Conduction of electric current in liquids

Method: Connect all the things as shown in the fig. A. A gap is left between the ends of crocodile clips A and B, so no electricity flows in this open circuit and hence the bulb does not glow. C: UsersAdministratorAppDataLocalTempwzaca6Untitled-2. jpg

The arrangement shown in the fig. A is used to find out whether an object or material conducts electricity or not. Fig. A

Caution: While testing a tester its free ends may not be joined for more than a few seconds, as this may drain the cells of the battery very fast Before using a tester it may be checked whether the tester is working or not. For this, the free ends of the tester may be joined together for a moment. This completes the circuit and thus the bulb should glow. If it doesn’t glow it means the tester is not working. Some of the possible reasons for the tester not working may be:

- Loose connections
- Fused bulbs
- Cells are used up

Therefore, in case if tester is not working first check that if the connections are tight. If they are, replace the bulb with another bulb. If still the tester is not working, replace the cells with fresh cells.

Content – 1. 1

It deals with conduction of electric current in liquids. The topic may be introduced by asking students to cite various examples of liquids. Samples of a few liquids out of the list which are conveniently available may be collected. Activity 1. 1 may be conducted in the class. The students may be

asked to fill the observation table. The contents of the table may be modified according to the availability of the samples.

Caution: Use only electric cells for the activities. We should not experiment with the electric supply from mains, inverter or generator. The students may be explained that when the liquid between the two ends of the tester allows the electric current to pass, the circuit of the tester becomes complete and the bulb glows.

Note: In some situations the liquid may be weakly conducting but the bulb may not glow. This is because if the current through the circuit is too weak, the filament of the bulb does not get heated up sufficiently and thus it does not glow.

The students may be informed that another effect of electric current can be used to make a tester. Electric current produces magnetic effect. A deflection in the compass needle can be seen even if a small amount of current flows in the wire. Thus, magnetic effects of current can be used to make a tester.

Light emitting diodes (LED) glow even when weak current flows through it. They can be a good source of electric current as they consume less electricity and have a longer life. But they are expensive and hence replaced by CFL’s The tray from a discarded matchbox may be taken and a small compass needle may be placed inside it. An electrical wire may be wrapped a few times around the tray. One free end of the wire may be connected to the terminal of a battery. Another piece of wire may be taken and joined to the other terminal of the battery. The free ends of the two wires may be

joined momentarily to see the deflection in the compass needle. This tester may be used to detect even a weak current.

Activity 1. 1 may be conducted again using a magnetic tester.

Content- 1. 2 deals with introduction of electrodes and electrolytes. The students may be explained the importance of electrode and electrolytes. Few pictures of electrodes are shown in the students' manual. Many more types of electrodes can be shown to them.

The term electrolyte may be introduced. Chemically, electrolytes are substances that become ions in solution and acquire the capacity to conduct electricity. Electrolytes are also present in the human body, and the balance of the electrolytes in our bodies is essential for normal function of our cells and our organs.

While describing weak/strong electrolytes, concept of Acids, bases and salts can also be explained.

Arrhenius concept of acids and bases may be explained. According to the concept, acid is a substance which gives hydrogen ions in solution while base is a substance which gives hydroxide ions in solution.

The students may be made to recall that neutralisation reaction between an acid and a base leads to the formation of salt. For example Sodium chloride is formed by the reaction between Hydrochloric acid and Sodium hydroxide.

Salts are of three types: Acidic, basic and neutral.

The terms ‘ dilute’ and ‘ concentrated’ ; ‘ strong’ and ‘ weak’ related to the electrolytes may be clearly explained to the students.

Extended learning

Students may be given a little idea of identifying an acidic, basic or neutral solution using a litmus paper/ pH paper. Acidic solutions turn blue litmus red while bases turn red litmus blue. Salts remain neutral towards litmus.

pH of an acidic solution is less than 7, pH of a basic solution is greater than 7 while pH of a neutral solution is 7. A few samples may be tested and identified as acids, bases and salts.

Content- 1. 3

After the students have clearly understood the concept of acids, bases and salts, content 1. 3 may be introduced.

Small amounts of mineral salts naturally in water are beneficial for human health but they make water a good conductor. Thus electrical appliances should not be handled with wet hands Activity 1. 2 may be conducted. Before testing the conductivity of acids, bases and salts, the teacher may take a little distilled water in a beaker and test its conductivity using a tester. It would be observed that the bulb does not glow. The teacher may now add a little salt to water and ask the students to observe.

After this the conductivity of various acids, bases and salts may be tested. The students may be asked to observe carefully the glow of the bulb. If the bulb glows brightly, the electrolyte is strong while the electrolyte is weak when the bulb’s glow is dim.

Worksheet 1 may be discussed with the students.

CONTENT – 1. 4

The teacher may explain to the students that in chemistry some reactions may proceed either naturally or on supplying heat.

The students may be asked to recap the previous knowledge on physical and chemical change.

Why boiling of water results in a physical change?

Boiling of water is a physical change because the chemical composition of water remains unchanged.

