Whitstone School
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Science Home Learning Task

Year 8

Acids and alkalis

Name ______________________________

Tutor Group ______________________________

Teacher ______________________________

Given out: Monday 4 November Hand in: Monday 11 November

Parent/Carer Comment
Staff Comment
Target

Investigating science

Welcome to your Science homework booklet. This booklet is designed to give you some extra practise in the "acids and alkali" section of the course.

You need to carry out tasks **1, 2, 3, 4 and 5. Try task 6 for a house point.**

Don't forget to ask a parent/carer to sign the box on the front.

<u>TASK 1</u> - Reading task

In modern chemistry, we have a sound understanding of acids and bases (also called alkalis). Acids and bases pervade our lives, from the laboratory to the kitchen, and these crucial substances are used as laboratory reagents, industrial catalysts, food additives, and in cleaning products. However, over the course of the history of chemistry, it took centuries to understand these substances fully.

During the time of the Ancient Greeks, the properties of acids and bases were only vaguely understood. During their attempts to categorise substances and try to bring balance, harmony, and perfection to the universe, they used a variety of tests to distinguish compounds. One of these was taste, and they divided substances according to whether they were sour, bitter, salty or sweet. As the Greek influence waned and their knowledge passed on to the Romans, they began to refer to sour substances, such as vinegar or lemon juice, as acids. The words 'acid' and 'acetic,' are both derived from the Latin word for 'sour-tasting,' *acere*. Bases, by contrast, were not as well studied, although they were recognized as substances that would neutralize acids, something that fitted well with the desire of the ancients to find balance and harmony in everything. The easiest way for the ancients to create bases was to take ashes from a fire, a process well known to the Greeks, who mixed ashes with animal fat to make soap. Many Greeks still use a similar process, using ashes and olive oil to make fine homemade soap. Bases are also referred to as alkalis, a word derived from the Arabic word for 'roasting', although why they later became called bases is unclear. Both words are perfectly acceptable and are often interchanged.

As science moved on through the Islamic Golden Age and the Renaissance, alchemists started to understand more about acids, discovering that stronger solutions could speed up the corrosion of metal and dissolve certain rocks. Medieval and Islamic alchemists had a range of acids and alkalis to choose from e.g. soda (sodium carbonate), sulfuric acid, acetic acid, citric acid, sulfuric acid and aqua regia, a mixture of nitric and hydrochloric acid that could even dissolve gold

In about 1300, a Spanish scholar, Arnaldus de Villa Nova, began to use litmus for studying acids and bases. This compound, extracted from a lichen, had been used as a dye since at least the time of the Vikings, but he was the first known scholar to use it as a test of acidity. This idea was expanded by Robert Boyle (25 January 1627 - 31 December 1691), who found that certain plant derived substances changed color in the presence of acids or bases. One example was syrup of violets, which is blue in a pH neutral environment but turns green when exposed to bases, and red when mixed with acid. These testing compounds opened up a realm of possibility, and chemists could work out which proportion of acids and bases would neutralize each other, allowing them to compare crudely the relative strengths of these substances. During most of the 18th century, when the thermodynamic Theory of Phlogiston held sway, the idea that heat was a separate element contained within combustible materials. Georg Ernst Stahl (October 22, 1659 - May 24, 1734) proposed that acids were all derived from sulphur and that the strength was dictated by the amount of phlogiston; this view would be shattered by the end of the century.

It was not until the time of Antoine Lavoisier (26 August 1743 - 8 May 1794), a brilliant French chemist who attempted to classify elements and understand the nature of heat, that a more systematic study of acids and bases took place. At this time, chemists began to define bases as substances that could neutralize acids to form water and a salt. In 1776, influenced by studies into the properties of gases, Lavoisier tried to isolate the compound in acids responsible for their unique properties. Incorrectly, he proposed that a substance called oxygen was responsible, but his observations led to further studies. The British scientist, Humphrey Davy (1778-1829), better known for his studies into gases, tested the theories of Lavoisier and discovered that oxygen was not the element responsible for the properties of acids. Many acids did not contain oxygen, so he proposed that something else must be responsible. During the Age of Enlightenment, scholars from many different countries contributed to the explosion in scientific endeavor, and the study of acids was no different. In Germany, Justus Frieherr von Liebig (1803-1873), another innovative chemist, instead isolated hydrogen as the element responsible, reasoning that it was the only element common to all acids. The Swedish chemist, Svante Arrhenius (1859-1927), was the next chemist to study acids and bases, proposing that acids and bases gained their properties because of the action of ions in the solution. Despite being shunted aside by his peers as a crank, he was awarded the Nobel Prize in 1903, in a perfect example of how fringe scientists can play a huge role in paradigm shifts. One of the buildings at Stockholm University is named after this great chemist, a fitting tribute. Arrhenius stated that acids are simply substances that add hydrogen cations, H^+ to water. For example, Hydrochloric acid, HCl, adds H^+ and Cl^- ions to water. Conversely, alkalis add hydroxyl ions, OH^-. For example, sodium hydroxide, adds Na^+ and OH^- to the water. The reason that acids and bases cancel each other out is because the H^+ and OH^- ions react to form water, leaving salts behind: $HCl + NaOH \longrightarrow NaCl$ (Table Salt) + H_20 This definition was fairly sound and research into these substances continued.

