Week 15

IGCSE Chemistry

Homework bundle for this week

本周作业合集

exercises.lol

Contents 目录

7. Acids, bases and salts

Starter Quiz · 课前小测

IGCSE Chemistry Name: _____ Score: _____

1. An acid produces which ion in water?
   - ☐ hydrogen ions (H^+)
   - ☐ hydroxide ions (OH^-)
   - ☐ sodium ions
   - ☐ chloride ions
2. An alkali is a base that:
   - ☐ dissolves in water
   - ☐ is always solid
   - ☐ turns litmus red
   - ☐ produces hydrogen ions
3. Metal oxides are usually:
   - ☐ basic
   - ☐ acidic
   - ☐ neutral
   - ☐ gases
4. Why is an excess of the base added to the acid?
   - ☐ to make sure all the acid is used up
   - ☐ to add more water
   - ☐ to colour the salt
   - ☐ to speed up evaporation
5. An insoluble salt is made by:
   - ☐ mixing two soluble salt solutions (precipitation)
   - ☐ reacting acid with excess base
   - ☐ electrolysis
   - ☐ evaporating sea water
6. What is the pH of a neutral solution?

   _____

7. Acid + carbonate produces a salt, water and carbon dioxide.

   ☐ True ☐ False

8. A basic oxide reacts with an acid to form a salt and water.

   ☐ True ☐ False

9. A salt forms when the hydrogen of an acid is replaced by a _____.

   _____

10. Heating hydrated copper sulfate (blue) drives off water, leaving white anhydrous salt.

    ☐ True ☐ False

IGCSE Chemistry

1. **hydrogen ions (H^+)**

   Acids release H^+ ions in water.

2. **dissolves in water**

   An alkali is a soluble base, giving OH^- ions.

3. **basic**

   Metal oxides tend to be basic.

4. **to make sure all the acid is used up**

   Excess base ensures complete reaction of the acid.

5. **mixing two soluble salt solutions (precipitation)**

   Precipitation forms an insoluble solid.

6. **7**

   pH 7 is neutral.

7. **True**

   Carbonates release CO_2 with acids.

8. **True**

   Basic oxides neutralise acids.

9. **metal**

   A metal (or ammonium) ion replaces the acid's hydrogen.

10. **True**

    Removing the water of crystallisation turns it white.

7.1 The characteristic properties of acids and bases

Name: _____ Class: _____ Date: _____ **Total: 8 marks**

KEY WORDS acid 酸 • base 碱 • alkali 可溶性碱 • ions 离子 • weak acid 弱酸

Objective

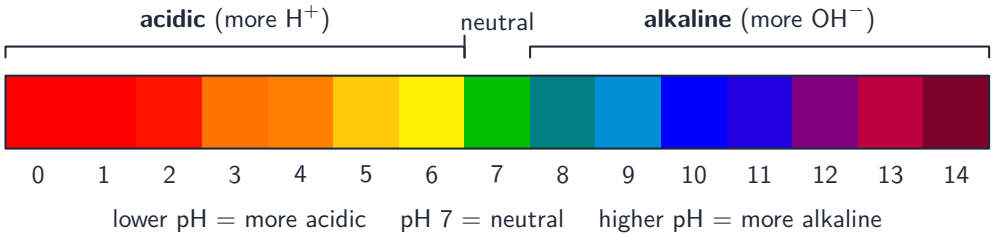
Build the skills to answer exam questions on **acids and bases** 酸与碱 — their reactions, **indicators** 指示剂, **strong/weak acids** 强酸/弱酸, and the **pH scale** pH 值.

You must be able to:

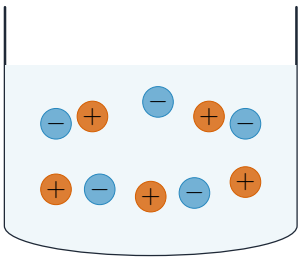
- give the three reactions of acids and the reaction of bases
- use indicator colours and the pH scale
- explain strong vs weak in terms of dissociation

1 Worked examples

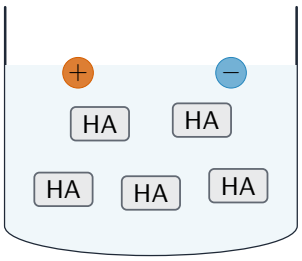
■ pH and acid strength



Below 7 acidic, 7 neutral, above 7 alkaline; acids contain H^+, alkalis contain OH^-



strong acid
fully split into ions (e.g. HCl)



weak acid
mostly molecules, few ions (e.g. ethanoic acid)

Strong = fully dissociated (HCl); weak = only partly dissociated (ethanoic acid)

- acid + metal → salt + hydrogen; acid + carbonate → salt + water + CO_2.

