NAME_____ DATE_____
PHYSICS A/R -- PERIOD ____ MR. LEACOCK

LABORATORY 8
Accelerated Motion II -- Gravity

Objective
To determine (using a spark timer) the acceleration of a falling object due to gravity, and to plot the acceleration versus time, velocity versus time, and distance versus time graphs for a falling object.

Diagram
Please draw a sketch of the lab set up in your lab notebook.

Materials
1.35 m sparks timer tape, spark timer, 500 g mass

Procedure
1. Fold a small portion of the spark timer tape at one end and attach it to the 500 g mass using a small amount of tape.

   Hold the spark timer against a firm vertical surface 1.5 m above the ground.

2. If available, place a small wooden board where the mass will impact the floor to prevent damage to the mass and the floor.

3. Thread the tape through the spark timer.

4. Holding the mass by the timer tape as high as possible, the student holding the spark timer should press the button starting the timer. When the student holding the tape hears the timer going, he/she should release the tape, allowing gravity to pull the mass towards the ground as it pulls the tape through the timer. **BE SURE YOUR FEET ARE CLEAR OF WHERE THE MASS WILL FALL; IT WILL HIT THE FLOOR VERY HARD!**

5. Circle the first dot and every third dot after that. This represents 1/20th second intervals. You should have enough for 10 intervals (0.5 s)

6. Measure the distance from the t=0 dot to each circled dot and enter it in your table [Δd_{total}].

7. Measure the distance between each pair of circled dots and enter them on your chart as the change in distance.

8. Plot total distance (y-axis) versus time (x-axis) (not a straight line).

9. Find each instantaneous velocity by subtracting each subsequent distance from its previous distance and dividing by its change in time, which is always 0.05 seconds [**v= Δd/t**]. Enter these on your data table.

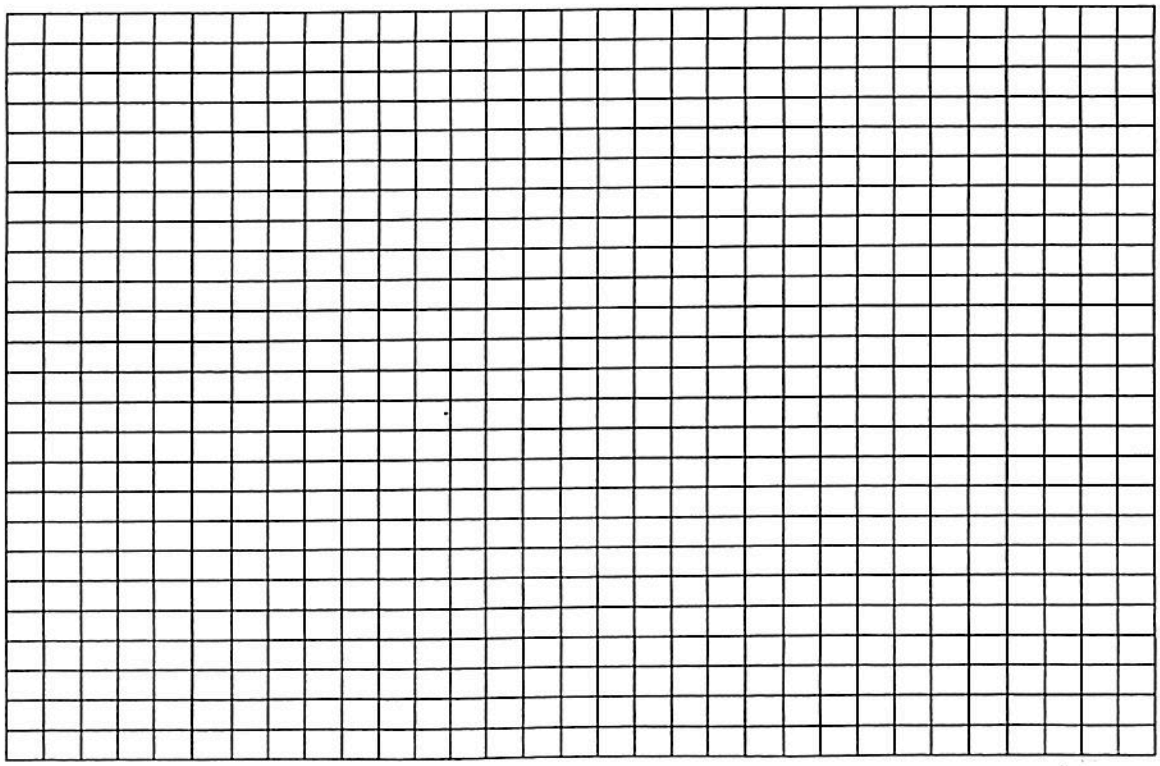
10. Plot velocity versus time. (Best fitting straight line).

