Paper Reference(s) **4CH0/2C**

Pearson Edexcel International GCSE

Chemistry

Unit: 4CH0
Paper: 2C

Wednesday 16 January 2019 – Afternoon

Time: 1 hour plus your additional time allowance

INSTRUCTIONS TO CANDIDATES
Write your centre number, candidate number, surname, other names and your signature in the boxes below. Check that you have the correct question paper.

Centre No.							
Candidate No.							
Surname							
Other names							
Signature							
Paper Reference	4	C	H	0	/	2	C

- Use BLACK ink or ball-point pen.
- Answer ALL questions.
- Answer the questions in the spaces provided – there may be more space than you need.
- Show all the steps in any calculations and state the units.
- Some questions must be answered with a cross in a box ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

MATERIALS REQUIRED FOR EXAMINATION

Calculator, ruler

ITEMS INCLUDED WITH QUESTION PAPERS

Periodic Table

INFORMATION FOR CANDIDATES

- The total mark for this paper is 60.
- The marks for EACH question are shown in brackets – use this as a guide as to how much time to spend on each question.
- A Periodic Table has been provided.

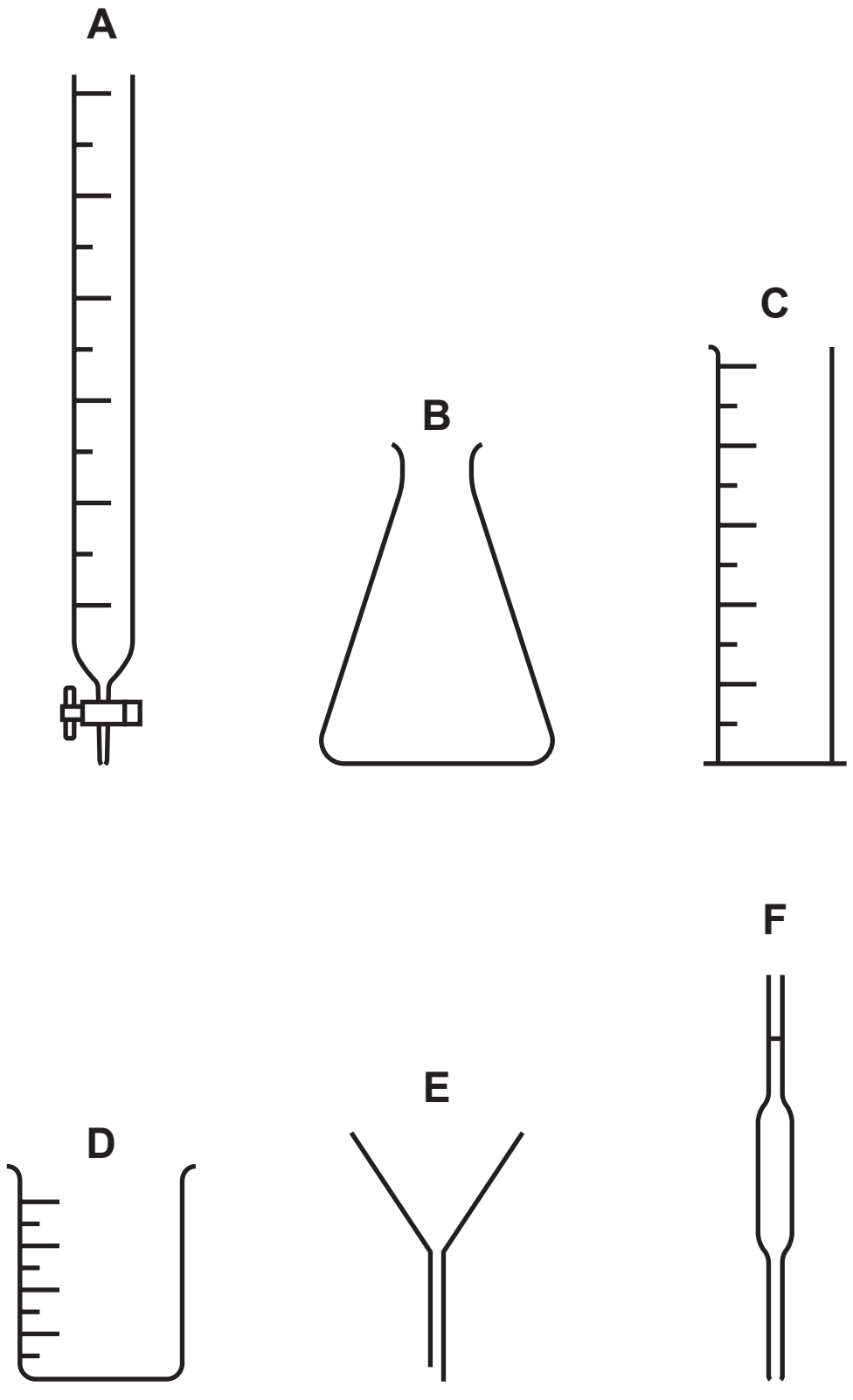
ADVICE TO CANDIDATES

- Read each question carefully before you start to answer it.
- Write your answers neatly and in good English.
- Try to answer every question.
- Check your answers if you have time at the end.

(Questions begin on next page) (Turn over)

Answer ALL questions.

1 The diagram shows six pieces of apparatus that are used in the laboratory.



(Question continues on next page) **(Turn over)**

The table lists the names of four pieces of apparatus.