Questions

1. Find **two words** in the passage that you are unsure about the meaning of and find out what they mean

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   ………
   ………
   ………

2. How did the Ancient Greeks first start to divide substances?

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   ………

3. What did Arnaldus de Villa Nova use an extract of lichen for?

   ………
   ………
   ………

4. What did Georg Ernst Stahl think that all acids were made from?

   ………
   ………

5. What advance was made towards acids in 1776?

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6. Which scientist discovered that hydrogen was the main ingredient in acids and when did they discover this?

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7. Why do acids and bases "cancel each other out"?

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8. In your opinion, why did it take so long and so many scientists to work out the active ingredient in acids and bases?

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<u>TASK 2</u> - Acids and alkalis

Answer each of the questions below.

1. **Acids** and **alkalis** can be found all around us, including the home. Make a list of any **acids** and **alkalis** found in your home in the table below.

Acids	Alkalis

2. Circle the correct **bold** word in the sentences below.

   Acids **taste sour/feel soapy**.

   Some acids and alkalis are **corrosive/correlated**.

   A concentrated solution of an acid is **more/less** corrosive than a dilute solution.

   A concentrated solution has **fewer/more** acid particles per litre than a dilute solution.

3. The concentration of an **acid** or **alkali** is measured by the amount of the solid that is dissolved in 1 litre of water. The more solid, the more concentrated it is.

a) **Solution A** contains 20g of **alkali** in 250cm^3 of water and **solution B** contains 10g of alkali in 500cm^3 of water. Which one is more concentrated? Show your working.

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b) **Solution A** contains 30g of **acid** in 500cm^3 of water and **solution B** contains 15g of **acid** in 250cm^3 of water. Which one is more concentrated? Show your working.

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<u>TASK 3</u> – Indicators and the pH scale

1. The **pH scale** is a measure of how ___________ or __________________ a solution is. An **acid** has a pH from _______ to _________ . An **alkali** has a pH from ________ to ____________. A **neutral** solution has a pH of exactly _______. You can use an ______________________ to find out whether a solution is acidic or alkaline.

2. Carry out the task below on the next page

a) Label the pH chart on the next page from 1-14 and colour it the colours you would expect to see with universal indicator.
b) Add these labels to your chart:

Neutral Weak acid Weak alkali Strong acid Strong alkali

c) Add the following substances to your pH chart in the correct place.

Substance	pH
Bee sting	3.5
Oven cleaner	13.0
Tap water	7.0
Skin	5.5
Toothpaste	9.5
Lemon juice	2.5
Blood	7.5
Vinegar	3.0
Wasp sting	10.0

Your pH chart

<u>TASK 4</u> – Neutralisation

1. What is meant by **"neutralisation"**?

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____

2. How can you **neutralise** an acid?

____

____

____

3. What is the pH of a solution that has been **neutralised**?

____

____

4. Bees and wasps are both insects which use a sting as part of their defence. The pH values of their stings are shown on the diagrams.

Bee, bee sting is pH 2

Wasp, wasp sting is pH 10

Complete the table below to show whether the stings are acidic or alkaline and what colour they would turn universal indicator paper.

	acid or alkaline	**colour of universal indicator paper**
bee sting (pH 2)		
wasp sting (pH10)		

The table below shows five household substances and the pH of each substance.

name of substance	**pH of substance**
bicarbonate toothpaste	8
lemon juice	3
vinegar	4
washing soda	11
water	7

Give the name of **one** substance in the table which would **neutralise** each sting.

(i) bee sting ____

(ii) wasp sting ____

TASK 5 – **Making salts**

Remember - when acids are reacted with different substances, they make a compound known as a **salt**. A salt has two names. The first part depends on the metal involved in the reaction and the second depends on the acid used.

1. **Acids and metals**

   Complete the equations below for the reactions of acids and metals.

a) Metal + acid → ______________ + ______________________

b) Magnesium + hydrochloric acid →

______________________________________ + ______________________

c) Zinc + sulfuric acid →

______________________________________ + ______________________

d) Sodium + hydrochloric acid →

______________________________________ + ______________________

e) Copper + nitric acid →

______________________________________ + ______________________

f) Iron + nitric acid →

______________________________________ + ______________________

2. Acids and bases

Finish the equations below for the reactions of acids and bases.