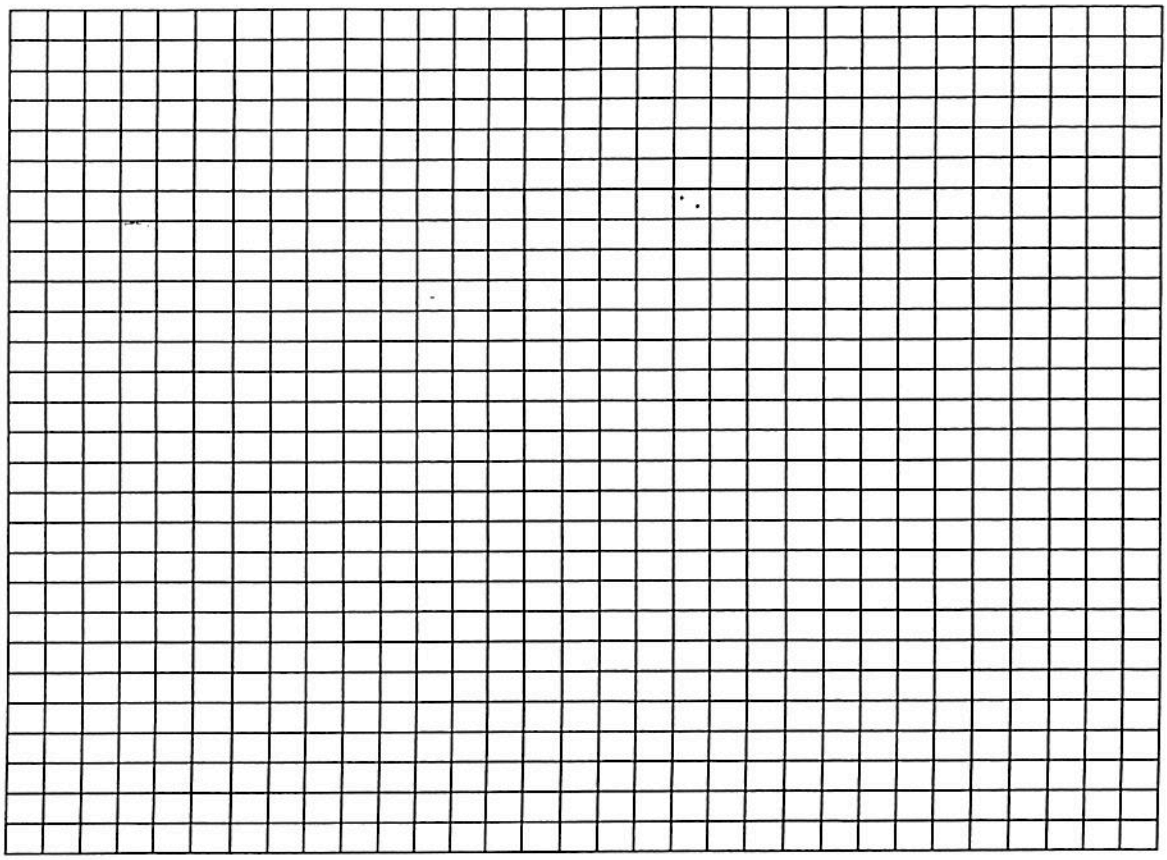
11. Find the acceleration at each moment by subtracting each velocity from its previous velocity and dividing by the change in time (0.05 s) [**a= Δv/t**]. Enter these on your data table. (You will not have values for the last trial.)