Complete the table by giving a letter, A, B, C, D, E or F, to identify each piece of apparatus listed. (4 marks)

Name of apparatus	Letter
beaker	
burette	
measuring cylinder	
pipette	

(TOTAL FOR QUESTION 1 = 4 MARKS)

(Questions continue on next page)

2 Rubidium is an element in Group 1 of the Periodic Table.

A sample of rubidium contains two isotopes,

$^{85}_{37}Rb$ and $^{87}_{37}Rb$

(a) (i) State how the nuclei of the two isotopes are similar. (1 mark)

_____

_____

_____

(ii) State how the nuclei of the two isotopes are different. (1 mark)

_____

_____

_____

(Question continues on next page)

(iii) How many electrons are in the outer shell of a rubidium atom? (1 mark)

☐ A 1

☐ B 3

☐ C 9

☐ D 37

(b) The relative abundances of the two isotopes in the sample of rubidium are

$^{85}_{37}Rb$ 72.2% $^{87}_{37}Rb$ 27.8 %

Calculate the relative atomic mass of rubidium.

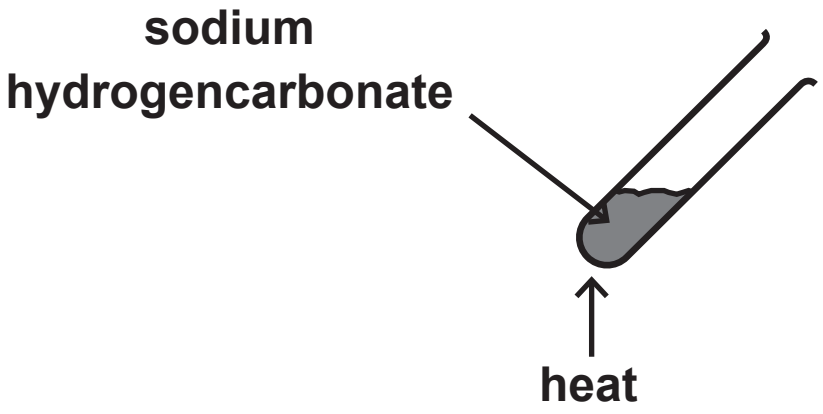
Give your answer to one decimal place. (2 marks)

relative atomic mass = _____

(TOTAL FOR QUESTION 2 = 5 MARKS)

(Questions continue on next page)

3 A student uses this apparatus to investigate the action of heat on sodium hydrogencarbonate ($NaHCO_3$).



The equation for the reaction is

$$2NaHCO_3(s) \longrightarrow Na_2CO_3(s) + H_2O(g) + CO_2(g)$$

(a) (i) State the type of reaction taking place.
(1 mark)

(Question continues on next page)

(ii) Describe a test to show that the gas given off is carbon dioxide. (2 marks)

test _____

_____

_____

result _____

_____

_____

(b) The student heats a 1·00 g sample of sodium hydrogencarbonate for one minute.

