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Centre Number		Candidate Number	
Candidate Signature			

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General Certificate of Secondary Education
June 2006



SCIENCE: DOUBLE AWARD A (MODULAR)
Paper 2
Higher Tier

3468/2H

Wednesday 14 June 2006 9.00 am to 10.30 am

For this paper you must have:

- the Data Sheet (enclosed)
- a ruler

You may use a calculator.

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.
- Answer the questions in the spaces provided.
- Do all rough work in this book. Cross through any work you do not want marked.

Information

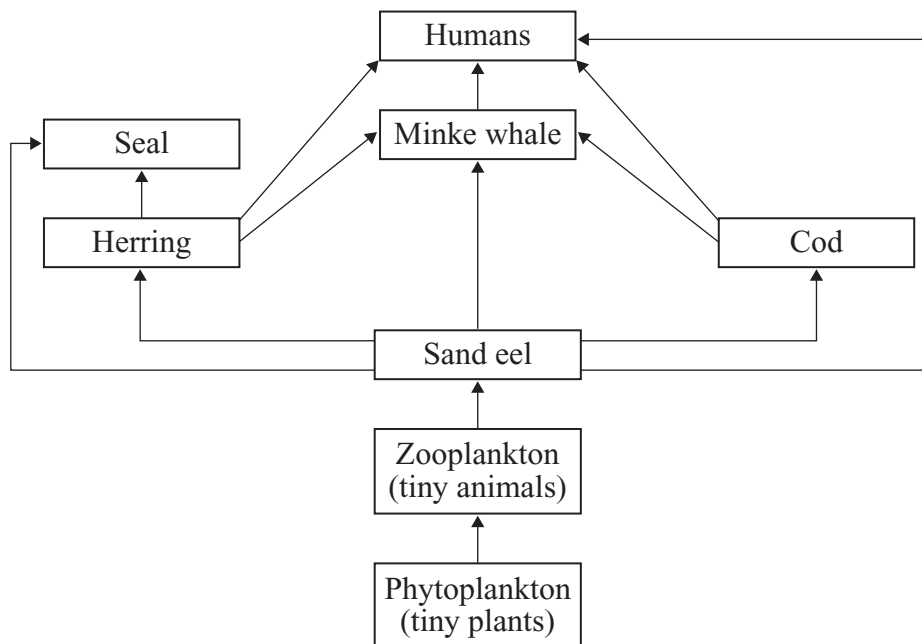
- The maximum mark for this paper is 90.
- The marks for questions are shown in brackets.
- You are reminded of the need for good English and clear presentation in your answers.

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

ENVIRONMENT

- 1 Over-fishing has caused a large decrease in the number of cod in the North Sea. In 2004, a ban on cod fishing was proposed.

This is part of a food web for the North Sea.



- (a) Which of the organisms is a producer?

..... (1 mark)

- (b) One group of scientists states that the ban on cod fishing will **decrease** the number of sand eels.

Another group of scientists states that the ban will **increase** the number of sand eels.

Explain why both groups of scientists could be correct.

Sand eels could **decrease** in number because

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Sand eels could **increase** in number because.....

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(4 marks)

5

Turn over for the next question

Turn over ►

- 2 The greenhouse effect is causing environmental problems on Earth. Carbon dioxide is one of the greenhouse gases.

The table shows some sources of carbon dioxide in the atmosphere.

Source	Emission of carbon dioxide in kg per day
A human	1
A motorbike	5
A cow	7
A car	10
A lorry	165
A bus	351
A train	3 448
A ship	41 660
A plane	770 267
Total emissions	815 914

The data in the table suggest that the largest proportion of carbon dioxide emissions comes from transport.

- (a) What other factor must be considered when calculating the proportion of carbon dioxide emissions?

.....
(1 mark)

- (b) What process in humans and cows releases carbon dioxide?

.....
(1 mark)

(c) Use information in the table to suggest **two** ways in which carbon dioxide emissions could be reduced.

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(2 marks)

(d) Give **one** way in which the greenhouse effect is causing environmental problems on Earth.

