ELECTROLYSIS

Key Words and Definitions:

compound – composed of two or more substances, ingredients, elements, or parts

electrolysis – chemical change, especially decomposition, produced in an electrolyte by an electric current.

electrolyte – a compound decomposable, or subjected to decomposition, by an electric current

element – a substance composed of atoms having an identical number of protons in each nucleus; elements cannot be reduced to simpler substances by normal chemical means.

hydrogen – A colorless, highly flammable gaseous element, the lightest of all gases and the most abundant element in the universe.

molecule – the smallest part of a substance that retains the chemical and physical properties of the substance and is composed of two or more atoms.

oxygen – an element that at standard temperature and pressure is colorless, tasteless, and odorless (required for nearly all combustion and in the cellular functioning of animals)

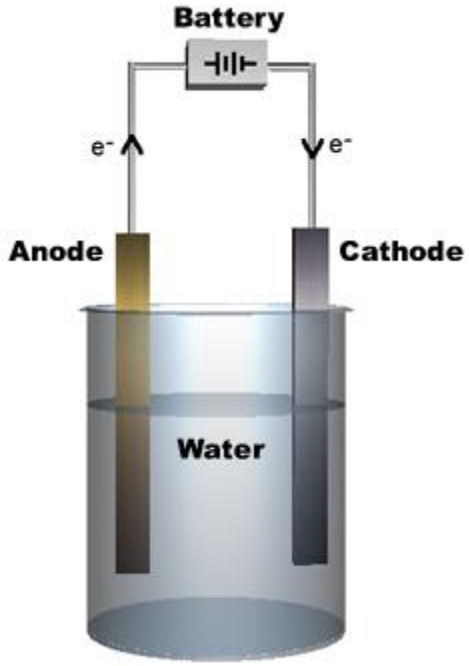
Background:

When you add salt to the water, the salt ions (which are highly polar) help pull the water molecules apart into ions. Each part of the water molecule has a charge. The OH- ion is negative, and the H+ ion is positive. This solution in water forms an electrolyte, allowing current to flow when a voltage is applied. The H+ ions, called cations, move toward the cathode (negative electrode), and the OH- ions, called anions, move toward the anode (positive electrode).

At the anode, water is oxidized: 2H O T O + 4H+ + 4e- 22

At the cathode, water is reduced: 4HO+4e- T2H +4OH- 22

Note that there is a net balance of electrons in the water. Bubbles of oxygen gas (O2) form at the anode, and bubbles of hydrogen gas (H2) form at the cathode. The bubbles are easily seen. Twice as much hydrogen gas is produced as oxygen gas.



The net reaction: 2H2O T 2H2 + O2

Electrolysis is a technique used by scientists to separate a compound or molecule into its component parts. By adding electricity to a liquid and providing a path for the different particles to follow, a liquid such as water can be separated into hydrogen and oxygen.

In the electrolysis of water, how many grams of oxygen gas will be produced for every gram of hydrogen gas formed?

Reaction: 2H2O(l) ===> 2H2(g) + O2(g)

For every molecule of hydrogen gas produced, one molecule of oxygen will be produced. This means that for every mole of oxygen produced, 2 moles of hydrogen will be produced. However, the mass of one mole of hydrogen, is not the same as the mass of one mole of oxygen. Since Hydrogen has an atomic mass of 1, every mole of Hydrogen has a mass of 1 gram. The atomic mass of Oxygen is 16, so one mole of oxygen will have a mass of 16 grams. So now we need to transpose ratios:

We want the ratio of oxygen mass:hyrdogen mass. We know that Oxygen mol:Hydrogen mol=1:2 expressed as a fraction $\frac{1}{2}$We then convert Oxygen mol to oxygen mass by multiplying the ratio by the ratio of atomic mass to moles of oxygen We then multiply our ratio by the ratio of atomic mass to moles of hydrogen to convert hydrogen to mass We then reduce the fraction and we get $\frac{8gO}{1gH}$ 8 grams of Oxygen to each gram of Hydrogen.

$$2H_2O \rightarrow 2H_2 + O_2$$

Mole ratio

$$H_2{:}O_2 = 2{:}1$$

Molar mass in grams

$$H_2 = 2$$

$$O_2 = 32$$

At the medium hydrogen is as $H_2$and Oxygen is as O_2.

Amount of H_2moles in 1g of Hydrogen $= \frac{1}{2}$

Amount of O_2 formed $= \frac{1}{2} \times \frac{1}{2} = 0.25$

Mass of $O_2 = 0.25 \times 32 = 8g$

So 8g of O_2 gas will be formed for every 1g of H_2.