Student Name: Ajulu Ojullu
Student Number: 8727639

Partner's Name and Student #: Maryem

Demonstrator's Name: Adam

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): Even

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

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 AO

Data Tables

Table 1. Pure Metal

Data	Trial 1	Trial 2
Identity of Metal	Magnesium	Magnesium
Mass of metal (g)	0.0280	0.0230
Uncalibrated volume of eudiometer (mL)	0.0	0.0
Volume of hydrogen gas (mL)	26.4	23.2
Height of water column (cm)	25.4	26.3
Density of water (kg/m^3)	1000	1000
Acceleration due to gravity (m/s^2)	9.80665	9.80665
Pressure of water column (Pa)	24427.28	25292.81
Water Temperature (°C)	22.9	22.8
Water Vapour pressure (Pa)	2.81	
Atmospheric Pressure (Torr)	754.56	754.56
Pressure of Hydrogen	550.26 Torr	543.77 Torr
Room Temperature	22.0 ˚C	22.0 ˚C
Ideal Gas Constant, R	62.3637 L·Torr/mol·K	62.3637 L·Torr/mol·K
Actual Moles of Hydrogen (mol)	0.0007868197	0.0006865
Theoretical moles of Hydrogen (mol)	0.001152	0.00095
Percent Yield (%)	68	73

Observations (Part 1):

The eudiometer tube became warm in temperature as the reaction took place.

The water in the eudiometer tube bubbled until the reaction was complete.

The reaction between magnesium and hydrochloric acid was very quick.

Table 2. Alloy

Data	Trial 1	Trial 2
Unknown Number	6480	6480
Mass of alloy (g)	0.0478	0.0435
Uncalibrated volume of eudiometer (mL)	0.0	0.0
Volume of hydrogen gas (mL)	28.8	26.1
Height of water column (cm)	20.3	23.6
Density of water (kg/m^3)	1000	1000
Acceleration due to gravity (m/s^2)	9.80665	9.80665
Pressure of water column (Pa)	19522.59	25100.47
Water Temperature (°C)	22.8	22.9
Water Vapour pressure (kPa)	2.81	
Atmospheric Pressure (Torr)	754.56	754.56
Pressure of Hydrogen	543.77 Torr	545.211 Torr
Room Temperature	22.0˚C	22.0˚C
Ideal Gas Constant, R	62.3637 L·Torr/mol·K	62.3637 L·Torr/mol·K
Moles of Hydrogen (mol)	0.0009160462	0.0007704802
Mass of Zinc (g)	0.0432	0.0409
Mass of Aluminum (g)	0.00459	0.00261
Percent Zinc (%)	90.4	5.99
Percent Aluminum (%)	9.6	94.0
Average Percent	92.2 % zinc and 7.79% aluminum	92.2 % zinc and 7.79% aluminum

Observations (Part 2):

The eudiometer tube became warm as the reaction took place.

The water in the eudiometer tube became foggy in appearance and bubbled vigorously until the reaction was complete.

The reaction between the alloy and HCl was moderately fast.

Sample Calculation : Pure Metal

1. Uncalibrated Volume of the Eudiometer:

0.0 mL - eudiometer was calibrated

2. Volume of Hydrogen gas:

23.2 mL

3. Pressure exerted by the water column:

$P_{water\ column} = dgh$
$= (1000\ kg/m^3)\ (\ 9.80665\ m/s^2)(0.263\ m)$
$=2579.14895\ kg/m\ s^2$

$=189.7116$ Torr

4. Pressure of hydrogen gas:

$P_{hydrogen} = P_{atmospheric} - P_{water\ column} - P_{water\ vapour}$
$= (754.56\ Torr) – (189.71\ Torr) – (21.08\ Torr)$
$= 543.77$ Torr

5. Moles of hydrogen gas (experimental):

$n_{hydrogen} = PV \div RT$
$= (543.77\ Torr)(0.0232\ L) \div (\ 62.3637\ L{\cdot}Torr/mol{\cdot}K)(295.95\ K)$
$= 0.00068\ 65$ mol