He then measures the mass of solid left in the test tube.

He repeats the experiment four times, heating separate samples of mass 1·00 g for a different number of minutes each time.

(Question continues on next page)

The table shows the student's results.

Time in minutes	1	2	3	4	5
Mass of solid left in test tube in g	0·89	0·78	0·69	0·63	0·63

(i) State why the mass of solid in each test tube decreases. (1 mark)

(ii) Suggest why the mass of solid stops decreasing after four minutes. (1 mark)

(TOTAL FOR QUESTION 3 = 5 MARKS)

(Questions continue on next page)

4 Sodium reacts with fluorine to form sodium fluoride.

The reaction is very exothermic.

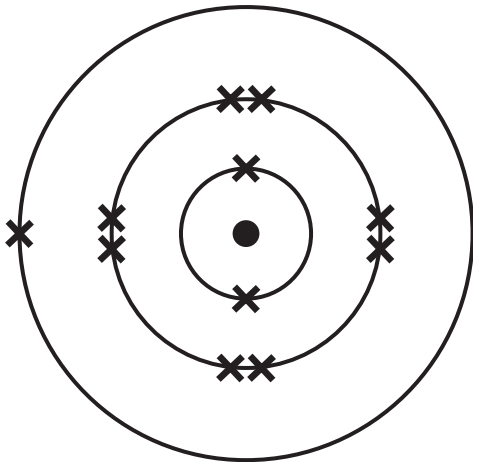
(a) State what is meant by the term EXOTHERMIC. (1 mark)

_____

_____

_____

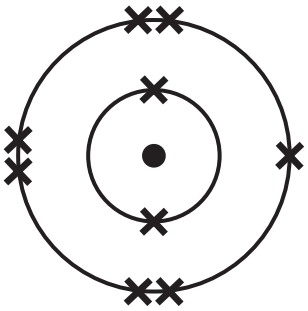
(b) The diagram shows the electronic configuration of a sodium atom.



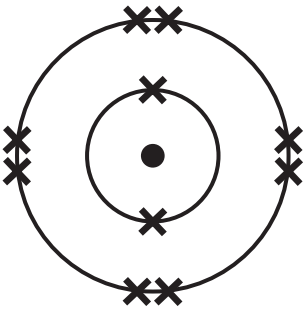
(Question continues on next page)

Which of these diagrams shows the electronic configuration of a fluorine atom? (1 mark)

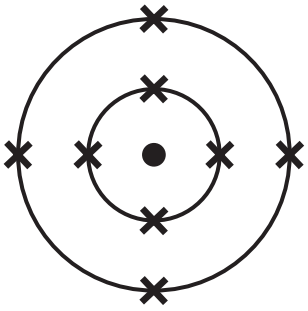
A ☐



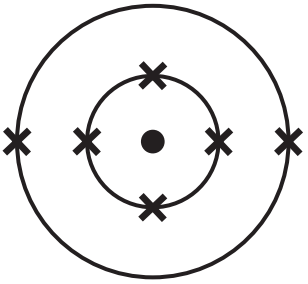
B ☐



C ☐



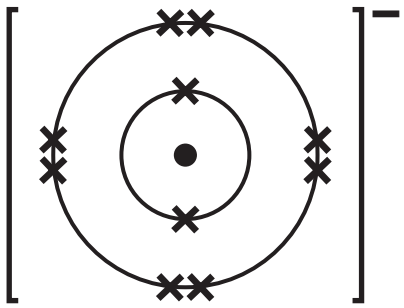
D ☐



(Question continues on next page)