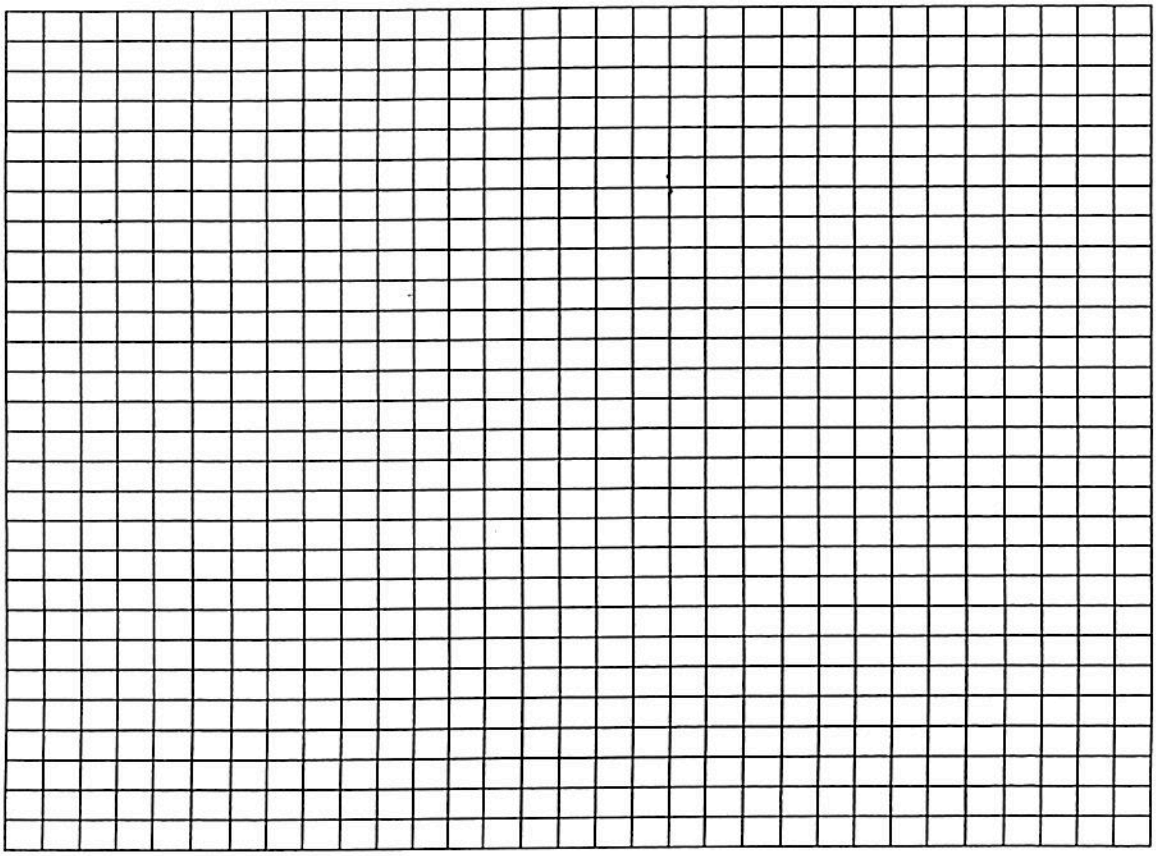
12. Plot acceleration versus time. (closest fitting straight (horizontal) line)

Data

t (s)	Δd (m)	Δd_{Total} (m)	v (m/s)	a (m/s^2)
0.00	0	0	0	
0.05				
0.10				
0.15				
0.20				
0.25				
0.30				
0.35				
0.40				
0.45				
0.50				XXXXX







Questions

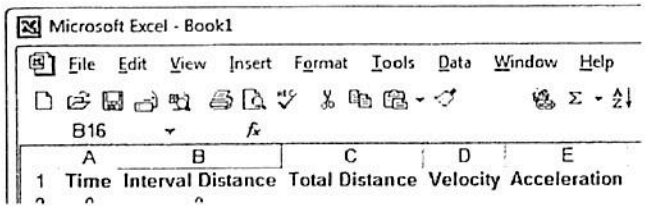
1. Using the average acceleration for the t=0.2 to t=0.4, find your percentage error if acceleration should be 9.8 m/s^2. To what might you attribute your error?

