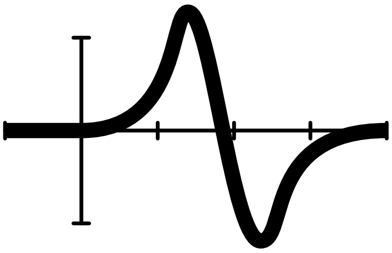
ADVANCED CONNECTIONS | CYSYLLTIADAU PELLACH

PHYSICS MENTORING PROJECT | PROSIECT MENTORA FFISEG

PRE-TUTORIAL MATERIAL

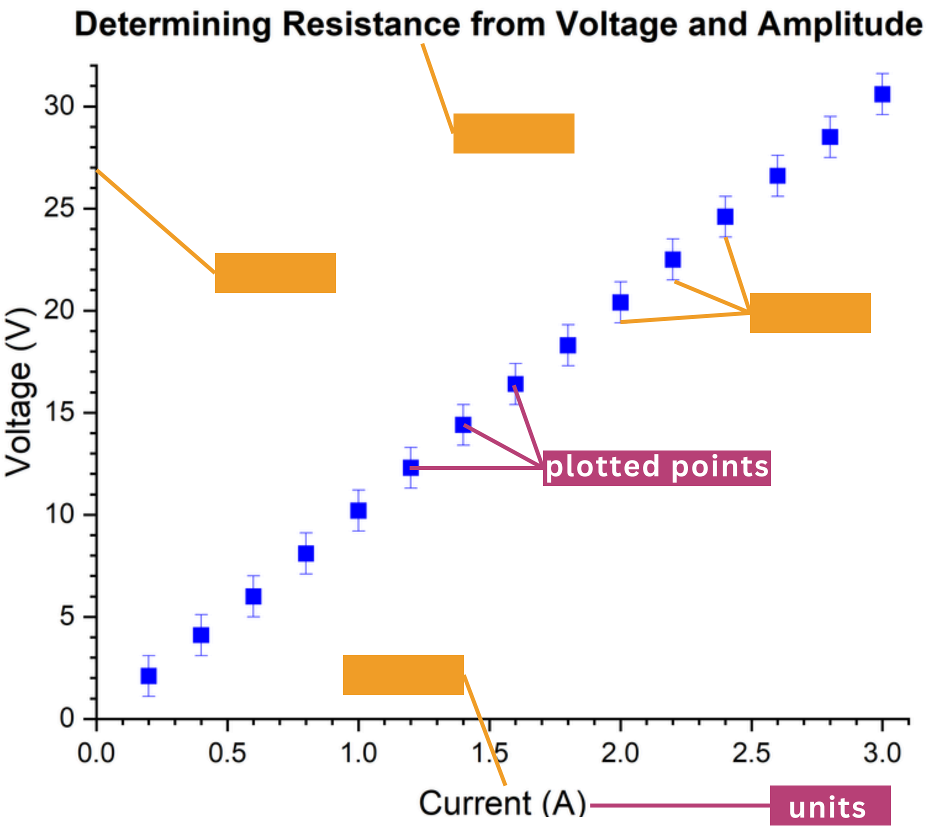
SESSION 4: ILLUSTRATING LIKE A PHYSICIST



Graphs are one of the primary tools for showing data or results for any physicist, or indeed anyone who works with data of any sort. They are able to immediately show trends or relationships between variables that would be comparatively unclear when just looking at a large amount of data. We can also perform further analysis using graphs that would be difficult to do without it.

TASK 1: THE BASICS

5 MINS



Match the labels to the different graph elements. NB there are more labels below than on the graph.

x-axis | y-axis

axis label | title

data | error bars

TASK 2: RECOGNISING GRAPHS

5 MINS

As mentioned above, graphs can show us the relationships between variables by sight alone. This is very useful in physics as we can associate a graph's shape with a certain equation that links the variables on the axes. We can then check this against our theories to see if they match up. But we have to know what the different equations look like when plotted. Match the plots on the graph on the next page to the equations that describe them.

