CPAC Pen portraits

A series of pen portraits has been written to clarify what is meant by 'not achieved', 'achieved' and ‘achieved at a level of competence exceeding the CPAC (Common Practical Assessment Criteria) standard.

These exemplars have been developed in collaboration between the four Awarding Bodies: AQA, Eduqas, OCR and Pearson.
They are intended for guidance and training purposes, and to give an indication of the standard necessary for each CPAC statement.

Although these pen portraits show (in the most part) CPAC skills in isolation, many practical exercises are likely to involve CPAC strands being assessed in combination.

CPAC 1: Follows written instructions

Not achieved	Achieved	Exceeds standard
Context Chemistry (Year 12): Make up a volumetric solution and carry out a simple acid-base titration.	Context Chemistry (Year 12): Make up a volumetric solution and carry out a simple acid-base titration.	Context Chemistry (Year 12): Make up a volumetric solution and carry out a simple acid-base titration.

Observed The practical lesson started with a full teacher demonstration and safety reminder in addition to all students being provided with a detailed set of written method steps. Working in pairs, glassware and other equipment was collected and set up. One student was responsible for the titration, the other for the preparation of the volumetric solution. There were several requests for reassurance from the teacher, particularly in the initial stages (the steps for the correct weighing procedure were very confused) leading to lots of teacher intervention and a spot demonstration of the drop-wise addition of burette solution towards endpoint. Although the method steps were being followed in the correct order, neither of the students were working independently of the teacher and it was difficult to ascertain the degree of input from each individual student throughout the practical as a whole. Students requested apparatus that was not needed to carry out the written method steps, indicating a lack of forward	Observed The student was provided with a full set of written method steps for the practical. This was supported by a brief class discussion at the start to highlight the safety requirements. Independently, the student methodically and confidently followed the method steps in the correct order; firstly to make the volumetric solution, then to carry out the titration work. They generated a set of expected titre volumes of sodium hydrogensulfate solution. Prior to the rough titration, the student asked the teacher for clarification about the number of drops of indicator to add ("2-3 drops" advised on the sheet) and decided to go with 3 drops to enable the endpoint to be seen more clearly. The student proceeded to carry out a further three titration runs, sufficient to ensure that two results were concordant.	Observed The class was provided with a simple outline of the practical method steps, as all the students had carried out a number of titration practicals in previous lessons and did not need the heavy 'scaffold'. Safety information was discussed verbally. Prior to starting, students could be seen reading the outline in full before selecting apparatus independently from a range of glassware provided on a trolley. Both elements of the practical work – making up the standard solution and titration work – were carried out efficiently, methodically and independently with little reference to the written practical outline. The students demonstrated a developing degree of fluency with the techniques and apparatus being used. Students designed and completed a table, the student checking for obvious anomalous titres after each attempt and ensuring that a sufficient amount of results had been collected to achieve concordant titres. All method steps were carried out in the

planning following reading the method.		correct order, readings were 'double checked' (this was not asked for) and expected outcomes were generated. It was clear that students had developed clear routines eg use of balance, addition of washings, re-filling of burette, endpoint addition etc that were fully embedded in their titration practical work.
Context Chemistry (Year 12): Preparation of a soluble salt using a titration. Observed The teacher demonstrated how to use titration apparatus. A student attempts to follow detailed written instructions but the teacher intervenes on a number of occasions to correct the student. The student is not working independently to follow instructions correctly as demonstrated by teacher intervention.	Context Biology (Year 12): Extraction of DNA from living material. Observed The class opened with a discussion about the principles of extraction of DNA. The specific detail of the method to be followed by students was not discussed, other than a reminder about safety issues. Students worked individually to complete the task. A student followed the written procedure carefully, confidently and without intervention by teacher.	Context Chemistry (Year 13): Estimation of copper(II) salts. Observed The student read the instructions through prior to starting the practical. He weighed accurately using 'weighing-by-difference' the mass of copper(II) sulfate and was able to use good technique to accurately make up the standard solution. At all points he worked efficiently and was able to complete the practical with minimal viewing of the instruction sheet.

