

Surname						Other Names					
Centre Number						Candidate Number					
Candidate Signature											

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General Certificate of Secondary Education
Summer 2004



**SCIENCE DOUBLE AWARD (MODULAR)
HIGHER TIER
Paper 2**

3468/2H

H

Monday 14 June 2004 9.00 am to 10.30 am

In addition to this paper you will require:

- the Data Sheet (enclosed);
- a ruler.

You may use a calculator.

For Examiner's Use			
Number	Mark	Number	Mark
1		8	
2		9	
3		10	
4		11	
5		12	
6		13	
7		14	
		15	
		16	
		17	
Total (Column 1)	→		
Total (Column 2)	→		
TOTAL			
Examiner's Initials			

Time allowed: 1 hour 30 minutes

Instructions

- Use blue or black ink or ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions in the spaces provided.
- Do all rough work in this book. Cross through any work you do not want marked.

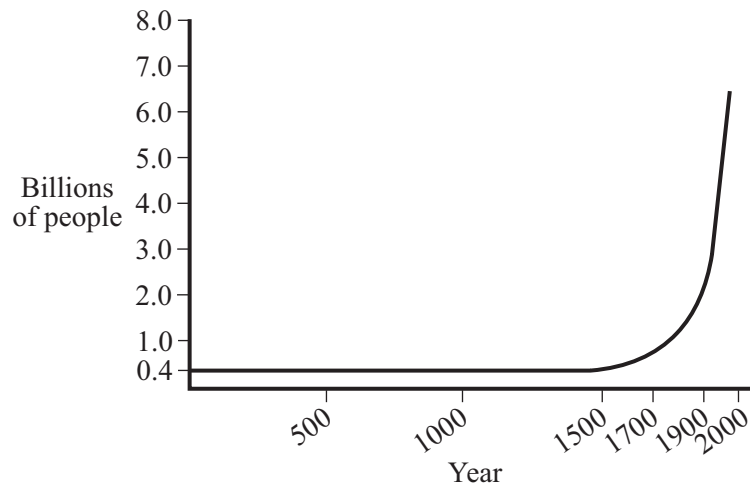
Information

- The maximum mark for this paper is 90.
- Mark allocations are shown in brackets.
- You are reminded of the need for good English and clear presentation in your answers.

ENVIRONMENT

- 1 Improving the quality of life for everyone without damaging the planet for the future is known as sustainable development.

One problem is the rapid growth in the Earth's population of humans during the last 500 years. This is shown by the graph.



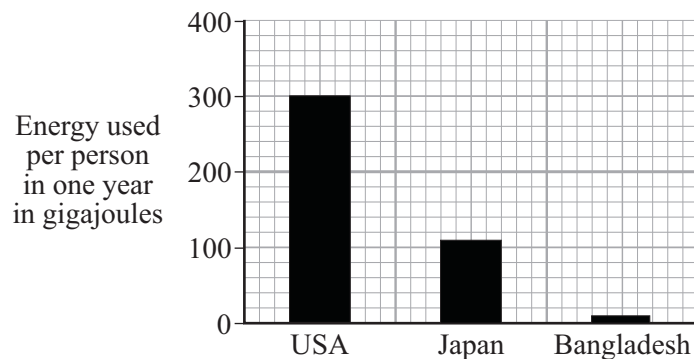
- (a) When the Earth's population was much smaller, the effects of human activities on forests were usually small and local. In the past 500 years there has been large-scale deforestation in some areas. Give **two** reasons for this.

1

2

(2 marks)

- (b) Look at the bar chart. It shows the average amount of energy used by each person in one year in the USA, Japan and Bangladesh.



(i) Suggest **one** reason why so much more energy is used per person in the USA than in Bangladesh.

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(1 mark)

(ii) Using a lot of resources for energy harms the Earth. Explain why.

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(2 marks)

(c) As we are using more resources, waste management is becoming more important. In the UK much of the solid waste is still being dumped in landfill sites. In 1996, the UK government introduced a landfill tax because landfill sites were being used up. However, the year after the landfill tax was introduced it was estimated that 18 million tonnes of landfill waste was not reported. The government was trying to encourage other forms of waste management, such as:

- reduce waste
- reuse waste
- recycle waste

(i) Explain the main problem caused by the landfill tax.

