Reactions of Acids

Question Paper 1

Level	GCSE (9-1)
Subject	Combined Science: Trilogy - Chemistry
Exam Board	AQA
Topic	5.4 Chemical Changes
Sub-Topic	Reactions of Acids
Difficulty Level	Bronze Level
Booklet	Question Paper 1

Time Allowed: **58 minutes**

Score: **/56**

Percentage: **/100**

Grade Boundaries:

Q1. The pH scale is a measure of the acidity or alkalinity of a solution.

(a) Draw one line from each solution to the pH value of the solution.

Solution	pH value of the solution
	5
Acid	7
	9
Neutral	11
	13

(2)

(b) Which ion in aqueous solution causes acidity?

Tick **one** box.

- H^+ ☐
- Na^+ ☐
- O^{2-} ☐
- OH^- ☐

(1)

(c) When sulfuric acid is added to sodium hydroxide a reaction occurs to produce two products.

The equation is:

$$H_2SO_4 + 2NaOH \rightarrow Na_2SO_4 + 2H_2O$$

How many elements are in the formula H_2SO_4?

Tick **one** box.

- 3 ☐
- 4 ☐
- 6 ☐
- 7 ☐

(1)

(d) What is this type of reaction?

Tick **one** box.

- Decomposition ☐
- Displacement ☐
- Neutralisation ☐
- Reduction ☐

(1)

(e) Name the salt produced.

.....

(1)

(f) Describe how an indicator can be used to show when all the sodium hydroxide has reacted with sulfuric acid.

.....

.....

.....

.....

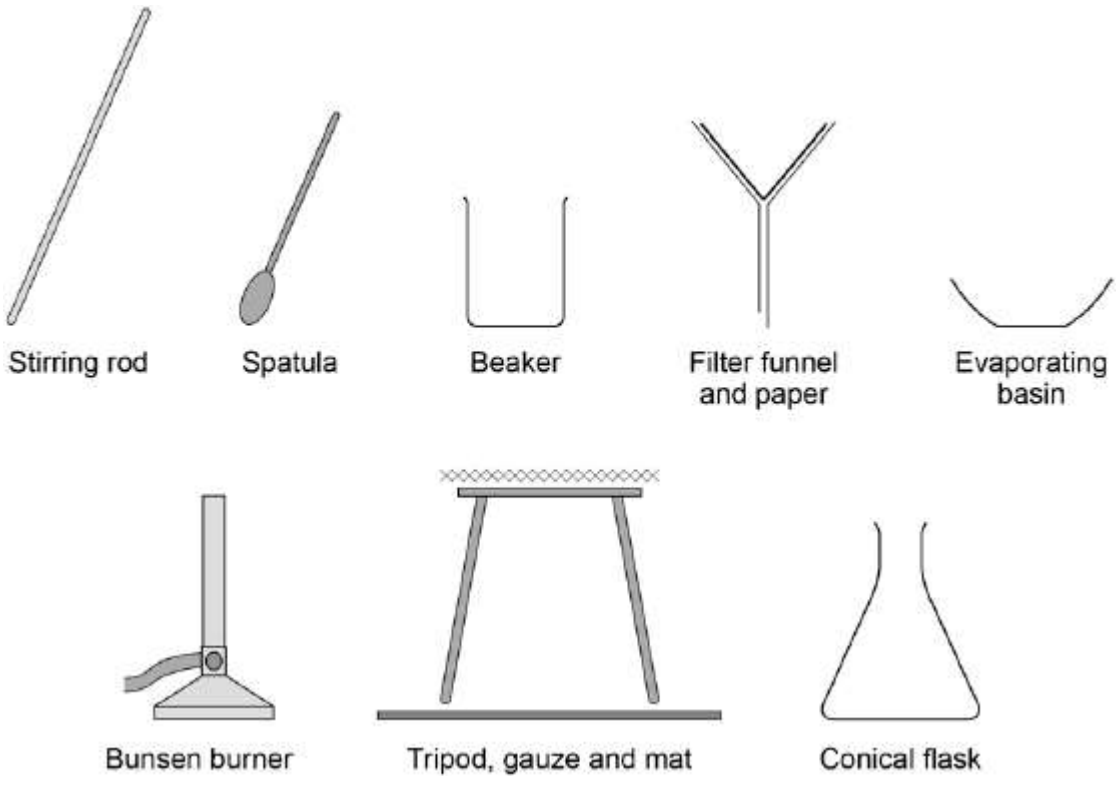
.....

