

Paper Reference(s) 1CH0/1H
Pearson Edexcel Level 1/Level 2 GCSE (9–1)

Chemistry

Paper 1

Higher Tier

Total Marks

Thursday 14 May 2020 – Morning

Time: 1 hour 45 minutes plus your additional time allowance

In the boxes below, write your name, centre number and candidate number.

Surname					
Other names					
Centre Number					
Candidate Number					

YOU MUST HAVE

Calculator, ruler

YOU WILL BE GIVEN

Diagram Booklet, Periodic Table

INSTRUCTIONS

Answer ALL questions.

Answer the questions in the spaces provided – there may be more space than you need.

Calculators may be used.

Any diagrams may NOT be accurately drawn, unless otherwise indicated.

You must show all your working out with your answer clearly identified at the end of your solution.

INFORMATION

The total mark for this paper is 100.

The marks for each question are shown in brackets – use this as a guide as to how much time to spend on each question.

In questions marked with an **ASTERISK (*)**, marks will be awarded for your ability to structure your answer logically showing how the points that you make are related or follow on from each other where appropriate.

A periodic table is provided.

ADVICE

Read each question carefully before you start to answer it.

Try to answer every question.

Check your answers if you have time at the end.

Answer ALL questions. Write your answers in the spaces provided.

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 ☐.

- 1 Alloys of gold are often used to make jewellery.
The purity of gold is measured in carats.
Different alloys of gold have different carats.**

- (a) Look at Figure 1 for Question 1(a) in the Diagram Booklet. It shows the percentage of different metals in two samples of gold.**

Explain why 18 carat gold is stronger than 24 carat gold.

You may use diagrams on page 6 to help your answer. (2 marks)

(continued on the next page)

1 continued.

(continued on the next page)

1 continued.

- (b) Look at Figure 2 for Question 1(b) in the Diagram Booklet. It shows the relationship between the purity of gold in carats and the percentage of gold in the alloy.**

A necklace with a mass of 5.0 g was found to contain 2.9 g of gold.

Determine the purity of the gold necklace in carats.

Show your working. (3 marks)

purity of the gold necklace = _____ carats

(continued on the next page)

1 continued.

(c) A gold ring contains 3.94 g of gold.

Calculate the number of gold atoms in the ring.

**(relative atomic mass: Au = 197,
Avogadro constant = 6.02×10^{23})**

Show your working. (2 marks)

number of gold atoms = _____

(TOTAL FOR QUESTION 1 = 7 MARKS)

- 2 Look at Figure 3 for Question 2(a) in the Diagram Booklet. It shows the apparatus that can be used to electrolyse sodium sulfate solution using inert electrodes.**

(a) Hydrogen is produced at the negative electrode during electrolysis.

- (i) Describe the test to show the gas is hydrogen.
(2 marks)**

(continued on the next page)

2 continued.

(ii) What is the name of gas X that forms at the positive electrode? (1 mark)

- ☐ A ammonia
- ☐ B oxygen
- ☐ C nitrogen
- ☐ D sulfur dioxide

(iii) State what is meant by the term **electrolysis**.
(2 marks)

(continued on the next page)

Turn over

2 continued.

- (b) The sodium sulfate solution was made by dissolving 28.4 g of sodium sulfate in water to make 250 cm³ of solution.

Calculate the concentration of this solution in g dm⁻³.

Give your answer to three significant figures.
(3 marks)

concentration = _____ g dm⁻³

(continued on the next page)

2 continued.

(c) The ions present in sodium sulfate are

sodium Na^+

sulfate SO_4^{2-}

Write the formula of sodium sulfate using this information. (1 mark)

(TOTAL FOR QUESTION 2 = 9 MARKS)

- 3 The word equation for the reaction between copper carbonate and dilute sulfuric acid is



- (a) (i) Complete the balanced equation for this reaction. (2 marks)



- (ii) Calculate the relative formula mass of copper carbonate, CuCO_3 . (2 marks)

(relative atomic masses: C = 12.0, O = 16.0, Cu = 63.5)

relative formula mass of $\text{CuCO}_3 = \underline{\hspace{2cm}}$

(continued on the next page)

3 continued.

