ScienceCube

Transformation of Cola (Oxidation-Reduction Reaction)

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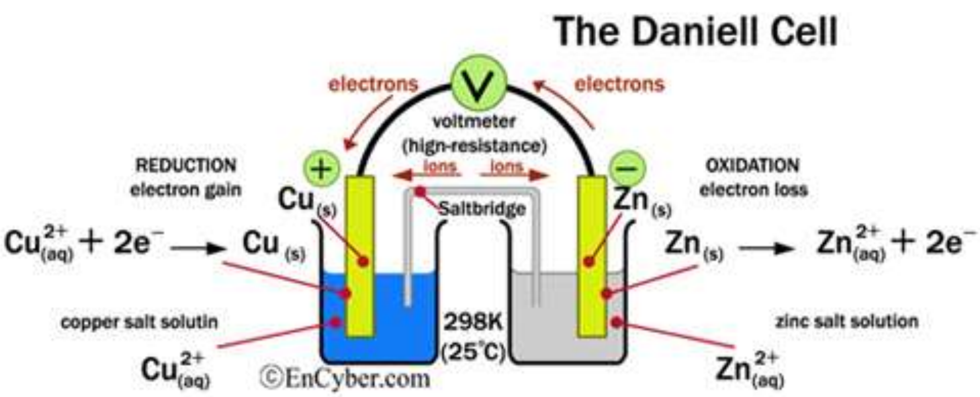
1. **Measure and explain the color change and ORP value change of reduced iodine.**
2. **Write and explain the oxidation-reduction reaction equation between iodine and vitamin solution.**

Fundamental Concept

1. Oxidation-reduction reaction

Oxidation and reduction reactions involve the transfer of electrons between substances. The substance that loses electrons increases its oxidation state and is oxidized, while the substance that gains electrons decreases its oxidation state and is reduced. The number of electrons lost and gained is always equal.

A common example of a redox reaction is in a chemical battery. In a battery made of zinc and copper, zinc loses electrons and is oxidized, while copper gains electrons and is reduced.



$Z_n(s) + Cu^{2+}(ag) \rightarrow {Z_n}^{2+}(\mathrm{ag}) + \mathrm{Cu(s)}$

A substance that reduces another substance while being oxidized itself is called a reducing agent. Conversely, a substance that oxidizes another substance while being reduced itself is called an oxidizing agent. Therefore, the stronger the tendency to gain electrons, the stronger the oxidizing agent, and the stronger the tendency to lose electrons, the stronger the reducing agent.

2. ORP Sensor

An ORP sensor consists of a measuring electrode made of platinum, which is immersed in the solution where the redox reaction takes place, and a reference electrode (Ag/AgCl) that is sealed in a saline solution. The measuring electrode either gives or receives electrons depending on the experimental solution, while the reference electrode maintains a constant output. The ORP sensor measures the difference in voltage between the two electrodes, within a range of -450 to +1100. A negative value indicates strong reducing potential, while a positive value indicates strong oxidizing potential.

Explore Various Careers

‘Water Quality Researcher’

Job Overview

Researchers in water quality work to protect polluted water environments by researching and developing related fields.

Job Duties

Research solutions to minimize and resolve damage caused by water pollution affecting the living environment.
Collect samples of wastewater and investigate the causes.
Analyze the collected data to identify the sources of pollution and develop countermeasures or create machinery.
Review, supervise construction, and address operational issues of pollution prevention facilities.
Experiment with and research facilities, devices, and methods to prevent water pollution.

Required Skills/Abilities

A preference for subjects like chemistry or physics and a general interest in environmental issues and nature are essential.
Analytical skills and systematic thinking are necessary to analyze pollution sources and find solutions.
A broad understanding of environmental science is required due to the wide range of applications.

Education/Qualifications

A degree in environmental engineering, civil engineering, biology, or chemistry from a university is advantageous.
Most employers require at least a bachelor's degree, and some may prefer candidates with a graduate degree.
Employment opportunities exist in environmental construction companies, service companies, environmental impact assessment firms, and research institutes.
The hiring process typically involves document screening and interviews. For government positions, it follows public service recruitment procedures.
Obtaining relevant qualifications like water environment technician certification is common, and with experience, one can acquire a professional engineer's license or start a related business.