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(1 mark)

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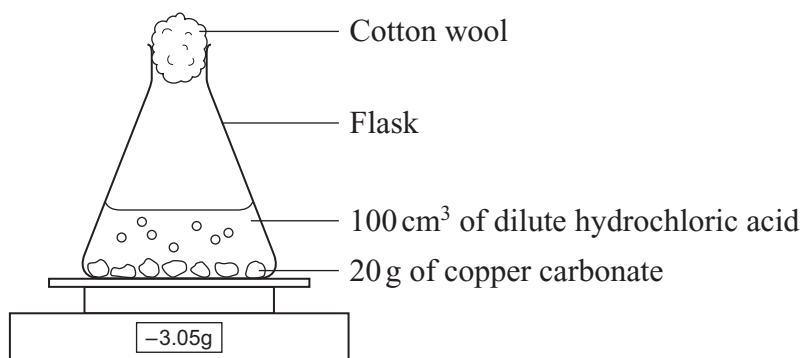
Turn over for the next question

Turn over ►

PATTERNS OF CHEMICAL CHANGE

- 3 The rate of the reaction between copper carbonate and hydrochloric acid was investigated as shown in the diagram.

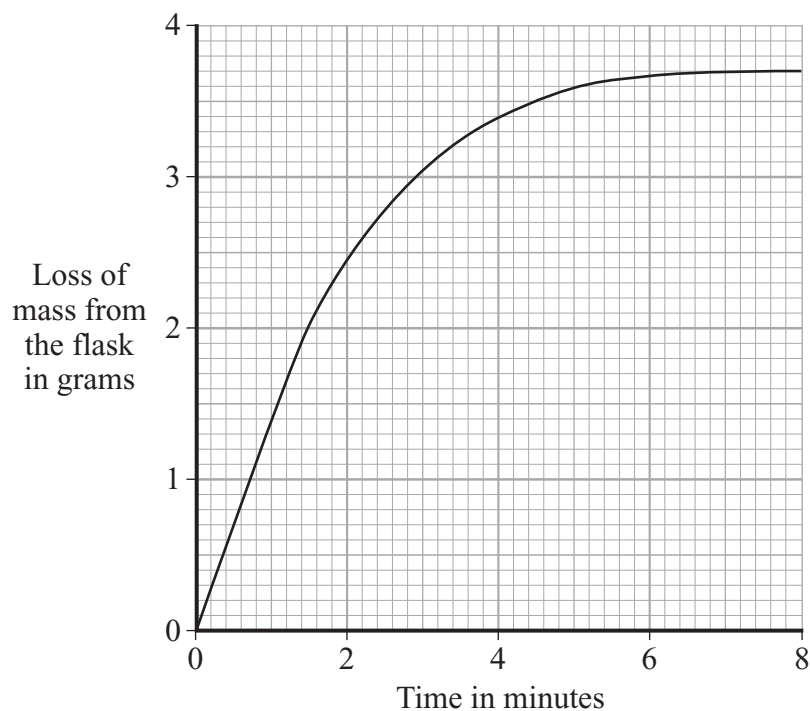
The reaction was done at room temperature, 20°C. At the end of the reaction, some of the copper carbonate remained unreacted.



The word equation for this reaction is:

copper carbonate + hydrochloric acid → copper chloride + water + carbon dioxide

This is a graph of the results.



(a) Why is there a loss of mass from the flask?

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(1 mark)

(b) (i) Describe how the rate of reaction changes during the experiment.

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(2 marks)

(ii) Explain these changes in rate, as fully as you can, in terms of:

- collisions between particles;
- concentration of the acid.

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(4 marks)

(c) Calculate the percentage of copper in copper carbonate, CuCO_3 .

Relative atomic masses: C = 12, O = 16, Cu = 64

Show your working.

