

- Q1.** (a) The hydrocarbon $C_{16}H_{34}$ was heated strongly in the absence of air.

This is one of the reactions which took place:



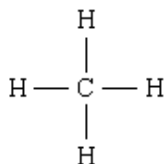
This type of reaction is carried out because there is a greater demand for the products than for the original hydrocarbon.

Suggest **two** reasons for this.

- 1
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- 2
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(2)

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

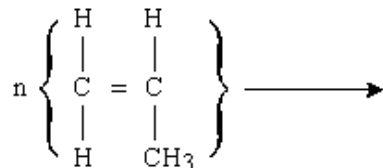


Draw a molecule of the compound ethene, C_2H_4 .

(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.

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(1)

(Total 6 marks)

- Q2.** 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.

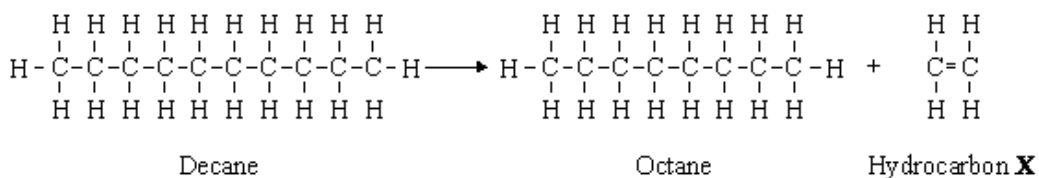
Give the **formulae** of these two compounds.

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(1)

(Total 7 marks)

- Q3.** The high demand for petrol (octane) can be met by breaking down longer hydrocarbons, such as decane, by a process known as cracking.



(a) Apart from heat, what is used to make the rate of this reaction faster?

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(1)

(b) Octane is a *hydrocarbon*.

(i) What does *hydrocarbon* mean?

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(1)

(ii) Give the molecular formula of octane.

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(1)

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

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

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(1)

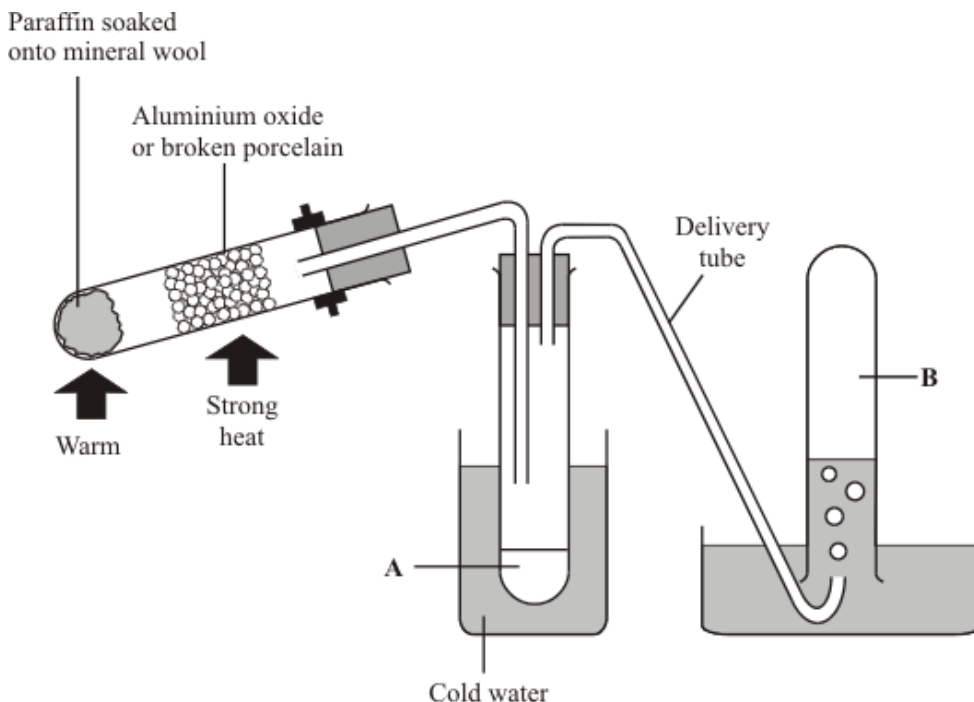
(ii) What is the name of the process in which **X** is changed into poly(ethene)?

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(1)

(Total 5 marks)

- Q4.** The diagram shows an apparatus that can be used to carry out cracking reactions in a laboratory.



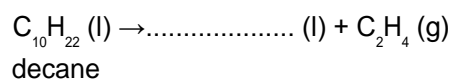
- (a) Why is aluminium oxide or broken porcelain used?

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(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.

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(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.

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(1)

(Total 9 marks)

Q5. 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'.