2. Find the slope of your v versus t graph drawing a best fitting straight line (this MAY not go through the origin). How does it relate to your a versus t graph? If there is a relation, why do you think this happens?

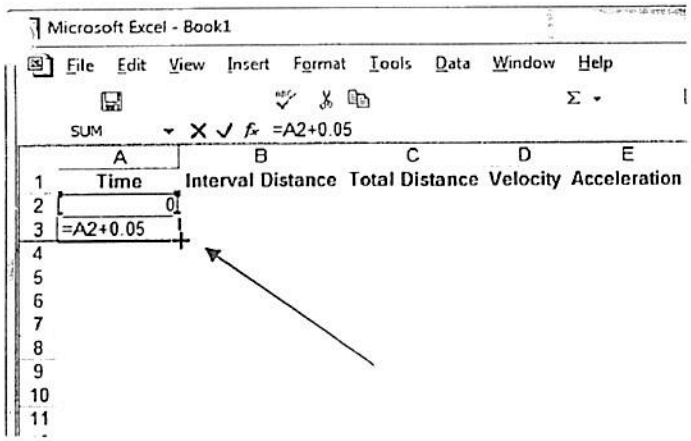
Name _____

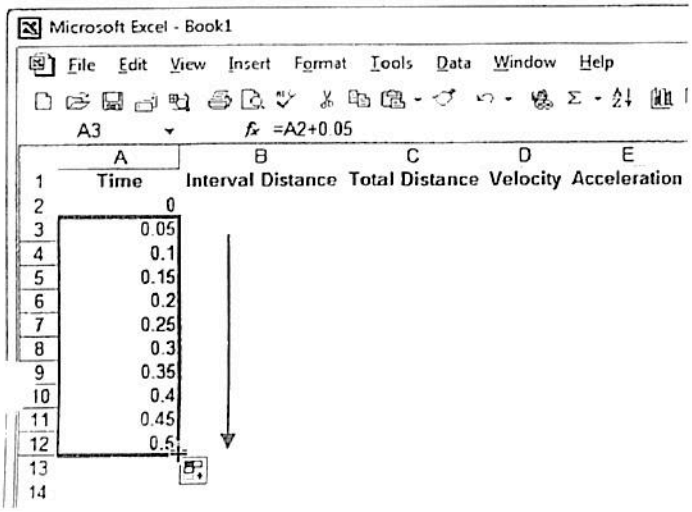
Acceleration due to Gravity – Computer Laboratory

1. Setup your headings as shown and adjust your column widths.

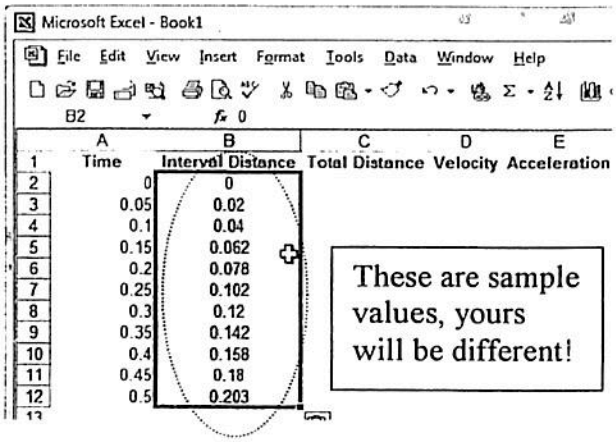


2. Enter your time going form 0.0 to 0.50 seconds in 0.05 second intervals. You want to use the power of Excel to make your life easy. Place your cursor on the lower right corner until the cursor becomes a "+". Left click while holding that corner and drag down. This replicates the equation, increasing the cell value so that the subsequent cells become **=B2+0.05**, **=C2+0.05**, **=D2+0.05 ...**

