

Applied Science

Advanced GCE A2 H575/H775

Advanced Subsidiary GCE AS H175/H375

Report on the Units

January 2009

H175/H375/MS/R/09J

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This report on the Examination provides information on the performance of candidates which it is hoped will be useful to teachers in their preparation of candidates for future examinations. It is intended to be constructive and informative and to promote better understanding of the syllabus content, of the operation of the scheme of assessment and of the application of assessment criteria.

Reports should be read in conjunction with the published question papers and mark schemes for the Examination.

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G620, G621, G624, G625, G626: AS Portfolio Units

General Comments

The portfolio work seen indicates that many of the candidates studying this qualification are competently carrying out a wide range of interesting research both on the internet and by actual visits. Most of the practical work seen shows a vocational link with suitable reasons on why the experimental work needs to be performed. Credit should also be given to the staff at the majority of centres as the assessment criteria is now being used appropriately and candidates' work is being assessed at the correct level. Many centres are now accredited and several were sampled this session.

The portfolio units moderated this session were as follows:

- G620 Unit 1 Science at Work
- G621 Unit 2 Analysis at Work
- G624 Unit 5 Chemicals for a Purpose
- G625 Unit 6 Forensic Evidence
- G626 Unit 7 Physics of Sport

Most centres were very responsive in returning scripts for moderation and moderators are very grateful to centres with low entries (less than 10 candidates) for sending all their portfolios directly to the moderator; this saved time and led to an efficient moderation exchange. It was noticeable this session that the majority of centres returned the Centre Authentication form with the candidates' work and most work was well organised and presented using treasury tags which allows moderators to easily read the work. Unfortunately some Centres are still not fastening their candidates' work together or putting on Candidates' Numbers or Centre Numbers. This is essential as work often moves around the country. Where centres are writing comments and page references on the URS forms, this is really appreciated and again supports the moderation process. Centres can try and help moderators locate the work by indicating the assessment code e.g. AO1 (a) and even better if they can indicate the mark band on the actual candidates' work.

Very few task sheets were seen this session; it does help the moderation when moderators are aware of what the candidates were given to support their research or practical work. The majority of candidates' work was at an acceptable standard for AS level. Accreditation of centres is now on going. Accredited centres need to ensure that the necessary Centre Authentication form is sent to OCR for each session that they are entering candidates for assessment and that if there is any change in the nominated staff, OCR is informed.

Scaling of candidates' work occurred, mainly at the higher mark bands. Work submitted did not reach the necessary standards required by the assessment criteria i.e. work was not sufficiently detailed and accurate and evaluations not at a high enough level for A grade work.

Work selected for moderation reflected coverage of all the units offered by this AS specification. A range of marks was seen. Candidates use and selection of research material obtained from the internet is showing a noticeable improvement.

Risk assessments are now being included with practical work as evidence of safe working but possibly more guidance is needed to ensure these are suitably detailed and not generic.

G620 Unit 1 Science at Work

Some excellent work was seen for the 5 surveys where candidates had clearly selected relevant information and produced work that linked to the requirements of the specification i.e.

- the products made or services offered
- the type of work that takes place
- an identification of the science involved
- information on health & safety constraints and guidance used in the organisation.

The weakest area was the related science, more focus is needed here and centre's should try and give more guidance to improve the quality. The text of the survey should use candidates' own words. Information cut and pasted from Internet sites is insufficient, although less and less of this is now seen. Excessive detail is not required for the surveys. This work is intended to be an overview of science in the work place.

Zoos seemed to be popular organisations for the in-depth study and there was evidence that the candidates had gathered their research from suitable visits. Independent work was more prevalent where candidates had visited organisations compared with work produced using Internet searches, although some very good selection of work extracted from the Internet was seen. It should be noted that for mark band 3 evidence of relevant information selected from a range of sources should really be recorded. It is good practice to include the resources used as a bibliography and should be encouraged. The range of organisations included many easily accessible organisations e.g. zoos, Garden Centres, health clubs/gyms, supermarkets, bakeries, breweries, pharmacists, power stations health centres, garages, colleges, universities schools, fast food establishments, as well several manufacturing organisations.

Some work was still seen where too much detail had been covered in the surveys and there was no definite focus for the in-depth study. Candidates from these Centres need to ensure that the following guidance is used when presenting their work for assessment:

- explanation of what is produced or details of the service offered
- information about the organisation including the number and range of staff employed
- further details on the scientific job roles specifically related to the chosen organisation
- some explanation and detail of the science involved in the organisation
- any further specific detail on research, quality control
- details and specific links of health and safety laws and regulations which can be used for the requirements of AO1c.

Again for mark band 3 the additional guidelines indicate a comprehensive study is required and information should be selected and clearly and logically presented. Some evaluation and justification of the use of the material needs also to be included for the higher mark bands. Comments on the validity of the sources used must be included if mark band 3 is to be reached. There was minimum evidence of evaluation and justification of the research material. However some excellent work was seen with precise informative research.

Some candidates were not including the specific laws and regulations for AO1c, even for mark band one candidates need to show awareness and a basic knowledge of health and safety laws and regulations. Higher marks can be obtained where candidates link health and safety with their surveys and also make suitable links in their main study. Several centres had this time completed independent assignments for this strand, this is not mandatory. Contributions to this strand can come from evidence included throughout the unit.

For AO2a where candidates had been given structured guidance, marks reflected the requirements of the specification and higher mark bands had been awarded. A simple statement of the overall effect of the organization to society is insufficient for mark band 2 and above. Evidence of an understanding of the core business of the organization on the benefits of society will support the higher marks.

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Guidance to help could include:

- benefits of the core business to the society
- the contribution of the organization to the economy
- details on waste management and environmental issues (where appropriate)
- ICT uses (where appropriate)
- details on the effect on the community of employment, transport issues and reasons for the position of the organization.

The work for this strand in the majority of scripts seen was included as part of the in-depth study. It would however be useful for moderators if an indication was given on the URS form of where this evidence could be located within the unit.