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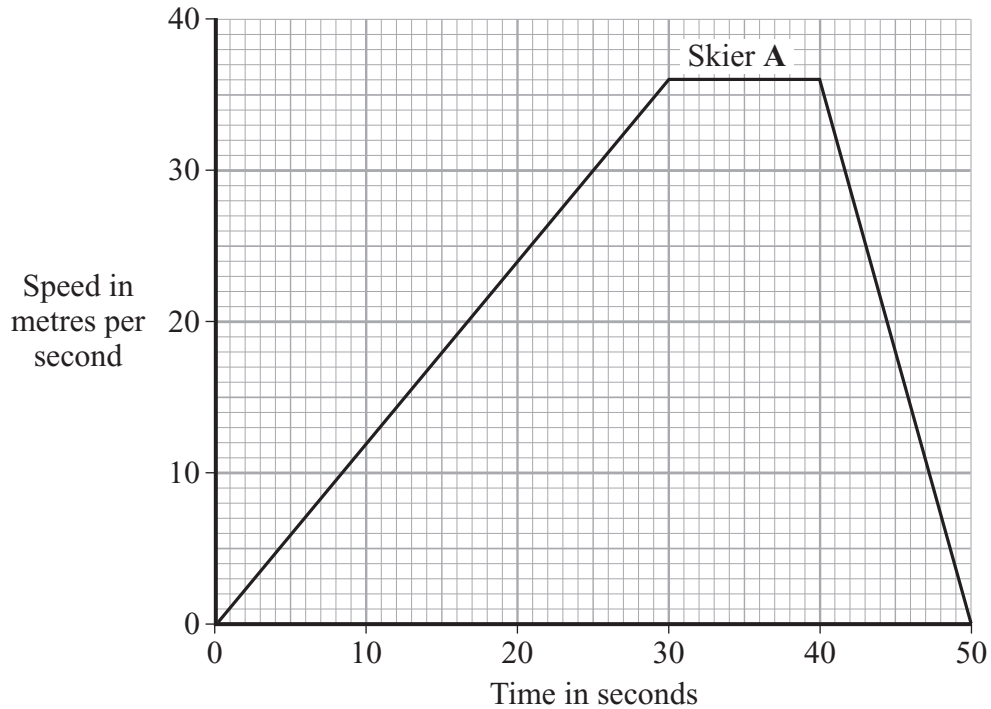
Percentage of copper in copper carbonate = %
(3 marks)

10

Turn over ►

FORCES

- 4 Two skiers, **A** and **B**, start a straight downhill race.
The graph shows how the motion of skier **A** changes during the race.



- (a) (i) What does the graph tell you about the speed of skier **A** between 30 and 40 seconds?

.....

(1 mark)

- (ii) What distance did skier **A** travel between 30 and 40 seconds?

.....

Distance = m
(2 marks)

(iii) Describe the motion of skier **A** after 40 seconds.

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(1 mark)

(iv) Calculate the acceleration of skier **A** between 10 and 20 seconds.

Show clearly how you work out your answer and give the unit.

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Acceleration of skier **A** =
(4 marks)

(b) Skier **B** wins the race.

On the grid, draw a possible graph for skier **B**.

(2 marks)

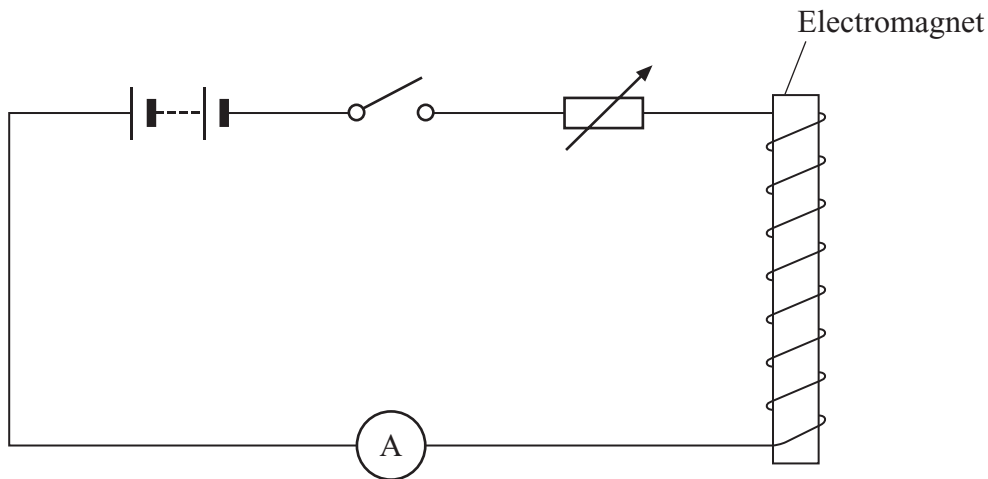
10

Turn over for the next question

Turn over ►

QUESTIONS RELATING TO PREVIOUSLY TESTED MODULES

5 The diagram shows an electromagnet in a circuit.



- (a) (i) What is used in this circuit to control the strength of the electromagnetic field?

.....
(1 mark)

- (ii) On the circuit, draw the symbol for a voltmeter connected so that it can measure the potential difference across the electromagnet. (1 mark)

- (iii) The ammeter reading was 0.5 A and the resistance of the coil on the electromagnet was $24\ \Omega$.

