Catalysis of the Zinc-Acid Reaction

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2.1.6 pH

The pH scale is composed of two extremes that describes a chemical property about the substance being tested, these extremes are called acids and bases. Mixing acids and bases together will induce a neutralisation reaction which can cancel out their extreme effects. A substance which is neither acidic nor basic is called a neutral substance. The pH scale ranges from 0 to 14, with 0 being as acidic as possible and 14 being as basic as possible. Neutral has a corresponding pH of 7 and therefore anything below 7 is acidic and anything above 7 is basic. The pH scale is illistrated below.

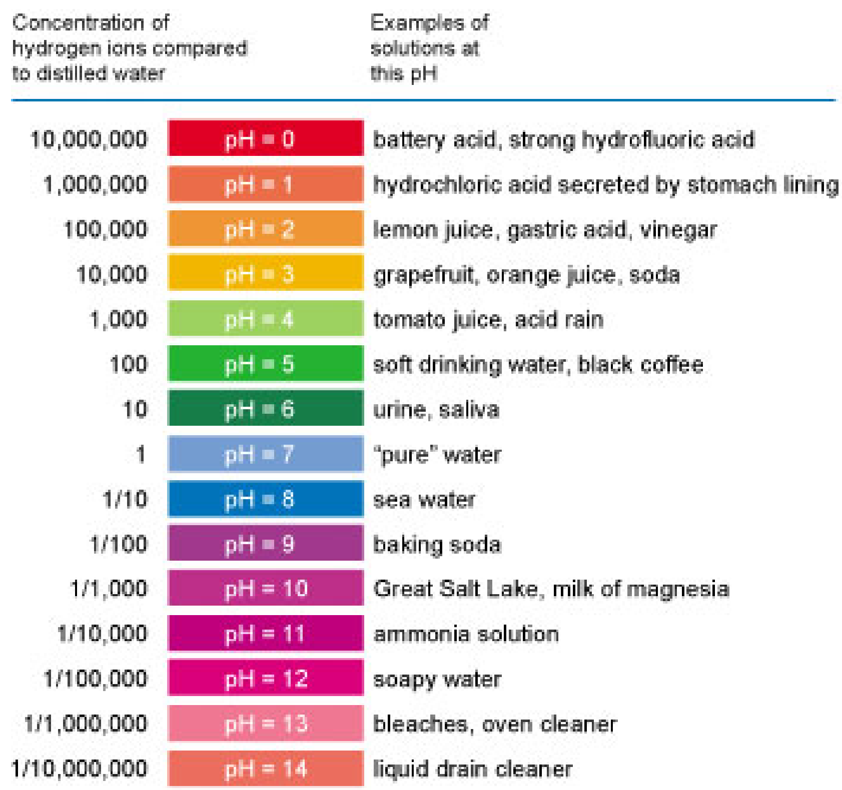

Figure 2.1: The pH scale

The pH scale is a man made scale which is used to measure the concentration of hydrogen ions, each concentration is given a corresponding place on the scale (pH). pH is mathematically defined as the negative logarithm of the hydrogen ion concentration. As a result of this we can determine that the pH scale is logarithmic, therefore each value above/below the neutral value (7) is ten times more basic/acidic respectively. For example pH 6 is ten times as acidic as pH 7 and pH 5 is one hundred times as acidic than pH 7. The mathematical equation for working out pH is illistrated below.

- $pH = -log[H^+]$

There are many indicators used to find out the pH of substances. A table of common indicators with their properties are displayed in the table below.

Indicator	Low pH color	Transition pH range	High pH color
Thymol blue (first transition)	Red	1.2 – 2.8	Yellow
Methyl red	Red	4.4 – 6.2	Yellow
Bromothymol blue	Yellow	6.0 – 7.6	Blue
Thymol blue (second transition)	Yellow	8.0 – 9.6	Blue
Phenolphthalein	Colorless	8.3 – 10.0	Fuchsia

Figure 2.2: List of pH Indicators

Universal indicator contains all of the chemicals above, all mixed into a single solution or into universal indicator paper. This allows for a continuous color change from about pH 2 to pH 10. Visual comparison of the colour of the universal indicator and a standard colour chart give a rough reading of the pH of the substance being measured, usually to the nearest whole number.

2.1.7 Acids

The Brønsted–Lowry theory defines an acid as a proton (H^+) donor.

-Weak/strong (organic/inorganic) (dissociation) -Low conc/High conc

2.1.8 Catalysts

2.1.9 Enthalpy Level Diagrams

2.1.10 Transition Metal Catalysts

2.1.11 D-Orbitals

2.1.12 Complexes and their Properties

2.2 Inventory

2.2.1 Equipment List

- 250 cm^3 conical flask.
- Bung fitted to a glass tube.
- Burette.