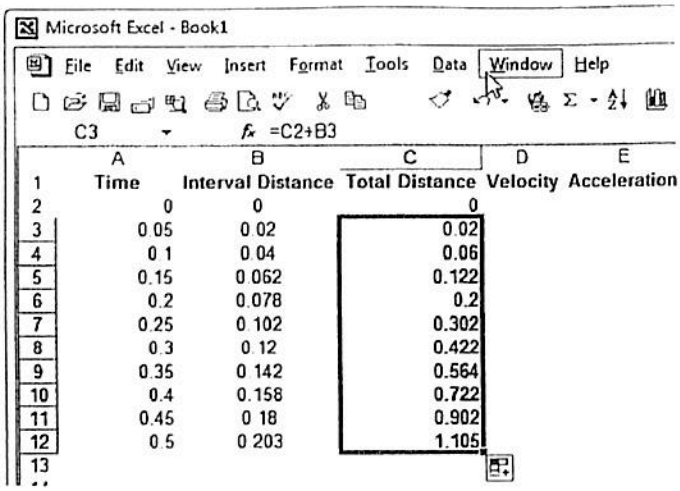




3. You already have determined the distance that the 500 gram mass dropped for each $1/20^{th}$ second interval (remember, this must be in meters). At t=0 the object had no displacement so enter a zero, and enter your measured distance for each subsequent interval.

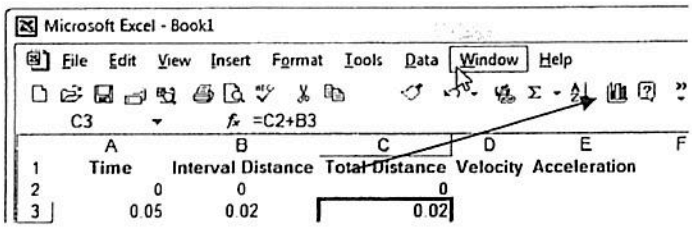


4. Under the **Total Distance** column, you want to values to indicate the total distance the mass fell from the start. In other words, at time = 0.05 seconds you want the value to indicate the total distance traveled from 0.0 s to 0.05 seconds, and for time = 0.10 seconds to be the distance it fell from 0.0 seconds to 0.10 seconds. This is easily done using the power of Excel. We know that the object had not moved at t = 0.00 seconds so enter a zero into cell **C2**. We want cell **C3** to give us a running total of the distances, basically adding **B3** and **C2** so into cell **C3** we will enter **=B3+C2**. When we replicate this down it will give us **=B4+C3** into cell **C4**, which means the 0.04 meter value in B4 will be added to the 0.02 meter value in C3, giving us a running total.



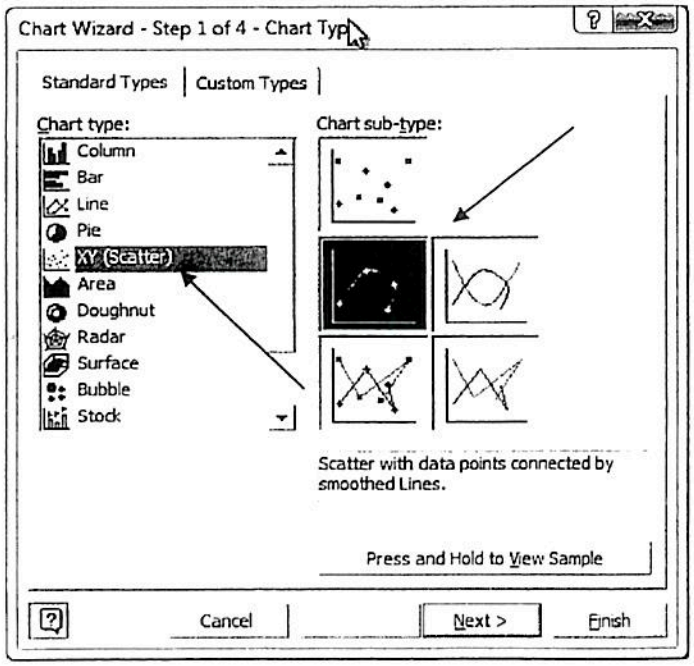
	A	B	C	D	E
1	Time	Interval Distance	Total Distance	Velocity	Acceleration
2	0	0	0		
3	0.05	0.02	0.02		
4	0.1	0.04	0.06		
5	0.15	0.062	0.122		
6	0.2	0.078	0.2		
7	0.25	0.102	0.302		
8	0.3	0.12	0.422		
9	0.35	0.142	0.564		
10	0.4	0.158	0.722		
11	0.45	0.18	0.902		
12	0.5	0.203	1.105		
13					

