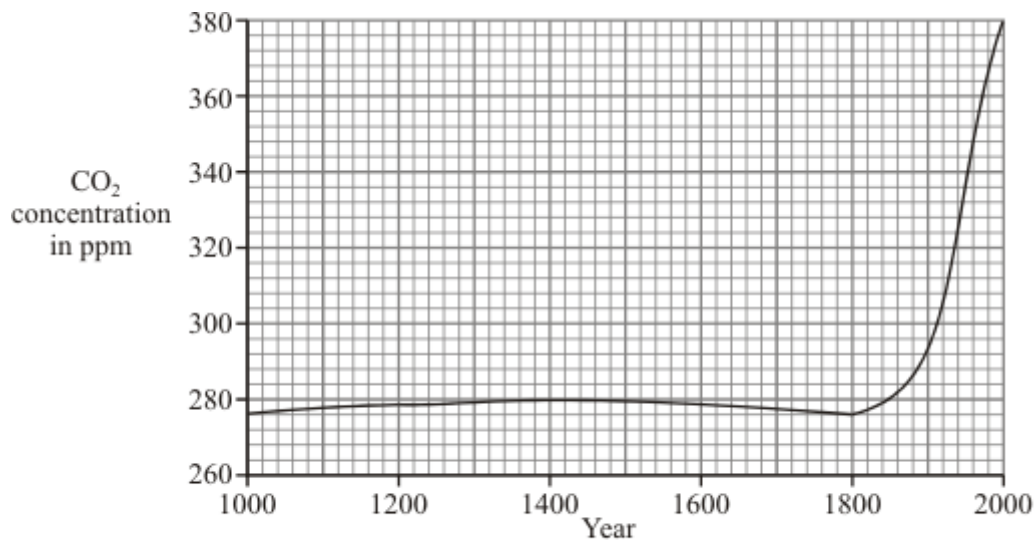
(1)

- (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.

(3)

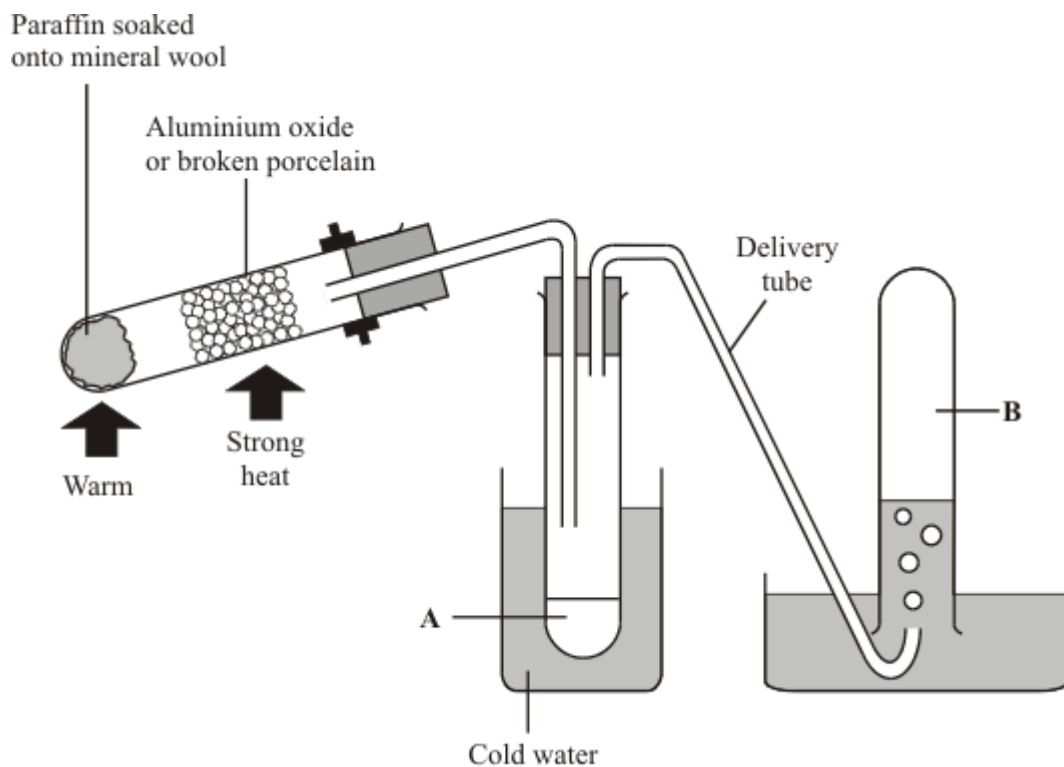
- (ii) Suggest why the concentration of carbon dioxide in the air has changed since the year 1800.