		The student was able to interpret instructions and use good techniques to meet their demand. The student shows advanced skills in being able to interpret simple instructions by 'adding flesh to the bones'. He was able to correctly interpret where mass readings needed to be accurate (weighing copper sulfate) and approximate (weighing potassium iodide) and needed no prompting to use appropriate weighing techniques.
Context Biology (Year 12): Qualitative testing for biological molecules – glucose. Observed The teacher reminds the class about the main points of the procedure, including safety matters.	Context Biology (Year 12): Qualitative testing for biological molecules – glucose. Observed The teacher reminds the class about the main points of the procedure, including safety matters.	Context Biology (Year 12): Qualitative testing for biological molecules – glucose. Observed The teacher reminds the class about the main points of the procedure, including safety matters.

However, the student does not manage to follow the instructions in the correct order and does not add Benedict's solution prior to heating in the water bath for the first test. This has to be pointed out by the teacher.	The student then works independently to collect the expected set of results. All procedural points are carried out in the correct order and the student is methodical and confident in their approach to the task. The teacher does not have to have any involvement.	Following this, the student works without intervention from the teacher and collects the expected set of results, having followed all of the method points in the correct order. The student engages in a discussion with the teacher about the temperature the water bath needs to be maintained at to see a result with Benedict's test and it is agreed that the instructions could be modified slightly.
Context Physics (Year 12): Determine the electrical resistivity of a material. Observed A student is working as part of a pair. The student asks the teacher for reassurance that the apparatus provided is correct for the experiment. He takes no part in the setting-up of the circuit, leaving this task to his partner.	Context Physics (Year 12): Determine the electrical resistivity of a material. Observed A student is working as part of a pair. The student reads the instructions provided for the practical. She is able to use the circuit diagram from the apparatus provided. With her partner, she asks her teacher to check the circuit, which is correct.	Context Physics (Year 12): Determine the electrical resistivity of a material. Observed The student is provided with an outline of the experiment, where some steps are given in outline only. He reads through the instructions provided and is able to formulate a correct method for the task.

The worksheet tells students to collect a reading every 10 cm along a 1-metre length of wire. The student collects three readings only, and asks his teacher if this is enough data.	At the end of the practical session, she has collected sufficient data, together with her partner, as outlined in the method on the worksheet.	He finds all the apparatus independently (CPAC 2d). He sets up the circuit, and checks that it is correct before turning on the power pack. He works methodically to collect the data required, ensuring that it is tabulated and checked as he goes along (CPAC 4b).

CPAC 2: Applies investigative approaches and methods when using instruments and equipment

Not achieved	Achieved	Exceeds standard
Context Biology (Year 12): Investigation into the effect of a named variable on the rate of an enzyme-controlled reaction. Observed In groups of three, students were invited to plan and carry out an investigation to find out the effect of temperature on the rate of trypsin enzyme. One of the students immediately took the lead and started to write things down. One of the others quickly joined in but the third, who was less familiar with enzyme work through recent absence from school, took a backseat. After a while it was clear to the teacher that little progress was being made as the group were unsure both how to measure trypsin action (dependent variable) or what	Context Biology (Year 12): Investigation into the effect of a named variable on the rate of an enzyme-controlled reaction. Observed An individual student was invited to investigate the effect of temperature on the rate of trypsin action. Using previous lesson theory and practical notes, they devised a potential set of simple method steps that would enable sufficient data to be generated. The student asked the teacher to consider what they had done before modifying their method for control of temperature, recognising with little prompting that electrostatically controlled water baths would be a better choice than beakers. From that point, the student chose all the necessary apparatus and prepared all the	Context Biology (Year 12): Investigation into the effect of a named variable on the rate of an enzyme-controlled reaction. Observed The teacher gave all the students in the class an open choice of which independent variable they might like to investigate when considering how trypsin enzyme reacts. The teacher provided a list of apparatus and chemicals that would be available to them, plus an indication of the lesson time that would be dedicated to the task. The students had been asked to carry out some research for homework to enable them to independently write a set of method steps to investigate their written hypothesis. Students were then given the

