PHYS 201 LAB Spreadsheet & Graphing

Name:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_    Day/Time:\_\_\_\_\_\_\_

Partner(s):\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Experiments in physics involve data collection and analysis. Throughout the semester we will use excel spreadsheet program for data analysis and graphing. In this lab you will be introduced to tabulation of data, calculating new variables, and graphing using Excel.

*A. Tabulation of data and Calculating values for a new variable: Area = Length X Width.*

1. Enter the following length and width data in the excel spreadsheet program. Please note that the first raw is used for titles and their units. It is customary to put units in parenthesis.

|  |  |
| --- | --- |
| **Length (cm)** | **Width (cm)** |
| 5.12 | 4.30 |
| 2.54 | 2.33 |
| 15.1 | 10.5 |
| 25.2 | 20.7 |
| 30.5 | 25.3 |
| 175 | 155 |
| 16.5 | 14.5 |
| 54.7 | 49.7 |
| 5.44 | 4.56 |

2. Title the third column as Area with its units.

3. Enter the formula to calculate the area in cell C2 as, =A2\*B2, and enter. Go back to cell C2 and move the mouse to the lower right corner until the white plus becomes a black plus. At this point click and drag down the mouse until cell C10 is highlighted and then release the mouse. Now the calculated area is displayed in the third column, C. Keep the significant figures to 3.

4. Insert your completed data table, in the digital copy.

 *B. Graphing Data* (Scatter Plots)

Here you will enter some temperatures in degrees Celsius, convert the temperature to degrees Fahrenheit using this [website,](https://www.mathsisfun.com/temperature-conversion.html) and graph Tf versus Tc.

1. Start with a blank page and title the first column as Tc (0C) and the second column as Tf (0F).  Enter the following temperatures in degrees Celsius in the first column: -40, -20, 0, 20, 40, 60, 80, 100, 120, 140, 160, and 180.

2. Convert the above temperatures to degrees Fahrenheit using this [website,](https://www.mathsisfun.com/temperature-conversion.html) and enter their values in the second column.

3. Make a scatter plot: Tf versus Tc: Tf on Y-axis and Tc on X-axis, and obtain the temperature conversion equation from the data fit.

Trendline equation:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Temperature conversion equation:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

4. Insert your plot in the digital copy.

5. Now you will make another scatter plot: Tc versus Tf: Tc on Y-axis and Tf on X-axis, and obtain the temperature conversion equation from the data fit.

Trendline equation:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Temperature conversion equation:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

6. Insert your plot in the digital copy.

 *C. Graphing Exercises* (Scatter plots)

C1. The force, F as a function of distance, Z is given below, where k and F0 are constants.

**F = kz + F0**.

|  |  |
| --- | --- |
| **Z (m)** | **F (N)** |
| 0.5 | 7.5 |
| 1.0 | 12 |
| 1.5 | 17 |
| 2.0 | 21.5 |
| 2.5 | 24 |
| 3.0 | 30 |
| 3.5 | 32 |
| 4.0 | 37 |

Plot the above data points to obtain a linear scatter plot and determine k and F0 from the Trendline equation. Include units for k and F0.

Given equation: **F = kz + F0**.

Trendline equation:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

k = \_\_\_\_\_\_\_\_\_\_\_\_\_\_            F0 = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Insert your graph in the digital copy.

C2. The distance, s as a function of time, t is given below, where *a* and *b* are constants.

                          **s = a t2 + b**

|  |  |
| --- | --- |
| **t (s)** | **s (m)** |
| 0 | 1 |
| 1 | 3 |
| 2 | 9 |
| 3 | 19 |
| 4 | 33 |
| 5 | 51 |
| 6 | 73 |
| 7 | 99 |

Enter the above data and make a scatter plot s versus t. Your graph should be a curve. Add a 2nd order polynomial trendline and determine *a* and *b* from the displayed equation. Include units for *a* and *b*. Insert your graph in the digital copy.

                           **s = a t2 + b**

Trendline equation (s versus t):\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

*a* = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_    *b* = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

To get a linear scatter plot, you need to plot s versus t2. Create t2 in the 3rd column, plot s versus t2, and obtain a and b from the graph. Include units for a and b. Insert your graph in the digital copy.

                           **s = a t2 + b**

Trendline equation (s versus t2):\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

*a* = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_    *b* = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

C3. The emf, e in millivolt, of a thermocouple operating between a bath at temperature T and an ice water standard is given by; e = AT + BT2, where A and B are constants.

|  |  |
| --- | --- |
| T (0C)     | e (mV) |
| 0 | 0 |
| 10 | 0.8 |
| 20 | 2.6 |
| 30 | 5.4 |
| 40 | 9.2 |
| 50 | 14.0 |
| 60 | 19.8 |
| 70 | 26.6 |
| 80 | 34.4 |

Enter the above data and make a scatter plot e versus T. Your graph should be a curve. Add an appropriate Trendline and determine A and B from the displayed equation. Include units for A and B. Insert your graph.
Given equation: e = AT + BT2

Trendline equation:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

A = \_\_\_\_\_\_\_\_\_\_\_\_\_\_            B = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

4. The period, T as a function of mass, m is given by the following equation; where k is a constant.



|  |  |
| --- | --- |
| **m (kg)** | **T (s)** |
| 0.1 | 0.39 |
| 0.2 | 0.56 |
| 0.3 | 0.69 |
| 0.4 | 0.78 |
| 0.5 | 0.88 |
| 1.0 | 1.25 |
| 1.5 | 1.54 |
| 2.0 | 1.78 |
| 3.0 | 2.16 |
| 4.0 | 2.50 |
| 5.0 | 2.79 |

Make a scatter plot T versus m, add a power Trendline, and determine the coefficient of the power fit. Insert your graph in the digital copy.

Trendline equation:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_Coefficient of the power fit = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Re-write the given equation in a form similar to the Trendline equation, below:

Equating the coefficient of the power fit, calculate the value of k. (include unit). k = \_\_\_\_\_\_\_\_\_

Re-write the given equation in a form similar to y = mx + b, where b = 0.

Make a linear scatter plot, and determine the slope, and then determine the constant k including unit. Insert your graph in the digital copy.
 Slope = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_    k = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

D. Plotting kinematic equations for $v\_{0}$ = 3 m/s and ***a*** = 5 m/s2. Here, ***d*** = displacement.

|  |  |  |
| --- | --- | --- |
| $$v=v\_{0}+at$$ | $$d=v\_{0}t+\frac{1}{2}at^{2}$$ | $$v^{2}=v\_{0}^{2}+2ad$$ |

Generate time interval, *t* data from 1 to 30 s, every second, in the first column. Calculate *v* in the second column, *d* in the third column, *v2* in the fourth column, and *d/t* in the fifth column. Make the following scatter plots and complete the table. Insert your data table & graphs in the digital copy. [After high-lighting a column in Excel, pressing the Ctrl key will let you high-light any other column]

 Obtain From the trendline equation

|  |  |  |  |
| --- | --- | --- | --- |
| Scatter Plot | Trendline equation | $v\_{0}$  |  *a*  |
| *v* VS. *t* |  |  |  |
| *d* VS. *t*  |  |  | Show your work |
| *v2* VS. *d* |  | Show your work | Show your work |
| *d/t* vs. *t* |  |  | Show your work |

E. Do the post-lab quiz before 11:59PM-Thursday and submit your digital copy (with graphs inserted) in Blackboard before the start of the next lab period.