

1.1

10 cm³ of solution **B** is added to a beaker.

Distilled water is added to the beaker until the final volume in the beaker is 1000 cm³

The pH of the solution is measured before and after distilled water is added.

Table 4 shows the results.

Table 4

Volume of solution in beaker	pH of solution B
10 cm ³	3
1000 cm ³	X

Calculate the value of **X**. **[2 marks]**

X = _____

[
-
]

Soluble salts are formed by reacting metal oxides with acids.

ou

2.1

Give **one** other type of substance that can react with an acid to form a soluble salt.

[1 mark]

2.2

Calcium nitrate contains the ions Ca^{2+} and NO_3^-

Give the formula of calcium nitrate.

[1 mark]

[6 marks]

This image shows a blank sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

This question is about acids and alkalis.

06

3.1

Dilute hydrochloric acid is a strong acid.

Explain why an acid can be described as both strong and dilute.

[2 marks]

3.2

A $1.0 \times 10^{-3} \text{ mol/dm}^3$ solution of hydrochloric acid has a pH of 3.0

What is the pH of a $1.0 \times 10^{-5} \text{ mol/dm}^3$ solution of hydrochloric acid?

[1 mark]

pH = _____

4.1

What is the formula of nitric acid?

[1 mark]

Tick (✓) **one** box.

HCl

☐

HNO₃

☐

H₂SO₄

☐

NH₄OH

☐

4.2

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

4.3

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	☐

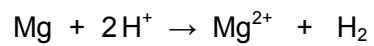
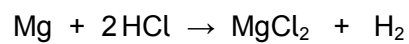
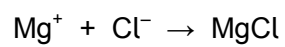
A student investigated the rate of the reaction between magnesium and hydrochloric acid.

5.1

Which is the correct ionic equation for the reaction?

[1 mark]

Tick (✓) **one** box.

☐☐☐☐

This question is about acids and alkalis.

6.1

Which ion do all acids produce in aqueous solution?

[1 mark]

Tick (✓) **one** box.

 H^+ ☐ H^- ☐ O^{2-} ☐ OH^- ☐

6.2

Calcium hydroxide solution reacts with an acid to form calcium chloride.

Complete the word equation for the reaction.

[2 marks]

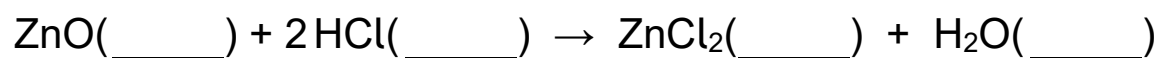
calcium hydroxide + _____ acid → calcium chloride + _____

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

7.1

Complete the equation for the reaction by writing the state symbols.

[2 marks]



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

Hydrochloric acid was the limiting reactant.

7.2 How could the student know when all the hydrochloric acid has reacted?

[1 mark]

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

Hydrochloric acid was the limiting reactant.

7.3

How could the student obtain zinc chloride solution from the reaction mixture when all the hydrochloric acid has reacted?

[1 mark]

7.4

Describe how zinc chloride crystals are produced from zinc chloride solution.

[2 marks]

Sulfuric acid and sodium hydroxide react to produce sodium sulfate.

7.5

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 = _____

Sulfuric acid and sodium hydroxide react to produce sodium sulfate.

7.6

Complete the symbol equation for the preparation of sodium sulfate.

You should balance the equation.

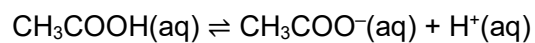
[2 marks]



8.1

Ethanoic acid ionises in water.

The equation for the reaction is:



Explain how the equation shows that ethanoic acid is a weak acid.

[2 marks]

8.2

A student adds a solution of ethanoic acid to zinc carbonate in an open flask on a balance.

Explain what happens to the mass of the flask and its contents during the reaction.

[3 marks]

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

9.1

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

☐

9.2

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

[1 mark]

Tick (✓) **one** box.

Decreases

☐

Stays the same

☐

Increases

☐

9.3

What is the state symbol for nitric acid?

[1 mark]

Zinc carbonate reacts with nitric acid.

ou

The word equation for the reaction is:

zinc carbonate + nitric acid → zinc nitrate + water + carbon dioxide

9.4

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 _____

9.5

The formula of the zinc ion is Zn^{2+}

The formula of the nitrate ion is NO_3^-

What is the formula for zinc nitrate?

[1 mark]

Tick (✓) **one** box.

ZnNO_3

☐

$\text{Zn}(\text{NO}_3)_2$

☐

Zn_2NO_3

☐

$\text{Zn}_2(\text{NO}_3)_2$

☐

Acids react with insoluble metal oxides to produce salts.

[6 marks]

This image shows a blank sheet of white paper with horizontal ruling lines. The lines are evenly spaced and extend across the width of the page. There are no margins, text, or other markings on the paper.

This question is about salts.

06

10.1

Name the salt produced by the neutralisation of hydrochloric acid with potassium hydroxide.

[1 mark]

10.2

Write an ionic equation for the neutralisation of hydrochloric acid with potassium hydroxide.

