OCR
Oxford Cambridge and RSA

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Wednesday 12 June 2019 – Morning

GCSE (9–1) Combined Science (Chemistry) A (Gateway Science)

J250/10 Paper 10 (Higher Tier)

Time allowed: 1 hour 10 minutes

You must have:
- a ruler (cm/mm)
- the Data Sheet (for GCSE Combined Science (Chemistry) A (inserted))

You may use:
- a scientific or graphical calculator
- an HB pencil

Please write clearly in black ink. **Do not write in the barcodes.**

Centre number | | | | | | Candidate number | | | | |

First name(s) _____

Last name _____

INSTRUCTIONS
- The Data Sheet will be found inside this document.
- Use black ink. You may use an HB pencil for graphs and diagrams.
- Answer **all** the questions.
- Where appropriate, your answers should be supported with working. Marks may be given for a correct method even if the answer is incorrect.
- Write your answer to each question in the space provided. If additional space is required, use the lined page(s) at the end of this booklet. The question number(s) must be clearly shown.

INFORMATION
- The total mark for this paper is **60**.
- The marks for each question are shown in brackets **[ ]**.
- Quality of extended responses will be assessed in questions marked with an asterisk (*).
- This document consists of **24** pages.

SECTION A

You should spend a maximum of 20 minutes on this section.

Answer **all** the questions.

Write your answer to each question in the box provided.

1 What is an enzyme?

A A biological catalyst

B A biological reactant

C A natural monomer

D A starch molecule

Your answer ☐ **[1]**

2 Which row of the table is correct for cracking?

	Description	Source of raw material
A	heating large molecules to make smaller molecules	crude oil
B	heating large molecules to make smaller molecules	nylon, poly(ethene)
C	joining small molecules to make larger molecules	crude oil
D	joining small molecules to make larger molecules	ethene, propene

Your answer ☐ **[1]**

3 Element **W** displaces **X** from a solution of **X** nitrate.

Element **X** displaces **Y** from a solution of **Y** sulfate.

Element **Z** displaces **W** from a solution of **W** nitrate.

What is the correct order of reactivity?

	most reactive → least reactive			
A	**W**	**X**	**Y**	**Z**
B	**W**	**Y**	**X**	**Z**
C	**Z**	**W**	**X**	**Y**
D	**Z**	**X**	**Y**	**W**

Your answer ☐ **[1]**

4 Which statement explains why methane is a greenhouse gas?

A It absorbs and re-emits infrared radiation.

B It absorbs and re-emits ultraviolet radiation.

C It contains carbon.

D It is released into the atmosphere by cattle.

Your answer ☐ **[1]**

5 Manganese dioxide, MnO_2, can act as a catalyst.

A student mixes 10 g of MnO_2, a black solid, with 4 different solutions, **A**, **B**, **C** and **D**.

With which solution does MnO_2 act as a catalyst?

	Does a chemical reaction happen?	After mixing
A	No	10 g of black solid left
B	Yes	10 g of black solid left
C	Yes	more than 10 g of green solid left
D	Yes	more than 10 g of pink solid left

Your answer ☐ **[1]**

6 Reversible reactions in a closed system reach a dynamic equilibrium.

At equilibrium, which statement is correct?

A rate of reverse reaction = 0

B rate of forward reaction = 0

C rate of forward reaction > rate of reverse reaction

D rate of forward reaction = rate of reverse reaction

Your answer ☐ **[1]**

7 Aluminium is extracted by electrolysis.

Iron is extracted by reduction with carbon.

Which row of the table **explains both** facts?

A	aluminium is more reactive than carbon	carbon is more reactive than iron
B	aluminium is more reactive than carbon	iron is more reactive than carbon
C	aluminium is more reactive than iron	carbon is more reactive than iron
D	aluminium is more reactive than iron	iron is more reactive than carbon

Your answer ☐ **[1]**

8 This question is about the elements in Group 1.

Which row of the table is correct?

	Reactivity	**Reason**
A	decreases down the group	it is easier to form positive ions
B	decreases down the group	it is easier to form negative ions
C	increases down the group	it is easier to form positive ions
D	increases down the group	it is easier to form negative ions

Your answer ☐ **[1]**

9 The elements neon and argon in Group 0 are unreactive.

Which statement explains why?

