OCR
Oxford Cambridge and RSA

GCE

Applied Science

Advanced GCE A2 **H575/H775**

Advanced Subsidiary GCE AS **H175/H375**

OCR Report to Centres June 2015

OCR (Oxford Cambridge and RSA) is a leading UK awarding body, providing a wide range of qualifications to meet the needs of candidates of all ages and abilities. OCR qualifications include AS/A Levels, Diplomas, GCSEs, Cambridge Nationals, Cambridge Technicals, Functional Skills, Key Skills, Entry Level qualifications, NVQs and vocational qualifications in areas such as IT, business, languages, teaching/training, administration and secretarial skills.

It is also responsible for developing new specifications to meet national requirements and the needs of students and teachers. OCR is a not-for-profit organisation; any surplus made is invested back into the establishment to help towards the development of qualifications and support, which keep pace with the changing needs of today's society.

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 specification 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.

OCR will not enter into any discussion or correspondence in connection with this report.

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OCR REPORT TO CENTRES

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

General Comments

All the portfolio units offered by the specification were moderated during this session. These were:

- **G620 Science at Work**
- **G621 Analysis at Work**
- **G624 Chemicals for a Purpose**
- **G625 Forensic Science**
- **G626 Physics of Sport**

Units **G620** and **G621** are taken by all candidates who complete the single AS qualification. Candidates completing the double AS qualification need to choose two units from **G624, G625** and **G626.**

Many Centres continue to be generous in their assessment decisions, especially where the higher mark bands were awarded. Work assessed at mark band 3 needs to be reflective of A/B grade work at AS. Although work covers the requirements of the assessment criteria, the level needs to demonstrate higher level scientific knowledge, with evidence showing competent use of candidates' research. Detailed evaluative work must be shown where candidates are fulfilling this criteria. Much of this work was very basic and although evaluations were completed the level of discussion and scientific reasoning was not reflective of high grade AS work. 'A' grade work needs to be detailed and accurate. All researched information should be suitably selected and referenced. Work given full marks at mark band 3, should be free of any minor errors and supported by scientific content which is suitably presented. Credit is given to those staff and candidates who are using the assessment criteria and specification content appropriately and consequently good work is being produced which is being assessed at the correct level.

The samples for moderation were again selected electronically and moderators found that the majority of work was returned efficiently with appropriate Centre Authentication Certificates. There are still a number of Centres who had not completed URS forms, provided work without Centre or candidate numbers and only given total marks. It is essential that the URS is fully completed for each candidate, with comments and page references, and attached to the candidates' work. Centres are also asked to check that correct candidate numbers are written on all work presented for moderation. The use of treasury tags and not plastic wallets is also recommended. Annotation of candidates' work in the form e.g. AO1 - 6 (i.e. the assessment criteria reference) is also useful. Appreciation is given to Centres where staff had supplied relevant task and assignment sheets and had fully annotated the candidates' work. Several clerical errors where the marks sent to OCR were not the same as the marks on the URS were again commonplace this session.

It was noticeable this session that the quality of much of the practical work had shown improvement in both the level required and accuracy of the presentation. It was good to see that many Centres had acted upon advice given in the moderation reports. Centres still however, need to take care that when giving full marks at mark band 2 all the criteria in that strand is met at the appropriate level, omissions and low level work was often seen where mark band 2 was awarded. Where Centres are offering the A2 qualification they are advised to ensure practical skills offered at AS allow candidates opportunity to build on these for the A2 investigative work in G627. Repetition and limited opportunities for the range of practical skills completed by the candidates was still evident in some Centres.

To support Centres with their candidates' portfolio assessment, OCR offers a free coursework consultancy service where up to three full or part completed portfolios will be moderated and the centre issued with a report on the assessment decisions completed by the Centre. Where a Centre's decisions were not in agreement with those of the moderators, Centres are encouraged to use this service for future submissions.

Accredited Centres need to ensure that the necessary Centre Authentication form is sent to OCR for each session in which they are entering candidates. If there is a change in the staff named for the accreditation OCR must be informed.

It is important that Centres do encourage their candidates to follow guidance given in this report. This is essential if standards are to be maintained and scaling is to be avoided in future submissions.

Internal moderation although not mandatory is highly recommended where more than one member of staff has assessed candidates' work. Centres are advised to refer to Appendix A Page 93 of the specifications for the performance descriptions for AS work to review the overall level of their assessment decisions.

Please note that the date for the final series in which units **and** certification will be available for GCE Applied Science is June 2018. This means that candidates can start a 2-year course in September 2016. For further information please refer to the OCR website/Applied Science Information for centres.

Comments on specific units

The guidance on the units given in this report again re- emphasises the need for Centres to refer candidates to both the requirements of the specification and the assessment criteria when they are studying these units. Some Centres continue to use assignments that they have used many times previously. This is acceptable as long as the candidates are given suitable opportunities to cover the full range of the requirements given in the specification and carry out practical work which shows suitable progression from those completed at GCSE.

