Ideas about acids

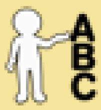
Instructions and answers for teachers

These instructions should accompany the OCR resource 'Ideas about acids' which supports OCR A Level Chemistry B.


AS and A LEVEL
CHEMISTRY B (SALTERS)
Ideas about acids

The Activity:

This worksheet looks at the history of ideas about acids from natural acids, through the erroneous ideas of Lavoisier, to Arrhenius and Brønsted–Lowry theory. The activity also goes beyond the specification to Lewis acid theory. It could be used as an information worksheet with questions or extended to researching each idea further.



This activity offers an opportunity for English skills development.

Learning outcome:

This lesson element relates to the specification learning outcome O(i).

Associated materials:

'Ideas about acids' Lesson Element learner activity sheet.

Introduction

Learners consider ideas about acids and how they have developed in the last 250 years.

Instructions

Learners could simply read the information on the sheet, then answer the questions. Alternatively, they could research a section and prepare a presentation on it, answering the questions as they go.

Answers to questions

1. Ethanol is a primary alcohol. It can oxidise first to ethanol then to ethanoic acid:
   $C_2H_5OH + O_2 \rightarrow CH_3COOH + H_2O$

2. Hydrochloric acid (HCl) is an example of an acid that does not contain oxygen.
   When Lavoisier burnt non-metal elements like sulfur, the oxides were acidic and covalent (often gases) so they turned litmus (held above the jar) red. Metals like magnesium burn to form basic oxides which are ionic, so they have high melting points. If Lavoisier had put the litmus at the bottom of the jar, it would have turned blue.

3. Electrolysis of acids would have produced hydrogen at the cathode:
   $2H^+ + 2e^- \rightarrow H_2$

4. From Arrhenius's ideas, water would be formed when acid reacts with base:
   $H^+(aq) + OH^-(aq) \rightarrow H_2O(l)$

5. The pH scale uses $-\log[H^+]$ because Sorensen found that the voltage in the electrochemical cell was proportional to the log of the hydrogen ion concentration. To find out more, look up the Nernst Equation.

   Universal indicator is a mixture of three indicators (thymol blue, bromothymol blue and bromocresol green) which change colour at different pHs so giving a range of colours.

6. The proton (the positive particle in the nucleus of hydrogen and other atoms) was not discovered and named until the early 1900s.

7.

NH_3	+	HCl	$\rightleftharpoons$	NH_4^+	+	Cl^-
conjugate base 1		conjugate acid 2		conjugate acid 1		conjugate base 2

   According to the Brønsted–Lowry definition, this makes NH_4^+ a conjugate acid and Cl^- a conjugate base.

8. Acid is the opposite of base, acceptor the opposite of donor and a negative electron the opposite of a positive proton. However, Lewis defines a base as an electron ***pair*** donor; this brings ligands and nucleophiles into the definition.

9. Chloric(VII) acid, $HClO_4$, is one of the strongest acids. It is 99.9999% ionised. Hydrochloric acid is a thousand times weaker: it is only 99.9% ionised. The difference in ionisation is small. Chloric(VII) acid is also a very powerful oxidising agent. Chemists have now made a range of 'super acids' like carborane acid $H(CHB_{11}Cl_{11})$; these are even stronger: 99.99999999% ionisation. But this makes very little difference to their pH. Their higher strength is simply caused by the higher stability of their conjugate base.