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Student Number: 8476106

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Demonstrator's Name: Hana Dureckova

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

Lab Day (circle): *Tues aft* *Tues night* **Wed** *Thurs aft* *Thurs night* *Fri*

Lab Week (circle): **1** 2

Laboratory Report Form

Experiment 1.

Determination of the Composition of an Alloy

Checklist:

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

Student's Initials: GC

Data Tables

Table 1. Pure Metal

Data	Trial 1	Trial 2
Identity of Metal	magnesium	Magnesium
Mass of metal (g)	0.0236	0.0271
Uncalibrated volume of eudiometer (mL)	N/A	N/A
Volume of hydrogen gas (mL)	24.65	28.60
Height of water column (cm)	29.70	22.40
Density of water (kg/m ³)	1.000	1.000
Acceleration due to gravity (m/s ²)	9.81	9.81
Pressure of water column (kPa)	2.84	2.20
Water Temperature (°C)	18	18
Water Vapour pressure (kPa)	2060	2060
Atmospheric Pressure (kPa)	101.6	101.6
Pressure of Hydrogen (kPa)	96.7	96.7
Room Temperature (°C)	18.9	18.9
Ideal Gas Constant, R	8.31446	8.31446
Actual Moles of Hydrogen (mol)	0.00098209	0.001147
Theoretical moles of Hydrogen (mol)	0.00097099	0.001115
Percent Yield (%)	101	102

Observations (Part 1):

- Metal was shiny
- Silver colour
- A lot of bubbles were formed
- Reaction was fast (done within seconds)
- Single piece of metal

Table 2. Alloy

Data	Trial 1	Trial 2
Unknown Number	5146	5146
Mass of alloy (g)	0.0441	0.0476
Uncalibrated volume of eudiometer (mL)	N/A	N/A
Volume of hydrogen gas (mL)	25.4	25.7
Height of water column (cm)	25.0	22.8
Density of water (kg/m ³)	1.000	1.000
Acceleration due to gravity (m/s ²)	9.81	9.81
Pressure of water column (kPa)	2.45	2.24
Water Temperature (°C)	18	19
Water Vapour pressure (kPa)	2.06	2.20
Atmospheric Pressure (kPa)	101.6	101.6
Pressure of Hydrogen	97.09	97.16
Room Temperature	18.9	18.9
Ideal Gas Constant, R	8.31446	8.31446
Moles of Hydrogen (mol)	1.016×10^{-3}	1.025×10^{-3}
Mass of Zinc (g)	3.56×10^{-2}	4.02×10^{-2}
Mass of Aluminum (g)	8.48×10^{-3}	7.38×10^{-3}
Percent Zinc (%)	80.8	84.5
Percent Aluminum (%)	19.2	15.5
Average Percent	Zinc: 82.65%	Aluminum: 17.35%

Observations (Part 2):

- Slow reaction
- Second trial was faster than first most likely because the alloy used on the first trial had larger pieces
- Silver, shiny
- Plenty of small pieces
- Black leftovers
- More bubbles than the reaction with magnesium

Sample Calculation : Pure Metal

done on a separate sheet

1. Uncalibrated Volume of the Eudiometer:
2. Volume of Hydrogen gas:
3. Pressure exerted by the water column:
4. Pressure of hydrogen gas:
5. Moles of hydrogen gas (experimental):
6. Moles of hydrogen gas (theoretical):
7. Percentage Purity of metal:
8. Average Percent Purity:

Sample Calculation : Alloy

done on a separate sheet

1. Pressure of water column and hydrogen gas:
2. Moles of hydrogen gas:
3. Masses of Zinc and Aluminum in the alloy:
4. Percent composition of the alloy:
5. Average Percent composition of the alloy (average of zinc values and average of aluminum values):

Discussion: (within space provided)

My values were overall reasonable, with the exception of the percentage yield. I used very little metal which generated very small numbers.

When I was calculating the percentage yield of the pure metal, I encountered an error on my procedure due to the fact I ended with >100%, which is impossible. I suspect that there were presences of air bubbles during the pure metal experiment.

The masses of the metals were very important during the calculations; the numbers on both trials were not necessarily the same because the initial total mass of the alloy and pure metal were slightly different in between trials, but they were still very close.