(1)

(Total 9 marks)

Q47.

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?

(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.

(3)

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

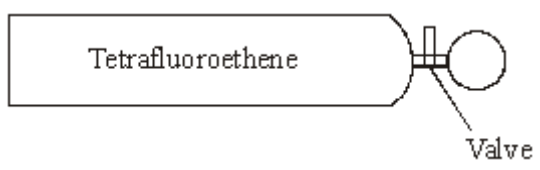
Suggest a method of separating this mixture.

(1)

(Total 9 marks)

Q48.

In 1939 Roy Plunkett opened the valve on a new cylinder of tetrafluoroethene gas. No gas came out!

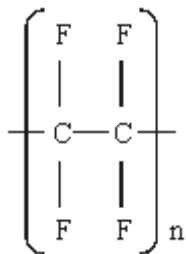


He cut the cylinder open and found that the gas had changed into a white solid. This solid was an addition polymer.

(a) Give the name of the addition polymer that formed inside the cylinder.

(1)

(b) The structure of this polymer can be represented by the diagram below.



Draw the structure of the monomer, tetrafluoroethene, from which it is formed.

(2)

(c) Describe how this addition polymer forms from monomers.

(3)

(Total 6 marks)

Q49.

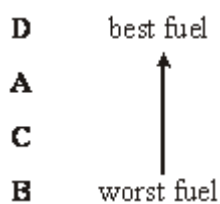
The table gives some data about four fuels, **A**, **B**, **C** and **D**.

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:



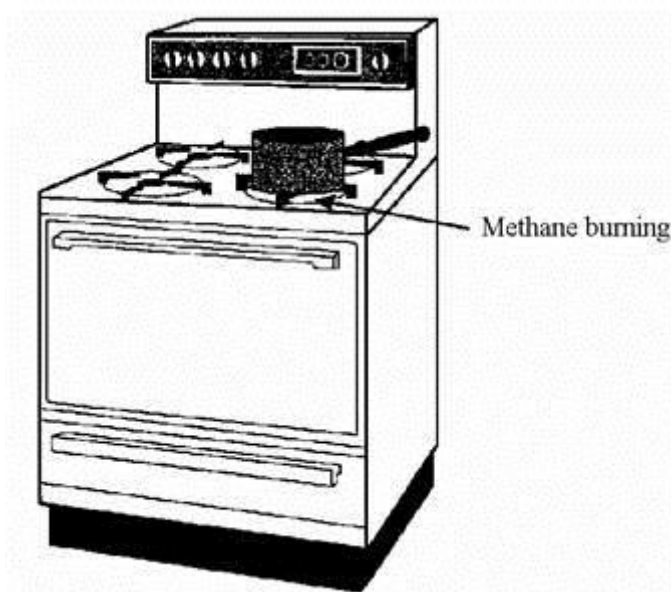
Use the information in the table to suggest reasons why the student chose this order.

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.

(Total 4 marks)

Q50.

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 → _____ + _____

(2)

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

(1)

(Total 5 marks)

Q51.

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

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

(2)

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

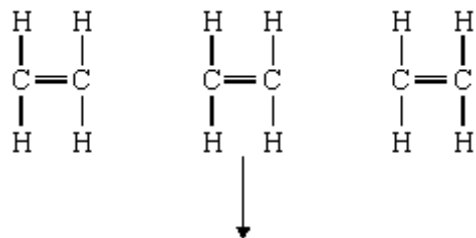
Test _____

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.

(2)

(Total 8 marks)

