# 2. Measurement techniques

**2.1 Measurements**

**2.2 Errors and uncertainties**

**Learning outcomes**

Candidates should be able to:

*(a)* use techniques for the measurement of length, volume, angle, mass,time, temperature and electrical quantities appropriate to the rangesof magnitude implied by the relevant parts of the syllabus.

In particular, candidates should be able to:

• measure lengths using a ruler, vernier scale and micrometer

• measure weight and hence mass using spring and lever balances

• measure an angle using a protractor

• measure time intervals using clocks, stopwatches and the

calibrated time-base of a cathode-ray oscilloscope (c.r.o.)

• measure temperature using a thermometer as a sensor

• use ammeters and voltmeters with appropriate scales

• use a galvanometer in null methods

• use a cathode-ray oscilloscope (c.r.o.)

*(b)* use both analogue scales and digital displays

*(c)* use calibration curves

*(d)* show an understanding of the distinction between systematic errors (including zero errors) and random errors

Systematic Random

Characteristics

Example

*(e)* show an understanding of the distinction between precision and accuracy

Precision

Accuracy

*(f)* assess the uncertainty in a derived quantity by simple addition of actual, fractional or percentage uncertainties (a rigorous statistical treatment is not required).

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PART 2

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