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(2 marks)

(ii) Describe **one** example of how each of the different forms of waste management can be put into practice.

Reduce waste.....

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Reuse waste.....

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Recycle waste.....

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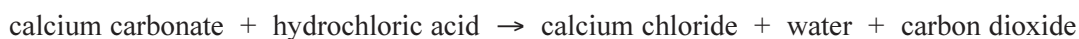
(3 marks)

10

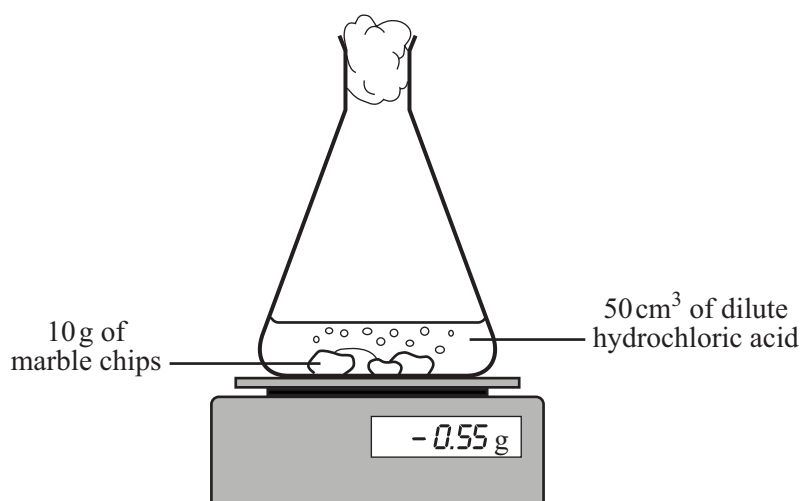
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PATTERNS OF CHEMICAL CHANGE

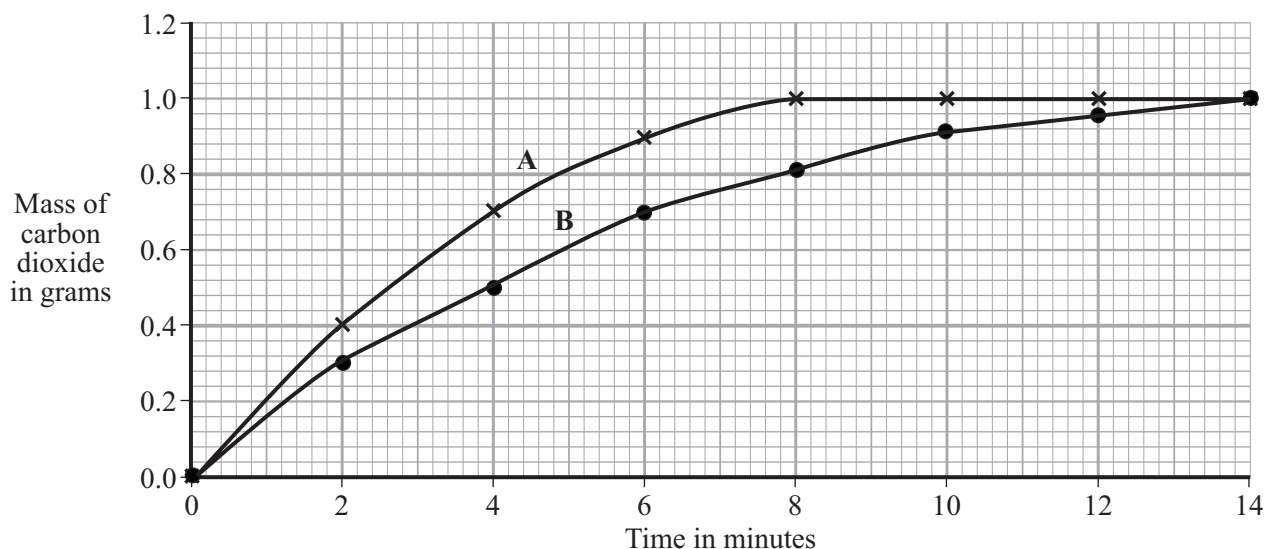
2 Marble is a rock that contains mainly calcium carbonate. This reacts with hydrochloric acid.



The rate of this reaction was followed by measuring the mass of carbon dioxide formed.



