

Acids and Bases

Warm-Up

Fill in the gaps for the following paragraph on techniques to measure pH.

red
neutral less
purple
green more

Universal indicator will turn in strongly acidic solutions and in strongly alkaline solutions. In a solution, Universal indicator will be green. A pH probe attached to a pH meter is accurate than Universal indicator as it displays a numerical value for pH.

- 1 This question is about acids and bases. **Table 1** shows some everyday substances.



Table 1

Substance	pH
Beer	4
Bicarbonate of soda	9
Milk	7

- 1.1 Write the name of the substance in **Table 1** that is an acid.

[1]

- 1.2 What colour would you expect to see if Universal indicator was added to bicarbonate of soda solution?

[1]

- 1.3 Which ion is produced by an acid in aqueous solution?
Tick **one** box.

☐ Cl^-

☐ H^+

☐ OH^-

☐ OH^+

[1]

- 1.4 State the range of the pH scale.

[2]

[Total 5 marks]

- 2 Acids and alkalis react together in neutralisation reactions.



- 2.1 Write the general word equation for a neutralisation reaction between an acid and an alkali.

[1]

- 2.2 In terms of hydrogen ions and hydroxide ions, write an ionic equation for a neutralisation reaction.

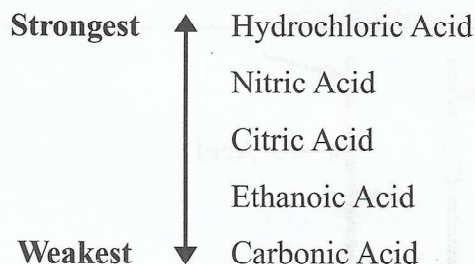
[1]

[Total 2 marks]



Strong Acids and Weak Acids

- 1 Below are some acids listed in order of strength.



- 1.1 Hydrochloric acid is a strong acid while carbonic acid is a weak acid.
Explain the difference between a strong acid and a weak acid.

.....

.....

[1]

- 1.2 Describe and explain the difference you would expect to find in the pH value of a 1 mol/dm³ solution of nitric acid and a 1 mol/dm³ solution of ethanoic acid.

.....

.....

.....

[3]

- 1.3 A 0.01 mol/dm³ solution of hydrochloric acid has a pH of 2.
Predict the pH of a 0.001 mol/dm³ solution of hydrochloric acid.

.....

[1]

- 1.4 A solution of citric acid in a beaker has a pH of 3. Which of the following would increase the pH?
Tick **three** boxes that apply .

- | | |
|--|--------------------------|
| Adding citric acid with a higher concentration to the beaker. | ☐ |
| Adding water to the beaker. | ☐ |
| Adding ethanoic acid to the beaker at the same concentration as the citric acid. | ☐ |
| Adding hydrochloric acid to the beaker at the same concentration as the citric acid. | ☐ |
| Changing the citric acid to nitric acid of the same concentration. | ☐ |
| Changing the citric acid to carbonic acid of the same concentration. | ☐ |

[3]

[Total 9 marks]

Exam Practice Tip

Make sure you understand what pH is and how it relates to the strength of an acid. It will also be jolly useful to understand how the concentration of H⁺ changes with pH. Remember, don't confuse strong acids with concentrated ones.



Reactions of Acids

1 Acids can react with bases and alkalis.



1.1 What type of reaction occurs when an acid reacts with an alkali?

Tick **one** box.

☐

Oxidation

☐

Decomposition

☐

Neutralisation

☐

Precipitation

[1]

1.2 A student adds 2 spatulas of zinc carbonate into a beaker of dilute hydrochloric acid.

Draw **one** line to connect the observation you would expect during this reaction with the explanation for that observation.

Observation

Explanation

Fizzing

Carbon dioxide is produced

A colour change

Hydrogen is produced

A white solid forming

A salt is made

No change

The zinc dissolves

[1]

[Total 2 marks]

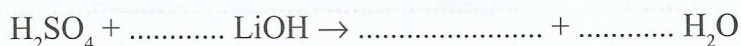
2 Acids can react with metal oxides and metal hydroxides to give a metal salt and water.



2.1 Write a word equation for the reaction of sulfuric acid and lithium hydroxide.

..... [2]

2.2 Complete and balance the symbol equation for the reaction of sulfuric acid and lithium hydroxide.



[2]

2.3 Acids can also react with metal carbonates. Compare the products of the reaction between sulfuric acid and lithium carbonate with the products of the reaction between sulfuric acid and lithium hydroxide.

.....

[2]

[Total 5 marks]



PRACTICAL

- 3.1 Zinc chloride can be made from the reaction of zinc oxide and hydrochloric acid. Describe a laboratory method to produce pure crystals of zinc chloride using this reaction.

