

Please check the examination details below before entering your candidate information

Candidate surname

Other names

**Pearson Edexcel**  
**International GCSE (9–1)**

Centre Number

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Candidate Number

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**Thursday 14 May 2020**

Morning (Time: 2 hours)

Paper Reference **4CH1/1C 4SD0/1C**

**Chemistry**

**Unit: 4CH1**

**Science (Double Award) 4SD0**

**Paper: 1C**

**You must have:**

Calculator, ruler

Total Marks

## Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- 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 .

## Information

- The total mark for this paper is 110.
- The marks for **each** question are shown in brackets  
– *use this as a guide as to how much time to spend on each question.*

## Advice

- 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.

Turn over ►

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# The Periodic Table of the Elements

1	2	3	4	5	6	7	0										
7 <b>Li</b> lithium 3	9 <b>Be</b> beryllium 4	11 <b>Na</b> sodium 11	12 <b>C</b> carbon 6	13 <b>Al</b> aluminium 13	14 <b>N</b> nitrogen 7	15 <b>P</b> phosphorus 15	16 <b>O</b> oxygen 8	17 <b>F</b> fluorine 9	18 <b>Ne</b> neon 10								
19 <b>K</b> potassium 19	20 <b>Ca</b> calcium 20	23 <b>Sc</b> scandium 21	24 <b>Ti</b> titanium 22	25 <b>V</b> vanadium 23	26 <b>Cr</b> chromium 24	27 <b>Mn</b> manganese 25	28 <b>Fe</b> iron 26	29 <b>Co</b> cobalt 27	30 <b>Ni</b> nickel 28	31 <b>Cu</b> copper 29	32 <b>Zn</b> zinc 30	33 <b>Ga</b> gallium 31	34 <b>Ge</b> germanium 32	35 <b>As</b> arsenic 33	36 <b>Se</b> selenium 34	37 <b>Br</b> bromine 35	38 <b>Kr</b> krypton 36
39 <b>Rb</b> rubidium 37	40 <b>Sr</b> strontium 38	45 <b>Y</b> yttrium 39	48 <b>Zr</b> zirconium 40	51 <b>Nb</b> niobium 41	52 <b>Mo</b> molybdenum 42	55 <b>Tc</b> technetium 43	56 <b>Ru</b> ruthenium 44	59 <b>Rh</b> rhodium 45	63.5 <b>Pd</b> palladium 46	65 <b>Cd</b> cadmium 48	70 <b>In</b> indium 49	73 <b>Sn</b> tin 50	75 <b>Sb</b> antimony 51	77 <b>Te</b> tellurium 52	80 <b>I</b> iodine 53	84 <b>Xe</b> xenon 54	86 <b>Rn</b> radon 86
55 <b>Cs</b> caesium 55	56 <b>Ba</b> barium 56	57 <b>La*</b> lanthanum 57	72 <b>Hf</b> hafnium 72	73 <b>Ta</b> tantalum 73	74 <b>W</b> tungsten 74	75 <b>Re</b> rhenium 75	76 <b>Os</b> osmium 76	77 <b>Ir</b> iridium 77	78 <b>Pt</b> platinum 78	79 <b>Au</b> gold 79	80 <b>Hg</b> mercury 80	81 <b>Tl</b> thallium 81	82 <b>Pb</b> lead 82	83 <b>Bi</b> bismuth 83	84 <b>Po</b> polonium 84	85 <b>At</b> astatine 85	[222] <b>Rn</b> radon 86
[223] <b>Fr</b> francium 87	[226] <b>Ra</b> radium 88	[227] <b>Ac*</b> actinium 89	[261] <b>Rf</b> rutherfordium 104	[262] <b>Db</b> dubnium 105	[266] <b>Sg</b> seaborgium 106	[264] <b>Bh</b> bohrium 107	[277] <b>Hs</b> hassium 108	[268] <b>Mt</b> meitnerium 109	[271] <b>Ds</b> darmstadtium 110	[272] <b>Rg</b> roentgenium 111	Elements with atomic numbers 112–116 have been reported but not fully authenticated						

1 H hydrogen 1

Key  
relative atomic mass  
atomic symbol  
name  
atomic (proton) number

\* The lanthanoids (atomic numbers 58–71) and the actinoids (atomic numbers 90–103) have been omitted.

