

Reactions of acids with metals, bases, and carbonates

Q1. (2018)

0 6

Group 2 metal carbonates thermally decompose to produce a metal oxide and a gas.

0 6 . 1

Give the formula of each product when calcium carbonate (CaCO_3) is heated.

[2 marks]

_____ and _____

Q2. (2018)

0 7

A scientist does two tests on four white solids. The solids are labelled **A**, **B**, **C** and **D**.**Test 1** Adds the sample of the solid to distilled water and stirs.**Test 2** Measures the pH of the solution after **Test 1****Table 2** shows the results.**Table 2**

Solid	Appearance after stirring	pH
A	colourless solution, no solid	14
B	colourless solution, no solid	3
C	colourless solution, solid remains	9
D	colourless liquid, solid remains	7

These four solids are:

- magnesium oxide
- phosphorus oxide
- silicon dioxide
- sodium oxide.

Table 3 shows the solubility of these four solids in water.**Table 3**

Solid	Solubility in grams per 100 cm ³ of water
Magnesium oxide	0.01
Phosphorus oxide	52
Silicon dioxide	0
Sodium oxide	109

0 7 . 1

Identify the solids **A**, **B**, **C** and **D**.

Explain your answers.

[6 marks]

Q3. (2018)

Iron reacts with dilute hydrochloric acid to produce iron chloride solution and one other product.

0 8 . 1

Name the other product.

[1 mark]

Q4. (2019)

Ammonium nitrate solution is produced when ammonia gas reacts with nitric acid.

0 2 . 1

Give the state symbol for ammonium nitrate solution.

[1 mark]

Q5. (2019)

0 2 . 2 What is the formula of nitric acid?

[1 mark]

Tick (✓) **one** box.

HCl

☐HNO₃☐H₂SO₄☐NH₄OH☐

Q6. (2019)

A)

0 2 . 3 Ammonia gas dissolves in water to produce ammonia solution.

Ammonia solution contains hydroxide ions, OH⁻

A student adds universal indicator to solutions of nitric acid and ammonia.

What colour is observed in each solution?

[2 marks]

Colour in nitric acid

Colour in ammonia solution

B)

0 2 . 4 The student gradually added nitric acid to ammonia solution.

Which row, **A**, **B**, **C** or **D**, shows the change in pH as the nitric acid is added until in excess?

[1 mark]

Tick (✓) **one** box.

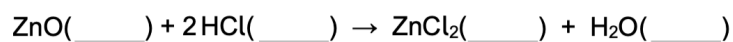
	pH of ammonia solution at start	pH after addition of excess nitric acid	
A	10	7	☐
B	2	10	☐
C	7	1	☐
D	10	2	☐

Q7. (2020)

A student reacted zinc oxide powder with hydrochloric acid to produce zinc chloride solution.

0 4 . 1 Complete the equation for the reaction by writing the state symbols.

[2 marks]



Q8. (2020)

0 4 . 5 Describe how zinc chloride crystals are produced from zinc chloride solution.

[2 marks]

Q9. (2020)

Sulfuric acid and sodium hydroxide react to produce sodium sulfate.

0 4 . 6 Sulfuric acid is gradually added to sodium hydroxide solution.

The pH of the mixture changes as the sulfuric acid is added until in excess.

Suggest the pH at:

- the start before sulfuric acid is added
- the end when sulfuric acid is in excess.

[2 marks]

pH at start = _____

pH at end = _____

Q10. (2020)

0 4 . 7 Complete the symbol equation for the preparation of sodium sulfate.

You should balance the equation.

[2 marks]



Q11. (2021)

0 2 Acids react to produce salts.

Universal indicator is added to water and then nitric acid is added to the mixture.

0 2 . 1 Give the colour change when nitric acid is added to the mixture of universal indicator and water.

[1 mark]

Tick (✓) **one** box.

Blue to red ☐

Green to purple ☐

Green to red ☐

Red to purple ☐

Q12. (2021)

0 2 . 2 What happens to the pH of water when nitric acid is added?

[1 mark]

Tick (✓) **one** box.

Decreases ☐

Stays the same ☐

Increases ☐

Q13. (2021)

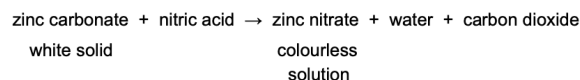
0 2 . 3 What is the state symbol for nitric acid?

[1 mark]

Q14. (2021)

Zinc carbonate reacts with nitric acid.

The word equation for the reaction is:



0 2 . 4 Give **two** observations that would be made when zinc carbonate is added to nitric acid until the zinc carbonate is in excess.

[2 marks]

1 _____

2 _____

Q15. (2022)

0 1 This question is about salts.

Green copper carbonate and sulfuric acid can be used to produce blue copper sulfate crystals.

A)

0 1 . 1 **Excess** copper carbonate is added to sulfuric acid.

Give **three** observations you would make.

[3 marks]

1 _____

2 _____

3 _____

B)

0 1 . 3 The pH of the solution changes during the reaction.