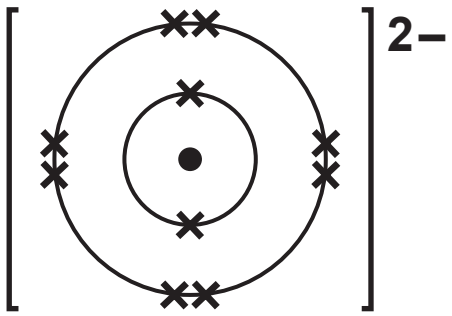
(c) **Sodium ions and fluoride ions are formed when sodium reacts with fluorine.**

The diagram shows the electronic configuration and charge of a fluoride ion.

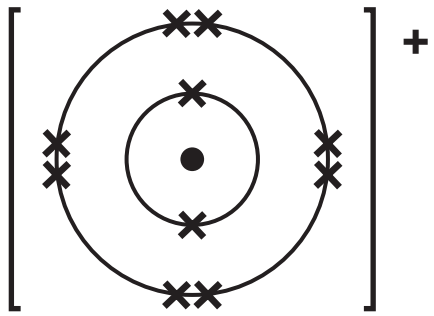


Which of these diagrams shows the electronic configuration and charge of a sodium ion?
(1 mark)

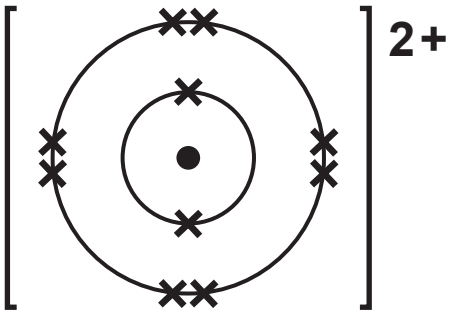
A ☐



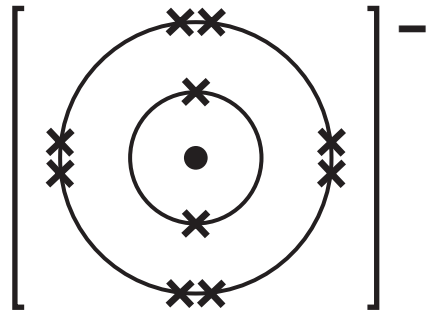
B ☐



C ☐



D ☐



(d) Explain, in terms of its structure and bonding, why sodium fluoride has a high melting point. (4 marks)