G620 Science at Work

This unit is mandatory and candidates need to be demonstrating progression from level 2 courses in both their research skills and practical work.

The assessment requirements for the specification include:

AO1 record of four surveys of science based organizations; one in depth study; work on health & safety laws and regulations

AO2 evidence of the impact organization has on society; calculations on provided data or data obtained from experimental work

AO3 two practicals with a vocational context with recorded processed and evaluated results

The requirements for the units do not change but some Centres are still not emphasising to their candidates that AO1a work needs to show evidence of research for a survey which is suitably selective and for AO1b, the study needs to be focused on ONE organisation with a report which is much more descriptive and detailed.

For AO1a each survey needs to include: the products made or services offered; the type of work that takes place; an identification of the science involved and information on health and safety constraints and guidance used in the organization. Work showing evidence of research from a range of methods including visits, visiting speakers, leaflets, as well as web based research which demonstrate good practice and different research skills from candidates. Surveys where

candidates had gathered their own primary information, again tended to be much more focused, however, sometimes the scientific content was quite limited. In these cases candidates should supplement their primary research with additional evidence from other sources. Lengthy reports with 'cut and pasted' evidence are not required. The skill for the higher mark bands is in the candidates' ability to select and use the required information. Centres still need to ensure that their choice of organizations is suitable to cover sufficient science.

The in-depth study needs to include: explanation of what is produced or details of the service offered; information about the organization including the number and range of staff employed; further details on the scientific job roles specifically related to the chosen organization; some explanation and detail of the science involved in the organization; any further specific detail on research, quality control; details and specific links of health and safety laws and regulations which can also be used as part of AO1c requirements. This session, work seemed to show less evidence of external visits, but where centres had completed these it did reflect candidates' interest. Zoos and sport/health centres continue to be very popular. Again if research is being carried out through web based methods staff need to ensure candidates are using their researched material within their reports and are not just 'cutting and pasting' interesting material. The use of more than one web site is to be encouraged and independent work needs to be evident. The in-depth study at mark band 3 needs to be a comprehensive research study where information is selected and clearly and logically presented. Some evaluation and justification of the use of the material needs also to be included supported by comments on the validity of the sources candidates have used.

Work for AO1c this session seemed generally to be better assessed. Hopefully the guidance given last year was adhered to. There seemed to be less candidates gaining very low marks. Coverage and links to the chosen organisations was much better, with candidates demonstrating how the organisations comply with relevant legislations and why they are needed. Many lower level candidates did complete an additional task which allowed them to give evidence to show some knowledge of a range of health and safety laws and regulations stated in the specification.

The report for AO2a was linked in many cases to the in-depth study, but in several cases assessment tended to be generous as coverage was very minimal and descriptions quite weak. More work needs to be done on ensuring suitable coverage and understanding is completed for this section. The content needs to 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. Please note again mark band 3 requirements state 'a comprehensive and thoroughly researched study of the impact of one organization on society focusing on all issues'. This was still not demonstrated in many reports seen.

Centres are continuing to assess generously for AO2b. The assessment guidance states a number of complex and straightforward calculations should be completed. Reference to Appendix C Page 129 of the specification gives guidance on the range of mathematical skills which may be covered during this A level course. If the data produced for practical work does not allow candidates to fulfill the higher mark bands then data can be supplied, however, it is not advisable to produce a number of stand-alone calculations. If this is necessary they could be presented in the form of a task sheet which perhaps would be completed by a technician in the workplace. For AO2b mark band 3, work should be correct and answers given to the appropriate degree of accuracy with correct significant figures. Errors are still commonly seen here. Just the completion of one calculation that was completed in the practical work or repetition of the same calculation is insufficient evidence for mark band 3.

The AO3 practical work offered this session did seem to show continual improvement in many cases, however, Centres must be encouraged to offer their candidates a range of practical activities. The opportunities are wide ranging and can include chemical, physical and biological experimental work as long as a clear progression from GCSE is demonstrated by the

candidates. Examples can include inorganic volumetric exercises and analysis, organic preparations and analysis, microbiological techniques, vitamin C and food testing, and colorimetric analysis, forensic focused analysis, optical and material investigations work, material and electricity investigations.

Candidates need to carry out two practical activities which can be chosen by the Centre but they need to show vocational links. Please note Centres are not advised to include several experiments and expect moderators to choose the best, evidence of this was still apparent. The practical work chosen does not necessarily need to link to the organizations studied for AO1 and AO2, although it needs to have some vocational link. Research is usual to support this, but ensure it is relevant and not just 'cut and paste' interesting research. Candidates are now including risk assessments but they need to ensure that they are suitably working documents and do not include generic and unnecessary or repetitive information. Relevant information on chemicals is needed with particular focus on the concentration used in the actual experimental work. It is advisable that candidates learn a range of skills in this unit and it is therefore not advisable to carry out practicals demonstrating the same techniques

For AO3b recording needs to be thoroughly checked by candidates to ensure accuracy, units and correct significant figures. Again quite a lot of over assessment was seen for this strand. Candidates need to be providing evidence of accurate recording, either by repeats or comparison with staff or other candidates' results. 5-6 marks were given when work was not accurate, units were missing, and observations were far from being detailed. Candidates need to be much more careful in their recording.