2 Practice

2.1 Give the products when an acid reacts with a carbonate. [1]

2.2 State the colour of litmus in an alkali. [1]

3 Exam-style questions

3.1 A solution with a pH of 2 is: [1]

- **A** strongly alkaline
- **B** neutral
- **C** weakly acidic
- **D** strongly acidic

3.2 Hydrochloric acid is a strong acid and ethanoic acid is a weak acid.

(a) Explain the difference between a strong and a weak acid. [2]

(b) Write an equation showing the dissociation of hydrochloric acid in water. [1]

3.3 Magnesium reacts with dilute sulfuric acid. Name the two products. [2]

Solutions

2.1 a salt + water + carbon dioxide.

2.2 blue.

3.1 D. pH 2 is strongly acidic.

3.2 (a) a strong acid is fully dissociated (split into ions) in water; a weak acid is only partly dissociated.
(b) $HCl(aq) \rightarrow H^+(aq) + Cl^-(aq)$.

3.3 magnesium sulfate; hydrogen.

20 Which statement describes a property of ethanoic acid?

A It does **not** produce carbon dioxide when added to sodium carbonate.

B It does **not** produce hydrogen when added to magnesium.

C It only donates some of its protons when added to excess aqueous sodium hydroxide.

D It only partially dissociates when added to water.

22 The equation shows the reaction between aqueous hydrogen bromide and aqueous ammonia.

$$HBr(aq) + NH_3(aq) \rightarrow NH_4^+(aq) + Br^-(aq)$$

Which statement describes the role of aqueous hydrogen bromide?

A It is a catalyst.

B It is a reducing agent.

C It is a proton acceptor.

D It is a proton donor.

21 Which statement describes a base?

A It reacts with ammonium chloride to produce ammonia gas.

B It reacts with calcium carbonate to produce carbon dioxide gas.

C It reacts with copper to produce hydrogen gas.

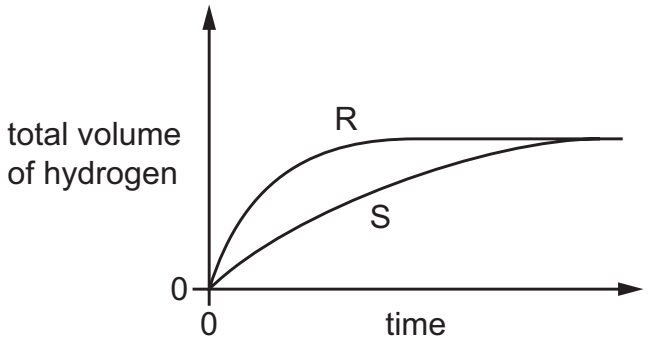
D It turns blue litmus red.

24 Dilute acid R and dilute acid S have the same concentration.

The same volume of each dilute acid is reacted separately with the same mass of magnesium ribbon. Both reactions are carried out at room temperature and pressure.

The volume of hydrogen produced is measured.

A graph of the results is shown.



Which statement about the reactions is correct?

A Acid S reacts faster than acid R.

B The final volume of hydrogen produced in each reaction is different.

C Acid R is a stronger acid than acid S.

D Acid S is a stronger acid than acid R.

34 Which statement about aqueous ethanoic acid is correct?

A It reacts with magnesium to form oxygen gas.

B It reacts with sodium carbonate to form carbon dioxide gas.

C It turns red litmus paper blue.

D It turns methyl orange yellow.

4 Nitric acid, HNO_3, and sulfuric acid, H_2SO_4, are strong acids. Ethanoic acid, CH_3COOH, is a weak acid.

(a) One mole of each acid is added separately to 1000 cm^3 of distilled water to form a dilute solution. All three acids dissociate in distilled water.

(i) State the formula of the common cation produced when each of the three acids dissociates in water.

..... [1]

(ii) Explain, in terms of dissociation, why:

- nitric acid is described as a strong acid

.....

- ethanoic acid is described as a weak acid.

.....
[2]

(iii) State which of the three dilute acids will have the highest pH value.