The relative atomic masses of copper and chlorine have not been rounded to the nearest whole number.

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**Answer ALL questions.**

**1** This question is about chemical elements.

Use the Periodic Table to help you answer this question.

(a) (i) Identify the element with atomic number 5 (1)

(ii) Give the symbol of a metallic element in Period 3 (1)

(iii) Identify the element whose atoms contain 14 protons. (1)

(iv) Identify the element whose atoms have the electronic configuration 2.5 (1)

(v) Give the name of the compound formed between oxygen and the element with atomic number 13 (1)

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(b) The position of an element in the Periodic Table can be used to predict its properties.

(i) Which group contains elements that are all unreactive? (1)

- A Group 2
- B Group 5
- C Group 6
- D Group 0

(ii) Which of these is the least reactive element in Group 1? (1)

- A caesium
- B lithium
- C potassium
- D sodium

(Total for Question 1 = 7 marks)



2 (a) The boxes list changes that may happen in a laboratory and the names of some changes.

Draw one straight line from each change to its correct name.

(3)

**Change**

**Name of change**

ice turns into water

solid carbon dioxide turns  
directly into a gas

a solute is stirred into a  
solvent

diffusion

dissolving

evaporation

freezing

melting

sublimation



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(b) A student has two solids, X and Y.

One of these solids is a pure substance and the other is a mixture.

Describe how the student could identify which solid is pure and which is a mixture by measuring a physical property of each solid.

(3)

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**(Total for Question 2 = 6 marks)**



3 This question is about metals.

- (a) Metals can be arranged in a reactivity series based on their reactions with water and their reactions with dilute hydrochloric acid.

The table shows how four metals, P, Q, R and S, react with water and with dilute hydrochloric acid.

Metal	Reaction with water	Reaction with dilute hydrochloric acid
P	no reaction	hydrogen gas forms very slowly
Q	no reaction	no reaction
R	hydrogen gas forms very quickly	not done
S	hydrogen gas forms quickly	hydrogen gas forms very quickly

- (i) Identify which of the metals P, Q, R or S could be gold.

(1)

- (ii) Suggest why the reaction between metal R and dilute hydrochloric acid was not done.

(1)

- (iii) Use the information in the table to place the metals in order of reactivity from most reactive to least reactive.

(1)

most reactive



least reactive





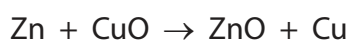
(b) Zinc is used to coat iron gates to prevent the iron from rusting.

(i) State the name of this method of preventing iron from rusting. (1)

(ii) State another method of preventing iron from rusting. (1)

(c) A mixture of zinc powder and copper(II) oxide is heated.

The chemical equation for the reaction that takes place is



(i) State how the reaction shows that zinc is more reactive than copper. (1)

(ii) Explain which substance is the oxidising agent. (2)

**(Total for Question 3 = 8 marks)**



4 Sodium hydroxide dissolves in water, forming a strongly alkaline solution.

Ammonia dissolves in water, forming a slightly less alkaline solution.

(a) (i) Identify the ion that makes the sodium hydroxide solution alkaline.

(1)

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(ii) What is a possible pH of ammonia solution?

(1)

- A 3
- B 6
- C 11
- D 14

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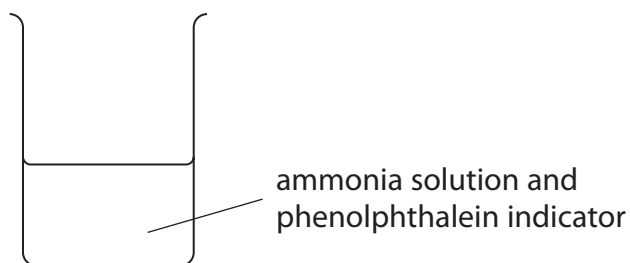
(b) When ammonia solution reacts with sulfuric acid, a neutralisation reaction occurs and ammonium sulfate forms.