Two 10 g samples of marble, **A** and **B**, were each reacted with 50 cm³ of dilute hydrochloric acid, at different temperatures. The mass of carbon dioxide formed in each reaction was recorded and plotted to produce the graph below.



Each reaction stopped when no more carbon dioxide was formed.

In both experiments some marble was left unreacted when the reaction stopped.

(a) Explain how you can tell which sample, **A** or **B**, reacted faster with the dilute hydrochloric acid.

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(2 marks)

(b) The faster rate of reaction was caused by using a higher temperature.
Explain, in terms of particles, why a higher temperature causes a faster rate of reaction.

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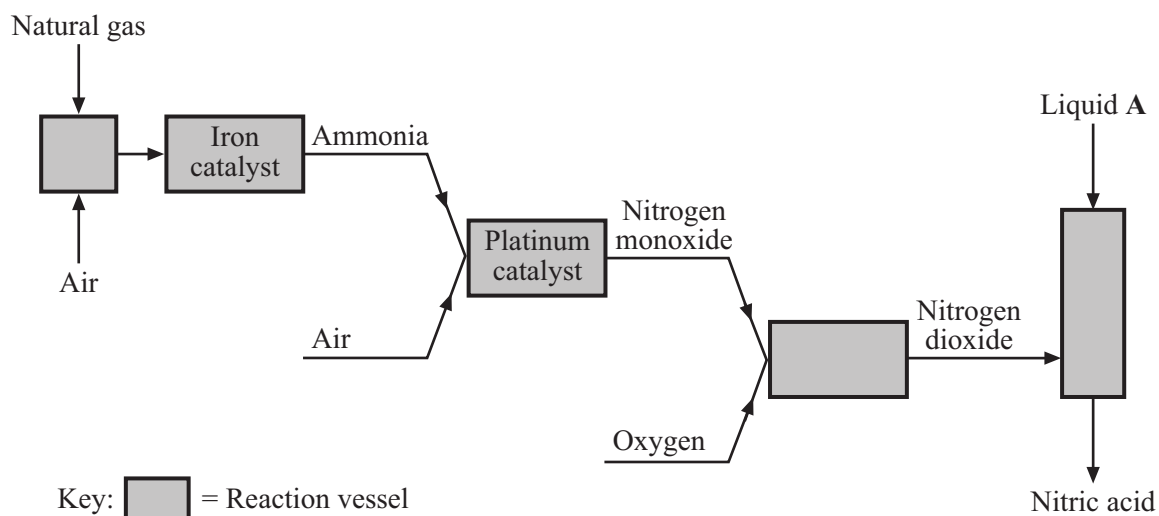
(3 marks)

5

TURN OVER FOR THE NEXT QUESTION

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- 3 The flow diagram shows some stages in the manufacture of the fertiliser ammonium nitrate (NH_4NO_3).



- (a) The elements needed to make ammonia (NH_3) are obtained from natural gas and air. Which element is obtained from the air?

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(1 mark)

- (b) The word equation for the formation of nitrogen monoxide is:



The platinum catalyst needs to be heated only at the start of the reaction. Suggest why.

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.....
(1 mark)

- (c) Name the liquid **A** that reacts with nitrogen dioxide (NO_2) to produce nitric acid (HNO_3).

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(1 mark)

- (d) Describe how ammonium nitrate (NH_4NO_3) can be made from **two** of the products shown in the flow diagram.

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(2 marks)

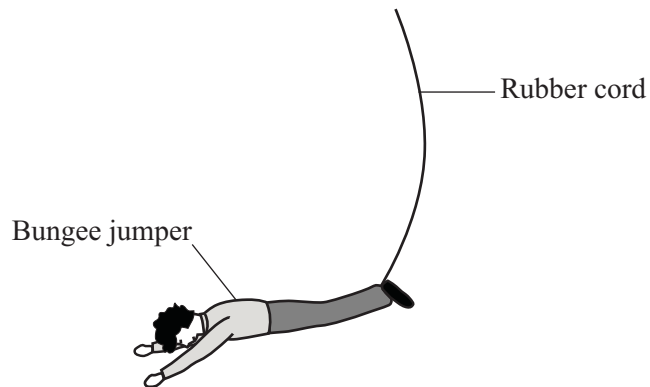
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TURN OVER FOR THE NEXT QUESTION