6. Moles of hydrogen gas (theoretical):

$Mg(s) + 2\ HCl(l) \rightarrow MgCl_2\ (aq) + H_2(g)$

1 mol Mg : 1 mol H_2

$n_{Mg} = 0.023\ g \div 24.305\ g/mol$
$=0.00095$ mol

$\therefore$ there are 0.00095 mol H_2

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

% Purity= Actual yield ÷ Theoretical yield x 100%
= 0.0006865 mol ÷ 0.00095 mol x 100%
= 0.7254 x 100%
= 73 %

8. Average Percent Purity:

Average % Purity = (% $Purity_{Trial_1}$ + % $Purity_{Trial_2)}$ ÷ 2
= (68 % + 73 %) ÷ 2
= 71 %

Sample Calculation : Alloy

1. Pressure of water column and hydrogen gas:

$P_{water\ column}$ = dgh
= (1000 kg/m^3) (9.80665 m/s^2) (0.203 m)
=1990.74995 kg/ m s^2

= 146.4314 Torr

$P_{hydrogen}$= $P_{atmospheric}$ - $P_{water\ column}$ - $P_{water\ vapour}$
= (754.56 Torr) – (146.43 Torr) – (21.08 Torr)
= 587.05 Torr

2. Moles of hydrogen gas:

$n_{hydrogen}$=PV÷RT
= (587.05 Torr) (0.0288 L) ÷ (62.3637 L·Torr/mol·K) (295.95 K)
= 0.0009160462 mol

3. Masses of Zinc and Aluminum in the alloy:

Zn (s) + 2 H+ (aq) → Zn_2+ (aq) + H_2 (g)
Al (s) + 3 H+ (aq) → Al^{3+} (aq) + 3/2 H_2 (g)

1. $n_{hydrogen\ total} = n_{hydrogen,\ zinc} + n_{hydrogen,\ aluminum}$
   $= n_{zinc} + 3/2\ n_{aluminum}$
   $= (m_{zinc} \div mm_{zinc}) + 3/2(m_{aluminum} \div mm_{aluminum})$
2. $m_{alloy} = m_{zinc} + m_{aluminum}$

$n_{hydrogen\ total}$=0.000916 mol
m_{alloy} =0.0478 g
mm_{zinc}=65.39 g/mol
$mm_{aluminum}$=26.9815 g/mol

Equation 2
$0.0478 = m_{zinc} + m_{aluminum}$
$m_{zinc} = 0.0478 - m_{aluminum}$

Equation 1
$0.000916 mol = (m_{zinc} \div mm_{zinc}) + 3/2(m_{aluminum} \div mm_{aluminum})$
$0.000916 mol = (0.0478\ g - m_{aluminum} \div 65.39\ M) + 3/2(m_{aluminum} \div 26.9815\ M)$
$0.000916 mol = (0.0478\ g - m_{aluminum} \div 65.39\ M) + (3\ m_{aluminum} \div 53.963 M)$
$0.000916 mol = (0.0478\ g - m_{aluminum} \div 65.39\ M) \times (53.963/53.963) +$
$(3m_{aluminum} \div 53.963\ g/mol) \times (65.39/65.39)$
$0.000916 mol = (2.579\ g - 53.963\ m_{aluminum} + 196.17\ m_{aluminum}) \div 3528.6\ M$
$0.000916 mol \times 3528.6 M = (2.579\ g - 53.963\ m_{aluminum} + 196.17\ m_{aluminum})$
$3.232\ g - 2.579\ g = 142.747\ m_{aluminum}$
$0.653\ g = 142.747\ m_{aluminum}$
$0.653\ g \div 142.747 = m_{aluminum}$
$0.00459\ g = m_{aluminum}$