The advice again is that in AO3c much more accuracy is needed in processing and graph work for the higher mark bands. Graphs were often poorly drawn with inappropriate scales and units missing from labelling of axes. Answers from calculations were not quoted with the correct numbers of significant figures. The inclusion of an evaluation does not automatically mean mark band 3. Candidates need to review the level of evaluations, much more scientific detail is needed to support basic evaluative comments made.

G621 Analysis at Work

Many Centres tended to be generous in their assessment of this unit, particularly for the practical skills. This mandatory unit gives candidates opportunities to research and understand information as well as carry out a range of practical analysis. Many candidates need to be much more selective in their research, although some excellent high level work was produced. For practical work, accuracy and the inclusion of the appropriate advanced science knowledge is needed to support the higher practical assessment. Here again the level of the practical work seen had shown considerable improvement from past portfolios moderated.

The assessment requirement for the specification include:

AO1 information showing an energy policy and energy usage of an organization with a consideration of energy efficiency and environmental impact

AO2 study of large scale and small scale generation to include energy transfers with data and calculations to show a comparison of fuel costs.

AO3 three practical analyses one qualitative analysis, one quantitative and a third investigation with results processed and interpreted.

For AO1a candidates are given the opportunities to select any energy policy, however, where candidates are almost left to their own devices, work still did not clearly show the organisation's energy policy and work was not structured. Environmental policies are still being included but this is not as evident as previously. Centres are again advised to review the web sites that candidates are accessing, to ensure that energy policy information is easily accessible. Retail stores, schools and colleges were amongst the most popular this session. Guidance on what is

required in each section of AO1a AO1b and AO1c needs to be clearly explained before candidates launch into extracting non-related information. The energy policy needs to be clearly presented and not threaded through the report in a disjointed way. Reports are still being seen where teachers have highlighted candidates' research to evidence the various requirements. The candidates need to use their research to extract the relevant information and then compose their report. Again it is important to note that for mark band 3, reports need to not only include a detailed description of an energy policy but also an evaluation of how energy consumption is limited. The evaluation needs to discuss the ways in which the introduction of the energy policy enables the organization to limit their energy consumption. All candidates were still not stating what is meant by energy efficiency and hence work was not covering the requirements of the assessment criteria. Again generous assessment at the higher end.

It was again pleasing to see that for AO2a the descriptions and comparisons of large scale and small electrical generation from two chosen sources was completed well by many candidates. Care still needs to be taken to ensure that mark band 3 work reflects candidates' own understanding as well as covering the requirements of the assessment criteria. Work needs to be both suitably detailed but selective.

A range of energy values and fuel/energy costs was evident but higher level candidates still need to be showing independent research and not just rewriting or using work provided. Even for mark band 1, candidates should be displaying energy values and costs as well as completing calculations. For mark band 2, candidates need to be showing evidence of their own research.

Although practical work has shown some improvement in the type of work completed Centres are still giving candidates full marks where work is not at all reflective of A grade AS practical work. The guidance stated below still holds and Centres need to continue to work to improve the level and accuracy of the write-ups of this requirement.

- Practical work needs to be a step up from that studied at GCSE, supported with good quality observations and accurate processing.
- Higher mark band work should be supported by correct balanced equations where appropriate.
- Risk assessments need to be workable documents and for those candidates aiming for high mark bands these should show selected focused hazards and risks associated to the chemicals/equipment used. Generic statements are not sufficient at the higher levels.
- Observations for qualitative analysis are still quite weak in both detail and accuracy. Just crosses and ticks are insufficient for observations at this level.
- Evaluation 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. The inclusion of an evaluation does not automatically indicate candidates can gain mark band 3, the level of discussion needs to be reflective of A/B grade work.

Evidence of the use of the same practicals for G620 & G621 is still being seen and although this practice is not forbidden it is not recommended, especially when Centres are familiar with the wide range of requirements needed for both G620 and G621. It does not allow candidates the opportunity to be taught and cover a range of practical examples stated in the specification. This is not good practice for candidates aiming for higher mark bands.

G624 Chemicals for a Purpose

This unit was not a popular choice this session but again assessment was generous at the higher end.

The assessment requirements for the specifications include:

AO1 a description of two examples of inorganic and two examples of organic chemical compounds, discussing their chemical structure, properties and uses and a detailed account of two compounds one of which is made from oil

AO2 relevant research of one industrial process that involves the use of a catalyst. A report which includes an understanding of the social, economic and environmental impact of the product selected.

AO3 a sample and account of the preparation of two products that have been synthesized, purified and analyzed.

