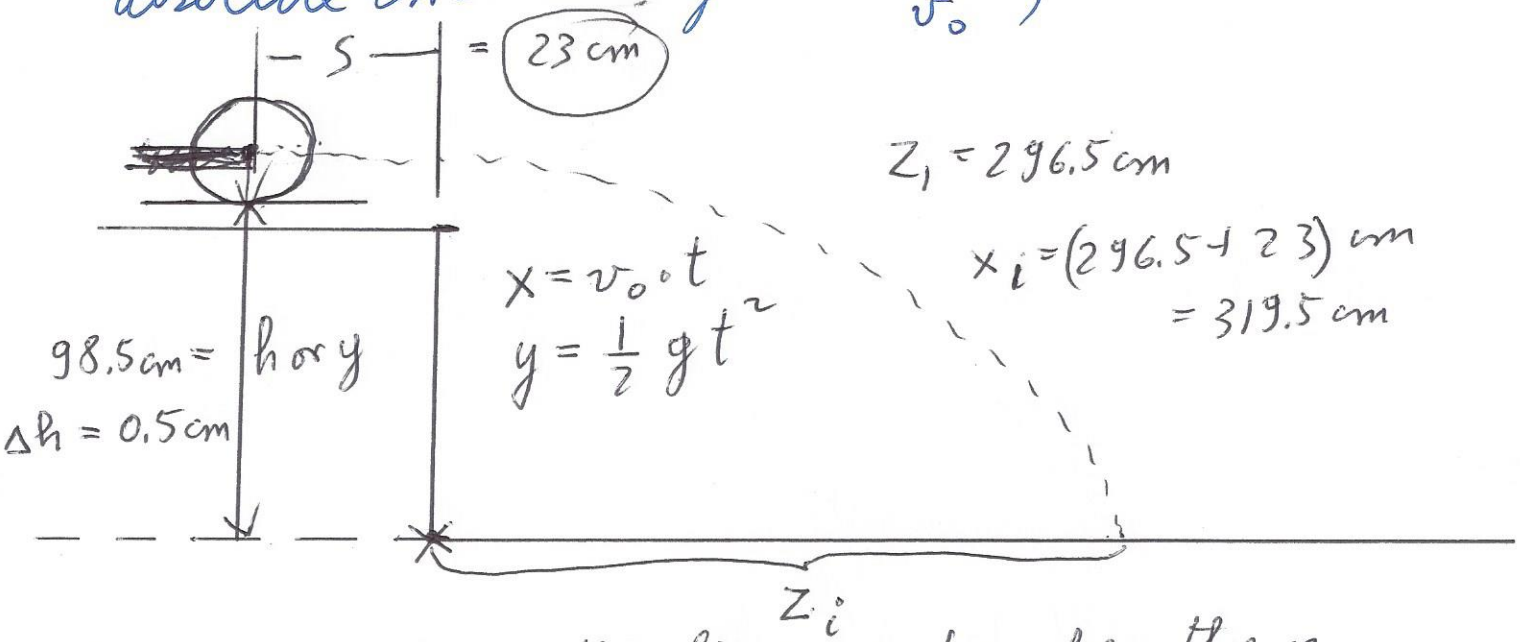
Lab 3 Projectile Motion

Shoot a projectile from the table on the floor and use the laws of projectile motion to find the initial velocity v_0 with the relative and absolute error margins $\frac{\Delta v_0}{v_0}$; Δv_0



Take 30 shots to the floor and number them. Measure all 30 values of x_i. Put your data for z_i and x_i in a column of Excel.

	z_i	x_i
	2.965	319.5 cm

$\bar{x}$ = average (...)

= 3.356 m (example)

$\Delta\bar{x}$ = stdev (...)

Eliminate t from the equations:

$$t = \frac{x}{v_0} \; ; \quad y = \frac{1}{2} g \frac{x^2}{v_0^2}$$

$$v_0 = x \sqrt{\frac{g}{2y}}$$

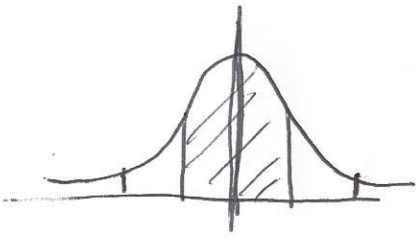
Find $\bar{x}$ in Excel : = average (~~select~~ x column)

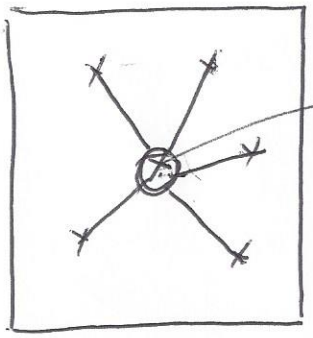
$3.356 = \bar{x}$

$$\bar{v}_0 = \bar{x} \sqrt{\frac{g}{2h}} \quad \downarrow$$

$$= 3.356 \sqrt{\frac{9.8}{1.97}} = 7.485 \text{ m/s}$$

$$\frac{\overline{\Delta v_0}}{\bar{v}_0} = \frac{\overline{\Delta x}}{\bar{x}} + \frac{1}{2} \frac{\Delta h}{h} \; ; \quad \Delta h = 0.5 \text{ cm}$$





$\bar{x}$

$\overline{\Delta x}$ = standard deviation

$$= \sqrt{\frac{\sum (x_i - \bar{x})^2}{N-1}}$$

standard deviation = stdev (....)

example $\overline{\Delta x} = 0.357128 \rightarrow 0.4$

$\overline{\Delta x} = 0.4$

$$\frac{\overline{\Delta v_0}}{\bar{v}_0} = \frac{0.04}{7.485} + \frac{1}{2} \cdot \frac{0.5}{0.985} = 0.266 = 1.446 \cdot 10^{-2}$$

$\bar{v}_0 = 3.356$

$$\overline{\Delta v_0} = \left(\frac{\overline{\Delta v_0}}{\bar{v}_0} \right) \cdot \bar{v}_0 = 0.1 \frac{m}{s}$$

$$\bar{v}_0 = \left(7.5 \frac{m}{s} \pm 0.1 \right) \frac{m}{s}$$