AQA

LEVEL 3 CERTIFICATE AND EXTENDED CERTIFICATE

APPLIED SCIENCE

ASC2: Applied Scientific Techniques
Report on the Examination

1776 & 1777
January 2019

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General

January 2019 was the fourth entry opportunity for this unit. Some colleges had taken advantage of the comprehensive Reports on the Examination published in previous series and, if necessary, had adjusted their approaches and marking to good effect.

In addition to the comments that follow, colleges are recommended to read the reports previously published and available on the AQA website, and which contain detailed comments and advice relating to the delivery and marking of this unit.

It is vital that college assessors take advantage of the Teacher Online Standardisation Materials (TOLS) available online via eAQA.

There were many examples of good quality work in the samples submitted for moderation. Most colleges had a clear understanding of the requirements of the specification and the performance outcomes, and understood that the approaches adopted by students should reflect fully the demands and expectations of a Level 3 qualification. Some colleges had underestimated the depth and breadth of the portfolio evidence expected and were too generous in their assessments. As a result some fell out of tolerance and marks were regressed.

Examples of good practice seen in high scoring portfolios include the following:

- Portfolios reflect the requirements of the content and also take the Assessment Amplification and Delivery Guidance into account.
- Content (including recorded data from experiments) is the student's own, with no direct downloads and no inappropriate group practical work.
- No college issued templates or scaffolding are used in portfolios.
- Standard procedures are fully trialled by colleges before use and produce sufficient data suitable for analysis and evaluation.
- Experimental work, especially titrations and determination of resistivity, is carried out individually.
- Where combination of data across two or more students is essential, this is annotated accordingly, and each student is assessed on their own contribution and practical skills.
- Each individual's ability to follow safely the standard procedure and record their own results is clearly evident for all six relevant Pass Performance Outcomes (POs).
- Photos of practical work to help support student attainment may be included, but graphs and tables of results should be the originals.
- Hand drawn lines of best fit to support student understanding are evident (and often more appropriate than computer generated lines).

Administration – colleges should ensure the following are adhered to:

- a fully completed Unit Submission form (both sides) must be appended to the front of each portfolio
- a completed Witness Statement (Observation Record) is included with each portfolio
- one copy of the Assignment Brief (if used) is included in the submission
- one copy of each college issued risk assessments and standard procedures is included
- after internal re-submissions, portfolios submitted for moderation are the final versions only
- for resits after new work has been added by the student, the portfolios submitted do not contain work which is no longer to be assessed
- submissions are free of poly-pockets and use treasury tags to secure portfolios.

PO1: Demonstrate experimental techniques in biology

P1, M1, D1

It is important that these three criteria cover both respiration and photosynthesis. As with previous series, the most common issue that arose was the absence of content relating to the uses of measurements of photosynthesis, both in P1 and D1.

P1 requires an outline of the uses of physiological measurements of respiration and photosynthesis. Typically this includes peak flow and lung capacity for respiration and improving yields and productivity for photosynthesis.

M1 is concerned with scientific principles underlying the measurements, the equations, descriptions of the two processes, the factors affecting them, and the principles of peak flow, lung capacity and blood pressure (specification p46, 47).

D1 needs to be extensive and detailed and should concentrate on how physiological measurements of respiration are applied in medical contexts and/or by sports physiologists. Also required is a consideration of commercial applications of measurements of photosynthesis relating to manipulation of factors to improve yields and productivity.

Appropriate content for D1 (respiration) would include normal/abnormal values and ranges, and how these are interpreted.

Good approaches again made excellent use of graphs, tables and images to support and demonstrate the points made, especially in M1 and D1.

PO1(a) Rate of Respiration: P2, M2, D2

The most successful approaches seen here involved the investigation of the effect of temperature on the rate of respiration of yeast or germinating seeds. This then allowed an appropriate number of values and range for the variable (temperature), and subsequent analysis and explanations in **M2**.