..... [1]

(iv) State the colour of thymolphthalein in all three dilute acids.

..... [1]

(v) Give the formula of the anion formed when:

- sulfuric acid dissociates in water

.....

- ethanoic acid dissociates in water.

.....
[2]

(vi) Name the **two** gaseous products formed during the electrolysis of dilute sulfuric acid using inert electrodes.

..... and ..... [2]

(vii) Name the salt formed when calcium reacts with ethanoic acid.

..... [1]

(b) Aluminium nitrate, $Al(NO_3)_3$, is made when dilute nitric acid reacts with aluminium hydroxide, $Al(OH)_3$.

(i) $Al(OH)_3$ acts as a base in this reaction.

Define the term base.

..... [1]

(ii) $Al(OH)_3$ is **not** an alkali.

State what this tells you about the solubility of $Al(OH)_3$.

..... [1]

(iii) Name **one other** compound which forms aluminium nitrate when added to dilute nitric acid.

..... [1]

(iv) The oxidation number of the O atoms in $Al(NO_3)_3$ is –2.
The formula of the aluminium ion in $Al(NO_3)_3$ is Al^{3+}.

Determine the oxidation number of the N atoms in $Al(NO_3)_3$.
Show your working.

oxidation number of N = ... [2]

[Total: 15]

18 Two experiments involving acids R or S are done.

- 0.10 mol of acid R completely dissolves in 500 cm^3 of water. 0.0048 mol of acid R is dissociated in the solution.
- 0.10 mol of acid S completely dissolves in 500 cm^3 of water. 0.0179 mol of acid S is dissociated in the solution.

Which statement about acids R and S is correct?

A Acid R is a strong acid, and acid S is a weak acid.

B Acid R is a weak acid, and acid S is a strong acid.

C Acid R and acid S are both strong acids.

D Acid R and acid S are both weak acids.

19 Which row shows the equations for the dissociation of hydrochloric acid and of ethanoic acid in aqueous solution?

	hydrochloric acid	ethanoic acid
A	$HCl(aq) \rightarrow H^+(aq) + Cl^-(aq)$	$CH_3COOH(aq) \rightleftharpoons H^+(aq) + CH_3COO^-(aq)$
B	$HCl(aq) \rightleftharpoons H^+(aq) + Cl^-(aq)$	$CH_3COOH(aq) \rightleftharpoons H^+(aq) + CH_3COO^-(aq)$
C	$HCl(aq) \rightarrow H^+(aq) + Cl^-(aq)$	$CH_3COOH(aq) \rightarrow H^+(aq) + CH_3COO^-(aq)$
D	$HCl(aq) \rightleftharpoons H^+(aq) + Cl^-(aq)$	$CH_3COOH(aq) \rightarrow H^+(aq) + CH_3COO^-(aq)$

22 Some information about two dilute acids is shown.

dilute acid	acid concentration in mol / dm^3	pH
nitric acid	0.1	1.0
propanoic acid	0.4	2.6

Three statements about the acids are listed.

1 Nitric acid has a lower pH because it dissociates more than propanoic acid.

2 Propanoic acid has a lower concentration of hydrogen ions than nitric acid.

3 Propanoic acid has a higher pH because it has a higher concentration.

Which statements are correct?

A 1 and 2 **B** 1 and 3 **C** 2 only **D** 3 only

7.2 Oxides

Name: _____ Class: _____ Date: _____ **Total: 8 marks**

KEY WORDS basic 碱性 • oxides 氧化物 • acidic 酸性 • amphoteric 两性 • acid 酸

Objective

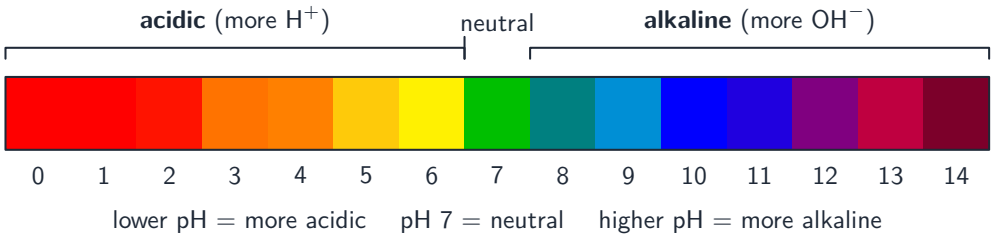
Build the skills to answer exam questions on **oxides** 氧化物 — classifying them as **acidic** 酸性, **basic** 碱性 or **amphoteric** 两性.