Some work was seen where candidates had only completed one or two calculations, this is insufficient for mark band 3 even if the calculation is complex. The assessment guidance states a number of complex and straightforward calculations should be completed. If the data produced for practical work does not allow candidates to fulfil the higher mark bands then data can be supplied. Where centres submitted work demonstrating the opportunity for candidates to complete a range of calculations, rather than just one example and evidence of additional tasks to cover a range of mathematical work, this supported mark band 3. It should be noted that mathematical guidelines of straightforward and complex calculations are given in the appendix of the specification. For mark band 3, work should be correct and answers given to the appropriate degree of accuracy with correct significant figures. Errors were still seen here.

Good practice was seen where centres are giving candidates the opportunity to link their practical tasks to a vocational context. An interesting range of research and up-to-date facts was seen which linked to analysis and preparative work. Centres should not be just carrying out a standard titration of HCl and NaOH or investigating the properties of a copper wire without any vocational link. Candidates are including suitably detailed risk assessments with their work and many assessors are now clearly giving evidence that candidates had completed their practical activities.

Errors are still being seen for AO3b. Accuracy of recording needs to be watched. The recording of titration results should be at least one decimal place and set out in a suitable format. All measurements need to show the required precision and include the relevant units. Omission of units was still widespread.

Generally, work seen is now being assessed appropriately for processing with interpretation even for mark band 1. Candidates are now showing the methods of processing of their results for higher mark bands and in some cases, evaluation of accuracy of apparatus and method is being included for mark band 3. Processing skills in graphs and calculations were clearly evident in work seen. Many candidates are still omitting units from graphs and not choosing suitable scales, more guidance is needed on this.

G621 Unit 2 Analysis at Work

A suitable range of energy policies were seen, however care is still needed to ensure energy specific statements are made for AO1a. It is difficult in some cases to extract the energy related information from organisations' energy/environmental information, but where candidates had selected appropriately they gained high marks. Sainsbury's, Tesco, colleges and universities and many local authorities have suitable information on energy and environmental work and this is now being fully researched.

There are still omissions for AO1b on energy efficiency for mark band 3 which need to include possible measures which need to be put in to place by companies in order to become efficient. Definitions of energy efficiency are now being seen. Centres should be guided by Section 2.2.5 Efficiency in the specification and link it to the requirements of AO1b.

Environmental issues are very topical and these issues are now being covered in a lot more depth and at a high level by several candidates. Candidates still need to ensure that they extract relevant information and relate it to their chosen organisation.

Energy transfers involved in the generation of electricity are now being seen in the majority of work moderated and where work is brief it is being assessed accordingly. Relevant data is now being provided by candidates and they are suitably comparing the relative benefits and problems of large scale and small scale electrical generation. Care is still needed however for candidates being awarded mark band 3 for the accuracy and correctness of answers for the mathematical requirements. Candidates need to be more careful and present answers etc. more clearly.

The requirements for AO3 is two physical analyses both chromatography and colorimetry, one qualitative chemical analysis (which can include investigative work on unknowns, forensic investigation, mummion, water, pollution analysis) and one quantitative analysis (examples seen included analysis of water vinegar, iron tablets, bleach ear drops metallic solutions etc.). Good practice was seen where practical work had a vocational link and again this was evident.

The candidates are now completing suitable practical work and are including detailed risk assessments. Reports do not necessarily need a rewrite of experimental methods but care needs to be taken that suitable detail is given on recording and processing of results. Care however is also needed in accuracy of calibration graphs for colorimetry, several errors were again seen.

Work seen generally reflected mark bands 1 and 2 but it still needs to be noted that work for mark band 3 needs to be suitably detailed, with evidence of vocational links. Evidence from the assessor that risk assessments have been produced, used and equipment has been safely used should also be included. Suitable evaluation is needed and this needs to be focused on the method and outcomes of the specific experimental work completed, not just a generic statement of the success of the work.

G624 Unit 5 Chemicals for a Purpose

This unit gives candidates the opportunity to extend their chemistry knowledge and study the properties and actions of examples of chemical products used in consumer goods. Work presented for assessment should be extracted from candidates' notes and focused on the requirements of the assessment criteria.

Although candidates may be taught generally about organic and inorganic compounds they need to choose four compounds: **two organic and two inorganic** for the evidence in their portfolio. It would be helpful if the candidates were given task sheets and possible assignments where they are given opportunities to select the appropriate compounds etc.. Candidates should be guided to choose compounds which will allow them to find information on both uses and properties of these compounds. It should also be noted that for the chosen compound for AO1c details are needed on how the structure and chemistry relates to its use.

Haber Process, Contact Process, fractional distillation/cracking and reforming are all suitable for AO2a. Centres need to note that two industrial processes are needed with conditions, raw materials and uses of the products. Care is needed on the accuracy of any equations given.

Work on catalysis generally reflected mark band 1 or 2. For mark band 3, an evaluation of the effect of the catalysts on the process and an understanding of the social and environmental impacts of the processes chosen is needed.

Generally aspirin was seen this session and care needs still to be taken that sufficient detail is given to the requirements of the assessment criteria to ensure suitable evidence is produced to enable higher mark bands to be reached. 19 marks are allocated to this section and consequently at least 20 hours of time should be allocated to this section. Please can candidates be encouraged to draw diagrams to scale – more care is needed in this area.

For AO3b candidates need to record both observations and amounts of chemicals taken and products produced. The yield needs to be calculated correctly and for mark band 3, how the theoretical yield is calculated needs to be included to reflect suitable knowledge at this level. For AO3 b mark band 2 candidates need to record all mass results to the same number of decimal places, this is not evident in work seen. For AO3c candidates needs to show an awareness that the yield can be increased by changing conditions just for mark band 1 and much more detail is needed to support higher mark bands. Actual workable suggestions are needed for mark band 2 and a full evaluation of the method chosen with a possible comparison of the suggestions are needed for mark band 3. Candidates need to work on improvements for this section.

G625 Unit 6 Forensic Science.

The forensic work moderated this session again showed that candidates continue to show enthusiasm in this topic. They had produced a range of interesting work both in the case studies and the experimental investigations and procedures. Candidates gave both interesting and informative work on methods of recording the crime scene through the use of photography, video methods and sketches.