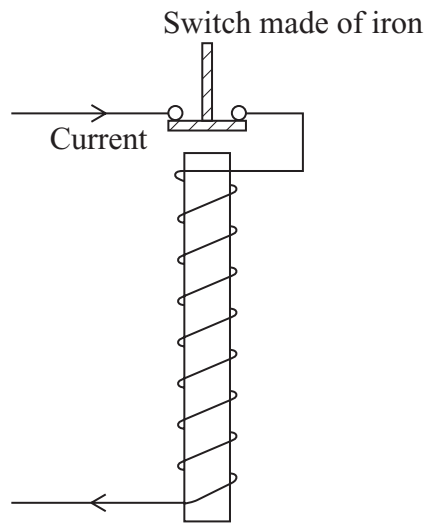
Calculate the potential difference across the electromagnet.

Show clearly how you work out your answer.

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Potential difference = V
(3 marks)

- (b) Circuit breakers are often used instead of fuses in many appliances. They use an electromagnet to work.



Describe, in as much detail as you can, how the electromagnet makes the circuit breaker work.

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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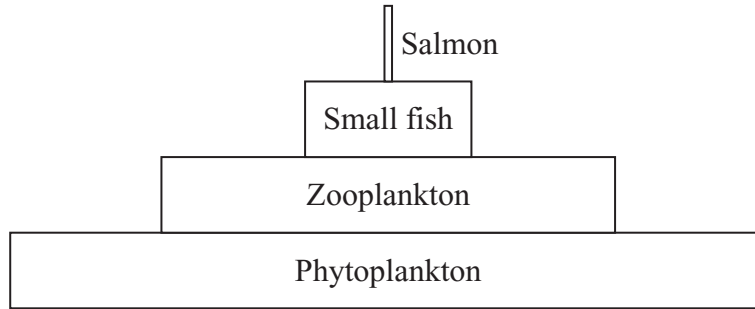
(5 marks)

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Turn over ►

ENVIRONMENT

- 6 (a) Salmon are fish that live in the sea. The pyramid of biomass shows the mass of living material at each stage in a food chain involving salmon.



Explain, as fully as you can, why the amount of biomass decreases at each stage in this food chain.

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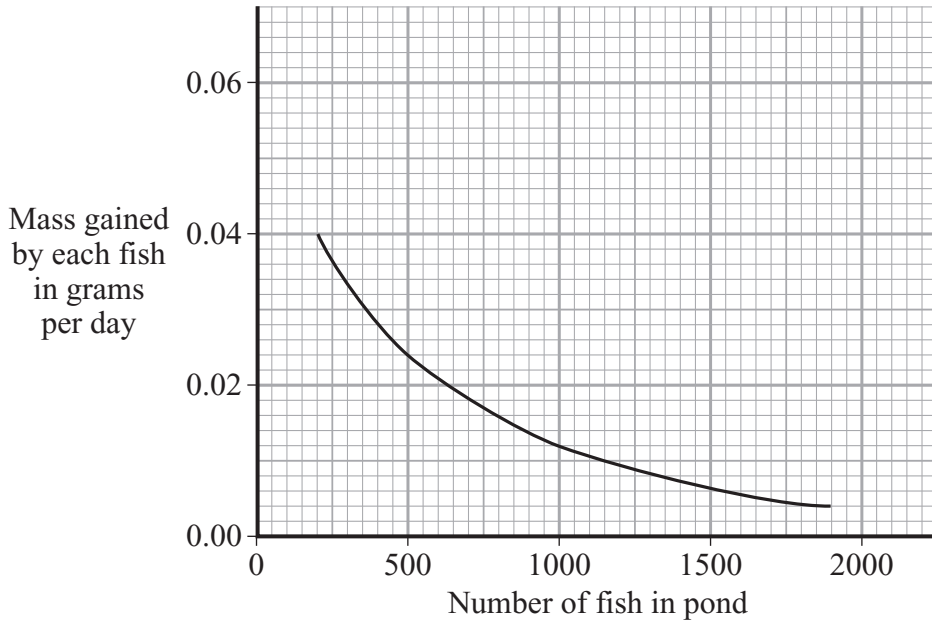
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(3 marks)

- (b) Young trout, each with a mass of 2 g, were used to stock several ponds. All the ponds had the same volume of water and contained the same amount of food, but were stocked with different numbers of trout.

The graph shows the mass gained by each fish per day in these ponds.



- (i) Calculate the mass of one fish after 30 days in a pond containing 1000 fish.

.....

