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**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 DD***

## *Data Tables*

### Table 1. Pure Metal

**(note: switched numbers because I put the data on the wrong side of the trial sections)**

| **Data** | **Trial 2** | **Trial 1** |
|---|---|---|
| Identity of Metal | Magnesium | Magnesium |
| Mass of metal (g) | 0.0232g | 0.0182g |
| Uncalibrated volume of eudiometer (mL) | 0 | 0 |
| Volume of hydrogen gas (mL) | 24.1mL | 19.2mL |
| Height of water column (cm) | 26.5cm | 33.8cm |
| Density of water ($kg/m^3$) | 999.97 | 999.97 |
| Acceleration due to gravity ($m/s^2$) | 9.8m/s^2 | 9.8m/s^2 |
| Pressure of water column (Pa) | 2.6x10^3 Pa | 3.3x10^3 Pa |
| Water Temperature (°C) | 17.5 degrees Celsius | 17.5 degrees Celsius |
| Water Vapour pressure (Pa) | 2000Pa | 2000Pa |
| Atmospheric Pressure (Torr) | 757.6 Torr | 757.6 Torr |
| Pressure of Hydrogen | $9.6x10^4$ Pa | $9.6x10^4$ Pa |
| Room Temperature | 18.7 degrees celsius | 18.7 degrees Celsius |
| Ideal Gas Constant, R | 0.0821 | 0.0821 |
| Actual Moles of Hydrogen (mol) | 9.49x10^-4 mol | 7.59x10^-4 mol |
| Theoretical moles of Hydrogen (mol) | 9.55x10^-4 mol | 7.49x10^-4 mol |
| Percent Yield (%) | 99.37% | 101.4% |

Observations (Part 1):
TRIAL 1
-Bubbles, metal floated to top and quickly dissolved, lots of bubbles when it floated to top

TRIAL 2
-bubbles increased when metal floated to very top, large bubbles and very quick dissolving of metal

### Table 2. Alloy

| **Data** | **Trial 1** | **Trial 2** |
|---|---|---|
| **Unknown Number** | 5201 | 5201 |
| Mass of alloy (g) | 0.0706g | 0.0812g |
| Uncalibrated volume of eudiometer (mL) | 0 | 0 |
| Volume of hydrogen gas (mL) | 42mL | 47.4mL |
| Height of water column (cm) | 7.4cm | 2.4cm |
| Density of water ($kg/m^3$) | 999.97 kg/m^3 | 999.97kg/m^3 |
| Acceleration due to gravity ($m/s^2$) | 9.8 | 9.8 |

| | | |
|---|---|---|
| Pressure of water column (Pa) | 7.3x10$^2$Pa | 2.4x10 Pa |
| Water Temperature (°C) | 19.5 degrees celsius | 19.8 degrees Celsius |
| Water Vapour pressure (kPa) | 2270Pa | 2340Pa |
| Atmospheric Pressure (Torr) | 757.6 Torr | 757.6 Torr |
| Pressure of Hydrogen | 9.8x10^4 Pa | 9.8x10^4 Pa |
| Room Temperature | 18.7 degrees celsius | 18.7 degrees celsius |
| Ideal Gas Constant, R | 0.0821 | 0.0821 |
| Moles of Hydrogen (mol) | 1.70x10^-3 mol | 1.91x10^-3 mol |
| Mass of Zinc (g) | 0.11g | 0.125g |
| Mass of Aluminum (g) | 0.069g | 0.077g |
| Percent Zinc (%) | 61.5% | 61.9% |
| Percent Aluminum (%) | 38.5% | 38.1% |
| Average Percent | Zn = 61.7% | Al = 38.3% |

Observations (Part 2):
TRIAL 1
Few bubbles, took a while to start. Some pieces of alloy floated to top quickly and some gathered at bottom. Time elapsed over 4 minutes and reaction is still occurring. Metal turned dark grey, almost black when dissolved and lots of gas was created. Black substance stuck to side of eudiometer as gas was created.
Reaction ended after long time, black substance resting on top of water in eudiometer
TRIAL 2
Same occurrence as trial 1, except more consistent of a reaction. Metal seemed to be more separated in sample holder than in trial 1 so more of the alloy pieces floated to the top and dissolved, and others dissolved halfway up the eudiometer as well as closer to the bottom.

