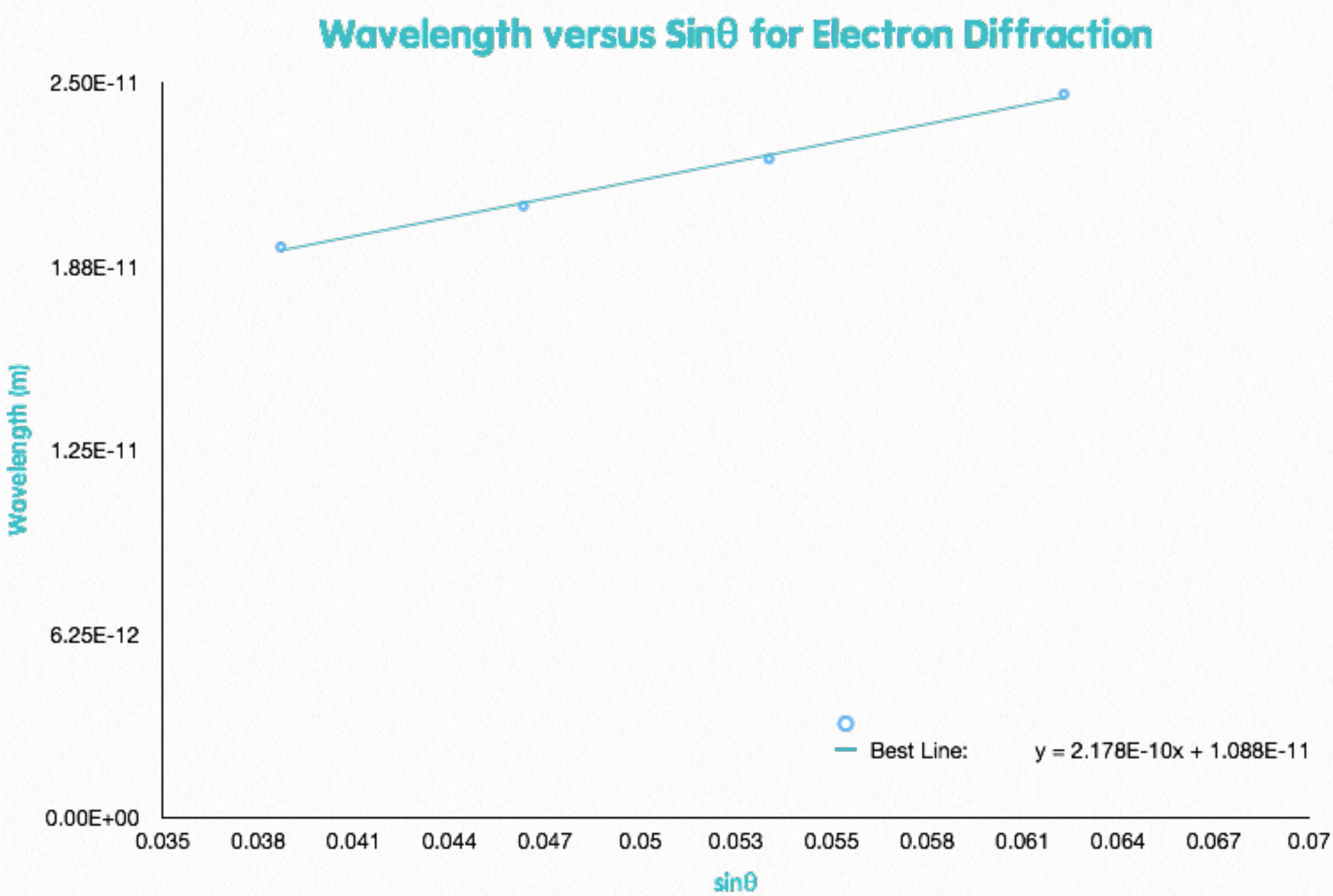
Answers

Investigating Electron Diffraction

Sample Data

Accelerating Voltage, *V (V)*	Momentum of electrons, *p* ($kgms^{-1}$)	de Broglie Wavelength of electrons, *λ (m)*	Distance between central point and 1st order maximum *D, (m)*	*θ (degrees)*	*sinθ*
4000	3.41×10^{-23}	1.94×10^{-11}	0.0058	2.21	0.0386
3500	3.19×10^{-23}	2.08×10^{-11}	0.0069	2.63	0.0460
3000	2.96×10^{-23}	2.24×10^{-11}	0.0080	3.07	0.0535
2500	2.70×10^{-23}	2.46×10^{-11}	0.0094	3.59	0.0625

Sample Graph



Answers - Continued

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Conclusion

The line of best fit that passes through all of the data points in the sample graph shows a linear trend but does not go through the origin, which is to be expected. The sample graph shows no anomalies as all of the data points lie on the line of best fit, although it did not prove possible to take any more than 4 readings. The sample results are reliable as the data points all lie on the line of best fit.

Gradient of the line of best fit = $2.178x10^{-10}m$

$2.178x10^{-10} = \frac{2d}{n}$ (First order ⇒ n=1)

$2d = 2.178x10^{-10}$

$d = 1.089x10^{-10}m$

The percentage difference between the experimental and actual value of the separation of carbon atoms is:
$\Delta \% = \frac{1.42x10^{-10} - 1.089x10^{-10}}{1.42x10^{-10}}x100\,\% = 23.3\,\%$, which is not very accurate.

Evaluation

The design and method of the experiment was useful as it provided all of the data needed for the equations, although a few more readings would improve reliability. The experimental result for the spacing between the carbon atoms in the lattice of graphite suggests that the sample data was reliable, but not accurate. This suggests that random and systematic errors were present in the method.

Weaknesses:

1. The Electron Diffraction Tube has a curved surface which makes it difficult to measure the distance between the central point and the 1st order maximum.

2. It often isn’t obvious when completing this experiment where the 1st order magnitude is. This could lead to significant errors if people attempt to guess where the 1st order magnitude is.

Improvements:

1. To improve the measurement of the curved tube, students could use paper and mark the centre point on it. Then the student could, whilst keeping the centre point in the same position, bend the paper so that it curves with the tube and then mark on where the 1st order magnitude is. Then the distance between the two points on the paper could be measured.

2. To overcome the problem of not being able to find where the first order magnitude is, simply use the 2nd order magnitude which should be more defined (remembering for further calculations that n=2).