You must be able to:

- classify metal oxides as basic and non-metal oxides as acidic
- recognise amphoteric oxides (Al_2O_3, ZnO)
- predict reactions with acids/bases

1 Worked examples

Classifying oxides



Acidic oxides (non-metals) lower the pH; basic oxides (metals) raise it

Oxide character changes across a period

- **acidic oxides:** non-metal oxides (SO_2, CO_2).
- **basic oxides:** metal oxides (CuO, CaO).

- **amphoteric:** react with both acids and bases (Al_2O_3, ZnO).

2 Practice

2.1 State whether copper(II) oxide is acidic or basic. [1]

2.2 Name one amphoteric oxide. [1]

3 Exam-style questions

3.1 Which oxide is acidic? [1]

- **A** CaO
- **B** Na_2O
- **C** SO_2
- **D** CuO

3.2 Aluminium oxide is amphoteric.

(a) State what 'amphoteric' means. [1]

(b) State the type of substance you would react it with to show its acidic behaviour. [1]

3.3 Predict whether magnesium oxide is acidic or basic, and write the product when it reacts with hydrochloric acid. [3]

Solutions

2.1 basic.

2.2 aluminium oxide (Al_2O_3) or zinc oxide (ZnO).

3.1 C. SO_2 is a non-metal oxide — acidic.

3.2 (a) it reacts with both acids and bases (to form a salt and water).
(b) a base (or alkali).

3.3 magnesium oxide is basic (it is a metal oxide); it reacts with HCl to form magnesium chloride and water.

22 Four metal oxides are listed.

1 Al_2O_3

2 CaO

3 CuO

4 ZnO

Which metal oxides are amphoteric?

A 1 and 4 **B** 1 only **C** 2, 3 and 4 **D** 2 and 3 only

21 Phosphorus is an element in Group V of the Periodic Table.

It burns in air to form an oxide that dissolves in water to form a solution with a pH of 1.

Which row describes this oxide of phosphorus?

	metal oxide	non-metal oxide	acidic oxide	basic oxide
A	✓	✗	✓	✗
B	✓	✗	✗	✓
C	✗	✓	✓	✗
D	✗	✓	✗	✓

key

✓ = yes

✗ = no

25 Which metal oxide reacts with aqueous sodium hydroxide to form a salt and water?

A calcium oxide

B copper(II) oxide

C sodium oxide

D aluminium oxide

20 Which three oxides are **all** acidic?

A CaO, NO_2, SO_2

B CaO, CO_2, Na_2O

C CO_2, NO_2, SO_2

D CO_2, Na_2O, SO_2

20 Which row identifies an acidic oxide, a basic oxide and an amphoteric oxide?

	acidic	basic	amphoteric
A	ZnO	SO_2	Al_2O_3
B	SO_2	Al_2O_3	Na_2O
C	ZnO	Al_2O_3	SO_2
D	SO_2	Na_2O	Al_2O_3

23 Element E is a metal in Group I of the Periodic Table and element G is a non-metal in Group VII. Both of these elements form oxides.

Which statement about their oxides is correct?

A Both oxides are acidic.

B Both oxides are basic.

C The oxide of E is acidic and the oxide of G is basic.

D The oxide of G is acidic and the oxide of E is basic.

IGCSE CHEMISTRY • EXERCISE SHEET

7.3 Preparation of salts

Name: _____ Class: _____ Date: _____ **Total: 30 marks**

KEY WORDS insoluble 不溶 • filter 过滤 • crystallise 结晶 • excess 过量 • evaporate 蒸发

Objective

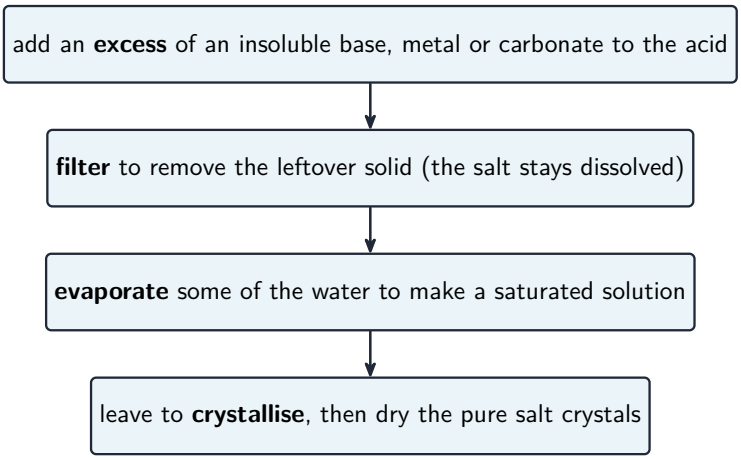
Build the skills to answer exam questions on the **preparation of salts** 盐的制备 — **solubility rules** 溶解性规则, making **soluble salts** 可溶盐, and making **insoluble salts** 不溶盐 by **precipitation** 沉淀.