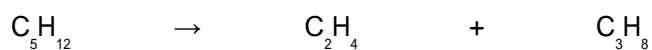
- (a) Plastic water bottles are made from a polymer.
The polymer is made from ethene.
Ethene is made by cracking hydrocarbons.

- (i) Name the polymer made from ethene.

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(1)

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

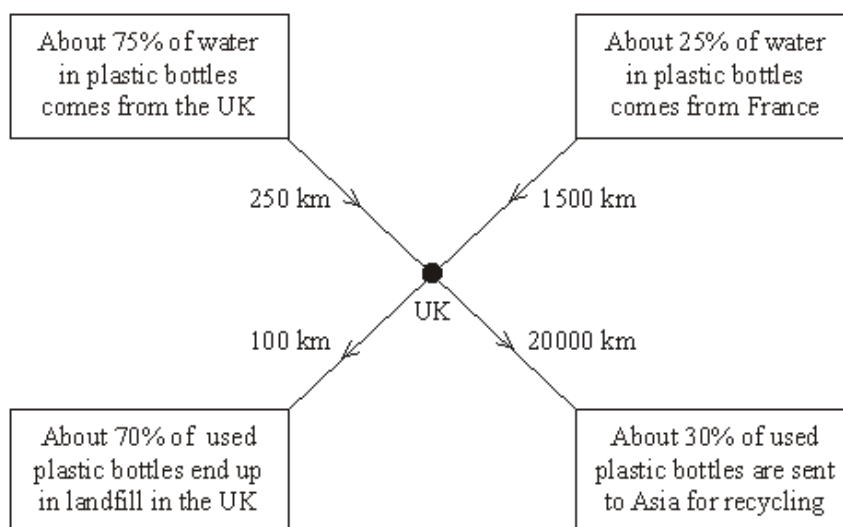


Explain why there is a 'carbon cost' for the process of cracking a hydrocarbon.

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(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.

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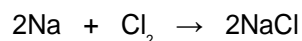
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(3)
(Total 6 marks)

- Q6.** (a) The chemical equation for a reaction of sodium is shown below.



Describe this reaction of sodium in terms of the names of the substances and the numbers of the atoms involved.

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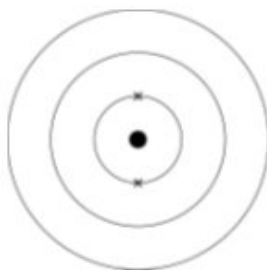
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(3)

(b) Use the periodic table on the data sheet to help you to answer this question.

(i) Complete the electronic structure of sodium.



(2)

(ii) How is the electronic structure of sodium different from the electronic structure of chlorine?

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(1)

(Total 6 marks)

Q7. Most plastic bags are made from poly(ethene).

Poly(ethene) is a polymer made from ethene.

Ethene is made by cracking saturated hydrocarbons from crude oil.

(a) Use words from the box to complete the sentences about cracking.

alkanes	alkenes	catalyst	fuel	gas
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Cracking involves heating the to make a vapour.

The vapour is either passed over a hot or mixed with steam and heated to a very high temperature so that thermal decomposition reactions happen.

(2)

(b) Poly(ethene) molecules are made from ethene molecules by a polymerisation reaction.

Describe what happens in a polymerisation reaction.

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(2)

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

There are millions of plastic bags in use. After use most of these plastic bags are buried in landfill sites. The amount sent to landfill could be reduced if the plastic bags:

- could be reused
- could be recycled by melting and making into new plastic products
- could be burned to release energy

Use the information above and your knowledge and understanding to give the positive and negative environmental impacts of using these methods to reduce the amount of plastic bags sent to landfill.

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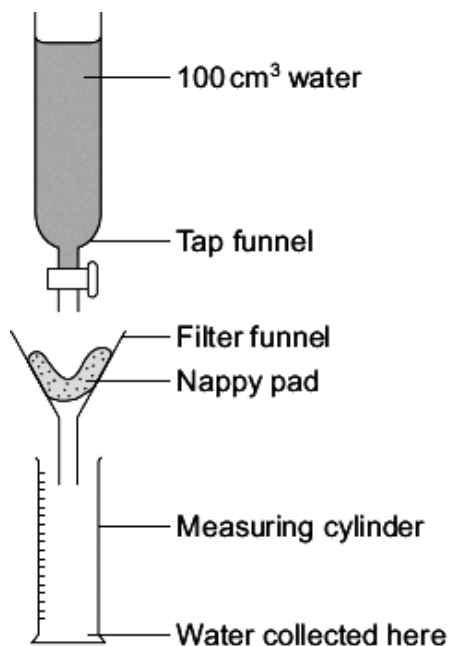
(6)
(Total 10 marks)

Q8. Disposable nappies for babies need to absorb as much water as possible.

