Pendulum Lab using a Photogate Timer (instead of using a stopwatch)

NOTE: For ***Pendulum Activity "Part 2: Data Collection and Analysis***", the instruction sheet assumes that a stopwatch will be used to determine the period. Instead, we'll use a photogate (much easier!!!). So, you have to revise the date table structure, as shown below:

a) ***Period "T" (s) vs Mass "M" (kg),*** while keep length and displacement angle the same in every trial (L and θ are controlled)

Period "T" (s) vs Mass "M" (kg) of a Simple Pendulum

(Constant length, Displacement Angle less than 15 degrees)

1	2	3	4	5	6
	Trial 1	Trial 2	Trial 3	(Average of the 3 trials)	
Mass "M" (kg)	Time for 10 cycles "t"(s)	Time for 10 cycles "t"(s)	Time for 10 cycles "t"(s)	Time for 10 cycles t_{ave}(s)	Period "T"(s) = time for one cycle = t_{ave}/10 *[column 5 divided by 10]*
0.050					
0.100					
0.150					
0.200					
0.250					
0.300					
0.400					
0.500					
0.550					
0.600					

b) ***Period "T" (s) vs Length "L" (m),*** while keep mass and displacement angle the same in every trial (M and θ are controlled; θ should be kept small, at 15° or less)

Period "T" (s) vs Length "L" (m) of a Simple Pendulum

with a mass of 0.200 kg, and Displacement Angle less than 15 degrees

1	2	3	4	5	6	7	8
(ideal – try to get the string close to this length)	(measured ***actual*** value)	Trial 1	Trial 2	Trial 3	(Average of the 3 measured trials)	(calculated from measured value)	(calculated from measured value)
Length "L" of pendulum (m) [ideal]	Length "L" of pendulum (m) (to the centre of mass of the pendulum)	Time for 10 cycles "t"(s)	Time for 10 cycles "t"(s)	Time for 10 cycles "t"(s)	Time for 10 cycles t_{ave}(s)	Period "T"(s) = time for one cycle t_{ave}/10 *[column 6 divided by 10]*	Period squared "T^2"(s^2) *[column 6 squared]*
1.00							
0.90							
0.80							
0.70							
0.60							
0.50							
0.40							
0.30							
0.20							
0.10							

The Photogate timer

1. Use “Gate A” only (do not attach Gate B)
2. Set up the system as shown in this photo:

3. Set Mode to **[Period]**
4. Note that the pendulum has to swing through 3 cycles before the timer displays data.
5. As the pendulum swings for several cycles, watch the display and pay attention to the fluctuations in the data. *To what precision do you feel confident in the measurement?* (i.e. how many decimal places seem reasonably stable and constant?). The digits (numbers) that you are confident are stable in your measurement are called “***significant digits***” (or ***significant figures = “sig figs”***). For example:
    a. Pretend that as the pendulum swings through 5 cycles, you see the following readings for period: 0.6534 s; 0.6512 s; 0.6549 s; 0.6469 s; 0.6501 s.
    b. You can see that the first 2 digits of the reading are stable and consistent (after rounding), but the last 2 digits fluctuate. In this case, you can feel confident that the period is T = 0.65 s, but the 3rd and 4th decimal places are uncertain. On the data table, you should include only the “certain” digits. You would write ***0.65 s*** in the column for period. This measurement is precise to the nearest 100th of a second, with 2 significant digits.
6. In the data table column for “Period” (T), write only the digits that you are confident are stable and correct (i.e. include only a reasonable and appropriate number of ***significant digits***).