(iii) What is the chemical test to show that a gas is carbon dioxide? (1 mark)

- ☐ **A bubble the gas through limewater, limewater turns cloudy**
- ☐ **B put damp blue litmus paper in the gas, litmus paper turns red**
- ☐ **C put a lighted splint into the gas, the splint is extinguished**
- ☐ **D measure the pH of the gas, pH = 4**

(continued on the next page)

3 continued.

(b) Look at Figure 4 for Question 3(b) in the Diagram Booklet. It shows a conical flask containing dilute sulfuric acid.

Copper carbonate is added to the acid in the flask.

The copper carbonate is added one spatula measure at a time until the reaction has finished.

State TWO observations that would show the reaction has finished. (2 marks)

1 _____

2 _____

(continued on the next page)

3 continued.

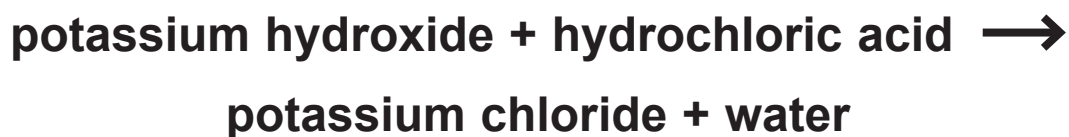
- (c) The electronic configuration of carbon is 2.4
The electronic configuration of oxygen is 2.6**

**Draw a dot and cross diagram for a molecule of
carbon dioxide.**

Show outer electrons only. (2 marks)

(TOTAL FOR QUESTION 3 = 9 MARKS)

- 4 Potassium hydroxide reacts with hydrochloric acid to form potassium chloride and water.**



- (a) A student carried out a titration to find the exact volume of dilute hydrochloric acid that reacted with 25.0 cm^3 of potassium hydroxide solution.**

There were five steps in the titration.

Look at the steps for Question 4 in the Diagram Booklet. They are not in the correct order.

(continued on the next page)

4 continued.

(i) Write the steps in the correct order.

Some of the steps have been completed for you. (1 mark)

first step

last step

K				M
---	--	--	--	---

(ii) Suggest an alternative piece of apparatus that could be used in step L to obtain exactly 25.0 cm^3 of potassium hydroxide solution. (1 mark)

(continued on the next page)

4 continued.

- (b) A student was then asked to produce a pure sample of solid potassium chloride.

After finding the volume of acid reacted in step M, the student added this volume of acid to a fresh 25.0 cm^3 sample of the potassium hydroxide solution. This mixture was then evaporated.

- (i) Explain why this new mixture was evaporated rather than the original mixture from the titration, to produce a pure sample of solid potassium chloride. (2 marks)

(continued on the next page)

Turn over

4 continued.

- (ii) After evaporation, the mass of the potassium chloride was determined.

The theoretical yield of the experiment was 0.70 g.

The actual yield was 0.84 g.

This gave a percentage yield greater than 100%.

Calculate the percentage yield of this experiment. (2 marks)

percentage yield = _____

(continued on the next page)

4 continued.

(iii) Suggest a reason why the actual yield was greater than the theoretical yield. (1 mark)

(continued on the next page)

4 continued.

(iv) The equation for the reaction between potassium hydroxide solution and dilute hydrochloric acid is



Calculate the atom economy for the production of potassium chloride from potassium hydroxide and hydrochloric acid.

(relative formula masses: $\text{KOH} = 56.0$, $\text{HCl} = 36.5$, $\text{KCl} = 74.5$, $\text{H}_2\text{O} = 18.0$)

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

(continued on the next page)

Turn over

4 continued.

atom economy = _____ %

(TOTAL FOR QUESTION 4 = 11 MARKS)

- 5 (a) A sample of rock salt contains a mixture of sodium chloride and some insoluble substances.**

The rock salt is added to water and the mixture stirred.

The mixture is then filtered to obtain a filtrate of sodium chloride solution.

- (i) Draw a labelled diagram of the apparatus used to filter the mixture and collect the sodium chloride solution. (2 marks)**

(continued on the next page)

Turn over

5 continued.

- (ii) Describe how a sample of pure, dry sodium chloride crystals can be obtained from the filtrate. (3 marks)**

(continued on the next page)

5 continued.

(b) Inks contain coloured dyes.