Suitable research was seen for AO1b which covered chemical, biological and physical techniques. Work on ethics is still quite patchy, but candidates who were given the higher mark bands did show an understanding of the need for an ethical code, and a range of relevant information on ethical issues in forensic work was produced

Case study work tended to be quite good but more discussion of strengths and weaknesses of analytical techniques used and an understanding of the probability of guilt with a review of the evidence needs to be worked upon with candidates.

Calculations included a range of Rf values for mark band 1, and refractive index calculations and bullet projectiles for mark bands 2 and 3.

Experimental work again included work on fingerprinting and taking footprints, measuring and use of photographs, a range of microscopic techniques, chromatography, qualitative and quantitative analysis. Refractive Index of glass was commonly seen from most. Mark band 3 candidates need to ensure detailed processing and interpretation of their results.

G626 Unit 7 The Physics of Sport

Candidates should be producing guidance leaflets which indicate that they have used suitable research techniques and have selected the relevant information. The leaflets should not include large amounts of cut and paste information. Mark band 3 work needs to show detailed knowledge written in candidates' own words with evidence of the linking of scientific knowledge to the chosen sport or equipment. Some good work was seen this session on motor sports.

Interesting research into materials and how new technology has improved performance was incorporated into appropriate leaflets and where candidates gave evidence and reasons for selection of a particular material for its chosen use mark band 3 was appropriately given. Work on sports techniques should allow candidates opportunity to complete suitable practical work.

It should be noted that time spent on practical work should relate to about 20 hours of class time. For the coefficient of restitution evidence of planning is needed and a range of measuring techniques should be included with evidence of the need to repeat. Safe working should include the completion of appropriate risk assessments. The practical work can be included as an additional piece of work and not just included within a leaflet. Candidates should take care to include suitable interpretation of data collected.

G622: Monitoring the activity of the human body

General Comments:

A pleasing performance was seen by more candidates this session. Each of the questions achieved good differentiation between candidates but still allowed the weaker candidates access to the paper showing evidence of a well balanced paper.

Comments on Individual Questions:

- 1 (a) Confusion existed between respiration and breathing (exchange of gasses). Uses of energy were often too vague e.g. movement.
- (b) Many gave good comparisons between aerobic/anaerobic respiration.
- (c) Vague answers were seen for sports comparisons e.g. running where sprinting was needed for anaerobic or long distance for aerobic (explosive vs endurance).
- 2 Spirometer was not recognised by many. Few mentions of medical grade oxygen were seen.
- 3 (a) (ii) Bronchiole was not known by many.
- (b) The spelling of diaphragm still seems to present problems.
- (c) Diffusion and concentration gradients not mentioned by many.
- 4 (a) Candidates must read the stem of the question – many answered with regards to an 18-year-old rather than a 20-year-old as required in question.

Hyperthermia was confused with hypothermia.
- (b) Peak flow often answered as vital capacity. Many did not emphasise rate of air movement.
- (c) ELISA was perhaps the least understood (even initials) there was confusion of antigens and antibodies and also the sequence.
- 5 (b) Graph was extended by many and this lost marks.
- (c) Speed or heroin often described as a performance-improving drug.

For drug testing, few realized the blood sample was divided into two samples (1 analysed, 1 stored) or mentioned repeats.
- 6 (a) This question did not ask for X-ray production or risks involved. What was required, was the different absorption of X-rays by different tissues and the effects of this on the film.
- (b) Many thought M.R.I. gave off ionising radiation.

G623: Cells and Molecules

General Comments:

G623/01 Planning exercise

A range of different methods to determine the effect of barley straw extract on the population growth of *Spirogyra* and *Chlorella* were seen in this task i.e. colorimetry; use of haemocytometers; dry mass, determination of dissolved oxygen by titration; cell density / cell length.

It is suggested that Centres remind their candidates to read the instruction brief carefully to avoid misinterpretation.

It is also suggested that Centres provide students with a self assessment tick sheet to ensure that the students have addressed all the marking points in their plans before final submission. However, a Centre or single student should not submit their plan pre-marked.

Please will centres ensure that:

- (i) attendance registers for the planning component are included with the candidate scripts
- (ii) candidate plans and tests are sent in separate OCR envelopes using the labels provided to enable script tracking for BOTH components.

G623/02 Test

Each of the questions and the paper as a whole achieved good differentiation between candidates. There was no evidence of candidates failing to complete the paper due to lack of time. There were no common misinterpretations of the rubric.

Comments on Individual Questions

G623/01 Planning exercise

- A** This needs to be a working document relevant to the intended practical work. An appreciation of electrical (colorimeter), glassware, biohazard, waste disposal and relevant chemical hazards need to be recognised.
- B** Prediction needs to make reference to both species of algae. Many candidates referred to 'algae' or just one species.
- C** Justification of prediction needs to be made using secondary sources and information on the accompanying OCR resource sheet.
- D/E/F/G** The majority of students did consider preliminary work. Where preliminary work was included, candidates justified or related it to the main method of the investigation in some cases. Preliminary work must inform the main method. Examples could include: methods of extract preparation; straw-extract concentration; selection of suitable population density for counting; incubation time; light source; culture technique; temperature.
- H/I** Many candidates listed at least two secondary sources, at least one from a researched source. However, some only used references as stated on the insert. Candidates must ensure that full reference details are given and they must state how these sources have helped in the investigation.