(i) How does the sulfuric acid act in this reaction?

(1)

- A as a neutron donor
- B as a neutron acceptor
- C as a proton donor
- D as a proton acceptor

(ii) The diagram shows a beaker containing some ammonia solution and a few drops of phenolphthalein indicator.



Dilute sulfuric acid is added to the beaker until it is in excess.

What are the colours of the phenolphthalein indicator before and after adding excess sulfuric acid?

(1)

	Before	After
<input type="checkbox"/> A	orange	red
<input type="checkbox"/> B	yellow	red
<input type="checkbox"/> C	pink	colourless
<input type="checkbox"/> D	colourless	pink



(c) Ammonium sulfate is used by gardeners as a fertiliser because it contains nitrogen.

(i) Explain why the chemical formula of ammonium sulfate is  $(\text{NH}_4)_2\text{SO}_4$

Refer to the charges on the ions in your answer.

(2)

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(ii) Calculate the relative formula mass of ammonium sulfate,  $(\text{NH}_4)_2\text{SO}_4$

(1)

relative formula mass = .....

(iii) Calculate the mass, in grams, of nitrogen in 1.0 kg of ammonium sulfate.

(3)

mass = ..... g

**(Total for Question 4 = 10 marks)**



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5 (a) Chlorine, bromine and iodine are elements in the Periodic Table.

Explain how the position of these elements in the Periodic Table depends on their electronic configurations.

(2)

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(b) Chlorine reacts with methane to form  $\text{CH}_3\text{Cl}$  and  $\text{HCl}$

(i) State the condition necessary for this reaction.

(1)

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(ii) Give the equation for this reaction.

(1)

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(iii) The bonds in a molecule of  $\text{CH}_3\text{Cl}$  are covalent.

Explain, in terms of electrostatic attractions, what is meant by a covalent bond.

(2)

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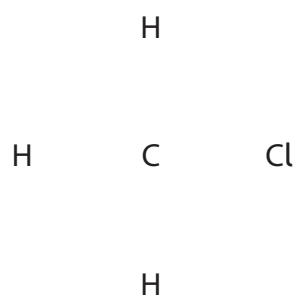
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(iv) Draw a dot-and-cross diagram for a molecule of  $\text{CH}_3\text{Cl}$

Show only the outer electrons of the atoms.

(2)



(v)  $\text{CH}_3\text{Cl}$  has a simple molecular structure.

Explain why  $\text{CH}_3\text{Cl}$  has a low boiling point.

(2)

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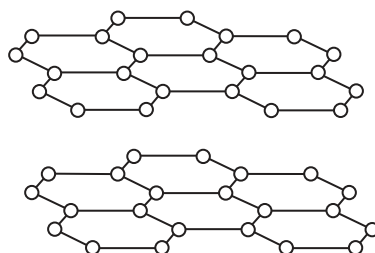
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(c) Graphite is another substance that contains covalent bonds.

The diagram shows the structure of graphite.



Most covalent substances do not conduct electricity.

Explain why graphite is able to conduct electricity.

(2)

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**(Total for Question 5 = 12 marks)**





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6 The table shows the molecular formulae of six organic compounds, A, B, C, D, E and F.

A	B	C	D	E	F
$C_2H_4$	$C_2H_6$	$C_3H_6$	$C_3H_8$	$C_4H_8$	$C_4H_{10}$

(a) (i) Explain which homologous series compound B belongs to.

(2)

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(ii) Give the letter of the compound that has the same empirical formula as its molecular formula.

(1)

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(iii) Compound F exists as two isomers.

Explain what is meant by the term **isomers**.

Include the structures of the two isomers of compound F in your answer.