Mass of one fish = g
 (2 marks)

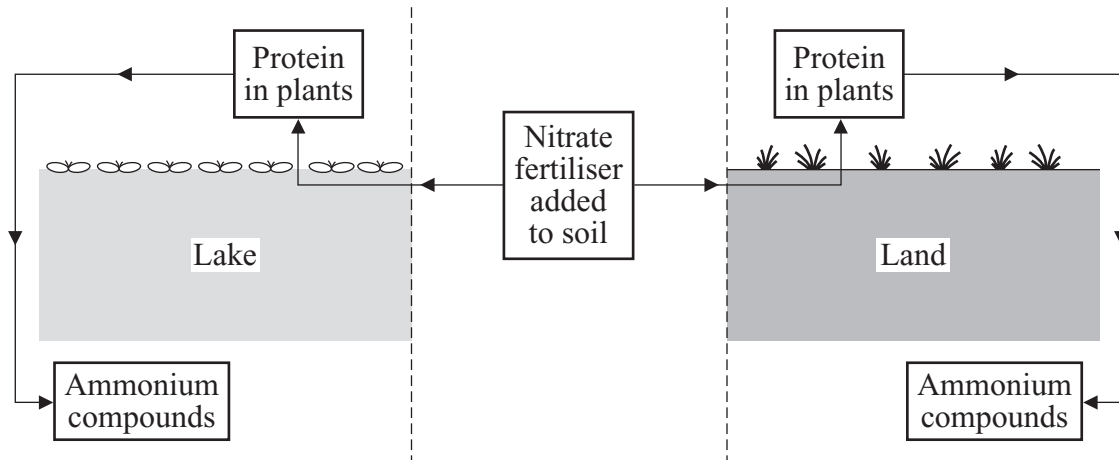
- (ii) The fish in the pond containing 1000 fish gained less mass than those in a pond containing 500 fish.

Explain why.

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(1 mark)

- 7 All living organisms need proteins to grow. Plants can make their own proteins if they are supplied with nitrates.



- (a) Explain how the ammonium compounds, shown in the diagram, were produced.

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(2 marks)

- (b) The level of dissolved oxygen in the lake would decrease if too much nitrate fertiliser were added to the soil.

Explain, as fully as you can, why this happens.

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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(5 marks)

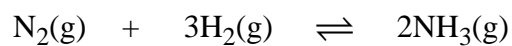
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Turn over for the next question

Turn over ►

PATTERNS OF CHEMICAL CHANGE

8 The reaction between nitrogen and hydrogen to produce ammonia is reversible.



This means that the reaction reaches an equilibrium.

(a) (i) What is happening at equilibrium?

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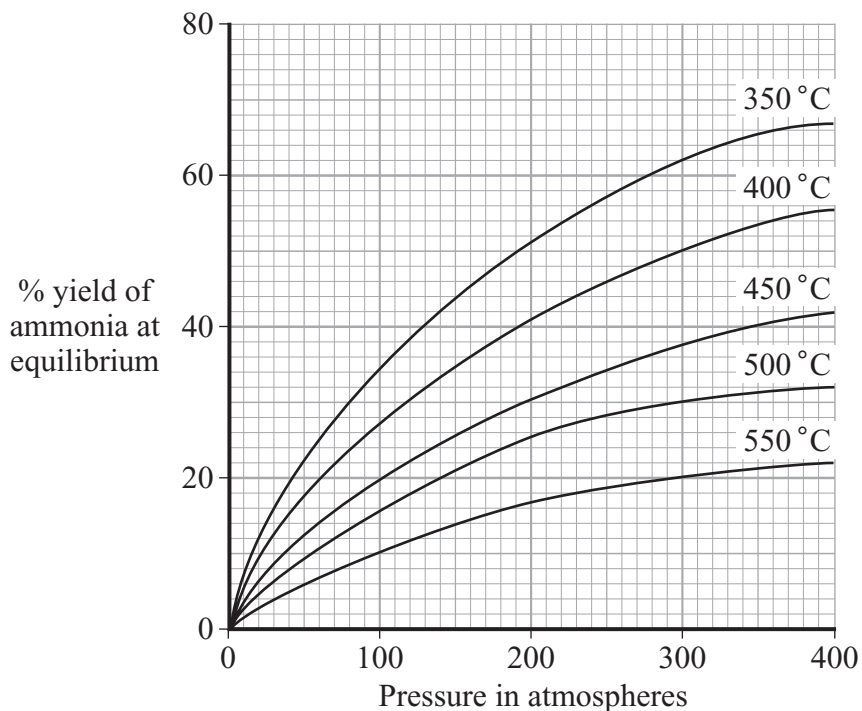
(1 mark)

(ii) Why is a catalyst used in this reaction?