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- J/K** Many students achieved marking points J and K. Many candidates wrote in some detail regarding their chosen method to enable reasonable degrees of accuracy and reliability.
- L/M** Students need to give a comprehensive list of equipment for M with qualified names and quantities. Some students failed to list the algal material.
- N** Students need to appreciate the importance of repeats and the need for experimental data to be comparative.
- O/P** Whilst many students stated a suitable range of straw-extract concentrations to use, very few candidates wrote about the need to come to a reliable conclusion / to have enough data to see a pattern or trend. Consequently criterion O was rarely awarded.
- Q/R** Whilst many students stated a minimum of 3 variables as dependent, independent and controlled variables, very few students explained how these variables were to be controlled. This needs to be an explicit section in the plan.
- S** Many students planned to tabulate their data in a suitable format. However, appropriate units of measurements must always be included in the headers. S was awarded on some occasions for display of serial dilution data.
- T** Many students planned to display their results graphically as % transmission or % absorbance against time. Care must be taken to ensure that appropriate scales on axes are chosen.
- U** Means and/or % absorbance/transmission values were the most common calculations seen in scripts. Some candidates were awarded U for their use of titration data to calculate dissolved oxygen concentrations. Care must be taken to avoid the calculation of mean cell numbers per volume over a period of several days, when only one value is taken each day.
- V** Few students addressed possible conclusions. Many candidates made reference to 'increased/decreased growth' without links to their observations of increase/decrease in cell numbers or changes to % transmission/absorption. Those that did failed to link possible conclusions to confirm or reject their prediction.
- W** Some students were able to recognise one possible source of error in their equipment/method although many stated generalised human errors which could have been avoided with due care and attention. Two are needed to award this marking point.
- X** Some candidates were able to suggest at least one possible method to improve the validity of their data (usually by suggesting an alternative method). However students still need to distinguish the difference between the terms accuracy and validity to enable suitable improvements to be suggested in future.

G623/02 Test

- 1 Many candidates could access this question. Many scored 6 marks out of the nine.
Most candidates could describe the cause of cystic fibrosis as a genetic/inherited condition whilst weaker students wrote about the symptoms of CF in (a).
In section (d) many students wrote the standard list of moral & ethical issues with no consideration of the context of the question and failed to gain marks accordingly. A large number of students gained marks for 'elective abortion' and 'religious issues'. Very few highlighted any post-natal issues.
Alternative valid points included the timing of a termination; quality of life for the CF child.
- 2 (a) The majority of students were able to achieve 2 or 3 marks in this section. However some candidates drew more than one line between structure and function negating any mark.
- (ii) Some failed to complete section (a)(ii). It was disheartening to find that some students still did not know the function of the nucleus, which is covered at Key Stage 3. A large number of students circled 1 and 3 failing to gain the mark.
- (b) This was a good discriminator. Those students who clearly had learnt about the electron microscope scored well on this section. Whilst many candidates knew that specimens have to be dead, many could not state the answers to sections (i) and (iv). Candidates could state the max magnification of a light microscope although values were confused with inappropriate units i.e. nm; μm , consequently the mark was not awarded.
- 3 (a) (i) The majority of candidates could state a version of 'iodine'. However, a minority of students were still writing Benedict's solution.
- (ii) Generally answered well.
- (iii) Many candidates made reference to reducing/non reducing sugars; monosaccharide/disaccharides.
- (b) (i)(ii) Generally answered well although some candidates confused hydrolysis and condensation.
- (iii) Many candidates could give a definition of a biological catalyst at the level of: 'they speed up chemical reactions'.
- (iv) Not answered well. Many students failed to appreciate that enzymes are proteins or the amount needed to promote change. Some students could identify temperature and pH as factors affecting activity although many wrote concentration without specifying substrate or enzyme and consequently these two marks were not awarded.
- 4 (a) (i) Many candidates stated 8 cells.
- (ii) Many students could show the volume of the central square.
- (b) Many students could state the need to count cells to identify anaemia/leukaemia and in certain cancer investigations. However few were awarded the first two points on the mark scheme.

- (c) Not answered well. Candidate knowledge of water potential is poor and their inability to express their ideas clearly made the marking of this section very difficult. The best attempt for the majority of candidates was to make a statement about movement of water from a high concentration to a low concentration (to gain 1 mark), with reference to the cell membrane as selectively permeable (for a second mark). Most of the cohort has little to no understanding of the concepts of zero water potential and negative water potential.

G627, G629, G630, G632, G633, G634: A2 Portfolio Units

General Comments

Candidates' portfolio work at this level shows a marked improvement in research skills, evidence of independent working and more selective use of the Internet. This is a credit to both the centres and their candidates. It was felt that centres now have a good understanding of the assessment criteria and much of the work seen was well organised and clearly annotated with the assessment criteria codes. Many centres are now accredited and several were sampled this session. The portfolio units moderated this session were as follows:

- G627 Unit 8 Investigating the Scientist's Work
- G629 Unit 10 Synthesising Organic Chemicals
- G630 Unit 11 Materials for a Purpose (limited entry)
- G632 Unit 13 The Mind and the Brain
- G633 Unit 14 Ecology and Managing the Environment
- G634 Unit 15 Applications of Biotechnology

Centres again were very responsive in returning scripts for moderation and where there was low entry (less than 10 candidates) it was appreciated when centres sent all scripts directly to the moderator; this saved time and led to an efficient moderation exchange.

Centres are again asked to include the task sheets given to the candidates as this helps to support the moderation process, very few were seen.

In the majority of Centres candidates' work was at an acceptable standard for A2 level. Where scaling did occur it was generally at the higher mark bands and the work submitted was not at a sufficiently high level for the A2 requirements of the assessment criteria.

G627 Unit 8 Investigating the Scientists' work

It was good to see work where candidates had thought out their own investigative and experimental requirements. It is not envisaged that candidates should just follow a number of set experiments provided by the Centre. Investigations chosen should build on work studied at AS level. A lot of further study was seen on enzymes which built on work studied for the biotechnology unit, this was good to see. Further investigative work included properties of materials, redox, food analysis, vitamin C in a range of food products and drinks, yeast /sugar/fermentation, health and fitness, effects of stimulants, energy drinks, caffeine etc on performance. It is important that the standard of experimental work is AS/A level and candidates have the opportunity to use equipment that will provide suitable accurate data for processing. Centres are encouraged to include evidence that candidates had actually carried out the practical work with further evidence that they had completed and used risk assessments. A statement written on the candidates' work is sufficient or alternatively a certificate of completion of practical

Full holistic plans, are now being included. These should provide detailed logs of the full investigation with suitable opportunities for the appropriate monitoring for AO3. AO1 however should include evidence of both scientific principles and details of a range of experimental techniques. Some candidates are still being quite repetitive in their chosen experimental work. A variety of different techniques is preferred. Predictions are not needed in this investigation, the aims and objectives of the investigation are needed and some vocational links are required. To help candidates with ideas for investigative work if they chose a topic and then ask a question about their chosen topic this should help to form the

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basis for an investigation e.g. topic aspirin; question 'which is the best method to prepare a pure sample and why is this?'. If candidates decide on their own questions about a provided topic, this can encourage candidates to carry out a range of investigations on the same topic but with a different focus.