A They all have eight electrons in their outer shells.

B They all have full outer electron shells.

C They are all gases at room temperature and pressure.

D They are all monatomic.

Your answer ☐ **[1]**

10 Chlorine is in Group 7 of the Periodic Table.

What is the mass of 2 moles of chlorine gas?

A 35.5g

B 71.0g

C 106.5g

D 142.0g

Your answer ☐ **[1]**

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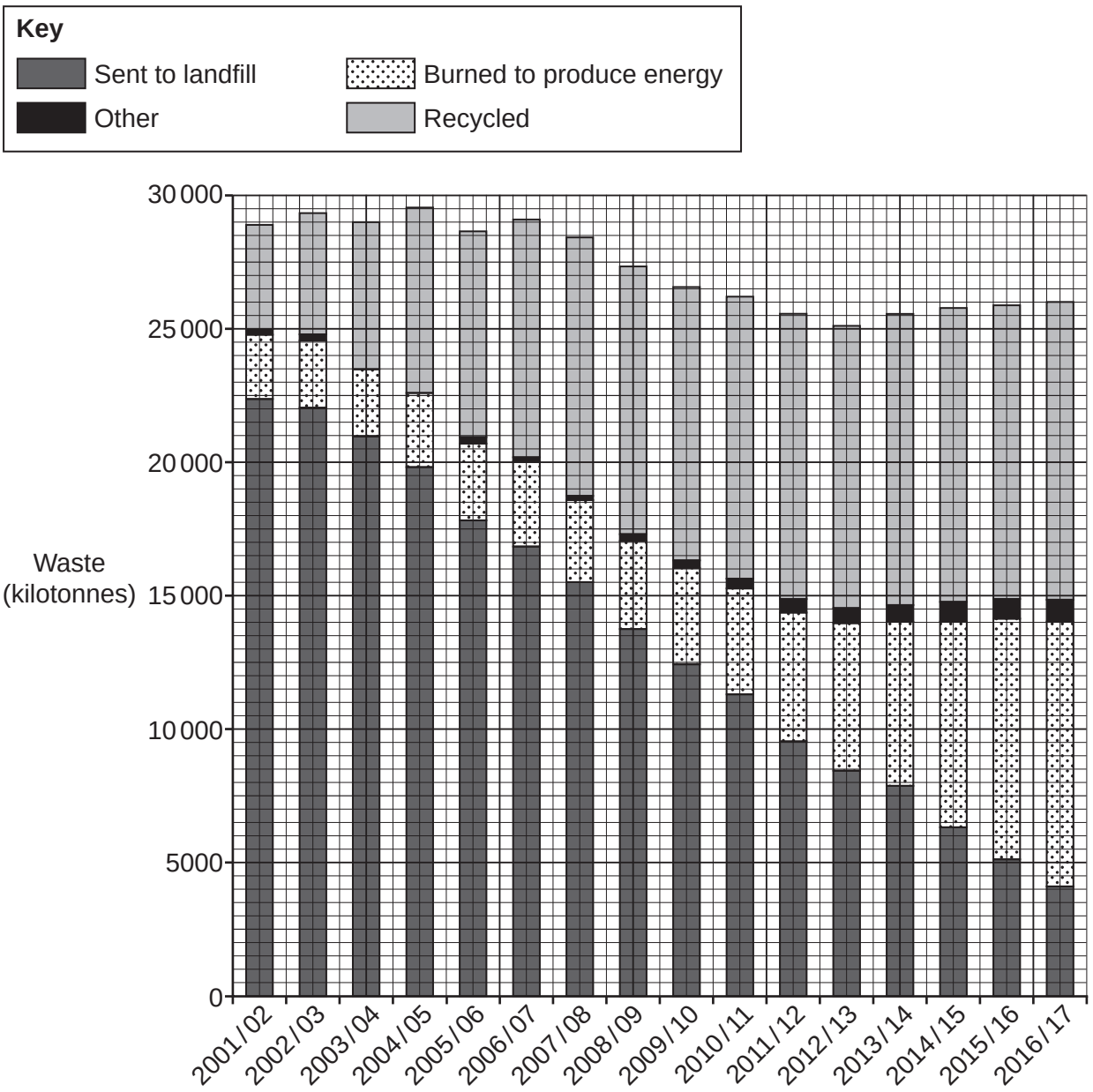
SECTION B

Answer **all** the questions.

