Student Name: Jack Bryant
Student Number: 8744807
Partner's Name and Student #: Tom Proud 8682641

Demonstrator's Name: Jesse

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): Tuesday

Lab Week (even/odd):odd

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

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 __JB___

Data Tables

Table 1. Pure Metal

Data	Trial 1	Trial 2
Identity of Metal	Mg	Mg
Mass of metal (g)	0.0271g	0.0280g
Uncalibrated volume of eudiometer (mL)	-	-
Volume of hydrogen gas (mL)	28.1mL	29.4mL
Height of water column (cm)	23.1cm	22.8cm
Density of water (kg/m^3)	1000kg/m^3	1000kg/m^3
Acceleration due to gravity (m/s^2)	9.81m/s^2	9.81m/s^2
Pressure of water column (Pa)	2266 Pa	2237 Pa
Water Temperature (°C)	21.9°c	23.5°c
Water Vapour pressure (Pa)	2640Pa	2640Pa
Atmospheric Pressure (Torr)	755 Torr	755 Torr
Pressure of Hydrogen	95.75 Kpa	95.75 Kpa
Room Temperature	21.6°c	21.6°c
Ideal Gas Constant, R	8.31145Kpa L mol^{-1} K^{-1}	8.31145Kpa L mol^{-1} K^{-1}
Actual Moles of Hydrogen (mol)	1.097×10^{-3} mol	1.141×10^{-3} mol
Theoretical moles of Hydrogen (mol)	1.114×10^{-3} mol	1.152×10^{-3} mol
Percent Yield (%)	98.5%	99%

Observations (Part 1):

Fast reaction – couple of minute before bubbles were forming
Bubbles filled up tube
Bubbles were produced often and fast

Table 2. Alloy

Data	Trial 1	Trial 2
Unknown Number		
Mass of alloy (g)	0.0404g	0.0436g
Uncalibrated volume of eudiometer (mL)	-	-
Volume of hydrogen gas (mL)	24.5mL	29.0mL
Height of water column (cm)	29.2cm	25.2cm
Density of water (kg/m^3)	1000kg/m^3	1000kg/m^3
Acceleration due to gravity (m/s^2)	9.81m/s^2	9.81m/s^2
Pressure of water column (Pa)	9515 Pa	9554 Pa
Water Temperature (°C)	22.2^{o}c	22.4^{o}c
Water Vapour pressure (kPa)	2.640Kpa	2.640Kpa
Atmospheric Pressure (Torr)	755 torr	755 torr
Pressure of Hydrogen	95.15 Kpa	95.54 Kpa
Room Temperature	21.6^{o}c	21.6^{o}c
Ideal Gas Constant, R	8.31145Kpa L mol^{-1} K^{-1}	8.31145Kpa L mol^{-1} K^{-1}
Moles of Hydrogen (mol)	9.49 x 10^{-4} mol	1.127 x 10^{-3} mol
Mass of Zinc (g)	0.032187g	0.03660 g
Mass of Aluminum (g)	8.213 x 10^{-3} g	7.000 x 10^{-3} g
Percent Zinc (%)	80%	84%
Percent Aluminum (%)	20%	16%
Average Percent	82% Zn	18% Al

Observations (Part 2):

Slower reaction compared to Mg
Took about 8 minutes for bubbles to start to appear
Bubbles were formed less often

Sample Calculation : Pure Metal

1. Uncalibrated Volume of the Eudiometer:

2. Volume of Hydrogen gas:

Used measuring stick to calculate Volume of H_2 gas. The point where the solution stopped, in the eudiometer, was the point to measure with the ruler. This was the volume that the gas was taking up.
Trial 1: 28.1mL Trial 2: 29.4Ml

3. Pressure exerted by the water column:

p=dgh
$p=(1000 kg/m^3)(9.81 m/s^2)(0.231)$
Trial 1 p= 2266 kg/m^2 = 2266 Pa
Trial 2 p=2237 Pa

4. Pressure of hydrogen gas:

$p_{hyrdrogen} = p_{atmospheric} - p_{water\ column} - p_{water\ vapor}$

= 100658 - 2266 – 2640
Trial 1 $p_{hydrogen}$ = 95752Pa = 95.75 Kpa

Trial 2 $p_{hydrogen}$ = 9578 Pa = 95.78 Kpa

5. Moles of hydrogen gas (experimental):

PV=nRT
n = PV/RT
n = (95.752Kpa)(0.0281L)/(8.3145Kpa L mol^{-1} K^{-1})(295.05k)
Trial 1 n= 1.097 x 10^{-3} mol
Trial 2 n=1.141 x 10^{-3} mol

6. Moles of hydrogen gas (theoretical):
$Mg(s) + 2HCl(l) \rightarrow MgCl_2 (aq) + H_2(g)$

m= 0.0271g
M= 24.305 g/mol
n = m/M
n= 0.0271/24.305
Trial 1 n= 1.114 x 10^{-3} mol
Trial 2 n= 1.152 x 10^{-3} mol

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

%y = (actual/theoretical) x 100%
%y = (1.097 x 10^{-3} mol) / (1.114 x 10^{-3} mol) x 100%
Trial 1 %y = 98.5%
Trial 2 %y = 99%

8. Average Percent Purity:

(Trial 1 %y + Trial 2 %y)/2
Avg %y = 98.75%

Sample Calculation : Alloy

1. Pressure of water column and hydrogen gas:

$p_{\text{water column}}$ = dgh
p = (1000kg/m^2) (9.81 m/s^2)(0.292m)
Trial 1 p = 2864.52 Pa
Trial 2 p = 2472.12 Pa
p_{H2} = 100658 - 2864.52 – 2640
Trial 1 p_{H2} = 95153.48 Pa = 95.15 Kpa