a) Base + acid → ________________ + ________________________

b) Zinc oxide + hydrochloric acid →

____ + __________________________

c) Sodium hydroxide + hydrochloric acid →

____ + __________________________

d) Copper oxide + sulfuric acid →

____ + __________________________

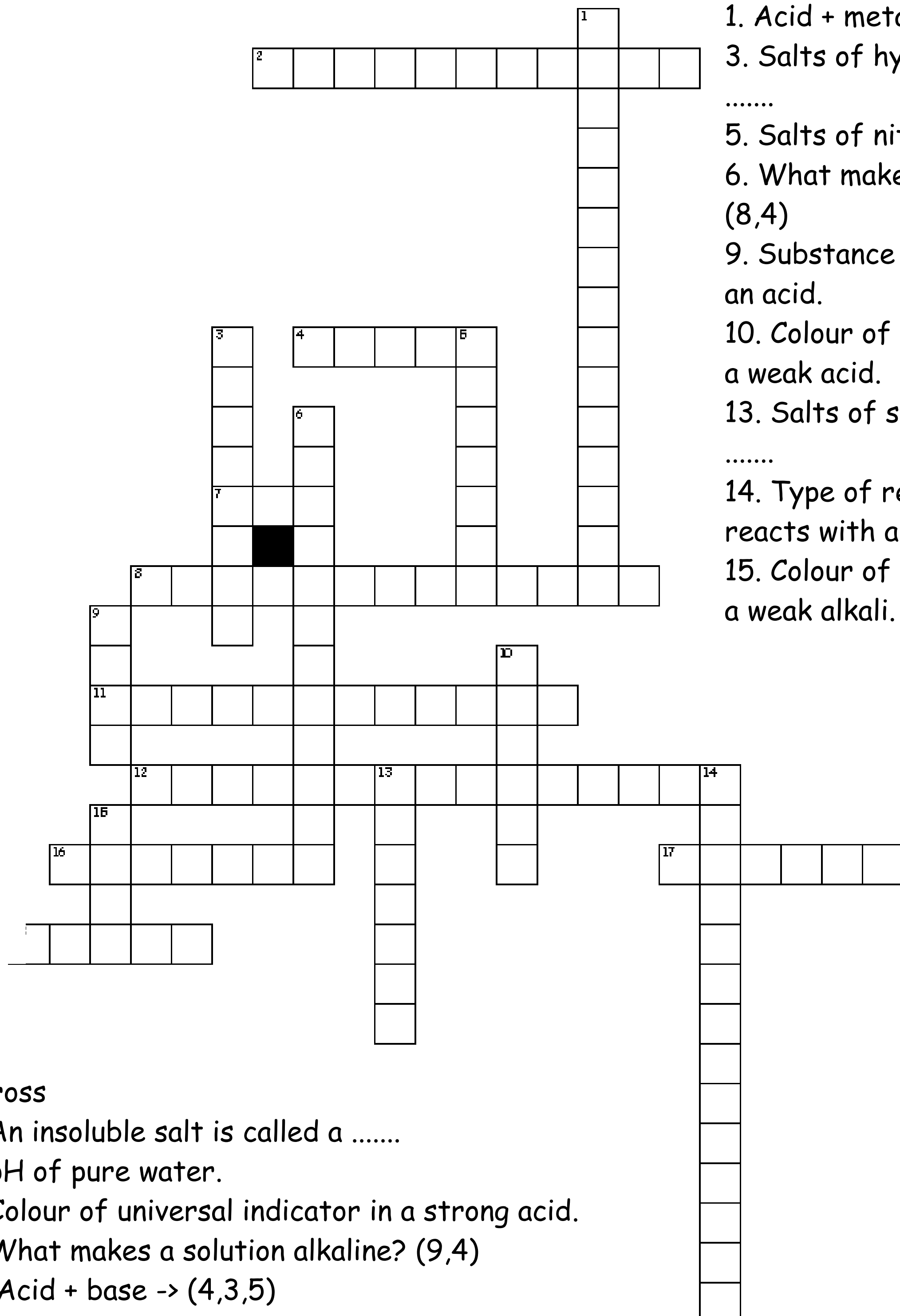
e) Magnesium hydroxide + nitric acid →

____ + __________________________

f) Iron oxide + nitric acid →

____ + __________________________

TASK 6



Down

1. Acid + metal -> (4,3,8)
3. Salts of hydrochloric acid end in ....
5. Salts of nitric acid end in ....
6. What makes a solution acidic? (8,4)
9. Substance that can neutralise an acid.
10. Colour of universal indicator in a weak acid.
13. Salts of sulfuric acid end in ....
14. Type of reaction when an acid reacts with an alkali.
15. Colour of universal indicator in a weak alkali.

Across

2. An insoluble salt is called a ....
4. pH of pure water.
7. Colour of universal indicator in a strong acid.
8. What makes a solution alkaline? (9,4)
11. Acid + base -> (4,3,5)
12. What does (aq) mean? (7,8)
16. Bases that dissolve in water.
17. Colour of universal indicator in a strong alkali.
18. Colour of universal indicator in a neutral solution.