[1 mark]



10.3

Soluble salts can be produced by reacting dilute hydrochloric acid with an insoluble solid.

Copper, copper carbonate and copper oxide are insoluble solids.

Which of these insoluble solids can be used to make a copper salt by reacting the solid with dilute hydrochloric acid?

[1 mark]

Tick (✓) **one** box.

Copper and copper carbonate only

☐

Copper and copper oxide only

☐

Copper carbonate and copper oxide only

☐

Copper, copper carbonate and copper oxide

☐

Hydrogen chloride and ethanoic acid both dissolve in water.

All hydrogen chloride molecules ionise in water.

Approximately 1% of ethanoic acid molecules ionise in water.

11.1

A solution is made by dissolving 1 g of hydrogen chloride in 1 dm³ of water.

Which is the correct description of this solution?

[1 mark]

Tick (✓) **one** box.

A concentrated solution of a strong acid

☐

A concentrated solution of a weak acid

☐

A dilute solution of a strong acid

☐

A dilute solution of a weak acid

☐

Hydrogen chloride and ethanoic acid both dissolve in water.

All hydrogen chloride molecules ionise in water.

Approximately 1% of ethanoic acid molecules ionise in water.

11.2

Which solution would have the lowest pH?

[1 mark]

Tick (✓) **one** box.

0.1 mol/dm³ ethanoic acid solution

☐

0.1 mol/dm³ hydrogen chloride solution

☐

1.0 mol/dm³ ethanoic acid solution

☐

1.0 mol/dm³ hydrogen chloride solution

☐

12.1

Rocks containing calcium phosphate are treated with acid to produce soluble salts that can be used as fertilisers.

Name the soluble salts produced when calcium phosphate reacts with:

- nitric acid
- phosphoric acid.

[2 marks]

Nitric acid _____

Phosphoric acid _____

12.2

Ammonium sulfate is a compound in fertilisers.

Ammonium sulfate can be made using an industrial process or in the laboratory.

In the industrial process, the following steps are used.

1. React streams of ammonia solution and sulfuric acid together.
2. Evaporate the water by passing the solution down a warm column.
3. Collect dry crystals continuously at the bottom of the column.

In the laboratory, the following steps are used.

1. React ammonia solution and sulfuric acid in a conical flask.
2. Evaporate water from the solution until crystals start to form.
3. Leave to cool and crystallise further.
4. Separate the crystals using filtration.
5. Dry the crystals between pieces of filter paper.

Evaluate the two methods for producing a large mass of ammonium sulfate.

[4 marks]

[

13.1

Hydrogen chloride dissolves in water to produce hydrochloric acid.

Hydrochloric acid is a strong acid.

What is meant by the term strong acid?

[1 mark]

13.2

Describe how magnesium can be used to distinguish between a strong acid and a weak acid of the same concentration.

[2 marks]

13.3

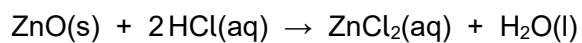
The concentration of hydrochloric acid is increased by a factor of 100

What is the change in pH?

[2 marks]

A student produces pure crystals of zinc chloride by reacting zinc oxide with hydrochloric acid.

The equation for the reaction is:



14.1

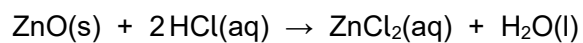
The student adds zinc oxide to hydrochloric acid until the zinc oxide is in excess.

Give **one** observation that the student could make to show that the zinc oxide is in excess.

[1 mark]

A student produces pure crystals of zinc chloride by reacting zinc oxide with hydrochloric acid.

The equation for the reaction is:



□ □

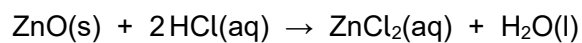
14.2

Why is excess zinc oxide used rather than excess hydrochloric acid?

[1 mark]

A student produces pure crystals of zinc chloride by reacting zinc oxide with hydrochloric acid.

The equation for the reaction is:



□ □

14.3

Name **one other** compound that the student could add to hydrochloric acid to produce zinc chloride.

[1 mark]

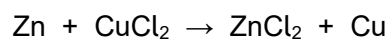
14.4

Describe how the student should obtain crystals of zinc chloride from a solution of zinc chloride.

[2 marks]

Zinc chloride is also produced in a displacement reaction between zinc and copper chloride solution.

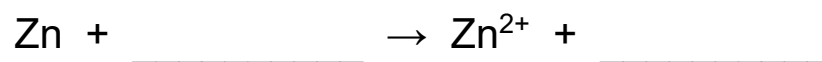
The equation for the reaction is:



out:

14.5

Complete the ionic equation for this reaction.

[1 mark]

15.1

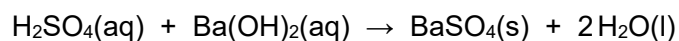
Explain why the pH of an acid depends on:

- the strength of the acid
- the concentration of the acid.

[4 marks]

Another student titrated sulfuric acid with barium hydroxide solution.

