

Investigation 1: Factors that affect the light absorbed by a transition metal complex

Moderator comments

Criterion	D	DCP	CE
Achievement level awarded	6	6	4
Achievement of aspects	c, c, c	c, c, c	c, p, p

Design

Defining the problem and selecting variables

Complete

The student clearly stated the problem and identified variables. The wavelength of light used could have been mentioned in the list of variables but has been mentioned in the method.

Controlling variables

Complete

The method allowed for effective control of the relevant variables.

Developing a method for the collection of data

Complete

The method allowed for the collection of appropriate data and was sufficient (the minimum of five data points) to plot a graph. The spread of points was uneven and ideally another data point or two should have been planned for in the concentration range 0.250 to 0.500 M. It did, however, cover the full range from the maximum available concentration of copper sulfate to zero concentration. This is a case where “complete” does not mean perfect.

Data collection and processing

Recording raw data

Complete

The student recorded all raw data, qualitative observations and uncertainties (although there was no need to convert all the absolute uncertainties into percentage uncertainties unless they were to be propagated later). The uncertainty associated with the concentration of the solution would have been better presented with the raw data but it is present and so the aspect is fulfilled.

Processing raw data

Complete

This is quite a simple processing task since the raw data is ready to be directly plotted and there is no need to calculate a gradient. Since the student in her conclusion stressed the linearity of the graph to support the Beer-Lambert Law, this is acceptable to assess data processing, that is, the shape of the graph was the crucial result. If, however, the purpose of the task was to simply show that increasing concentration increases absorbance, then the graph would not have fulfilled any purpose and the processing would have been deemed incomplete, that is, partial.

Presenting processed data

Complete

The student has plotted and annotated the graph appropriately. Uncertainties have been considered but the y-axis error bars have been calculated wrongly (the uncertainty in concentration should have been shown as an x-axis error bar). However, error bars are not required in chemistry internal assessment and therefore the suitable best-fit line is sufficient to secure complete. Students who try to go beyond the aspect descriptors should not be penalized for doing so if there is a slight mistake as a result.

Conclusion and evaluation

Concluding

Complete

A valid conclusion was reached based on the data gathered and processed. The student correctly noted that the graph is linear within the limits of random error. The conclusion is correctly justified through reference to accepted theory.

Evaluating procedure

Partial

The results are evaluated and few weaknesses were identified. The uneven spread of data points or limited range of concentrations (copper (II) sulfate can be made up to nearly 2 M at room temperature) should have been commented on. The student has seen the linear relationship confirmed and has then ceased to look critically.

Improving the investigation

Partial

The student suggested further research away from the focused research question under consideration rather than modifications to reduce random error (only suggesting repeats) or to increase the range over which conclusions could be drawn.