(3)

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(b) Describe how compound D can be obtained from crude oil using the industrial process of fractional distillation.

(4)

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(c) Compound C can be used to make a polymer.

(i) State the type of polymer formed from compound C.

(1)

(ii) Name the polymer formed from compound C.

(1)

(iii) Draw the structure of this polymer.

Include the displayed formula of the repeat unit.

(2)

**(Total for Question 6 = 14 marks)**



- 7 Dilute hydrochloric acid reacts with a solution of sodium thiosulfate ( $\text{Na}_2\text{S}_2\text{O}_3$ ) to form a precipitate.

The equation for the reaction is

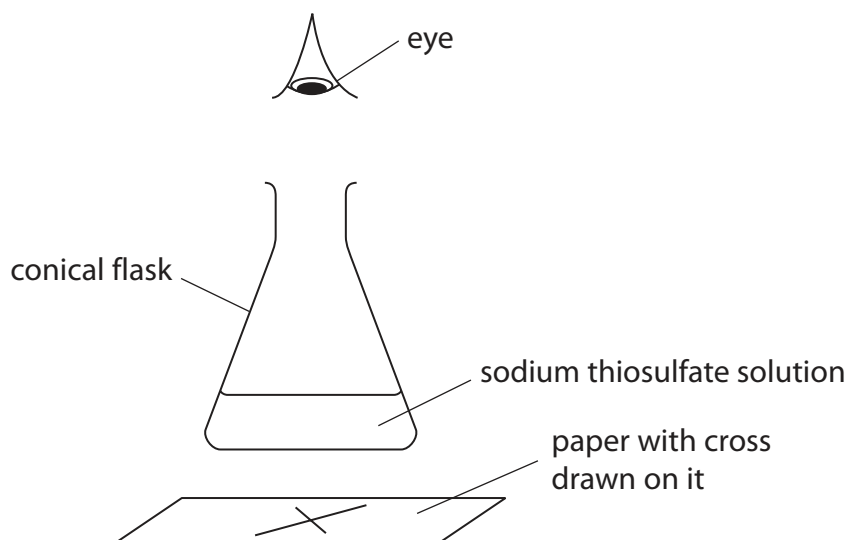


- (a) State the name of the precipitate that forms.

(1)

- (b) The reaction is often used to investigate rates of reaction.

The diagram shows the apparatus a student uses to investigate the effect of temperature on the rate of the reaction.



This is the student's method.

- pour  $50\text{ cm}^3$  of cold sodium thiosulfate solution into a conical flask and heat it to  $20^\circ\text{C}$
- draw a cross (X) on a piece of paper and place it under the flask
- add  $5\text{ cm}^3$  of dilute hydrochloric acid to the flask
- look at the cross from above and record the time taken until the cross cannot be seen



The student repeats the experiment four times, using sodium thiosulfate solution at a different temperature each time.

He keeps the volumes of sodium thiosulfate solution and hydrochloric acid constant in each experiment.

Give two other factors that the student should keep constant.

(2)

1 .....

2 .....

(c) The table shows the student's results.

Temperature in °C	Time until cross cannot be seen in s
20	400
30	188
40	84
50	44
60	24

The highest temperature the student uses is 60 °C because he thinks the results might not be as accurate at temperatures higher than 60 °C.

Suggest a reason why the results might not be as accurate at temperatures higher than 60 °C.

(1)

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(d) The student wants to compare the rates of the reaction at the different temperatures.