P2 does not require a Q10 or RQ approach and factors with just two or three 'values' cannot properly access M2.

M2 requires calculations of rate, graphical representation of rate v factor and explanations of the shape of the graph in terms of enzyme kinetics; explanations need to be at Level 3 standards.

D2 was met by few and tended to lack a full, systematic evaluation of the methodology used, data, outcomes, and the qualitative and quantitative errors.

PO1(b) The light dependent reaction in photosynthesis (the Hill reaction): P3, M3

This experiment was again successfully achieved in most colleges, and the few that obtained no clear results seemed not to have trialled the experiment beforehand. There are several different approaches, including one with a link on the CLEAPSS website and also on YouTube.

P3 requires clear evidence that the student has followed the standard procedure and recorded results (even if negative).

M3 requires the standard procedure already used in P3 to be modified to allow three other factors to be investigated. Adaptations need to be explained with scientific support, eg:

- how distance and light intensity are related
- how the colour of gels or filters are related to wavelength and the visible spectrum
- how a range of carbon dioxide concentrations is achieved using sodium hydrogen carbonate
- how heat shields are used where appropriate.

PO2: Demonstrate experimental techniques in chemistry

P4, M4

Both volumetric analysis and colorimetry must be considered. At Merit level, an appropriately detailed approach is expected with well-developed explanations relating to standard solutions and indicators. This would include specific reference to pH titration curves and a range of indicators and thus supporting reasons for the choice of indicator for the titration to be carried out.

P4 should have an outline reference to:

a) types of titration; use of standard solutions; end points, indicators, equivalence/mole ratios, and
b) absorption of light from the visible spectrum by coloured compounds; the basic construction of a colorimeter and how it works.

M4 develops the ideas behind:

a) standard solutions and their use, and the choice of indicators, and
b) the Beer-Lambert Law and its application to a calibration graph of abs v concentration.

PO2(a) Volumetric analysis: P5, M5, D3

The standard procedure may be issued by the college but should have been trialled to ensure it gives suitable titres. For titrations, it is expected that practical work is carried out individually and results should be clearly unique to the student. There are still a number of colleges who misinterpret the way in which a standard solution is prepared.

Good practice, as seen in high scoring portfolios, includes the following:

P5 requires correct recording of all data including:

- mass data for the weighing related to the standard
- titration data to include initial and final burette readings and titres
- correct tabulation and units
- correct precision of recording – burette readings to ±0.05

M5 requires two calculations, one for the concentration of the standard solution based on the mass weighed out, and one for the titration.

D3 requires a detailed comparison of apparatus (eg auto-pipettes, auto-titrators, sensors/ electrodes) with standard laboratory glassware and a comparison of the resolution or precision of recording and overall accuracy. The properties of primary standards and their use is also expected, including examples for a number of types of titration.

PO2(b) Colorimetric analysis: P6, M6, D4

Each student must demonstrate the ability to use solution dilutions and record absorbance values (not transmission). Good work was apparent in many cases but some results were poor.

Good practice includes:

For **P6**, a suitable range of concentrations was used and absorbance values recorded, including the unknown (correct zeroing of the colorimeter with an appropriate blank was not always apparent however, and, in some cases, the standard procedure generated too many values above abs = 1 when linearity is often no longer achieved). The unknown concentration was clearly determined from the graph.

For **M6**, the explanation of how the choice of filter was made is supported by data or a suitable graph of abs v wavelength. Inconsistencies/anomalies in abs data are identified from the calibration graph and how well the line and data fit the Beer-Lambert Law is explained (this however was an area most students found difficult).

D4 demonstrated a systematic consideration of the methodology and qualitative errors, and also an assessment of the data and percentage errors in the measurements made. A comparison with the expected or teacher value is made and overall percentage error calculated.

PO3: Demonstrate experimental techniques in physics

P7, M7

P7 required better research and selection and presentation of content than was often seen, and this followed through to M7 as well. Suitable approaches to these two criteria included the following:

P7 started with a definition, including relationships, symbols, formulae, units and an explanation. Suitable examples of a range of different materials followed and links to the properties of those materials are made. This is repeated for each of the terms, resistivity and specific heat capacity.

