

GCSE Chemistry (9 – 1)

Reactions of Acids

Name:

Group:

Instructions

- Read each question carefully before you begin to answer it.
- Use black ink or black ball-point pen for your answers.
- Fill in the boxes at the top of this page with your name and group.
- Attempt to answer every question in the booklet.
- Answer the questions in the spaces provided – there may be more space than you need in some answer spaces.
- Calculators may be used for this booklet.
- For any calculations, you **must** show all your working.
- Any and all drawings or graphs should be completed in pencil.



For markers use	
Question	Mark
1	/4
2	/12
3	/13
4	/6
5	/18
6	/11
Total	/64
%	
Grade	

Information

- The maximum mark for this paper is 64 marks.
- The marks for each question are shown in brackets.
- Please be aware that good English and clear presentation are required in your answers.



1. Acids react predictably with different substances to form a salt.

Circle the letter of the correct answer for each of the following questions.

a. A white precipitate of barium sulfate can be formed by mixing two solutions.

Which pair of solutions would produce a precipitate of barium sulfate?

- A Barium chloride and sodium hydroxide.
- B Barium nitrate and potassium sulfate.
- C Barium chloride and silver nitrate.
- D Barium hydroxide and hydrochloric acid.

(1 mark)

b. A student adds magnesium ribbon to a test tube containing dilute hydrochloric acid.

A gas is produced which burns with a squeaky pop.

What is the correct word equation for this reaction?

- A magnesium + hydrochloric acid → magnesium chloride + carbon dioxide
- B magnesium + hydrochloric acid → magnesium hydroxide + hydrogen
- C magnesium + hydrochloric acid → magnesium chloride + hydrogen
- D magnesium + hydrochloric acid → magnesium oxide + water

(1 mark)

c. All neutralisation reactions between an acid and an alkali involve the same fundamental process.

Which ionic equation correctly represents this process?

- A $\text{H}^+(\text{aq}) + \text{OH}^-(\text{aq}) \rightarrow \text{H}_2\text{O}(\text{l})$
- B $\text{H}^+(\text{aq}) + \text{Cl}^-(\text{aq}) \rightarrow \text{HCl}(\text{g})$
- C $\text{Na}^+(\text{aq}) + \text{OH}^-(\text{aq}) \rightarrow \text{NaOH}(\text{aq})$
- D Acid + Alkali → Salt + Water

(1 mark)

d. What is the correct sequence of steps for the preparation of a pure sample of copper(II) sulfate crystals from copper(II) oxide and sulfuric acid?

- A dissolving → crystallisation → evaporation → filtration
- B dissolving → evaporation → filtration → crystallisation
- C dissolving → filtration → crystallisation → evaporation
- D dissolving → filtration → evaporation → crystallisation

(1 mark)

(Total for Question 1 is 4 marks)

2. There are three methods of preparing salts.

Method A – use a burette and an indicator.

Method B – mix two solutions and obtain the salt by precipitation.

Method C – add an excess of an insoluble base or carbonate to a dilute acid and remove the excess by filtration.

For each of the following salt preparations, choose one of the **methods A, B or C**, name any additional reagent needed and then write the equation.

a. The soluble salt, copper(II) chloride, from the insoluble substance, copper(II) carbonate.

Method:

Reagent:

Word equation:

(3 marks)

b. The soluble salt, sodium sulfate, from the soluble base, sodium hydroxide

Method:

Reagent:

Balanced symbol equation: :

(3 marks)

c. The insoluble salt, silver chloride, from the soluble salt, silver nitrate.

Method:

Reagent:

Balanced symbol equation: :

(4 marks)

d. In Method C, it is important to add the insoluble base in excess.

Explain why.

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(2 marks)

(Total for Question 2 is 12 marks)

3. Pure dry crystals of copper(II) sulfate can be made by reacting excess copper(II) carbonate powder with warm, dilute sulfuric acid.

a. During the reaction, bubbles of a colourless gas are given off.
State the name of this gas.

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(1 mark)

b. Why is excess copper(II) carbonate used?

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(1 mark)

c. How is the excess copper(II) carbonate removed from the reaction mixture?