11 Local councils collect waste from households.

The graph shows what happened to the waste between 2001 and 2017.



(a) Describe **and** explain **one** trend shown by the graph.

.....

.....

.....

..... **[2]**

(b) State **one** disadvantage of recycling.

.....

..... **[1]**

12 A student adds some magnesium to dilute hydrochloric acid (HC*l*).

Magnesium chloride ($MgCl_2$) and hydrogen gas is formed.

(a) Write a **balanced** symbol equation for this reaction.

..... **[2]**

(b) She wants to investigate how changing the concentration of hydrochloric acid affects the rate of reaction.

The student uses:

- hydrochloric acid with a concentration of 1 mol / dm^3
- magnesium ribbon
- a conical flask
- a measuring cylinder
- a mass balance
- a stopwatch.

(i) Identify the independent variable in the investigation.

..... **[1]**

(ii) Identify **two** control variables in the investigation.

1 .....

2 .....

[2]

(c) The student measures the time it takes from adding the magnesium to the hydrochloric acid until the reaction mixture stops bubbling.

The table shows the student's results.

Concentration of acid (mol / dm^3)	Time 1 (s)	Time 2 (s)	Time 3 (s)	Mean (average) time (s)
1.00	15	15	15	15
0.75	65	55	41	54
0.50	85	90	88	88
0.25	300	290	295	295

The results at 0.75 mol / dm^3 are **not** precise.

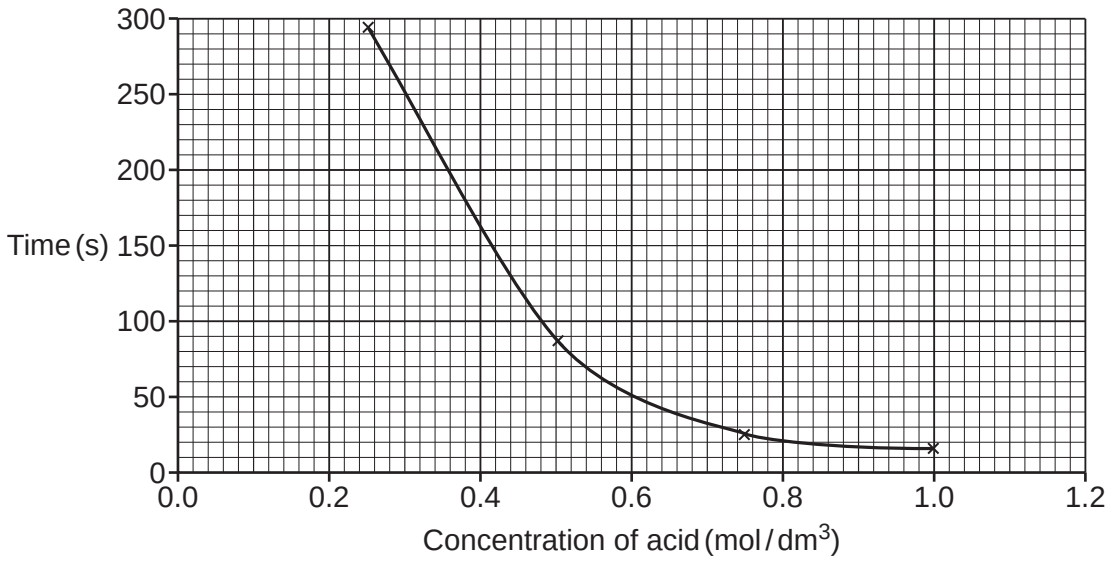
Suggest **one** reason why this might have happened.

.....

..... **[1]**

(d) The results at 0.75 mol / dm^3 are repeated.

This is a graph of the student's results.



What conclusion can you make from these results?

Include ideas about **particles** in your answer.

