# Quiz #6

Name:_____

Use a pencil, not a pen.

This quiz should be done in Excel without a calculator. The Excel document you create can then be copied and re-used as a prototype for your data collection when you perform the actual experiment. But, you will only submit this paper (not your Excel file). In this quiz, there will only be 5 data points. In the actual experiment, there might be 30.
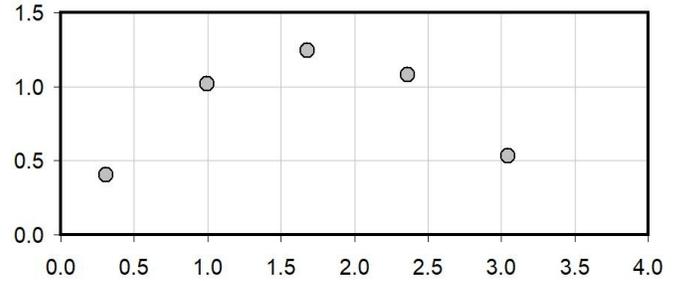
The figure shows several frames of a video showing the motion of a ball through the air, as seen from the side. The squares are 50 cm each (so, the axis labels you already see are in meters). We think the ball started at (0, 0), but sadly, there is no image of the ball there. The video camera recorded 5 frames per second, so the amount of time between frames was 0.2 seconds.

t (tracker, s)	corrected t (s)	x (cm)	y (cm)
0.0			
0.2		*100*	
0.4			
0.6			
0.8			

1. [2] **In this chart**, estimate the (x, y) positions of the ball for these 5 "video frames". Your estimates must be accurate to ± 5 cm. Leave a blank column for corrected time, as shown in the chart. I already wrote one number for you to help you check the units.

2. [1] Use Linest and/or Trendline to fit a straight line for x vs. t. You do not need uncertainties. Don't yet bother with y vs. t.

Slope (**cm/s**)	*Intercept* (**cm**)

3. [1] Tracker will incorrectly say that the first image is when $t = 0$ s. But we want $t = 0$ to instead refer to the moment that the ball left the launcher. To fix this, first compute the ratio of intercept over the slope. Make a cell for this value in Excel. Do not use a calculator. Write the result here. This value represents the amount of time between the ball's launch and the first image, so it must be smaller than 0.2 seconds.

$t_{\text{offset}} =$ *Intercept/Slope* (**s**)

4. [1] In Excel, let's now create the corrected time values. For this column, just add your answer for question #3 to *each* given time value. In Excel, you should not need to type any numbers, just one formula (with a dollar sign) that you drag down through all the rows. Using three decimals, copy those numbers into the chart above. *Look* at the results and be sure you added correctly.

5. [2] Now plot y vs. (true t). Find a parabolic fit of the form $c_1 t^2 + c_2 t + c_3$. Note that we expect that $c_3 \approx 0$ as a result of using the "new" times. Record the values *and units* here. Do not use scientific notation.

c_1 ( )	c_2 ( )	c_3 ( )

6. [1] As usual, we expect $g \approx -2c_1$ (and, since g is ALWAYS positive, this means you should have a negative number for c_1!). Write your discovered value of g here:

g (**cm/s^2**)

7. [1] You already found v_{0x} (it was the slope you found in step 2). v_{0y} is just c_2. Use the Pythagorean theorem to determine the initial speed of the ball.

v_0 (**cm/s**)

8. [1] Review question 7. The initial angle of the ball is found using $\theta_0 = \tan^{-1}(v_{0y} / v_{0x})$. In Excel, the result is in radians. Make a second cell for θ_0 in degrees (degrees = radians $\times$ 180 / π). In Excel, use "pi()" for π… so the formula for degrees will look something like **= C21*180/pi()** , where "C21" was the angle in radians.

θ_0 (**degrees**)