variables to control so they gave the group a prescriptive set of method steps to follow. The students then chose appropriate equipment. They set up water baths using beakers and the started the procedure but, due to a lack of concentration and urgency demonstrated within the group, the data generated did not reflect the trend expected and so the teacher needed to intervene to help them to get back on track. For example, the teacher pointed out that the water baths were cooling. In this group, despite one of the students being able to discuss the reasons for the method steps being carried out, the group as a whole were not convincingly able to express an understanding of what they were doing and how their work related either to the hypothesis or the expected conclusion.	enzyme and substrate test tubes independently, allowing all tubes to equilibrate in the water baths for 10 minutes prior to mixing. The student investigated 5 different temperatures with 10 degree intervals and repeated each temperature three times. It was clear that this student had also recognised that the thickness of the pen used to draw the cross on the test-tube glass was a control variable as they were seen using a fine marker prior to their use of a black board marker. This was as a result of the first set of enzyme – substrate tubes being mixed. When questioned by his teacher about why they had changed marker pens, the student explained that they had found it difficult to fully judge the disappearance of the cross and so a modification of method steps was necessary and the first set of tubes was fully repeated. The student produced a set of data that showed the expected trend.	opportunity to carry out some preliminary practical work to enable them to tighten their written method. One student, who decided to investigate the effect of temperature, carried out a trial experiment to decide the percentage concentration of trypsin enzyme to use (to ensure the experimental runs carried out at higher temperatures were measurable and not too fast). The student was also keen to ensure that the overall volume of enzyme-substrate mixture was not too great to ensure that the contents of each tube were fully submerged in the water bath at the desired working temperature. Through questioning, the teacher could clearly evidence that the student had a full understanding of what they were doing, could justify all their actions and link them to the expected outcome. Repeats had been considered to allow the mean data to generate the expected trend. The data table designed provided evidence of an understanding of accurately recording the independent variable, temperature. For example,

		despite the water bath dial being set at 20 °C, the temperature recorded was 21 °C, taken from a thermometer in the water bath.
Context Biology (Year 13): Investigation into the abundance and distribution of plants in a habitat. Observed The students were asked to work in groups of three to plan and carry out the investigation. One of the students appeared to have more input into the groups plan while the other two appeared to be more easily distracted and allowed the first candidate to lead. They were clearly distracted and consequently worked less methodically than they could have. Appropriate equipment was used by the members of	Context Chemistry (Year 13): Planning a sequence of tests to identify organic compounds. Observed A student devised a suitable testing sequence that would allow for the identification of the compounds in relatively few steps. He was able to follow the steps, choosing appropriate reagents for each of the identified tests with minimal assistance. He recognised that one of the steps in his sequence was not necessary when testing compound 'V' – (benzenecarbaldehyde) and he modified his testing sequence accordingly. He was able to give reasons for his testing sequence and understood what he was doing.	Context Physics (Year 13): Measurement of *g* with a pendulum. Observed The students were given a box of equipment and asked to devise a method to measure *g* using only equipment from the box. A student illustrated the method that she would follow by drawing a simple diagram and by outlining the steps she proposed to follow. The student first chose to make two trial runs to measure the time of a period for both the longest and shortest length in order to check the range of values and also to determine whether the shortest

the group although they demonstrated a somewhat cavalier approach to collecting the information. There was also some confusion over recording information. One student in the group was able to give a rationale for the way in which they completed the investigation but the other two seemed less clear. It was difficult to be certain who contributed what to the investigation. One student clearly took the lead but the group work was poorly managed which lead to some failures in the 'doing' of the activity. While group work may be allowable under certain circumstances, it is important that the contribution of each student is clearly identifiable and that the students can evidence the key aspects of the CPAC2 skills. In this case, the best that can be said is that one student was working towards aspects of the assessment criteria while the other two showed little evidence.		length could be measured without significant error. She decided to increase the length of the pendulum of her shortest run in the light of her experience. The student understood what she was doing and could give clear reasoning for the method she proposed. The student recognised the need to take multiple readings for each period of the pendulum and could give reasons for variations in the period for each length.