You must be able to:

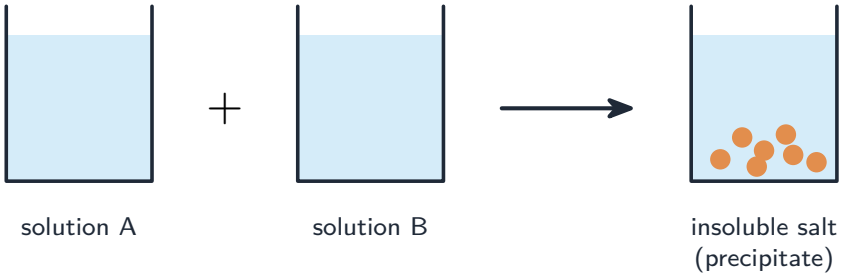
- use the solubility rules
- describe making a soluble salt (excess solid, filter, evaporate, crystallise)
- describe making an insoluble salt by precipitation

1 Worked examples

Two salt-making routes



Soluble salt from an insoluble solid: react with excess, filter, evaporate, crystallise



Insoluble salt: mix two solutions each carrying one needed ion → filter, wash, dry

- **soluble:** all Na/K/ammonium and nitrates; most chlorides/sulfates.

Choosing the route, and writing the equation

Decide from the solubility rules first. **Soluble:** all sodium, potassium and ammonium salts, all nitrates, most chlorides (not silver or lead) and most sulfates (not barium, calcium or lead). **Insoluble:** most carbonates and hydroxides (except sodium, potassium and ammonium).

Route 1, a soluble salt from an insoluble base or carbonate. Warm the acid, add the solid in **excess** so all the acid is used up, **filter** off the leftover solid, **evaporate** the filtrate until crystals begin to form, then leave it to **crystallise** and dry the crystals between filter papers. Use this when one reactant is insoluble, which is what makes "add in excess and filter" possible.

Route 2, a soluble salt from a soluble base (titration). Both reactants are in solution, so nothing can be filtered off. Find the exact volume of acid that neutralises the alkali by titration with an indicator, then repeat with the same volumes **without** the indicator, and evaporate and crystallise.

Route 3, an insoluble salt (precipitation). Mix solutions that each carry one of the needed ions, then **filter**, **wash** the residue with distilled water, and **dry** it.

Worked example. Describe how to prepare pure, dry copper(II) sulfate crystals from copper(II) oxide.

1. Warm dilute sulfuric acid in a beaker.
2. Add copper(II) oxide a little at a time, stirring, until some remains unreacted: this shows the acid has all reacted.
3. Filter to remove the excess copper(II) oxide.
4. Evaporate the blue filtrate until crystals just start to appear at the edge.
5. Leave the solution to cool and crystallise, then dry the crystals between filter papers.

The equation is $CuO + H_2SO_4 \rightarrow CuSO_4 + H_2O$. For a precipitation, an **ionic equation** shows only the ions that change: $Ba^{2+}(aq) + SO_4^{2-}(aq) \rightarrow BaSO_4(s)$.

2 Practice

2.1 State whether silver chloride is soluble or insoluble. [1]

2.2 Name the method used to make an insoluble salt. [1]

2.3 Identify which of these salts is insoluble: sodium chloride, barium sulfate, potassium nitrate. [1]

2.4 Write the ionic equation for the formation of silver chloride from silver nitrate and sodium chloride solutions. [2]

2.5 Explain why the solid is added in excess in the filtration route. [2]

3 Exam-style questions

3.1 A soluble salt is best made from an acid and an **excess** of an insoluble base by, in order: [1]

- **A** filter, react, crystallise
- **B** react, filter, evaporate, crystallise
- **C** evaporate, react, filter
- **D** precipitate, wash, dry