Samples of four inks, W, X, Y and Z, were separated using paper chromatography.

Look at Figure 5 for Question 5(b) in the Diagram Booklet. It shows the chromatogram obtained.

(i) In the experiment, the solvent front moved 6.5 cm.

Calculate the R_f value of the dye that is present in both inks X and Z. (1 mark)

$R_f =$ _____

(continued on the next page)

5 continued.

- (ii) State what could be changed in the experiment to make the R_f value more accurate. (1 mark)**

- (iii) In this experiment, ink sample Y did not move from the start line.**

Explain a change to the experiment that would be needed to separate the dyes in ink sample Y. (2 marks)

(TOTAL FOR QUESTION 5 = 9 MARKS)

Turn over

6 Titanium and iron are examples of transition metals.

- (a) Look at Figure 6 for Question 6(a) in the Diagram Booklet. It shows the percentage abundance of each isotope in a sample of titanium.**

Calculate the relative atomic mass of titanium in this sample. (3 marks)

(continued on the next page)

Turn over

6 continued.

relative atomic mass = _____

(b) Iron, when heated in air, reacts with oxygen to form iron oxide.

(i) This reaction is an example of (1 mark)

☐ A crystallisation

☐ B distillation

☐ C neutralisation

☐ D oxidation

(continued on the next page)

6 continued.

- (ii) Look at Figure 7 for Question 6(b)(ii) in the Diagram Booklet. The equipment shown can be used to find the mass of oxygen that combines with iron.**

**Describe how the equipment shown in Figure 7 could be used to find the mass of oxygen that combines with 0.500 g of iron wool in a crucible and lid of known mass.
(3 marks)**

6 continued.

(continued on the next page)

6 continued.

- (c) 2.24 g of iron combines with 0.96 g of oxygen to form an oxide of iron.**

Determine the formula of this oxide of iron and use it to complete the balanced equation on page 33.

(4 marks)

(relative atomic masses: Fe = 56.0, O = 16.0)

You must show your working.

(continued on the next page)

Turn over

6 continued.

balanced equation for the reaction is



(TOTAL FOR QUESTION 6 = 11 MARKS)

- 7 (a) Methane reacts with steam to form hydrogen and carbon dioxide.

The reaction takes place in two stages.



- (i) Stage 1 takes in heat energy, it is endothermic.

Explain the effect of increasing the temperature on the yield of the products of stage 1. (2 marks)

(continued on the next page)

7 continued.

(ii) The overall equation for the process is



0.40 g of methane were fully reacted with steam to form carbon dioxide and hydrogen.

Calculate the maximum volume of hydrogen in dm^3 , measured at room temperature and pressure, that could be made in this reaction.
(3 marks)

(relative formula mass: $\text{CH}_4 = 16$,
1 mol of any gas at room temperature and pressure occupies 24 dm^3)

(continued on the next page)

Turn over

7 continued.

maximum volume of hydrogen = _____ dm³

(continued on the next page)

7 continued.

- *(b) Hydrogen-oxygen fuel cells can be used to provide electrical energy in a spacecraft.**

The reaction that takes place in the fuel cell is



Evaluate the advantages and disadvantages of providing electrical energy in a spacecraft using hydrogen-oxygen fuel cells rather than chemical cells. (6 marks)

(continued on the next page)

Turn over

7 continued.

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7 continued.

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7 continued.

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(TOTAL FOR QUESTION 7 = 11 MARKS)

- 8 (a) Calcium has an atomic number of 20.
A calcium atom has a mass number of 40.

(i) Which row of the table shows the number of protons and number of neutrons in this atom of calcium? (1 mark)

	number of protons	number of neutrons
<input type="checkbox"/> A	20	20
<input type="checkbox"/> B	40	20
<input type="checkbox"/> C	20	60
<input type="checkbox"/> D	60	20

(continued on the next page)

8 continued.

- (ii) Look at Figure 8 for Question 8(a)(ii) in the Diagram Booklet. It shows the arrangement of electrons in an atom of calcium.**

Explain, using the information in Figure 8, in which period of the periodic table calcium can be found. (2 marks)

(continued on the next page)

8 continued.

(b) Calcium and potassium react with water in similar ways.

(i) One similarity in the reactions is that hydrogen gas is produced.