M7 requires descriptions of how a range of different values of resistivity and specific heat capacity are linked to and determine the uses of materials in industry.

Researched tables of data covering high, low and intermediate values will be needed and cross referenced to those materials being discussed. Semi-conductors should be included in the discussions for resistivity as must water for specific heat capacity.

PO3(a) Resistivity: P8, M8, D5

The majority of students completed the practical determination of resistivity, although the accuracy of the methods employed was low in some cases (and for no apparent reason), and colleges would do well to trial this experiment before use.

There is a requirement to record results for **P8**, and this must include the diameter of the wire, typically recorded in several places along its length. If students wish to use standard wire gauge conversions as a comparison, that is a good addition to the approach, and may later contribute to **D5**.

M8 will need the resistivity to be calculated and then compared with a researched value for the industry standard data. Any differences should be discussed and anomalies in the recorded data identified and accounted for via an evaluation of the methodology used. Some experimental values were orders of magnitude away from industry standards making comparisons difficult.

D5 requires significant research into methods and equipment used in industry to achieve more accurate and valid outcomes. The approach must clearly demonstrate Level 3 understanding of the relevant science and an appropriate breadth of research and content. Precision of recording of data and also issues with contact resistance and methods of reducing it.

Gold plated connectors, 4 point collinear probes, Kelvin sensing, Kelvin bridge, are all areas for comment and the different types of measurement – bulk / volume, sheet resistivity measurements have also been compared in some good examples.

PO2(b) Specific heat capacity: P9, M9, D6

Most colleges used a solid 1 kg block of, for instance, aluminium specifically designed for specific heat capacity determination. The percentage error for **M9** needs to consider the errors in the measurements made and the overall percentage error compared with the data book value. The 'error bars' expected on the graph can be uncertainties in temperature measurements, although these were sometimes omitted or inappropriate / incorrect. Graphs were often poorly done by students and the requirements to plot temperature **change** ignored.

M9 requires, in addition to the points mentioned above, an explanation of the shape of the graph. This should be in terms of heat transfer, heat loss / cooling effects and the balance between the two. Good portfolios may notice the non-linear section to the line initially, followed by a straight line, and then a tailing off of temperature rise at higher temperatures. The best responses will go on to discuss Newton's Law of cooling and how it relates to the graphical evidence.

PO4: Understand safety procedure and risk assessment when undertaking scientific practical work

P10

This has been reported on adversely for all previous submissions, and there are still many issues which arise, not only in student generated risk assessments, but also in some college issued risk assessments.

- three risk assessments must be student generated, one for each of PO1, PO2, PO3 (annotated appropriately).
- The other three risk assessments can be college issued, but must be present (one copy per sample is sufficient).
- The approach to risk assessments needs to be coordinated across the three science areas as some significant differences in standards and approaches have been noted in this submission.
- Risk assessment s should start with identification of materials (chemicals, microorganisms, other materials, apparatus) and, where relevant, their state and concentration, name, type. Apparatus should also be included, but 'glassware' can be one entry as can 'mains electrical equipment'.
- Students must make it clear that they understand the difference between hazard and risk and assign these to the next two columns. The nature of the hazard should correctly reflect the state / concentration of the chemicals, both of which must be considered as essential information to be included.
- A numerical approach to risk is not expected or required.
- Further column entries should then consider control measures and PPE, disposal if relevant, and action on spillage / emergency or similar points.
- Risk assessments written entirely in prose are not suitable and are unlikely to gain credit.

Mark Ranges and Award of Grades

Grade boundaries and cumulative percentage grades are available on the Results Statistics page of the AQA Website.

Converting Marks into UMS marks

Convert raw marks into Uniform Mark Scale (UMS) marks by using the link below.
UMS conversion calculator