Job Outlook

Employment for water quality researchers is expected to increase over the next five years. Strengthened global environmental regulations and heightened environmental awareness will drive sustained growth in the environmental industry.
This industry typically thrives in developed countries and grows with increasing national income and enhanced quality of life, leading to greater demand for environmental conservation.
As the market for environmental solutions expands rapidly, the demand for water quality researchers who measure, research, and provide solutions for water quality improvement will increase..

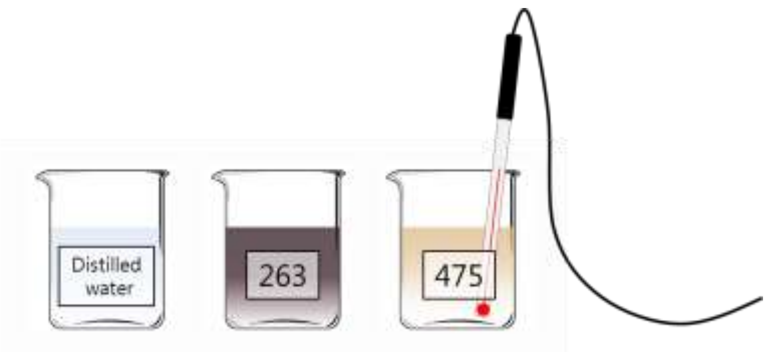
Experiment

Materials Needed

Interface, Science# Program, ORP Sensor, Vitamin Solution (or Vita500), 250 mL Beaker, Iodine Solution (red antiseptic), Distilled Water, ORP Calibration Solution 263, ORP Calibration Solution 475, Sensor Cable, Three 200 mL Beakers

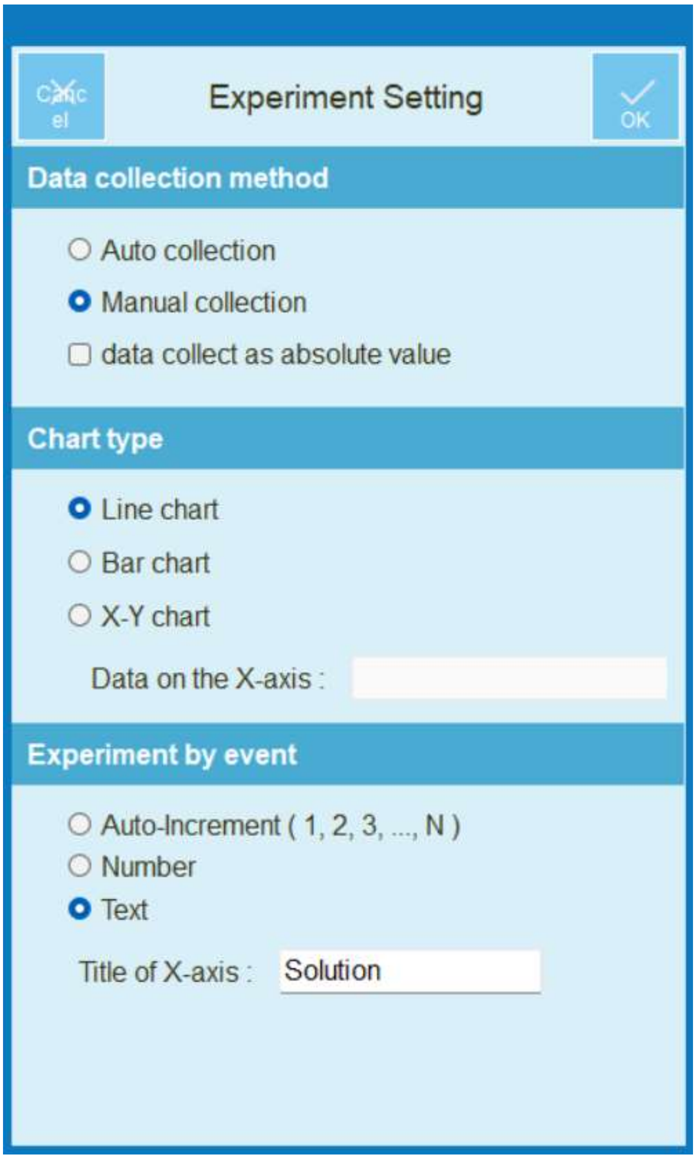
Interface Setup

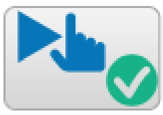
1. Launch the Science# program.
2. Attach the ORP electrode to the sensor and connect it to the interface.
3. Open the ORP electrode cap, wash the electrode with distilled water, and press the calibration button.
4. Immerse the electrode in the 475 ORP solution, and press the calibration button once the value stabilizes.



