



## **General Certificate of Education**

### **Applied Science**

**8771/8773/8776/8777/8779**

**SC07      Planning and Carrying out a  
Scientific Investigation**

## **Report on the Examination**

*2010 examination - June series*

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Set and published by the Assessment and Qualifications Alliance.

## General Comments

The number of candidates entered has again increased this year *for many units* and many centres have continued to guide candidates to achieve well. The award has generated much high quality work from centres. Credit should be given to both teachers and candidates in making every effort to meet the requirements of the award, producing portfolios, many of which demonstrated a commendable standard of content, approach and presentation. The centre accreditation scheme currently numbers 94 centres at AS and 26 centres at A2 level and random sampling of these centres has again confirmed the value of the process – with centre marking being confirmed as in line with AQA standards in the vast majority of cases, but with a small number showing some “slippage” with marks going out of tolerance leading to loss of accreditation.

## Portfolio issues

Portfolio construction remains a concern for some candidates, and it is evident that better centre guidance is required in some cases. However, it is very important that centres provide the opportunity for candidates to demonstrate flair and individuality. It is easier for moderation if portfolio structure matches the structure of the unit. Centres are also advised to monitor portfolios during production to identify “cut and paste” styles of working early and to ensure approaches are appropriate. Some centres correctly down-marked candidates’ final portfolio marks due to inappropriately including cut and paste or copied work – but early identification and correction of such work could have avoided these final mark reductions. Other centres missed the inclusion of un-reworded downloads and these were dealt with appropriately by moderators, with most instances resulting in portfolio marks falling out of tolerance, a situation which unfortunately affects the entire entry for that unit. It is essential that these situations are dealt with at centre level before submission of marks in order that all candidates are treated fairly.

Some candidates continue to produce unreasonably large portfolios and it is rare for such portfolios not to include irrelevant material or be repetitive or, indeed, to have omitted some areas that would benefit from additional time and consideration.

For some units, it appears that the levels of expectation of the quality of portfolio content and/or the outcomes that candidates are allowed to produce are set too low. A number of centres are still judged to have marked candidates work too generously and where this was the case, marks were reduced and fell out of tolerance.

Some of the causes of over-generous marking included:

- Misinterpretation of the requirements of unit
- Too much work on non-essential areas and/or too little on required aspects
- Failure to fully complete fundamental aspects of the unit as required in the “Banner”
- Over-lenient interpretation of the assessment grids
- Failure to appreciate that high scores are likely to equate to “A” grade which means very good work in all areas of a unit – marks allocated to students should be matched to the track record and overall ability of students to ensure they are justified. Weak students gaining uncharacteristically high grades could indicate lenient marking.
- Lack of rigour in marking/assessment of work – incorrect science accepted, incorrect calculations marked as correct, incorrect statements accepted, praise for work which is of poor quality, marks allocated for work for which there is no evidence – or no supporting teacher comment (# in the assessment grids).

- The inclusion of materials directly down-loaded from the internet – such work should be awarded NO MARKS as original student work.
- Weak candidate skills in practical activities leading to a lack of precision and unreliability as evidenced in results, but high marks awarded.
- A lack of description by the centre assessor of each candidate's level of practical skills, their awareness of safety procedures and degree of autonomy (marked # in the assessment grids) and resulting inconsistencies between the marks awarded and the portfolio evidence.
- Many units require the use of risk assessments, and whilst many candidates include these, centre assessors are frequently over-generous in their allocation of marks in this area. The following are examples of where candidates are insufficiently accurate or specific and where marking is lenient.
  - Where solutions are used, the concentration is important and this can significantly affect the hazard and subsequent risk factors.
  - Where compounds or solutions are used, it is inappropriate simply to refer to and use the elemental form of the cation component of a compound – sodium has quite a different hazard rating to sodium chloride!
  - Common sense and an understanding of science should be applied when judging risk. Candidates should consider what are the real and sensible hazards and risks and then relate these to the actual compounds used at the concentrations involved as appropriate.

