**Series N° 01**

**DIMENSIONAL ANALYSIS**

**Exercise n°1 :**

Using the dimensions of the basic quantities, complete the following table:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Physical Quantity | Symbol | Formula used | Dimension | Unit (IS) |
| Speed or velocity Angular velocity  Acceleration  Force  Pressure , Stress  Work  Energy ( all form )  Electrical charge  Electric field  Electric Potential  Electrical resistance  Electric power | *𝑣*  *ω*  *a*  F  *p*  *W*  *E*  *q*  *u*  *R*  *Pe* |  |  |  |

**Exercise n°2:**

Find the dimensions of the following quantities:  the gravitational constant, the vacuum permittivity and the vacuum permeability, knowing that these three constants appear in the following equations:

 …. (1),  …. (2) et  …. (3)

Where:  is a force,  and  are masses,  and  electric charges,  and  distances and  Electric Current Intensity.

2- The speed of light (c) is a function of these three constants:****. Find the expression for c.

**Exercise n°3 :**

A student noticed, in a physics laboratory, that the position **x** of an electron as a function of its acceleration **a** and time **t** is written in the form

k is a dimensionless constant.

1. Determine the exact expression of the position by calculating and**.**
2. Using the logarithmic method, find the relative uncertainty about the position x based on and .

**Exercise n°4 :**

Find the dimension of G with  where **t** denotes time, **x** is a length and g is an acceleration of gravity

1. Find the absolute uncertainty of the physical quantity G.
2. Find the relative uncertainty of the centripetal force 

**Exercise n°5 :**

1. The ideal gas law states that (**PV = NRT)**, where **P** is the absolute pressure of a gas, **V** is the volume it occupies, **N** is the number of atoms and molecules in the gas, and **T** is its absolute temperature.
2. What is the dimension of the universal gas constant R?
3. What is its unity in the international system?
4. The equation of state of a real gas molecule is given by :

****

In this expression **a** and **b** are coefficients such that a=3.5 .10-3 SI and b=2.5 .10-5 SI.

* Give the equations for the dimensions of **a** and **b**.

**Exercise n°6: optional**

Kepler's third law, which relates the period (T) and the semi-major axis (a) of the orbit of a planet around the sun, is written in the form :

Where (G) is the universal gravitational constant and (Ms) the mass of the sun.

For planet earth,

T=(365,25636567±0,00000001) days and a=(1.4960±0.0003).10+11 m.

We also give G=(6.668±0.005).10+11 SI.

1. Determine the dimension and unit of G.
2. Calculate the mass of the sun and the absolute error of this mass (∆Ms) using the total differential.
3. Check the homogeneity of the following expression:  (period of a simple pendulum).