Stewards Academy

Science KS4: Blended Learning Booklet

C4 Chemical changes

Name:

Form:

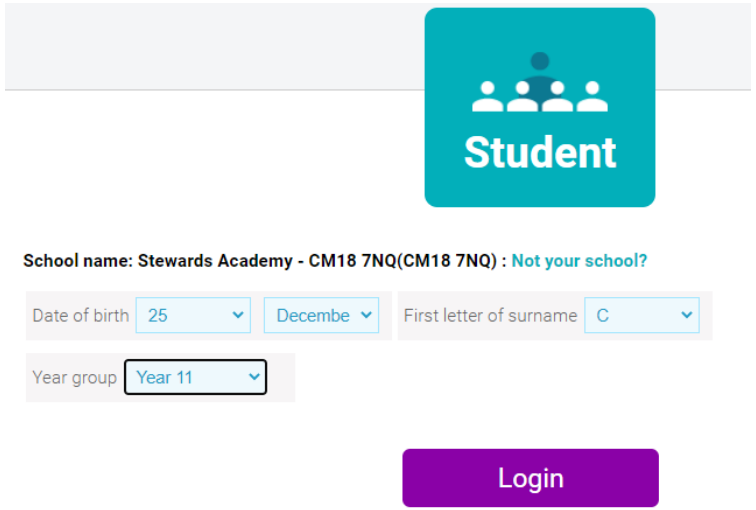
Aim to complete four lessons each week. Watch the videos and follow the four part lesson plan

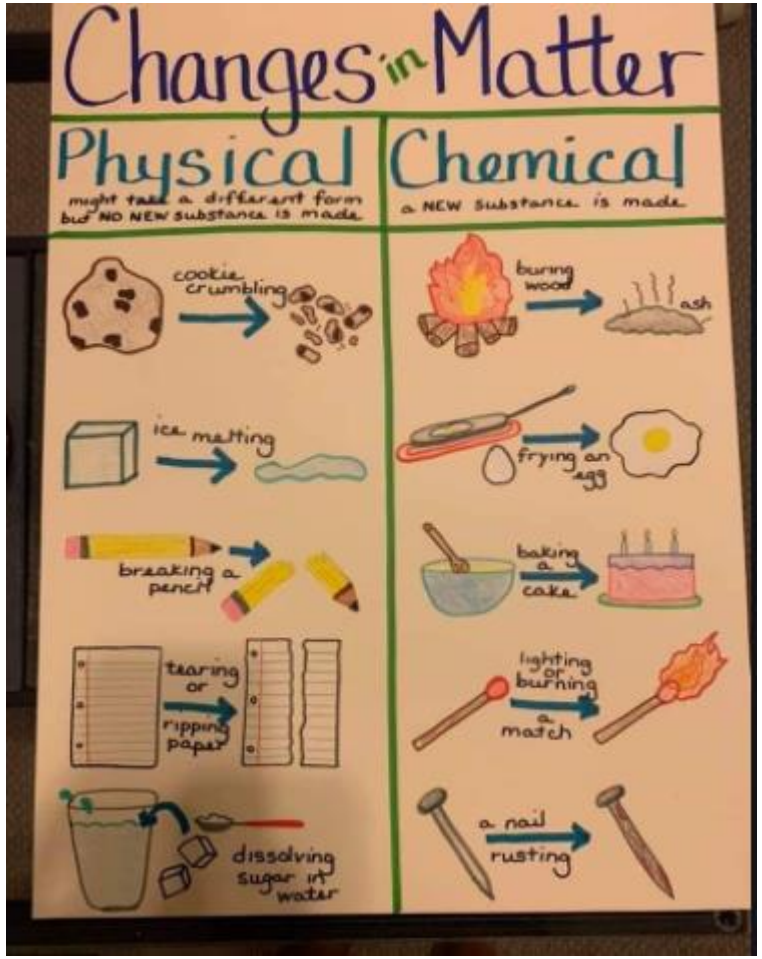
All video clips are online using the ClassCharts link. Upload all work onto ClassCharts for feedback.