Disposable nappies have a pad containing a special polymer called a hydrogel.

Hydrogels absorb water.

A company called Aqanaps compared the water absorption of its nappy pads with nappy pads made by other companies.



- A scientist from Aqanaps poured 100cm³ of water onto the pad of one of its nappies.
- He measured the volume of water that passed through.
- He did the test three times using a new nappy pad for each test.
- The scientist then repeated the procedure using the nappy pads from three other companies, **A**, **B** and **C**.

The results are shown in the table.

Company	Volume of water collected in cm ³		
	Pad 1	Pad 2	Pad 3
Aqanaps	55	57	55
A	47	46	39
B	65	63	64
C	38	39	38

(a) (i) Choose **one** result in the table that should be tested again.

Result: Company Pad

Explain why you chose this result.

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(2)

(ii) Suggest **one** variable that should be controlled in this investigation.

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(1)

(iii) Suggest **one** possible cause of error in this investigation.

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(1)

(b) (i) The Aqanaps company studied the results. The company concluded that it should increase the amount of hydrogel used in its nappy pads.

Give **two** reasons why the company decided to increase the amount of hydrogel used in its nappy pads.

1
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2
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(2)

(ii) Suggest **one** disadvantage for the company if it increases the amount of hydrogel used in its nappy pads.

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(1)

(Total 7 marks)

Q9. 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?

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(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.

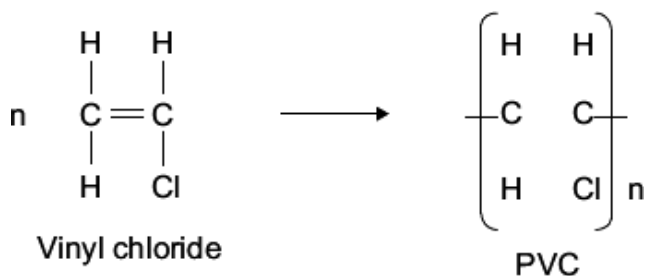
Complete the chemical equation by writing in the formula of the product vinyl chloride.



(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.

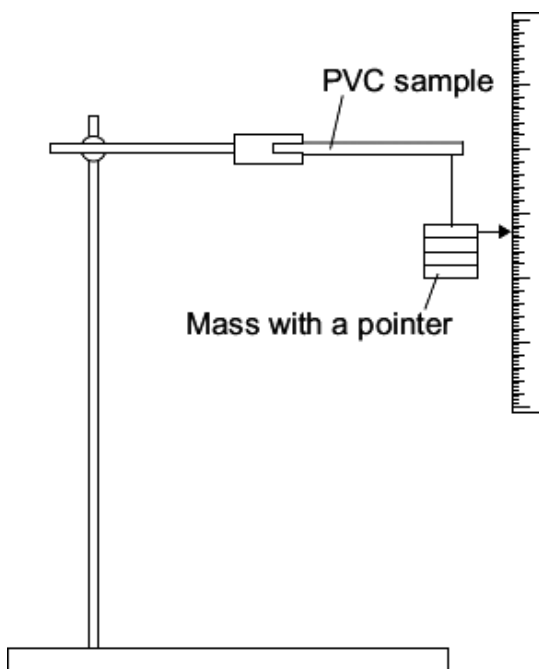


(1)

- (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.

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(1)

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

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(1)

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

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(2)

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

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(1)

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

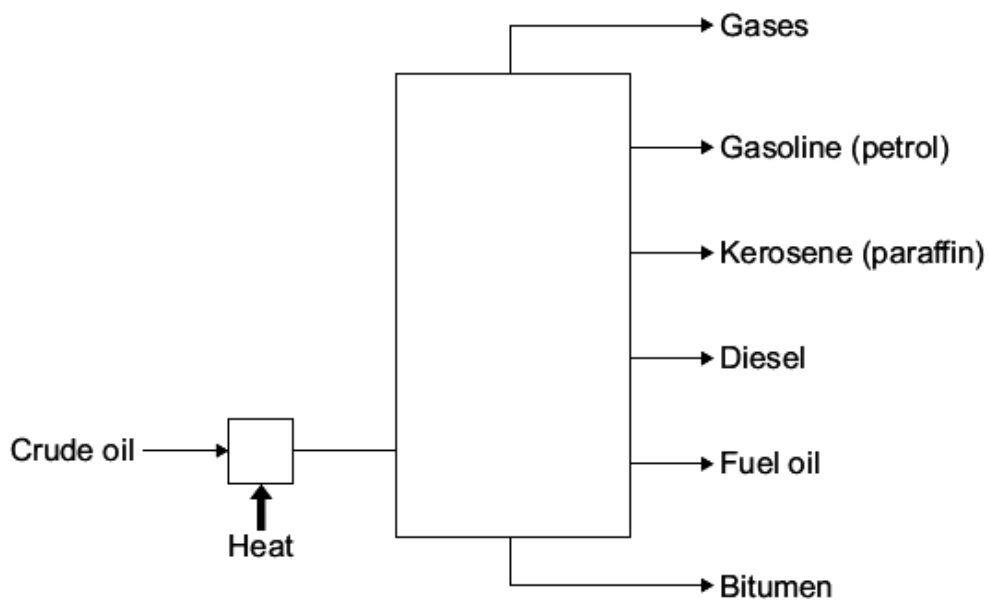
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(1)