2.2.2 Chemical List

- Distilled Water.
- 0.20 mol dm$^-$3 Copper Sulfate $_(aq)$.
- 1.0 mol dm$^-$3 Sulfuric Acid$_(aq)$.
- Granulated Zinc$_(s)$.
- Mixture of Different Catalysts.

2.3 Methods

2.3.1 Chosen Method

Setting Up

1. Fill the Burette with distilled water.
2. Fit the bung (fitted with glass tube) into the conical flask.
3. Fit the inverted Burette to the end of the glass tube.

Carrying out the Experiment

1. Remove the bung from the conical flask and pour 30 cm^3 of distilled water and 10 cm^3 of sulfuric acid into the conical flask.
2. Weigh out 1.0 g of granulated zinc.
3. Add the measured 1.0 g of granulated zinc to the conical flask.
4. Place the bung back in the conical flask.
5. Record the volume of hydrogen produced in cm^3 every 30 seconds for 5 minutes from the burette markings to 1 decimal place.
6. Repeat the experiment but use 30 cm^3 of copper sulfate instead of distilled water.

Interpreting the Data (as discussed before)

1. Plot a graph of the volume of hydrogen against time.
2. From the graph draw a tangent to the line at the initial point.
3. Calculate the gradient of the tangent by using the equation:
4. The gradient is equal to the rate of reaction.

2.3.2 Justification of Chosen Method

In addition to the method discussed above, there are two other methods which would allow me to carry out my experiment:

- The Gas Syringe Method
- The Mass Change Method

Below, the methods are explained:

Gas Syringe Method

Setting up involves a similar set up to my chosen method, but the gas syringe replaces the burette. This is shown below:

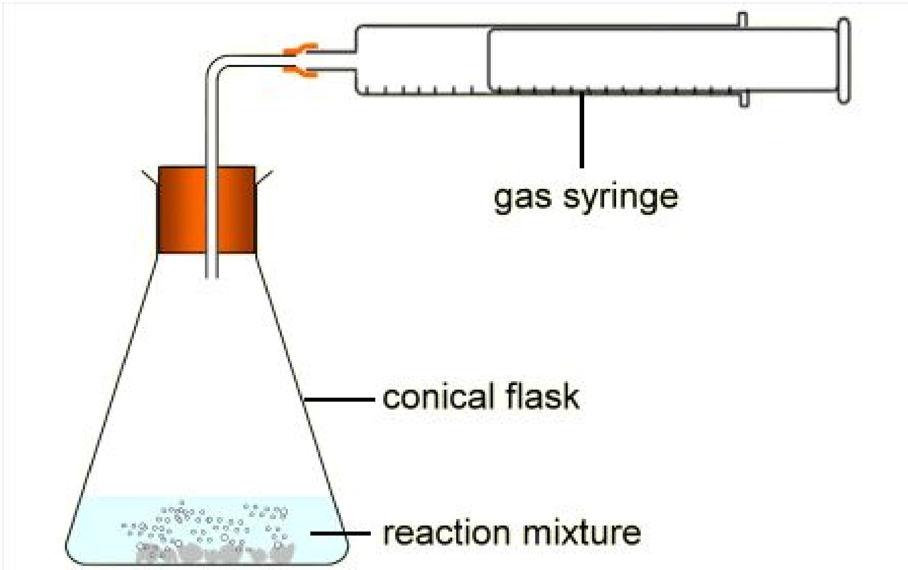

Figure 2.3: Gas Syringe Equipment

Carrying out the method is precisely the same as my chosen method except a reading is taken from the gas syringe instead of the burette. This is precisely the reason I have chosen to not use this method. The gas syringes available to me have graduations every 1 ml, whereas the burrettes available to me have graduations every 0.1 ml. Therefore the accuracy of my readings will be greater using the burette method and consequently I have chosen the burette method ovet the gas syring method.