Context Physics (Year 13): Potential divider investigation. Observed Students working in pairs are unable to get their circuit to operate. The teacher leaves them for 15 to 20 minutes to try and overcome their difficulties before stepping in to guide them to assembling a correctly functioning circuit.	Context Physics (Year 13): Potential divider investigation. Observed Students working in pairs are unable to get their circuit to operate. The students work though their circuit and after 15 to 20 minutes overcome their difficulties and are able to collect data as required. (Achieves the use of instruments and equipment although not investigative 2a, b)	Context Physics (Year 13): Potential divider investigation. Observed Students working in pairs set up their apparatus with no issues, each participating and communicating with each other. They collect data as required and have completed the task set within twenty minutes. The teacher then asks them to determine the best value for the fixed resistor in their circuit to optimise the range of potential difference output. (Achieves the use of equipment and investigative nature 2a, b, c)
Context Biology (Year 12): Investigate a factor affecting the initial rate of an enzyme controlled reaction.	Context Biology (Year 12): Investigate a factor affecting the initial rate of an enzyme controlled reaction.	Context Biology (Year 12): Investigate a factor affecting the initial rate of an enzyme controlled reaction.

Observed Although the student is following a clear outline of the experiment, it is evident that he does not know which variables should be controlled, so ends up varying the temperature, but failing to have a constant amount of enzyme in each experiment. The experimental steps are not carried out in a logical order, and the data collected is to a variety of significant figures.	Observed The method followed by the student tells them to vary the concentration of the substrate. The student knows that temperature must be controlled, and sets up a beaker to use as a water bath, to control the temperature (CPAC 2c). The student correctly sets up a series of different substrate concentrations and, before adding the enzyme, places her test-tubes in the water bath, the water level rises; so the student then changes this to a larger beaker (CPAC 2b).	Observed The worksheet used by the student contains an outline of the experiment. The student decides to investigate temperature as the factor, and plans to ensure that other factors (concentration of substrate, amount of enzyme used) are kept the same (CPAC 2c). Without prompting, he is able to find, in a text book, a suitable method to follow and selects and sets up appropriate apparatus for the experiment (CPAC 2d). When the teacher comes around to check, the student is already collecting data, and his blank results table shows that he is controlling concentration and planning to collect results at 5 different temperatures, using a water bath (CPAC 2c). Although he has planned to collect results every 10 °C, the teacher can see that the current experiment is using a water bath at 29 °C, and the student has already corrected the results table (CPAC 2b).

CPAC 3: Safely uses a range of practical equipment and materials

Not achieved	Achieved	Exceeds standard
Context Chemistry (Year 12): Carry out simple test-tube reactions to identify cations and anions in aqueous solution. Observed The student set up three test-tube racks of test-tubes, one for each of the parts of the experiment. In haste a couple of the test-tubes fell in the student's attempt to carry them over to the work space and broken glass was evident on the floor. Keen to get on with the practical steps, the student did not deal with the incident and was seen gently kicking the glass under the desk. Other students expressed their concern as they were walking on it and carrying things around the laboratory floor and so the teacher intervened and brushed up the broken glass. Later on during the practical	Context Chemistry (Year 12): Carry out simple test-tube reactions to identify cations and anions in aqueous solution. Observed The student had carefully set up an organised workspace and collected all the glassware, other equipment and reagents to limit the need for a lot of walking around the laboratory once the procedures started. Two of the reagents were located in the fume cupboard and the student was fully aware of that and had identified any hazards and risks associated with the practical as a whole. The student handled the equipment confidently and sensibly, disposing of each of the reacted tubes as directed by their teacher.	Context Chemistry (Year 12): Carry out simple test-tube reactions to identify cations and anions in aqueous solution. Observed The student was keen to write a full, detailed risk assessment to cover all aspects of the practical work. The number of reagents involved gave the student an opportunity to gain more understanding about the hazards associated with a range of different chemicals. This exceeded the requirement as students simply need to *be able to identify hazards and risks in their work and be able to address those accordingly.* The student carried out the practical 3-part procedure confidently in a well organised work place with no need for

