[](https://www.google.ps/url?sa=i&rct=j&q=&esrc=s&source=images&cd=&cad=rja&uact=8&ved=0ahUKEwiXkvOBo6HSAhXMtBoKHbRWCLEQjRwIBw&url=https://en.wikipedia.org/wiki/File:Birzeit_University_logo.svg&psig=AFQjCNFpnpXtrjWTp_fTkxvhtGLlIhXMOw&ust=1487769385132017)

**Physics Lab 211**

**Experiment No. 6**

**Torsional Torques and the Torsional Modulus**

**(Only Calculations and Graphs)**

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**Partner’s Name:**

**-Main Result:**

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**Data Sheet:**

**Part 1:**

|  |  |  |
| --- | --- | --- |
| **(rad)** | **(N)** | **(N.m)** |
| 0.174 | 0.11 | 0.017 |
| 0.349 | 0.21 | 0.032 |
| 0.524 | 0.27 | 0.041 |
| 0.698 | 0.35 | 0.053 |
| 0.873 | 0.46 | 0.069 |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Rod** | **d (mm)** | **(sec)** |  |  |  |
| 1 | 1.960 | 2.231 | 0.071 | -2.708 | -1.146 |
| 2 | 2.960 | 1.015 | 0.345 | -2.529 | -0.462 |
| 3 | 3.960 | 0.552 | 1.165 | -2.402 | 0.066 |

**Part 2**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Rod** | **l (cm)** | **(sec)** |  |  |  |
| 1 | 48.0 | 2.231 | 0.071 | -0.319 | -1.146 |
| 2 | 38.0 | 2.043 | 0.085 | -0.420 | -1.070 |
| 3 | 27.2 | 1.774 | 0.113 | -0.565 | -0.947 |

**Part 3**

**Calculations:**

**Part I:**

We can obtain the value of from the slope of (**Graph I**). And then, we can substitute in the period equation, to calculate the value of(T is measured in part II):

, this value is constant.

**Part II:**

The length is the same in these three rods and is , we can find the torsional constant for every one of them using the following equation:

**Rod 1**:

**Rod 2**:

**Rod 3**:

By rearranging the equation: , we obtain:

, is the slope, and is the y-intercept.

From (**Graph II**):

**Part III:**

The diameter is the same in these three rods and is , we can find the torsional constant for every one of them using the following equation:

**Rod 1**:

**Rod 2**:

**Rod 3**:

By rearranging again the equation: , we obtain:

, is the slope, and is the y-intercept.

From (**Graph III**):

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Now in order to find, we must substitute in the y-intercept equation of the two graphs:

From (**Graph II**):

From (**Graph III**):

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**Results & Conclusions:**

The shear modulus for aluminum is , so by using the discrepancy test:

Therefore, our obtained value is accepted.

The torsional constant accuracy can be indicated from the y-intercept of the first graph. The theoretical y-intercept must equal zero, experimentally it is 0.002 N.m, which is a negligible quantity.

This experiment is very sensitive and lots of random errors may have occurred. Most likely, the rods are not completely straight which affects the whole experiment by giving a wrong value for the torsional force which leads to an error in the torsional constant and eventually in the moment of inertia. Also, the difference in time between completing the period and stopping the stop watch could have affected the experiment as well. Another source of error is that the rods considered to be with the same length or same diameter were not actually like that, which increases the possibility of errors in the values of the constants n & m.

**Graph I**

|  |  |  |
| --- | --- | --- |
|  | **slope** | **y-intercept** |
|  | 0.072 | 0.004 |
| **Error** | 0.004 | 0.002 |

**Graph II**

|  |  |  |
| --- | --- | --- |
|  | **slope** | **y-intercept** |
|  | 3.960 | 9.570 |
| **Error** | 0.100 | 0.255 |

**Graph III**

|  |  |  |
| --- | --- | --- |
|  | **slope** | **y-intercept** |
|  | -0.809 | -1.406 |
| **Error** | 0.025 | 0.011 |