3.2 Describe how to make pure, dry copper(II) sulfate crystals from copper(II) oxide and dilute sulfuric acid. [4]

3.3 Barium sulfate is insoluble. Name two solutions that could be mixed to make it, and state what you would do after mixing. [3]

3.4 A student prepares two salts: zinc sulfate crystals from zinc carbonate, and lead(II) iodide.

(a) Write the equation for the reaction of zinc carbonate with dilute sulfuric acid. [2]

(b) Describe how the student obtains pure, dry crystals of zinc sulfate, giving the practical steps in order. [5]

(c) Explain how the student knows when enough zinc carbonate has been added. [2]

(d) Lead(II) iodide is insoluble. Identify two solutions that could be mixed to prepare it, and write the ionic equation. [3]

(e) State the three steps needed to obtain the dry lead(II) iodide from the mixture, and state why the residue is washed. [3]

Solutions

2.1 insoluble.

2.2 precipitation.

2.3 Barium sulfate.

2.4 $Ag^+(aq) + Cl^-(aq) \rightarrow AgCl(s)$.

2.5 So that all of the acid is used up; the excess solid can then be filtered off, leaving a solution containing only the salt.

3.1 B. React (excess base), filter off the excess, evaporate, then crystallise.

3.2 add excess copper(II) oxide to warm dilute sulfuric acid until no more reacts; filter to remove the excess solid; evaporate some water from the filtrate; leave to crystallise, then dry the crystals.

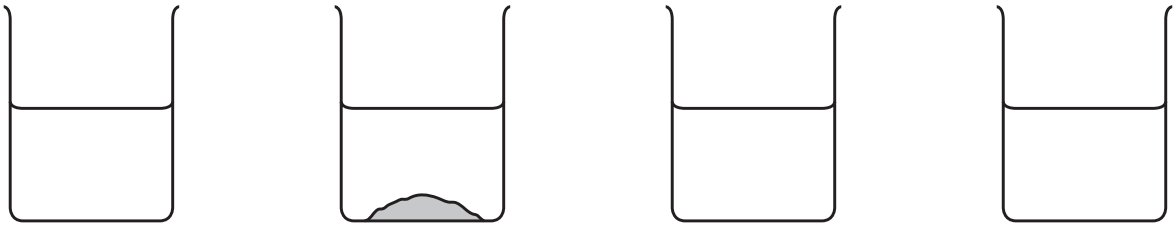
3.3 mix a solution of a soluble barium salt (e.g. barium chloride) with a soluble sulfate (e.g. sodium sulfate); then filter, wash and dry the precipitate.

3.4 (a) $ZnCO_3 + H_2SO_4 \rightarrow ZnSO_4 + H_2O + CO_2$.
(b) Warm the dilute sulfuric acid; add zinc carbonate a little at a time, with stirring, until it is in excess; filter to remove the excess solid; evaporate the filtrate until crystals begin to form at the edge; leave it to cool and crystallise, then dry the crystals between filter papers.
(c) Solid stays at the bottom of the beaker and no more bubbles of carbon dioxide are produced; this shows all the acid has reacted.
(d) Any soluble lead salt, such as lead(II) nitrate, with any soluble iodide, such as potassium iodide; $Pb^{2+}(aq) + 2I^-(aq) \rightarrow PbI_2(s)$.
(e) Filter the mixture, wash the residue with distilled water and dry it; it is washed to remove the soluble salt solution left on the crystals, which would otherwise contaminate the product.

IGCSE Chemistry: **w25 21**

21 A student adds different solid salts to an excess of water. The student stirs the mixtures to determine the solubilities of the salts.

The results are shown.



W X Y Z

What could the four different salts be?

	W	X	Y	Z
A	calcium sulfate	lead(II) chloride	ammonium nitrate	potassium sulfate
B	ammonium nitrate	sodium carbonate	calcium sulfate	lead(II) chloride
C	sodium carbonate	calcium sulfate	potassium sulfate	ammonium nitrate
D	lead(II) chloride	ammonium nitrate	sodium carbonate	calcium sulfate

IGCSE Chemistry: **w25 22**

20 Which method is used to prepare a pure, dry sample of lead(II) chloride?

A mix aqueous lead(II) nitrate and dilute hydrochloric acid → filter → crystallise and dry the filtrate

B mix aqueous lead(II) nitrate and dilute hydrochloric acid → filter → wash and dry the residue

C mix solid lead(II) hydroxide and aqueous sodium chloride → filter → crystallise and dry the filtrate

D mix solid lead(II) hydroxide and aqueous sodium chloride → filter → wash and dry the residue

IGCSE Chemistry: **w25 23**

11 Which statement describes a saturated solution?

A It is a solution that contains the maximum concentration of solute.