lesson, the same student carried a stock dropper bottle of concentrated H_2SO_4 from the fume cupboard to use at their workspace. Others around them started to cough, drawing the teacher's attention to the action, again requiring immediate intervention. On both occasions the student had failed to consider, and therefore minimise, risk or harm to themselves or other students around them. There was a lack of consideration of health and safety procedure and too many prompts were required by the teacher to ensure safe working practice.	During Part 1 they accidentally spilled a small amount of limewater on the desk but without fuss, wiped it up with a paper towel. One of the students on the same desk had left a stopper off one of the reagent bottles and they needed little prompting to replace it when they realised. When pupils worked in pairs, it was clear that they had an understanding of any medical issues that might need consideration eg asthma. On one occasion the student asked for clarification about how much solid a 'small spatula measure of solid potassium chloride' was, realising that this had a safety implication.	teacher intervention. Mid-way through the lesson they noticed that another student had brought a fume cupboard reagent across to their desk and left the dropper bottle stopper of it. They calmly went over and pointed it out to the student, replaced the stopper and offered to take it back to the fume cupboard before alerting the teacher after they saw another student do exactly the same thing minutes later. It was clear that they had a full understanding of how to deal with an incident should it occur. The same student, when completing a part of the investigation using solid halides was seen halving the amount of solid that they had originally poured into the reaction tube, amending the procedure slightly to make it safer.
Context Chemistry (Year 12): Indirect determination of an enthalpy change of reaction.	Context Physics (Year 13): Measurement of the specific heat capacity for a solid by the method of heat transfer.	Context Chemistry (Year 13): Planning a sequence of tests to identify organic compounds.

Observed A student breaks a mercury thermometer in the course of an experiment and is seen putting the broken thermometer in a draw. No attempt is made to deal with any spilt mercury. The student continues with his work and does not report the incident to the class teacher. The incident is mentioned to the teacher who then intervenes. The student has failed to minimise risk of harm to himself or others in the class.	Observed A student identifies hazards and risks associated with their procedure. His work space is well organised. He works safely and handles equipment confidently and competently. The practical period is completed without incident.	Observed A student prepares a detailed (suitable and sufficient) risk assessment covering all aspects of the practical work. The student completes the investigation safely in accordance with laboratory requirements and risk assessment. At all times she works confidently and without need for intervention. Her work space is well organised. She spills a small amount of ethanamide in the fume cupboard but warns those working near her and then reports this to the teacher (laboratory rules specify that spills are to be reported to the teacher who deals with the situation). Students are expected to identify hazards and risks in work. A detailed risk assessment exceeds this requirement.
Context Biology (Year 12): Investigation into the effect of exercise on pulse rate.	Context Biology (Year 12): Investigation into the effect of exercise on pulse rate.	Context Biology (Year 12): Investigation into the effect of exercise on pulse rate.

Observed The student starts the investigation without consideration of the impact of the exercise on those participating. One participant has an asthma attack and has to stop and take medication and it is determined, in hindsight, that this individual should not have been asked to exercise.	Observed The student asks the individuals participating in the exercise if they have any relevant health concerns. He then proceeds with the investigation without incident once it has been established that no one suffers from a heart or lung condition.	Observed The student considers detailed risks and hazards with the investigation, including whether any participant has a relevant health concern and the safety of the exercise to be carried out. One participant is asked not to take part as she has a heart condition. When the participants start the exercise (running up and down a flight of stairs), the student decides that this is actually quite risky as there is more foot traffic in the school than originally anticipated. Therefore, he changes the exercise to a longer period of star jumps on the spot. A detailed risk assessment is provided as part of the investigation.
Context Chemistry (Year 12): Finding the concentration of a solution of hydrochloric acid by titration.	Context Chemistry (Year 12): Finding the concentration of a solution of hydrochloric acid by titration.	Context Chemistry (Year 12): Finding the concentration of a solution of hydrochloric acid by titration.