Conclusion: (no more than two lines)

I was able to conclude that the first alloy was made up of 80.8% Zinc and 19.2% of Aluminum; and the second alloy was made up of 84.5% Zinc and 15.5% of Aluminum.

Experiment 1
23/09/15

Raw data

Giovanna O. Cabimari
8476106

1 Metal
magnesium

Identity
Mass of metal
unc. volume of
~~an~~udiometer

0.0236 0.0271

Obs: - Shiny
- a lot of bubbles
- Fast (seconds)
- single piece

29.7

Pure Metal

1

~~0.0236g~~

0.0236g
 $V_H = 24.65 \text{ mL}$

$h_{H_2O} = 29.7 \text{ cm}$

$T_{H_2O} = 18^\circ\text{C}$ | $T_{\text{room}} = 18.9^\circ\text{C}$

$P_{H_2O} = 2.06 \text{ kPa} = 0.0206 \text{ bar}$

$P_{\text{atm}} = 1.016 \text{ bar} = 762.06267 \text{ torr}$
 $d = 1 \text{ kg/m}^3$

Sample #
5146

2

0.0271g

$V_{\text{air}} = 28.6 \text{ mL}$

$h_{H_2O} = 22.4 \text{ cm}$

$T_{H_2O} = 18^\circ\text{C}$

$P_{H_2O} = 2.06$

$P_{\text{atm}} = 1.016 \text{ bar}$
 $d = 1 \text{ kg/m}^3$

$R = 0.082057 \frac{\text{L}\cdot\text{atm}}{\text{mol}\cdot\text{K}}$

H. Pirelli

Alloy

(2)

$m = 0.0441$ (with 5146 above)

$V_{air} = 25.4 \text{ mL}$

$h = 25.0 \text{ cm}$

$T_{H_2O} = 18^\circ\text{C}$

$P_{H_2O} = 2.06 \text{ kPa}$

$m = 0.0476 \text{ g}$ (with 5146 above)

$V_{air} = 25.7 \text{ mL}$

$h = 22.8 \text{ cm}$

$T_{H_2O} = 19^\circ$
 $T_{room} = 18.9^\circ$

$P_{H_2O} = 2.06 \text{ kPa}$

Obs: ① slow, ② faster (probably due to the fact that ① had larger pieces, clumps)

- silver, many little pieces

$pV = nRT$

- ~~turned~~ black leftovers

- more bubbles

~~AD~~

$1 \text{ bar} = 750.061683 \text{ torr}$

Calculations

Trial 1

Pure Metal

$$P_{H_2O} = dgh$$

$$= (1000 \text{ kg/m}^3)(9.81 \text{ m/s}^2)(0.297 \text{ m}) \times \frac{1 \text{ kPa}}{1000 \text{ Pa}}$$

$$= 2.8449 \text{ kPa} \approx 2.84 \text{ kPa}$$

$$P_{H_2} = P_{atm} - P_{H_2O} - P_{H_2Og}$$

$$= 101.6 \text{ kPa} - 2.8449 \text{ kPa} - 2.000 \text{ kPa}$$

$$= 96.6951 \text{ kPa} \approx 96.7 \text{ kPa}$$

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

$$= \frac{(96.6951 \text{ kPa})(0.02465 \text{ L})}{(8.31446)(291.9 \text{ K})}$$

$$= 9.8209 \times 10^{-4} \text{ mol} \approx 9.821 \times 10^{-4} \text{ mol}$$

Trial 2

$$P_{H_2O} = dgh$$

$$= 2.19744 \text{ kPa}$$

$$\approx 2.20 \text{ kPa}$$

$$P_{H_2} = P_{atm} - P_{H_2O} - P_{H_2Og}$$

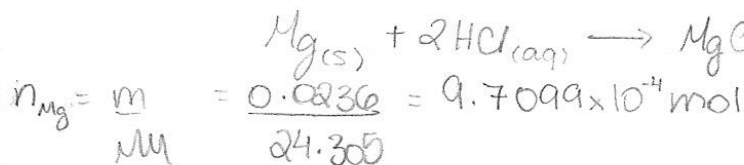
$$= 97.34256 \text{ kPa}$$

$$\approx 97.3 \text{ kPa}$$

$$n_{H_2} = \frac{PV}{RT}$$

$$= 1.147098 \times 10^{-3} \text{ mol}$$

$$\approx 1.147 \times 10^{-3} \text{ mol}$$



$$n_{Mg} = \frac{1 \text{ mol } H_2}{1 \text{ mol } Mg} = 9.7099 \times 10^{-4} \text{ mol } H_2$$