He uses this formula to obtain a value for each rate of reaction

$$\text{rate} = \frac{1}{\text{time in s}}$$

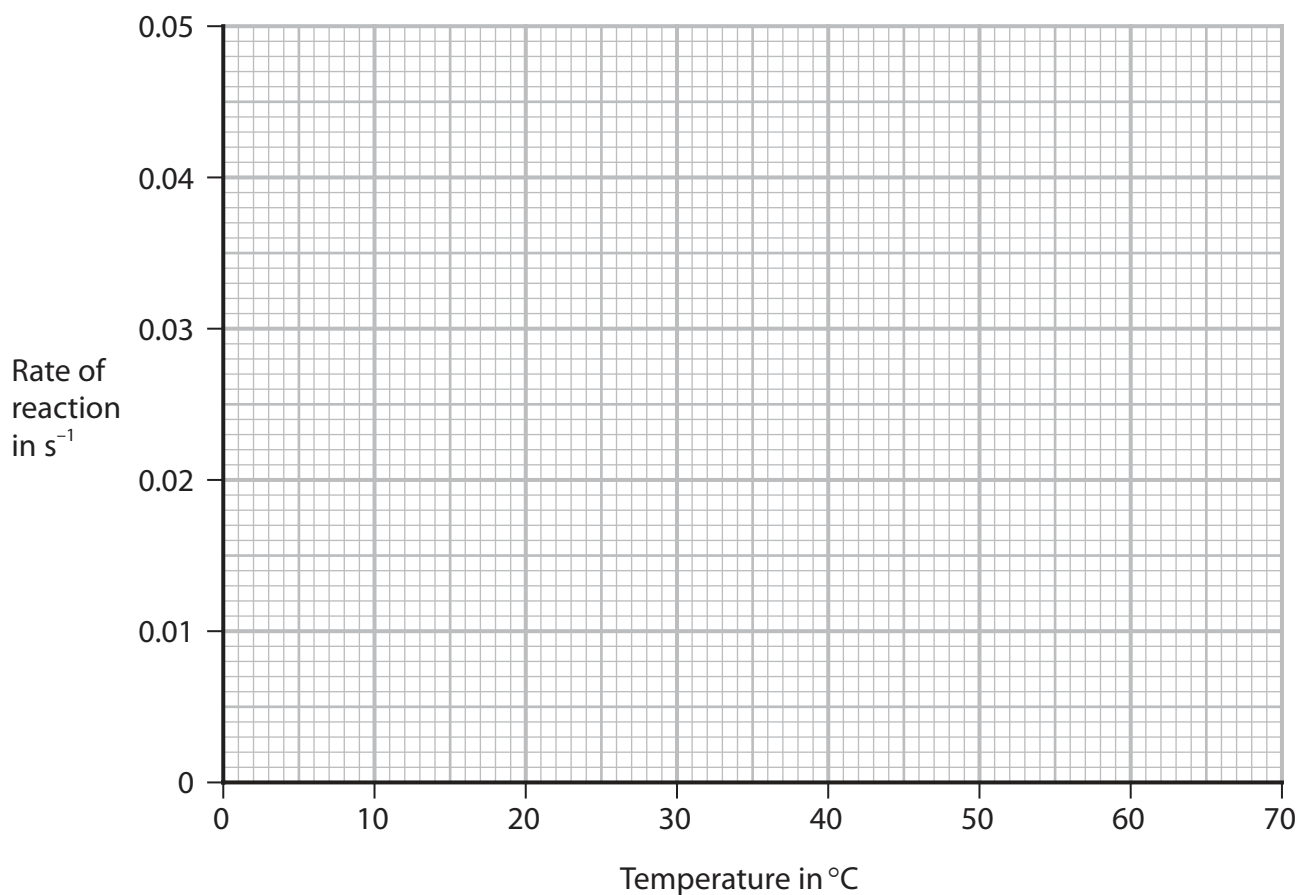
The table shows the value of the rate of reaction at each temperature.

Temperature in °C	Time until cross cannot be seen in s	Rate of reaction in s <sup>-1</sup>
20	400	0.0025
30	188	0.0053
40	84	0.012
50	44	0.023
60	24	0.042

Plot the values of temperature and rate of reaction on the grid.

Draw a curve of best fit through the points.