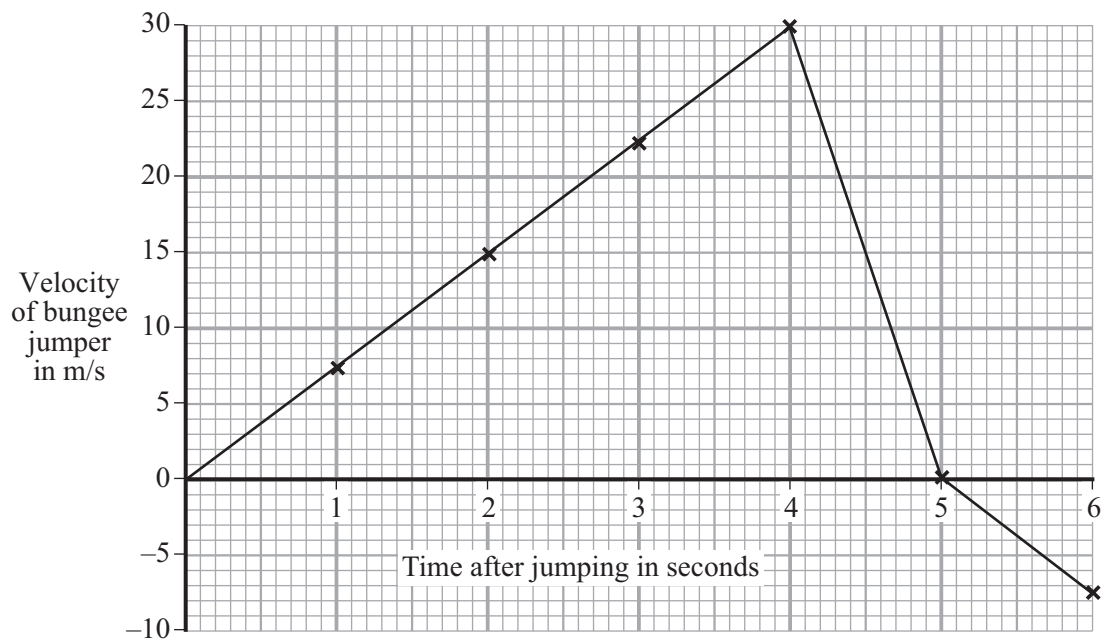
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FORCES

4 In bungee jumping, a fixed rubber cord is fastened to the jumper's ankles.



The graph shows how the bungee jumper's velocity changes during part of the jump.



(a) Calculate the acceleration of the bungee jumper between 2 and 4 seconds. Show your working.

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Acceleration =m/s²
(3 marks)

(b) Describe, in as much detail as you can, what happens to the bungee jumper after 4 seconds.

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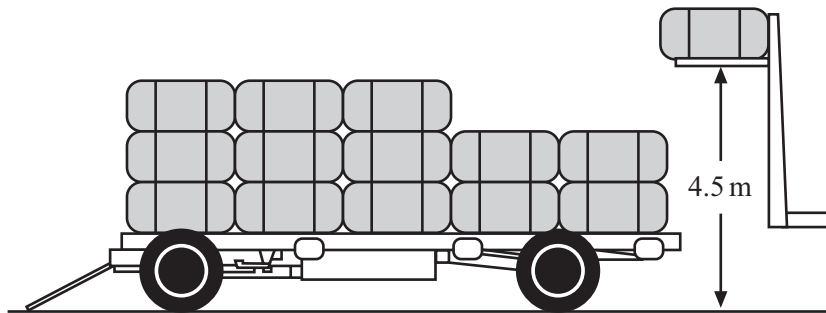
(3 marks)

6

TURN OVER FOR THE NEXT QUESTION

Turn over ►

- 5 A forklift truck was used to stack boxes on to a trailer.
It lifted a box weighing 1900 N through 4.5 m.



- (a) Calculate the work done on the box. Show your working.

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Work done = J
(3 marks)

- (b) The efficiency of the forklift truck is about 80%.
Explain what happens to the wasted energy.