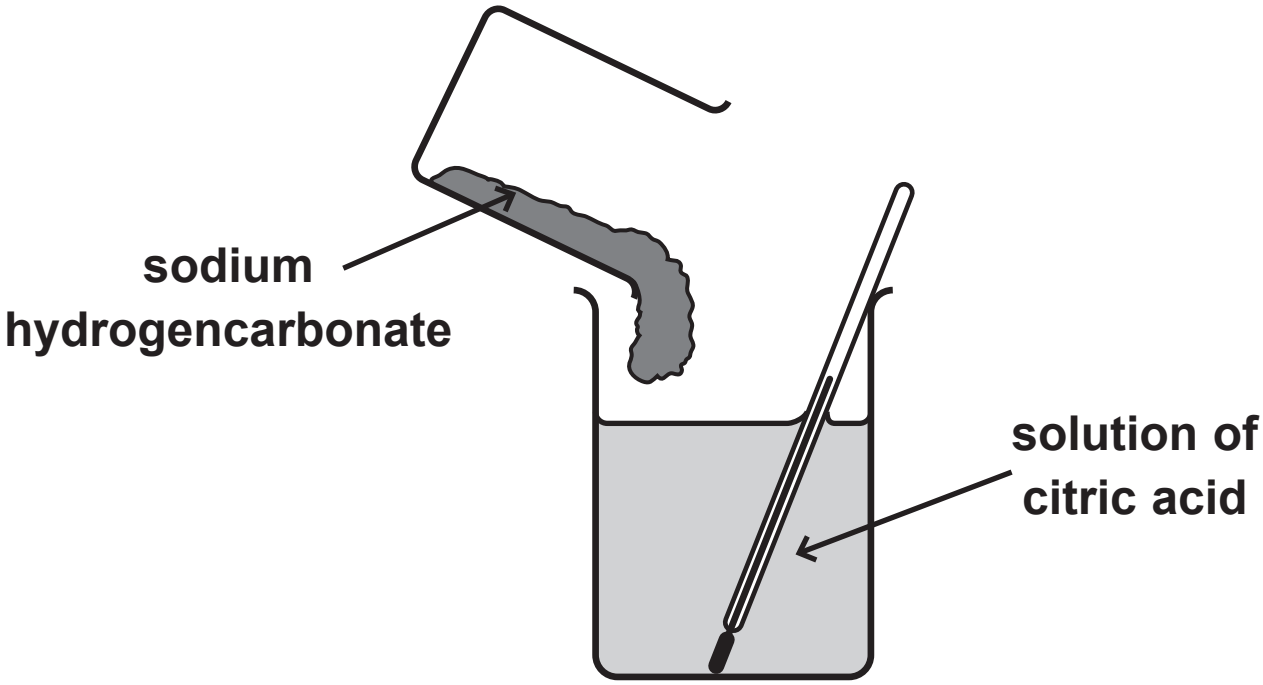
(Continue your answer on next page)

(TOTAL FOR QUESTION 4 = 7 MARKS)

(Questions continue on next page)

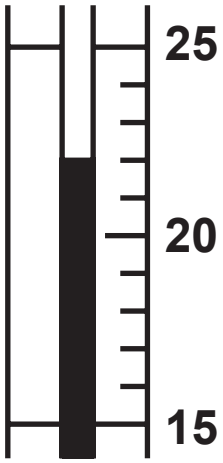
5 A student finds the temperature change when a mass of 0·5 g of sodium hydrogencarbonate is added to 50 cm^3 of a solution of citric acid.

She repeats the experiment using masses of 1·0 g, 1·5 g and 2·0 g of sodium hydrogencarbonate.

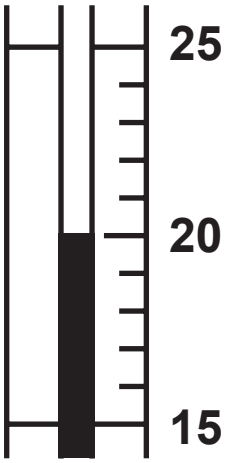


(Question continues on next page)

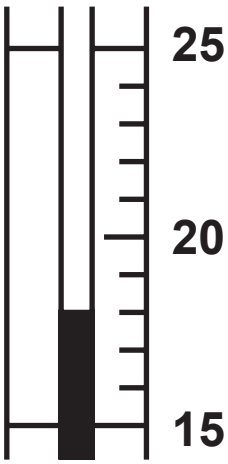
(a) The diagrams of the thermometer show the lowest temperature reached, in °C, for each experiment.



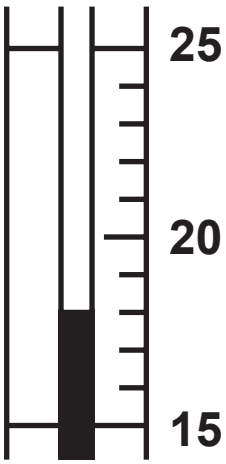
0·5 g of sodium hydrocarbonate



1·0 g of sodium hydrocarbonate



1·5 g of sodium hydrocarbonate



2·0 g of sodium hydrocarbonate

(Question continues on next page)

Use the diagrams to complete the table of results. (2 marks)

Mass of sodium hydrogencarbonate in g	Initial temperature in °C	Lowest temperature reached in °C	Decrease in temperature in °C
0·5	25		
1·0	24		
1·5	23		
2·0	23		

(Question continues on next page)

(b) Another student does the experiment.
The table shows his results.

