Khemis Miliana University
Faculty of Science and Technology
Department of Sciences of the Matter

جامعة الجيلالي بونعامة خميس مليانة
كلية العلوم والتكنولوجيا
قسم علوم المادة

L1 Sciences of the Matter

Perform some simple experiments with Phyphox

https://phyphox.org

Dr. S.E. BENTRIDI:
Email: s.bentridi@univ-dbkm.dz

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Outline:

- Free fall
- Measure the sound velocity
- Bouncing ball: (in)elastic collisions
- Simple pendulum

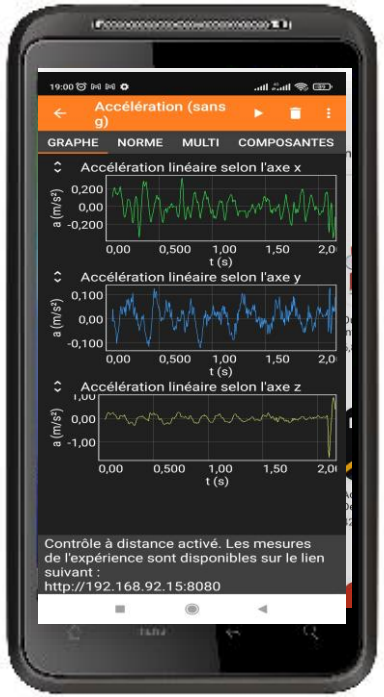