The online textbook has all the key information and vocabulary to help you with this unit

To log on to the online textbook:

- https://connect.collins.co.uk/school/portal.aspx
- Type in “stewards” and select Stewards Academy
- Login using your date of birth,
  initial of your surname and your
  academic year





Contents

Contents

(T) = Triple scientists only

Big Picture – Year 10 Overview
Science

Unit Test

End of Year Exams

Nest Year

IR emission and absorption (T)

Colour, lenses, images and magnification (T)

The electro-magnetic spectrum

Sound waves and seismic waves (T)

Properties of waves

UNIT P6

Unit Test

Spectroscopy and other instrumental methods (T)

Tests for gases, metals, hydroxides and anions (T)

Pure substances and chroma-tography

Polymers and poly-merisation (T)

Waves

I will be able to describe characteristics of waves that can be measured. **I will** be able to measure reflection and refraction of waves and explain why they occur. **I will** be able to place visible light withing the electromagnetic spectrum. ***I will** be able to sound waves can reveal structures (T). **I will** be able to explain how lenses work (T)*

Hydrocarbons & Chemical analysis

I will be able to describe the properties of hydrocarbons. ***I will** be able to describe the properties of alkenes, alcohols, carboxylic acids and polymers (T).* **I will** be able to use techniques to produce and identify a pure substance. ***I will** be able to identify positive and negative ions and evaluate different analysis techniques (T).*

Meiosis and reproduction

Genetics and gene disorders

The work of Gregor Mendel (T)

Unit Test

UNIT C7 & C8

Crude oil, hydrocarbons and fractional distillation

Combustion and cracking of alkanes

Alkenes, alcohols and carboxylic acids (T)

DNA structure and protein production (T)

Genetics

I will be able to explain how we inherit our characteristics as a result of our genes which are made of DNA. **I will** be able to explain how the DNA is replicated and packaged in a specialised way to form the sex cells. ***I will** be able to describe the work by Gregor Mendel around plant genetics*

I will be able to explain how forces affect motion and how an understanding of these forces can make driving safer. ***I will** be able to explain the effects of forces on levers and in creating pressure (T).* I will be able to explain the effects of forces applied to springs.

Forces

DNA, genes and the human genome

UNIT B6

Unit Test

Forces and energy in springs

Moments, levers and pressure (T)

Momentum and road safety

Mass and Weight

Forces, speed and acceleration

UNIT P5

Energy Changes & Reaction Rates

I will be able to describe, explain and represent energy changes in chemical reactions and link them to bond energies and the particle theory. ***I will** be able to explain how dells produce a voltage and how fuel cells work (T).* **I will** be able to measure and calculate the rate of a reaction and describe factors that can affect rate. ***I will** be able to apply Le Chatelier's principle to reactions in equilibrium (T).*

Unit Test

Exo and endo thermic reactions

Reaction profiles

Cells, batteries and fuels cells (T)

Measuring rates of reaction

Factors affecting rates of reaction

Catalysts and collision theory

Reversible reactions and energy changes

Factors affecting equilibrium

UNIT C5 & C6

I will be able to explain how conditions in the body, processes and organ systems are coordinated and controlled. **I will** be able to describe how hormones control sexual development and human reproduction, *as well as how hormones enable plants to respond to stimuli (T)*

Homeostasis

Unit Test

Plant hormones (T)

Human reproduction and IVF

The endocrine system and the kidneys (T)

The nervous system *and the eye (T)*

Homeostasis

UNIT B5

Unit Test

Nuclear fission and fusion (T)

I will be able to reconise an atomic isotope and explain how one isotope can turn into another through three different forms of radioactive decay. **I will** be able to represent radioactive decay using a nuclear equation.

Atomic structure

Hazards and uses of radiation

Titration (T)

Electrolysis

Oxidation and reduction)

Unit Test

UNIT P4

Atomic structure

Radioactive decay

Nuclear equations

Neutralisation

Chemical changes

I will be able to describe why some metals are more reactive than others, **I will** be able to describe how neutralization occurs and how salts are formed. **I will** be able to explain how some metals are extracted by electrolysis rather than oxidation

I will be able to describe how lifestyle choices can affect the risk of catching a non-communicable disease. **I will** be able to explain how communicable diseases are spread and how we can control their spread. ***I will** be able to describe how plants are affected by and protected from disease causing organisms (T).*

Health

Metal reactivity

UNIT C4

Unit Test

Plant diseases & defenses (T)

Protecting the body

Malaria

Pathogens

Health and disease

UNIT B4

Year 10

ZOOM IN...

MY LEARNING JOURNEY:

Subject: Chemical Changes Year: 10 Unit: C4

AIMS

This unit will support students will explain the oxidation and reduction of metals in terms of loss or gain of oxygen or electrons. They will deduce a reactivity series for metals based on experimental results and relate this to the tendency of metals to form positive ions and the extraction method used to extract each metal. They will also make soluble salts by neutralising acids with metals, metal oxides, carbonates or alkalis and write equations for these reactions. They will distinguish between strong acids and concentrated acids and explain what happens during neutralisation. Students will also identify the products formed when molten or dissolved binary compounds are electrolysed and write equations for the reactions at each electrode.

DEVELOPING COURAGE

- **C** Learn how to handle hazardous materials safely
- **O** To carry out some chemical reactions
- **U** Understand how elements form compounds
- **R** Use the basic rules of chemistry to explain how and why a reaction occurs
- **A** How the laws of chemistry can be used to our advantage
- **G** See how atom share their electrons
- **E** Seeing the periodic table in action

UP NEXT

Energy Changes

- Exo & endothermic reactions
- Reaction profiles
- Cells & Batteries
- Fuel Cells

CAREERS

- Synthetic Chemist
- Chemical Engineer
- Cleaner
- Metallurgist

PREVIOUS LEARNING

Pupils will have some knowledge of what the reactivity series shows and why some metals are easier to extract than others. They will know neutralisation of an acid with an alkali produces a salt and water. They should be able to name a strong and a weak acid. They will have seen electrolysis before as a method that uses electricity to purify a metal. .

WHAT WE KNOW/ REMEMBER

- .....
- .....
- .....
- .....
- .....

RECOMMENDED READING

1. Rare: The High-Stakes Race to Satisfy Our Need for the Scarcest Metals on Earth by Keith Veronese
2. Acids and Alkalis (Science Essentials - Chemistry) by Denise Walker
3. The PH Scale (Look at Chemistry) by Mary Griffin

PERSONAL OBJECTIVES

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Lesson 1: C4.1 – Metal oxides

Connection

Have a look at the topic overview and the C4 zoom in.

Populate what you know and your personal objectives.

Activation

LI – Identify that metals react with oxygen to form metal oxides

https://www.youtube.com/watch?v=UdWLlmLiESY

1. Make a note of the title and the LI
2. Read pages 132-133
3. Define “metal oxide” & “ore”
4. Draw figure 4.2, 4.3 and 4.4 and state what bauxite consists of

Demonstration

Attempt questions 1-6.
In 15 mins answer as many questions as you can.
Self mark the questions you have done making any necessary corrections in blue pen

Challenge yourself to answer as many as you can:
Green questions to GCSE Level 3
Blue questions to GCSE Level 6
Purple questions to GCSE Level 9

Consolidation

Complete and self assess the relevant past paper question for this topic - From the C4 DIP file

Extension

Make a note of one thing you think you understand well and one thing that you would like to ask your teacher

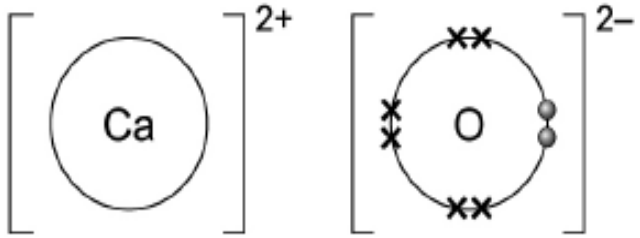
Answers: C4.1 – Metal oxides

Connection

NA

Demonstration

1 Oxidation since zinc gains oxygen
2 Reduction since oxygen is removed from lead oxide (and carbon is oxidised)
3 Electrolysis of aluminium oxide requires large amounts of energy to supply the electricity and to make the aluminium oxide molten.
4 $CaO\ (s) + H_2O\ (l) \rightarrow Ca(OH)_2\ (aq)$
5



6 $Ca \rightarrow Ca^{2+} + 2\ e^-$

Lesson 2: C4.2 – Reactivity series

Connection

Q1. State the three most abundant elements in the Earths crust

Q2. State a common ore of Iron

Q3. Explain what is meant by oxidation

Activation

LI – Describe the reactions, if any, of metals with water or dilute acids

https://www.youtube.com/watch?v=2i5Lm7BMtpo

1. Make a note of the title and the LI
2. Read pages 134-135
3. Define “reactivity”, “tendency” & “displacement”
4. Draw figure 4.10, 4.11, and 4.12 and state an example of a displacement reaction

Demonstration

Attempt questions 1-3
In 15 mins answer as many questions as you can.
Self mark the questions you have done making any necessary corrections in blue pen

Challenge yourself to answer as many as you can:
Green questions to GCSE Level 3
Blue questions to GCSE Level 6
Purple questions to GCSE Level 9

Consolidation

Complete and self assess the relevant past paper question for this topic - From the C4 DIP file

Extension

Make a note of one thing you think you understand well and one thing that you would like to ask your teacher

Answers: C4.2 – The reactivity series

Connection

1. Aluminium, oxygen and silicon
2. Haematite
3. Oxidation is a reaction involving loss of electrons or a reaction involving gain of Oxygen

Demonstration

1 Sodium is more reactive than magnesium when placed in water. Magnesium is more reactive than zinc when reacted with acids. So sodium must be more reactive than zinc.

2. The single outer shell electron in potassium is further from the nucleus (potassium has one more shell than sodium). So there is less attraction from the nucleus and the electron is more easily lost.

3. $Zn + Cu^{2+} \rightarrow Zn^{2+} + Cu$

Lesson 3: C4.3 – Extraction of metals

Connection

Q1. State which is more reactive: Iron or Lead

Q2. Describe what is meant by displacement

Q3. Explain why sodium forms ions more easily than lithium

Activation

LI – Explain how extraction methods depend on metal reactivity

https://www.youtube.com/watch?v=gvNuMpxqG7Q

1. Make a note of the title and the LI
2. Read pages 136-137
3. Define “reduction” & “positive ion”
4. Draw table on page 136
5. Look at Fig 4.15 and describe what has happened to consumption of steel in China compared to the rest of the world

Demonstration

Attempt questions 1-6
In 15 mins answer as many questions as you can.
Self mark the questions you have done making any necessary corrections in blue pen

Challenge yourself to answer as many as you can:
Green questions to GCSE Level 3
Blue questions to GCSE Level 6
Purple questions to GCSE Level 9

Consolidation

Complete and self assess the relevant past paper question for this topic - From the C4 DIP file

Extension

Make a note of one thing you think you understand well and one thing that you would like to ask your teacher

Answers: C4.3 – Extraction of metals

Connection

1. **Iron**
2. **Reaction where an element takes the place of another element from a compound**
3. **As outer electron in sodium I further from nucleus than in lithium so there is less attractive force and therefore more easily lost**

Demonstration

1 Oxygen is removed from zinc oxide so it is reduced. Carbon has had oxygen added so it is oxidised.

2 Carbon has been oxidised since oxygen has been added.

3 Iron(III) oxide has been reduced since oxygen has been removed. Carbon monoxide has been oxidised since oxygen has been added.

4 a $CuO + C \rightarrow Cu + CO$

b Copper(II) oxide is being reduced (oxygen removed) to copper. Carbon is being oxidised (oxygen added) to carbon monoxide.

5 $2ZnS + 3O_2 \rightarrow 2ZnO + 2SO_2$

6 Fe_2O_3 is composed of Fe^{3+} ions. These are reduced (gain 3 electrons) to Fe.

Lesson 4: C4.4 – Oxidation and reduction in terms of electrons

Connection

Q1. State why gold is found as a pure metal

Q2. state the two stages in the extraction of Zinc

Q3. In the extraction of Iron from Iron oxide using Carbon monoxide , state which substance is oxidised and which is reduced

Activation

LI – Use experiemental results of displacement reactions to confirm the reactivity series

https://www.youtube.com/watch?v=Lak04nkLxhY
https://www.youtube.com/watch?v=0lYXFJDDYAQ

1. Make a note of the title and the LI
2. Read pages 138-139
3. Define “Half equation” & “Ionic equation”
4. Draw table and key on page 138
5. Look at Fig 4.19, What is happening to the iron nail?

Consolidation

Complete and self assess the relevant past paper question for this topic - From the C4 DIP file

Demonstration

Attempt questions 1-7
In 15 mins answer as many questions as you can.
Self mark the questions you have done making any necessary corrections in blue pen

Challenge yourself to answer as many as you can:
Green questions to GCSE Level 3
Blue questions to GCSE Level 6
Purple questions to GCSE Level 9

Extension

Make a note of one thing you think you understand well and one thing that you would like to ask your teacher

Answers: C4.4 – Oxidation and reduction in terms of electrons

Connection

1. **As Gold is extremely unreactive**
2. **1. To convert the ore Zinc blende to Zinc oxide**
   2. To convert the Zinc oxide to Zinc
3. **Iron oxide has been reduced and Carbon monoxide has been oxidised**

Demonstration

1 Increasing reactivity: Copper, iron zinc, magnesium
2 Tin displaces copper (ions) but not zinc or iron(II). So tin is more reactive than copper but less reactive than zinc and iron.
3 $Mg + NiSO_4 \rightarrow MgSO_4 + Ni$
4 $Mg + Cu^{2+} \rightarrow Mg^{2+} + Cu$
5 $Mg \rightarrow Mg^{2+} + 2\ e^-$
$Fe^{2+} + 2e^- \rightarrow Fe$
6 Aluminium is oxidised – it has lost 3 electrons. Cr^{3+} has been reduced since it has gained 3 electrons
7 a $Mg \rightarrow Mg^{2+} + 2e^-$ Magnesium has lost electrons and has been oxidised.
$Ag^+ + e^- \rightarrow Ag$ Silver has gained electrons and has been reduced.
b $Mg + 2Ag^+ \rightarrow Mg^{2+} + 2Ag$

Lesson 5: C4.5 – Reaction of metals with acids

Connection

Q1. State in terms of electrons, what is meant by oxidation

Q2. State in terms of electrons, what is meant by reduction

Q3. State whether there would be a displacement reaction between magnesium and copper sulfate and if so, what would the products be

Activation

LI – Describe how to make salts from metals and acids

https://www.youtube.com/watch?v=ofw6oHSYGFI

1. Make a note of the title and the LI
2. Read pages 140-141
3. Define “acid”, “metal” & “Salt”
4. Draw Figure 4.22 and both tables on page 141

Demonstration

Attempt questions 1-7
In 15 mins answer as many questions as you can.
Self mark the questions you have done making any necessary corrections in blue pen

Challenge yourself to answer as many as you can:
Green questions to GCSE Level 3
Blue questions to GCSE Level 6
Purple questions to GCSE Level 9

Consolidation

Complete and self assess the relevant past paper question for this topic - From the C4 DIP file

Extension

Make a note of one thing you think you understand well and one thing that you would like to ask your teacher

Answers: C4.5 – Reactions of metals with acids

Connection

1. **Oxidation is loss of electrons**
2. **Reduction is gain of electrons**
3. **Yes a reaction would occur and the products would be magnesium sulfate and copper**

Demonstration

1 Magnesium chloride
2 Iron + sulfuric acid → iron(II) sulfate + hydrogen
3 $Zn + 2HCl \rightarrow ZnCl_2 + H_2$
4 $2Fe + 6HCl \rightarrow 2FeCl_3 + 3H_2$ (or half the ratios)
5 $Zn \rightarrow Zn^{2+} + 2e^-$
$2H+ + 2e^- \rightarrow H_2$
6 Iron is oxidised since it has lost electrons. Hydrogen ions, H^+, have been reduced since they have gained electrons.
7 Balanced equation: $2Al + 3H_2SO_4 \rightarrow Al_2(SO_4)_3 + 3H_2$
Half equations:
$Al \rightarrow Al^{3+} + 3e^-$
$2H^+ + 2e^- \rightarrow H_2$ (or $3H^+ + 3e^- \rightarrow 1.5\ H_2$) or $6H^+ + 6e^- \rightarrow 3H_2$

Lesson 6 C4.6 Neutralisation of acids and salt production

Connection

Q1. Write the name of the salt formed between Zinc and Sulphuric acid

Q2. write a balanced symbol equation of the reaction between Sodium and hydrochloric acid

Q3. Write half equations for the reaction between Calcium and an acid

Activation

LI: Describe ways that salts can be made

https://www.youtube.com/watch?v=lBjwMcHUyBY

1. Make a note of the title and the LI
2. Read pages 142-143
3. Draw and label figures 4.27 and 4.28

Demonstration

Attempt questions 1-7
In 15 mins answer as many questions as you can.
Self mark the questions you have done making any necessary corrections in blue pen

Challenge yourself to answer as many as you can:
Green questions to GCSE Level 3
Blue questions to GCSE Level 6
Purple questions to GCSE Level 9

Consolidation

Complete and self assess the relevant past paper question for this topic - From the C4 DIP file

Extension

Make a note of one thing you think you understand well and one thing that you would like to ask your teacher

Answers: C4.6 – Neutralisation of acids and salt production

Connection

1. **Zinc sulphate**
2. **$2Na + 2HCl \rightarrow 2NaCl + H_2$**
3. **$Ca - 2e^- \rightarrow Ca^{2+}$**

$2H^+ + 2e^- \rightarrow H_2$

Demonstration

1. potassium hydroxide + hydrochloric acid → potassium chloride + water
2. copper carbonate + nitric acid → copper nitrate + water + carbon dioxide
3. Zinc nitrate
4. Copper sulfate
5. $ZnCl_2$
6. $Cu(NO_3)_2$
7. $CaCO_3 + 2HNO_3 \rightarrow Ca(NO_3)_2 + H_2O + CO_2$

Lesson 7 C4.7 Soluble salts

Connection

Q1. Describe the difference between a base and an alkali

Q2. predict the name of the salt formed when sulphuric acid reacts with Zinc

Q3. Deduce the formula of Magnesium Nitrate

Activation

LI: Describe how to make pure, dry samples of soluble salts

https://www.youtube.com/watch?v=lpM_VCMPFug

1. Make a note of the title and the LI
2. Read pages 144-145
3. Give definitions for the key words
4. Draw and label figures 4.29

Demonstration

Attempt questions 1-6
In 15 mins answer as many questions as you can.
Self mark the questions you have done making any necessary corrections in blue pen

Challenge yourself to answer as many as you can:
Green questions to GCSE Level 3
Blue questions to GCSE Level 6
Purple questions to GCSE Level 9

Consolidation

Complete and self assess the relevant past paper question for this topic - From the C4 DIP file

Extension

Make a note of one thing you think you understand well and one thing that you would like to ask your teacher

Answers: C4.7 – Soluble salts

Connection

1. **Metal oxides and metal carbonates are bases. A few bases are soluble in water and these are called alkalis**
2. **Zinc Sulphate**
3. **$Mg(NO_3)_2$**

Demonstration

1. If the solid is in excess, all of the acid will have reacted and totally converted into the soluble salt. Also, if some acid was unreacted, it would contaminate the salt solution. The excess solid is easy to filter off.

2. It is heated to make the salt solution more concentrated. This means that the crystals form more effectively (saturated solution).

3. copper oxide + sulfuric acid → copper sulfate + water

4. potassium hydroxide + hydrochloric acid → potassium chloride + water

5. $ZnCO_3 + 2HCl \rightarrow ZnCl_2 + H_2O + CO_2$

6. $MgO + 2HNO_3 \rightarrow Mg(NO_3)_2 + H_2O$

Lesson 8 C4.8 Required practical: Preparing a pure dry sample of a soluble salt from an insoluble oxide or carbonate

Connection

Q1. Describe why an excess of solid is added to an acid when making a soluble salt

Q2. Explain how you know when an excess of solid is added

Q3. Write a balanced equation for the reaction between Copper oxide and Hydrochloric acid

Activation

LI: Explain the apparatus, materials and techniques used for making a soluble salt

https://www.youtube.com/watch?v=qIOMlwBoe_4

1. Make a note of the title and the LI
2. Read pages 146-147
3. Give definitions for the key words
4. Carry out required practical

Demonstration

Attempt questions 1,2,3,7,8,10 and 11
In 15 mins answer as many questions as you can.
Self mark the questions you have done making any necessary corrections in blue pen

Challenge yourself to answer as many as you can:
Green questions to GCSE Level 3
Blue questions to GCSE Level 6
Purple questions to GCSE Level 9

Consolidation

Complete and self assess the relevant past paper question for this topic - From the C4 DIP file

Extension

Make a note of one thing you think you understand well and one thing that you would like to ask your teacher

Answers: C4.8 – Required practical: Preparing a pure dry sample of a soluble salt from an insoluble oxide or carbonate

Connection

1. **The solid is added in excess to ensure that all of the acid has reacted**
2. **There will be solid residue at the bottom of the beaker after stirring and heating**
3. **$CuO + HCl \rightarrow CuCl_2 + H_2$**

Demonstration

1. Magnesium carbonate and sulfuric acid.
2. Magnesium mass is measured with a balance. Sulfuric acid solution is measured with a measuring cylinder (though a pipette would be more accurate).
3. For magnesium powder: g. For sulfuric acid solution: cm^3(ml).
7. The salt solution is heated to evaporate some water and concentrate the solution. The solution is then left so that the rest of the water evaporates and the salt crystallises.
8. It can be washed with a small volume of the solvent (water). It can then be dried. Also, recrystallisation can be carried out. This involves dissolving the solid salt in the minimum amount of hot water. Then leaving it to cool and crystallise again. The impurities remain in the solution. This can be repeated several times depending on the purity required.
10. When impurities are present, the melting point will be lower than the data book value. The purer the salt, the closer to the data book value.
11. It is not possible to tell whether there is a trend in melting points e.g. 41.6 °C, 41.4 °C, ? °C. A third measurement would have confirmed whether the readings were randomly scattered about the "true" value or part of a trend. Generally, when melting points are measured, the first one is rough and the second accurate. But it is not possible to say whether this is true with the data provided.

Lesson 9 C4.9 pH and neutralisation

Connection

Q1. Identify the two substances needed to make magnesium sulfate

Q2. Describe the safety measures you need when adding substances

Q3. Explain how you would test the purity of the final sample

Activation

LI: Describe the use of universal indicator to measure pH

https://www.youtube.com/watch?v=ckbsHM2igT0

1. Make a note of the title and the LI
2. Read pages 148-149
3. Give definitions for the key words on page 148
4. Draw fig 4.35 on page 149

Demonstration

Attempt questions 1-7
In 15 mins answer as many questions as you can.
Self mark the questions you have done making any necessary corrections in blue pen

Challenge yourself to answer as many as you can:
Green questions to GCSE Level 3
Blue questions to GCSE Level 6
Purple questions to GCSE Level 9

Consolidation

Complete and self assess the relevant past paper question for this topic - From the C4 DIP file

Extension

Make a note of one thing you think you understand well and one thing that you would like to ask your teacher

Answers: C4.9 – pH and neutralisation

Connection

1. **Magnesium carbonate and Sulfuric acid**
2. **The powdered metal or base will need to be added carefully as the acid is hot and may effervesce violently**
3. **To test the purity, the melting point needs to be looked up and compared with the melting point of your product**

Demonstration

1. Hydrogen ion / H^+
2. An acid produces hydrogen ions in aqueous solution. Alkalis produce hydroxide ions in aqueous solution.
3. Red and pH 1. Green and pH 7. Purple and pH 14.
4. 7
5. (a) 3 H^+ / PO_4^{3-}
   (b) Phosphoric acid: high concentration of H^+ ions. Sodium hydroxide: high concentration of OH^- ions.
6. $H^+ (aq) + OH^- (aq) \rightarrow H_2O(l)$
7. (a) 8–10 (alkaline). There is an excess of OH^- and a low concentration of H^+ .
   (b) Magnesium hydroxide contains OH^- ions and hydrochloric acid in the stomach contains H^+ ions. These react together to form water. The acid is therefore neutralised.