- Plot and discuss ALL the functions of *% T vs. dye concentration* that you calculated.
- For each plot, remember to:
  - Label x-axis and y-axis (with units)
  - Use appropriate software to find the straight-line trends (such as m, y-intercept)
  - Include the R^2 factor as a statistical measure of the best straight-line fit
  - Show an example of the spreadsheet formulas
  - Also write the best fit equation for each plot: $f(\%T) = m(concentration) + b$
  - *For example, if the slope is 0.6 and y-intercept is 4.2 for the* $\sqrt{\%T}$ *vs. concentration plot, then the equation is:* $\%T = (0.6 \times concentration + 4.2)^2$
- Show one example of calculation of making diluted solutions from 100% original dye solution
- Use of proper units
- Include and discuss the percent transmittance, *%T,* (light vs. dye) in terms of wavelength (which wavelength is best for each dye solution? Why?)

Table 1. Percent Transmittance by Wavelength

Dye Color	430 nm (Blue/Violet light)	470 nm (Blue light)	565 nm (Yellow light)	635 nm (Red light)
Color 1 *e.g. Red*	~~[illegible]~~	37.48%	81.04%	112.93%
Color 2 *e.g.* ~~Green~~ Yellow	30.23%	50.36%	100.46%	117.01%
Color 3 *e.g. Blue*	100.50%	105.46%	64.88%	50.73%

- Include a table of the original data: dye concentration vs. *%T*

Table 2. Percent Transmittance of the 10 Dilutions of the Red Food Coloring

Concentration	Blank	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1
%T	100.45%	100.43%	95.45%	87.33%	72.48%	63.62%	55.03%	47.57%	42.01%	38.2%	~~[illegible]~~ 32.08%

Discussion (1pt) 2 paragraphs-1 page in length

- Did your results confirm your hypothesis? Why or why not?
- Which graph gives the best fit line, or the straightest line?
  - Does it match the equation of Beer-Lambert's law?
  - Explain each term (and its units) of the Beer-Lambert's equation
- Discuss how wavelength affected the percent transmittance of dyes
- Discuss possible limitations in the spectroscopy technique used in this investigation
- Mention possible improvements, suggestions to the experiment.

Conclusion (1pt) 1 paragraph-1/2 page in length

- Restate the goal of this experiment
- **Summarize** the factors that affect the intensity of color.
- Summarize the straight-line plot that relates the function of *%T vs. dye concentration*. Describe the usefulness of having a straight-line plot how is this related to Beer-Lambert's law.
- Relate the experiment to outside research conducted; i.e, how are scientists using these techniques in their experiments? How can these techniques help you in possible field research?

Beatriz I. Smith 2/24/15

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Spring 2017 113 RUBRIC
Investigation 19: What Factors Affect the Intensity of Color?

General

- Title page: TA's name, Date, Section, & Group member names
- Written in third person, past tense, passive voice; no use of first person, and no contractions or slang.
- Proper grammar and spelling. Use superscripts and subscripts for chemical formulas and scientific notation. Remember to put a zero in front of the decimal point.
- Double-spaced
- 12-pt font, Arial or Times New Roman font, and 1" margin
- Label each of the sections (listed below). Bold or underlined.
- Include all bibliographic entries of all reference material used.
- Attached *Team Contribution Forms* from each group member
- Report is due by beginning of next week' class. Late lab reports will not be accepted.
- One hard copy of the report per group.

Introduction (lpt) 2 paragraphs-1 page minimum

- Brief description of the goal in this experiment
- Brief explanation of the spectroscopy technique to support the investigation and the related concepts: light, transmittance, concentration, Beer-Lambert's law, etc.
- Hypothesis, what do you think the relationship between %T and concentration will be?
- Brief description of the experimental plan used to achieve your goal.

Procedure (1pt) DO NOT exceed 1 page

- Provide a list of reagents/equipment made available in the lab that you used.
  - Molarities of solutions must be listed correctly.
  - Proper subscripts and physical states are very important.
- Provide a clear description (in a paragraph style) of the procedures used during the course of the experiment; include concentration/volumes of solutions. *This should be detailed enough that another group could duplicate your work.*

Results (3.5pts)

- *For one dye color*, plot the following functions of %T vs. concentration:
  - % transmittance (y-axis) vs. concentration (x-axis)
  - $(\%T)^2$ vs. concentration
  - $\frac{100}{\%T}$ vs. concentration
  - $\sqrt{\%T}$ vs. concentration
  - $\log\left(\frac{\%T}{100}\right)$ vs. concentration
  - $\log\left(\frac{100}{\%T}\right)$ vs. concentration
  - $10^{\left(\frac{\%T}{100}\right)}$ vs. concentration

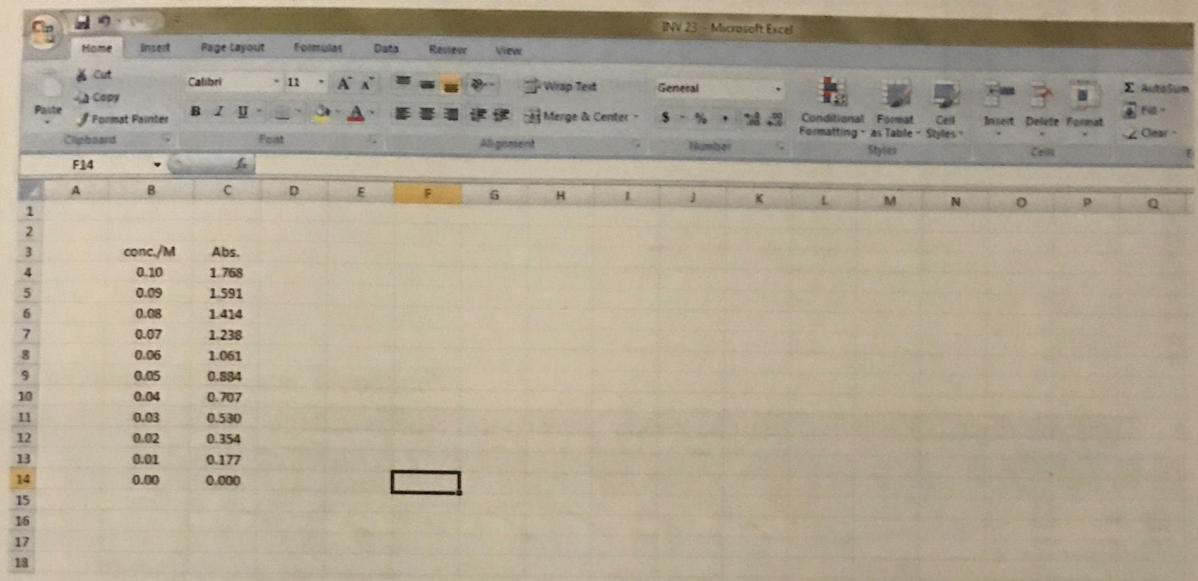
Beatriz I. Smith 2/24/15

How to Make a Standard Curve (Excel 2007)

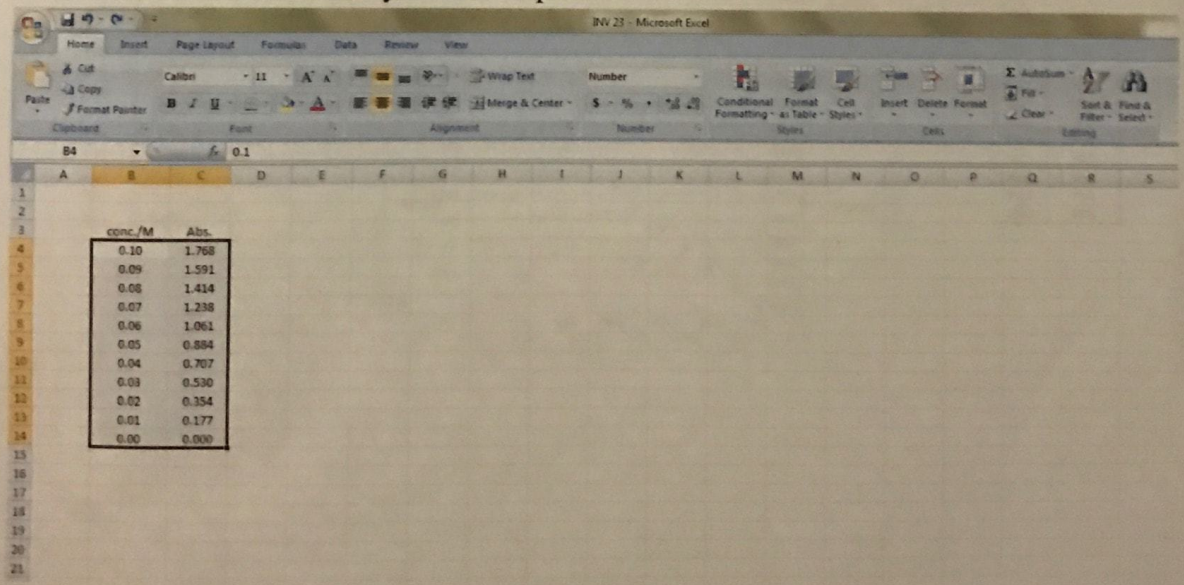
Note: The steps below should be used as a guide to plot your own data to create a standard curve in EXCEL. The examples shown are specific variables (concentration and absorbance), however your variables and data may vary. Other versions of Excel may require different instructions than those stated below.

1. Fill in the columns with the concentrations of the standard solutions and the corresponding absorbance as follows:

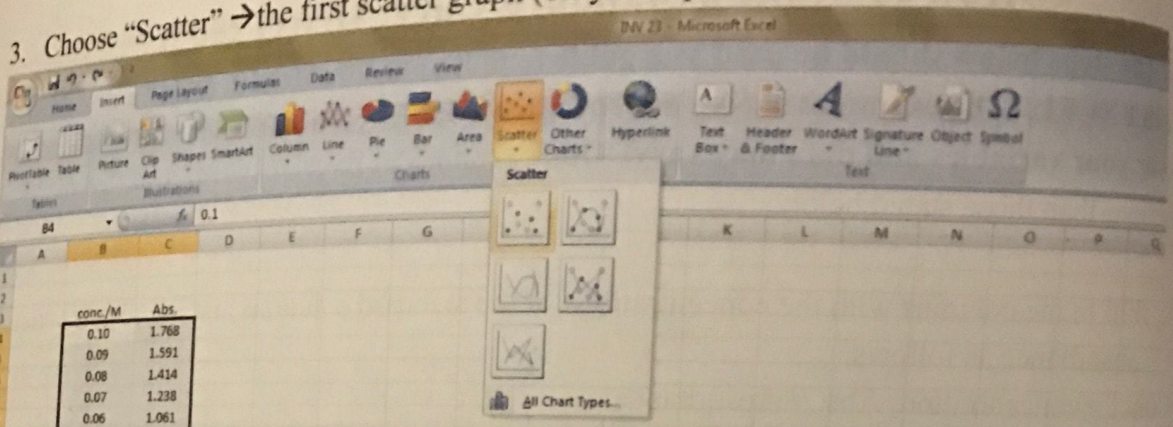
Conc. = concentration, Abs. = Absorbance.



2. Choose the data area that you want to plot:

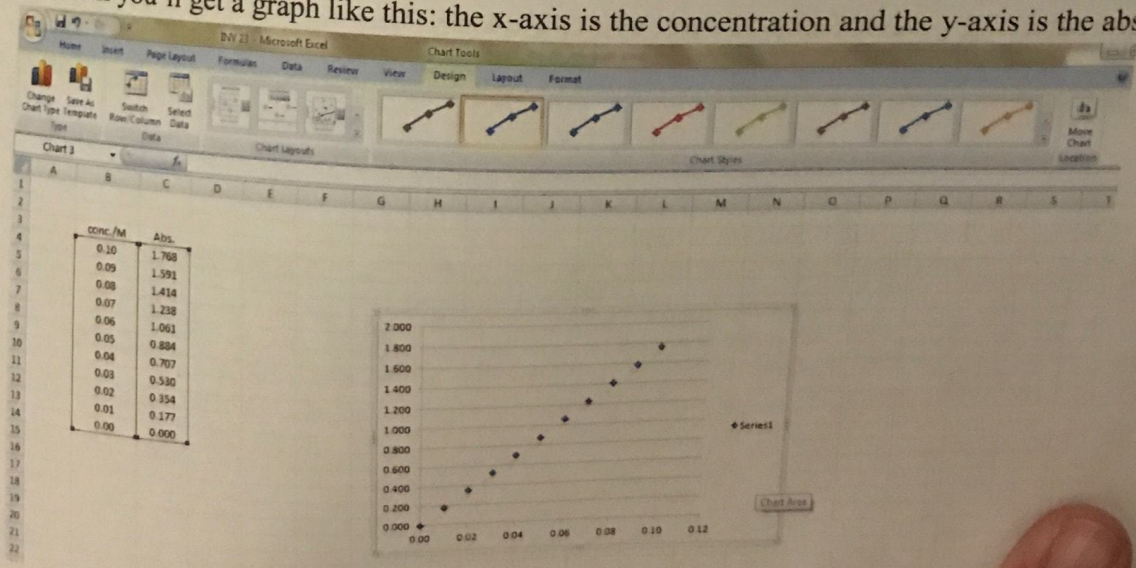


3. Choose "Scatter" →the first scatter graph (only data points, no lines)

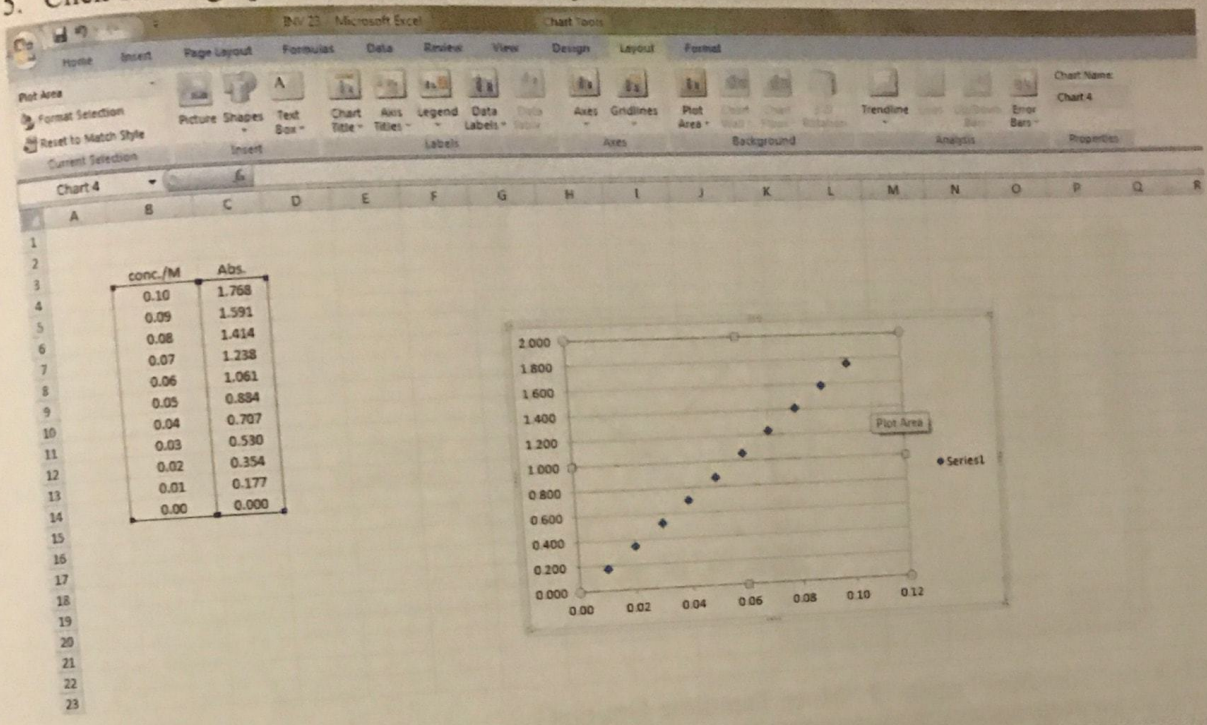


conc./M	Abs.
0.10	1.768
0.09	1.591
0.08	1.414
0.07	1.238
0.06	1.061
0.05	0.884
0.04	0.707
0.03	0.530
0.02	0.354
0.01	0.177
0.00	0.000

4. Then you'll get a graph like this: the x-axis is the concentration and the y-axis is the absorbance.

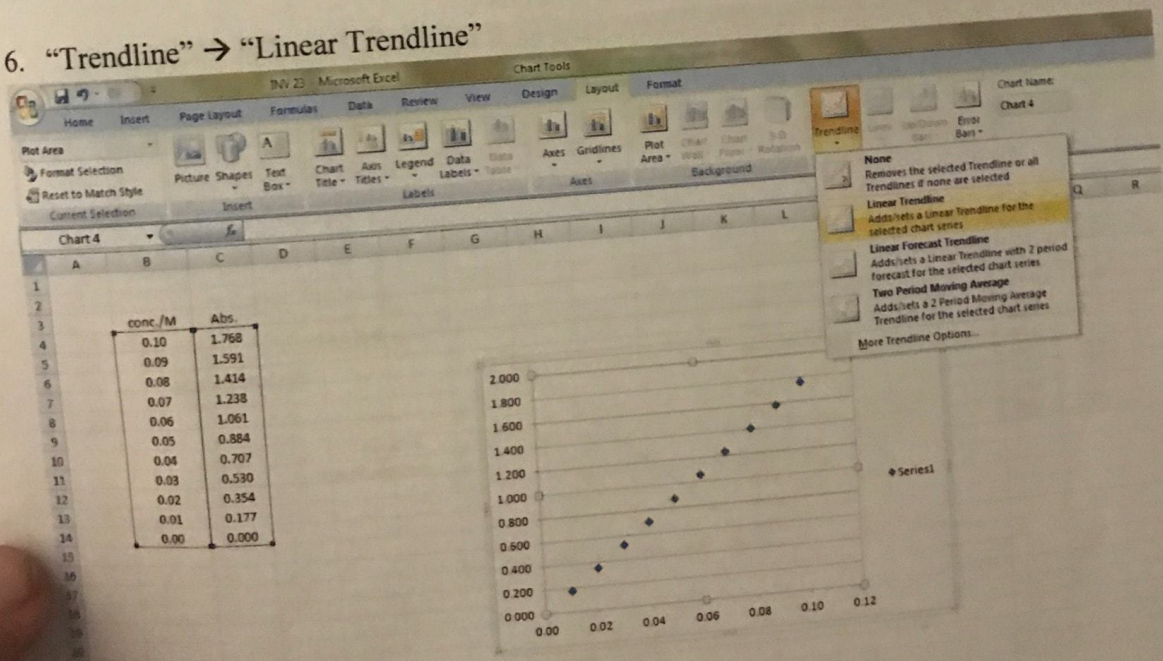


5. Click on the graph area, then choose “Layout”:



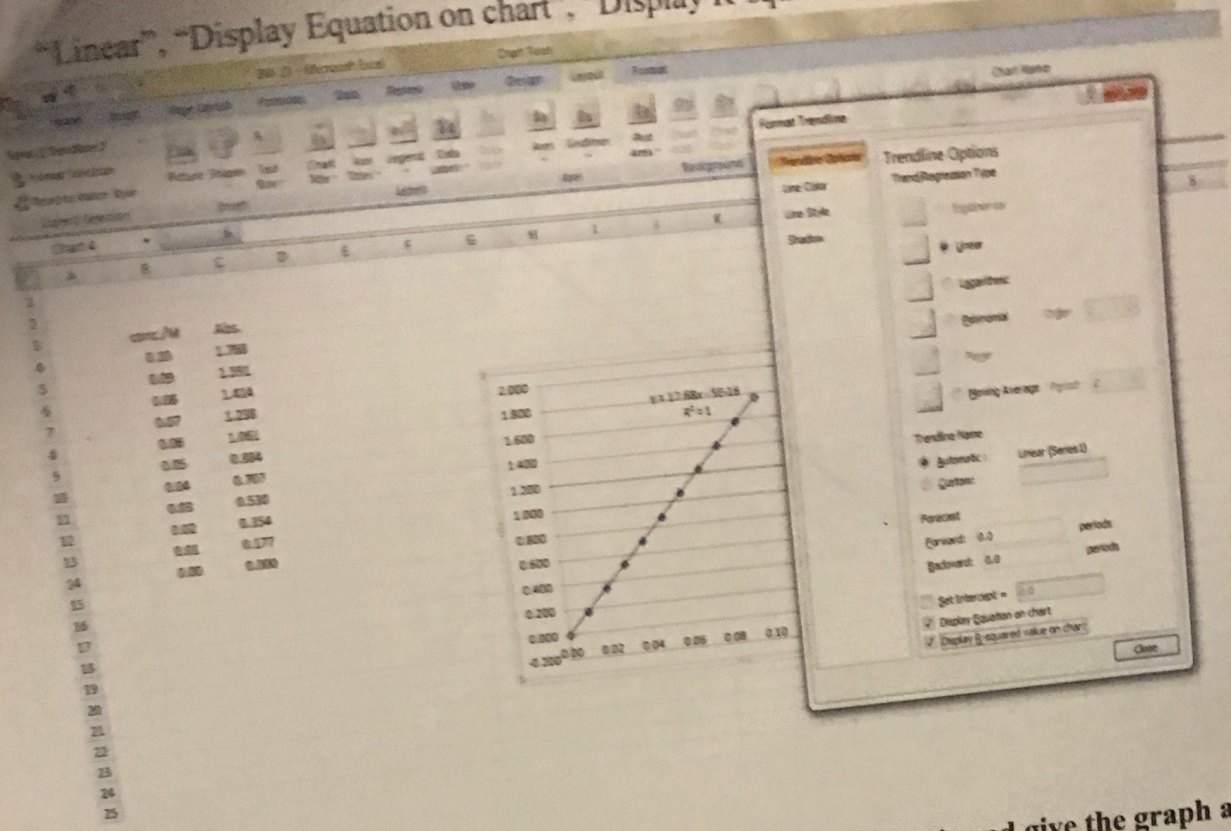
conc./M	Abs.
0.10	1.768
0.09	1.591
0.08	1.414
0.07	1.238
0.06	1.061
0.05	0.884
0.04	0.707
0.03	0.530
0.02	0.354
0.01	0.177
0.00	0.000

6. “Trendline” → “Linear Trendline”

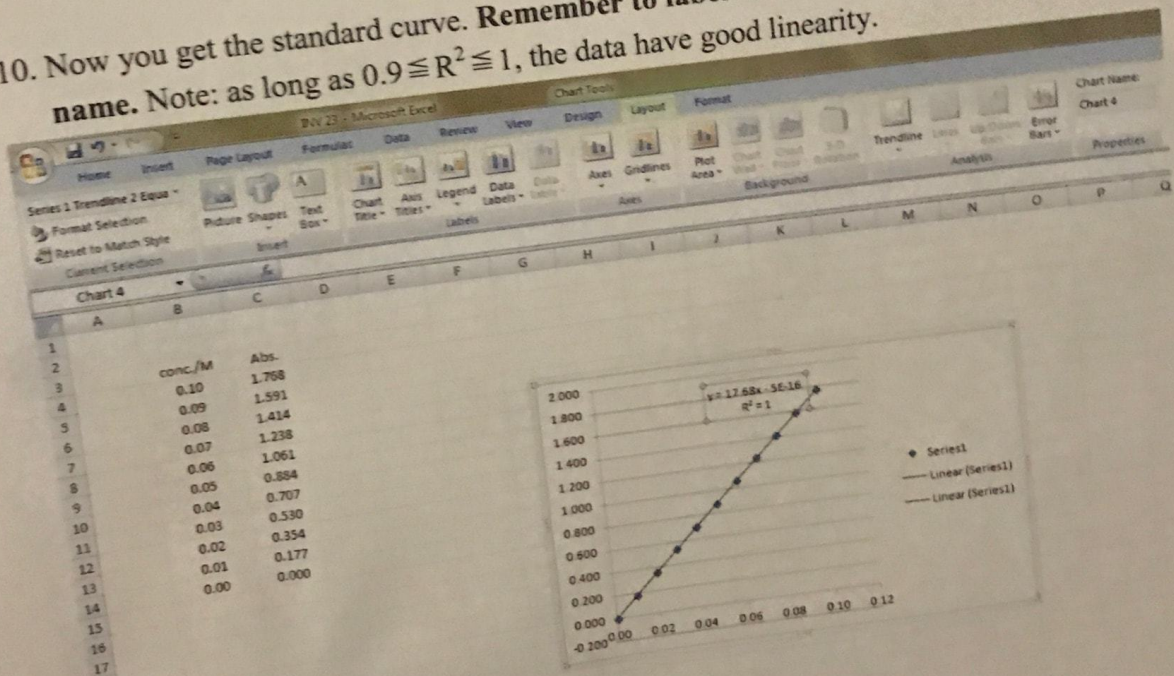


conc./M	Abs.
0.10	1.768
0.09	1.591
0.08	1.414
0.07	1.238
0.06	1.061
0.05	0.884
0.04	0.707
0.03	0.530
0.02	0.354
0.01	0.177
0.00	0.000

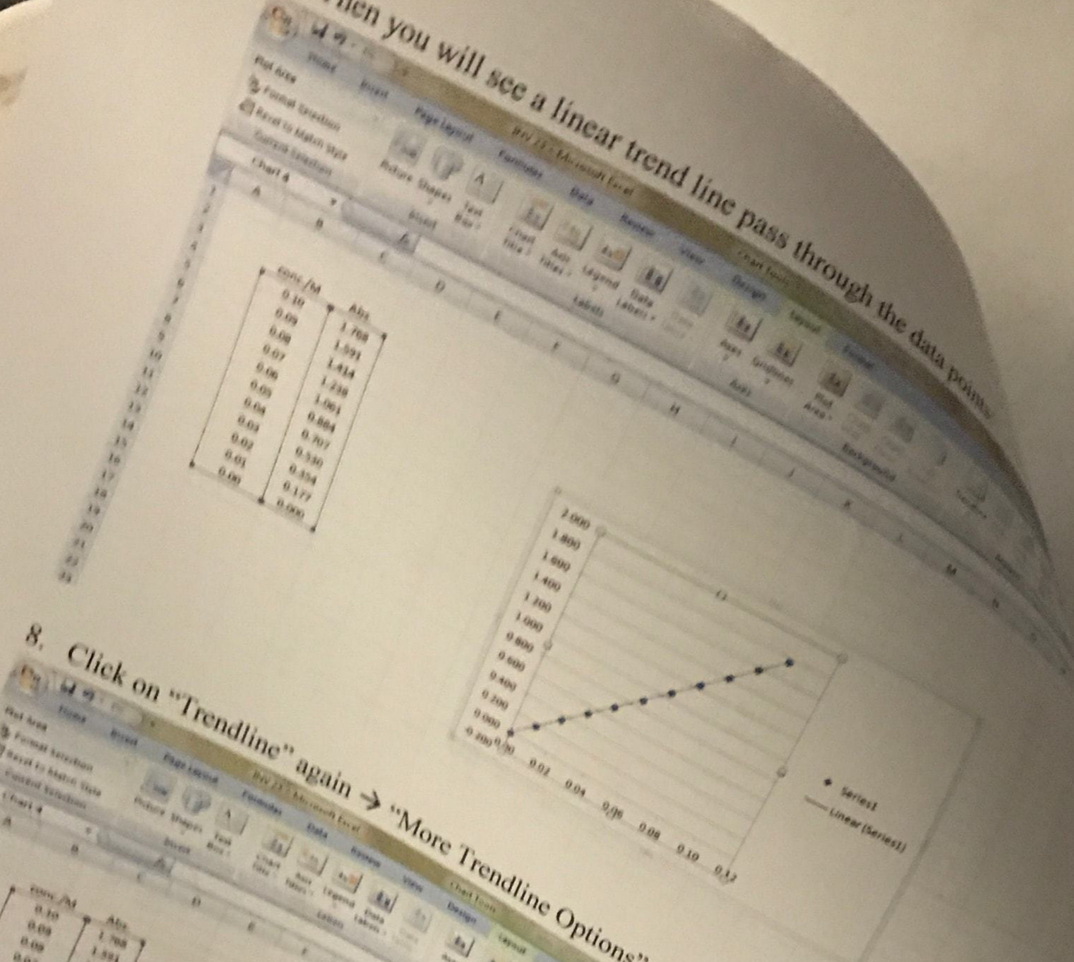
"Linear", "Display Equation on chart", "Display R-squared value on chart" → "close"



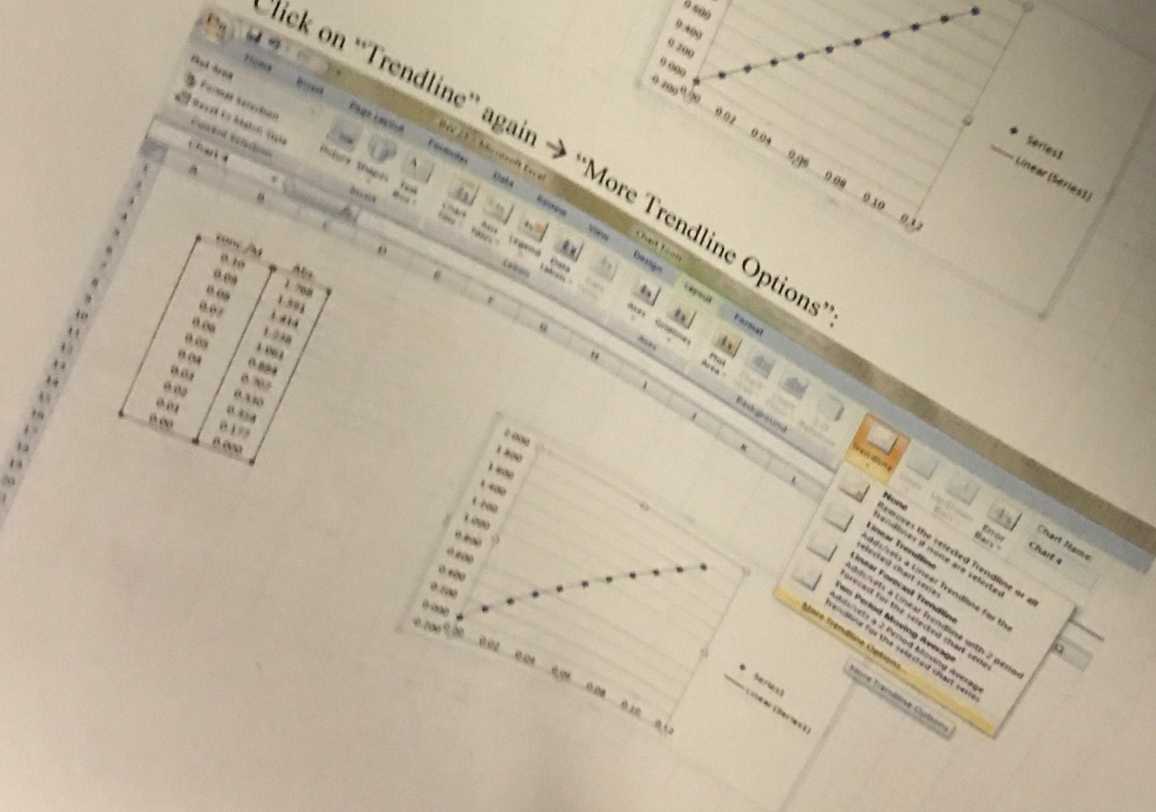
10. Now you get the standard curve. **Remember to label the axis and give the graph a proper name.** Note: as long as $0.9 \leqq R^2 \leqq 1$, the data have good linearity.



7. Then you will see a linear trend line pass through the data points:



8. Click on "Trendline" again → "More Trendline Options":



11.Example of a graph with a proper title, x and y-axes labeled with proper units. Also, as indicated in step 9, "Display Equation on chart" and "Display R-squared value on chart".

Absorbance vs. Concentration at _____nm for _____dye