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1st Year LMD (ST)

PW of physics 1

PW N°1 : Errors and Uncertainty

Name and Family name	Group	Homework mark …../05	Report's mark …../15
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PW N°1 : Errors and Uncertainty

1 - Aim of the experiment

The overall aim of this experiment is to know how to make measurements the property physics, and to calculate the errors that may arise during this measurement and to get closer to the real value of the quantity.

2 - Notions and preparatory work

2 – 1 Definition : Errors, which produce a difference between the real value and the one we measured, are the outcome of something going wrong in the measuring process.

$$\boldsymbol{\delta_n = x_r - x_n}$$

$\boldsymbol{x_r}(\bar{x}\ or\ x_m)$: is the real value (experimentally is the mean value)

$\boldsymbol{x_n}$: is the measured value.

2 – 2 Statistical calculation :

a – The mean : defined as being the ratio of the arithmetic sum of a number n of measure to their number, which can be expressed as follows :

$$\boldsymbol{\bar{x} = \frac{x_1 + x_2 + x_3 + \cdots + x_n}{n} = \frac{\sum_{i=1}^{n} x_i}{n}}$$

b - The absolute uncertainty*(Δ x)* : Because of the difference between the real value and the measured one, a degree of uncertainty will pertain to our measurements. The actual value exists in an 'uncertainty range'. This is the maximum value that can take an error, is reported as :

$$\boldsymbol{Mean\ value \pm absolute\ uncertainty}$$

b – 1 *Direct measurement* : $\boldsymbol{\Delta x = max\ (\delta_n)}$

b – 2 *Indirect measurement* : if the physical quantity depends on several variables, $x = f(a,b,c...)$, the absolute uncertainty will be given by the following expression :

$$\boldsymbol{\Delta x = \left|\frac{\partial f}{\partial a}\right| \Delta a + \left|\frac{\partial f}{\partial b}\right| \Delta b + \left|\frac{\partial f}{\partial c}\right| \Delta c + \cdots}$$

c- Relative uncertainty : it is the ratio of the absolute uncertainty to the average value, and given by : $\frac{\Delta x}{\bar{x}}$

Remark : the measured value is written in the following form : $\boldsymbol{x = \bar{x} + \Delta x}$

PW of physics 1PW N°1 : Errors and Uncertainty

2. Practical

2.1 – measurement of mass and density:

a –direct measurement

Take a steel ball, weigh it "***m***", repeat the procedure 10 times and record the results in the table below :

N° measure	1	2	3	4	5	6	7	8	9	10
Mass m (gr)										

Questions

1°- Calculate the mean of the measured value $\bar{m} =$

2°- Calculate absolute uncertainly $\Delta m =$

3°- Calculate relative uncertainly $\frac{\Delta m}{\bar{m}} =$

4°- write the measured value $m =$

b – Indirect measurement

Take the same ball, measure its radius***R***, repeat the procedure 10 times and record the results in the table below :

N° measure	1	2	3	4	5	6	7	8	9	10
Radius *R* (cm)										
Density ρ (gr/cm^3)										

Questions

1°- Calculate the mean of the measured value $\bar{\rho} =$

2°- Calculate absolute and relative value of the radius *R*. $\bar{R} =$ $\Delta R =$

3°- Give the expression of the absolute uncertainty $\Delta\rho$as a function of R, m, ΔRandΔm

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4°- Calculate absolute uncertainly $\Delta\rho =$

5°- Calculate relative uncertainly $\frac{\Delta\rho}{\bar{\rho}} =$

6°- write the measured value $\rho =$