جامعة بيرزيت

BIRZEIT UNIVERSITY

Faculty of Science كلية العلوم

Department of Physics دائرة الفيزياء

Phys111 Report

9/10

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

Name:		**ID #:**	
Partner:		**ID #:**	
Section:	3		
Date:	6/4/2022		

(1) Abstract:

Aim of the experiment:

Calculate the density of a block of metal, and calculate the approximate distance between atoms.

The main results are:

- The density of the metal block is ρ = 7.40 ± 0.04 g/cm^3
- The distance between at atoms is a = 2.32 A_o = 2.32×10^{-8} cm

(2) Data:

Block #: S 32 **Mass (M)** = 87.5 ± 0.1 gm

	1.	2.	3.	4.	5.	6.
L (cm)	4,000	3,980	3,990	4,010	4,005	4,000
W (cm)	1,900	1,915	1,920	1,930	1,905	1,925
T (cm)	1.540	1,545	1,546	1,547	1,549	1,548

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(3) Calculations:

$\bar{L}$ = 3.997 cm	$\sigma_s(L) = 0.0108$	$\Delta\bar{L}$ = 0.004 cm
$\bar{W}$ = 1.916 cm	$\sigma_s(W) = 0.01158$	$\Delta\bar{W}$ = 0.005 cm
$\bar{T}$ = 1.545 cm	$\sigma_s(T) = 0.00316$	$\Delta\bar{T}$ = 0.0013 cm

$V = \bar{L} \times \bar{W} \times \bar{T} = 11.831999\ cm^3$

$\frac{\Delta V}{V} = \frac{\Delta \bar{L}}{\bar{L}} + \frac{\Delta \bar{W}}{\bar{W}} + \frac{\Delta \bar{T}}{\bar{T}} = \frac{\Delta V}{11.831999} = \frac{0.004}{3.997} + \frac{0.005}{1.916} + \frac{0.001}{1.545} = 4.2576 \times 10^{-3}$

$\Delta V = 0.05\ cm^3$

$\rho = \frac{M}{V} = \frac{87.5\ gm}{11.831999\ cm^3} = 7.3952\ g/cm^3$

$\frac{\Delta \rho}{\rho} = \frac{\Delta M}{M} + \frac{\Delta V}{V} = \frac{\Delta P}{7.3952} = \frac{0.1}{87.5} + \frac{0.05}{11.831999} = 5.3686 \times 10^{-3}$

$\Delta \rho = 0.0397 \approx 0.04\ g/cm^3$

$a = \sqrt[3]{\frac{A_w}{N_A \rho}} = \sqrt[3]{\frac{55.845}{6.023 \times 10^{23} \times 7.3952}} = 2.323 \times 10^{-8} cm = 2.323\ A_o$

$A_o = 10^{-10} m$

(4) Results:

- The density of the metal block is $\rho = 7.40 \pm 0.04\ g/cm^3$
- The distance between at atoms is $a =$ 2.320 A_o

(5) Conclusions:

* Our measured value of the density of Iron is 7.40 g/cm^3 with an error of 0.04 g/cm^3 come from many reasons. First, we might measure the block while it's oblique and wrongly mounted, second we might stress on the micrometer so the measured value is not accure.

* The discrepancy Test: $|R_{True} - R_{exp}| \leq 2\Delta R$ The true value is $\rho_{Iron} = 7.88\ g/cm^3$

$|7.88 - 7.40| \leq 2 \times 0.04 \Rightarrow 0.48 \nleq 0.08 \Rightarrow$ False so the value is not accepted, that's because some mistakes accure during the measuring process mentioned above

* We repeat the measurements many times in differen locations in order to avoid any systimatic error and correct it in the next time,

* The systematic errors doesn't affect standard deviation σ_s.

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