Mass of sodium hydrogencarbonate in g	0·5	1·0	1·5	2·0	2·5
Decrease in temperature in °C	2	4	6	6	6

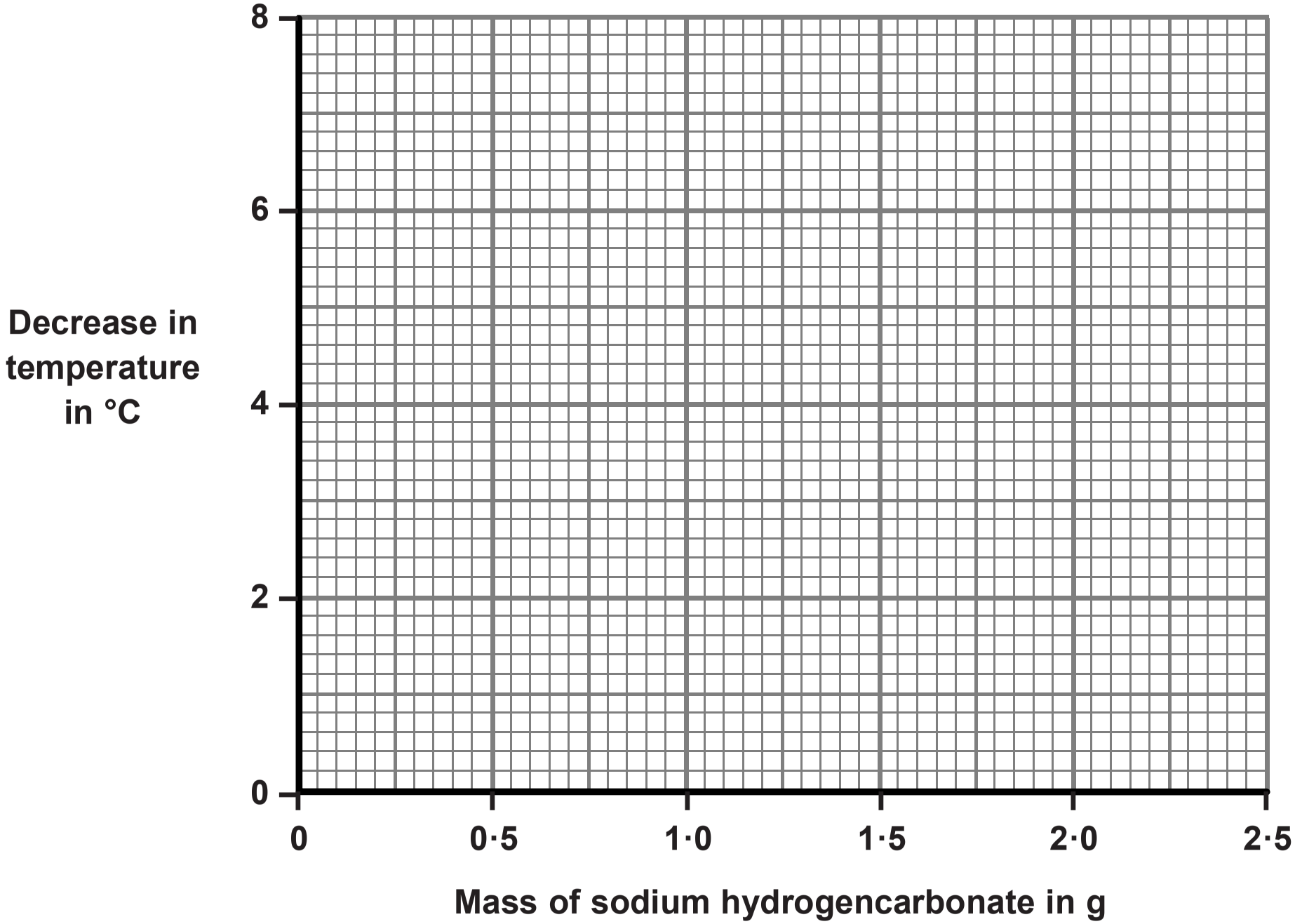
(Question continues on next page)

(i) Plot this student's results on the grid on page 20.