2010 was the first year for Quality of Written Communication (QWC) to feature in all portfolio units. The criteria appear in AO1 of Sc01 and AO3(ii) for all other units. Whilst appearing in particular assessment objectives, the intention is for the QWC statements to be applied across the entire portfolio. As explained at teacher standardising meetings, the intention was that QWC would consist of a cluster of criteria within each mark band and would generally be in line with other criteria at the level in question. As such there would be little change to existing standards. This has proved to be the case and only in a minority of instances did marks move up or down due to QWC alone. It was generally clear that centres had taken into consideration the QWC elements in their assessments. Unfortunately a minority of centres have continued to use the older criteria where QWC statements are not included and all centres are advised that they should be using the correct assessment grids.

Centres are reminded that many issues and points of guidance made in the 2008 and 2009 examination reports are still valid and these remain valuable sources of information.

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## SC07

The portfolios seen this year demonstrated various approaches and methods of delivery. Some investigations based on links between centres and scientific organisations, companies or university departments were in evidence; the use of a real client who set specific, realistic and relevant objectives for the investigation generally provided an excellent starting point and candidates frequently responded well. Where such links are unavailable, centre led investigations with a hypothetical client can work well - provided the objectives are realistic and the degree of centre prescription not significant. The provision of scenarios that allow candidates to develop investigations with a level of demand firmly set at A2 in terms of both the practical methodology and the associated scientific principles is ideal. The depth and breadth of approach are equally important: some investigations are still submitted where the work is simply a sub-set of another unit, for instance SC12, SC13 or SC16. The idea is to build on skills and techniques used in other units rather than just repeat the same thing. There were instances this year where candidates had essentially undertaken what was an SC09 fitness plan in its entirety as an investigatory topic. Such work is inappropriate since it does not meet the assessment criteria requirements. This resulted in very significant mark reductions for these candidates.

Some centres provide a single investigatory topic for the whole group and this can compound problems since all candidates follow identical strategies with the same (centre determined, even centre issued) standard procedures. This approach can constrain candidates, especially those aspiring to the high mark bands, and it can compromise some assessment criteria when the methodology and the likely outcomes are pre-determined. This strategy can restrict marks in AO1 and AO2. For instance, candidates may only research one practical method (the one they will be using), ignoring other, perhaps more accurate, methods which could have been identified had candidates tried to research methods rather than relying on what they had been advised to use. Alternatively, candidates may research two or three practical methods, but only trial and adopt one, not necessarily the most accurate or reliable, or make or not explain the need for changes in procedures without scientific explanation.

Sometimes, where candidates are given a wide choice, or even a free choice, it is necessary for the centre to advise and guide so that the level of demand, the objectives, the depth of treatment, etc are appropriate. Whilst some of the more extreme cases of low levels of demand seen in previous years are less prevalent, there were still a number of investigations set by centres where the levels of demand were barely GCSE level, sometimes even lower. These often provide scant opportunity for candidates to move beyond mark bands 1 or 2 particularly where the nature of the “data” obtained was purely subjective or qualitative.

Good practice seen this year included the following:

- A realistic client and realistic objectives. (Realistic objectives do not really include those where the findings of the proposed investigation can simply be looked up in literature, on the Internet or, indeed, on the packet or carton from which a product has been obtained! A very contrived client and investigation with objectives which are strongly centre led constrains candidates' opportunities to access higher mark bands). The term **suitable** appears in mark band 2 and above.
- Extensive research into the proposed standard procedures, the background and supporting scientific principles and health and safety issues.
- Validation of secondary sources allowing the award of marks above mark band 2 for this aspect.