(2)





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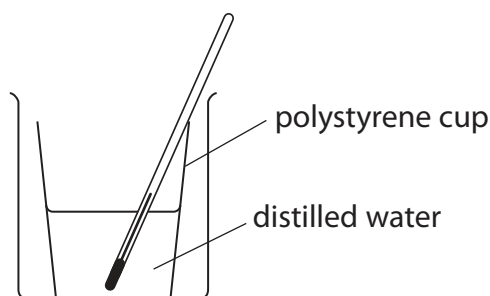
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- 8 A student uses this apparatus to investigate the heat energy change when a salt dissolves in water to form a solution.



This is the student's method.

- add  $50\text{ cm}^3$  of distilled water to a polystyrene cup
- record the initial temperature of the water
- add a known mass of solid anhydrous copper(II) sulfate to the polystyrene cup and stir the solution with the thermometer until all the solid has dissolved
- record the maximum temperature of the copper(II) sulfate solution

- (a) (i) Name the piece of apparatus the student should use to add the distilled water to the polystyrene cup.

(1)

- (ii) The student stirs the solution to help the solid dissolve more quickly.

Suggest another reason why the student stirs the solution.

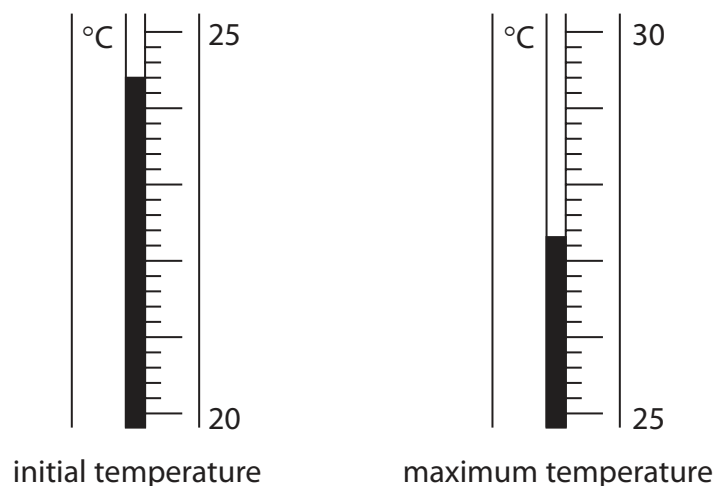
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- (iii) State the colour of the copper(II) sulfate solution.

(1)



(b) The diagram shows the temperatures in one experiment.



Complete the table, giving all values to the nearest 0.1 °C.

(3)

maximum temperature in °C	
initial temperature in °C	
increase in temperature in °C	

(c) In a second experiment, when a student dissolves the anhydrous copper(II) sulfate in 50 cm<sup>3</sup> of distilled water, the increase in temperature is 3.3 °C.

(i) Show that the heat energy change ( $Q$ ) in this second experiment is approximately 700 J.

[for water,  $c = 4.2 \text{ J/g}^\circ\text{C}$ ]

[mass of 1.0 cm<sup>3</sup> of water = 1.0 g]

(2)



(ii) In this experiment the student uses 1.70 g of the anhydrous copper(II) sulfate.

Calculate the molar enthalpy change ( $\Delta H$ ) in kJ/mol.

Include a sign in your answer.

[ $M_r$  of  $\text{CuSO}_4 = 159.5$ ]

(4)

$\Delta H = \dots\dots\dots$  kJ/mol

(d) Another student does a similar experiment but uses hydrated copper(II) sulfate instead of anhydrous copper(II) sulfate.

The table shows his results.

initial temperature in $^{\circ}\text{C}$	23.8
final temperature in $^{\circ}\text{C}$ when all solid dissolves	22.7

Explain what the results show about the type of energy change that occurs when hydrated copper(II) sulfate dissolves.

(2)

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**(Total for Question 8 = 14 marks)**

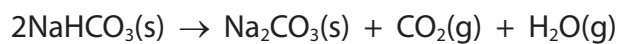
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9 Sodium hydrogencarbonate ( $\text{NaHCO}_3$ ) is also known as baking soda.

Baking soda can be used to make cakes increase in size in an oven.