B It is a solution that contains the maximum amount of solvent.

C It is a hydrocarbon that contains both double and single bonds.

D It is a hydrocarbon that contains only single bonds.

3 A student makes crystals of the salt sodium sulfate, Na_2SO_4. The student reacts 0.200 mol / dm^3 dilute sulfuric acid, $H_2SO_4(aq)$, with aqueous sodium hydroxide, NaOH(aq).

The student uses the following steps.

step 1 The student places 40.0 cm^3 of NaOH(aq) into a conical flask. This volume contains 0.0100 moles of NaOH.

step 2 The student adds a few drops of methyl orange indicator to the NaOH(aq) in the conical flask.

step 3 The student adds 0.200 mol / dm^3 $H_2SO_4(aq)$ to the flask until the end-point is reached.

step 4 The student transfers the mixture from the conical flask to an evaporating basin and obtains dry crystals.

(a) Complete the symbol equation for the reaction. Include state symbols.

$$H_2SO_4(aq) + 2NaOH(aq) \rightarrow Na_2SO_4(.....) + ...(.....)$$

[2]

(b) State the type of exothermic reaction taking place.

..... [1]

(c) Calculate the concentration of NaOH(aq) used in **step 1**.

concentration of NaOH(aq) = ... mol / dm^3 [1]

(d) Name the item of apparatus the student uses to add $H_2SO_4(aq)$ in **step 3**.

..... [1]

(e) Calculate the volume of $H_2SO_4(aq)$, in cm^3, added in **step 3**.

volume of $H_2SO_4(aq)$ = ... cm^3 [2]

(f) State the colour change observed in **step 3**.

from ..... to ..... [2]

(g) The dry crystals formed in **step 4** are coloured and **not** white. This is because the student should do an additional step between **step 3** and **step 4**.

Suggest what the student should do in this additional step to produce white crystals.

.....

..... [1]

(h) In **step 4**, the student gently heats the solution in the evaporating basin until the solution is saturated. The student then stops heating and leaves the hot solution to cool. Crystals start to appear.

(i) Explain the term saturated solution.

.....

.....

..... [2]

(ii) Explain why crystals start to appear as the hot solution cools.

.....

..... [1]

(iii) Suggest the effect, if any, on the mass of crystals collected in **step 4** if the solution in the evaporating basin is allowed to dry without gentle heating.

..... [1]

[Total: 14]

3 A student prepares a sample of the insoluble salt barium sulfate, $BaSO_4$.
The student adds aqueous sodium sulfate, $Na_2SO_4(aq)$, to aqueous barium chloride, $BaCl_2(aq)$.

The student carries out the following steps.

step 1 Dissolve 0.100 moles of solid $BaCl_2$ in 100 cm^3 of distilled water in a beaker to form $BaCl_2(aq)$.

step 2 Add an aqueous solution which contains 0.100 moles of $Na_2SO_4(aq)$ to the beaker containing the $BaCl_2(aq)$ from **step 1**.

step 3 Stir the mixture and then filter it.

step 4 Dry the solid left in the filter paper.

(a) Complete the symbol equation for the reaction. Include state symbols.

$$BaCl_2(aq) + Na_2SO_4(aq) \rightarrow BaSO_4(.....) + ...(.....)$$

[2]

(b) Calculate the mass of solid $BaCl_2$ dissolved in **step 1**.

mass = ... g [2]

(c) The concentration of $Na_2SO_4(aq)$ in **step 2** is 1.25 mol/dm^3.

Calculate the volume, in cm^3, of 1.25 mol/dm^3 $Na_2SO_4(aq)$ added in **step 2** which contains 0.100 moles of Na_2SO_4.

volume = ... cm^3 [1]

(d) State the colour of the solid formed in **step 2**.

..... [1]

(e) The mixture is filtered in **step 3**.

State the general term given to a solid left in the filter paper after filtration.

..... [1]

(f) The actual mass of dry $BaSO_4$ collected in **step 4** is greater than the expected mass. This is because the student should do an additional step between **step 3** and **step 4**.