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.....

(2 marks)

(b) The data show yields of ammonia under different conditions.



Manufacturers use a pressure of about 200 atmospheres and a temperature of about 450 °C.

A pressure of 400 atmospheres and a temperature of 350 °C would produce a higher yield of ammonia.

Explain, as fully as you can, why manufacturers do not use the higher pressure and the lower temperature.

Higher pressure (400 atmospheres).....

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Lower temperature (350 °C)

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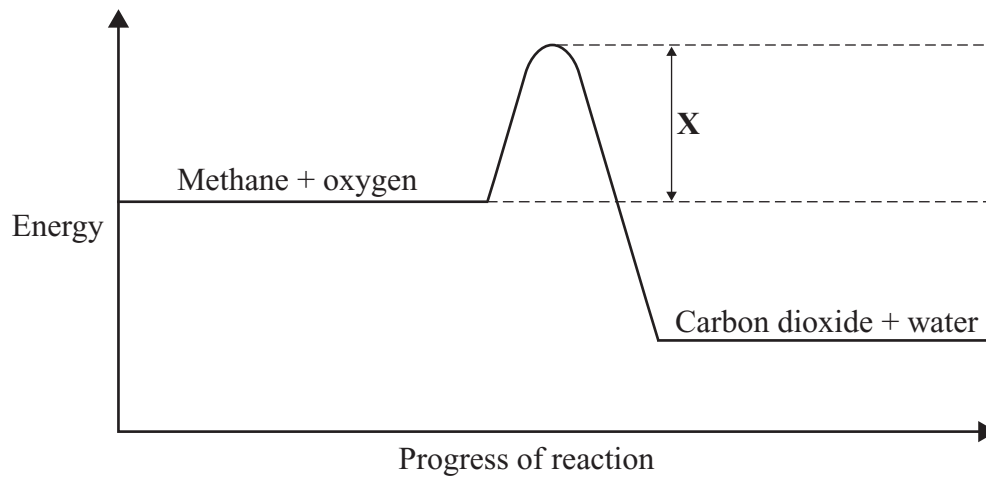
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(4 marks)

7

Turn over ►

- 9 Methane (natural gas) is the fuel used in most gas central heating systems. The energy level diagram shows the energy changes during the reaction between methane and oxygen.

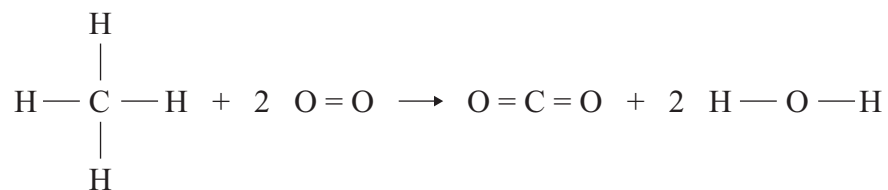


- (a) (i) What is represented by **X** on the energy level diagram?

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(1 mark)

- (ii) On the energy level diagram, draw the line that you would expect to get if a catalyst had been used. (1 mark)

(b) The balanced structural equation for this reaction is



The bond energies are shown in the table.

Bond	Energy in kJ
C — H	413
O — H	464
O = O	498
C = O	805

Calculate the amount of energy released by this exothermic reaction.

To obtain full marks you must show the energy needed to break the bonds of the reactants and the energy released when the bonds of the products are formed.

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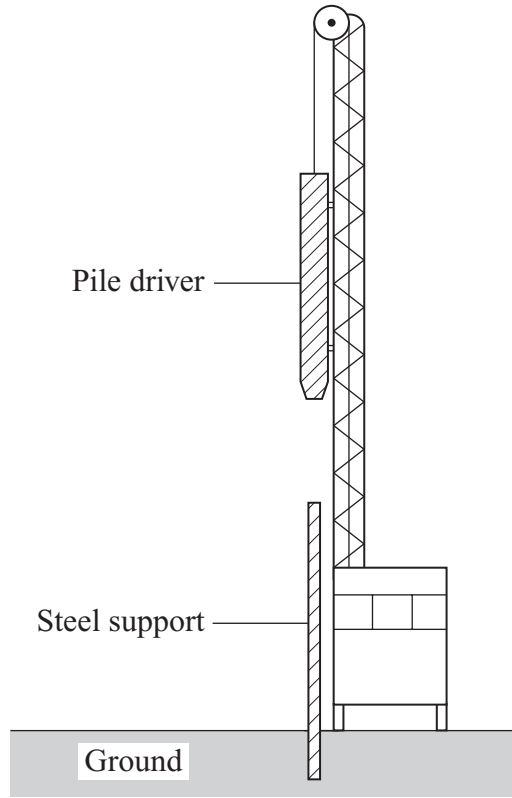
Energy released by this reaction = kJ
(4 marks)