State ONE other similarity in the products of the reactions of calcium and potassium with water. (1 mark)

(ii) Potassium is higher in the reactivity series than calcium and reacts more vigorously with water than calcium reacts with water.

State why potassium is higher in the reactivity series and reacts more vigorously with water than calcium. (1 mark)

(continued on the next page)

Turn over

8 continued.

- *(c) Calcium chloride can be prepared by the reaction of calcium with chlorine gas.**

Look at Figure 8 for Question 8(c) in the Diagram Booklet. It shows some properties of calcium, chlorine and calcium chloride.

Explain, in terms of bonding and structure, why the properties of the product, calcium chloride, are different from the properties of the reactants, calcium and chlorine. (6 marks)

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Turn over

8 continued.

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Turn over

8 continued.

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(continued on the next page)

Turn over

8 continued.

[illegible]

(continued on the next page)

Turn over

8 continued.

(TOTAL FOR QUESTION 8 = 11 MARKS)

9 (a) Dilute hydrochloric acid is a strong acid.

(i) Explain why dilute hydrochloric acid is described as a strong acid. (2 marks)

(ii) 1 cm^3 of hydrochloric acid of pH 2 is made up to a volume of 10 cm^3 with distilled water.

State the pH of the new solution. (1 mark)

pH = _____

(continued on the next page)

9 continued.

- (b) Magnesium oxide reacts with dilute hydrochloric acid to produce magnesium chloride solution and water.**



**Write the ionic equation for this reaction.
(3 marks)**

- (c) In an experiment magnesium hydroxide powder is added in 0.1 g portions to 25 cm³ of dilute hydrochloric acid until the magnesium hydroxide is just in excess.**

Universal indicator paper can be used to test the pH of the solution after each addition of magnesium hydroxide.

- (i) Give the name of an alternative piece of equipment that can be used to measure pH.
(1 mark)**
-

(continued on the next page)

Turn over

9 continued.

(ii) State and explain how the pH changes as the magnesium hydroxide is added to the dilute hydrochloric acid. (4 marks)

[illegible]

(TOTAL FOR QUESTION 9 = 11 MARKS)

Turn over

10 (a) Ammonia is manufactured by the Haber process.

The equation for the reaction is



The reaction is reversible and can reach equilibrium.

(i) An iron catalyst can be used in the reaction.

Which row of the table shows how adding the iron catalyst affects the rate of attainment of equilibrium and the equilibrium yield of ammonia? (1 mark)

	rate of attainment of equilibrium	equilibrium yield of ammonia
<input type="checkbox"/> A	increases	increases
<input type="checkbox"/> B	decreases	does not change
<input type="checkbox"/> C	decreases	increases
<input type="checkbox"/> D	increases	does not change

(continued on the next page)

10 continued.

**(ii) Which of the following statements is correct when the reaction reaches equilibrium?
(1 mark)**

- ☐ **A the reverse reaction starts to take place**
- ☐ **B the amounts of nitrogen, hydrogen and ammonia are equal**
- ☐ **C the amounts of nitrogen, hydrogen and ammonia become constant**
- ☐ **D the reaction stops**

(continued on the next page)

10 continued.

- (iii) The reaction is carried out at a pressure of 200 atmospheres.**

Explain what effect a pressure higher than 200 atmospheres would have on the rate of attainment of equilibrium and on the equilibrium yield of ammonia. (4 marks)

(continued on the next page)

Turn over

10 continued.

(b) Ammonium sulfate and ammonium nitrate are used as fertilisers as they both contain nitrogen, which will increase the yield of crops.

(i) Suggest ONE other reason for using solid ammonium sulfate and solid ammonium nitrate as nitrogenous fertilisers. (1 mark)

(ii) Ammonium nitrate can be made by the reaction of ammonia with nitric acid.

Write the balanced equation for this reaction.
(2 marks)

(continued on the next page)

Turn over

10 continued.

(iii) Describe ONE similarity and ONE difference between the industrial production of ammonium sulfate and the laboratory preparation of ammonium sulfate. (2 marks)

similarity _____

difference _____

(TOTAL FOR QUESTION 10 = 11 MARKS)

TOTAL FOR PAPER = 100 MARKS

END