.....

(3)
(Total 9 marks)

Q2. This question is about making copper salts.

The figure below shows the apparatus given to a student.



Outline a safe plan the student could use to make pure, dry, crystals of the soluble salt copper sulfate from the insoluble metal oxide and dilute acid.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(Total 6 marks)

Q3. This question is about the reactions of acids.

(a) When dilute hydrochloric acid is reacted with sodium hydroxide solution there is a temperature change.

Explain how the temperature changes.

.....

.....

.....

.....

(2)

(b) Acids produce hydrogen ions in aqueous solutions.

What is the ionic equation for neutralisation reactions?

Tick **one** box.

$H^+(aq) + H_2O(l) \rightarrow H_3O^+(aq)$ ☐

$H^+(aq) + OH^-(aq) \rightarrow H_2O(l)$ ☐

$2\ H_2O(l) \rightarrow H_3O^+(aq) + OH^-(aq)$ ☐

$H_2O(l) \rightarrow 2\ H^+(aq) + O^{2-}(aq)$ ☐

(1)

(c) Sulfuric acid reacts with copper carbonate to produce a salt, water and carbon dioxide.

$H_2SO_4 + CuCO_3 \longrightarrow CuSO_4 + H_2O + CO_2$

What is the name of the salt produced?

.....

(1)

(d) A student reacted four metals with water and with a dilute acid to work out the order of reactivity of the metals.

The table below shows some of the observations.

Metal	Reaction with water	Reaction with dilute acid
Calcium	Bubbles of gas	**X**
Copper	**Y**	No bubbles of gas
Magnesium	Few bubbles of gas	Bubbles of gas
Zinc	No bubbles of gas	Bubbles of gas

Write the observations for **X** and **Y**.

Observation at **X** .....

Observation at **Y** .....

(2)

(e) Write the four metals, calcium, copper, magnesium and zinc, in order of reactivity.

Start with the **most** reactive metal.

....

(2)

(f) Some gases given off in reactions can be identified by chemical tests.

Draw **one** line from each chemical test to the name of the gas.

Chemical test	Gas
Put in a lighted splint. The gas burns with a pop sound.	Carbon dioxide
	Chlorine
Put in a glowing splint. The gas relights the splint.	Hydrogen
	Nitrogen
Put into limewater. The gas turns limewater cloudy.	Oxygen

(3)

(g) Acids react with bases to produce salts and water (H_2O).

The electronic structure of a hydrogen atom is 2,1

The electronic structure of an oxygen atom is 2,6

Draw a diagram to show the arrangement of the outer shell electrons in a molecule of water.

(2)
(Total 13 marks)

Q4. Some pollutants cause acid rain.

A student tested 25.0 cm^3 samples of three types of rainwater, **P, Q** and **R**.
The student titrated the samples with sodium hydroxide solution (an alkali).

The student recorded the volume of sodium hydroxide solution needed to neutralise the rainwater. The student's results are shown in **Table 1**.

Table 1

	Volume of sodium hydroxide needed to neutralise the rainwater in cm^3				
Type of rainwater	**Titration 1**	**Titration 2**	**Titration 3**	**Titration 4**	**Mean value**
P	18.0	15.5	14.5	15.0	15.0
Q	13.0	10.0	11.0	10.5	10.5
R	23.0	19.5	18.5	19.0	19.0

(a) (i) The student calculated the mean value for rainwater **R** as 19.0 cm^3.

Show how the student calculated the mean value for rainwater **R**.

.....

.....

.....

.....

(2)

(ii) Write down **P, Q** and **R** in order of their acidity.

Most acidic .....

.....

Least acidic .....

(2)

(b) A second student repeated the experiment and recorded the results in **Table 2**.

Table 2

	Volume of sodium hydroxide needed to neutralise the rainwater in cm^3	
Type of rainwater	**Titration 1**	**Titration 2**
P	17	15
Q	11	9
R	20	18

Use **Table 1** and **Table 2** to suggest **two** improvements the second student could make to obtain more accurate results.

.....

.....

.....

.....

(2)

(c) The results of the two students show that the experiment is reproducible.