$$\text{percent yield} = \frac{\text{actual}}{\text{theoretical}} \times 100\%$$

$$= \frac{9.8209 \times 10^{-4} \text{ mol}}{9.7099 \times 10^{-4} \text{ mol}} \times 100\%$$

$$= 1.0113 = 101\% \leftarrow \text{due to error in procedure}$$

$$n_{Mg} = 1.114997 \times 10^{-3} \text{ mol}$$

$$n_{Mg} \times \frac{1 H_2}{1} = 1.114997 \times 10^{-3} \text{ mol } H_2$$

$$\approx 1.11 \times 10^{-3} \text{ mol } H_2$$

$$\% \text{ yield} = \frac{1.147098 \times 10^{-3}}{1.114997 \times 10^{-3}} \times 100\%$$

$$= 102\%$$

Trial 1

Alloy - 5146

Trial 2

$$V_{H_2} = 0.0254 \text{ L} \quad m = 0.0441 \text{ g}$$

$$P_{H_2} = P_{atm} - P_{H_2O} - P_{H_2Og} = 97.0875 \text{ kPa}$$

$$n_{H_2} = \frac{PV}{RT} = 1.01608 \times 10^{-3} \text{ mol}$$

$$V_{H_2} = 0.0257 \text{ L} \quad m = 0.0476 \text{ g}$$

$$P_{H_2} = 97.16 \text{ kPa}$$

$$n_{H_2} = 1.025334 \times 10^{-3} \text{ mol}$$

$$\textcircled{1} n_{H_2} = \frac{m_{Zn}}{MM_{Zn}} + \frac{3m_{Al}}{2MM_{Al}}$$

$$\textcircled{2} m_{Zn} = m_T - m_{Al}$$

$$\rightarrow n_{H_2} = \frac{(m_T - m_{Al})}{MM_{Zn}} + \frac{3m_{Al}}{2MM_{Al}}$$

$$n_{H_2} = \frac{2MM_{Al}(m_T - m_{Al})}{2MM_{Zn}MM_{Al}} + \frac{3m_{Al}MM_{Zn}}{2MM_{Al}MM_{Zn}}$$

$$n_{H_2} = \frac{2MM_{Al}m_T - 2MM_{Al}m_{Al} + 3MM_{Zn}m_{Al}}{2MM_{Zn}MM_{Al}}$$

$$1.01608 \times 10^{-3} \text{ mol} = \frac{2(26.982)(0.0441 \text{ g}) - 2(26.982)m_{Al} + 3(65.39)m_{Al}}{2(26.982)(65.39)}$$

$$1.01608 \times 10^{-3} = \frac{2.3792 - 53.964m_{Al} + 196.17m_{Al}}{3528.70596}$$

$$142.206m_{Al} = 1.20565$$

$$m_{Al} = 8.478 \times 10^{-3} \text{ g}$$

$$\rightarrow m_{Zn} = m_T - m_{Al}$$

$$= 0.0441 \text{ g} - 8.478 \times 10^{-3} \text{ g}$$

$$= 0.035622 \text{ g}$$

$$\text{Zn: } 0.0441 \times = 3.56$$

$$x = 80.78\%$$

$$\text{Al: } 0.0441 \times = 0.8478$$

$$x = 19.22\%$$

same equation as Trial 1

$$\rightarrow 1.025334 \times 10^{-3} = \frac{2.5687 + 142.206m_{Al}}{3528.70596}$$

$$m_{Al} = 7.37956 \times 10^{-3} \text{ g}$$

$$m_{Zn} = m_T - m_{Al}$$

$$= 0.04022 \text{ g}$$

$$\text{Zn: } 0.0476 \times = 4.022$$

$$x = 84.50\%$$

$$\text{Al: } 0.0476 \times = 0.737956$$

$$x = 15.50\%$$

∴ Alloy = $\begin{matrix} \text{First Trial} & \text{Second Trial} \\ 80.8\% \text{ Zinc and} & 84.5\% \text{ Zinc and} \\ 19.2\% \text{ Aluminum} & 15.5\% \text{ Aluminum} \end{matrix}$