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Demonstrator's Name: ___Greg MacNiel

PLEASE NOTE: If ANY of the above information is UNCLEAR or not provided, your grade will NOT be recorded!!

Lab Day (T/W/Th/F):

Lab Week (even/odd):

Lab time (10:00, 2:30, 6:30):

Laboratory Report Form

Experiment 1.

Determination of the Composition of an Alloy

<u>Checklist:</u>

- **Raw Data Sheet written in pen, signed by TA and attached**
- **Report Form typed and attached**

Student's Initials __shallom

Data Tables

Table 1. Pure Metal

Data	**Trial 1**	**Trial 2**
Identity of Metal	Magnesium	Magnesium
Mass of metal (g)	0.030	0.030
Uncalibrated volume of eudiometer (mL)	0.00	0.00
Volume of hydrogen gas (mL)	30.0	32.6
Height of water column (cm)	10.8	15.8
Density of water (kg/m^3)	1000	1000
Acceleration due to gravity (m/s^2)	9.8	9.8
Pressure of water column (Pa)	1058.4	1548.4
Water Temperature (°C)	23	23
Water Vapour pressure (Pa)	2.81	2.81
Atmospheric Pressure (Torr)	753.8	753.8
Pressure of Hydrogen	96.6316kpa	96.1416kpa
Room Temperature	22^{o}c	22^{o}c
Ideal Gas Constant, R	8.1344621 J/kmol	8.1344621 J/kmol
Actual Moles of Hydrogen (mol)	1.203×10^{-4}	1.301×10^{-4}
Theoretical moles of Hydrogen (mol)	1.234×10^{-4} mol	1.234×10^{-4} mol
Percent Yield (%)	97%	103%

Observations (Part 1):

The magnesium is thin and sliver in colour. The magnesium moves upwards in the eudiometer once it touches the hydrochloric acid. The reaction is immediate which starts forming bigger bubbles at the beginning of the reaction but later smaller bubbles are seen in the eudiometer. The eudiometer containing water and HCL reduces producing hydrogen gas.

Table 2. Alloy

Data	Trial 1	Trial 2
Unknown Number	2287	3390
Mass of alloy (g)	0.040	0.040
Uncalibrated volume of eudiometer (mL)	0.00	0.00
Volume of hydrogen gas (mL)	21.5	25.9
Height of water column (cm)	36	29.3
Density of water (kg/m^3)	1000	1000
Acceleration due to gravity (m/s^2)	9.8	9.8
Pressure of water column (Pa)	1058.4pa	1548.4pa
Water Temperature (°C)	23	24
Water Vapour pressure (kPa)	2.81	2.98
Atmospheric Pressure (Torr)	753.8	753.8
Pressure of Hydrogen	94.162kpa	94.6486kpa
Room Temperature	22	22
Ideal Gas Constant, R	8.1344621 J/kmol	8.1344621 J/kmol
Moles of Hydrogen (mol)	8.22 x 10^{-4}mol	9.22 x 10^{-4}mol
Mass of Zinc (g)	3.478 x 10^{-2} g Zn	3.1 x 10^{-2} g Zn
Mass of Aluminum (g)	5.21786 x 10^{-3}g Al	9.44 x 10^{-3}g Al
Percent Zinc (%)	86.95%	77%
Percent Aluminum (%)	13%	23.6%
Average Percent	81.98%	18.3%

Observations (Part 2):

The aluminum and zinc are silver in color. Once the alloy touches the eudiometer filled with HCL and water it takes a long time for the reaction to take place in comparism to the magnesium. When the reaction takes place small bubbles are seen in the eudiometer and the alloy floats towards to the top of the eudiometer, then the rate of the alloy slowly decreases as it moves in the liquid until it is used up. In the reaction the liquid is seen to have a grey or black color as the alloy dissolves in the liquid mixes with HCL and H2O.