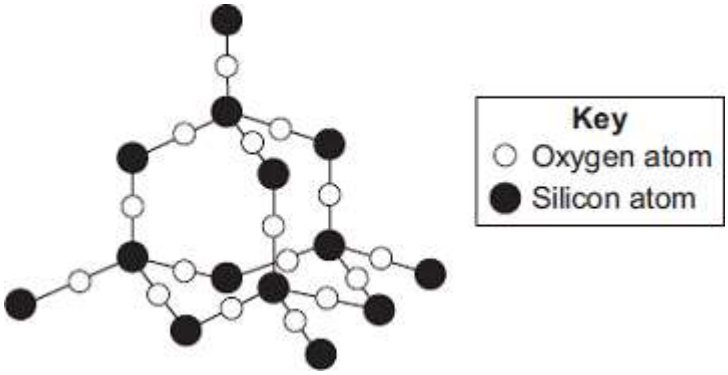
Give the reason why.

.....

.....

(1)
(Total 7 marks)

Q5. The diagram shows a small part of the structure of silicon dioxide.



(a) Use the diagram above to answer the question.

Draw a ring around the correct answer to complete each sentence.

In silicon dioxide, each silicon atom is bonded with [two / three / four] oxygen atoms.

The bonds in silicon dioxide are [ionic. / covalent. / metallic.]

(2)

(b)

© Oleksiy Mark/iStock

Silicon dioxide is used as the inside layer of furnaces.

Suggest why.

.....

.....

(1)

(c) Nanowires can be made from silicon dioxide.

Draw a ring around the correct answer to complete the sentence.

The word 'nano' means the wires are very

brittle.
thick.
thin.

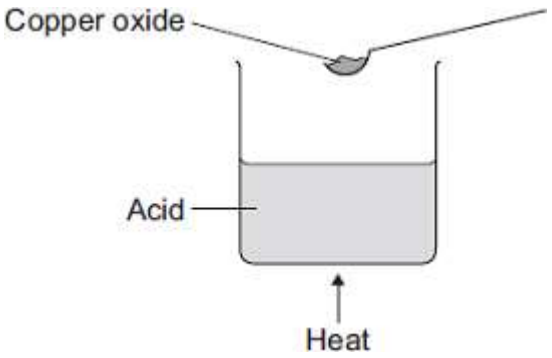
(1)
(Total 4 marks)

Q6. A student added copper oxide to an acid to make copper sulfate.

The student heated the acid.

The student added copper oxide until no more reacted.

(a) The diagram shows the first stage in the experiment.



(i) Complete the word equation.

Copper oxide + ... acid → copper sulfate + water

(1)

(ii) Which **one** of these values could be the pH of the acid?

Draw a ring around the correct answer.

1 **7** **11**

(1)

(iii) Why is the acid heated?

.....

.....

(1)

(b) After the reaction is complete, some solid copper oxide remains.
Why?

.....

.....

(1)

(c) The student removed the solid copper oxide from the solution.

Suggest what the student should do to the solution to form copper sulfate crystals.

.....

.....

(1)

(d) The mass of copper sulfate crystals was less than the student expected.

Tick (✓) the **one** statement that explains why the mass of copper sulfate crystals was less than expected.

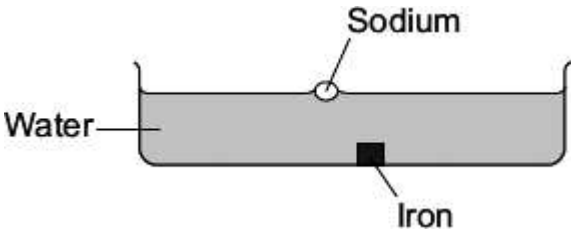
Statement	**Tick (✓)**

Some copper sulfate may have been lost during the experiment.	
The student added too much copper oxide.	
The copper sulfate crystals were wet when they were weighed.	

(1)
(Total 6 marks)

Q7. How a metal is used depends on its properties.

A teacher demonstrated some of the properties of sodium (an alkali metal) and iron (a transition element) by placing a small cube of each metal into water.



A student observed that:

Sodium	Iron
floated on the surface of the water	sank to the bottom of the water
melted to form a molten ball of sodium	did not melt
reacted to produce a gas	did not react
no sodium was left after 5 minutes	the cube of iron remained after 5 minutes

(a) Tick (✓) **two** properties of sodium compared with iron that are shown by the student's observations.

Sodium compared with iron	Tick(✓)
sodium has a higher boiling point	
sodium has a lower density	

sodium is harder	
sodium is more reactive	
sodium is softer	

(2)

(b) Draw a ring around the correct answer to complete the word equation.

sodium + water → sodium hydroxide + [carbon dioxide / hydrogen / oxygen]

(1)

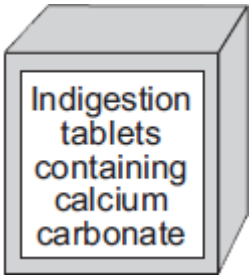
(c) Draw a ring around the correct answer to complete the sentence.

