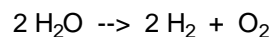


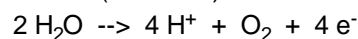
Chemistry 146 Lecture Problems

Hydrolysis of Water

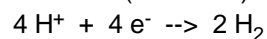
In this experiment the current used for hydrolysis of water is measured and used to determine how much hydrolysis occurs. The balanced redox reaction is:



The Anode (oxidation) reaction is:



The Cathode (reduction) reaction is:



Experimental Data:

Electrolysis Current: $i := (28 \cdot 10^{-3}) \cdot \text{amp}$

Electrolysis time: $t := 0 \cdot \text{hr} + 30 \cdot \text{min} + 30 \cdot \text{sec}$ $t = 1.83 \cdot 10^3 \text{ sec}$

From the current and the time, calculate the total charge (in coulombs) used:

Charge Calculations

$$C := i \cdot t$$

$$F := 96484.6 \cdot \text{coul} \cdot \text{mole}^{-1}$$

$$C = 51.24 \text{ coul}$$

Now Calculate the number of moles used in this reaction (as it is written):

Moles of electrons:

$$\text{mole}_{\text{electron}} := \frac{C}{F}$$

$$\text{mole}_{\text{electron}} = 5.31069 \cdot 10^{-4} \text{ mole}$$

Number of electrons in balanced equation: $n := 4$

Moles of reaction:

$$\text{mole}_{\text{reaction}} := \frac{\text{mole}_{\text{electron}}}{n}$$

$$\text{mole}_{\text{reaction}} = 1.32767 \cdot 10^{-4} \text{ mole}$$

Moles gas from the reaction $2 \text{H}_2\text{O} \rightarrow 2 \text{H}_2 + \text{O}_2$:

$$\text{Mole H}_2 \quad \text{mole H}_2 := \text{mole}_{\text{reaction}} \cdot 2 \quad \text{mole H}_2 = 2.65535 \cdot 10^{-4} \text{ mole}$$

$$\text{Mole O}_2 \quad \text{mole O}_2 := \text{mole}_{\text{reaction}} \quad \text{mole O}_2 = 1.32767 \cdot 10^{-4} \text{ mole}$$

Calculated Volume of gas:

$$P \cdot V = n \cdot R \cdot T \quad T := 298 \cdot \text{K} \quad R := 8.31441 \text{ joule} \cdot \text{mole}^{-1} \cdot \text{K}^{-1}$$

$$V_{\text{H}_2} := \text{mole}_{\text{H}_2} \cdot R \cdot \frac{T}{1 \cdot \text{atm}} \quad V_{\text{H}_2} = 6.4931 \text{ mL}$$

$$V_{\text{O}_2} := \text{mole}_{\text{O}_2} \cdot R \cdot \frac{T}{1 \cdot \text{atm}} \quad V_{\text{O}_2} = 3.24655 \text{ mL}$$

Measured Volume of gas: This is calculated from the number of centimeters of gas produced and the calibration of the volume of the glass tubing. From some previous measurements the volume of the tubing is 10 mL for every 26.4 cm of tubing.

$$V_{\text{H}_2_{\text{measured}}} := \frac{10 \cdot \text{mL}}{26.4 \cdot \text{cm}} \cdot 18 \cdot \text{cm} \quad V_{\text{H}_2_{\text{measured}}} = 6.81818 \text{ mL}$$

$$V_{\text{O}_2_{\text{measured}}} := \frac{10 \cdot \text{mL}}{26.4 \cdot \text{cm}} \cdot 9 \cdot \text{cm} \quad V_{\text{O}_2_{\text{measured}}} = 3.40909 \text{ mL}$$

The results for the two methods of calculation come out quite close to the same. With a more careful experiment (remember that the current changed some during the time it was running) the results would be even closer.

In addition there are some other factors that we did not take into account. Do you have any thoughts about what some of these factors are?