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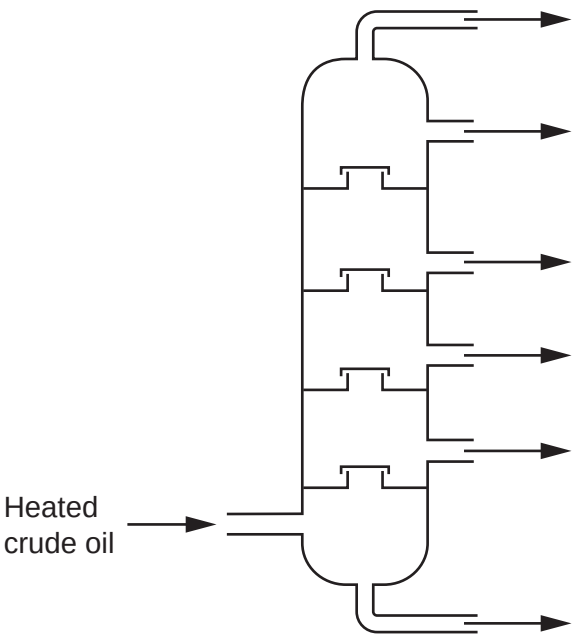
..... **[3]**

13* Fractional distillation can be used to separate different fractions from crude oil.

Fig. 13.1 and **Fig. 13.2** give some information about the process.



Fraction	Average number of carbon atoms in alkanes present in fraction
LPG	3
Naphtha	10
Kerosene	15
Gas oil	20
Lubricating oil	35
Residue	40

Fig. 13.1

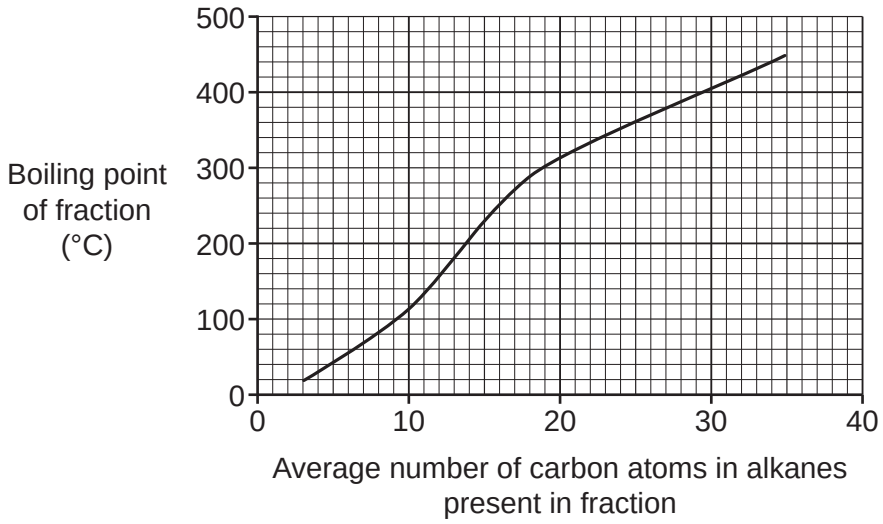


Fig. 13.2

13

Explain how fractional distillation produces the different fractions from crude oil.

Use the information in **Fig. 13.1** and **Fig. 13.2** in your answer.

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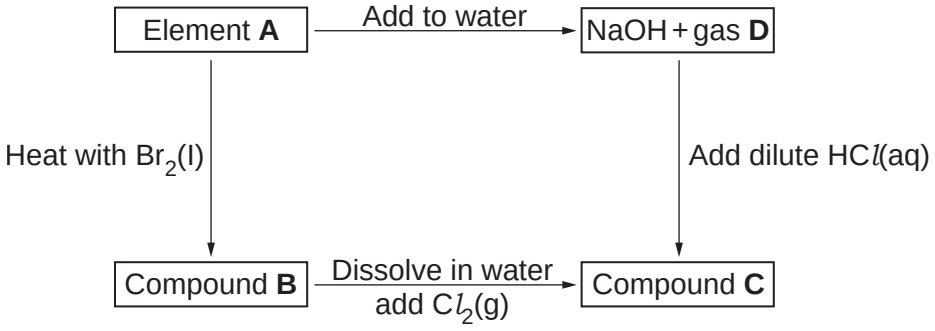
..... **[6]**

14 Some Group 1 and Group 7 elements are very reactive.

Look at the reaction cycle.



(a) Identify element **A**.

..... **[1]**

(b) **(i)** Identify compound **B**.

..... **[1]**

(ii) Write a balanced equation for the reaction of element **A** with $Br_2(l)$.

Include state symbols in your answer.

..... **[2]**

(c) **(i)** Identify compound **C**.

..... **[1]**

(ii) Give a reason for your answer to **(c)(i)**.

.....

..... **[1]**

(d) **D** is a colourless gas.

How can you show if the gas is carbon dioxide, hydrogen or oxygen?

Describe the tests for carbon dioxide, hydrogen and oxygen and the results you would expect with gas **D**.

test for carbon dioxide .....

.....

result with gas **D** .....

test for hydrogen.....

.....

result with gas **D** .....

test for oxygen .....

.....

result with gas **D** .....

[3]

15 The reaction between sulfur dioxide and oxygen is reversible.

$2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)$ energy change = –198 kJ / mol

(a) The table shows some relative atomic masses.

Element	Relative atomic mass
sulfur	32.1
oxygen	16.0

Calculate the maximum mass of SO_3, in g, that can be made from 100 mg of SO_2.

Give your answer to **2** decimal places.

Mass = ... g **[4]**

(b) The equilibrium position of reversible reactions may be altered by changing the reaction conditions, such as temperature and pressure.

Write down **one other** condition which may alter the equilibrium position.

..... **[1]**

(c) (i) When the reaction between sulfur dioxide and oxygen is at equilibrium, what is the effect of increasing the temperature?

Explain your answer.

.....

.....

..... **[2]**

(ii) When the reaction between sulfur dioxide and oxygen is at equilibrium, what is the effect of increasing the pressure?

Explain your answer.

.....

.....

..... **[2]**

(d) (i) Write down **two** sources of sulfur dioxide in the atmosphere.

1 .....

2 .....
[1]

(ii) Describe **two** problems caused by the release of sulfur dioxide into the atmosphere.

1 .....

.....

2 .....

.....
[2]

16 One homologous series of organic compounds is called the alkanes.

(a) The general formula for an alkane is C_nH_{2n+2}.

Methane (n = 1) and ethane (n = 2) are the first two alkanes.

Write down their chemical formulae.

methane.....

ethane.....

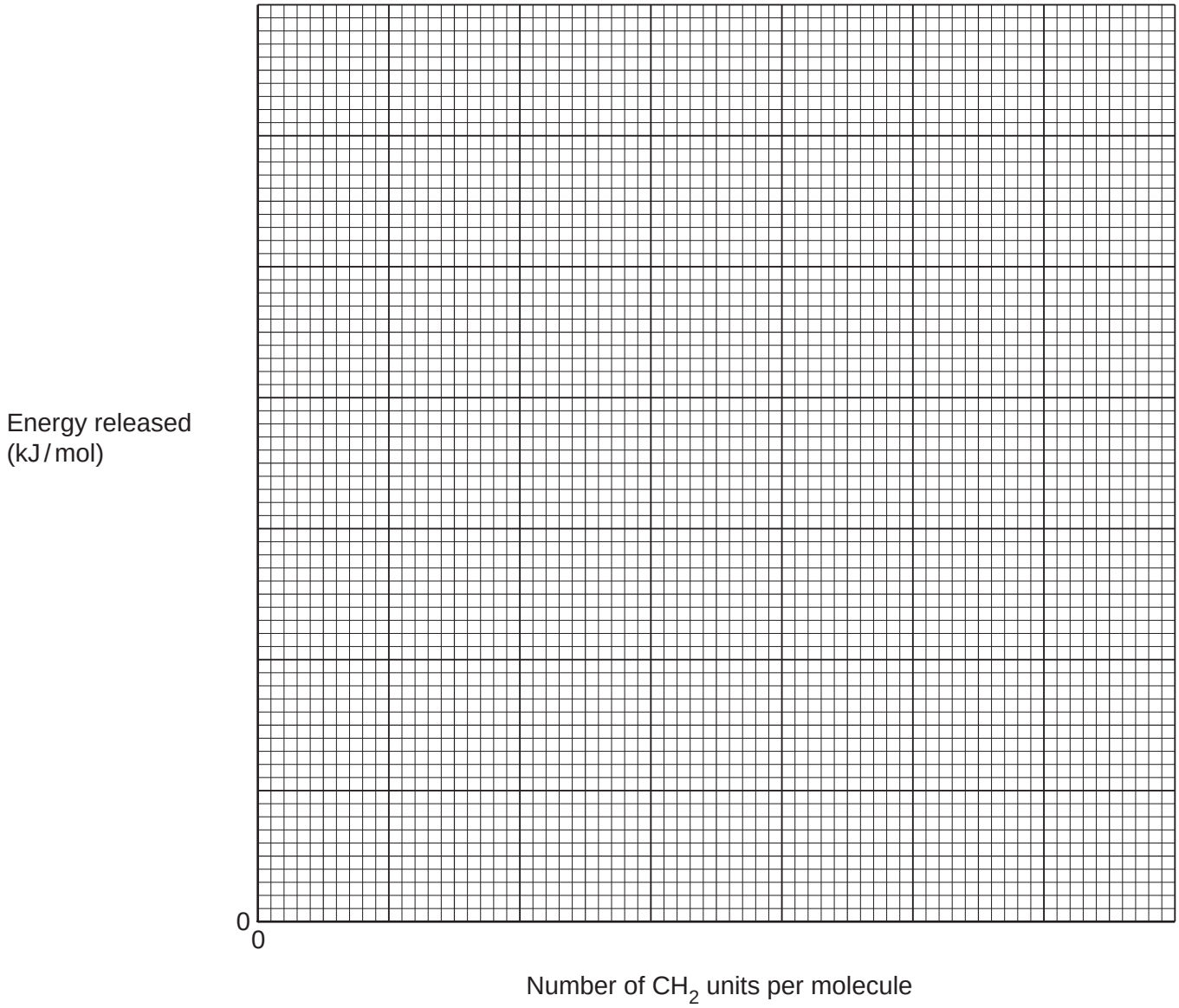
[1]

(b) This table shows the energy released when one mole of an alkane is completely burned in oxygen.

S Zumdahl, S Zumdahl, 'Chemistry (5th edition)', p373, Houghton Mifflin, 2000. Item removed due to third party copyright restrictions. Link to material: http://butane.chem.uiuc.edu/cyerkes/Chem104ACSpring2009/Genchemref/bondenergies.html

Table 16.1

(i) Plot a graph using the data in **Table 16.1** and draw a line of best fit.
Use the axes below.



[2]

(ii) Calculate the gradient (slope) of the graph.

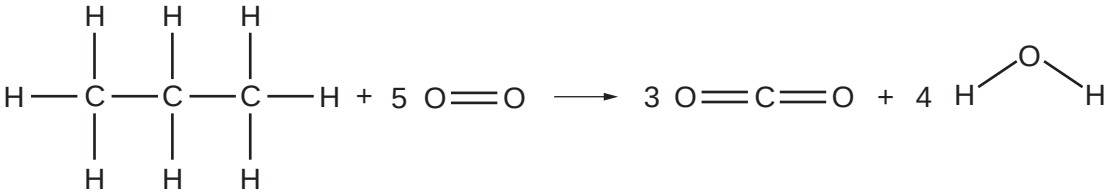
Gradient = ... (kJ / mol / CH_2 unit per molecule) **[2]**

(iii) Estimate the energy released when decane ($C_{10}H_{22}$) burns.

Use your answer to **(b)(ii)** to help you.

Energy released = ... kJ / mol **[2]**

(c) Propane burns in oxygen to form carbon dioxide and water.



The table shows some bond energies.

Bond	Bond energy (kJ / mol)
C=O	805
C–C	347
O=O	498
O–H	464

The total energy released in the reaction between propane and oxygen is 2220 kJ / mol.

Calculate the bond energy of C–H.

Give your answer to **3** significant figures.

Bond energy of C–H = ... kJ / mol **[4]**

END OF QUESTION PAPER

ADDITIONAL ANSWER SPACE

If additional space is required, you should use the following lined page(s). The question number(s) must be clearly shown in the margin(s).