Sodium hydroxide is an alkali because it produces [$H^+(aq)$ / $OH^-(aq)$ / $Na^+(aq)$] ions

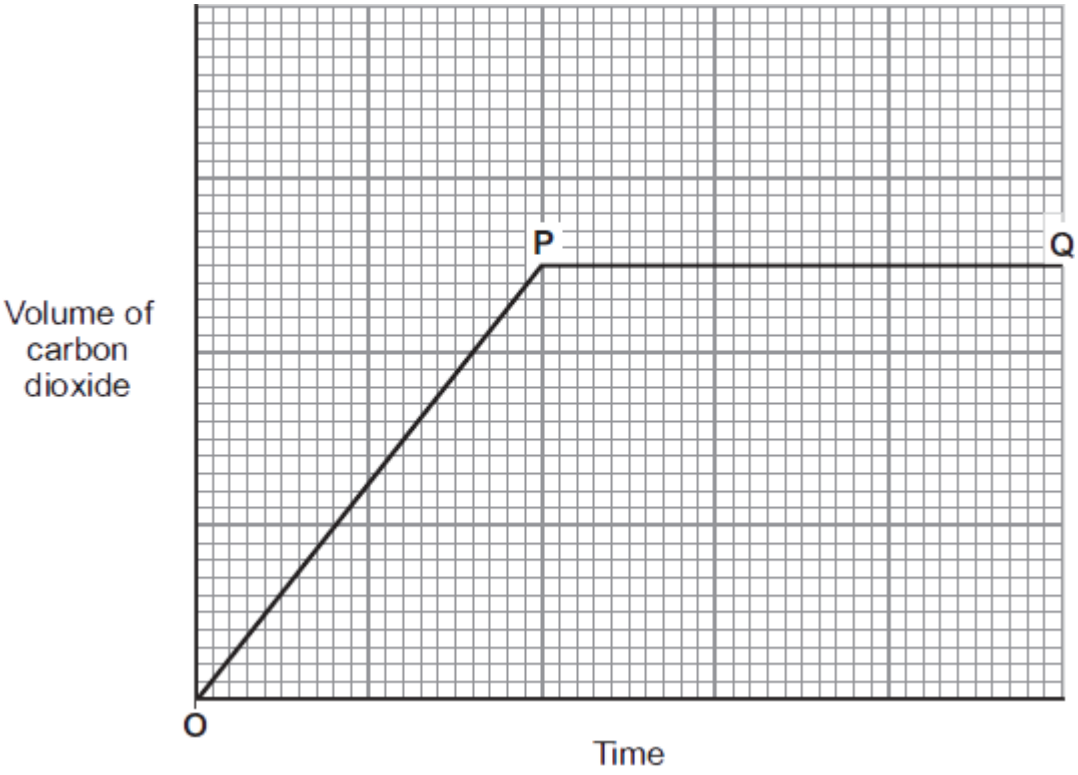
in aqueous solution.

(1)
(Total 4 marks)

Q8. Human stomachs contain hydrochloric acid.
Stomach ache can be caused by too much acid in the stomach.
Indigestion tablets can be used to reduce the amount of acid in the stomach.



(a) The graph shows how the volume of carbon dioxide produced changes with time, after some calcium carbonate is added to hydrochloric acid.



(i) Complete the sentence to explain what happens between **O**and **P**.

Between **O**and **P**the calcium carbonate and hydrochloric acid .....

(1)

(ii) Complete the sentence to explain what happens at **P**.

At **P**the calcium carbonate and hydrochloric acid .....

because .....

(2)

(iii) Describe the test for carbon dioxide gas.

Test .....

Result of the test .....

(2)

(b) Calcium carbonate is found in limestone.
Limestone is removed from the ground by quarrying.

Photograph supplied by Stockbyte/Thinkstock

Tick (✓) **one**advantage and tick (✓) **one**disadvantage of quarrying limestone.

Statement	Advantage Tick (✓)	Disadvantage Tick (✓)
Quarrying limestone destroys the shells and skeletons of marine organisms that formed the limestone.		
Quarrying limestone releases dust, and lorries release carbon dioxide from burning diesel fuel.		
Quarrying limestone provides building materials, employment and new road links.		
Quarrying limestone removes ores from the ground.		

(2)
(Total 7 marks)