Practical works in mechanical elements

Dr. Adel DAOUD

Assistant Professor, (MAB) University Mohamed Khider Biskra

Faculty of Science and Technology Common Core in Science and Technology

Email: adel.daoud@univ-biskra.dz

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I. General introduction

Definition of physical quantity:

Physics describes matter and space, their properties and behaviors. The goal of physics study is to explain observed phenomena by giving care to the measurement concept called physical quantity, it is an observable property, either directly or with the help of a measuring instrument. When their measurement is expressed by a single number, it is referred to as a scalar quantity. It represents a vector quantity when a set of multiple numbers is needed. To perform quantities, they must be compared to a dimension of same nature, chosen as a unit. A physical quantity is any physical property that can be quantified and measured, under specific conditions, takes on a defined numerical value that can vary (increase or decrease). The set of units is grouped into a coherent and universal system of units called the international System (SI). Therefore, any physical quantity can be expressed based on these fundamental (base) units.

Objectifs spécifiques (selon la taxonomie de Bllom)	**Activités prévues**	**Justifications**
I - Practical Work N°1: Physical measurements **The objectives of this experiment are as follows:** 1. Know the difference between direct measurement (length, temperature, time...) and indirect measurement for composite quantities (area, work, and moment) of a physical quantity. 2. Identify uncertainty, its types, and how it can be calculated. 3. Identify the measuring tools and devices used, compare their accuracy, and apply uncertainty to them.	Calculate absolute uncertainty and relative uncertainty.	In this applied work, we chose the most important unit in physics, which is length, for different shapes: 1. cube 2. ball 3. cylinder We measured the length using: 1. Ruler 2. Ductal foot 3. Palmer As a direct

		measurement As for indirect measurement, we calculated the volume We applied the laws of uncertainty in both cases.
II - Practical Work N°2: Free fall **The objectives of this experiment are as follows:** 1. To measure the displacement of a freely falling object 2. To test the hypothesis that the acceleration of a freely falling object is uniform 3. To calculate the uniform acceleration of a falling object due to gravity (g).	Applying Newton's laws of motion to an iron ball, neglecting Archimedes' impulse.	In this applied work, we let an iron ball fall from different heights, and we want to prove the nature of uniformly accelerated movement, and that the acceleration of movement is the same as the acceleration of gravity, by applying Newton's laws. We calculated the uncertainty of the Earth's gravitational acceleration (g).

IV. Final evaluation exam test de sortie test pre-requis

I- To calculate the Earth's acceleration (gravity) g using a pendelum, we measure the length of the pendelum l and the period of oscillation T, and then use the formula: T = 2.π√(l/g)

with l = 1,552 ± 0.002 [m] and T = 2,50 ± 0,02 [s]

1. Evaluate g with its relative and absolute uncertainties ?

$g = (4 \cdot \pi^2 \cdot l) / T^2 = (4 \cdot \pi^2 \cdot 1{,}552\ [m]) / (2{,}5\ [s])^2 = \underline{9{,}80\ [m/s^2]}$

$\Delta g / g = \Delta l/l + 2 \cdot \Delta T/T = (0{,}002m/1{,}552m) + 2 \cdot (0{,}02s/2{,}5s) =$

$0{,}00129 + 2 \cdot (0{,}008) = 0{,}01729 \cong \underline{1{,}7\ \%}$

$\Delta g = (\Delta g / g) \cdot g = 0{,}01729 \cdot 9{,}8\ [m/s^2] = 0{,}169\ [m/s^2] \cong \underline{0{,}17\ [m/s^2]}$

$\underline{g = 9{,}80 \pm 0{,}17\ [m/s^2]}$ (donc g est compris entre 9,63 [m/s²] et 9,97 [m/s²])

ou plus prudent:

$\underline{g = 9{,}8 \pm 0{,}2\ [m/s^2]}$ <u>(donc g est compris entre 9,6 [m/s2] et 10,0 [m/s²])</u>

The relation is given: $g = g0/(1+h/R)^2$ where g and g0 are accelerations and h,R are distances. Calculate the relative uncertainty of g in terms of $\Delta g0$, Δh and ΔR.

$$\boldsymbol{lng = ln\frac{g_0}{\left(1+\frac{h}{R}\right)^2} = lng_0 - 2ln\left(1+\frac{h}{R}\right) = lng_0 - 2ln(R+h) + 2lnR}$$

$$\frac{dg}{g} = \frac{dg_0}{g_0} - 2\frac{dR+dh}{R+h} + 2\frac{dR}{R} = \frac{dg_0}{g} - 2\frac{dh}{h+R} - 2\frac{dR}{h+R} + 2\frac{dR}{R} =$$

II- We consider an iron ball falling freely from the following distances of 10 cm, 40 cm, and 90 cm, during the following times, 100 ms, 200 s, and 300 s.

1. Calculate instantaneous velocities?

2. What do you conclude?

The solution:

II-1. Instantaneous velocity is the distance during the time:

Vinst1= X1/t1=0.1/0.1=1 m/s

Vinst2= X1/t1=0.4/0.2=2 m/s

Vinst3= X1/t1=0.9/0.3=3 m/s

II-2. We conclude that the velocity of the iron ball increases instantaneously from 1 m/s to 3 m/s, which means that the motion is Rectilinear Uniformly Accelerated Motion (RUAM)