For each question please create code contained a **single Code Cell**. You can use markdown headings above each cell, to specify which question each cell corresponds to. Make sure your Notebook is saved **in an appropriate folder on OneDrive** as you will be asked to modify this code in the coming weeks.

1. Straight line fitting: Hooke's law [3 marks]

Write a code that fits a best fit line to the Hooke's law data given in section 3.2.2. The code should give the best fit line with uncertainties on the slope and intercept and plot a graph showing the data and best fit line. Ensure that the code is well commented.

2. Straight line fitting: Current vs Amplitude [1 mark]

An experiment is performed to measure the resistance of a component. The voltage and current are measured:

Voltage (V)	Current (mA)
0.0	2
1.0	104
2.0	212
3.0	302
4.0	398
5.0	507
6.0	606
7.0	692

Copy of your code Hooke's Law program into a new Code Cell and then:

a. Enter the above data into your program in place of the Hooke's Law data and update the answers and labels on the graph to have the correct names and units.
b. Run your program to calculate the gradient and intercept with errors.
c. Calculate the resistance and the error in the resistance.
d. The component tested was marked as a 10 Ω resistor. Are the experimental results consistent with this?

Note: that the plot **must** be made with **voltage on the x-axis** as it's the quantity we control. Marks will be deducted otherwise – the final error **must be propagated** from that plot.

3. Fitting exponential decay [1 mark]

A radioactive source of Lead-214 was analysed and the number of radioactive decays in the last 10 seconds of each minute were recorded. The data are given in the table below.

Time (minutes)	Counts (in 10 second interval)
1	20
2	16
3	13
4	10
5	8
6	7
7	5

8	4
9	3

The radioactivity equation is $N(t) = N_0 e^{-\lambda t}$ where N(t) is the number of radioactive nuclei at time t, N_0 is the number of radioactive nuclei at time t = 0 and λ is the decay constant. The activity (counts) of the sample at a time t is directly proportional to the number of radioactive nuclei at time t. So, the number of observed counts as a function of t should satisfy a similar equation.

Use this to calculate the decay constant λ by

a. Entering this data into your straight line fit program
b. Manipulating the data arrays so that the data should lie on a straight line
c. Calculate the gradient and intercept of the best fit line, and the associated uncertainties.
d. Determine the decay constant λ, quote your result along with the correposnding uncertainty.