Risk assessments need to be included with all experimental work to fulfil the health and safety requirements. For mark band 2 AO1b evidence needs to be shown of a range of relevant research with information on why this has been chosen with statements to support its validity. Mark band 3 needs to also include constraints that the candidates are working to with suitable contingency plans. A write up of the method etc. is not evidence that the candidates have completed the practical. The report does not necessarily need the candidates to include write ups of methods. A standard procedure which was used can be attached. The report needs to show the outcomes of the investigation with suitable evidence of an understanding of the scientific concepts involved. Centres also need to ensure candidates relate the outcome to the original aims of the investigation. Evaluations need to focus on the whole investigation not just single experimental tasks.

G629 Unit 10 Synthesizing Organic Chemicals

Work for this unit is now showing evidence that candidates are building on organic chemistry researched and studied for the AS portfolio units. It would help the moderation if task sheets were included and a vocational link was supplied. Perhaps link assignment to research work needed for an organisation. The work for AO1 still needs to be focused on the requirements of the specification and not just a repetition of candidates' notes. Evidence for higher marks needs to show summaries of classification and identification of functional groups with evidence of understanding the different type of isomerism. The importance of isomerism linked to specific examples is really needed to secure mark band 3.

Some interesting research work was seen for AO1c. Good practice is shown where candidates complete work in a table form: suggested headings could be Type of drug/How it is used/example/importance in health care /further information. More detailed information however on therapeutic effects and the use is needed to support mark band 3.

AO2 work needs to show evidence of research work on a process used to manufacture an organic compound; alcohol, several selected haloalkanes and medicinal drugs were chosen AO2b needs to focus on costs and benefits to individuals, companies and society associated with the manufacture of the organic compound.

Preparations of aspirin, ethanoic acid, benzoic acid, iodoform (triiodomethane) and paracetamol were seen. Candidates need to take care that for mark band 3, risk assessments are accurate and sufficiently detailed. Risk assessments tended to be mark band 2 rather than mark band 3. Candidates need to be guided to ensure they record suitable observations for both their preparations and also ensure the processing of results is recorded and completed to a sufficiently high level. Evidence on calculations of theoretical yield is needed. Evaluation of the process again needs to be detailed and focused on the techniques used, sources of errors and reaction route. Centres need to note that a total of 26 marks is allocated to the practical work and hence between 25 to 30 hours should be allocated to AO3 work.

G632 Unit 13 Mind and the Brain

Work seen for this unit indicated that candidates were keen to research for AO1. Interesting leaflets on stress and illness and the healthy and damaged brain were seen. Candidates are showing suitable selections of material.

AO2a again allowed candidates to research the clinical methods of studying the brain and interesting work was seen. Diagnosis of brain diseases was generally well covered and some good illustrations supported the candidates' work. Work seen for this session tended to be mark band 2. AO2b moral and ethical implications of brain research still needs to show evidence of suitable discussion by the candidates; although some good arguments were given from some candidates. AO2c does ask for a fact sheet detailing statistical evidence. Candidates are using a wide range of statistical testing on their results but additional information is still needed to ensure the higher mark bands.

Centres need to note that 26 marks are available for this section and therefore candidates need to spend the appropriate time in their experimental work (25-30hours). For mark band 3 a range of data needs to be collected and processed. Generally, suitable statistical processing was completed on experimental data. AO3 e however for mark bands 2 & 3, care needs to be taken to ensure the requirements of the criteria are suitably covered.

Unit 14 Ecology and Managing the Environment

A lot of high quality work which reflected suitable coverage of mark band 3 requirements was moderated. Again candidates' work indicated interest and enthusiasm in this topic area. Although candidates seem to enjoy completing large quantities of work for this unit, selection of relevant evidence will also allow high marks to be accessed.

Candidates clearly are demonstrating an understanding of ecological succession and the effects of change on ecosystems and biodiversity. AO1b research on the effect of agricultural practice, human habitation and greenhouse gas production on ecosystems and biodiversity was also suitably covered especially where candidates had been given the appropriate guidelines. Centres need to ensure that all three areas are equally covered. For mark band 3 evaluative work and justification on the choice of material needs to be included.

AO2 work moderated reflected very good coverage. Some good work on scientific, moral and ethical reasons on preserving ecosystems was seen. Whales and elephant exploitation were amongst several very interesting topics discussed. Data was provided for AO2b and this was good to see. Calculations were usually linked to data gathered from practical work carried out. Centres need however to ensure that if they are going to use this, suitable opportunities are given for candidates to collect quantitative data. Some good statistical analysis was seen in this section.

Some excellent practical work had been carried out by candidates. Generally candidates had taken part in field trip work; this is an excellent opportunity for candidates to produce high quality work. A range of experimental techniques were seen and it was good to see photographic evidence of work carried out. Risk assessments generally for this session seemed to be suitably detailed and did include the risk out in the field as well as back in the lab. For AO3c the displaying of data did show a range of different ways, kite diagrams were often seen to support data display. Conclusions at mark band 3 must show suitable interpretation of results and be related to the occurrence and distribution of species within the ecosystem studied.

Unit 15 Applications of biotechnology

Moderated work indicated candidates produced work which showed good research skills for AO1 and investigative practical work for AO3.

Information produced for AO1 is now showing suitably selected information on the science of genetic engineering and the use of recombinant DNA technology. Work for the higher mark bands should not be sections just cut and pasted from the Internet but show suitable selection and use of the researched information. The inclusion of suitable references supports evidence to show a variety of sources have been used for mark band 3

Again for AO2c mark band 2, work on moral, ethical and environmental issues concerning the use of recombinant DNA technology in the production of GM plants needs an explanation of two types of controls placed on scientists that work in this field. Mark band 3 however needs a more detailed report with additional explanations and evaluative work on the two types of controls placed on scientists and how effective they are.