**Sample Calculation : Pure Metal**

1. Uncalibrated Volume of the Eudiometer:

Eudiometer was already calibrated

2. Volume of Hydrogen gas:

V=19.2mL

3. Pressure exerted by the water column:

P=dgh
d= 999.97kg/m$^3$
g= 9.8m/s$^2$
h= 0.0338m
P= (999.97kg/m$^3$) (9.8m/s$^2$) (0.338m)
P= 3.3x10$^3$Pa

4. Pressure of hydrogen gas:

$P=P_{atm}-P_{water\ column}-P_{water\ vapour}$

$P=1.01x10^5Pa-3.3x10^3Pa-2000Pa$

$P=9.6x10^4Pa$

5. Moles of hydrogen gas (experimental):

n=PV/RT

P=0.94744atm (converted from $9.6x10^4$ Pa)

V=0.0192L

R=0.0821 Lxatm/molxK

T=291.85K

n=(0.94744atm)(0.0192L)/(0.0821 Lxatm/molxK)(291.85K)

$n=7.592x10^{-4}mol$

6. Moles of hydrogen gas (theoretical):

Moles Mg: $0.0182g/24.305g_{/mol} = 7.49x10^{-4}mol$

Mole Ratio for Mg:$H_2$ is 1:1 thus:

$n=7.49x10^{-4}mol$

**Sample Calculation : Alloy**

1. Pressure of water column and hydrogen gas:

P=dgh

d= $999.97kg/m^3$

g= $9.8m/s^2$

h= 0.0074m

$P=(999.97kg/m^3)(9.8m/s^2)(0.074m)$

$P=7.3x10^2Pa$ water column pressure

$P=P_{atm}-P_{water\ column}-P_{water\ vapour}$

$P=1.01x10^5Pa-7.3x10^2Pa-2270Pa$

$P=9.8x10^4Pa$ hydrogen gas pressure

2. Moles of hydrogen gas:

n=PV/RT

P=0.9672 (converted from $9.8x10^4$Pa)

V=0.042L

R=0.0821 Lxatm/molxK

T=291.85K

n=(0.977atm)(0.042L)/(0.0821 Lxatm/molxK)(291.85K)
$n=1.70x10^{-3}mol$

3. Masses of Zinc and Aluminum in the alloy:

Moles H = Moles Zn + 3/2 Moles Al
Moles Zn:
$n=1.70x10^{-3}mol$
Moles Al:
3/2 ($1.70x10^{-3}$mol)
$n=2.55x10^{-3}mol$
Mass Zn:
($1.70x10^{-3}$mol)(65.39$g_{/mol}$)
m=0.11g

Mass Al:
($2.55x10^{-3}$mol)(26.982$g_{/mol}$)
m=0.069g

TOTAL MASS = 0.179g

4. Percent composition of the alloy:
   % Composition Zn
   (0.11g/0.179g)(100)=61.5%
   % Composition Al
   (0.069g/0.179g)(100)=38.5%

5. Average Percent composition of the alloy (average of zinc values and average of aluminum values):
   Zn:
   (61.5%+61.9%) /2 = 61.7%
   Al:
   (38.5%+38.1%) /2 = 38.3%

**Discussion: (within space provided)**

The observations recorded from the reactions of the pure metal and alloy with the HCl show that the pure metal reacted much faster with the acid as compared to the alloy. The pure Mg metal produced a clear solution and happened within about 2 minutes, whereas the alloy took over 4 minutes to complete, and there was a black precipitate-looking substance leftover. The leftover black substance could possibly be other impurities in the alloy that would have not been in the purified metal.

Sources of error were very frequently observable throughout the experiment. First of all, the volumes of the water were measured as the beaker being “half full” as opposed to if the volume were precisely recorded. Other volume-related sources of error include the volume readings on the eudiometer (the naked eye can only measure so precisely) and the ruler use to measure the column height could have been figured out more precisely using some kind of subtraction equation of the total height minus the height of the $H_2$ gas, or if the eudiometer also had height in *cm* and not just volume. That could have increased the accuracy of the water column height. Also, the sample holder could have had a larger volume to increase the space that the HCl had to react with all of the metal evenly, because when we reacted the alloy, some of the metal stayed in the sample holder when it reacted and looked almost stuck. Increasing the size of the sample holder could have made the reaction with the alloy and acid more consistent instead of less metal reacting at the beginning before the acid could reach the rest that was at the bottom of the sample holder. The last very obvious source of error that was observed was that one small piece of alloy fell out of the sample holder inside of the beaker and did not react with the rest of the metal that was still in the eudiometer, so the mass measurement of the alloy would be off by a small quantity. Overall, more careful and precise transfer of the eudiometer into the beaker-sample apparatus along with more careful transfer of the metals (glove-wearing to prevent touching the metal and adding mass), as well as pipette/graduated cylinder use for ALL volume measurements could have all come together to create a general more precise experiment with less error and therefore a higher yield.

**Conclusion: (no more than two lines)**

Based on the precise results of the reactions, it is justified that you can use a metal-acid reaction to determine the % composition of metals in an alloy.