Mass Change Method

Setting up this method involves:

- Balance (reading to 0.01 g)
- Conical Flask
- Cotton Wool

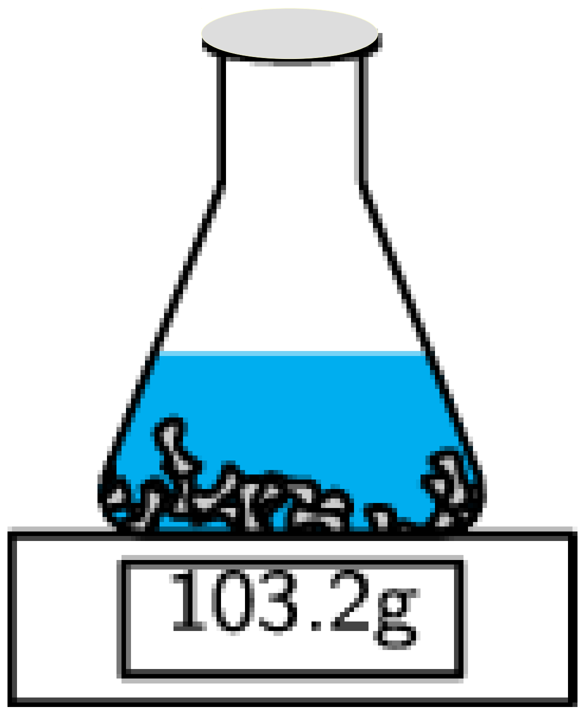

Figure 2.4: Mass Change Equipment

Carrying out this method involves:

1. Zero the Balance.
2. Pour 30 cm^3 of distilled water and 10 cm^3 of sulfuric acid into the conical flask.
3. Take note of the Balance value + 1.0 g
4. Weigh out 1.0 g of granulated zinc.
5. Add the measured 1.0 g of granulated zinc to the conical flask.
6. Place the cotton wool in the conical flask to stop acid 'spray' excaping.

7. Record the loss in mass in grams every 30 seconds for 5 minutes to 2 decimal places.
8. Repeat the experiment but use 30 cm^3 of copper sulfate instead of distilled water.

I have chosen not to carry out this method as the balance will be a lot more sensitive to the environment and there will be room for a lot more human error. For example, left over residue could land on the scales and scew the results during the experiment.

2.4 Risk Assessment

Name of Chemical	**Source of Information**	**Hazards**	**Risks**	**Control Measures**	**Disposal Method**	**Emergency Procedures**
Copper Sulfate (aq)	CLEAPSS Hazcards	• Harmful • Dangerous for the Environment	• Harmful if swallowed • Irritating to eyes and skin	• Do not put near mouth • Use gloves • Use goggles • Keep away from water, unless intended.	Dissolve 64 g in 1 litre of water before pouring the solution down a foul-water drain. This disposal procedure should be kept to a minimum.	Seek medical attention. Wash contaminated area.
Hydrated Copper Sulfate (s)	CLEAPSS Hazcards	• Harmful • Dangerous for the Environment	• Harmful if swallowed • Irritating to eyes and skin	• Do not put near mouth • Use gloves • Use goggles • Label: Harmful, if above 1 $moldm^{-}3$	Crystals may be used for solutions. Dilute to less than 0.4 mol $dm^{-}3$ or dissolve 100 g in 1 litre of water before pouring the solution down a foul-water drain. This disposal procedure should be kept to a minimum .	Seek medical attention. Wash contaminated area.

Sulfuric Acid (aq)	CLEAPSS Hazcards	• Corrosive • Irritant	Causes serious burns	• Label: Irritant, if above 0.5 $moldm^-3$ • Label: Corrosive, if above 1.5 $moldm^-3$ • Wear gloves • Wear goggles	Add slowly no more than 10 cm^3 of concentrated sulfuric(VI) acid to 1 litre of 1 mol dm^-3 sodium carbonate solution (containing indicator) which should be constantly stirred. Let the mixture cool (or add ice), before adding more acid. Pour the solution down a foul-water drain.	Remove contaminated clothing and quickly wipe as much liquid as possible off the skin with a dry cloth before drenching the area with a large excess of water. If a large area is affected or blistering occurs, seek medical attention.
Granulated Zinc (s)	CLEAPSS Hazcards	• Low Hazard	N/A	Place in normal refuse	N/A	N/A

Chapter 3

References

3.1 Sources

- Source 1 -

3.2 Figures

- Figure 2.1 - http://www.heartupdate.com/prevention/ph-body-influence-daily-life_94/ - Accessed 13:01, 09/02/2015.
- Figure 2.2 - Ben Keppie Table - Table made from information from: Foster, Laurence S. and Irving J. Gruntfest, "Demonstration Experiments Using Universal Indicators", J. Chem. Ed., 14, 274 (1937).
- Figure 2.3 - http://www.bbc.co.uk/schools/gcsebitesize/science/add_ocr_gateway/chemical_economics/reaction1rev1.shtml - Accessed 14:20, 09/02/2015.
- Figure 2.4 - http://everythingmaths.co.za/science/grade-12/07-rate-and-extent-of-reaction/07-rate-and-extent-of-reaction-03.cnxmlplus - Accessed 15:19, 09/02/2015.