6

Turn over ►

FORCES

10 A pile driver is used to push steel supports into the ground. A pile driver does this because it has a lot of kinetic energy as it hits the steel support.



(a) Give **two** ways in which the kinetic energy of the pile driver as it hits the steel support could be increased.

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- 2
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(2 marks)

(b) The mass of the pile driver is 500 kg.

The kinetic energy of the pile driver as it collides with the steel support is found to be 36 000 J.

Calculate the speed of the pile driver just before it hits the steel support.

Show clearly how you work out your answer and give the unit.

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Speed of the pile driver =
(4 marks)

6

Turn over for the next question

Turn over ►

11 The Universe is made up of at least a billion galaxies. Each galaxy is made up of millions of stars. Stars are formed from dense clouds of dust and gas (mainly hydrogen).

(a) What is meant by the ‘big bang’ theory?

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(2 marks)

(b) Describe, in as much detail as you can:

(i) how a star forms from dust and gas;

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(3 marks)

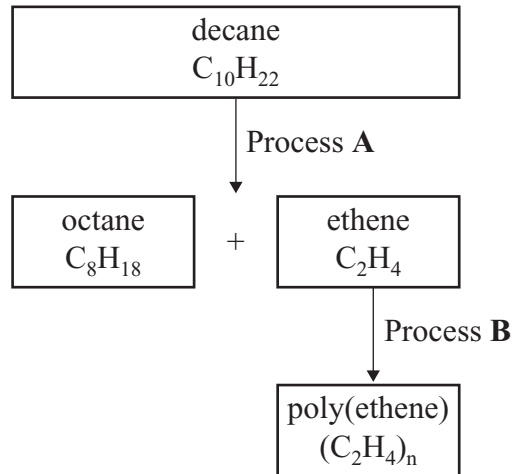
(ii) why a star is then able to release vast amounts of energy.

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(2 marks)

QUESTIONS RELATING TO PREVIOUSLY TESTED MODULES

12 The hydrocarbon decane, $C_{10}H_{22}$, can be used to produce poly(ethene).



(a) Name process **A**.

.....
(1 mark)

(b) Give **two** differences in the structures of decane and ethene.

1

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2

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(2 marks)

(c) In process **B**, ethene (a monomer) is used to produce poly(ethene) (a polymer). Describe how ethene forms poly(ethene).

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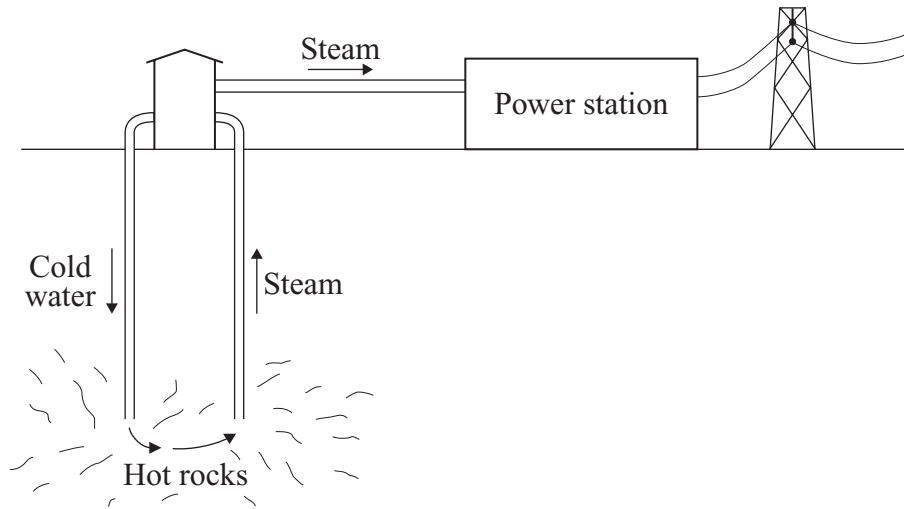
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(2 marks)

5

Turn over ►

- 13 For many millions of years, rocks inside the Earth’s crust have remained hot because of the decay of radioactive substances, such as uranium.