Free Fall

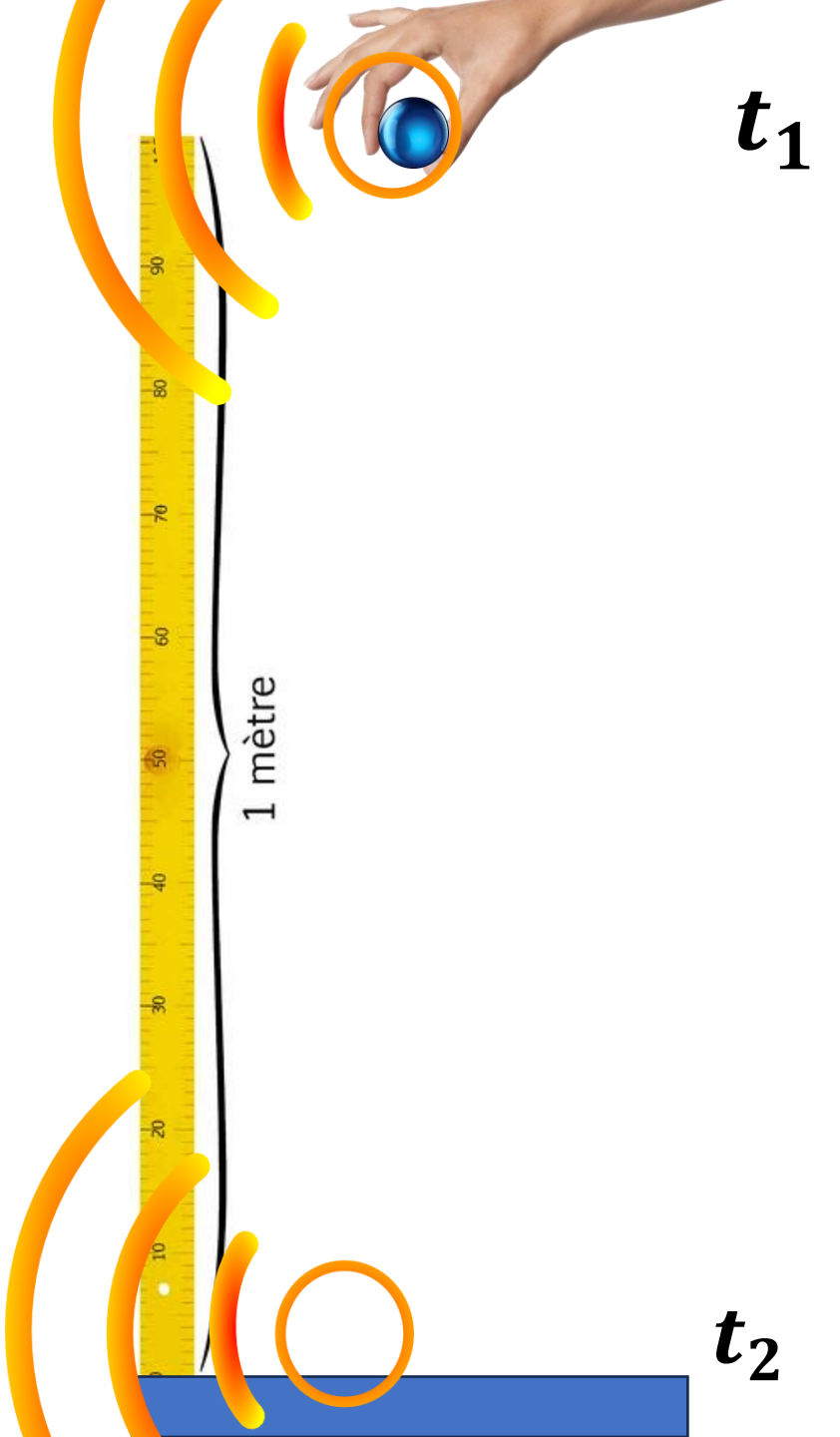
Free Fall

$$\Delta t = t_2 - t_1$$

$$z = \frac{1}{2} g \Delta t^2 + z_0$$

$$\Delta t = \sqrt{\frac{2\Delta z}{g}} = \sqrt{\frac{2h}{g}}$$





Measure the sound velocity:

Measure the sound velocity: (require two smartphone)

$$v_s = \frac{\Delta x}{t_{B1} - t_{A1}} = \frac{\Delta x}{t_{A2} - t_{B2}} \rightarrow \Delta x + \Delta x:$$

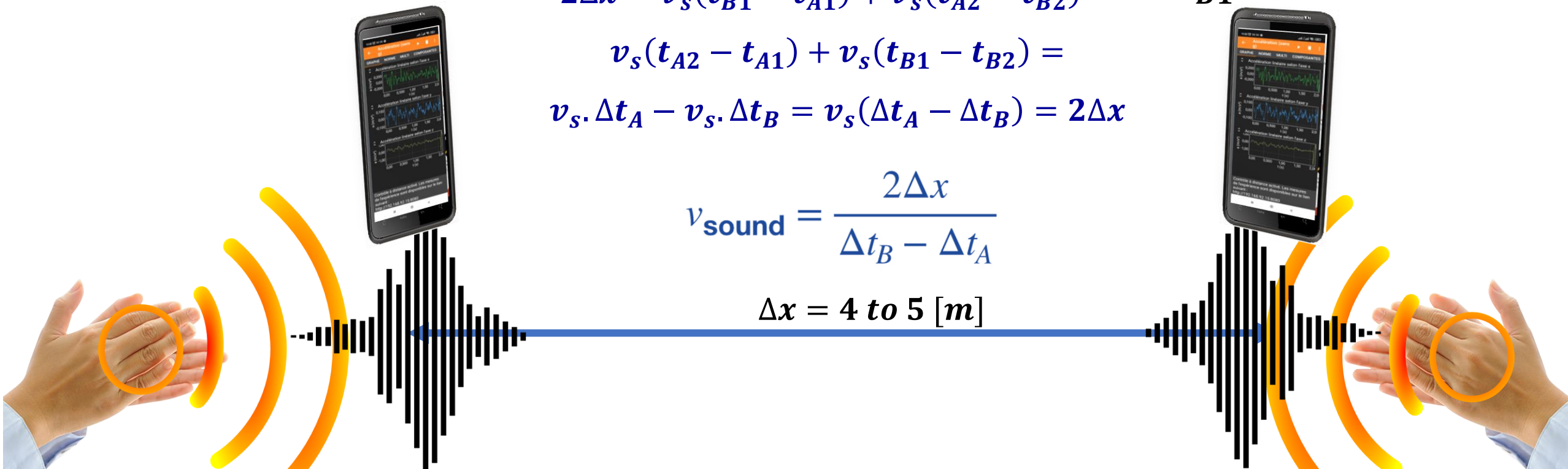
$$2\Delta x = v_s(t_{B1} - t_{A1}) + v_s(t_{A2} - t_{B2}) =$$

