The Mathematical Pendulum

Mechanics Lab nr. 1

UNIVERSITY OF BUCHAREST
Faculty of Physics

Contents

1 Purpose of the experiment

-Estimation of the gravitational acceleration constant

2 Formulae

$$T = 2\pi\sqrt{\frac{l}{g}} \tag{1}$$

From (1) we can derive:

$$g = \frac{4\pi^2 l}{T^2} \tag{2}$$

Also for the graphical representation in section 4 we shall map the length of the pendulum l to the square of the period T^2:

$$4\pi^2 l = g \cdot T^2 \tag{3}$$

where,
g - is the gravitational constant
l - is the length of the pendulum
T - is the period of the pendulum
$\pi \approx 3.142$

3 Experimental Data and Results

Using equation (2) we computed different values of g from the experimental data and averaged out the result.

Table 1: Gravitational acceleration

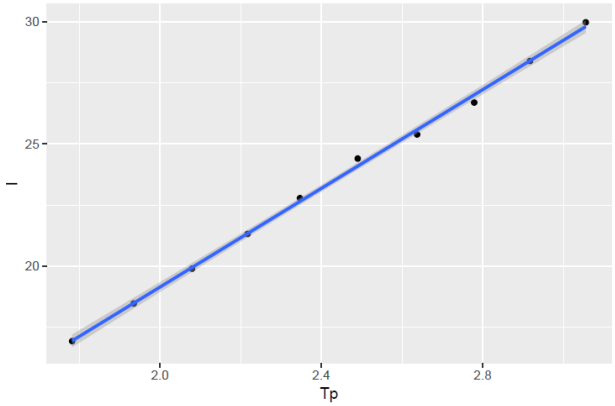
$l(m)$	$T(s)$	$4\pi^2 l(m)$	$T^2(s^2)$	$g(\mathrm{m/s^2})$	$\overline{g}$
0.759	1.748				
0.719	1.708				
0.676	1.667				
0.643	1.624				
0.618	1.578				
0.577	1.532				
0.54	1.489				
0.504	1.442				
0.468	1.391				
0.429	1.335				

4 Graphs

4.1 Fitting graph

In this section we plotted $y = 4\pi^2 l$ to $x = T^2$, the slope of the linear curve being exactly g.

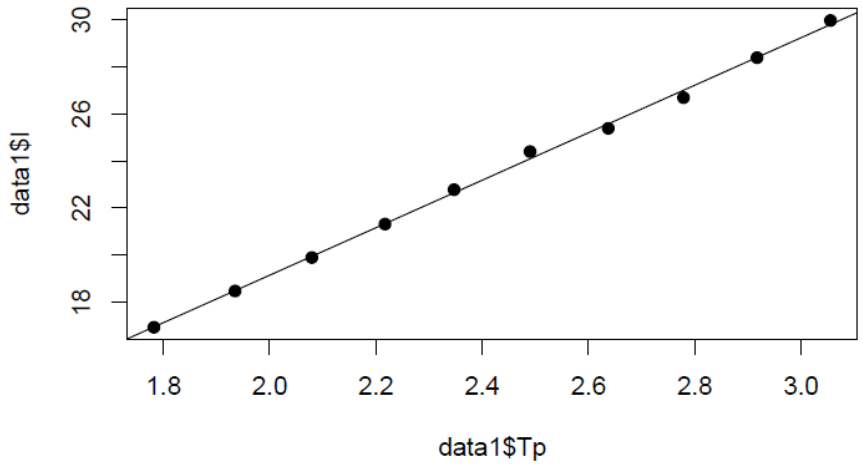
Example:



$\tan\alpha = g$ =?

4.2 The least square rule

Example:



5 Error analysis

$$g = g_{ev} \pm \delta g \tag{4}$$

where,

-g_{ev} is the evaluated gravitational acceleration in the experiment (from Table 1, row 2);

-δg is the absolute error of g

$$g(\pi, l, T) = \frac{4\pi^2 l}{T^2}$$

Version I

$$\delta g = \left|\frac{\partial g}{\partial \pi}\right| \delta\pi + \left|\frac{\partial g}{\partial l}\right| \delta l + \left|\frac{\partial g}{\partial T}\right| \delta T$$

Version II

Calculate ε_g with elementary function rules and $\delta_g = g_{ev} \times \varepsilon_g$