LEVEL 3 EXTENDED CERTIFICATE

APPLIED SCIENCE

ASC5: Investigating Science
Report on the Examination

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General

Summer 2018 saw the first submissions for ASC5, Investigating Science. The unit is assessed via a number of performance criteria which is a mixture of:

- scientific principles
- various aspects of investigative procedure
- practical work
- analysis and evaluation of data
- reporting outcomes.

There were some excellent examples of investigations, characterised by:

- comprehensive portfolios created with a firm understanding of the depth of treatment expected
- excellent research and use of secondary sources
- wide-ranging approaches to all elements of the investigation
- good levels of scientific knowledge and understanding
- appropriate practical methods producing accurate and reliable data
- sensible marking by assessors who clearly understood the need for content at this level
- clear annotation identifying where performance outcomes had been met and awarded.

Some of these were investigations based on those listed in the specification, and some were based on other scientific areas of the school / colleges choosing. In the case of the latter, some schools / colleges had sought advice from their NEA Adviser before starting (see specification page 90), but there were other examples where advice was not sought and the adopted approaches lacked suitable depth and / or breadth.

Whilst most of these investigations may have had the potential to allow access to the criteria, some were limited by the narrowness of approach, with a general lack of understanding of the standards expected. In general, these were typified by:

- limited research into the scientific background
- few variables / 'factors' considered or investigated (sometimes only one)
- only one standard procedure identified, used or trialled (and sometimes issued, not researched)
- restricted outcomes and levels of data recorded
- less than 60 guided leaning hours devoted to the investigation
- very little work submitted
- little or no assessor annotation to support award of marks.

Learners would benefit from guidance on the following:

- The levels of science expected and the depth of knowledge and understanding that should be demonstrated.
- Using practical techniques of suitable levels of demand and avoiding GCSE level work.
- How to access sources which are not predominantly based on GCSE work (or below).

With the right decisions, many investigations can meet all the criteria at a good level. However, it is possible for two investigations with the same title to be met at Distinction level or at below Pass level depending on the decisions made and approaches adopted.

To an extent, some credit may normally be available if investigative processes and procedures have been followed, but some criteria cannot be met for low level approaches, weak science and restricted, inaccurate or unreliable data.

PO1: Prepare for a scientific investigation

P1, M1, D1

These criteria involve progressively more research and more detailed explanations of scientific principles across the performance outcomes grid. The principles to be covered concern all aspects of the investigation including:

- the scientific area concerned and the underlying theories and principles
- the science related to the relevant procedures, techniques and possible approaches to the investigation
- the science relating to the variables / factors to be investigated
- the science related to all other factors / variables which may be relevant and have to be controlled during experiments

Often, if the levels of science are appropriate at this stage, much of the rest of the investigation falls more easily into place. If the science is too narrow and / or low level, it is likely the rest of the investigation will be too. Some examples seen which scored poorly in PO1 include investigations such as:

- electroplating, but without reference to current, time, the Faraday, coulombs
- reaction time, but without identifying and discussing the necessity to control the many variables that apply: age, gender, practice, caffeine, fatigue, etc
- LDRs, but without researching how they are constructed, how they work and the different types that exist
- pH, but without defining it in terms of hydrogen ion concentrations and explaining how its value changes, for instance, with temperature or dilution
- viscosity, but without moving beyond simple explanations and experiments at GCSE level or below.

Although not a pre-requisite, some investigations will have direct, extensive links to other areas of the specification, for instance ‘reaction time’ and ASC4, and this gives an idea of the level of theory that is appropriate. In this example, relevant parts of ‘The structure and function of the nervous system and brain’ and ‘Nerve impulses’ from ASC4 would provide a good high level basis for the scientific principles behind the investigation. In addition, further areas, relating to the standard procedures and factors / variables investigated or controlled, would also need to be considered.

P2, M2, D2

These criteria are also connected and move on sequentially from Pass to Merit to Distinction.

P2 requires a plan to be produced, although it was often not clearly identifiable in portfolios. The plan should incorporate:

- researched standard procedures / techniques to be followed
- potential alternative methods / techniques / procedures for comparison in trials
- aims / purposes of the tasks (objectives).

Trials are carried out and details of these are required for **M2**. Trials are designed to identify the standard procedures to be used, and how variables are best controlled to give accurate, reliable data. Changes to the plan, including modifications of parameters eg concentrations, times, etc as appropriate, need to be described.

To then access **D2**, the final techniques chosen have to be justified.

In lower-attaining portfolios, trials were usually limited as they were not aimed at trialling methodology, and subsequent modifications were not extensive, if present at all.

PO2: Carry out the investigation and record results

P3, M3

Over the whole entry, risk assessments were not at the level expected. The problems encountered were common to ASC2 from summer 2017 and January 2018. Learner generated risk assessments identifying hazard, risk, control measures, PPE, action on spillage, and disposal if relevant are required. Hazards and risks must be correct for the states and concentrations used and quoted in the risk assessment.

