BIRZEIT UNIVERSITY

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Department of Physics دائرة الفيزياء

Phys111 Report

Experiment #1: Density of a Metal and Distance between Atoms

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(1) Abstract:

Aim of the experiment:

Find the density of a metal block & Find the distance between its atoms.

The main results are:

- The density of the metal block is $\boldsymbol{\rho} = 2.677 \pm 0.012$ **g/cm^3**
- The distance between at atoms is $\boldsymbol{a}$ =2.56 **A**

(2) Data:

Block #:A.29 **Mass (M) =** 35.3 **±** 0.1 g

	1.	**2.**	**3.**	**4.**	**5.**	**6.**
$\boldsymbol{L}$ $(\boldsymbol{cm})$	4.700 cm	4.688 cm	4.684 cm	4.682 cm	4.702 cm	4.690 cm
$\boldsymbol{W}$ $(\boldsymbol{cm})$	2.274 cm	2.273 cm	2.273 cm	2.273 cm	2.270 cm	2.270 cm
$\boldsymbol{T}$ $(\boldsymbol{cm})$	1.236 cm	1.236 cm	1.236 cm	1.235 cm	1.241 cm	1.238 cm

(3) Calculations:

$\bar{L} = 4.691$ cm	$\sigma_s(L) = 8.270429251 \times 10^{-3}$ cm	$\Delta\bar{L} = 3.376388603 \times 10^{-3}$ cm
$\bar{W} = 2.272166667$ cm	$\sigma_s(W) = 1.722401428 \times 10^{-3}$	$\Delta\bar{W} = 7.031674386 \times 10^{-4}$ cm
$\bar{T} =$ 1.237 cm	$\sigma_s(T) = 2.19089023 \times 10^{-3}$	$\Delta\bar{T} = 8.94427191 \times 10^{-4}$ cm

$V = \bar{L} \times \bar{W} \times \bar{T} =$ (4.691) x (2.272166667) x (1.237) = 13.18485375 **CM^3**

$\frac{\Delta V}{V} = \frac{\Delta\bar{L}}{\bar{L}} + \frac{\Delta\bar{W}}{\bar{W}} + \frac{\Delta\bar{T}}{\bar{T}} =$ (3.376388603 **x** 10^{-3} ÷ 4.691) **+** (7.031674386 **x** 10^{-4} ÷ 2.272166667) + (8.94427191 **x** 10^{-4} ÷ 1.237) **=**

(7.197588154 **x** 10^{-4}) **+** (3.094700089 **x** 10^{-4}) **+** (7.230615934 **x** 10^{-4}) **=** 1.752296418 **x** 10^{-3}

$\Delta V =$ (1.752296418 **x** 10^{-3}) **x** (13.18485375) **=** 0.023103771 **CM^3**

$\rho = \frac{M}{V} =$ (35.3) ÷ (13.18485375) = 2.677314491 **g/cm^3**

$\frac{\Delta\rho}{\rho} = \frac{\Delta M}{M} + \frac{\Delta V}{V} =$**(**0.1 ÷ 35.3) **+** (1.752296418 **x** 10^{-3}) **=** 4.58157668 **x** 10^{-3}

$\Delta\rho =$4.58157668 **x** 10^{-3} **x** 2.677314491 = 0.012275909 **g/cm^3**

$a = \sqrt[3]{\frac{A_w}{N_A \rho}} = \sqrt[3]{\frac{26.982}{(6.023 \text{ x } 10\text{^}23)\text{x } (2.677314491)}}$ **=** 2.560059178 **x** 10^{-8} **CM**

(4) Results:

- The density of the metal block is $\rho = 2.677 \pm 0.012$ **g/cm^3**
- The distance between at atoms is $a = 2.56$ **A**

(5) Conclusions:

$\rho \pm \Delta\rho = 2.677 \pm 0.012$ g/cm^3

Discrepancy Test = |true value – exp. Value| ≤ 2 * error

= |2.7 – 2.677| ≤ 2*0.012 →→→ **=** 0.023 ≤ 0.024 (its correct)

The result is accepted. **(The true value = 2.7 is the aluminum density).**

We make the discrepancy test to see if the result is accepted or not.

We repeat the measurements in length, width and thickness (**L,W,T**) from several places in the experiment to increase the accuracy of the reading that we did it, and to reduce the random errors.

Also , the systematic errors affect the real value because they make the reading far from the true value this leads to confusion in the result and make doubts in the result of the experiment .

In this experiment , we use caliper , micrometer and balance scale ,
To reduce the uncertainly we need to use a better and advanced version of this equipment .