For AO3 generally suitable practical work was seen but still plans need to be clearer. Interesting work and research was seen on cat milk. Preliminary work from candidates was included and in some scripts there was good research work on enzyme activity. Care needs to be taken that suitable immobilised enzymes are prepared and used. Evidence of good displays of results need to be included for AO3c. Conclusions and interpretation of results are still basic and candidates need to check they spend the appropriate time on AO3c and AO3d to ensure sufficient coverage. For AO3 d level 2 candidates need to check that as well as interpretation of results and basic conclusions, the advantages of using bioreactors and enzyme immobilisation are included.

G628: Sampling, testing and processing

General Comments:

This was the third time that this paper had been taken in the winter and the number of candidates was around 320, slightly more than in January 2008. The total for the paper was 90 marks and, as on previous occasions, many papers showed a score of between 30 and 50. Fewer candidates scored in the fifties and sixties, but many of these provided well thought out answers to the more demanding questions.

It was pleasing to see that there were far fewer candidates scoring less than twenty. There was often evidence of careful preparation from the case study material and, as a result, there was less in the way of irrelevant responses, than in the past. As in previous papers, questions that test a candidate's ability to design an experiment for the specific purpose outlined in the question continue to be a weak area.

The examiners felt that candidates had read the questions more carefully than in the past and responses were seen that reflected this. However, sometimes the responses given were not at the intellectual depth required for this A2 paper. There was little evidence that the candidates found the paper too long but sometimes answers to question 3, which was not based on the case study material, were weaker than the first two questions.

On balance the examiners thought that the paper had performed well and that candidates had been able to demonstrate their knowledge and understanding, and then apply it to new situations.

Comments on Individual Questions:

- 1 (a) (i) The word 'homogeneous' was poorly understood.
- (ii) Candidates were generally well aware of the hazards likely to be encountered when collecting oil shale samples.
- (iii) There were a number of acceptable answers for the size of sample chosen.
- (iv) The need to avoid contamination was well understood.
- (v) Most candidates gained full credit here for labelling their sample.
- (b) (i) The examiners were looking for an electronic and a paper based source. 'Science books' was acceptable but not just 'books'.
- (ii) A standard procedure is used so that the results can be compared - this was not always stated.
- (c) (i) This was simply a question of subtraction but many candidates did not read the question carefully enough.
- (ii) This was a more challenging question but many candidates chose C and gained 2 of the 3 marks available. Those who chose B were able to gain a single mark for a relevant statement.
- (iii) Percentages continue to cause problems and this is an area that needs attention.

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- (d) Although many candidates could explain the term 'sedimentary rock', hydrocarbon and immiscible were often described very poorly. A hydrocarbon contains ONLY carbon and hydrogen.
- (e) (i) Many candidates continue to have problems using large numbers, even though the answer was given.
(ii) This too, involved large numbers and again caused probable calculator problems.
- (f) (i) The need for a risk assessment was clearly understood.
(ii) Candidates handled this calculation and that in (iii) with ease and many correct responses were seen.
(iv) There were many acceptable answers here and most candidates gained at least 1 out of 2.
(v) The need for the absence of flames and the avoidance of toxic vapours was well understood.
- (g) The examiners were looking for a diagram showing heating and a pipe to vent off vapours but this was not always produced.
- (h) The article gave hints to these answers and maximum credit was often given.
 - (i) Many candidates gave 'break into smaller pieces' but few stated 'mix better'.
 - (ii) 'How much water to add' and 'how to add the water' were the most common acceptable answers.
 - (iii) The use of gravel / glass wool or other solid material was the usual correct response.
 - (iv) it was disturbing to see that a number of candidates could not read correctly from a graph.
 - (v) 'The alum contains other substances' was the commonest correct answer.
- 2. (a) (i) Some candidates wrote that it was a 'fair test'. This response is not considered adequate at this level.
(ii) The need to produce nettle plants that were similar for testing was not always realised.
- (b) (i) If rate is to be determined then some timing is necessary. Many candidates failed to respond in this way.
(ii) This was often poorly answered. Many candidates merely repeated what was seen on the graph instead of giving a reasoned answer.
(iii) The need to remove excess enzyme / impurities was well understood.

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- (iv) This was a higher level question and the answers needed to reflect the standard required. To compare the results the diameter of the thread needed to be kept constant and to provide more precise results, smaller masses needed to be added.
- (c) (i) Many candidates had difficulty with this question. There were 100 plants in each row and, if a wrong answer was given, then (ii) was marked consequently.
- (d) Many candidates recognised two relevant environmental factors and gained both marks.
- (e) Most candidates gained at least one of the two marks in these questions that considered percentages.
- (f) (i) There were a number of factors that should be kept constant and many candidates identified two of these.
(ii) There were three factors to consider when drawing the graph. Most candidates could gain at least two of the marks.
- (g) (i) This was a discriminating question. Only the strongest candidates could devise an experiment in an ordered way with the correct use of spelling, punctuation and grammar.
(ii) Most candidates could give two factors that should be considered when selecting a fireproofing solution for children's clothes.
- (h) (i) It was disappointing to see that a few candidates did not know the meaning of the term placebo.
(ii) 'More people' and 'for a longer time period' were the commonest acceptable answers.
- 3 (a) (i) This question required candidates to change cubic centimetres to cubic decimetres. Many candidates were unable to do this or did not notice the different units present.
(ii) Nearly all candidates gave an acceptable size of beaker for this preparation.
(iii) Very few candidates had any idea of how to modify the method to give an acceptable product.
(iv) The interpretation of the graph was generally poor with some candidates simply describing the graph.
(v) Some sound suggestions were seen but these were few. Suggesting why the graph had this shape proved very difficult, although a number of possible reasons were acceptable.
(vi) The need to wear goggles and gloves were frequently seen and these gained merit.
- (b) This was well answered - candidates were able to 'picture' the problems of spraying a powder rather than a solution.

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- (c) (i) Both increased surface area and a faster reaction were commonly given and either gained the mark.
- (ii) The greater effectiveness of using an air draught rather than external heating was not often appreciated.
- (iii) Although a mark for a conveyor belt was often given, it was unusual to see a sketch that merited both marks.
- (iv) This was better answered than (iii) but again demonstrated the difficulty that candidates have when required to design a simple process.
- (v) Many candidates correctly gave 'exothermic'.
- (vi) This question required a conversion between grams and kilograms and a number of candidates could not make this connection.