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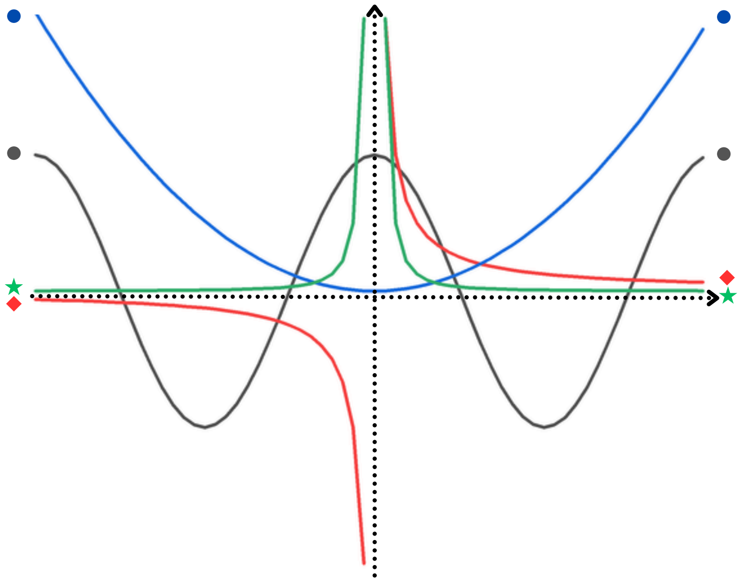
$$y = k\cos(x)$$
$$y = k\sin(x)$$
$$y = kx^{-2}$$
$$y = kx^{-1}$$
$$y = kx$$
$$y = kx^{2}$$



ANALYSING GRAPHS

A straight-line graph can tell us a lot about how the two plotted variables are related. First, we know immediately that they are related by an equation of the form: $y = mx + c$ Where x and y are the variables plotted on the x-axis and y-axis respectively. What's more, we can find out what both m (the gradient) and c (the y-intercept) are. We can also find certain values by using the area under the curve (in maths this is called integration). There is more on this in 'Optional Extras'.

EXAMPLE: STRAIGHT-LINE GRAPH

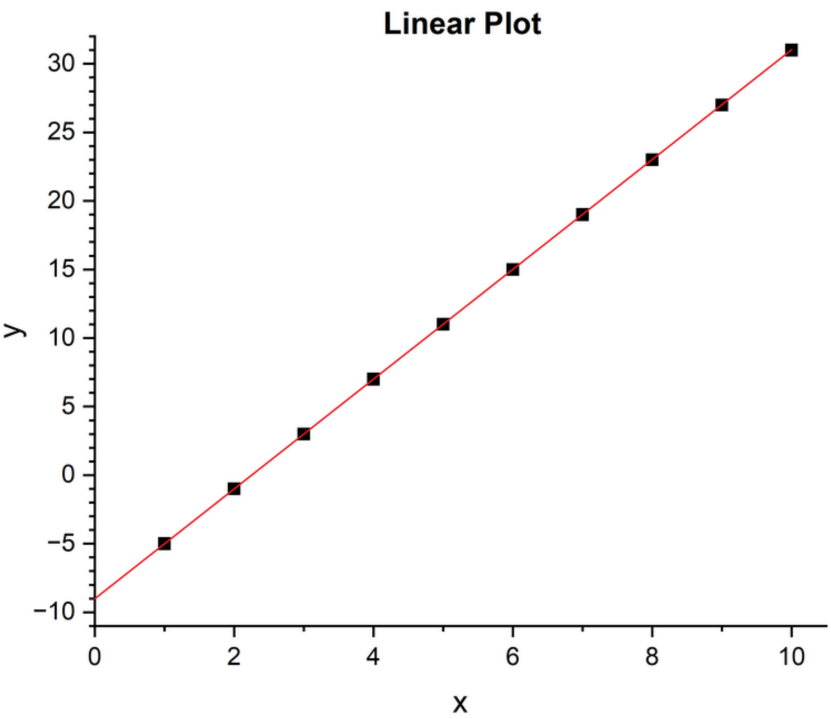
Once we've plotted a straight-line graph, finding the y-intercept (c) is very easy. This is simply the value of the y-variable when the graph crosses the y-axis (in other words, find y when x = 0). In this case, c = -9.

The gradient is a measure of the steepness of the line. To find it, we divide the amount that the graph rises in the y-direction (this can be negative) over a given section of the graph by the amount it increases in the x-direction of this same section. This can be represented by taking any two points on the graph with coordinates (here, m=4):

$$(x_1, y_1) \& (x_2, y_2)$$

And using the equation:

$$m = \frac{y_2 - y_1}{x_2 - x_1}$$



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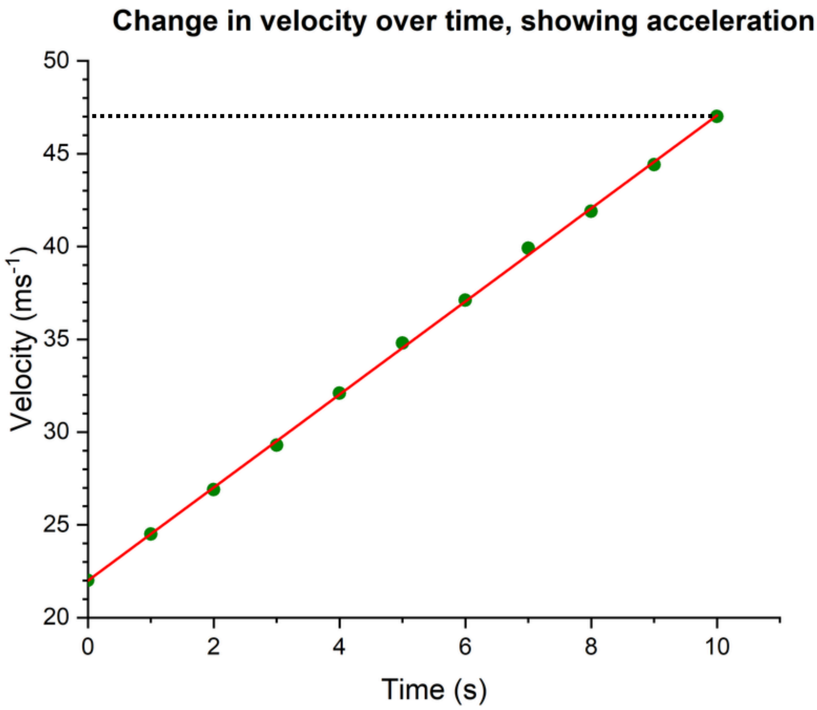
TASK 3: FIND THE CONSTANTS

10 MINS

Use the graph below to find the values of both the starting velocity (u) and the acceleration (a) according to the equation:

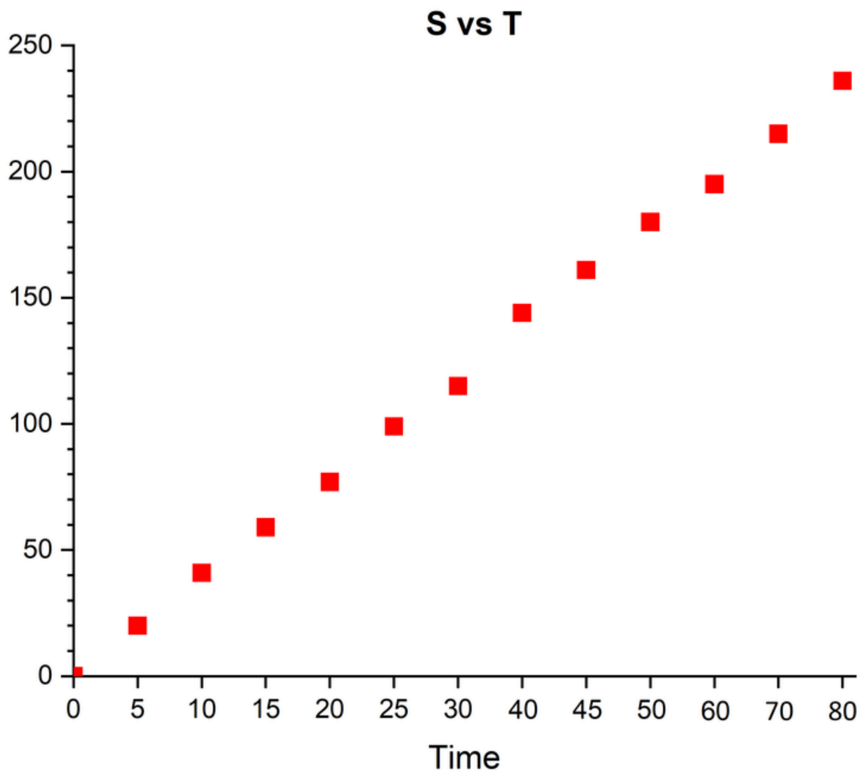
$$v = u + at$$



TASK 4: PLOTTING GRAPHS

5 MINS

We also need to know how to plot graphs. This isn't just as simple as drawing crosses in the right spots; graphs need to have enough information so that the person reading it can make sense of it or use it. Take a look at the graph below and try to come up with at least 3 elements of it that should be improved.



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OPTIONAL EXTRAS

SKETCHING GRAPHS

Try sketching some graphs yourself based on the following equations. Because they're sketches they can be quite simple, much like those in Task 2.

$$y = 5 - x$$

$$y = 25\sin(x)$$

$$y = -x^2$$

$$2y - 7x + 1 = 0$$

PLOTTING GRAPHS

Try plotting your own graph using the data below. Use graph paper if possible, but if you can't then normal paper is fine too. What are the gradient and y-intercept? What might the data be showing?

F (N)	2	4	6	8	10	12	14	16	18
a (ms^{-2})	12	25	37	47	58	71	83	95	107