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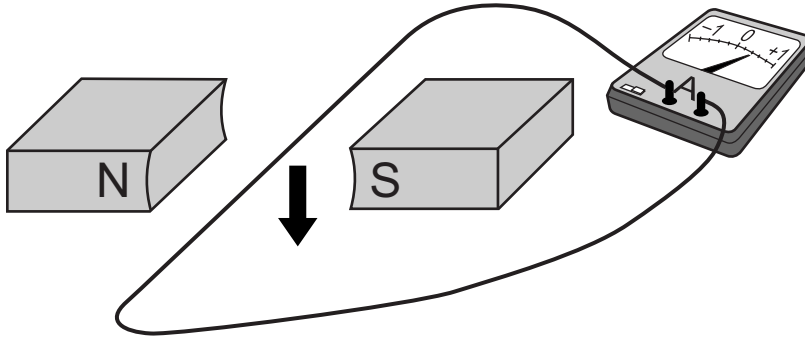
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(1 mark)



7 Magnets have many uses.

- (a) When the wire in the diagram is moved downwards, so that it ‘cuts through’ the magnetic field, the ammeter pointer moves to the right.



- (i) What happens to the ammeter pointer when the wire is moved upwards through the magnetic field?

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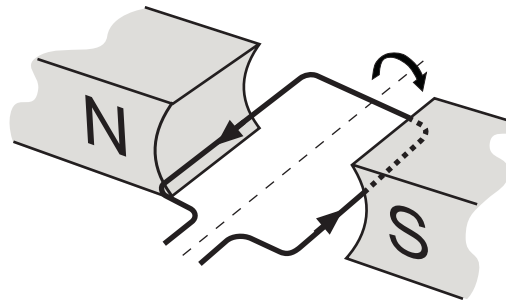
 (1 mark)

- (ii) Why does a current flow in the wire when it is moved through the magnetic field?

.....

 (1 mark)

- (b) Rotating a wire coil in a magnetic field generates electricity.



Give **two** ways of increasing the current generated.

1
 2
 (2 marks)

- (c) Some of the methane in the atmosphere comes from leaks in gas pipelines, crude oil well-heads, natural gas deposits, landfill sites, melting permafrost and termites.

To reduce the amount of methane in the atmosphere, it seems like a good idea to trap and burn as much of the methane as possible.

This may **not** be as good an idea as it seems. Explain why.

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(2 marks)



TURN OVER FOR THE NEXT QUESTION

Turn over ►

PATTERNS OF CHEMICAL CHANGE

10 'Iron tablets' usually contain iron sulphate (FeSO_4).

- (a) This salt can be made by reacting iron with sulphuric acid.



Calculate the mass of iron sulphate that could be obtained from 4 g of iron.

(Relative atomic masses: Fe = 56, H = 1, O = 16, S = 32)

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Mass of iron sulphate = g
(3 marks)

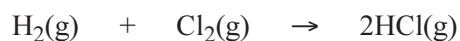
- (b) Under different conditions, another type of iron sulphate may form.
Balance the symbol equation for this reaction.



(1 mark)



11 Hydrogen chloride is made by reacting hydrogen with chlorine.



Bond	Bond energy in kJ
H – H	436
Cl – Cl	242
H – Cl	431

Is the reaction between hydrogen and chlorine exothermic or endothermic?
Use the bond energies to explain your answer.

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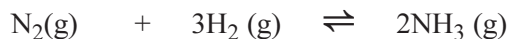
(3 marks)

3

TURN OVER FOR THE NEXT QUESTION

Turn over ►

12 In the Haber process, nitrogen and hydrogen react to make ammonia.



nitrogen + hydrogen \rightleftharpoons ammonia

Pressure in atmospheres	% ammonia present at equilibrium				
	Temperature in °C				
	100	200	300	400	500
10	88.2	50.7	14.7	3.9	1.2
25	91.7	63.6	27.4	8.7	2.9
50	94.5	74.0	39.5	15.3	5.6
100	96.7	81.7	52.5	25.2	10.6
200	98.4	89.0	66.7	38.8	18.3
400	99.4	94.6	79.7	55.4	31.9
1000	99.9	98.3	92.6	79.8	57.5

The actual conditions used in the Haber process are usually 450 °C and 200 atmospheres.

- (a) What effect does increasing the pressure have on the percentage of ammonia made? Use the balanced symbol equation to explain why.

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(2 marks)

- (b) A lower temperature of 100 °C gives high percentages of ammonia at most pressures. Why is this temperature **not** used in the Haber process?

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(1 mark)

- (c) Describe and explain the effect of an increase in the temperature on the reaction between nitrogen and hydrogen in the Haber process.

