**2. Indicators & The pH Scale**

**1. Hazards**

**7.9 – Acids & Bases**

**3. Neutralisation**

**What do I need to be able to do?**

•Define acids and alkalis in terms of neutralisation reactions

•Describe the reactions of acids with alkalis to produce a salt plus water

•Understand the pH scale for measuring acidity/alkalinity; and indicators

•Construct word equations to demonstrate neutralisation reactions

•Identify pH from colour of indicator and vice versa

•Describe the hazards associated with acids and alkalis

A **neutralisation** reaction occurs when an acid and a base are mixed together. A neutral solution is made if you add the right amount of acid and base together.

Neutralisation is an **exothermic** reaction. Hint – See 7.5 Reactions for more on exothermic reactions

***Different types of bases will make different products during neutralisation:***

**Metal oxide + acid 🡪 salt + water**

e.g. copper oxide + sulfuric acid 🡪 copper sulfate + water

**Metal hydroxide + acid 🡪 salt + water**

e.g. lithium hydroxide + sulfuric acid 🡪 lithium sulfate + water

**Metal carbonate + acid 🡪 salt + water + carbon dioxide**

Zinc carbonate + sulfuric acid 🡪 zinc sulfate + water + carbon dioxide

An **indicator** is a substance that **changes colour** when it is added to an acidic or alkaline solution. *Litmus paper and universal indicator are commonly used in the lab.*

Universal indicator is a very useful indicator because it not only tells us if a substance is acidic or alkaline, it can also indicate the **strength.**

•The closer to pH 0 you go, the more strongly acidic a solution is

•The closer to pH 14 you go, the more strongly alkaline a solution is

**Strong** acids and alkalis are **corrosive.** This means that that they can damage or destroy materials, including skin, if they are spilled.

You’ll see this **warning label** on bottles of strong acids and alkalis that we use in the lab.

*To keep ourselves safe from harm we should wash our hands immediately if we get any on our skin, and report spillages to the teacher*

Weak acids and alkalis do not pose much risk. Acids have a **sour taste** so can be used in food e.g. vinegar (ethanoic acid). Alkalis **feel soapy** so are used in toothpaste and shampoos. Even though weak acids are less hazardous, they will still hurt if you get them in your eyes!





**5. Making Salts**

**7. Uses of Neutralisation**

**6. Strength vs. Concentration**

**4. Naming Salts**

Strength and concentration of an acid or an alkali are very often used interchangeably but they are very different!

The **strength** of an acid or an alkali is related to the identity of the substance. Some acids are stronger (hydrochloric acid) than others (ethanoic acid)

**Concentration** of an acid or an alkali is the **Number of particles in a given volume of water**. We can make an acid more dilute, by adding water

Farmers use the base calcium oxide to neutralise acid soils, caused by acid rain

Your stomach contains hydrochloric acid, and too much of this causes indigestion. Antacid tablets contain bases such as magnesium hydroxide and magnesium carbonate to neutralise the extra acid.

Bee stings are acidic. They can be neutralised using baking powder, which contains sodium hydrogen carbonate

Bacteria in your mouth produce plaque acid that can damage your teeth. Toothpaste contains the base calcium carbonate to neutralise the plaque acid.

**To make crystals of the salt, copper sulfate:**

**Copper oxide + sulfuric acid 🡪 copper sulfate + water**

**1.** Warm the sulfuric acid gently using a Bunsen burner – *to increase the rate of reaction*

**2.** Add a spatula of copper oxide to sulfuric acid, one at a time and stir, until no more will dissolve – *this is to ensure all of the acid reacts*

**3.** Pour the mixture through funnel and filter paper – *to remove the excess copper oxide that didn’t dissolve.*

***To name the salt made in neutralisation reactions:***

•Prefix of the name is dependent on the metal used

•Suffix is dependent on the acid used:

|  |  |
| --- | --- |
| **Type of Acid** | **Suffix of salt name** |
| Hydrochloric acid | Chloride |
| Sulphuric acid | Sulphate |
| Nitric acid | Nitrate |

e.g.