Observed	Observed	Observed
The student reads the worksheet provided, which gives some information on safety for this experiment. The student collects safety glasses, but they spend the majority of the time pushed up on her head – she only pushes them down over her eyes when prompted by her teacher. She turns around to talk to someone else in the laboratory during the practical, and knocks over a conical flask as she turns. She does not notice the spillage.	The student looks at the method given, and follows the instructions about correct use of lab coat and safety glasses. He tells his teacher how he attached the pipette filler to the pipette – this method is safe, and the teacher confirms this. Once he has used the pipette, he detaches the filler and puts the pipette somewhere where it will not roll off the lab bench. When he is washing up after the experiment, he accidentally pours some acid on his skin. He washes it off with plenty of water, and then tells his teacher what has happened: no further action is necessary.	On being told that the experiment is a titration, the student knows that the safety equipment required will be a lab coat, eye protection and a pipette safety filler. The student is working in a pair, and she reminds her lab partner of the safe method of attaching the pipette filler to the pipette. She remembers all the key points for safely filling a burette, including bringing the burette down to a safe working level before filling. When her teacher asks what she would do in the event of a spillage, she is able to describe a safe method of clearing it away.

CPAC 4: Makes and records observations

Not achieved	Achieved	Exceeds standard
Context Biology (Year 12): Production of a dilution series of a solute to produce a calibration curve with which to identify the water potential of plant tissue. Observed A student prepared all the dilutions of sucrose solution from 1.0M stock solution as directed and correctly completed a given table to show volumes of both stock sucrose and water they added to make up the required 20 cm^3 of all concentrations in the desired range. They then proceeded to use the cork borer to remove equally sized, peel free chips and blot them to remove excess moisture. Feeling tired and slightly pushed for time, the student quickly scribbled down a results table. Each of the variable headings was present but without units, in fact some values had units	Context Biology (Year 12): Production of a dilution series of a solute to produce a calibration curve with which to identify the water potential of plant tissue. Observed A student designed a results table for their raw data that was complete with variable headings and units to the format expected outlined in their practical handbook. After blotting dry the chips, the student weighed each one, recording the initial masses to 2 decimal places as it was being collected. This number of significant figures appropriate for the weighing balance was used.	Context Biology (Year 12): Production of a dilution series of a solute to produce a calibration curve with which to identify the water potential of plant tissue. Observed The student on this occasion was keen to reduce the uncertainty in their data and so wanted to carry out a number of repeats for each sucrose concentration. They had planned to use a number of sets of sucrose tubes and chips and demonstrated the ability to both make and record multiple readings throughout the procedure. Their data table had variable headings and units to the expected format and, in addition to their raw data, the table had columns housing processed data. This included both gain in mass and percentage gain in mass, enabling them to then draw their graph as

on the same line as the value, others did not. Unfortunately the student did not consistently use the appropriate number of decimal places, with some data recorded to only one decimal place and others to two, which was more appropriate. When this became obvious to the teacher towards the end of the practical lesson, it was too late to repeat the tests.		directed.
Context Biology (Year 12): Preparation and scientific drawing of onion cells including calibration of actual size and magnification of drawing. Observed Three cells are drawn but these appeared out of proportion with cells viewed by candidate. Very little observation of the image was made by the student who	Context Chemistry (Year 12): Back titration – determination of calcium carbonate in limestone. Observed A student accurately records data from the titration. He determines the mass weighed by difference. He records all readings at the time of	Context Physics (Year 13): Measurement of g with a pendulum. Observed The candidate made two trial runs to measure the time of a period for the longest and shortest length she proposed to use in order to check the range of values and also determine whether the shortest length could be made measured without