Suggest what the student should do in this additional step, and explain why the actual mass collected is greater than the expected mass.

.....

.....

.....

..... [2]

(g) State the name of this method of salt preparation.

..... [1]

(h) State the name of a different:

- barium salt that can be used in place of $BaCl_2$ .....
- sulfate salt that can be used in place of Na_2SO_4 .....
- barium salt that can be made by this method. .....

[3]

[Total: 13]

5 This question is about metallic compounds.

(a) Insoluble metal salts, such as lead(II) sulfate, are made by precipitation.

When aqueous lead(II) ions react with aqueous sulfate ions, a precipitate of lead(II) sulfate forms.

A sample of pure lead(II) sulfate can be obtained from the precipitate formed.

(i) Write an ionic equation for this precipitation reaction. Include state symbols.

..... [3]

(ii) State the name of an aqueous solution containing lead(II) ions.

..... [1]

(iii) State the name of an aqueous solution containing sulfate ions.

..... [1]

(iv) The lead(II) sulfate precipitate is separated from the rest of the reaction mixture by filtration. The impure lead(II) sulfate remains on the filter paper.

State the general term given to an insoluble substance that remains on the filter paper during filtration.

..... [1]

(v) Describe how the lead(II) sulfate is purified after filtration.

.....

..... [2]

(b) Copper is a transition element.

A list of properties of copper is shown.

- It has good electrical conductivity.
- It has variable oxidation states.
- It forms soluble salts.
- It forms coloured compounds.
- It forms basic oxides.
- It acts as a catalyst.

(i) Give **two** properties from the list that show how copper is similar to metals in Group I of the Periodic Table.

1 .....

2 .....
[2]

(ii) Give **two** properties from the list that show how copper is different from metals in Group I of the Periodic Table.

1 .....

2 .....
[2]

[Total: 12]

19 Lead(II) sulfate is an insoluble salt.

Which process is **not** used to prepare a pure sample of this salt?

A crystallisation

B drying

C filtration

D precipitation

1 A student prepares some crystals of pure potassium sulfate by reacting aqueous potassium carbonate with dilute sulfuric acid. The equation for the reaction is shown.

$$K_2CO_3(aq) + H_2SO_4(aq) \rightarrow K_2SO_4(aq) + H_2O(l) + CO_2(g)$$

The student:
- places 25.0 cm^3 of aqueous potassium carbonate in a conical flask
- adds a few drops of a suitable indicator to the conical flask
- uses a burette to add dilute sulfuric acid to the conical flask until the end-point is reached and the indicator changes colour.

Table 1.1 shows the burette readings the student obtains.

Table 1.1

final burette reading / cm^3	18.8
initial burette reading / cm^3	4.2
volume of dilute sulfuric acid added / cm^3	

(a) Complete Table 1.1 by calculating the volume of dilute sulfuric acid added to the conical flask. [1]

(b) State which solution, aqueous potassium carbonate or dilute sulfuric acid, is the **least** concentrated. Give a reason for your answer.

least concentrated solution .....

reason .....
[1]

(c) Name a piece of apparatus suitable for measuring the 25.0 cm^3 of aqueous potassium carbonate.

..... [1]

(d) Name a suitable indicator and give the colour change of this indicator at the end-point.

indicator .....

colour change at end-point ..... to .....
[2]

(e) As the student added the dilute sulfuric acid to the aqueous potassium carbonate they looked for a colour change.

State what the student should do as they add the dilute sulfuric acid to the aqueous potassium carbonate in the conical flask. Do **not** include observations in your answer.

.....

..... [1]

(f) Describe what the student should now do to obtain crystals of pure potassium sulfate.

.....

.....

.....

.....

..... [3]

[Total: 9]

24 Lead(II) sulfate is an insoluble salt.

Which method is suitable for obtaining pure solid lead(II) sulfate?

A Mix aqueous lead(II) nitrate and aqueous potassium sulfate, heat to evaporate all of the water, collect the solid and then wash and dry it.

B Mix aqueous lead(II) nitrate and aqueous potassium sulfate, filter, collect the filtrate, crystallise, then wash and dry the crystals.

C Mix aqueous lead(II) nitrate and dilute sulfuric acid, filter, then wash and dry the residue.

D Titrate aqueous lead(II) hydroxide with dilute sulfuric acid, crystallise, then wash and dry the crystals.