

## Excellence Discussions Examples

- Does the response make it clear that the student understands **why** a particular action had to be carried out?

E.g. Consider the following evidence statements:

*When I set up the equipment I was very careful to make sure that the pivot for the rod was placed exactly at its centre. If it had not been at the centre there would have been a **systematic error** in all the balancing distances.*

*When I set up the equipment I was very careful to make sure that the pivot for the rod was placed exactly at its centre. If it had not been at the centre the mass of the rod would have **caused an extra torque about the pivot point**, which would have affected all the balancing distances.*

*When I set up the equipment I was very careful to make sure that the pivot for the rod was placed exactly at its centre. If it had not been at the centre the mass of the rod would have caused an **extra torque about the pivot point which would have caused all balancing distances to be a bit longer than they should have been in order to compensate for the extra torque on the other side of the pivot.***

The first statement correctly describes what had to be done but the explanation is not sufficiently explicit for this statement to be at the excellence grade and can only provide evidence towards merit.

In the second statement the physics of the situation has been identified and there is evidence that some critical thinking has taken place. However, by itself, this is not sufficient evidence to award excellence. There would have to be at least one other discussion point that showed a similar level of critical thinking, before the evidence could be considered to be at the excellence grade.

The third statement shows a sufficiently high level of critical thinking to be accepted as excellence evidence.

- Does the response make it clear that the student understands how the experimental process could cause the gradient of the graph to be inaccurate?

E.g. Consider the following evidence statements:

*The experimental value for the strength of gravity ( $8.2 \pm 0.6 \text{ N kg}^{-1}$ ) was too low showing that the gradient of the graph was too high. This means that there must have been a **systematic error** in the timings.*

*The experimental value for the strength of gravity ( $8.2 \pm 0.6 \text{ N kg}^{-1}$ ) was too low showing that the gradient of the graph was too high. For this to happen, **for each length chosen the timings must have been too long**. For this to affect the steepness of the line, rather than just its position, the timings must have been “out” by more when the lengths were large than when they were small.*

*The experimental value for the strength of gravity ( $8.2 \pm 0.6 \text{ N kg}^{-1}$ ) was too low showing that the gradient of the graph was too high. For this to happen, **for each length chosen the timings must have been too long**. However the problem must have had less effect when the lengths were short because the graph went through the origin. I did notice that while the bar was swinging it was also wobbling, sometimes quite erratically. This may have been the reason why the timings were too long. Also, I timed a particular number of swings, which meant that for short lengths the total time was much less and so the wobbling would not have had such a great effect on the timings. What I should have done is time for about the same length of time for each length and vary the number of swings. This would have given me a more consistent systematic error and so a better gradient value.*

The first statement correctly relates the inaccuracy in the calculated constant to a problem with the graph line but the explanation does not show critical thinking and can only provide evidence towards merit.

In the second statement there is evidence of understanding how graph line inaccuracies can arise. However, by itself, this is not sufficient evidence of the ability to think critically to award excellence. There would have to be at least one other discussion point that showed a similar level of critical thinking, before the evidence could be considered to be at the excellence grade.

The third statement shows a sufficiently high level of critical thinking to be accepted as excellence evidence.

- Does the response make it clear that the student understands the role of uncertainties in the assessment of the reliability of the conclusion?

E.g. Consider the following evidence statements:

*The experimental value for the capacitance was  $80 \pm 20 \mu\text{F}$ . The theoretical value is  $100 \pm 5\% \mu\text{F}$ . The theoretical value is within the range of the uncertainty in the experimental value showing that the experiment was accurate.*

*The experimental value for the capacitance was  $80 \pm 20 \mu\text{F}$ . The theoretical value is  $100 \pm 5\% \mu\text{F}$ . Although the theoretical value is partly within the range of the uncertainty in the experimental value, the range is very large and the expected value is right at one end of the range. These two things combined show that the experiment was not particularly accurate.*

*The experimental value for the capacitance was  $80 \pm 20 \mu\text{F}$ . The theoretical value is  $100 \pm 5\% \mu\text{F}$ . Although the theoretical value is partly within the range of the uncertainty in the experimental value, an experiment that results in a 25% uncertainty in the experimental value cannot be considered to be accurate. The major source of this uncertainty was not in the reactance values as the maximum percentage uncertainty was 5%. It was because, even with error bars drawn, it was not possible to draw a line of best fit that fitted the plotted data closely. Clearly there was some other source of error that was causing random inaccuracies in the measurements. I did notice, when I set the frequency values, that it was very difficult to judge where to set the pointer on the knob to get a particular frequency. Also the pointer did not have to be turned very much to change the frequency by quite a lot. This means that a very small misjudgement in the pointer position would mean quite a big error in the frequency value. As this misjudgement could have been either way, the error caused would have been random.*

The first statement correctly describes the accuracy of the experimental value in relation to the theoretical value but fails to recognise that the extent of the uncertainty makes the value of any conclusions questionable. This evidence can only provide evidence towards merit.

In the second statement some critical thinking and understanding has been demonstrated but there is not sufficient evidence to award excellence. There would have to be at least one other discussion point that showed a similar level of critical thinking, before the evidence could be considered to be at the excellence grade.

The third statement shows a sufficiently high level of critical thinking and understanding to be accepted as excellence evidence.