G635: Working Waves

General Comments

The majority of candidates attempted to answer most sections of this paper. Where responses were attempted, they were usually full and appeared complete (even if incorrect). Weaker candidates often confused different sections of the specification, for example confusing thermal imaging, endoscopy, X-ray imaging and the gamma camera. Reasonable attempts were made at the calculations, but conversion of units such as m to nm confused many.

In some cases there was evidence which suggested they had learned answers to questions on previous papers. Where this occurred, marks could sometimes not be awarded as the responses were not appropriate.

Comments on Individual Questions

- 1 (a) (i) Most candidates knew the correct equation.
- (ii) The majority of candidates were able to transpose the equation and substitute values to obtain the figure of 4×10^{-7} (without giving units) for the wavelength of violet light but most did not attempt to convert to nm and a number of those who attempted to convert did so incorrectly.

Most candidates stated that the velocity of orange light is $3.0 \times 10^{17} \text{ m s}^{-1}$, having apparently multiplied the values for frequency and wavelength without converting the wavelength from nm to m. This calculation was unnecessary for those who recognised that the velocity of orange and violet light in air are the same.

- (b) (i) Most candidates had learnt that incoherent optical fibres bundles are arranged randomly. A few stated that data travelling down such cables arrived out of sequence rather than randomly arranged in position. Most incorrect answers appeared to be based on guesswork.
- (ii) This section was well answered. A few stated why coherent fibres are necessary for some other application. Many answers which failed to score described the characteristics of coherent fibre bundles.
- (iii) The vast majority recognised that incoherent fibres are cheaper. Very few gave the alternative correct answer that they are easier to manufacture. Many non-scoring responses were to the reverse question, namely why coherent bundles might be preferred to coherent bundles.
- (iv) This question was well answered 'endoscope' was the most frequent response but other correct answers such as image transmission, data transmission and internet/telephone communication were also common.
- (c) (i) Many candidates correctly drew the emerging ray. A minority showed it undeviated or bending towards the normal or even emerging on the wrong side of the normal. Very few responses included a reflected ray.
- (ii) A large number of candidates drew either the emerging ray at a grazing angle or the reflected ray, but few drew both. Lines in a variety of other directions were seen. On this occasion candidates were not penalised for failing to put arrows on their rays, but they should be reminded to do so.

- (iii) The reason for including this area of Physics is the application of total internal reflection. It was therefore disappointing that a number of candidate showed emerging rays on this diagram.
- (d) Candidates who had seen a demonstration of the increased brightness of a totally internally reflected ray were able to correctly answer this question. Incorrect answers included:
- 'the ray in fig 1.1 is brighter'
 - 'the rays in fig 1.1. and 1.3 are of equal intensity'
 - 'the ray in fig 1.2 is brighter' (1.2 was not referred to in this part of the question)
- Many answers referred to the size of the angles, suggesting that candidates did not fully understand the term intensity.
- (e) (i) Only about half of the candidates answered this correctly. A small number who recognised that the velocities are similar did not show that they appreciated how very close the values are.
- (ii) A number of candidates recognised that the results would be the same but did not explain why by referring to the fact that the velocity of light is the same.
- (f) This section of the question was more challenging and part (iii) in particular was only answered correctly by the best candidates.
- 2 (a) Many candidates scored 3 or 4 marks recognising most commonly:
- the use of Infra-red
 - not having to dig up the floor
 - finding problems/leakages/blockages
 - the use of false colours
 - images represent different temperature
- Although most candidates correctly addressed this particular application, a few referred to other applications such as locating bodies which were not relevant here.
- Most answers were well set out and easy to understand.
- (b) Most candidates scored 3 or less. Whilst it was anticipate that some might confuse the upper and lower frequency ends of the spectrum (despite many having learnt it at GCSE) the visible range was clearly marked on the question paper so it was disappointing to see answers such as 'a' for the Sun.
- (c) The majority of candidates drew roughly the right shape, with varying degrees of accuracy. Incorrect answers included multiple curves, sine waves and straight lines.
- 3 (a) Most candidates showed a network and most of these indicated the ideal hexagonal shape of cells. The exact location of base stations was not always indicated clearly. Where a scale was given, this usually gained a mark but in many cases the scale was not shown. On this occasion a separation of cells of up to 20 miles was allowed although this is unlikely in the context of a city.
- Incorrect answers included (sometimes detailed and time-consuming) pictures of mobile phones, masts, satellites and concentric circles indicating signal transmission but failed to show how the city is divided into a network of cells.

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- (b) Most candidates gave a simple description of communication within cells. This question required more. The keys to the availability of mobile phones to all are multiplexing (e.g. TDMA covered in a later part of the question) and frequency reuse. The cell structure makes the latter possible and was the focus of this section. Only the best candidates explained this.
 - (c) Most candidates recognised half and full duplex. To obtain full marks required reference to the use of a single frequency in half duplex systems and two separate frequencies in full duplex systems. Simply stating that only one or both users can speak at any one time only scored one of the final two marks on this occasion as it is stated in the question that “CB radio users took it in turns to speak”.
 - (d) This question achieved a better response than in past examinations.
 - (e) (i) Most candidates were distracted by the requirement to put their answer in context and failed to mention binary, let alone discrete levels.
 - (ii) Far more correct responses were seen than when this question was previously asked. Although some incorrect answers were near-misses, most appeared to be guesses.
 - (iii) The better candidates understood that frequency is spilt into time slots or that each call is given a certain portion of time but few gave both of these points.
- 4
- (a) (i) Many correct answers. Constant wavelength was accepted instead of constant frequency/period because one follows from the other, but it suggests that candidates had not taken into account of the axis labelling. A minority which answered ‘same frequency and same wavelength’, thus gaining one mark rather than two unless they also mentioned amplitude. Some failed to score one of the marks because they answered “displacement” rather than “maximum displacement” or “amplitude”.
 - (ii) Most candidates reproduced the correct units from the graph, although m/s was seen on a number of occasions. Few gave the correct numerical value or showed that they had attempted to measure the time more than one cycle and divide. Incorrect answers included 4.0 (the whole time) and 5.5 (misreading the time for 1 and a half cycles). Very few attempts were made to take a measurement using more than one cycle.
 - (iii) A number of candidates gained some credit for ecf, but many omitted to give their answer to 2 significant figures or struggled to find the correct units.
 - (b)(c) Most candidates recognised amplitude and frequency modulation although a minority named them the wrong way round. Only the best candidates were able to correctly draw the modulating signal, especially in the case of frequency modulation.
 - (d) (i) Many candidates scored two marks by drawing on the graph to indicate sampling at an appropriate frequency. The text did not always give confidence that the sampling had been fully understood.