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(3 marks)

6

TURN OVER FOR THE NEXT QUESTION

Turn over ►

FORCES

- 13** A rollercoaster car stops above a vertical drop.
Suddenly it falls under gravity.



The drop is 60 metres high and at the bottom of the drop the car travels at 125 km/h.
The acceleration experienced by the people in the car is 10 m/s^2 . The mass of the car and its passengers is 1210 kg.

Calculate the force exerted on the car and its passengers. Show your working.

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Force =N
(3 marks)

3

14 A rocket has a mass of 5000 kg and is travelling at a speed of 600 m/s.



(a) Calculate the rocket's kinetic energy in kilojoules. Show your working.

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Kinetic energy = kJ
(3 marks)

(b) Rockets are used to put satellites into orbit. There are two main kinds of satellite.

- Satellite **A** orbits the Earth once every 24 hours.
- Satellite **B** orbits the Earth every 1.25 hours.

Suggest the type of orbit **and** the purpose of each satellite.

Satellite **A**

Satellite **B**

(2 marks)



Turn over ►

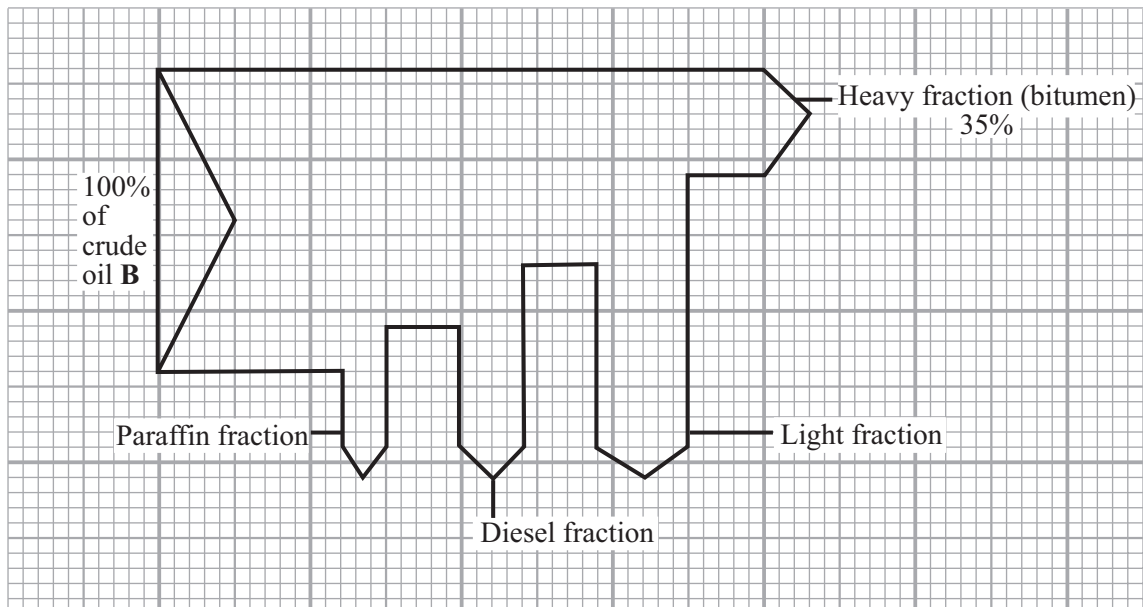
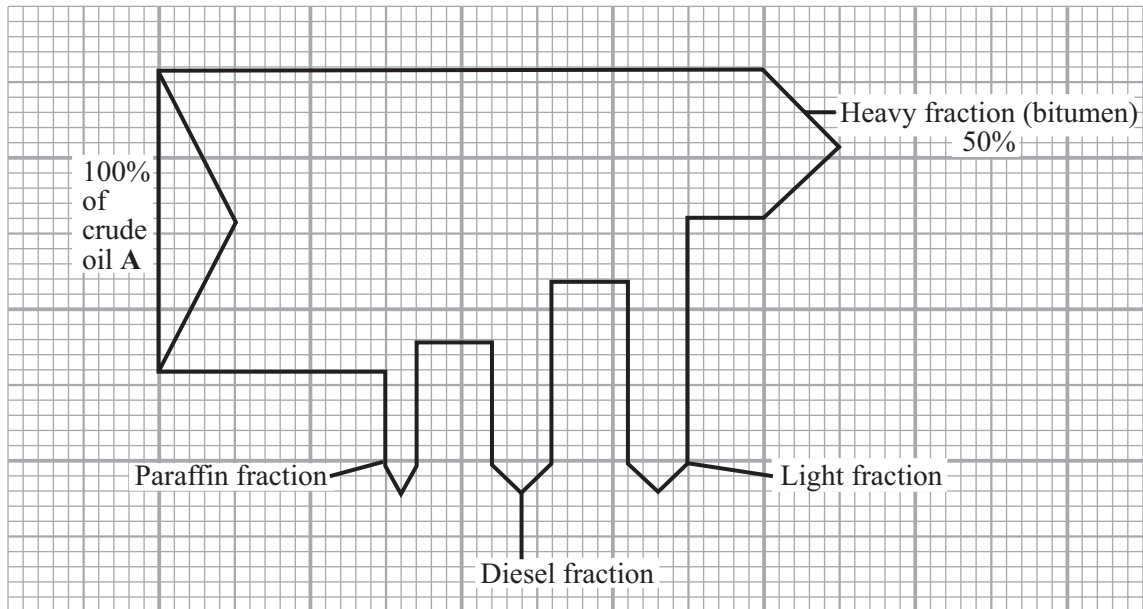
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TURN OVER FOR THE NEXT QUESTION

