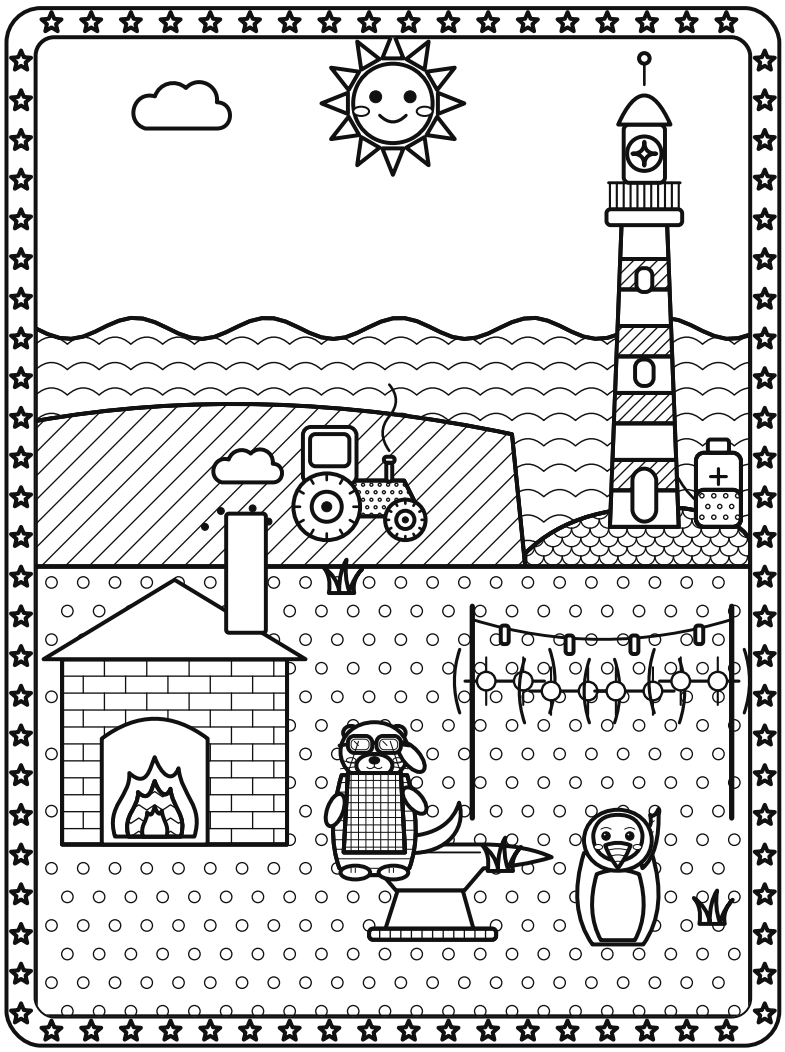
REAL-LIFE CHEMISTRY

Chemistry in Society

Workbook for National 5 Chemistry

Unit: Chemistry in Society



C. Blewis

Blewis LEARNING

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How to use this book

This book covers Chemistry in Society for National 5 Chemistry: metals and redox, electrochemical cells, plastics, fertilisers, nuclear chemistry and chemical analysis. Each topic follows the same pattern, so you always know what comes next.

EACH TOPIC HAS

Opener	the story for the topic, what you will learn and the key words
Learn pages	short explanations with diagrams, and questions to try
Practical	You plan the investigation yourself, carry it out safely, take repeat readings, draw a graph and evaluate your method.
Brain break	a calm puzzle or colouring page
Check-up	a few questions to show what you know, and a checklist

PRACTICAL WORK: STAY SAFE

- Only start a practical when an adult says it is OK.
- Read the whole method and the Stay safe table first.
- Tell your teacher about anything that might affect you, like asthma or an allergy.
- Stop and tell an adult if you feel unwell or something goes wrong.

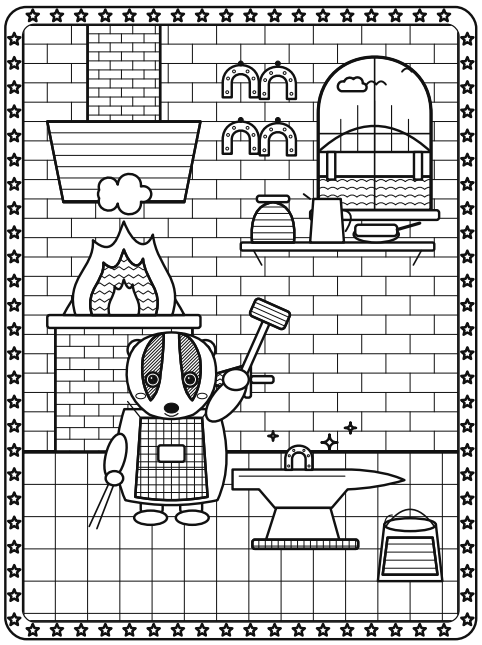
NO LAB TODAY?

Every practical has a set of example results. If you could not do the experiment, use these to finish the results, graph and conclusion.

DOODLE CORNERS

Some pages have a doodle corner. Colour it or doodle in it when you need a short break.

Metals



Gold coins found in a shipwreck still shine after 300 years under the sea, but an iron anchor from the same ship has rusted away. Why?

Theme: the Glen Arrin forge. Owen helps out at the Glen Arrin forge, where old tools are mended and new gates are made. He wants to know why some metals rust, how metals are made from rocks, and why the forge pays so much more for some scrap metals than others.

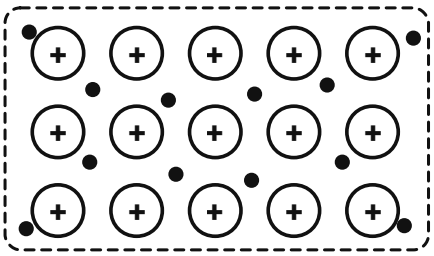
IN THIS TOPIC YOU WILL LEARN TO

Skill 1	explain metallic bonding and why metals conduct, and use the reactivity series to predict reactions
Skill 2	link the method used to extract a metal to its reactivity, including electrolysis with a d.c. supply
Skill 3	write ion-electron equations for oxidation and reduction, and combine them into redox equations

KEY WORDS

Metallic bond	attraction between positive ions and delocalised electrons
Reactivity series	metals listed from most to least reactive
Ore	a naturally occurring compound of a metal
Oxidation	loss of electrons
Reduction	gain of electrons
Redox	a reaction where oxidation and reduction happen together

❶ Metallic bonding and reactivity



+ positive metal ion ● delocalised electron

In a metal, the atoms lose their outer electrons. The electrons are **delocalised**: free to move through the whole structure. A **metallic bond** is the attraction between the positive metal ions and the delocalised electrons.

Metals **conduct electricity** because the delocalised electrons can flow when a voltage is applied.

The **reactivity series** lists metals from most to least reactive. The more reactive the metal, the faster it reacts with oxygen, water and dilute acid.

Reacts with	Word equation	Example
oxygen	metal + oxygen → metal oxide	magnesium burns with a bright white flame
water	metal + water → metal hydroxide + hydrogen	sodium and potassium react fast; copper does not react
dilute acid	metal + acid → salt + hydrogen	zinc fizzes; copper, silver and gold do not react

Order (most reactive first): potassium, sodium, lithium, calcium, magnesium, aluminium, zinc, iron, tin, lead, copper, silver, gold.

1 Explain why copper wire conducts electricity.

Answer:

2 Write a word equation for the reaction of calcium with water.

Answer:

3 Use the reactivity series to explain why the gold coins in the shipwreck still shine.

Answer:

4 Owen drops a piece of tin and a piece of zinc into dilute hydrochloric acid. Predict which fizzes faster, and name the gas.

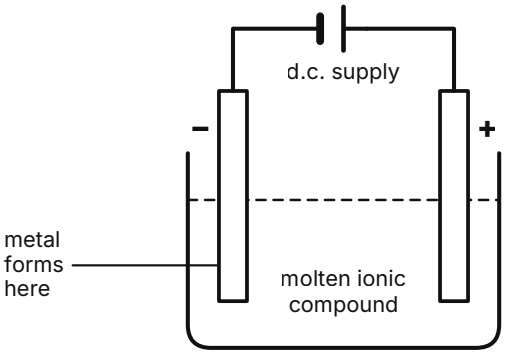
Answer:

❷ Getting metals from ores

Most metals are found joined to other elements in **ores**. Extracting a metal is a **reduction**: the metal ions gain electrons to become atoms. The more reactive the metal, the more energy is needed, so the method depends on where the metal is in the reactivity series.

Method	Used for	How it works
Heat alone	silver, mercury	the oxide breaks down when heated
Heat with carbon or carbon monoxide	copper, lead, tin, iron, zinc	carbon takes the oxygen away from the metal oxide
Electrolysis	aluminium and more reactive metals	electricity splits the molten ionic compound

Gold is found uncombined, so it needs no extraction.



Electrolysis uses a **d.c.** supply, so each electrode always has the same charge and the products can be identified. Positive metal ions move to the **negative** electrode and gain electrons. The compound must be **molten or dissolved** so its ions are free to move.

MAKING A SALT FROM A METAL

Add zinc to dilute sulfuric acid until no more gas is given off (zinc in excess). Filter off the spare zinc, then evaporate the solution to leave zinc sulfate crystals.

1 Iron is extracted by heating iron oxide with carbon. Explain why aluminium cannot be extracted in the same way.

Answer:

2 Explain why a d.c. supply, and not an a.c. supply, is used for electrolysis.

Answer:

3 Give the reason the zinc is added in excess when making zinc sulfate.

Answer:

PRACTICAL 1

Plan it: which metal reacts most with acid?

AIM To place four metals in order of reactivity by measuring the **TEMPERATURE RISE** when each reacts with dilute hydrochloric acid.

1 Variables

I will change the independent variable	
I will measure the dependent variable	
I will keep the same controlled variables (give three)	

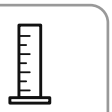
2 Prediction

I think the order will be .....

because .....

3 Equipment

Tick the equipment you need. Not everything here is useful.



☐ **Measuring cylinder**



☐ **Thermometer**



☐ **Polystyrene cup in beaker**



☐ **Balance**



☐ **Spatula**



☐ **Eye protection**



☐ **Burette**

4 Stay safe

The first row is done for you. Add two more hazards.

Hazard What could cause harm?	**Risk** What could happen?	**Control** How will I stay safe?
Dilute hydrochloric acid (1.0 mol l^{-1}) is low hazard but can sting eyes and cuts	It could splash into your eyes	Wear eye protection; wipe up spills; rinse skin with water.

Method and results

5 Write your method

1. What volume of acid will you use, and how will you measure it?

2. How will you make sure each metal sample is the same?

3. When will you read the thermometer? How will you find the temperature rise?

4. How many repeats will you do? How will you work out the mean?

6 Results

Complete the headings, including units.

				Mean rise

NO LAB TODAY? USE THESE RESULTS

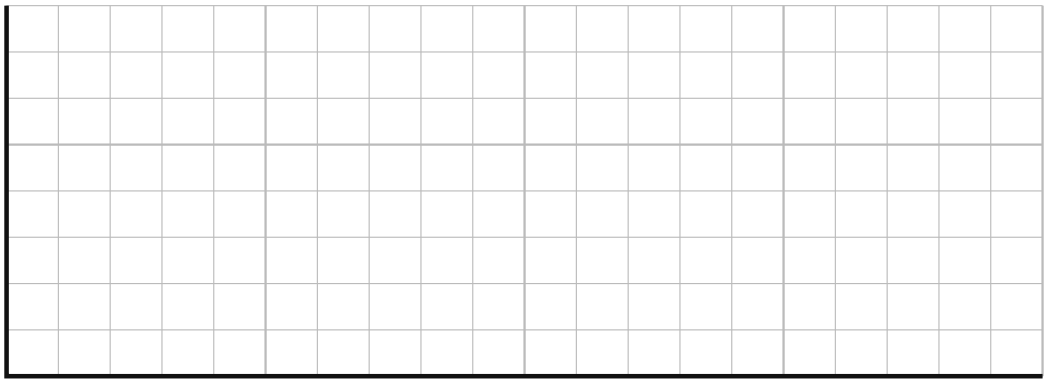
Metal	Rise 1 (°C)	Rise 2 (°C)	Rise 3 (°C)	Mean rise (°C)
magnesium	18.6	19.2	18.3	
zinc	4.2	3.8	4.4	
iron	2.1	2.5	2.0	
copper	0.0	0.1	0.0	

0.50 g of metal powder (magnesium as ribbon pieces) added to 25 cm^3 of 1.0 mol l^{-1} acid in a polystyrene cup. Work out the means yourself (1 decimal place).

Analyse and evaluate

7 Draw a bar graph

Draw a bar graph of mean temperature rise for each metal. Choose your own scale and label both axes, with units.



MEAN AND RELIABILITY

Repeat each test, leave out any result that is clearly wrong (an outlier), then add the rest and divide by how many there are. Repeats that agree closely make the result more reliable. For zinc: (4.2 + 3.8 + 4.4) ÷ 3 = 4.1 °C.

8 Conclusion

The order of reactivity, most reactive first, is .....

.....

9 Evaluate

a Why is a polystyrene cup used instead of a glass beaker?

Answer: .....

b Magnesium was used as ribbon, not powder. Explain why this makes the comparison less fair, and suggest an improvement.

Answer: .....

.....

ASSIGNMENT LINK

For an assignment you could compare your order with a reactivity series from a textbook or website, and give a reference for that source (title, author or organisation, and date).

FREE SAMPLE

Chemistry in Society (N5 Chemistry)

This sample shows a few pages. The full printed workbook is available from Amazon.

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