Draw a straight line of best fit through the first three points and another straight line of best fit through the last two points.

Make sure the two lines cross. (3 marks)

(Question continues on next page)



20

(Question continues on next page)

(ii) Use your graph to find the mass of sodium hydrogencarbonate required to produce a decrease in temperature of 3 °C. (1 mark)

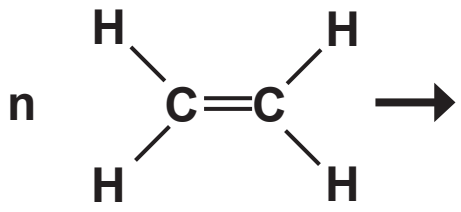
mass = _____ g

(TOTAL FOR QUESTION 5 = 6 MARKS)

(Questions continue on next page)

6 Poly(ethene) is an addition polymer made from ethene, C_2H_4

(a) Complete the equation to show the formation of poly(ethene) from ethene. (2 marks)



(b) State why poly(ethene) is described as an addition polymer, not a condensation polymer. (1 mark)

(Question continues on next page)

(c) Many shopping bags are made of poly(ethene).

(i) One useful property of poly(ethene) is that it is inert so it does not react with food.

Explain two other properties of poly(ethene) that make it useful for shopping bags.
(2 marks)

1 _____

_____

_____

2 _____

_____

_____

(Question continues on next page)

(ii) **Another property of poly(ethene) is that it is non-biodegradable.**

Two methods of disposing of poly(ethene) are landfill and burning.

Give one problem caused by each method of disposal. (2 marks)

landfill _____

_____

_____

burning _____

_____

_____

(TOTAL FOR QUESTION 6 = 7 MARKS)

(Questions continue on next page)

7 Magnesium can be obtained by the electrolysis of magnesium chloride.

Solid magnesium chloride is obtained from seawater.

The magnesium chloride is melted and then electrolysed. The positive electrode is made of graphite and the negative electrode is made of steel.

Magnesium forms at the negative electrode. Chlorine forms at the positive electrode.

(a) Explain why the magnesium chloride has to be melted before it can be electrolysed. (2 marks)

(Question continues on next page)

(b) Write an ionic half-equation to represent the formation of magnesium at the negative electrode. (1 mark)

(c) Suggest why steel is NOT used for the positive electrode. (1 mark)

(TOTAL FOR QUESTION 7 = 4 MARKS)

(Questions continue on next page)

8 Submarines that spend a long time underwater use sodium peroxide (Na_2O_2) to absorb carbon dioxide (CO_2) from the air in the submarine.

The equation for the reaction is

$$2Na_2O_2 + 2CO_2 \longrightarrow 2Na_2CO_3 + O_2$$

(a) There are 140 people on the submarine.

Each person produces 480 dm^3 of carbon dioxide per day.

(i) Calculate the total amount, in moles, of carbon dioxide produced on the submarine in one day.

[assume 1 mol of CO_2 occupies 24·0 dm^3]

(2 marks)

amount of CO_2 = _____ mol

(ii) Calculate the mass, in kilograms, of sodium peroxide required to absorb all of the carbon dioxide produced in the submarine in one day. [M_r of Na_2O_2 = 78·0]

(2 marks)

mass of Na_2O_2 = _____ kg

(Question continues on next page)

(b) Spaceships use either lithium hydroxide (LiOH) or lithium peroxide (Li_2O_2) to absorb carbon dioxide.