There are other reactions which are forced to occur by supplying energy with an external source e. g. electric current.

The chemical composition of water may be introduced. The teacher may explain that breaking water (compound) into its constituent elements (i. e. hydrogen and oxygen) can be achieved by passing electric current and the process will be a chemical change.

Electrolysis may be defined.

The use of electrolysis may be discussed. For example electrolysis is used to produce and refine metals for industries, making jewelleries, protecting metal from corrosion etc.

The diagram of an electrolytic cell may be used to explain the mechanism of electrolysis and the different types of electrodes used for the same.

The class may be divided into four groups. Each group may be asked to list the substances as follows:

- Group I: Solids which are good conductors of electricity
- Group II; Solids which are poor conductors of electricity
- Group III: Liquids which are good conductors of electricity
- Group IV: Liquids which are poor conductors of electricity.

The results may be discussed.

Activity – 3A & 3B may be demonstrated

Though it is not a practical way to light up our home, electricity may be generated from fruits. The teacher may help the students to create a fruit battery by demonstrating Activity- 3C which may be performed with different fruits to observe the varied results. While collecting the different samples for the fruit battery experiment it may be kept in mind that it is just a test. Part of the fun of science is trying different methods some may work others may not – that’s all part of the learning process. Students may be involved in the decision making.

NOTE:

The students may be made aware of the corrosive nature of dilute acids, the combination of electricity and aqueous solution during electrolysis. Suitable precautions must be taken to ensure safe use.

Any D. C. power supply giving 8 – 12 V is safe.

Recently, some laptop computers come with rechargeable lithium ion batteries, (LIBs). Electrolysis played an important part in the research and development of these batteries.

CONTENT – 1. 5

The teacher may ask the students to name the valuable metals they are aware of.

The teacher may take the example of gold , silver etc. which are valuable metals and explain to the students that the products made from these metals in their pure form are either too expensive or lack the strength or hardness.

This problem can be overcome by using a relatively inexpensive yet strong metal and then coating it with another metal.

Teacher may now define Electroplating and explain that electroplating is a form of preservation where electricity is used in the coating process. The coating may be purely decorative or it can help protect against corrosion.

Electroplating is both an art and a science. Although based on several technologies and sciences it retains in some ways the aspects of an art, in which experience is the only teacher.

Electroplating is an important industrial process today.

The following electrolytic cell may be used to explain the process of electroplating a metal with another metal.

http://upload. wikimedia. org/wikipedia/commons/thumb/b/b6/Copper_electroplating. svg/220px-Copper_electroplating. svg. png

Electroplating of a metal (M) with Copper in a copper bath.

Activity -4 may now be demonstrated.

The teacher may discuss the importance of Electroplating. The following uses may be discussed:

It makes the material more resistant to damage.

Zinc or Aluminium plating can protect an item from corrosion.

It can improve the appearance of the metal.

e. g. Chromium plating is done on many objects such as car parts, bath taps, kitchen gas burners, wheel rims etc.

Gold is often plated on silver or less expensive metal to reduce the cost of jewellery.

With examples of electroplating all around us, the students may be asked to list the objects they come across which have been electroplated.

Inquiry-based laboratory work can improve student learning of chemistry. The students may work in groups and conduct the experiment to plate an object, for example a spoon or an iron nail.

CONTENT 1. 6

The teacher may ask the students to list the uses of copper and discuss them. The following uses of copper may be discussed: copper is widely used in:-

- Electrical wiring
- Domestic plumbing
- Boilers and heat exchangers

In the production of metals, initially impure metal is obtained.

(The blister copper obtained is virtually 99% pure)

The following question may be asked.

What is the need to purify the copper metal obtained after the extraction of copper from its ore?

The teacher may bring to the notice of the students that impurities greatly reduce the copper metals conductivity. An even small concentration of impurities lower’s the electrical conductivity of copper.

High degree of purity can be obtained by Electro-refining (Electrolytic refining)

Electro-refining may be defined and the process can be explained by the following set up:

http://4. bp. blogspot. com/-uSDsEkrPuEA/TgyalqI7D-I/AAAAAAAAAIs/W3U99uk5aKc/s400/Metallurgy_clip_image001_0001. gif

It may also be brought to the notice that the impurities in the electro-refining of copper are very precious for example gold, silver, platinum etc. which help to overcome the cost of refining.

Worksheet 2 may be discussed with the students.

The teacher- learning of the complete unit thus requires a number of demonstrations, hand on activities and use of visual aids for effective delivery of the content. Teaching can be made more effective by showing video clippings of electrolysis, electroplating and their applications. Additional use of web links can further enrich the quality of teaching.

Sample worksheets are given at the end of this manual. Worksheets 3, 4, 5 may be discussed with the students. The various thought provoking questions can strengthen the concepts of the students. Similar worksheets may be designed.

SOLUTIONS TO WORKSHEETS

WORKSHEET 1

1. Name of the substance

Whether bulb glows weakly strongly?

