1.2.1 Practical skills

**Independent thinking**

 (a) apply investigative approaches and methods to practical work

**Use and application of scientific methods and practices**

 (b) safely and correctly use a range of practical equipment and materials

 (c) follow written instructions

 (d) make and record observations/measurements

 (e) keep appropriate records of experimental activities

 (f) present information and data in a scientific way

 (g) use appropriate software and tools to process data, carry out research and report findings

**Research and referencing**

 (h) use online and offline research skills including websites, textbooks and other printed scientific sources of information

 (i) correctly cite sources of information

**Instruments and equipment**

 (j) use a wide range of experimental and practical instruments, equipment and techniques appropriate to the knowledge and understanding included in the specification.

*Through use of the apparatus and techniques listed below, and a minimum of 12 assessed practicals, learners should be able to demonstrate all of the practical skills listed within 1.2.1 and CPAC as exemplified through:*

1.2.2 Use of apparatus and techniques

(a) use of appropriate analogue apparatus to record a range of measurements (to include length/ distance, temperature, pressure, force, angles and volume) and to interpolate between scale markings

(b) use of appropriate digital instruments, including electrical multimeters, to obtain a range of measurements (to include time, current, voltage, resistance and mass)

(c) use of methods to increase accuracy of measurements, such as timing over multiple oscillations, or use of fiduciary marker, set square or plumb line

(d) use of a stopwatch or light gates for timing

(e) use of calipers and micrometers for small distances, using digital or vernier scales

(f) correctly constructing circuits from circuit diagrams using DC power supplies, cells, and a range of circuit components, including those where polarity is important

(g) designing, constructing and checking circuits using DC power supplies, cells, and a range of circuit components

(h) use of a signal generator and oscilloscope, including volts/division and time-base

(i) generating and measuring waves, using microphone and loudspeaker, or ripple tank, or vibration transducer, or microwave/radio wave source

(j) use of a laser or light source to investgate characteristcs of light, including interference and diﬀracton

(k) use of ICT such as computer modelling or data logger with a variety of sensors to collect data, or use of sofware to process data

(l) use of ionising radiaton, including detectors.

Common Practical Assessment Criteria, CPAC

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| (1) Follows written procedures | a) Correctly follows instructions to carry out experimental techniques or procedures. |
| (2) Applies investigative approaches and methods when using instruments and equipment | a) Correctly uses appropriate instrumentation, apparatus and materials (including ICT) to carry out investigative activities, experimental techniques and procedures with minimal assistance or prompting. |
|  | b) Carries out techniques or procedures methodically, in sequence and in combination, identifying practical issues and making adjustments when necessary. |
|  | c) Identifies and controls significant quantitative variables where applicable, and plans approaches to take account of variables that cannot readily be controlled. |
|  | d) Selects appropriate equipment and measurement strategies in order to ensure suitably accurate results. |
| (3) Safely uses a range of practical equipment and materials | a) Identifies hazards and assesses risks associated with these hazards, making safety adjustments as necessary, when carrying out experimental techniques and procedures in the lab or field. |
|  | b) Uses appropriate safety equipment and approaches to minimise risks with minimal prompting. |
| (4) Makes and records observations | a) Makes accurate observations relevant to the experimental or investigative procedure. |
|  | b) Obtains accurate, precise and sufficient data for experimental and investigative procedures and records this methodically using appropriate units and conventions. |
| (5) Researches, references and reports | a) Uses appropriate software and/or tools to process data, carry out research and report findings. |
|  | b) Cites sources of information, demonstrating that research has taken place, supporting planning and conclusions. |