P4

This is awarded for following the standard procedures (Observation Record required) and also for using 'a range of practical equipment and materials'. Several investigations were seen where the 'range of equipment and materials' was not met due to the restricted nature, simplicity and very low level of the practical work. The portfolio evidence needs to include copies of all standard procedures and the results, correctly tabulated. The stanard procedure should be suitably detailed to allow it to be followed to a successful conclusion and replicate results.

P5, M4, D3

For **P5**, data must be recorded to correct levels of precision (significant figures / decimal places) with correct units and adhering to normal conventions. The following points are also important:

- It is assumed that all data recorded are the learner's own.
- Learners and assessors sign the USF to confirm this.
- If any secondary data are included, these should be tabulated separately and annotated accordingly.

M4 assesses effectiveness of methods used from the perspective of the recorded quantitative data, and considering the method and apparatus used:

- Are data complete / are sufficient data recorded?
- Are sample sizes adequate?
- Is the precision of recording appropriate?
- Are there any anomalies?
- Are the data repeatable?
- Are there any issues with accuracy?

D3 then considers the responses made in M4 and makes suggestions for improvements that would lead to more accuracy, reliability, etc. These improvements could be to the methodology employed and / or to the equipment used.

P03: Analyse results, draw conclusions and evaluation the investigation

P6, M5, D4

P6 could include suitable calculations and analysis of data using graphs and charts as appropriate.

This then leads on to **M5** which assesses the methods used for analysis and whether they are appropriate and also if IT was used. Suitable uses of IT could include graphical analysis, generation of charts, use of (non-trivial) spreadsheet formulae. The use of IT does have to be appropriate, and should enhance the ways in which data are manipulated and presented. Some Excel graphs are too simplistic, often with inappropriate lines of best fit, to be useful.

D4 discusses the methods and formats used in the analysis in the context of the outcomes and their relevance to the original aims of the investigation. Justifications can also consider the methods used and what further information or outcomes are derived as a result of using those methods.

P7, M6

P7 identifies sources of error and anomalous data. Errors may be:

- qualitative, based on the methodology used
- quantitative, being related to the measurements made and the levels of precision of recording.

M6 then explains these sources of error further. Where appropriate, higher-attaining learners then explained ways of minimising these errors, for instance in terms of the instruments used. Where they identified anomalies, reasons were suggested and ways of minimising them considered.

P8, M7, D5

P8 and **M7** were particularly difficult areas for most learners. Conclusions should be linked to the objectives established at the planning stage of the investigation (in P2). These conclusions should then be compared with equivalent information (data) gained from secondary sources: for example researched expected outcomes, literature values (these then give access to M7). There was often no evidence of comparison of conclusions drawn on primary data gathered by the learner and those based on secondary data.

Using other learners' results as secondary data may well be of limited value, and should not be seen as a substitute for extensive research and recording of relevant secondary data from reliable sources.

D5, in some ways, ties together the explanations in M6 and the review of outcomes in M7. A full evaluation of the outcomes and qualitative and quantitative errors is an essential start point. The use of percentage errors can then lead to a comparison of the accuracy of the calculated outcomes with expected values in the context of the overall error.

PO4: Present the findings of the investigation to a suitable audience

P9, M8, D6

The report on the investigation, **P9**, is effectively the portfolio and no separate 'mini-report' is expected. The presentation can be in various formats, but should be designed for a suitable audience, and should be appropriate for that audience. The presentation should contain text and images.

P9 does use the word 'concise', however, some very poor PowerPoint presentations were seen with slides that are far too 'wordy'. Many learners would benefit from guidance in the design and content of PowerPoint presentations. On the other hand, leaflet based presentations were used well for some investigations and audiences.

M8 connects to M7 in terms of secondary data, but does cover its use in other POs such as P1, M1, and D1. M8 also has the additional expectation of use of correct scientific terminology throughout.

D1 also assessed the science and its relationship to industrial / commercial uses, and now **D6** revisits these, but from the point of view of the relevance of the results and outcomes of the investigation to those industrial processes.

P10, M9

P10 is quite simple to achieve, assuming sources have been used in research for PO1 and for secondary data for M7. It is expected that only a simplified version of the Harvard Reference System need be used, such as a numbered reference (eg [12]) in the body of the text, and the reference listed in a footer or in a bibliography at the end.

M9 requires 'usefulness' and 'validation'. These were often missed out in the submissions seen, and both are expected for M9 to gain credit. Validation can consider a whole range of checks and ideas depending on the nature of the source. Approaches may include:

- type of publication, who published it and where
- purpose of the publication
- academic standing of the author
- advertising / Government / academic / commercial / industrial/ pressure group
- peer review / editorial control / adopted textbook / book reviews / citations / cross referencing.

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