The equations for the two reactions are

Equation 1 $2LiOH + CO_2 \longrightarrow Li_2CO_3 + H_2O$

Equation 2 $2Li_2O_2 + 2CO_2 \longrightarrow 2Li_2CO_3 + O_2$

Using information from the equations, give two reasons why lithium peroxide is more suitable than lithium hydroxide for use on spaceships.
(2 marks)

1 _____

_____

_____

2 _____

_____

_____

(TOTAL FOR QUESTION 8 = 6 MARKS)

(Questions continue on next page)

9 Ethanol (C_2H_5OH) is made in industry by reacting ethene (C_2H_4) with steam at a temperature of 300 °C and a pressure of 70 atm. The percentage yield of ethanol is 43%.

The equation for the reaction is

$$C_2H_4(g) + H_2O(g) \rightleftharpoons C_2H_5OH(g) \qquad \Delta H = -45{\cdot}3\ kJ/mol$$

(a) (i) State what the symbols $\rightleftharpoons$ and ΔH represent. (2 marks)

$\rightleftharpoons$ _____

ΔH _____

(ii) Name the catalyst used in this industrial process. (1 mark)

_____

(Question continues on next page)

(b) (i) **Predict the effect on the yield of ethanol if the reaction is carried out at a temperature lower than 300 °C, but at the same pressure of 70 atm.**
[assume reaction reaches equilibrium]

Give a reason for your answer. (2 marks)

(Question continues on next page)

(ii) Predict the effect on the yield of ethanol if the reaction is carried out at a pressure lower than 70 atm, but at the same temperature of 300 °C.

[assume reaction reaches equilibrium]

Give a reason for your answer. (2 marks)

(Question continues on next page)

(c) One method of obtaining ethene is by cracking crude oil fractions.

Ethene can also be made by passing ethanol vapour over a hot aluminium oxide catalyst.

The equation for the reaction is

$$C_2H_5OH(g) \longrightarrow C_2H_4(g) + H_2O(g)$$

(i) State the type of reaction taking place.

(1 mark)

(Question continues on next page)

(ii) **Suggest why it may be necessary, in the future, to make ethene using this reaction rather than by cracking crude oil fractions.**

(1 mark)

(TOTAL FOR QUESTION 9 = 9 MARKS)

(Questions continue on next page)

10 Samarium, Sm, is a metal used to make powerful magnets.

(a) Samarium can be obtained by heating its oxide with lanthanum, La.

$$Sm_2O_3 + 2La \longrightarrow 2Sm + La_2O_3$$

The table shows the melting points of the substances involved in this reaction.

Substance	samarium	samarium oxide	lanthanum	lanthanum oxide
Melting point in °C	1072	2335	920	2315

(Question continues on next page)

(i) The operating temperature for this reaction is 1030 °C.

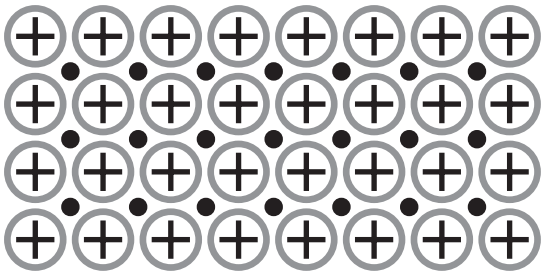
Explain which substance in the table could exist as a liquid at this temperature. (2 marks)

(ii) Samarium oxide neutralises hydrochloric acid to form samarium chloride, $SmCl_3$

Write a chemical equation for this reaction. (1 mark)

(Question continues on next page)

(b) The diagram shows the arrangement of the particles in samarium.



Key

⊕ samarium ion

• electron

Explain why samarium is malleable and is a good conductor of electricity. (4 marks)

(TOTAL FOR QUESTION 10 = 7 MARKS)

TOTAL FOR PAPER = 60 MARKS

END