Strong/weak electrolyte

1. Hydrochloric acid

Strongly

Strong electrolyte

2. Carbonic acid

Weakly

Weak electrolyte

3. Ammonium hydroxide

Weakly

Weak electrolyte

4. Sodium chloride

Strongly

Strong electrolyte

5. Potassium hydroxide

Strongly

Strong electrolyte

2. Salt Sodium chloride behaves as a strong electrolyte in the molten or aqueous state, when it dissociates into its ions. It does not conduct in solid state.

3. The bulb glows in case of Hydrochloric acid which shows that it conducts electricity as it completely dissociates into ions.

The bulb glows feebly in case of acetic acid which shows that it is not a very good conductor. It dissociates into its ions partially.

Thus HCl is stronger acid than acetic acid.

4. 1. f

2. c

3. d

4. a

5. b

6. e

5. Pencil cells (electric cells)

It is not safe to use generator, inverter or electric supply from mains.

6. (a) Bulb does not glow in case of distilled water as it does not contain ions.

(b) Impurities in the form of soluble salts eg. Sodium chloride, Magnesium chloride etc. may be added.

(c) Salts when added to water dissociate into ions which carry current and hence help in its conduction.

7. Vinegar contains acetic acid while lemon juice contains citric acid. Both the acids are weak acids. The conduction of current is poor. In contrast, hydrochloric acid is a strong acid which dissociates completely into its ions and hence the bulb glows brightly.

WORKSHEET 2

Chemical

Electrochemistry

Anode

Good

Poor

Following are some of the chemical effects of electric current:

Bubbles of a gas may be formed on the electrodes.

Deposits of metal may be seen on the electrodes.

Change in the colour of the solution may be observed.

An electrolyte is a substance which conducts electric current in the aqueous or the molten state.

A = Hydrogen gas

B= Dilute sulphuric acid

C= Container

D= Oxygen gas

Electrode

Volume of the tube filled

Identify the gas

Positive

Oxygen

Negative

Hydrogen

Electrolysis of water is a chemical change because water breaks down into its constituent elements hydrogen and oxygen.

Pure water is a poor conductor of electricity; therefore dilute sulphuric acid is added to make it a good conductor.

No, like many conductors, a lemon can conduct because it is very acidic, but it cannot produce electricity of its own.

Anode : Iodine gas

Cathode: Hydrogen gas

WORKSHEET 3

Electroplating

Negative

Negative

During the electrolytic refining of copper impurities from the anode settle down at the bottom of the anode and are called anode mud.

It is the process by which metals containing impurities are purified by electrolysis to obtain the pure metal.

Aqueous solution of copper sulphate.

Impure rod of copper metal

A pure thin strip of copper.

Cathode

Anode

Silver

Electrolyte

Ions

Anions

http://chemistry58. wikispaces. com/file/view/250px-Electroplating-of-spoon. png/204888904/250px-Electroplating-of-spoon. pngchemistry58wikispaces. com

Following are the uses of Electroplating

It is used to protect the metal by providing a protective coating of another metal.

It is used to alter the appearance of the metal.

WORKSHEET 4

Electrolytic cell.

LED

Ions.

Positive

H2O

(d)

Following are the applications of electrolysis:

Electroplating

Electro-refining

Electro-metallurgy (the process of extraction of metals from its ore by electrolysis)

Two volume of hydrogen gas and one volume of oxygen gas (2: 1).

The compound is placed in an electrolytic cell, if the bulb connected to the cell glows brightly it is a strong electrolyte and if it glows dimly it is a weak electrolyte.

Following are the conditions required for electrolysis to take place:

Source of electric current (direct current)

Electrodes

Electrolyte (in solution or molten state)

– (2)

– (1)

– (4)

– (3)

WORKSHEET 5

Weak electrolyte dissociates partially into its ions. Thus a weaker conductor. Strong electrolyte dissociates completely into its ions which carry electric current and thus makes it a good conductor.

Concentrated solution means the amount of solute is more in the solvent while in a dilute solution the solute is present in lesser amount. Conductivity depends on nature of solute.

Strong electrolyte dissociates completely into ions, thus a good conductor while a weak electrolyte dissociates partially and thus a weak conductor.

No, all substances possess some conductive properties. Generally organic compounds (such as benzene, alcohols, and petroleum products) have very low conductivities, while metals have very high conductivities.

Plastic/rubber covers are poor conductors of electricity, thus prevent the electrician from getting electrical shock.

Anode: Thick block of impure metal M

Cathode: Thin strip of pure metal M

Electrolyte: Acidified solution of water soluble salt of metal M.

Beaker D < Beaker C < Beaker A < Beaker B

There are many chemical hazards when chrome plating because the procedure uses a process called acid baths. An acid bath occurs when the object is placed in chemicals that include hydrochloric, nitric-hydrofluoric and sulfuric acids that clean surfaces. These chemicals may cause corrosion of the skin and damage to the eyes. These chemicals can also release vapors that can cause severe burns and damage to the throat, lungs and other internal organs. Chromium(V) is carcinogenic in nature.