Appendix B: Experiment protocol[1]

Investigating oxidation-reduction reaction

Introduction

Metals that are above hydrogen in the activity series will displace hydrogen from an acid and produce hydrogen gas. Magnesium is an example of a metal that is more active than hydrogen in the activity series. The reaction between magnesium metal and aqueous hydrochloric acid is an example of a single replacement reaction (a type of redox reaction). The chemical equation for this reaction is shown below:

$$Mg_{(s)} + 2H_3O^+_{(aq)} \rightarrow Mg^{+2}_{(aq)} + H_{2(g)} + 2H_2O_{(l)}$$

In the first stage of this inquiry lab, you will conduct an experiment enabling you to get familiar with this reaction, documenting as many observations as you can. In the second stage, you will choose one variable you are interested in investigating concerning this reaction and plan an experiment to understand its behavior. Lastly, you will conduct your planned experiment.

Phase 1: Getting familiar with the phenomena

Reagents and Supplies

1500 ml Erlenmeyer flask
15 ml centrifuge tube
Lab scoop
1 metric ruler
1 glove
2 Litmus papers
0.8 g of Magnesium (Mg) powder
100 ml of hydrochloric acid (HCl) 1M in a beaker

Procedure

Please note: wear safety goggles and gloves!

1. Use the centrifuge tube to measure 100 ml of HCl 1M and add it to the Erlenmeyer flask
2. Measure the pH of the solution using the litmus paper
3. Use the lab scoop to add the 0.8g of magnesium to the glove
4. Stretch the glove over the mouth of the Erlenmeyer flask until it securely covers the mouth of the flask. During this step, do not allow any magnesium metal to fall into the flask.
5. Shake the glove to let the magnesium powder fall into the Erlenmeyer flask
6. Observe what happens and document your observations
7. After a few minutes, measure the circumference of the glove, and the pH of the solution.

Phase 2: Planning an inquiry-based experiment

1. Formulate at least 5 relevant and varied questions that arise as a result of the observations you have made
2. Choose one of the questions you raised. Formulate this question as the research question
3. Formulate in a clear and concise manner a hypothesis appropriate to the question you have chosen to investigate. Justify your hypothesis on the basis of scientific knowledge
4. Design an experiment that aims to investigate the question you have proposed:
   - Define the dependent and the independent variable.
   - List the constant variables
   - Prepare a detailed list of materials and equipment needed to perform the planned experiment
   - List all the experimental stages, including the control stage

[1] https://stwww1.weizmann.ac.il/heker/?p=288. Translated from Hebrew

Phase 3: Conducting the inquiry-based experiment

1. Present the observations and the results in an organized manner (i.e. table format).
2. Analyze your results and display them graphically.
3. Describe in detail the graphical representation of the results.
4. Draw as many conclusions as possible based on all the results of the experiment.
5. Critically address the results: (a) research limitations, (b) compatibility between the conclusions and the hypotheses, (c) desired changes in the research process.
6. Formulate 1-2 new research questions that arise from the inquiry process