A geothermal power station makes use of this thermal energy. Two holes are drilled deep into the hot rocks. Cold water is then forced, under pressure, down one of the holes. The water is heated as it flows through cracks in the rocks and returns to the surface through the second hole as steam. The steam is used to move turbines that spin generators which produce electricity.

- (a) Apart from cost, give **two** disadvantages of using wind turbines rather than geothermal power to produce electricity.

1

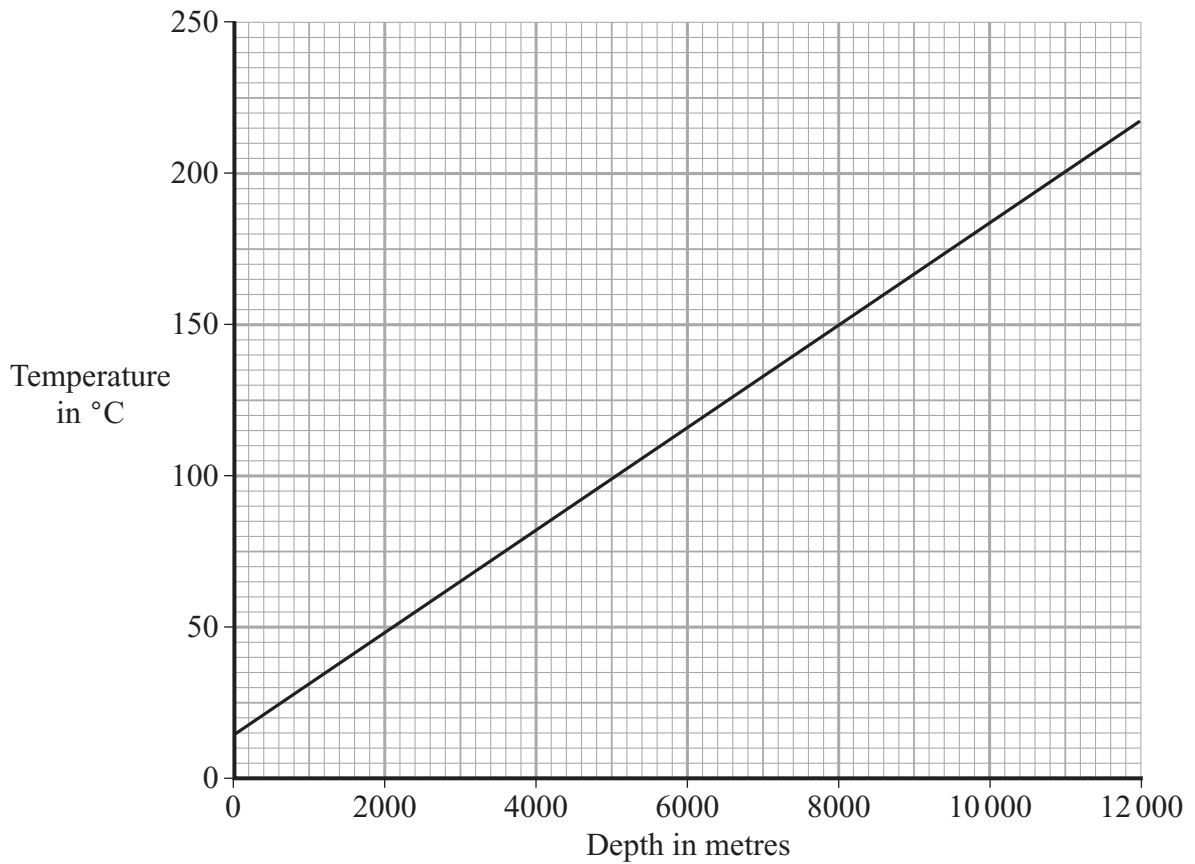
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2

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(2 marks)

(b) The graph shows how the temperature of rocks in the Earth's crust changes with depth.



Suggest how deep the drill holes will have to be for a geothermal power station. Explain your choice.

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(2 marks)

(c) Non-renewable sources of energy, such as natural gas, will continue to be used in power stations much more than geothermal energy. Apart from cost, explain why.

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(2 marks)

END OF QUESTIONS

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