**Lithium** oxide + hydrochloric acid 🡪 lithium chloride + water

 Li2O + 2HCl 🡪 2LiCl + H2O

Calcium carbonate + sulphuric acid 🡪 calcium sulphate + water + carbon dioxide

 CaCO3 + H2SO4 🡪 CaSO4 + H2O + CO2



**4.** Transfer the filtered solution to an evaporating dish and evaporate most (but not all) of the water using a Bunsen burner

**5.** Remove from the heat and leave to cool – *crystals will form*



**To see this done**

|  |  |
| --- | --- |
| **Key term** | **Definition**  |
| Volume | The amount of space an object occupies, or that is enclosed in a container  |
| Concentration | Amount of substance per unit of volume |
| Evaporate  | Change of state from a liquid to a gas |
| Corrosive | Causes damage by chemical action  |
| Hazard | A possible danger or risk  |
| Indicator  | A substance or mixture of substances that changes colour to indicate whether a substance is acidic or alkaline  |
| Neutral  | Substances that are neither acidic nor alkaline and have a pH of 7  |
| pH | A measure of the degree of acidity of a substance  |
| Neutralisation | The reaction between an acid and a base to produce products with a pH of 7 |
| Exothermic reaction | Energy is transferred from the reacting molecules to the surroundings. |
| Salt  | Product of a neutralisation reaction.  |
| Base  | Opposite of an acid.  |
| Alkali  | A soluble base |
| Filtration  | Removal of an insoluble solid from a solution. The insoluble solid particles are too big to fit through the tiny holes in the filter paper and so remain on the paper  |
| Rate of reaction | Speed of the reaction. The mass/volume of product made every second  |

**Grasp it**

**Indicators and PH Scale**

1. Why do we use universal indicator more often in the lab, rather than other indicators

2. How would you describe a solution with a pH of 10?

3. How would you describe a solution with a pH of 2?

4. How would you describe a solution with a pH of 6?

**Neutralisation and Naming Salts**

5. Write a full word equation for the reaction between:

a. calcium oxide and nitric acid

b. sodium hydroxide and hydrochloric acid

c. magnesium carbonate and sulfuric acid

d. zinc carbonate and hydrochloric acid

e. nitric acid and iron oxide

6. What acid would you need to use to produce lithium nitrate?

7. Which possible bases could you use to produce strontium chloride?

**Making Salts**

8. Why is the acid warmed to start with?

9. Why is the base added in excess to the acid?

10. Why is copper oxide a base, but not an alkali?

11. Why is the mixture filtered?

12. Why don’t you evaporate all of the water from the filtered solution?

**Strength vs Concentration**

12. Draw a diagram to show a concentrated acid solution and a dilute acid solution

13. Explain why you cannot make an acid stronger by making it more concentrated.

14. Ethanoic acid and carbonic acid are weak acids. Research where you’d find these acids.

**Link it**

**1.** Design an investigation to put 4 different unknown solutions into the order of their pH. Include details of:

* Independent variable
* Dependent variable and how you will measure it
* Control variables
* Safety precautions
* How your results will indicate to you, the order of pH of the solutions

**2**. If 60g of sodium oxide reacts with 73g of hydrochloric acid, what mass of products is produced?

**3.** If 40g of magnesium oxide produces 95g of magnesium chloride and 18g of water when it reacts with hydrochloric acid, what mass of hydrochloric acid reacts?

**4.** Concentration(g/cm3) = mass(g)

 Volume (cm3)

**a.** Calculate the concentration of the hydrochloric acid solution formed when 10g of hydrogen chloride is dissolved in 50cm3 of water

**b.** Calculate the concentration of the sulphuric acid solution formed when 250g of hydrogen chloride is dissolved in 1000cm3 of water

**c.** Which is the most concentrated solution?:

- 60g in 300 cm3

- 50g in 200 cm3

**5. A student plans a method to prepare pure crystals of copper sulfate.**

The student’s method is:

1. Add one spatula of calcium carbonate to dilute hydrochloric acid in a beaker.

2. When the fizzing stops, heat the solution with a Bunsen burner until all the liquid is gone.

**The method contains several errors and does not produce copper sulfate crystals.**

Explain the improvements the student should make to the method so that pure crystals of copper sulfate are produced.

**Know it**

**Hazards**

1. What hazard symbol would you find on a bottle of hydrochloric acid in the lab?

2. How can we keep our self safe when using acids and alkalis in the lab?

3. Why are we able to eat some acids?

**Indicators and PH Scale**

4. Define the term ‘indicator’

5. Which indicator do we use mostly in the lab?

6. What pH indicates a neutral solution?

7. If a substance has a pH of 1, what type of substance is it?

8. If a substance has a pH of 14, what type of substance is it?

**Neutralisation**

9. Define the term ‘neutralisation’

10. Define the term ‘salt’

11. What additional product is made when using a metal carbonate as the base?

**Naming Salts**

12. Name the salt produced when lithium oxide and hydrochloric acid react together

13. Name the salt produced when calcium hydroxide and sulfuric acid react together

14. Name the salt produced when tin carbonate and nitric acid react together

**Making Salts**

15. Name the base needed to make copper sulfate crystals

16. Name the acid needed to make copper sulfate crystals

17. Define the term ‘filtration’

**Strength vs Concentration**

18. Define the term ‘concentration’

19. Describe how we can reduce the concentration of an acid or an alkali