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- A high level of understanding of the scientific basis of the chosen area of study and how scientific principles are applied to the investigation. This aspect covers all assessment objectives AO1, AO3(i) and AO3(ii).
  - A comprehensive plan or research outline including the nature of experiments, standard procedures with modifications (where appropriate) pre- and post trialling, complete risk assessments (*a time-line or sequence of activities is often a useful addition to this.*) Clear evidence to support this area supports marks in AO3(ii).
  - Correct calculations, and a high level of precision including full working and explanations. In AO2, up to 12 marks are available, so calculations can make a significant contribution to the mark awarded.
  - Evidence of extensive trials with results, together with a full explanation of how standard procedures are modified to allow the investigation's objectives to be met. If evidence of appropriate trialling is missing, marks in AO3(i) are likely to be reduced.
  - Complete observations and measurements presented in a logical precise manner with appropriate units – allowing access to higher marks in AO3(i).
  - Analysis of data, construction of relevant graphs or charts and conclusions drawn to match the evidence. Evaluation of the methodology, describing qualitative errors, and the equipment used, including quantitative errors, and an appreciation of the accuracy of results obtained, are all well considered. These all contribute to the possibility of access to high marks in AO3(ii).
  - An overall, clear report which is logical and well structured with a good use of technical terms, spelling punctuation and grammar. This component of AO3(ii) is significant and should not be omitted. High scoring candidates should show good scientific understanding and explain it clearly using correct terminology and command of English.
  - A separate presentation of the findings to the client which conveyed all the **relevant** information relating to the original objectives and indicates the scientific basis for the conclusions. This is a significant component of AO3(ii) and if omitted will significantly limit marks – right across the mark bands.

Some specific areas of weakness that continue to limit marks for some candidates include the following:

- Lack of demand of activities, both in terms of the scientific basis for the investigation and the adopted methodology.
- Insufficient research into the scientific basis of the chosen area of study and possible standard procedures.
- Unrealistic clients and objectives.
- Contrived scenarios which lead to a considerable degree of centre prescription including pre-determining the outcomes.
- Clients who readily have access to the information generated from known, pre-existing sources making the basis of the investigation un-necessary.
- A lack of practical skill evident from results that lack precision, concordancy and accuracy.
- A lack of realisation that volumetric analysis stands or falls on the accuracy of the standard solutions used. Failure to standardise solutions, even those which are well known to be problematical such as DCPIP, sodium hydroxide, iodine and hydrochloric acid, which results in inaccuracies in final data.

Group work can lead to unreliable results. Some practical tasks are simply not appropriate for “combined efforts” and do not allow an individual’s skill levels to be assessed. Combining results where data are recorded to different levels of precision or reliability can compromise an individual’s own results due to inaccuracies by others or lead to problems of autonomy - where it is unclear who did what or where all candidates have virtually identical or the same set of results.

There appears to be a number of centres where investigatory work undertaken by candidates suffers from issues out of the control of candidates which makes their opportunities to gain marks and to operate successfully more difficult. These are centre issues and these actually compromise student marks and standards of attainment and – as a result - final outcomes.

Some of the problems were identified which place unfair barriers to student progress:

1. Failure to provide sufficient apparatus for activities.
2. Failure to provide fully operational and sufficiently up-to-date equipment.
3. Failure to provide operating instructions for apparatus to facilitate use.
4. Provision of out of date solutions or ingredients.
5. Provision of incorrectly standardised or incorrect strength solutions.
6. Setting investigatory work well above the knowledge levels expected in the specification, making the work out of context of the award and too challenging.
7. Allowing investigatory work to proceed which targets too low a level of demand and likely outcome.
8. Setting work at inappropriate times of the course – time limits too short or inappropriate times of the year.
9. Expecting or allowing candidates to produce too much work – massive portfolios are not necessary, take too long to produce and to read and are not helpful for anyone – teacher, candidate or moderator.

## **Mark Ranges and Award of Grades**

Grade boundaries and cumulative percentage grades are available on the [Results statistics](#) page of the AQA Website.