1 - Aim of the experiment

The overall aim of this experiment is to study the fall of an object, which is not subjected to any external force acting on it, and to calculate the value of the acceleration of gravity "***g***".
The acceleration can then be calculated using an equation of motion.
This is done by measuring the time "***t***" it takes an object to fall a certain distance "***h***" (height).

2 - Notions and preparatory work

2.1 - Motion formulation

2.1.1 - Starting from the fall of an object in the general conditions, find the equation of motion?

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2.1.2 - In the particular case of the initial conditions where the speed and the height (ordinate) are zero. Deduce the equation of motion?

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2.2 – Preparatory

Let a cylindrical body of ***m = 52 gr*** and height ***l = 17 mm*** drop from a height h.
Calculate the time of the fall assuming that the acceleration due to gravity g = 9.8 m/s^2?

h (cm)	***80***	***70***	***60***	***50***	***40***	***30***	***20***
t^2 (s)							
t (s)							

2.2.1 - Complete the table
2.2.2 - Plot the change in height as a function of time ***h = f (t^2)***.
2.2.3 - What does the slope represent?

3 - Manipulation

3.1 - Description

Figure 1 shows a descriptive schematic of an object in free fall. This experiment method is to determine acceleration of a falling object, allowing to vary the height of the cylindrical object drops and to measure the time taken by the apparatus

3.2 - Operating mode

- set up the apparatus according to figure 1.
- Attach the optical light gate at a starting distance of around 10 cm
- Adjust and fix the electromagnet to the top of clamp stand, according to the heights indicated in the table compared to the optical light gate.
- The height h between the optical light gate and the electromagnet, can be measured using a meter ruler
- Place the cylindrical body directly underneath the electromagnet so that the axis of the cylinder is vertical. Make sure it faces directly downwards and not at an angle. Do not switch on the current till everything is set up.
- Switch on the current to the electromagnet and place the cylindrical body directly underneath so it is attracted to it
- Press the "Start-Stop" button. The current to the electromagnet switches off, the object drops and the timer starts.
- When the object drops through the optical gate, the timer stops. The reading on the timer indicates the time *"**t**"* and *"**δt**"* it takes for the object to fall a height *"**h**"*.
- Repeat the experiment measurement at least 03 times for each different values of the height h should be used, and calculate an average value of the time *"**t**"* in order to reduce random error.

3.3 - Complete the table

h (cm)	80	70	60	50	40	30	20
t (s)							
$\overline{t}\ (s)$							
$\overline{t}^{\,2}\ (s)$							
$g = \frac{2\,.\,h}{t^2}\ (m/s^2)$							
$\delta t\ (s)$							
$\overline{\delta t}\ (s)$							
$v = \frac{l}{\overline{\delta t}}\ (m/s)$							
$E_m^0 = E_c^0 + E_P^0\ (J)$							
$E_m^f = E_c^f + E_m^f\ (J)$							
E_m^0/E_m^f							

3.4 - Work requested

3.4.1 - Plot the variation of ***h*** as a function of time ***h = f (t²)***.

3.4.2 - Deduce from the graph (***Figure 2***) the experimental value of the acceleration gravity ***g***. Compare this value of g with that assumed in the theoretical study. Comment ?

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3.4.3 - Compare the mechanical energy (kinetic + potential) at the start of the movement with that measured at the point of attachment of the optical barrier. Comment ?

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3.4.4 - Write the value of the acceleration due to gravity in the form $\boldsymbol{g} = \bar{\boldsymbol{g}} \pm \boldsymbol{\Delta g}$

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3.4.5 - Give a general conclusion

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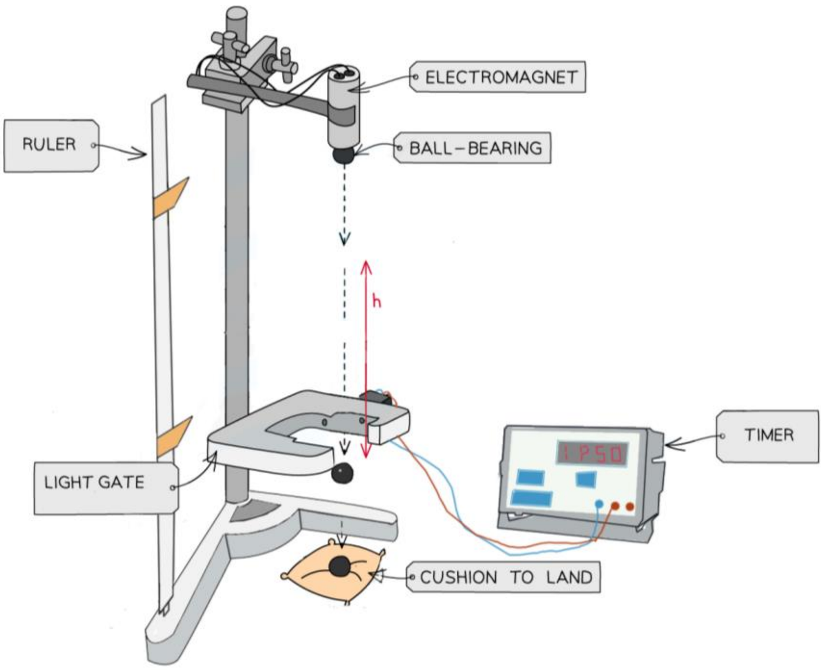

Figure 1 : Apparatus setup to measure the time for the object to drop

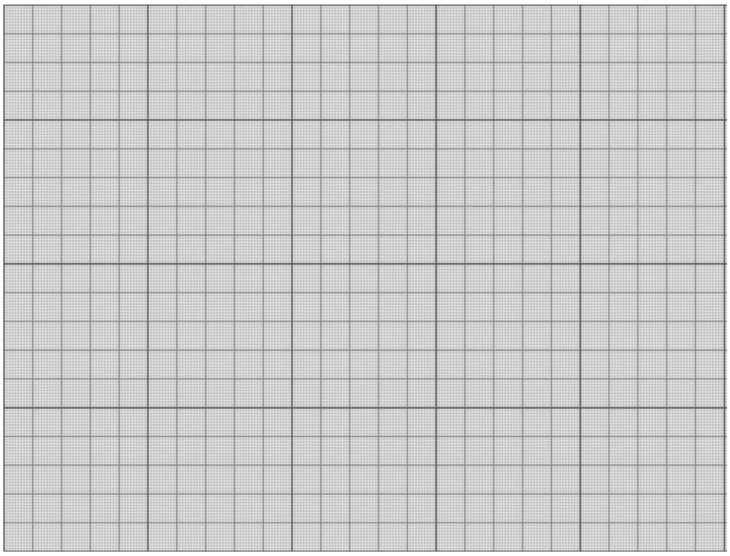

Figure 2 : Draw the graph