Topic 11: Measurement and data processing (2 hours)

11.1 Uncertainty and error in measurement

1 hour

	Assessment statement	Obj	Teacher's notes
11.1.1	Describe and give examples of random uncertainties and systematic errors.	2	
11.1.2	Distinguish between *precision* and *accuracy*.	2	It is possible for a measurement to have great precision yet be inaccurate (for example, if the top of a meniscus is read in a pipette or a measuring cylinder).
11.1.3	Describe how the effects of random uncertainties may be reduced.	2	Students should be aware that random uncertainties, but not systematic errors, are reduced by repeating readings.
11.1.4	State random uncertainty as an uncertainty range (±).	1	
11.1.5	State the results of calculations to the appropriate number of significant figures.	1	The number of significant figures in any answer should reflect the number of significant figures in the given data.

11.2 Uncertainties in calculated results

0.5 hour

	Assessment statement	Obj	Teacher's notes
11.2.1	State uncertainties as absolute and percentage uncertainties.	1	
11.2.2	Determine the uncertainties in results.	3	Only a simple treatment is required. For functions such as addition and subtraction, absolute uncertainties can be added. For multiplication, division and powers, percentage uncertainties can be added. If one uncertainty is much larger than others, the approximate uncertainty in the calculated result can be taken as due to that quantity alone.

11.3 Graphical techniques

0.5 hour

TOK: Why are graphs helpful in providing powerful interpretations of reality.

	Assessment statement	Obj	Teacher's notes

11.3.1	Sketch graphs to represent dependences and interpret graph behaviour.	3	Students should be able to give a qualitative physical interpretation of a particular graph, for example, the variables are proportional or inversely proportional.
11.3.2	Construct graphs from experimental data.	3	This involves the choice of axes and scale, and the plotting of points. **Aim 7:** Software graphing packages could be used.
11.3.3	Draw best-fit lines through data points on a graph.	1	These can be curves or straight lines.
11.3.4	Determine the values of physical quantities from graphs.	3	Include measuring and interpreting the slope (gradient), and stating the units for these quantities.