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(1 mark)

d. Describe how you can obtain pure dry crystals of copper(II) sulfate from a solution of copper(II) sulfate.

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(2 marks)

e. Describe one other reaction that makes copper(II) sulfate.

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(1 mark)

f. Write a word equation for the reaction you suggested in part (e).

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(1 mark)

g. Copper(II) sulfate is used as a fungicide on plants.

Explain why the chemicals used in fungicides need to be as pure as possible.

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(1 mark)

- h. A student repeats the experiment using excess sulfuric acid.
She obtains 16.0 g of copper(II) sulfate from 12.4 g of copper(II) carbonate.

How much copper(II) sulfate can the student obtain from 3.1 g of copper(II) carbonate?

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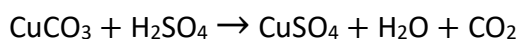
(1 mark)

- i. A sample of 25.0 g of impure copper(II) sulfate contains 24.5 g of pure copper(II) sulfate.
Calculate the percentage purity of the copper(II) sulfate.

Percentage purity = ...

(1 mark)

- j. A different student performs the experiment.
They react 6.2 g of copper(II) carbonate with excess sulfuric acid and produce 7.2 g of pure, dry copper(II) sulfate crystals. The balanced equation for the reaction is:



Calculate the percentage yield of copper(II) sulfate.

Relative atomic masses: C = 12, O = 16, S = 32, Cu = 63.5)

Percentage yield = ... %

(3 marks)

(Total for Question 3 is 13 marks)

5. A student plans to make a sample of the soluble salt nickel(II) sulfate by reacting nickel(II) carbonate with dilute sulfuric acid. Nickel(II) carbonate is an insoluble green powder.

When the student adds the nickel(II) carbonate powder to the sulfuric acid, they observe effervescence.

- a. Name the gas produced during this reaction.

.....

(1 mark)

- b. Describe the chemical test and the positive result for this gas.

Test:

Result:

(2 marks)

- c. The student adds the nickel(II) carbonate until it is in excess.

Explain why it is necessary to add an excess and how this excess solid is then removed from the mixture.

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(2 marks)

The balanced chemical equation for the reaction is shown below.

- d. Complete the equation by adding the chemical formulae of the **two** other products.



(2 marks)

After removing the excess solid, the student is left with a pure aqueous solution of nickel(II) sulfate.

- e. Describe the method the student should use to obtain a pure, dry sample of nickel(II) sulfate crystals from this solution.

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(6 marks)

- f. The student started with 3.0 g of nickel(II) carbonate and produced 3.5 g of nickel(II) sulfate. Calculate the percentage yield for this experiment.

Relative atomic masses (Ar): C = 12, O = 16, S = 32, Ni = 59

Percentage yield = ... %

(3 marks)

- g. Lead(II) sulfate is an insoluble salt.

Name **two** soluble compounds that could be mixed to produce a precipitate of lead(II) sulfate.

Compound 1:

Compound 2:

(2 marks)

(Total for Question 5 is 18 marks)

6. A student investigates the reaction between zinc metal and dilute hydrochloric acid to produce the soluble salt zinc chloride.

a. State the **word** equation for the reaction between zinc and hydrochloric acid.

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(2 marks)

b. The student observes bubbles of gas being produced.

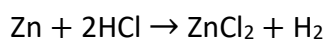
i. Name the gas produced.

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(1 mark)

ii. Describe the chemical test for this gas.

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(1 mark)

c. The balanced equation for the reaction is:



Calculate the atom economy for the production of zinc chloride (ZnCl_2) by this method.

Relative atomic masses (A_r): $\text{H} = 1$, $\text{Cl} = 35.5$, $\text{Zn} = 65$

Atom economy = ... %
(2 marks)

d. A student reacts 3.25 g of zinc powder with 50.0 cm³ of 1.50 mol/dm³ hydrochloric acid.

Determine which reactant is limiting and calculate the maximum mass of zinc chloride (ZnCl_2) that can be formed.

Maximum mass = ... g
(4 marks)

e. Suggest **one** practical reason why the actual yield of pure, dry zinc chloride crystals obtained by the student would be less than the maximum theoretical mass calculated in part (d).

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(1 mark)

(Total for Question 6 is 11 marks)