Equation 2
$m_{zinc} = m_{alloy} - m_{aluminum}$
$= 0.0478\ g - 0.00459\ g$
$m_{zinc} = 0.0432\ g$

4. Percent composition of the alloy:

$mass\%_{\ zinc} = m_{zinc} \div m_{alloy} \times 100\%$
$= 0.0432\ g \div 0.0478\ g \times 100\ \%$
$= 90.4\ \%$
$mass\%_{\ aluminum} = m_{aluminum} \div m_{alloy} \times 100\%$
$= 0.00459\ g \div 0.0478\ g \times 100\ \%$
$= 9.6\ \%$

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

Avg mass% $_{zinc}$ = (mass% $_{zinc}$ Trial 1 + mass% $_{zinc}$ Trial 2) ÷ 2

= (90.4 % + 94%) ÷ 2

= 92.2%

Avg mass% $_{aluminum}$ = (mass % $_{aluminum}$ Trial 1 + mass % $_{aluminum}$ Trial 2) ÷ 2

= (9.6% + 5.99%) ÷ 2

= 7.79%

Discussion: (within space provided)

It is difficult to predict the results of an experiment with an unknown alloy. An alloy is a mixture of metals, meaning the alloy given could have been composed of any different types of metals and amount of metals. Because of this, you should not expect the same results if multiple trials are done with alloys.

The results of the experiment in terms of magnesium were lower than expected. The percent purity was 68% for trial 1 and 73% for trial 2.

There are many potential sources of error in this lab experiment:

During each reaction of magnesium with HCl and the alloy with HCl, some of the metal floated up and stuck to the side of the eudiometer. Because of this, not all of the metal in the sample reacted, resulting in <100% yield of hydrogen in all trials; While carrying out the procedure, some of the air from the room possibly entered the eudiometer tube. This affects the reaction of the metal/ alloy with the HCl. This also affects the reading of the volume of hydrogen gas; The equipment used for the experiment was possibly coated with other substances that caused side reactions to occur.

Conclusion: (no more than two lines)

The values obtained for hydrogen gas in the magnesium trials 1 and 2 were 0.0007868 moles and 0.0006865 moles and the percentage yield was 68% and 73% respectively. The alloy was found to be composed of 92.2% zinc and 7.79% aluminum on average.

Ajulu Ojullu
8727639

Lab 1 Trial #2

Magnesium
Mg - 0.023 g
HCl - 10.0mL
room temp. - 22.0°C
room pressure - 100.6 kPa
water temp. 22.8°C
vol of gas - 23.2 mL
height of water column - 26.3cm

Observations
- eudiometer was warm
- water was bubbly
- reaction was relatively fast

Alloy
alloy - ~~0.0409g~~ 0.0435 g
HCl - 10.0 mL
room temp - 22.0°C
room pressure - 100.6 kPa
water temp. 22.9°C
vol of gas - 26.1 mL
height of water column - 23.6 cm

Observations
- eudiometer was warm
- water bubbled aggressively
- water was foggy
- rxn was relatively slow

Ajulu Ojullu
8727639

Maryem 514 292 0564

TA Adam
aclou053@uottawa.ca

Lab 1 Trial #1

Magnesium - 0.0280 g
alloy - 0.0478 g
HCl - 10.0 mL

magnesium
room temp 22.0°C
room pressure - 100.6 kPa
temp of water - 22.9°C
vol of gas - 26.4 mL
Mg - 0.0280 g
HCl - 10.0 mL
height of water column - 25.4 cm

Observations
- reaction was quick
- water in tube was bubbling
- eudiometer tube felt warm during reaction

alloy 6480

~~observations~~
room temp - 22.0°C
room pressure - 100.6 kPa
temp of water. 22.8°C
vol of gas - 28.8 mL
alloy - 0.0478 g
HCl - 10.0 mL
height of water column - 20.3 cm

Observations
- reaction was relatively slow
- water in tube was bubbling vigorously
- water was foggy in the tube
- eudiometer tube felt warm during reaction