[illegible]

[4]

- 3.2 Suggest an alternative to zinc oxide that would also react with hydrochloric acid to form the desired product.

.....

[17]

[Total 5 marks]

- 4*** A student is given three different unlabelled solutions. One contains sodium hydroxide, one contains sodium carbonate and one contains a sodium salt. Use your knowledge of chemical reactions to describe experiments that the student could do to decide which solution is which. Explain how your experiments would allow the student to identify the solutions. Clearly describe the reactants and products of any reactions you include.



(The page contains horizontal dotted lines for writing.)

[Total 6 marks]



The Reactivity Series



- 1 Metals can be placed in order of reactivity based on how vigorously they react with acids.

1.1 Write a word equation for the reaction of magnesium with hydrochloric acid.

..... [1]

1.2 What does the reaction of magnesium with hydrochloric acid produce? Tick **one** box.

Positive chloride ions

☐

Positive hydrogen ions

☐

Positive magnesium ions

☐

Negative magnesium ions

☐

[1]

1.3 Explain why iron reacts less vigorously with hydrochloric acid than magnesium does.

..... [1]

1.4 Name **one** metal that would react more vigorously with hydrochloric acid than magnesium does.

..... [1]

[Total 4 marks]

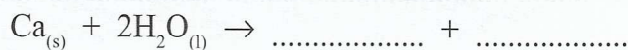
- 2 Some metals can react with water.



2.1 Write the general word equation for the reaction of a metal and water.

..... [1]

2.2 Complete the symbol equation below, for the reaction of calcium and water. Include state symbols.



[2]

2.3 Suggest a metal which will react more vigorously with water than calcium. Explain your answer.

..... [2]

2.4 Put the metals sodium, zinc and potassium in order, based on how vigorously you think they would react with water.

Most vigorous Least vigorous [1]

[Total 6 marks]

- 3 A student investigated the reactions of some metals and found the results shown in **Table 1**.



Table 1

Reaction	Observation
Lithium + water	Very vigorous reaction with fizzing, lithium disappears
Calcium + water	Fizzing, calcium disappears
Magnesium + water	No fizzing, a few bubbles on the magnesium
Copper + water	No fizzing, no change to copper
Iron + water	No fizzing, no change to iron
Lithium + dilute acid	Very vigorous reaction with fizzing, lithium disappears
Magnesium + dilute acid	Fizzing, magnesium disappears
Zinc + dilute acid	Fizzing, zinc disappears
Copper + dilute acid	No fizzing, no change to copper

- 3.1 Use the results in **Table 1**, along with your knowledge of the general reaction between an acid and a metal, to explain whether lithium or magnesium forms positive ions more easily.

.....

 [3]

- 3.2 Predict what the student would have seen if they had added sodium to water.

.....
 [2]

- 3.3 Put the metals calcium, copper and lithium in order from most reactive to least reactive.

..... [1]

- 3.4 Explain why it would be difficult to decide the order of reactivity of magnesium and zinc using these experiments. Suggest an experiment that could be used to decide which is most reactive.

.....
 [2]

[Total 8 marks]

Exam Practice Tip

Learning the order of the reactivity series could be really useful when it comes to answering questions in the exams. Try learning this mnemonic to help you remember... Papa Smurf Likes Calling My Clarinet Zany — Isn't He Cute. (You don't have to use my Booker prize winning concoction, though. You could also make up your own.)



Separating Metals from Metal Oxides

- 1 Most metals are found as compounds in ores in the earth. Some of the metals can be extracted from their ores by reduction with carbon.



1.1 Name a metal that can be found in the ground as an element.

..... [1]

1.2 Why are most metals found in the earth as compounds?

..... [1]

1.3 Define reduction in terms of the loss and gain of oxygen.

..... [1]

1.4 Explain why magnesium **cannot** be extracted from magnesium oxide by reduction with carbon.

..... [1]

[Total 4 marks]

- 2 Iron can be extracted by heating iron oxide, Fe_2O_3 , with carbon. The reaction releases large amounts of heat so there is no need to continuously heat the reaction.



2.1 Write a symbol equation for a reaction between carbon and iron(III) oxide, Fe_2O_3 .

..... [2]

2.2 For the reaction of iron(III) oxide and carbon to form iron, identify whether carbon has been reduced or oxidised. Explain your answer in terms of the transfer of oxygen.

..... [2]

2.3 Magnesium is extracted from magnesium oxide by reaction with silicon.
A temperature of 1200°C is required together with a reduced pressure.

Suggest why magnesium extraction is very costly when compared with iron extraction.

..... [2]

[Total 6 marks]