It is important that candidates chose suitable organic and inorganic compounds. There was still evidence of incorrect choices of compounds and practical work. Inorganic compounds could include: sulphuric and hydrochloric acids, sodium hydroxide, sodium chloride, copper sulfate, ammonia and ammonium salts, carbon dioxide and sodium carbonate. For organic: alkenes, alcohols, aldehydes (alkanals) and ketones (alkanones), haloalkanes, esters and carboxylic acids as well various polymers.

For AO1c candidates need to be producing a detailed account of two chosen compounds one of which is made from oil. It was noticeable this session that this strand was often integrated with AO1a & AO1b. It is advisable to choose two different compounds for AO1c. This is useful for the higher level candidates as it is allows a wider choice and range of research. Candidates need to be made more aware of the bullet points listed in AO1c to ensure that the choice of compound will allow suitable coverage. Candidates choosing polymers for this section are often restricted on choice of reactions and explanation of such reactions is often too complex for AS candidates. Alkenes or alkanes could be used as examples. Good practice is shown where a bibliography is included and evidence of where each reference is used throughout the report. Use of A level text books again would possibly help candidates more to demonstrate use of the research.

Centres need to be aware that for AO2a full marks at mark band 3, candidates need to show completion of both simple and complex calculations which includes researched data on costs of chemicals and data obtained from at least one of the preparations. Structured, stepwise calculations for yield does not support mark band 3. Mark band 3 candidates should be demonstrating independent skills in calculating and work on researched data should not be totally directed by the Centre.

Again some good work was seen for AO2b. Centres need to note that even for mark band 2 work needs to include detailed descriptions of all the listed bullet points with the report to include energy costs, waste products availability and sustainability of raw materials, these were often omitted. For mark band 3, candidates were suitably describing and explaining the role of the catalyst used, but an understanding of the social, economic and environmental impact of the product was not fully discussed. Generally research was often just ‘cut and pasted’ and not used by the candidates. Examples for this section could include nitric acid, sulfuric acid, ammonia and ethanol. Again good practice is seen where candidates complete logically structured reports based on the bullet points listed in the assessment criteria. Referencing should be seen as well as detailed but focused work.

AO3a gives candidates opportunities to prepare, purify and analyse both an **organic** and **inorganic** compound. It is important that the two products chosen do include ONE organic and ONE inorganic. This was not the case in a number of scripts seen. There are no restrictions of choice of product but Centres are advised to ensure that candidates are able to complete all three tasks for each: synthesis, purification and analysis. Good practice is seen where candidates research and reference each section for both compounds prepared. Recrystallisation is an example of purification and melting point will show purity but further analytical tests should also be completed where the higher marks are to be awarded. Initial and final weighings and accurate recording of melting points are still not always seen. Just one temperature for a

melting point is insufficient. Candidates should also be including observations for all parts, this is still very poorly done.

Processing needs to include calculations on theoretical, actual and percentage yields. For mark band 3, evidence of how the theoretical yield is calculated should be included to reflect suitable knowledge at this level. Work needs to be supported by suitably balanced chemical equations. For AO3c candidates need to show an awareness that the yield can be increased by changing conditions. Actual workable suggestions are needed for mark band 2 and a full evaluation of the methods chosen with a possible comparison of the suggestions is needed for mark band 3. This is still not adequately covered.

G625 Forensic Science

Limited forensic work was moderated this session. The popularity of this unit has diminished over time. Some well selected and researched work was seen from a number of Centres and both candidates and staff should be congratulated on the level of work completed.

The assessment requirements for the specifications include:

AO1 a knowledge and understanding of the need to preserve and record the scene of crime; the chemical, biological and physical techniques used to collect and visualise forensic evidence; including ethical considerations.

AO2 a report on a forensic case study on evidence and proof; work which demonstrates the use of calculations to support forensic measurements or observations.

AO3 at least one forensic analysis in each of the following areas biological, chemical and physical techniques.

Most of the work seen did support the requirements of the assessment criteria and these Centres should be congratulated on the support given to their candidates. AO1a research work generally included information of a range of techniques with a reasoned link to the recording and preserving of the crime scene. Suitable work to cover chemical, biological and physical techniques was seen.

Centres still need to work on ensuring a range of information on ethical issues are discussed for AO1c and mark band 3, candidates' work needs to show understanding of the need for an ethical code, statements or 'cut and paste' information were often seen here. This is an area where assessment still tended to be generous, just a mention of the need for an ethical code does not automatically mean a candidate reaches mark band 3. A range of case studies tended to be seen this session with candidates being aware of the need to cover the bullet pints listed in the assessment criteria. Again good practice was seen where reports were well structured and covered information listed in the criteria on both evidence and proof. It isn't advisable to ask candidates to report on more than one case study,

Candidates are showing evidence of completing standard calculations as suggested. These include a range of Rf values for mark band 1, refractive index calculations and bullet projectiles for mark band 2 and 3. Calculations involving concentration and dilution work have also been seen. Candidates' work still needs to show evidence of less guidance and more independent thought.