The equation for the reaction is:



The student measured the electrical conductivity of the mixture during the titration.

The better a conductor, the higher the electrical conductivity value.

15.2

Explain why the electrical conductivity of the mixture was zero when the sulfuric acid had just been neutralised.

Use the equation for the reaction.

Refer to ions in your answer.

[3 marks]

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

16.1

Which ion makes the solution acidic?

[1 mark]

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

16.2

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

Give the result of the test.

[2 marks]

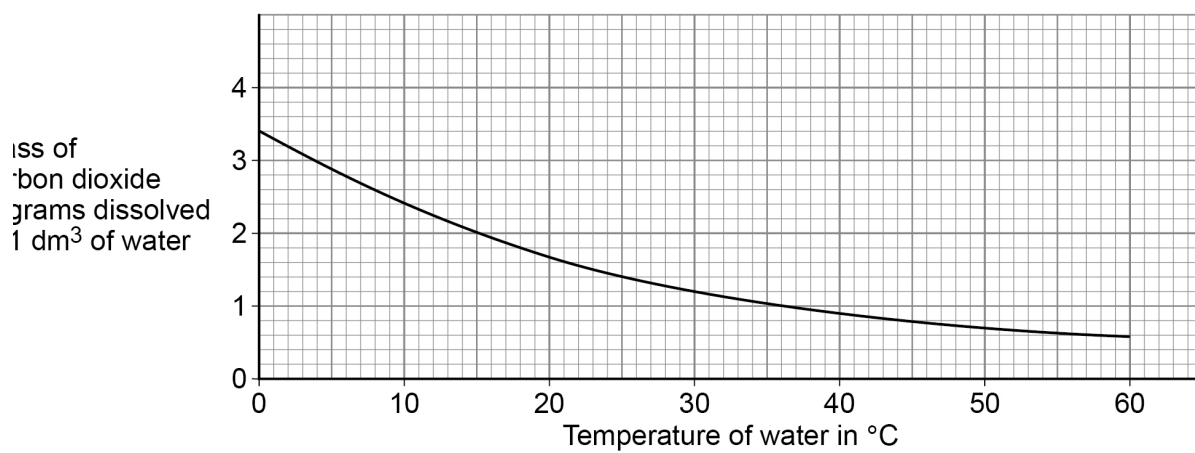
Indicator _____

Result _____

Figure 1 shows the mass of carbon dioxide that will dissolve in 1 dm³ of water at different temperatures.

ou

Figure 1



16.3

Carbon dioxide dissolves in water to form an acidic solution.

How does the pH of the solution change as the temperature of the water increases?

Use **Figure 1**.

[1 mark]

Tick (✓) **one** box.

pH of the solution decreases

☐

pH of the solution does not change

☐

pH of the solution increases

☐

17.1

[6 marks]

[illegible]

17.2

Name **two** other substances that can each be reacted with a dilute acid to make zinc chloride.

Do **not** refer to zinc carbonate in your answer.

[2 marks]

1 _____

2 _____

[]

This question is about acids and alkalis.

out

18.1

Ethanoic acid is a weak acid.

What is meant by 'weak acid'?

Answer in terms of ionisation.

[1 mark]

18.2

The concentration of an acid can be measured in mol/dm^3 .

Which combination of changes **increases** the concentration of an acid?

[1 mark]

Tick (✓) **one** box.

The mass of acid dissolved is halved and the volume of the solution is halved.

☐

The mass of acid dissolved is halved and the volume of the solution is doubled.

☐

The mass of acid dissolved is doubled and the volume of the solution is halved.

☐

The mass of acid dissolved is doubled and the volume of the solution is doubled.

☐

18.3

The concentration of an acid can be determined by titration.

An indicator is added to an alkali in a flask.

Name an indicator that can be used in this titration.

Give the colour change of the indicator when acid from a burette is added to the alkali in the flask.

[2 marks]

Name of indicator _____

Colour change from _____ to _____

18.4

Sodium carbonate dissolves in water to produce an alkaline solution.

Give the formula of the ion that makes a solution alkaline.

[1 mark]

When hydrochloric acid dissolves in water, hydrogen ions (H^+) and chloride ions (Cl^-) are produced.

out

18.5

A solution of hydrochloric acid with pH 4.5 has a concentration of H^+ ions of $3.16 \times 10^{-5} \text{ mol/dm}^3$.

What is the concentration of H^+ ions in a solution of hydrochloric acid with pH 2.5?

[1 mark]

Concentration of H^+ ions = _____ mol/dm^3

Barium (Ba) is an element in Group 2 of the periodic table.

out

Barium reacts with hydrochloric acid.

19.1

Suggest **two** observations that could be made when barium reacts with hydrochloric acid.

[2 marks]

1 _____

2 _____

Barium (Ba) is an element in Group 2 of the periodic table.

out

Barium reacts with hydrochloric acid.

□ □

19.2

Write a balanced symbol equation for the reaction between barium and hydrochloric acid.

[3 marks]

_____ + _____ → _____ + _____

[
-
]