University of Batna 2 2023/2024
Faculty of Natural and Life Sciences (FNLS)
1st Year Common Base NLS
Module: Physics

Tutorial Series No. 1

Mathematical Remainder

Part I: Dimensional Analysis

Exercise 1:

Complete the following table:

Physical Quantity	Symbol of the Quantity	Formula used	dimension	Unite (SI)
Area				
Volume				
Mass density				
Velocity				
Acceleration				
Force				
Pressure				
Energy				
Power				

2. The unit of force in the International System is the Newton, while in the CGS system, it is the dyne. Find the ratio between the two units of force.

Exercise 2:

The attractive force between two material points of masses m and m′, separated by a distance r, is given by the magnitude of Newton's law:

$$F = G.\frac{m.m'}{r^2}$$

Here, G is the gravitational constant.

1. What is the dimension of the gravitational constant?
2. Deduce its unit in the SI system.

Exercise 3:

Are the following expressions homogeneous, that is, physically acceptable?

a) $m_1^2 - m_2 = m^3$
b) $m_1 . l_1 = m_2 . l_2 . e^{-t_1}$
c) $\frac{l_1}{l_2} = \ln\left(\frac{t_1}{t_2}\right)$
d) $m_1 . \cos\left(\frac{l_1 t_1}{l_2 t_2}\right) = m_2 . e^{-\frac{t_1}{t_2}}$

Here, $\boldsymbol{l}_i$ represents a length, $\boldsymbol{m_i}$ represents a mass, and $\boldsymbol{t_i}$ represents time.

Exercise 4 :

1. The experiment demonstrates that the force exerted by a liquid on a submerged sphere is proportional to the radius of the sphere (R) and its linear velocity (v). Its expression is written as: $F = 6\pi\eta^x R^y v^z$, where η is a dimensional coefficient [η]= $ML^{-1}T^{-1}$. Find the values of x, y, and z.
2. When the velocity is somewhat high, the force expression becomes $F = kSv^2$, where k is a constant and S is the surface area of the large circle. Determine the dimensions of the constant k.

Part II: Uncertainty Calculation

Exercise 1:

Five students took turns measuring the diameter of a compact disc, and they recorded their results in the following table:

Student 1	Student 2	Student 3	Student 4	Student 5
120.5 mm	119.0 mm	119.7 mm	118.9 mm	120.0 mm

1. Provide the result of this set of measurements using two different methods.

2. What is the measurement precision in each case?

Exercise 2:

The electrical resistivity (ρ) of a cylindrical wire with length l, diameter D, and resistance (R) is given by the relation:

$$\rho = \frac{\pi . R . D^2}{4 . l}$$

University of Batna 2 2023/2024

Faculty of Natural and Life Sciences (FNLS)

1st Year Common Base NLS

Module: Physics

Provide the uncertainty in electrical resistivity (ρ) using:

a. The total differential method.

b. The logarithmic method.

Calculate ρ, the absolute uncertainty (Δρ), and provide the measurement precision (Δρ/ρ).

Given for numerical application:

l= (2,0000 ± 0,0001)m, R = (2,4562 ± 0,0002)Ω, D = (2,30 ± 0,01)mm. Assume these values are known exactly.