BADJI-MOKHTAR ANNABA UNIVERSITY *2023-2024*
FACULTY OF TECHNOLOGY
PHYSICS 1 MODULE

Series 1: Dimensional equations

Exercise 1:
1- Determine the dimensional equations of the following quantities and give their units in the international system (SI): The bulk density ρ - The intensity of a force *F*- The work *W*- The power *P*- The electrical charge *Q*- the electrical tension *U*, The electrical resistance *R*- The capacitance of a capacitor *C*.
2- Verify the homogeneity of the following expressions: $\frac{1}{2}mv^2 - mgh - Ri^2t - F\ell cos\theta$.

Exercise 2:
Stokes' formula F=6πaηv gives the resistive force exerted on a sphere of radius *a*, velocity *v*, in a viscous fluid of viscosity coefficient η.
Determine the dimensional equation for the coefficient η.

Exercise 3:
The speed limit reached by a weighted parachute is a function of its weight P and its surface area S is :

$$v = \sqrt{\frac{P}{KS}}$$

- Give the dimensions of the constant *k*.

Exercise 4:
The density ρ of a cylinder of mass *m*, radius *R* and length *l* is given by the following relationship:

$$\rho = \frac{m^{\alpha}}{\pi\, l^{\beta} R^2}$$

1- Using the dimensions, find the two constants α and β.
2- Deduce the exact expression for the bulk density ρ.

Exercise 5:
The limiting velocity *v* of a sphere of radius *R* and density ρ' falling into a viscous medium of viscosity coefficient η and bulk density ρ is given by the formula :

$$v = \frac{1}{9}\frac{R^2 g(\rho' - \rho)}{\eta}$$

where g is the acceleration of gravity. The dimensional equation for the coefficient η is: $ML^{-1}T^{-1}$.
-Verify the consistency of this formula.

Exercise 6 :

The electric field E created by a charge q is given by the relation $E = \frac{1}{4\pi\varepsilon_0}\frac{q}{r^2}$ and the

magnetic field B is given by the relation $B = \frac{\mu_0 qv}{4\pi r^2}$.

Where *r* is distance and *v* is velocity. Remember that the Lorentz force is given by the relation $F = qvB$.

- Give the dimensions of ε_0 and μ_0.
- Verify the following relationship : $[\varepsilon_0 \mu_0 c^2] = 1$

Exercise 7:

Calculate the relative uncertainty of the capacity measurement (C) of a capacitor equivalent to two mounted capacitors C_1 and C_2 :

a- in parallel

b- in series

Exercise 8:

Let the relation: $y = y_0 e^{-\omega t}$

Calculate the absolute uncertainty of y as a function of the absolute uncertainties: $\Delta\omega$, Δt, Δy_0

Exercise 9 : (Homework)

The period of oscillation *T*, of a torsion pendulum consisting of a sphere of mass *m* and radius *R*, is written :

$$T = \frac{1}{2\pi}\sqrt{\frac{\frac{2}{5}mr^2}{c}}$$

- Find the dimension of the constant c.
- Calculate the relative uncertainty of c ($\frac{\Delta c}{c}$), considering that:

T= (0.700±0.001)s, m=(0.960±0.001)Kg and R=(0.072±0.001)m.