Sample Calculation : Pure Metal

1. Uncalibrated Volume of the Eudiometer:

The Eudiometer was already calibrated before the experiment

2. Volume of Hydrogen gas:

Trial 1: 30.00mL

Trial 2: 32.6

Average volume of the hydrogen gas = $\frac{30.0ml + 32.6ml}{2}$

= 31.3ml

3. Pressure exerted by the water column:

Pressure exerted by the water column = dgh

Trial 1: convert 10.80cm to m

$=1000\frac{kg}{M^3} \times 9.8\frac{m}{s^2} \times 0.108m$

= 1058.4pa

=1.0584kpa

Trial 2: convert 15.8cm to m

$=1000\frac{kg}{M^3} \times 9.8\frac{m}{s^2} \times 0.158m$

= 1548.4pa

=1.5484kpa

4. Pressure of hydrogen gas:

$P_{h} = P_{atm} - P_{wc} - P_{wc}$

Trial 1:

= 100.5kpa – 2.81kpa – 1.0584kpa
= 96.6316kpa

Trial 2:

=100.50kpa – 2.81kpa – 1.5484kpa
=96.1416kpa

5. Moles of hydrogen gas (experimental):

Pv = nRT

$$n = \frac{pv}{RT}$$

Trial 1:

P = 96.6316kpa
V = 30.0ml = 0.03l
R = 8.134 J/Kmol
T = 23 + 273.15 = 296.15k

$$n = \frac{96.6316kpa \times 1.0584kpa}{8.1344621\ J/kmol \times 296.15k}$$

n = 0.0001203372 mol

$n = 1.203 \times 10^{-4}$

Trail 2:

P = 96.1416kpa
V = 32.6ml = 0.0326l
R = 8.134
T = 23 + 273.15 = 296.15k

$$n = \frac{96.1416kpa \times 0.0326l}{8.1344621\ J/kmol \times 296.15k}$$

n = 0.00130101033mol
$n = 1.301 \times 10^{-4}$

6. Moles of hydrogen gas (theoretical):

$Mg_{(s)} + 2HCL_{(aq)}$ -----> $Mgcl_{2\ (aq)} + H_{2\ (g)}$

Trial 1:

$$N_{h\,(g)} = \frac{M_{(mg)}}{M_{(mg)}} \times \frac{1\ mol\ H_2}{1\ mol\ Mg}$$

$$= 0.030g\ mg \times \frac{1mol\ mg}{24.31g\ mg} \times \frac{1mol\ H_2}{1mol\ mg}$$

= 0.00123406mol

$= 1.234 \times 10^{-3}$ mol

Trial 2:

$$N_{h\,(g)} = \frac{M_{(mg)}}{M_{(mg)}} \times \frac{1\ mol\ H_2}{1\ mol\ Mg}$$

$$= 0.030g\ mg \times \frac{1mol\ mg}{24.31g\ mg} \times \frac{1mol\ H_2}{1mol\ mg}$$

= 0.00123406mol

$= 1.234 \times 10^{-3}$ mol

7. Percentage Purity of metal (percentage yield of hydrogen):

Trial 1:

$$= \frac{1.203 \times 10^{-3}}{1.234 \times 10^{-3}} \times 100\%$$

= 97%

Trial 2:

$$= \frac{1.273 \times 10^{-3}}{1.234 \times 10^{-3}} \times 100\%$$

= 103%

8. Average Percent Purity:

$$\frac{97 + 103}{2} \times 100\%$$

= 100%

Sample Calculation : Alloy

1. Pressure of water column and hydrogen gas:

Trial 1: convert 36cm to m

$= 1000\frac{kg}{M^3} \times 9.8\frac{m}{s^2} \times 0.36m$

$= 3528\frac{kg}{M^2}$

= 3.528kpa

$P_h = p_{atm} – P_{wc}$ -- P_{wv}

= 100.5kpa – 3.528kpa – 2.81kpa

=94.162kpa

Trial 2: convert 29.3cm to m

$= 1000\frac{kg}{M^3} \times 9.8\frac{m}{s^2} \times 0.293m$

$= 2871.4kg/m^2$

= 2.8714kpa

$P_h = p_{atm} – P_{wc}$ -- P_{wv}

= 100.5kpa – 2.8714kpa – 2.98kpa

=94.6486kpa

2. Moles of hydrogen gas:

Pv = nRT

$n = \frac{Pv}{RT}$

Trial 1:

$N_h = \frac{94.162kpa \times 0.0215l}{8.3144624 \times 296.15k}$

= 0.000822184mol

$= 8.22 \times 10^{-4}mol$

Trial 2:

$= \frac{94.6486kpa \times 0.0259l}{8.3144624 \times 297.15k}$

= 0.000922mol

$= 9.22 \times 10^{-4}mol$

3. Masses of Zinc and Aluminum in the alloy:

Trial 1:

$$M_{Al} = \frac{8.22 \times 10^{-4}mol - \frac{0.040g}{65.39g/mol}}{\frac{3}{2(26.98g/mol)} - \frac{1}{65.39g/mol}}$$

$$= \frac{0.0002103}{0.04030388}$$

$$= 0.00521786$$
$$= 5.21786 \times 10^{-3} g\ Al$$

$$M_{zn} = 0.040 - 5.21786 \times 10^{-3} g\ Al$$

$$= 0.03478$$
$$= 3.478 \times 10^{-2}\ g\ Zn$$

Trial 2:

$$M_{Al} = \frac{9.922 \times 10^{-4}mol - \frac{0.040g}{65.39g/mol}}{\frac{3}{2(26.98g/mol)} - \frac{1}{65.39g/mol}}$$

$$= \frac{0.0003804}{0.04030388}$$

$$= 0.009440778$$
$$= 9.44 \times 10^{-3} g\ Al$$
$$M_{zn} = 0.040 - 9.44 \times 10^{-3} g\ Al$$

$$= 0.030559222$$
$$= 3.1 \times 10^{-2}\ g\ Zn$$

4. Percent composition of the alloy:

Percent composition of Zn and Al = $\frac{M_{Zn\ \&\ Al}}{M_{alloy}} \times 100$

Trail 1:

$$M_{Zn} = \frac{3.478 \times 10^{-2}\ g\ Zn}{0.040g} \times 100$$

$= 86.95\%$

$M_{Al} = \frac{5.21786 \times 10^{-3} g\ Al}{0.040g} \times 100$

$= 13\%$

Trial 2:

$M_{Zn} = \frac{3.1 \times 10^{-2}\ g\ Zn}{0.040g} \times 100$

$= 77\%$

$M_{Al} = \frac{9.44 \times 10^{-3} g\ Al}{0.040g} \times 100$

$= 23.6\%$

5. Average Percent composition of the alloy (average of zinc values and average of aluminum values):

Average percent composition of Zn $= \frac{86.95\% + 77\%}{2}$

$= 81.98\%$

Average percent composition of Al $= \frac{13\% + 23.6\%}{2}$

$= 18.3\%$

Discussion: (within space provided)

The main purpose of this lab was to coordinate series of trials to find the amount of hydrogen gas produced from both the magnesium and alloy. To also determine the purity of magnesium and the percent composition of the alloy by reacting it with a mixture of water and hydrochloric acid and based on the experiment hydrogen gas is released in the eudiometer and measurements are taken. After collecting data analysis from each trials, we use specific equations to determine the purity of magnesium and the percent composition of the alloy. Some of the observation in the experiment of both the magnesium and the alloy shows that magnesium reacted faster than an alloy containing both zinc and aluminum. During the experiment some errors may have occurred which may have affected our calculations. Error due to parallax when using the ruler to measure the amount of gas released and the height of water column. Another error may have occurred when we took our thumb off the top of the eudiometer too early which may have allowed air into the eudiometer which will increase the amount of space occupied by gas. Another error would be the inaccurate measurements of mass before the experiment or if the eudiometer was not calibrated before the experiment.

Conclusion: (no more than two lines)

The reaction of magnesium in hydrochloric acid was found to have an average percent yield of 101% and the reaction of alloy in hydrochloric acid resulted to the production of 81.98%Zn and 18.3%Al.