appeared to draw what she thought should be present. The student was clearly distracted from the task by chatting to her neighbour. No indication of length in eye piece units was given. The candidate forgot to record the magnification of the drawing.	taking them. His readings are recorded into suitable tables to an appropriate number of decimal places taking into account the resolution of the apparatus (eg burette readings were to 2 decimal places with second figure as '0' or '5'). On one titre reading he omitted to write down '0'. This appeared to be an oversight by the candidate who recognised his error when it was brought to his attention.	significant error. She increased the length of the pendulum of her shortest run in the light of her experience. The candidate then made multiple readings of the period of the pendulum at a total of six lengths approximately evenly spaced over the range she determined. She took period readings for six different lengths. She recorded all information immediately into a suitable table to an appropriate precision with units correctly recorded. Her tables also facilitated the recording of processed data. This is a capable candidate who displays the full range of making and recording skills in one procedure. It is possible that different aspects of these skills could have been demonstrated in more than one experiment. It is not necessary to record processed data – only raw data- in an appropriate table so this candidate has exceeded the standard.

Context Biology (Year 12): An investigation into the water potential of potato Observed As part of the investigation, the student is expected to draw an accurate results table. In this case, the student confuses the dependent and independent variables and draws a table where the units are repeated in each line of data. This is pointed out by the teacher in discussion with the student and the student is then able to draw a more suitable table and know the format for the next time this skill is required.	Context Biology (Year 12): An investigation into the water potential of potato Observed The student uses a balance to 2 decimal places to weigh and record the mass of her potato chips. The table used has the variables and headings correctly labelled. The student is reminded of the importance of recording all readings at the time of taking them and so does this for all readings after the first one.	Context Biology (Year 12): An investigation into the water potential of potato Observed The student records the mass of potato chips accurately using a balance to 2dp and writes them down in a suitable table as they are weighed. The table has all headings and variables correctly labelled but the table is rough and sketched in the student's lab book. The student then goes on to draw a further table for processed data to include the percentage gain or loss of water of each chip and the mean. This is all recorded correctly.
Context Physics (Year 12): Determine the Young modulus of a material.	Context Physics (Year 12): Determine the Young modulus of a material.	Context Physics (Year 12): Determine the Young modulus of a material.

Observed The student takes a measurement of the diameter of the wire, but is not familiar enough with using a micrometer and only takes a single reading. Only two different loads are used in the experiment, so the student simply records two forces and two extensions. It is not clear from the student's results what the units are for either measurement.	Observed The student is competent in the use of the micrometer and reads the scale correctly to record the diameter of the wire. The student keeps a rough table of the mass used in each experiment (in grams) and the extension of the wire (in mm). In the time available, the student collects five* data points. His graph does have an outlier, but he draws a line of best fit and calculates a value for the test wire. The value does not match the data book, but the teacher is confident that the data has been collected as accurately as the apparatus allows and that the correct gradient has been calculated from the graph. *the exact number of data points to meet CPAC 4 may vary from experiment to experiment.	Observed The student takes two or three measurements of the diameter of the wire, using the micrometer with accuracy, and calculates a mean value. The student records extension and load, with units, in a suitable table and makes a rough plot of force versus extension as data is collected. The student continues to take readings up to the elastic limit of the test wire. The value that the student calculates does not match the data book value, but the student carries out an error analysis to help explain why the value may not match that in the literature.