Trial 2 p_{H2} = 95545.88 = 95.54 Kpa

2. Moles of hydrogen gas:

PV = nRT
n = PV/RT
n= (95.153 Kpa)(0.0245L)/(8.3145 Kpa L mol^{-1} K^{-1})(295.35K)
Trial 1 n= 9.49 x 10^{-4} mol H_2
Trial 2 n= 1.127 x 10^{-3} mol H_2

3. Masses of Zinc and Aluminum in the alloy:

$n_{H2} = n_{zn} + 3/2\ n_{Al}$

$n_{H2} = m_{zn}/M_{zn} + 3/2\ m_{Al}/M_{Al}$

$m_{alloy} = m_{zn} + m_{Al}$
$m_{zn} = m_{alloy} – m_{Al}$

m_{zn} equation into n_{H2} equation

$n_{H2} = (m_{alloy} – m_{Al})/M_{zn} + 3/2\ m_{Al}/M_{Al}$
$n_{H2} – m_{alloy}/M_{Zn} = m_{Al} (-1/M_{Zn} + 3/M_{Al})$
(9.49 x 10^{-4} mol) – (0.0404g)/(65.38g/mol)= m_{Al} (-1/(65.38g/mol)) + 3/2(26.98g/mol))
Trial 1 m_{Al} = 8.213 x 10^{-3} g
Trial 2 m_{Al} = 7.000 x 10^{-3} g
$m_{Zn} = m_{alloy} – m_{Al}$
m_{zn} = 0.0404g – (8.213 x 10^{-3}g)

Trial 1 m_{Zn} = 0.032187g
Trial 2 m_{Zn} = 0.03660 g

4. Percent composition of the alloy:

Trial 1
%Zn = m_{Zn} / m_{alloy}
%Zn = 0.032187/0.0404
%Zn = 80%

%Al = m_{Al} / m_{alloy}
%Al = 0.008213/ 0.0404
%Al = 20%

Trial 2
%Zn= 84%
%Al = 16%

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

Avg % Zn = Avg m_{Zn} / Avg m_{alloy}
Avg % Zn = 0.034392 / 0.04200
Avg % Zn = 82%

Avg % Al = Avg m_{Al} / Avg m_{alloy}
Avg % Al = 0.0076065 / 0.04200
Avg % Al = 18%

Discussion: (within space provided)

If the eudiometer was not calibrated at the beginning your experiment findings would be off. You need to calibrate to have consistent results with measurements. Calibrating the eudiometer will give a number that is needed to be added to every measurement since the measurement is off. The metal is the limiting reagent. There is less metal than acid, so the metal is used up faster in the reaction. The metals weight is what we will be using in our calculations since it is the limiting reagent. If air enters the eudiometer it will affect the results. The air will take up space that should be filled with H2 gas. This will make your H2 gas reading higher than what the actual measurement is. This will affect a lot of the calculations because it changes the pressure of the gas. If the metal floats up and sticks it might not react as rapidly or it may stop reacting since the acid would be at the bottom of the water. This would change your results by lowering the gas and water levels. Same for if some of the metal does not react. Your gas and height of water will go down. If the percent yield of the metal is over 100% then there was an experimental error. The actual yield cannot exceed the theoretical yield. If the percent yield is 100% then all the possible reactant was used and made into product. If the yield is under 100% not all the reactant was reacted into the right product. This is normally the case for a chemical reaction. Side reactions can happen most reactions. Which can use up some of the reactant to create a different product than what is desired. Alloy's are two or more metallic elements that have been combined. I expect alloys to react slower and not as intensely. I expect this because alloys are stronger than pure metals, so I expect it to take more energy and time to complete the reaction. Multiple trials with an alloy will give similar results. The alloy is built in a certain way with the % composition of the two or more metals. I believe they will both react and produce similar results. The mass of metal and the mass of alloy both affect your results. Since an alloy is comprised of metals, adding mass of metal increases the mass of alloy.If results are not expected it can a count of many things. Experimental is probably where you can mess up your results the most. It is very easy to mess up measurements. Which in turn will affect all of your calculations. If you mess up your procedure you can affect your results as well. If you do the experiment in the wrong order you could see changes in the results. This experiment helped me better understand how moles and pressures relate. When moles of gas increases so does the pressure and vice versa.

Conclusion: (no more than two lines)

When reacting this sample of Mg with HCl I determined the average percent purity to be 98.75%.

With the experiment of the alloy I was able to determine that the average percent composition of Alloy 6375 was 82% zinc and 18% Aluminum.

~~Graduated cylinder~~

	T1	T2
mass of metal	0.0271g	0.0280g
mass of alloy (6375)	0.0404g	0.0436g
T of Room	21.6 °C	21.6 °C
P of Room	100.7 kpa	100.7 kpa

	Metal rxn (mg)		Alloy (6375)	
T1	H_2 gas	28.4 mL	H_2 gas	24.5 mL
	height of H_2O	23.1 cm	height of H_2O	29.2 cm
	Temp H_2O	21.9 °C	Temp H_2O	22.2 °C
T2	H_2 gas	29.4 mL	H_2 gas	29.0 mL
	Height of H_2O	22.8 cm	height of H_2O	25.2 cm
	Temp H_2O	23.5 °C	Temp H_2O	22.4 °C

Observations

Metal
- fast bubbling
- Large bubbles
- Large amount of bubbles

Alloy
- Slower rxn
- medium bubbles
- small amount of bubbles