What is the pH of the solution at the end of the reaction?

[1 mark]

pH = _____

Q16. (2022)

0 1 . 4 Copper carbonate and sulfuric acid react to produce copper sulfate.

What type of reaction is this?

[1 mark]

Q17. (2023)

0 1 This question is about carbon dioxide.

Carbon dioxide is soluble in water and forms an acidic solution.

0 1 . 1 Which ion makes the solution acidic?

[1 mark]

Q18. (2023)

0 1 . 2 Name an indicator that could be used to test if the solution is acidic.

Give the result of the test.

[2 marks]

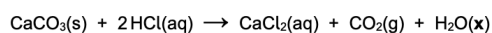
Indicator _____

Result _____

Q19. (2023)

Calcium carbonate reacts with hydrochloric acid to produce carbon dioxide.

The equation for the reaction is:



0 1 . 5 What is the state symbol (x) in the equation?

[1 mark]

Tick (✓) **one** box.

(aq) ☐ (g) ☐ (l) ☐ (s) ☐

Q20. (2023)

0 2 . 2 Calculate the relative formula mass (M_r) of sulfuric acid (H_2SO_4).

Relative atomic masses (A_r): H = 1 O = 16 S = 32

[2 marks]

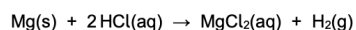
Relative formula mass (M_r) = _____

Q21. (2023)

0 6 Acids react with some metals to produce soluble salts.

A student adds magnesium to hydrochloric acid until no more acid reacts and excess magnesium remains.

The equation for the reaction is:



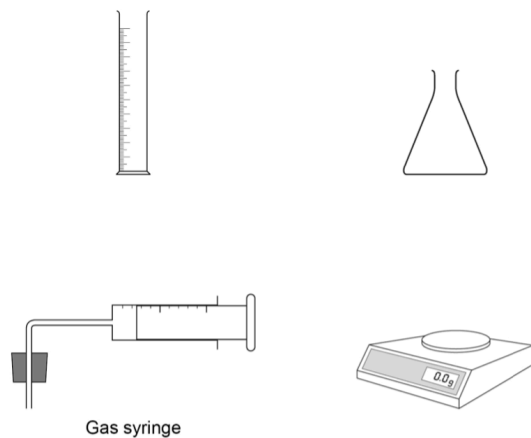
0 6 . 1 Describe how solid magnesium chloride is obtained from the reaction mixture.

[2 marks]

Q22. (2023)

0 1 . 6 Figure 2 shows equipment a student used for an investigation.

Figure 2



The student investigated the volume of carbon dioxide produced when different masses of calcium carbonate react with hydrochloric acid.

Describe a method the student could use.

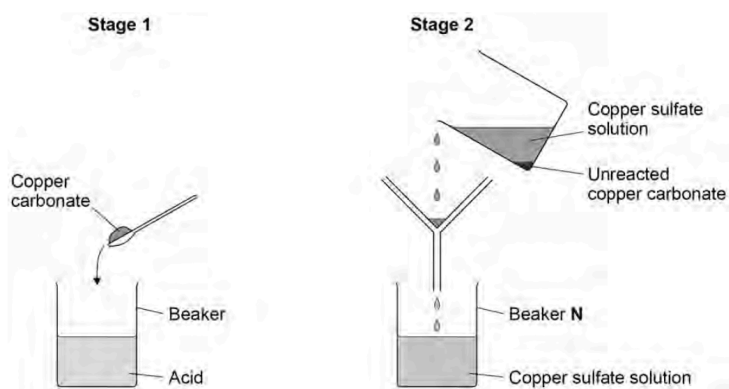
[6 marks]

Q23. (2024)

0 2 A student prepared copper sulfate by reacting an acid with excess copper carbonate.

Figure 3 shows the first two stages in the preparation of copper sulfate.

Figure 3



A)

0 2 . 1 What is the formula of the acid used to prepare copper sulfate?

[1 mark]

Tick (✓) **one** box.

- | | |
|--------------------------------|--------------------------|
| HCl | ☐ |
| HNO ₃ | ☐ |
| H ₂ SO ₄ | ☐ |

B)

0 2 . 2 Why is excess copper carbonate used in **stage 1**?

[1 mark]

Q24. (2024)

0 4 . 4 Write the **ionic** equation for the reaction between an acid and an alkali.

[1 mark]

_____ + _____ → _____

Q25. (2024)

The equation shows the reaction between magnesium carbonate and nitric acid.



0 4 . 5 What is the ratio of the number of moles of magnesium carbonate to the number of moles of nitric acid in the reaction?

[1 mark]

Tick (✓) **one** box.

1 : 1 ☐

1 : 2 ☐

2 : 1 ☐

2 : 2 ☐

Q26. (2024)

0 4 . 6 A student mixed some magnesium carbonate with excess nitric acid.

The student then added two drops of universal indicator to the solution.

What colour was the solution after the addition of universal indicator?

[1 mark]

Tick (✓) **one** box.

Red ☐

Green ☐

Blue ☐