5. Wash the electrode with distilled water again, then immerse it in the 263 ORP solution, and press  the calibration button once the value stabilizes.
6. Press  the save button to store the calibration values.
7. Press  the settings button to configure the experimental environment as shown below, or use the auto-setup button. 

   [Chart Type: Bar Chart]



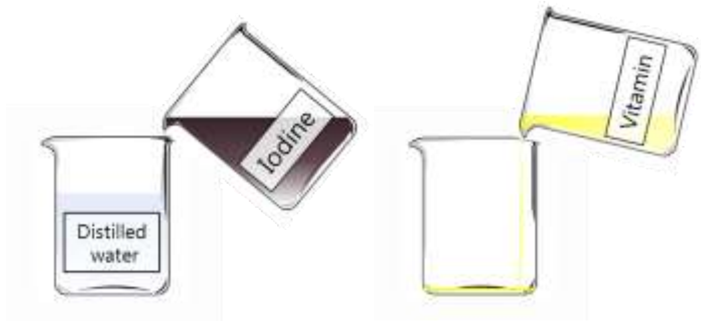


Data Collection

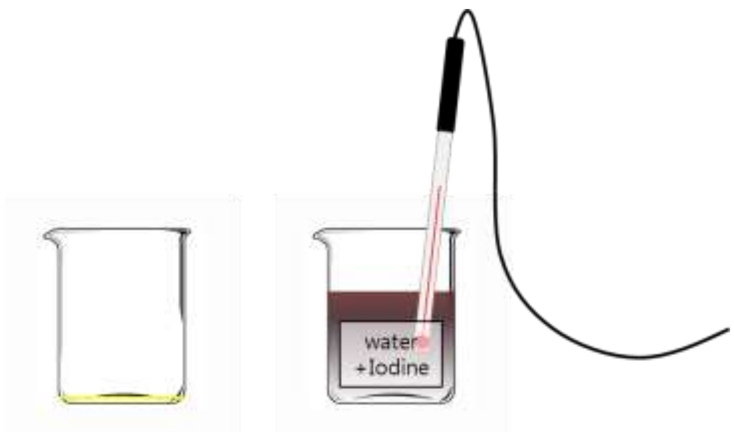
1. Dilute 10 mL of iodine in 200 mL of distilled water to create a solution that resembles

cola in color.

2. Pour about 3 mL of vitamin solution into an empty beaker, just enough to cover the bottom.

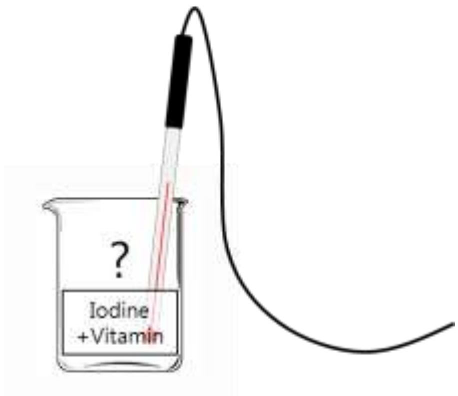


3. Press the button to start data collection..
4. Press the button to measure the ORP value of the iodine solution..
5. Press the button to measure the ORP value of the vitamin solution.



6. Pour the diluted iodine solution into the beaker containing the vitamin solution and observe the color change.

7. Press the button to measure the ORP value of the mixture of vitamin and iodine solutions.



Data Analysis

Recording Data

1. Record and photograph the color of the iodine solution diluted in distilled water

2. Record and photograph the color of the iodine solution added to the vitamin solution.

3. Measure the ORP values of the iodine solution and the iodine-vitamin solution mixture, and plot the data on a graph.

4. Complete the table below with the measured ORP values and the colors of the solutions.

Solution	Iodine Solution	Vitamin Solution	Iodine + Vitamin
ORP			
Color			

Data Application

1. Write and explain the oxidation-reduction reaction equation between iodine and vitamin solutions..

2. Explain the reason for the observed color change when iodine solution is added to the vitamin solution..

3. Describe the damage caused by acid rain and investigate measures related to redox reactions to mitigate these effects.