AO3 experimental work included fingerprinting and taking footprints, measuring and use of photographs, a range of microscopic techniques, chromatography, qualitative and quantitative analysis, and the measurement of the refractive index of glass. Some higher level work was supported by chemical equations and a range of explained spectroscopic analysis. Mark band 3 candidates need to ensure detailed processing and interpretation of their results and a discussion of their significance.

G626 The Physics of Sport

This unit gives candidates the opportunity to research into science involved in a range of sporting activities. Work completed this session showed a wide range of abilities with some good practical and leaflet work evident.

The assessment requirements include:

AO1 a series of 4 short sport guidance leaflets for the coaches at a sport and recreation centre to help them answer questions of a technical nature for their trainees linked to Measurement; Seeing; movement and technique

AO2 a presentation which will discuss the required material properties and how these are achieved in sports equipment; evidence of the completion of a number of calculations related to the physics of sport

AO3 evidence of two investigations relating to the physics of sport.

Candidates for this unit do now generally present their work as leaflets, however, more work needs to be done on the use and selection of their research material.

The following guidance needs to be emphasised again:

- Centres are directed to the information on page 106 of the assessment criteria regarding the target audience for leaflets
- candidates should be suitably selecting material for their leaflets and using the specification reference, page 33, for the content
- mark band 3 work needs to show detailed knowledge written where appropriate in the candidate's own words with evidence on the linking of scientific knowledge to the chosen sport or equipment.

AO2 gives candidates the opportunity to produce a presentation linked to sporting equipment. Most candidates are now presenting their research for AO2a as a presentation. It was good to see that higher level candidates were supporting their slides with suitably scientific explanatory notes. Some very interesting information again was seen on tennis, golfing, squash, cricket equipment and balls. Skate boards, surf boards and fishing tackle were also seen. Candidates still need to ensure that they focus on the reasons for the choice of materials and on the physics principles relating to the choice of materials.

For AO3a the assessment criteria clearly states candidates need to plan and conduct safely two investigations. Plans are still not sufficiently detailed and candidates are only producing methods.

Candidates should be choosing variables to show their planning skills. The choice of practical is left to the centre but it needs to relate to the content of the specification. Coefficient of restitution is completed by most centres and a range of other practicals covering the testing of different properties of materials and a range of optical /lens work. For AO3b candidates need to be collecting a wide range of suitable data and it needs to be suitably recorded. Even for mark band 2 repeats are required, this was absent in several pieces of the work moderated. Processing and interpretation of results needs to show progression from GCSE work and graphs need to be well drawn with fully labelled axes. Good practice is seen where error bars are included. Again the inclusion of an evaluation does not automatically allow mark band 3 to be awarded. Conclusions need to link to the science involved and for mark band 3 the significance of the investigative work needs to be discussed.

G622 Monitoring the Activity of the Human Body

General Comments

Many candidates were able to access all aspects of the paper. The marks ranged from 4 to 75 out of 90. The more open, level of response items were challenging for many candidates. However, some did well with the insulin/diabetes item but less well with the item on pulse rate and monitoring fitness levels. Such items did not appear to be hindered by factual recall but did not follow a logical order and/or focus on the application of knowledge in relation to the scenario presented. Many candidates used the space provided for these and other items.

The majority of items did not seem to generate errors due to the misinterpretation of instructions or rubric. Many candidates appear to have been well-prepared for this paper and completed all items. A small number of candidates crossed out responses but they tended to replace them with an alternative response. Candidates appeared to have sufficient time to complete the paper and the number of 'nil responses' was relatively limited.

Comments on Individual Questions:

1(a)(i) This item was well-answered. A pattern of incorrect, alternative responses was not apparent.

1(a)(ii) No issues were identified for this item. Some candidates referred to other physiological equipment but no clear distractor was identified.

1(a)(iii) Many candidates were able to recall the correct values for normal systolic and diastolic pressures.

1(a)(iv) Some unexpected responses were observed for this item. For some, there was confusion with the activity levels of the body rather than the heart.

1(b)(i) Many candidates provided the correct critical temperature for hypothermia. Few referred to higher values.

1(b)(ii) Some good descriptions of vasoconstriction were seen and relatively few candidates incorrectly referred to blood vessels moving away from the skin surface.

1(c) The majority of candidates scored full marks for this straightforward item. A few focussed on costs of health care and did not obtain the relevant marking points.

2(a)(i) Some candidates obtained full marks but others were confused with the location of aerobic and anaerobic phases in cells. It was unfortunate that some responses included 'energy' creation, rather than that of ATP molecules.

2(a)(ii) This item was designed to be accessible for candidates. However, some were challenged by the content and did not focus on the essential differences between combustion and cellular respiration. One common error referred to the involvement of glucose.

2(b) Many options were available as marking points. The most commonly-used correct responses included the transport of oxygen or oxygenated blood and the transport of blood around the body or to named organs.

2(c) A number of candidates described changes in the viscosity and colour of blood rather than the reduced transport of oxygen etc.

2(d)(i) The purpose of the drawing was to focus the candidates onto the structures involved. However, there was some confusion about the role of smooth muscle and elastic tissue but many understood the function of the cartilage and goblet cells.

2(d)(ii) Most candidates were confident when responding to this item and selected 'peak flow meter'. A frequent distractor was 'respirometer'.

2(d)(iii) This item was challenging for many candidates. The required link was between the inactivity of the cilia and the accumulation of mucus. This was frequently overlooked by candidates.

2(d)(iv) Many candidates could not express a clear response for this item. It was challenging because the topic was somewhat out of context, possibly due to the absence of a supporting diagram.

3(a) Hazards and risks are often confused with this form of item. However, many candidates successfully described the relevant features of needle injuries. General descriptions of contamination were not appropriate for this particular table.

3(b) Many candidates were aware of the cellular features of anaemia and leukaemia. Some also correctly referred to AIDS/HIV for white blood cell counts.

3(c)(i) A number of correct responses were observed for this item, with a focus on ELISA and gas chromatography. Unqualified references to chromatography etc. did not obtain a mark.

3(c)(ii) This is a frequently-asked topic and many candidates were able to obtain full marks. Unfortunately, some candidates included alcohol in their responses but this was specifically discounted in the stem of the item.

4(a)(i) In the absence of a scenario explaining the glucose tolerance test or a graph providing test data, many candidates struggled with this item. It was expected that they would be aware of the use of a known level of glucose in a drink and the need to monitor glucose levels across the period of the test.

4(a)(ii) Many were unable to recall the correct values and a significant number of candidates used mmol dm^3, rather than mmol dm^{-3}.

4(a)(iii) A challenging item for the majority of candidates. However, some correctly included high levels of glucose and/or a lack of insulin production in their response.

4(b) Some candidates included unnecessary descriptions of the action of insulin in their response to this extended writing item. There was some confusion about the intake of sugar/glucose foods or drinks and the relevance of exercise. Most were able to refer correctly to injection of insulin. Overall, the item was accessible to many candidates.

4(c) This was a difficult item for many candidates. They were challenged by the different context for gestational diabetes. However, some candidates were able to obtain one or two marks for the item.

5(a) It can be difficult to explain the link between the different densities of bones and soft tissues in relation the absorption of X rays and the type of image formed. Some, however, did well and provided good explanations. Others incorrectly referred to X rays bouncing off objects and, possibly, confusing image formation with that of the ultrasound.

5(b) This is a familiar and well-understood topic for many candidates. The item was well-answered and many candidates obtained both marks.

5(c)(i) This was often successfully answered but some candidates incorrectly referred to the non-invasive feature of ultrasounds. This was not related to the scenario of this item.

5(c)(ii) Many candidates clearly understand the differences between the two types of blood vessel but, unfortunately, the item focussed on structural features and not those relating to direction of blood flow or level of oxygenation.

6(a) This item was not answered well by the majority of candidates. The scenario and stem of this item were challenging and many candidates described the removal of CO_2 rather than the problem of inhaling soda lime.

6(b)(i) A variety of numerical responses were presented by the candidates. Although many correctly calculated 0.7 or 0.6, some candidates provided answers with a ten-fold increase to those expected.

6(i)(ii) An 'ecf' mark was allocated to this item. This was beneficial for some candidates but others also miscalculated the range in this item and so were prevented from obtaining any marks.

6(b)(iii) It was surprising to observe that many candidates described a decrease in the tidal volume. This does not happen immediately after such exercise. Many correctly referred to the need of oxygen etc.

6(c)(i) Many candidates did well with this item and were able to interpret the data effectively. Although some made errors when they included data in their response, other marks were available for this item.

6(c)(ii) This was a most accessible item for the majority of candidates. The lack of oxygen and the accumulation of lactic acid were particularly popular responses.

6(c)(iii) Mixed responses were obtained for this item. Some candidates struggled to express themselves clearly and there was some confusion about the change in lung volume.

6(d) This extended writing item enabled many candidates to obtain marks. However, few were able to successfully link the outcome of pulse rate monitoring with an effective explanation of fitness levels. Details of heart strength and size and stroke volume were often missing.

G623/01 Cells and Molecules – Planning Exercise

General Comments:

'Plan an investigation to compare the growth rate of the microalga Dunaliella salina with the growth rate of one other named species of microalga, in a range of saline concentrations'.

A wide range of marks was achieved in this session. Some Centres had clearly spent time working on this plan and a lot of individual candidate input was evident. In some Centres, however, work was very prescriptive, with all candidates following the same method, stating the same variables and proposing the same limitations and improvements.

A limited range of different methods to compare the growth rate of the microalga Dunaliella salina with the growth rate of one other named species of microalga, in a range of saline concentrations, was seen in this task. Many candidates made use of the haemocytometer and microscope, whilst some Centres chose colorimetry to measure % absorbance/ transmission of light, in algal samples. However, all too often, candidates failed to compare the growth rates of the two species of alga across a range of saline concentrations. Centres are asked to ensure that candidates read the instruction brief carefully to avoid misinterpretation of the task. In many Centres, candidates failed to use the information in the insert to suggest an appropriate range of saline values to assess the effect on the growth rate of the two named species of microalgae.

Whilst there is no requirement for candidates to carry out the investigation, some of the assessment objectives are more easily accessed if candidates do so. It is still most important that Centres acknowledge the existence of all the assessment criteria and ensure that candidates address all of them, in their plans. A candidate tick sheet would be useful to help with this. Too many candidates failed to adapt relevant information from reliable secondary sources and reference them correctly. Much of the information collected was irrelevant and did not inform the planning process. Candidates are urged to check their work thoroughly before final submission to ensure that the work is legible.

Limited direction is anticipated from subject staff, during initial discussions of the task. Centres however, must ensure that by including and signing the authentication clause, the work submitted is that of the candidate. It still remains a concern that plans from some Centres had evidence of heavily guided and assisted work which should have been reported using the necessary paperwork provided. It is also important that Centres ensure that attendance sheets are accurately completed to assist in the checking process. Centres are asked to dispatch the G623/01 Plan separately from the G623/02 Test, using the relevant dispatch labels and OCR stationary provided.

The overall performance of the candidates was generally of a similar standard to that of previous examinations. The marks ranged from 4 – 21 out of 25, with the majority scoring from 12 and 15 marks.

The following summarises the major comments regarding the marking point criteria:

Comments on Individual Questions

Question No.

A. Few candidates identified three appropriate safety procedures, stating the hazard, risk and control measure clearly. This proved more difficult than in previous investigations; responses were too superficial and all too often were not relevant to the practical method described. Many candidates chose to monitor growth rates using a haemocytometer but failed to mention the hazard of the electrical supply to the microscope, and the risk of electrocution.

B & C. Candidates often failed to refer to changes in saline concentration and compare two named species of algae. Correct scientific references were rarely included to justify the award of 'C' despite the information given in the insert.

D & E. Responses regarding preliminary work were very Centre-specific. Preliminary work MUST inform or develop the main investigation. In this session, preliminary work was often not clearly related to the task set or main investigation i.e. yeast was used. Candidates who had shown evidence of relevant preliminary work were awarded marking point 'D'.

F & G Where Centres had done preliminary work, usually clear reasons for its purpose were given, but often not in enough detail to earn marking point 'G'. For Centres where preliminary work was done, 85% described why, about 10% in detail.

H & I. The majority of candidates identified two appropriate secondary sources in addition to the OCR Insert (H), but a significant number did not include reference to how these sources assisted in the planning process. The relevance of the sources to help inform or develop the plan must be stated for 'I'. When textbooks are quoted, candidates need to provide title, author(s), publisher and year of publication; "OCR textbook" is not sufficient to count towards the minimum number of two references required to earn 'H'.

J & K The vast majority of candidates earned marking point 'J', mostly through the use of the haemocytometer and microscope. Lack of detail in the main method precluded the award of 'K', e.g. for failing to allow cultures an incubation time.

L & M Candidates earned marking point 'L' for a list of the main items of equipment and materials needed. This was not awarded if major items were omitted such as glassware, measuring equipment, microalgae and salt. 'M' was given less often (frequently due to failure to name both algal species or the omission of a microscope, if a haemocytometer was used.)

N Approximately 50% of candidates earned 'N' for testing at least 5 different saline concentrations and the inclusion of repeats, which were often evident in 'Repeats' columns in a results table.

O & P Many candidates chose saline concentrations outside the range implied by the insert, so failed to earn 'P'. Candidates also suggested too few saline concentrations (often three) and/or a very limited range. Less than 15% of all candidates justified their choice of range, to enable the award of 'O'. Justifications, where offered, were often based on the information from the OCR insert, or alternatively as a result of the candidate's own investigations.

Q & R Misunderstanding between independent, dependent and control variables was still apparent in some Centres. However, the majority of candidates could state at least two control variables although few could state how these would be controlled. Many referred to the equipment items to be used but made no reference to quantitative methods of control, where appropriate to do so. Consequently 'R' was not awarded very often.

S & T. Unlike previous sessions many candidates did not gain marking point 'S' for a table of results. Marks were often lost due to omission of appropriate headings and/or units. Units of concentration were often missing, or more frequently, candidates failed to state a volume in which the cell count was to be taken. Candidates must ensure that tabulated data is presented in a clearly defined box and not as a 'list' and that appropriate units are given in the headers of the table. 'T' where awarded to approximately 50% candidates, was usually for a line graph relating % transmission/absorption or cells per unit volume against saline concentration.

However, too often, this mark was lost for incorrect labelling or lack of relevant units on the axes. Random graphs downloaded from the internet and not directly relevant to the candidate's own investigation, were not credited.

