Teacher Resource Bank

GCE Physics A

Other Guidance:

- Glossary of Terms

AQA Physics Specification A –
Glossary of terms relating to measurements

The AQA team of physics GCE examiners have produced the following list of definitions for use with AQA GCE Physics specifications and examinations.

AQA wish to establish a consistency in the way these terms are used by our examiners in setting all our question papers across both our GCE specifications at AS and A2 levels.

The senior examiners recognise that at other levels of examinations in physics and in other subjects there will be some variation in how these terms are used. We feel that the developing level of understanding of physics students as they progress from GCSE to A level and beyond requires an increasingly sophisticated grasp of these terms and this enhanced understanding requires a more precise set of definitions.

Term	Definition or meaning
Accepted value	The accepted value of a measurement is the value of the most *accurate measurement* available. It is sometimes referred to as the 'true' value.
Accuracy	Accuracy is a measure of confidence in an *accurate measurement*, often expressed as an upper and lower limit of the measurement based on the *uncertainty* in the measurement (eg $g = 9.8 \pm 0.3\,\text{m}\,\text{s}^{-2}$).
Accurate measurements	A measurement which can be described as accurate is one that has been obtained using accurately calibrated instruments correctly and where no systematic errors arise.
Dependent variable	Dependent variables are those variable physical quantities whose values change as a result of a change of value of another variable quantity. The dependent variable is usually plotted on the vertical or y-axis of a graph.
Error	The difference between a measurement and its accepted value. Often a misnomer suggesting that a mistake was made in taking a reading.
Independent variable	Independent variables are those variable physical quantities whose values are controlled or selected by the experimenter. Changing the value of an independent variable usually results in a change of value of a dependent variable. The independent variable is usually plotted on the horizontal or x-axis of a graph.
Linearity	This is a design feature of many instruments and it means that the readings are directly proportional to the magnitude of the variable being measured. *The scale of a moving coil meter is linear if it has evenly spaced graduations on its scale each representing equal increases in current.*
Mean value	The mean value of a set of readings is calculated by adding the readings together and dividing by the number of readings.

Percentage uncertainty (of a mean value)	$\text{percentage uncertainty} = \frac{\text{uncertainty}}{\text{mean value}} \times 100$
Precision	The precision of a measurement is the degree of exactness (sometimes the number of significant figures) to which the measurement of a quantity or value can be obtained and reproduced consistently. • If a reading is constant when repeated, the precision of the measurement will be the precision of the instrument. • If a reading fluctuates the precision of the measurement (its mean value) is given by half the maximum range of the readings.
Precision of an instrument	The precision of an instrument is the smallest non-zero reading that can be measured using the instrument.
Probable error	See 'uncertainty'.
Random error	Random errors are errors with no pattern or bias. Readings with random errors vary in an unpredictable manner with no discernable pattern or trend. The effect of random variations in measurements of a quantity is reduced by taking more readings and finding a mean value.
Range	The range of a set of readings or calculated values is the difference between the smallest and the largest values.
Reliability	Reliability is the extent to which the measurements of a quantity remain consistent over repeated measurements of the same quantity under identical conditions. • An experiment is reliable it if yields consistent results of the same measurement. • An experiment or investigation is unreliable if repeated measurements give different results or if the scatter of measurements on a line graph is too great to establish the line. • Reliability is higher when random errors are reduced. • The reliability of data can be improved by carrying out repeat measurements and calculating a mean value.

Sensitivity	The traditional meaning of sensitivity is based on the ratio: $\text{sensitivity} = \frac{\text{output response}}{\text{input stimulus or signal}}$ (ie output per unit input quantity). The sensitivity of an instrument with a scale is the scale reading it gives per unit of the physical quantity it measures: $\text{sensitivity} = \frac{\text{scale reading}}{\text{quantity measured}}$ *eg The sensitivity of a moving-coil instrument is the number of scale divisions its pointer moves per milliamp of current.* These definitions result in a larger value for the sensitivity of an instrument when it is more sensitive, ie gives a larger response. **Note about alternative scale calibrations** However, some measurement applications use an alternative 'sensitivity' definition which is in fact the ***reciprocal*** of the traditional concept and should be considered as a method of calibrating a scale. *A prime example of this is the format used for the scale divisions on the screen of an oscilloscope where the 'sensitivity' or scale calibration is given in volts per scale division. An appropriate term for this calibration is the **y-gain** of the oscilloscope rather than its sensitivity. The voltage reading is obtained by multiplying the number of scale divisions by the volts per scale division.* This approach is a method of ***calibration*** of a scale in which a value is assigned to each scale division. e.g. *graduations on a thermometer scale each worth 0.2°C; centimetre squares on an oscilloscope screen each worth 2.0 mV.*
Systematic error	Systematic errors in measurements are errors which show a pattern or a bias or a trend. Systematic errors can result from an instrument calibration error (eg zero errors), from incorrect use or reading of instruments (eg parallax errors) or be caused by another factor changing the quantity in an unknown or unrecognised manner.
Uncertainty	The uncertainty of a measurement is an expression of the spread of values which are likely to include the accepted value. *For these physics specifications,* the uncertainty in a measurement is taken as half the range from the lowest to the highest value obtained. The uncertainty in a measurement is expressed as a ± value attached to the mean value. The uncertainty of a value may also be indicated by an error bar on a graph. *For these specifications the 'uncertainty' and 'probable error' in a measurement will be taken to have the same meaning.*
Valid	Valid measurements are those which give the required information by an acceptable method.
Zero error	A zero error arises when an instrument gives a non-zero reading for a true zero value of the quantity it measures. A zero error is a systematic error which must be added to (or subtracted from) all readings obtained with a particular instrument. *An example is often found with micrometer screw gauges which give a non-zero reading when the jaws are closed together.*