$$v_s(t_{A2} - t_{A1}) + v_s(t_{B1} - t_{B2}) =$$

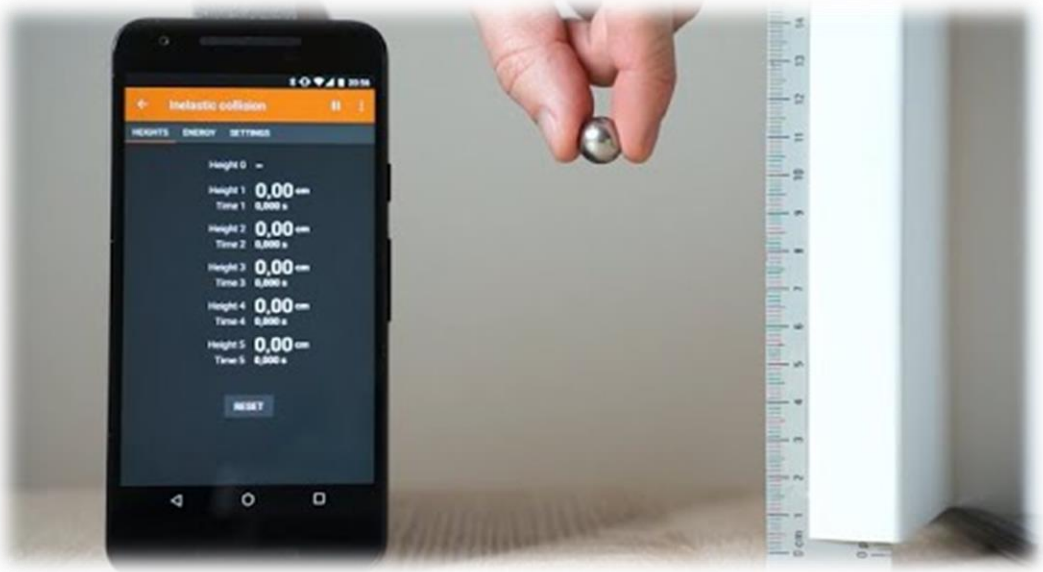
$$v_s.\Delta t_A - v_s.\Delta t_B = v_s(\Delta t_A - \Delta t_B) = 2\Delta x$$

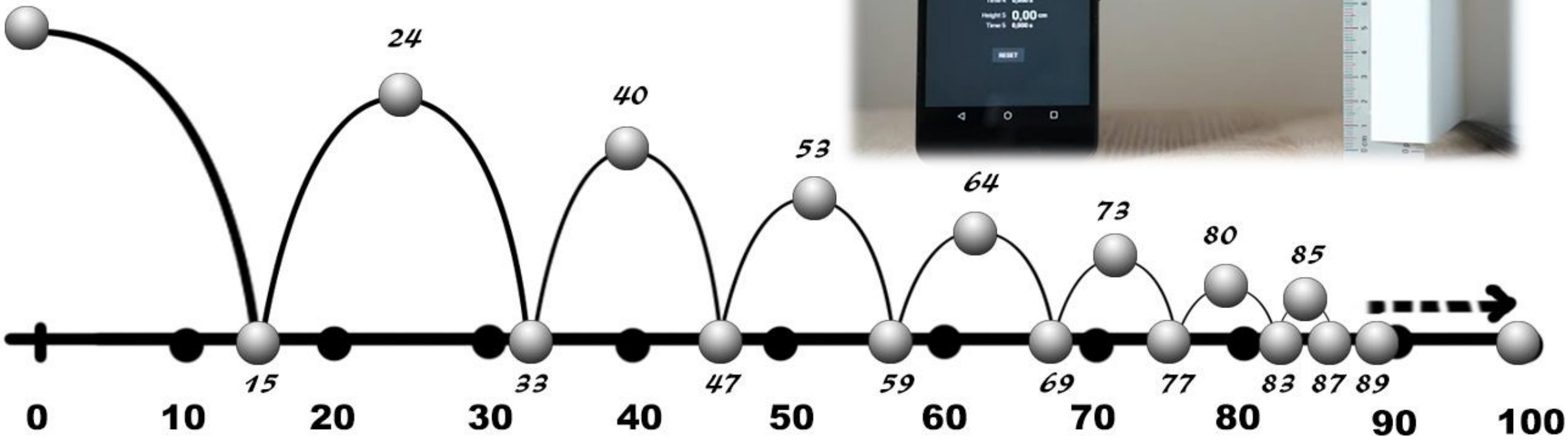
$$v_{\text{sound}} = \frac{2\Delta x}{\Delta t_B - \Delta t_A}$$

$$\Delta x = 4 \; to \; 5 \; [m]$$

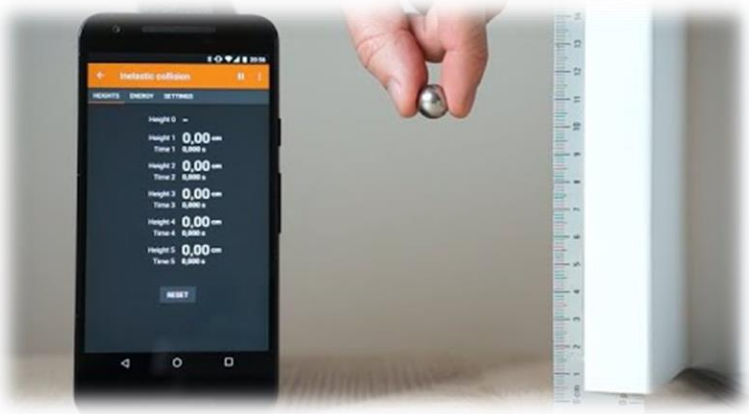


Bouncing ball experiment: (in)elastic collision





Bouncing ball experiment: (in)elastic collision



Mathematicaly we know that:

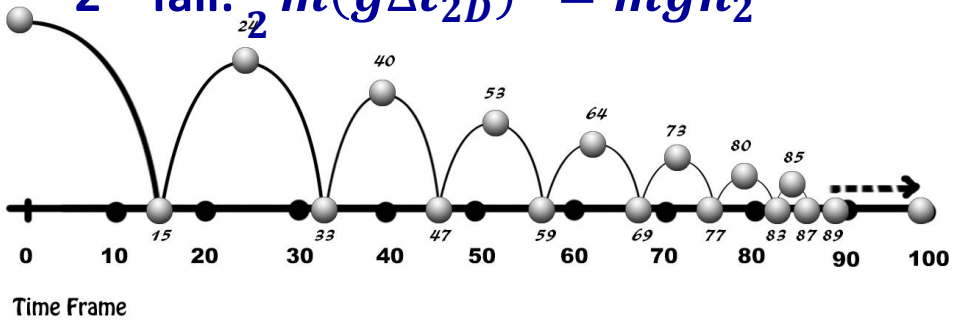
Initial fall: $mgh_0 = \frac{1}{2}mv_0^2 = \frac{1}{2}m(g\Delta t_0)^2$

1st rebound: $\frac{1}{2}m(g\Delta t_{1U})^2 = mgh_1$

1nd fall: $mgh_1 = \frac{1}{2}m(g\Delta t_{1D})^2 = \frac{1}{2}m(g\Delta t_{1U})^2$

2nd rebound: $\frac{1}{2}m(g\Delta t_{2U})^2 = mgh_2$

2nd fall: $\frac{1}{2}m(g\Delta t_{2D})^2 = mgh_2$



Since the phone will measure :

$$(\Delta t_{1U} + \Delta t_{1D}); (\Delta t_{2U} + \Delta t_{2D}); \dots (\Delta t_{nU} + \Delta t_{nD}):$$

$$\Delta t_1;\ \Delta t_2; \dots \Delta t_n$$

Then, we can get:

$$h_1 = \frac{1}{8}g(\Delta t_1)^2; h_2 = \frac{1}{8}g(\Delta t_2)^2; \dots h_n = \frac{1}{8}g(\Delta t_n)^2:$$

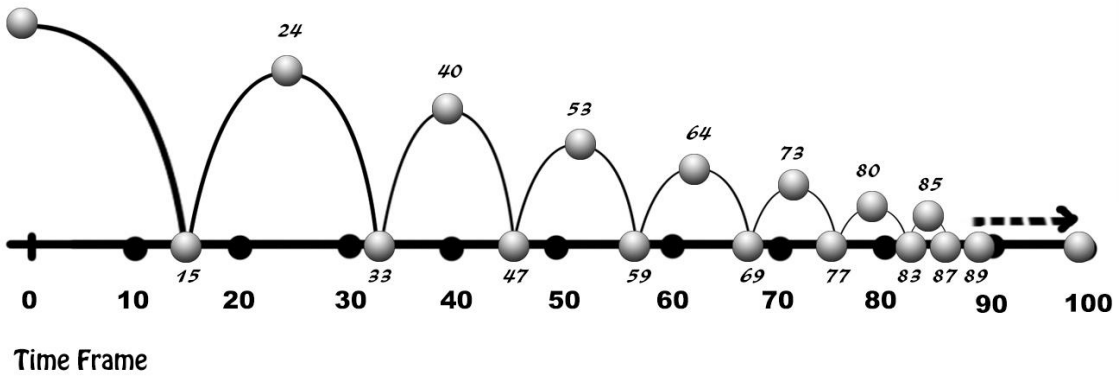
$$\frac{h_2}{h_1} = \left(\frac{\Delta t_2}{\Delta t_1}\right)^2; \frac{h_3}{h_2} = \left(\frac{\Delta t_3}{\Delta t_2}\right)^2; \dots \frac{h_n}{h_{n-1}} = \left(\frac{\Delta t_n}{\Delta t_{n-1}}\right)^2$$

$$if\ \frac{h_2}{h_1} = \frac{h_1}{h_0} = \dots = \frac{h_n}{h_{n-1}} = Cte$$

$$\frac{h_2}{h_1} = \frac{h_1}{h_0} \rightarrow h_0 = \frac{h_1^2}{h_2} \leftrightarrow h_0 = \frac{h_1}{\alpha}$$

Bouncing ball experiment: (in)elastic collision

How could we estimate the height of the amphitheater roof ?



Simple pendulum

Mesure the pendulum period: