WHAT TO DO WITH MAX AND MIN LINES IN IB PHYSICS

Remember that most Physics experiments lead to graphical analysis of data. We can use graphs to express and find uncertainties. You must include graphs of your data in aspect 3 in Analysis.

Let's say you have gotten to the point where you have:

- taken data
- decided which variables to graph on the x and y axes, and done so with proper error bars shown
- found the line of best fit and the slope of this line (in Graphical Analysis or another suitable graphing program)

Therefore, you have found a value of the slope that corresponds to some physical quantity. Now you must use the **maximum** and **minimum best-fit lines** to determine the final uncertainty in the stated value of the slope of your best-fit line. Here's how:

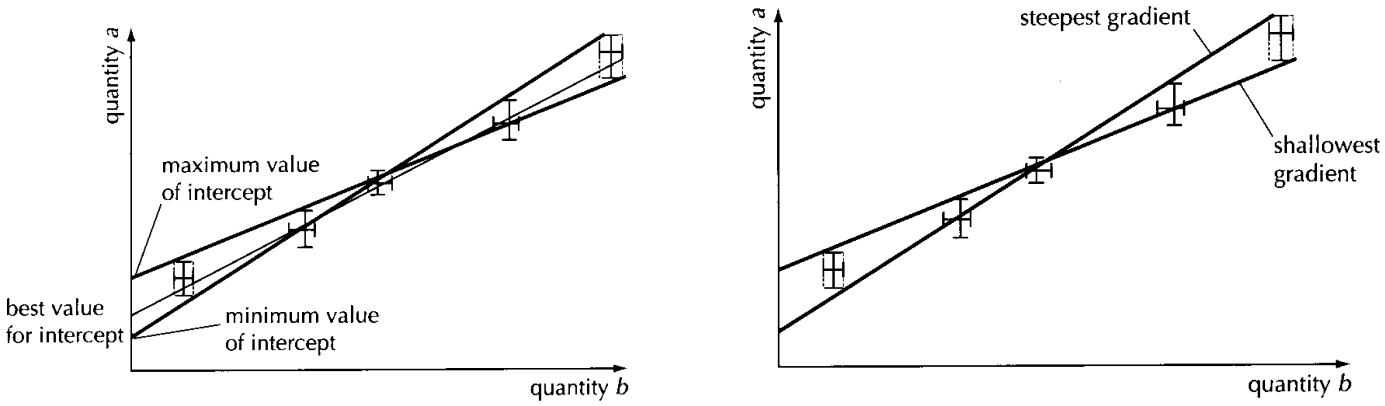
1. Draw a straight line with the **least** slope possible (minimum best-fit line) that connects corners of your first and last error boxes.

2. Draw a straight line with the **greatest** slope possible (maximum best-fit line) that connects corners of your first and last error boxes.

3. Determine the slopes of these two lines.

4. Your final uncertainty in the stated value of the slope of your best fit line is: (max slope - min slope)/2.

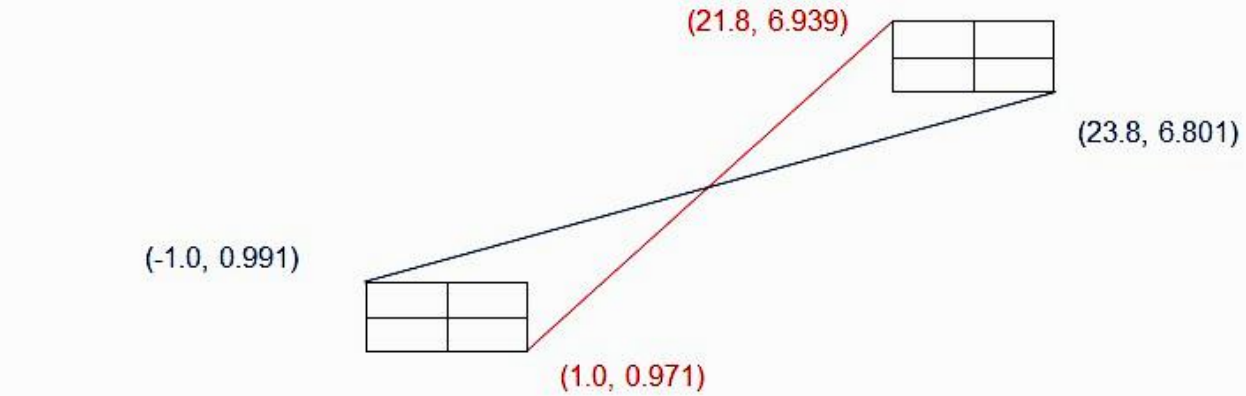
Source: Physics for the IB Diploma Study Guide, Kirk



Lines of Best Fit and Max/Min Lines for 'Graph of Quantity a vs. Quantity b'

Note that by using this technique, you may get max and min lines that do not go through the error boxes of every data point. This is ok and you will not be penalized for it. Sometimes it is impossible to make a line go through every error box.

Another way to think of it; consider the following diagram showing only the first and last data points of experimental data:



Gradient of steep (maximum slope) line = $\frac{\Delta y}{\Delta x} = \frac{6.939 - 0.971}{21.8 - 1.0} = 0.287 = 0.29$

Gradient of shallow (minimum slope) line = $\frac{\Delta y}{\Delta x} = \frac{6.801 - 0.991}{23.8 - (-1.0)} = 0.234 = 0.23$

You can deduce from this visual that the first and last data points are (0, 0.981) and (22.8, 6.870), respectively. Therefore, the slope of the best-fit line is 0.258 = 0.26.

Having these max and min line slopes then allows you to determine the final uncertainty in your end result. The error in the above slope is:

$\frac{\text{Max slope} - \text{Min slope}}{2}$ which in this case would yield 0.03.

Therefore, the final stated value for the gradient of this line would be: **0.26 ± 0.03** (units).

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