CPAC 5: Researches, references and reports

Not achieved	Achieved	Exceeds standard
Context Physics (Year 12): Determination of *g* by free-fall method. Observed The student completed their experiment and was asked by his teacher to report his findings. It was evident after a while that they were having difficulty processing their raw data using the calculator and there was some lack of understanding and so the teacher needed to intervene. Despite a lot of support, the report produced was very brief and still contained some of the processed errors that the teacher had supported the student managing. This, coupled with the fact that there was no evidence of any research conducted by the student to support them with either the practical work or calculation work, led to an unsatisfactory write up on this occasion.	Context Physics (Year 12): Determination of *g* by free-fall method. Observed Independent processing of raw data collected through the practical lesson was followed by a short, concise report being produced by the student in their own words. They commented on the value of *g* obtained through calculation, the report commenting on the significance of uncertainty. Several, relevant research resources were included in the report, detailed to include the full URL address and the time and date accessed so they could be accessed again if necessary. It was evident that the student had accessed more information than the teacher had shared through this research.	Context Physics (Year 12): Determination of *g* by free-fall method. Observed A full, detailed report had been completed in the student's own words, heavily supported by the extensive, relevant research resources that they had used to support them in practical work. The student used the Harvard system to reference. The student had been keen to minimise uncertainty in the data collection and so had considered several ways of adapting the procedure eg the use of a *g* ball with an integrated timer, the use of a millisecond timer electromagnetic circuit. Full, scientific terminology had been used correctly and a calculator used without error to process raw data to calculate *g*.

Context Chemistry (Year 12): Determination of an enthalpy change of combustion. Observed The students were asked to report their findings. The student observed had some difficulties calculating the enthalpy change and needed assistance from the teacher. The final report was brief and contained some processing errors. There was no evidence of research (eg checking literature values for enthalpy changes).	Context Biology (Year 12): Investigation into the effect of temperature on enzyme activity. Observed The students were asked to write a report on their findings. The student observed was able to process results to obtain an appropriate graph of rate (1/t) against temperature. His report commented on the significance of the findings and contained two relevant websites whose URLs and date accessed were recorded. The report was written in his own words and was not simply a 'cut and paste' from websites.	Context Physics (Year 12): Determination of *h* using LEDs. Observed The student completed a formal and detailed report of his findings using their own words. The student correctly used a calculator to find relevant values. The report contained suitable graphs plotted using Excel to correctly determine *h*. The report also contained references to critically chosen websites and a textbook. The references were recorded using the Harvard system. There is no requirement to use the Harvard System or to formally write up an experiment's findings and therefore the student's work exceeds requirements.

Context Any subject or Year: Materials Report Observed Student presents information, which may be correct, but without any references or evidence of additional knowledge found from researching.	Context Any subject or Year: Materials Report Observed Student has identified a minimum amount of new information relevant to the material being studied and linked it to understanding from teaching. The references do not follow a standard format, but would allow the reader to locate the information.	Context Any subject or Year: Materials Report Observed Student has taken the project seriously and researched a wide range of additional data to support how the internal structure of a material lends that material to a particular use. The references follow an accepted pattern and are complete.
Context Biology (Year 12): Investigation of plant mineral deficiencies. Observed As part of the preparatory work in advance of the practical, students are asked to undertake some research concerning the	Context Biology (Year 12): Investigation of plant mineral deficiencies. Observed As part of the preparatory work in advance of the practical, students are asked to undertake some research concerning the	Context Biology (Year 12): Investigation of plant mineral deficiencies. Observed As part of the preparatory work in advance of the practical, students are asked to undertake some research concerning the

factors that could be investigated in this investigation. The student's research is poor: his only source of information is the textbook and, although he has read up on some of the theory, he has not considered how this would affect the practical work to be undertaken. No written record is made by the student to say which sources were used in his research.	factors that could be investigated in this investigation. The student uses Wikipedia as a source, along with her textbook, and she writes some notes in her lab book that show some factors that could be investigated. Her written report includes the URL for Wikipedia, along with the data and time accessed; and the title of the textbook used, the author, and the pages from which she obtained the information. When questioned, she acknowledges that Wikipedia is not always a reliable source, but says that the information on the website agreed with her textbook.	factors that could be investigated in this investigation. The student writes some notes in his lab book, based on the use of two different websites, and back-up by two different textbooks. All sources used are accurately referenced. He uses these sources to state the main factors, and then goes on to outline a possible plan for the experiment, including some excellent experimental detail on apparatus and quantities.