(Total 10 marks)

Q10. 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.

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(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?

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(1)

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

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(1)

- (c) Fuels are substances that release energy.

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

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(1)

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

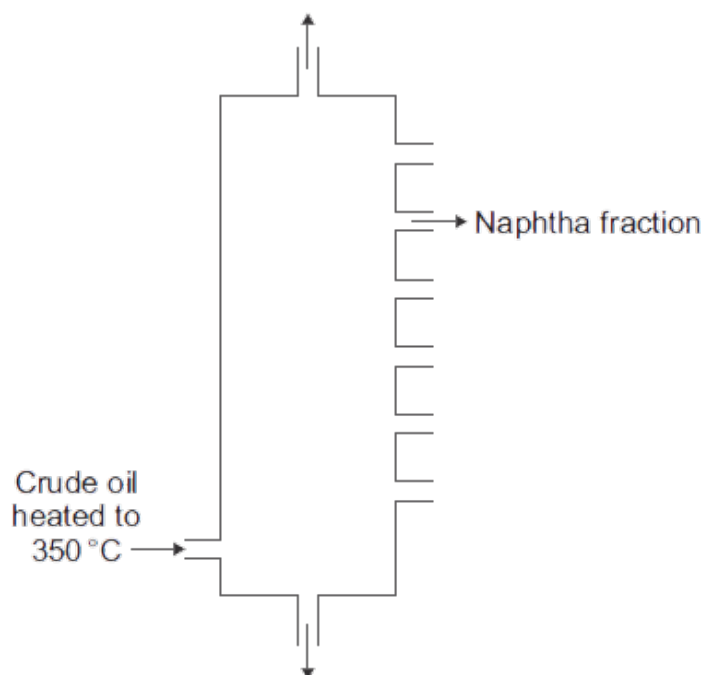
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(2)

(Total 8 marks)

Q11. 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

(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).

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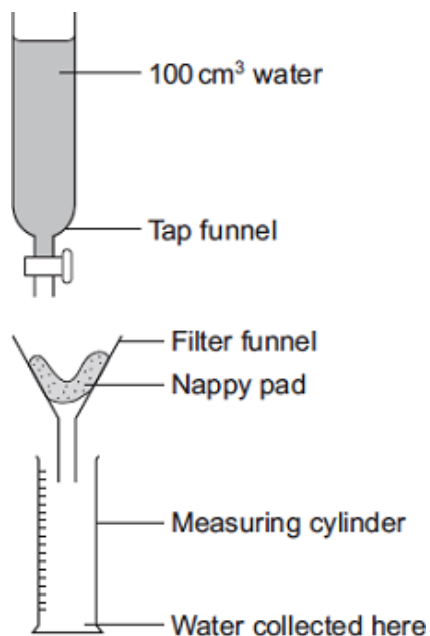
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(6)
(Total 10 marks)

Q12. Disposable nappies for babies need to absorb as much water as possible. Disposable nappies have a pad containing a special polymer called a hydrogel. Hydrogels absorb water.

A company called Aqanaps compared the water absorption of its nappy pads with nappy pads made by other companies.



- A scientist from Aqanaps poured 100 cm³ of water onto the pad of one of their nappies.
- He measured the volume of water that passed through.
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- The scientist then repeated the procedure using the nappy pads from three other companies, **A**, **B** and **C**.

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(a) (i) Choose **one** result in the table that should be tested again.

Result: Company Pad

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(2)

(ii) Suggest **one** variable that should be controlled in this investigation.

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(1)

(iii) Suggest **one** possible cause of error in this investigation.

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(1)

(b) (i) The Aqanaps company studied the results. The company concluded that it should increase the amount of hydrogel used in its nappy pads.

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1
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2
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(2)

(ii) Suggest **one** disadvantage for the company if it increases the amount of hydrogel used in its nappy pads.

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(1)

(Total 7 marks)