5. At this point you need to create a graph of Total Distance vs. Time. Click on the link for **Chart Wizard**.

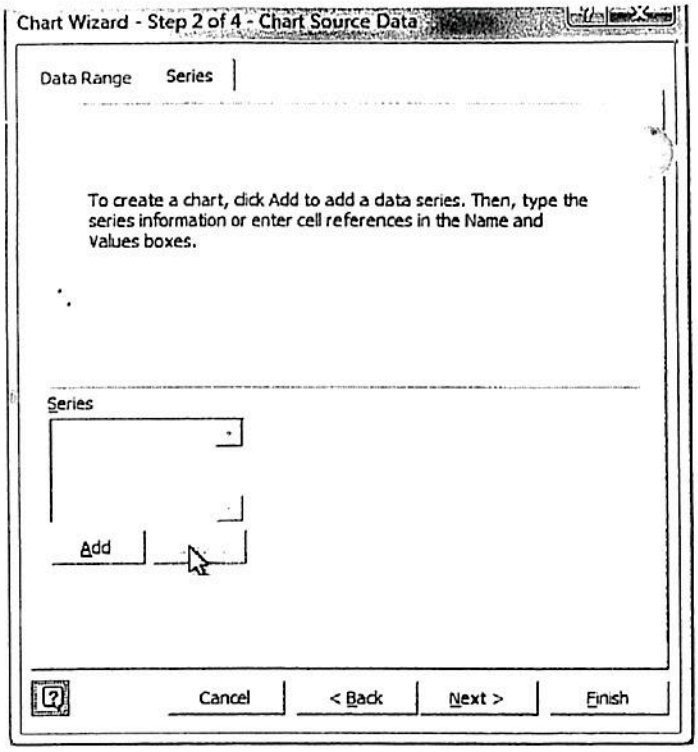


	A	B	C	D	E	F
1	Time	Interval Distance	Total Distance	Velocity	Acceleration	
2	0	0	0			
3	0.05	0.02	0.02			

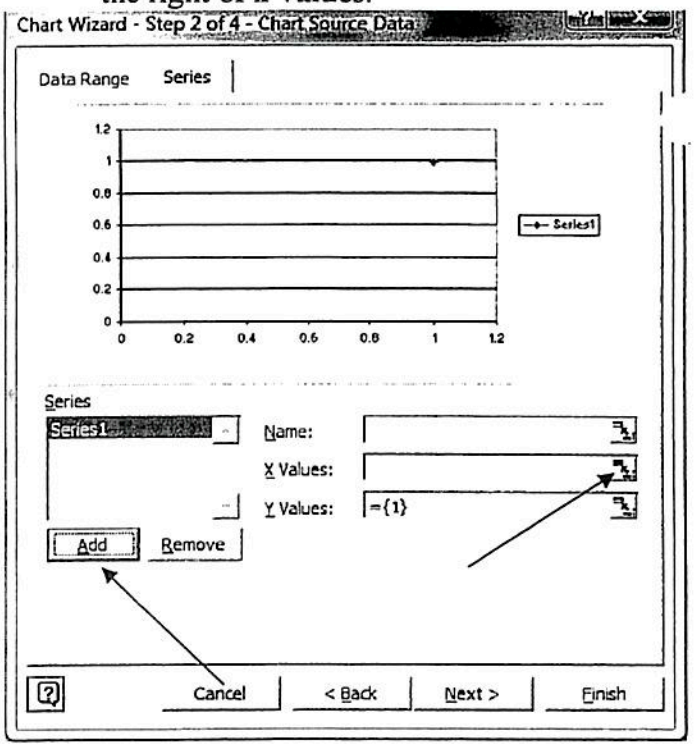
6. Click on **XY (scatter)** and choose **Smooth line.** Click **Next.**



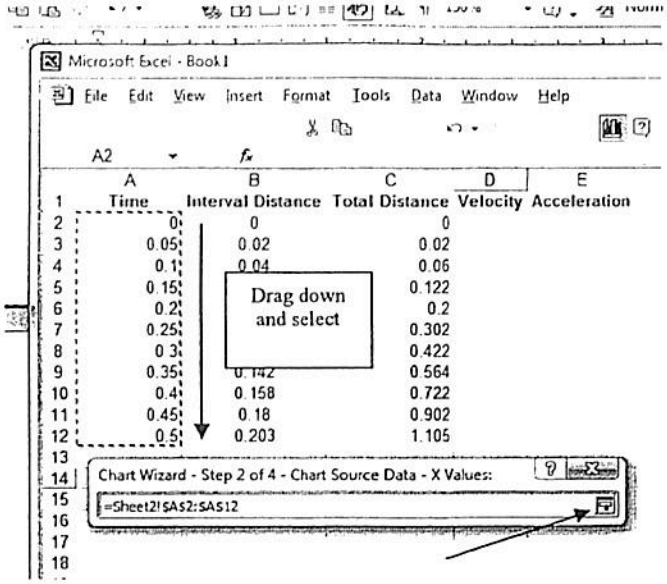
7. Click on the **Series** tab and **Remove** until all the series are removed



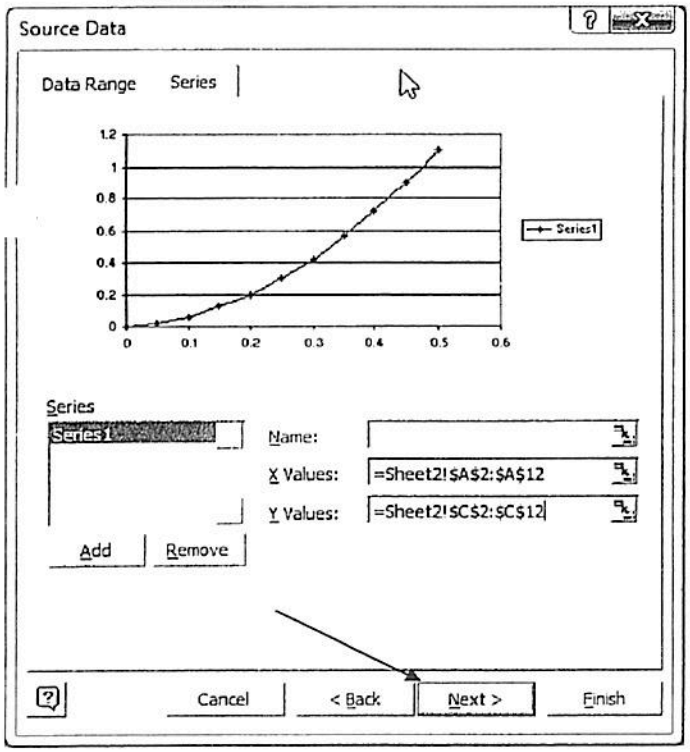
8. Click on the **Add** button and the button to the right of **x-values**.



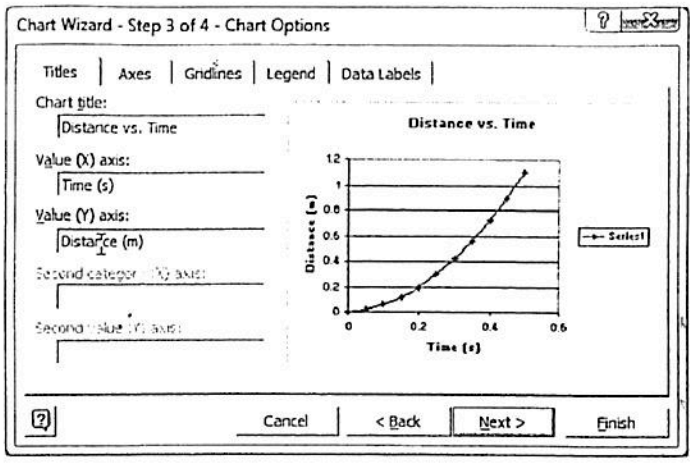
9. A small window will open. Click and highlight the data under time. The cell numbers will be indicated in the window. Click the button to the right of the small window to close it and enter the data.



10. Repeat step eight and click on the button next to **Y-Axis**. Perform the same task using entering **Total Distance** into the data field. Click **Next.**



11. Enter the axis labels and chart title. Click **Next**.



12. Select **As new sheet** and click **Finish.**