Exercise walk-through

4.2
Reactions of acids and making salts (4.4.2.1–4.4.2.6)

AQA · GCSE · Chemistry

The reactivity of metals

- When metals react, their atoms lose electrons and form a **positive ion** .
- The more easily a metal does this, the more reactive it is.
- The **reactivity series** puts the metals in order: potassium, sodium, lithium, calcium, magnesium, zinc, iron, copper, from most to least reactive.
- Carbon and hydrogen are not metals, but they are included as reference points.

$$\mathrm{Zn(s)} + \mathrm{CuSO_4(aq)} \rightarrow \mathrm{ZnSO_4(aq)} + \mathrm{Cu(s)}$$

Electrolysis

- At the **cathode**, the metal forms if it is less reactive than hydrogen (such as copper). Otherwise hydrogen forms.
- At the **anode**, if the solution contains a **halide** ion (**chloride**, bromide or iodide), the **halogen** forms. Otherwise oxygen forms.
- hydrogen burns with a squeaky pop when a **lighted splint** is held near it;

$$\mathrm{Al}^{3+} + 3\mathrm{e}^- \rightarrow \mathrm{Al} \qquad 2\mathrm{O}^{2-} \rightarrow \mathrm{O}_2 + 4\mathrm{e}^-$$

Sources for this lesson

- AQA, *GCSE Chemistry (8462) specification*, section 4.4, and the required practicals handbook.
- Smithsonian Institution, "The Aluminum Apex of the Washington Monument" (1884 capstone, 100 troy ounces).
- C. M. Hall, US Patent 400,766, "Process of Reducing Aluminium from its Fluoride Salts by Electrolysis" (filed July 1886), and P. Héroult, French patent 175,711 (April 1886).
- Royal Society of Chemistry, *Practical Chemistry*: "Preparing a salt" and "Electrolysis of solutions".

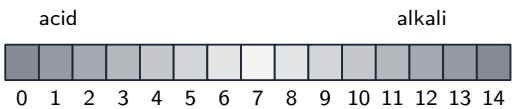
Exercises 2.1·2.2

2.1 Name the salt made when magnesium oxide reacts with hydrochloric acid, and the salt made when calcium carbonate reacts with nitric acid. [2]

magnesium oxide + hydrochloric acid → …

calcium carbonate + nitric acid → …

2.2 Give the pH of a neutral solution, and name the ion that makes a solution acidic. [2]



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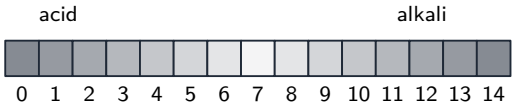
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2.1

- **magnesium chloride**; **calcium nitrate**

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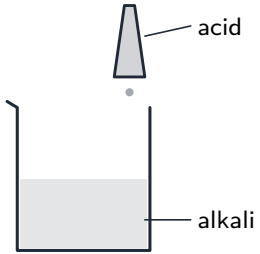


2.2

- pH **7**; the hydrogen ion, $\mathbf{H}^{+}$

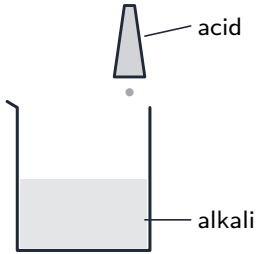
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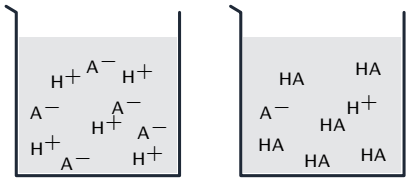


2.3

- $H^+(aq) + OH^-(aq) \rightarrow H_2O(l)$

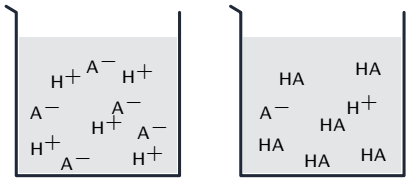
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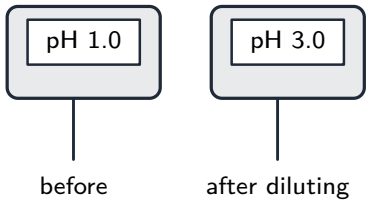


3.1

- a strong acid is completely ionised in water
- a weak acid is only partly ionised
- concentration is the amount of acid in a volume of solution, not how much it ionises

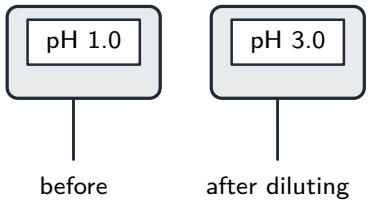
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3.2 Hydrochloric acid of pH 1 is diluted until its pH is 3. Explain how the concentration of H^+ ions changes. [3]



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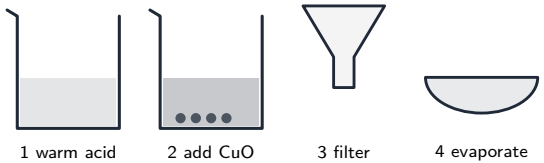
3.2

- each increase of 1 pH unit means the H^+ concentration is 10 times lower
- the pH has increased by 2 units
- so the H^+ concentration is **100** times lower

Exercise 3.3 (a)

3.3 A student makes copper sulfate from copper oxide and dilute sulfuric acid.

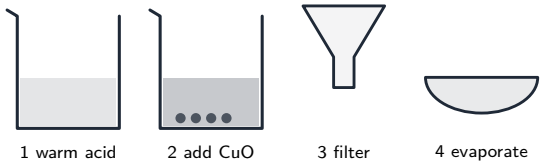
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(a) $CuO + H_2SO_4 \rightarrow CuSO_4 + H_2O$

Exercise 3.3 (b)

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(b) so that all of the acid reacts; the black solid that stays undissolved shows the copper oxide is in excess; the excess is removed by filtering

Exercise 3.3 (c)

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(c) Calculate the maximum mass of copper sulfate that 4.0 g of copper oxide can make. (M_r: CuO 80, $CuSO_4$ 160) [2]

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(c) $4.0 \div 80 = 0.050$ mol, which gives 0.050 mol $CuSO_4$; $0.050 \times 160 =$ **8.0** g

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(d) points to include:

- measure dilute sulfuric acid into a beaker and warm it gently
- add copper oxide a little at a time, stirring, until some is left over
- filter to remove the excess copper oxide
- heat the blue solution in an evaporating basin until about half the water has gone
- leave it in a warm place to crystallise
- pat the crystals dry with filter paper

Levels: **5–6** a full, logical answer with correct chemistry and correct terms; **3–4** several correct points, partly linked; **1–2** one or two relevant points.