This is the equation for the reaction that takes place when baking soda is heated.



(a) (i) What type of reaction is this?

(1)

- A combustion
- B decomposition
- C oxidation
- D reduction

(ii) Suggest why the reaction makes the cakes increase in size.

(1)

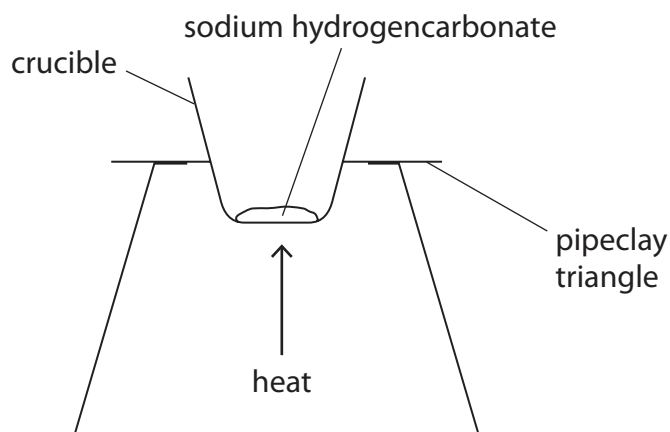
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- (b) A student uses this apparatus to investigate the reaction that takes place when sodium hydrogencarbonate is heated.



This is the student's method.

- weigh a crucible and record the mass
- add some sodium hydrogencarbonate to the crucible, reweigh it and record the mass
- heat the crucible and contents for five minutes, then allow to cool before weighing and recording the mass
- heat the crucible and contents again for a further three minutes, then allow to cool before weighing and recording the mass

- (i) Give a reason why the crucible and contents are heated for a further three minutes. (1)

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- (ii) The student considered using a lid on the crucible in the experiment.

Suggest an advantage and a disadvantage of using a lid on the crucible. (2)

advantage .....

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disadvantage .....

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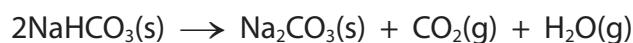
(c) The table shows some of the student's results.

mass of crucible and sodium hydrogencarbonate in g	29.75
mass of empty crucible in g	26.50

- (i) Calculate the mass of sodium hydrogencarbonate that the student uses. (1)

mass = .....g

- (ii) Using this equation, calculate the maximum mass of sodium carbonate ( $\text{Na}_2\text{CO}_3$ ) that could form in the student's reaction.



[ $M_r$  of  $\text{NaHCO}_3 = 84$        $M_r$  of  $\text{Na}_2\text{CO}_3 = 106$ ] (3)

maximum mass = .....g



(d) In a second experiment, the student uses a larger mass of sodium hydrogencarbonate. She calculates that she should obtain 4.8 g of sodium carbonate. She actually obtains 4.2 g of sodium carbonate.

(i) Calculate the percentage yield from the student's experiment. (2)

percentage yield = .....%

(ii) Other than spillages, suggest a possible reason why the student's actual yield is less than expected. (1)

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**(Total for Question 9 = 12 marks)**



10 The table gives information about some lead compounds.

Compound	Formula	Appearance	Solubility in water
lead(II) oxide	PbO	yellow solid	insoluble
lead(IV) oxide	PbO <sub>2</sub>	brown solid	insoluble
red lead oxide	Pb <sub>3</sub> O <sub>4</sub>	red solid	insoluble
lead(II) nitrate	Pb(NO <sub>3</sub> ) <sub>2</sub>	white solid	soluble

- (a) When a sample of red lead oxide is heated, it changes into a yellow solid and a gas forms that relights a glowing splint.

Complete the word equation for this reaction.

(2)

red lead oxide → ..... + .....

- (b) A sample of one of the oxides of lead contains 86.6% lead and 13.4% oxygen by mass.

Show by calculation that the sample is lead(IV) oxide, PbO<sub>2</sub>

[A<sub>r</sub> of Pb = 207      A<sub>r</sub> of O = 16]

(3)







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