Turn over ►

QUESTIONS RELATING TO PREVIOUSLY TESTED MODULES

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



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

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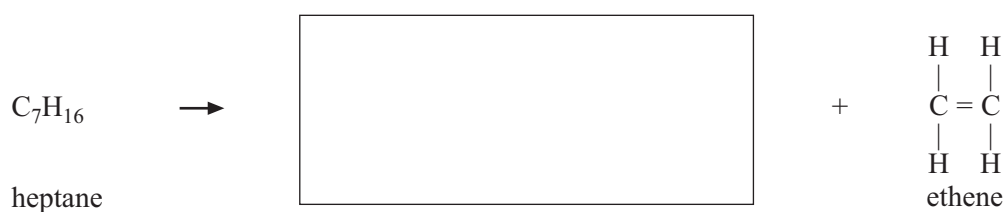
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(2 marks)

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



- (i) In the box, draw the structural formula of the other hydrocarbon produced. (1 mark)
- (ii) Describe how the reaction is carried out.

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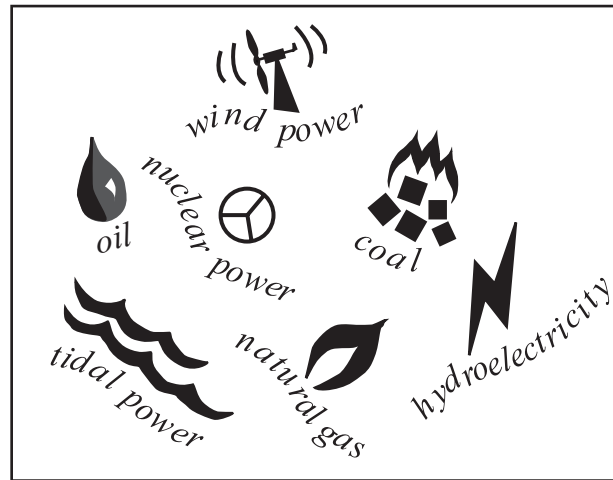
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(2 marks)

5

Turn over ►

17 Different energy sources are shown in the box.



An 'Eco-home' is one which is friendly to the environment. Imagine you are designing an 'Eco-home' which can use any of the energy sources above to generate electricity.

- (a) Choose **one** non-renewable energy source from the box above that could provide the electricity supply to your 'Eco-home', but which would be **unsuitable**.

Write the energy source in the table and explain, as fully as you can, why it is **unsuitable** for an 'Eco-home'.

Non-renewable energy source	Unsuitable for an 'Eco-home' because
.....
.....

(2 marks)

- (b) Choose **two** suitable renewable energy sources from the box opposite that could provide an electricity supply to your 'Eco-home'.

Write the two energy sources in the table and describe, in as much detail as you can, the undesirable environmental effects of using these.

Renewable energy source	Undesirable environmental effects
1
2

(4 marks)

6

END OF QUESTIONS

THERE ARE NO QUESTIONS PRINTED ON THIS PAGE