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- (ii) Many candidates described what is meant by a binary number rather than giving an example of one.
- 5 (a)(i) & (b)(i) In past examinations candidates' answers have confused diagnosis and treatment. These questions were intended to check that candidates do understand the difference and to prompt them to distinguish between the two in their subsequent answers.
The majority of candidates gave correct answers, although a few of these still confused the two in other parts of the question.
- (a) (ii) Many correct answers seen.
 - (iii) Many answers referred to X-rays and CAT scanners, but better candidates were able to give examples of the isotopes used. There were many instances of confusion with a barium meal.
- (b) (ii) Generally well answered, but a minority of candidates gave the answer chemotherapy.
- (iii) As with (a)(iii) many candidates referred to X-rays although γ -rays are mentioned in the question. A significant number of responses gave details of fractionated doses and rotating sources in order to spare healthy tissue. Most included a reference to destroying cancerous cells. Incorrect answers sometimes referred to MRI and CAT scanners.
- (c) Most candidates had a basic idea that bones absorb X-rays because they are 'dense' (better candidates referred to Calcium and/or high atomic number), and that soft tissue does not absorb (as readily) because it has a lower atomic number.
Many responses stated that X-rays reflect from bone. Only a small minority mentioned the air in the lungs. Some answers consistently referred to light rather than X-rays.
Few candidates gave answers with less than two errors in spelling punctuation or grammar.
- (d) Very few correct answers were seen. Most candidates described the use of a collimating grid. Others described image intensifying screens.
A large minority included the importance of reducing the radiation burden on the patient.

Grade Thresholds

Advanced GCE Applied Science AS (H175, H375) and
GCE Applied Science A2 (H575, H775)
January 2009 Assessment Session

Portfolio Unit Threshold Marks (AS)

Unit		Maximum Mark	a	b	c	d	e	u	Total nos of candS
G620	Raw	50	42	37	32	27	22	0	489
	UMS	100	80	70	60	50	40	0	
G621	Raw	50	42	37	32	27	22	0	214
	UMS	100	80	70	60	50	40	0	
G624	Raw	50	42	37	32	27	22	0	73
	UMS	100	80	70	60	50	40	0	
G625	Raw	50	40	35	30	25	21	0	70
	UMS	100	80	70	60	50	40	0	
G626	Raw	50	42	37	32	27	23	0	80
	UMS	100	80	70	60	50	40	0	

Examined Unit Threshold Marks (AS)

Unit		Maximum Mark	a	b	c	d	e	u	Total nos of candS
G622	Raw	90	71	62	53	45	37	0	1120
	UMS	100	80	70	60	50	40	0	
G623	Raw	90	69	61	53	45	37	0	128
	UMS	100	80	70	60	50	40	0	

Portfolio Unit Threshold Marks (A2)

Unit		Maximum Mark	a	b	c	d	e	u	Total nos of candS
G627	Raw	50	42	37	32	27	23	0	153
	UMS	100	80	70	60	50	40	0	
G629	Raw	50	42	37	32	27	23	0	24
	UMS	100	80	70	60	50	40	0	
G630	Raw	50	42	37	32	27	22	0	6
	UMS	100	80	70	60	50	40	0	
G632	Raw	50	43	38	33	28	23	0	15
	UMS	100	80	70	60	50	40	0	
G633	Raw	50	42	37	32	28	24	0	100
	UMS	100	80	70	60	50	40	0	
G634	Raw	50	42	37	32	27	22	0	18
	UMS	100	80	70	60	50	40	0	

Examined Unit Threshold Marks (A2)

Unit		Maximum Mark	a	b	c	d	e	u	Total nos of candS
G628	Raw	90	68	60	53	46	39	0	330
	UMS	100	80	70	60	50	40	0	
G635	Raw	90	65	57	50	43	36	0	267
	UMS	100	80	70	60	50	40	0	

Specification Aggregation Results

Uniform marks correspond to overall grades as follows.

Advanced Subsidiary GCE (H175):

Overall Grade	A	B	C	D	E
UMS (max 300)	240	210	180	150	120

Advanced Subsidiary GCE (Double Award) (H375):

Overall Grade	AA	AB	BB	BC	CC	CD	DD	DE	EE
UMS (max 600)	480	450	420	390	360	330	300	270	240

Advanced GCE (Single Award) (H575)

Overall Grade	A	B	C	D	E
UMS (max 600)	480	420	360	300	240

Advanced GCE (Double Award) (H775)

Overall Grade	AA	AB	BB	BC	CC	CD	DD	DE	EE
UMS (max 1200)	960	900	840	780	720	660	600	540	480

Cumulative Percentage in Grade

Advanced Subsidiary GCE (Single Award) (H175):

A	B	C	D	E	U
1.9	14.8	40.7	66.7	90.7	100.0
There were 55 candidates aggregating in January 2009.					

Advanced Subsidiary GCE (Double Award) (H375):

AA	AB	BB	BC	CC	CD	DD	DE	EE	U
0.0	0.0	0.0	11.1	22.2	33.3	44.4	77.8	77.8	100.0
There were 11 candidates aggregating in January 2009.									

Advanced GCE (Double Award) (H775):

AA	AB	BB	BC	CC	CD	DD	DE	EE	U
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0
There was 1 candidates aggregating in January 2009.									

For a description of how UMS marks are calculated see:

http://www.ocr.org.uk/exam_system/understand_ums.html

Statistics are correct at the time of publication.

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