U For those candidates who included the need for repeats in their plan, 'U' was often awarded for a column for 'Mean' in a results table. 'U' was also credited to candidates who had calculated masses of NaCl to be used to make a range of different solutions with a range of molarities.

V This was rarely given. Attempted conclusions were often marred by the omission of evidence (reference to the gradient of graphs) to justify their original prediction.

W & X Two appropriate sources of error were given by a large number of candidates and in many cases, suggestions to improve the accuracy and/or validity of the investigation were also given for marking point 'X'. Whilst the inclusion of repeats helps to improve reliability, it does not address improvements in accuracy or validity. Statements about human error must be specific; 'I could have made a mistake with the measuring' is insufficient for this mark.

Y This was achieved by most, although candidates are advised to complete a thorough check of their work prior to submission to avoid unnecessary misuse of scientific terminology and incorrect spelling of key words.

G623/02 Cells and Molecules – Test

General Comments:

The general standard of candidates' work was broadly similar to that of previous examinations. Marks ranged from 6 to 39 out of a total of 45. Approximately 50% of candidates gained marks between 15 and 24.

Each of the questions and the paper as a whole achieved good differentiation between candidates of varying ability. Questions which targeted the A/B grade boundary were within Q2(d)(iii); Q3(c); Q3(d); Q4(c)(iii), Q5(a); Q5(b)(ii);

There was no evidence of candidates failing to complete the paper due to lack of time. However, the frequency of 'no responses' appeared slightly higher than in previous sessions, particularly for 2d(iii), 4(c)(i) and 4(c)(ii). There was no common misinterpretation of the rubric.

The overall performance still varied between Centres. Centres either had a good range of marks or had many poor scripts.

Comments on Individual Questions:

Question No.

Q1(a) Contrasting features of the light and electron microscopes were, in general, well known, although 'surroundings' and 'maximum magnification' probably least so.

Q1(b) 'Mitochondria' and 'endoplasmic reticulum' were both correctly identified by many candidates. The most common mistake was identifying W as Golgi apparatus. A few candidates had not read the question carefully and identified it as a 'chloroplast'

Q1(c)(i) and (ii) Many candidates interpreted the information in the pie charts given in the stem of the question. A common omission in (i) was any reference to higher rate/more respiration or ATP required. In (ii) many candidates had not taken note of the requirement for TWO pieces of evidence. Most included ER, far fewer made reference to a higher proportion of Golgi or vesicles for the second mark. A significant number of candidates stated 'nucleus', which was not credited or used up the answer space by describing the role of their chosen organelle, instead of providing a second piece of evidence.

Q2(a) The haemocytometer was recognised by the majority of candidates (Coulter counter was the incorrect alternative response).

Q2(b) A surprising low number of candidates offered 12 or 14 as acceptable responses, the value of which was dependent on the version of the rule taught in centres.

Q2(c) Justification of the volume (0.004 mm^3) eluded most candidates, since many struggled to find the value of 0.2mm for the sides of the square.

Q2(d)(i) The reason for dilution (to avoid clumping of cells etc.) was not often appreciated by many candidates. Frequent vague responses included 'easier to count' or 'easier to see'.

Q2(d)(ii) Most candidates successfully calculated the average.

Q2(d)(iii) This calculation defeated all but the most able candidates. Some candidates earned one mark for the first part of the calculation, but then did not multiply by 1000. Too many candidates multiplied 22 by 0.004 instead of dividing.

Q2(e) Generally this question was answered well. It should be noted that using a Coulter Counter does not eliminate human error, just reduces it.

Q3(a) The glycosidic bond was often not known but more able candidates identified Benedict's reagent in (ii) and gave appropriate colours in (iii). However, some confusion still remains with expected colour changes for positive starch and protein tests.

Q3(b) This section was not answered well. Many candidates circled more than two groups (e.g. all the –NH2 and/or –COOH groups).

Q3(c) Hydrogen bonds were fairly well known amongst candidates. However, few gained the second mark, since 'peptide', 'glycosidic' and 'ester' bonds continued to be popular incorrect responses.

Q3(d) More able candidates recognised the α-helix but a lesser proportion named hydrogen bonds correctly. Many weaker candidates confused the α-helix with the structure of DNA, and consequently this misconception was not credit worthy. A mark for 'hydrogen bonds' was not awarded when it was clear that the candidate was discussing DNA.

Q4(a) Less than 50% of candidates gave an appropriate suggestion. Many candidates had clearly understood the link between genes and the proteins for which they code.

Q4(b) Most candidates were able to state at least one appropriate clinical symptom for Huntington's disease.

Q4(c)(i) 'DNA' was identified by surprisingly few candidates.

Q4(c)(ii) All three marks were gained by 'better candidates' but the majority appeared to guess (any words beginning with C, A and G, e.g. a gene etc., were given). Correct phonetic spellings were credited.

Q4(c)(iii) Surprisingly, very few candidates were awarded more than two of the four available marks. The valid points most frequently included reference to 'errors in testing', 'selective abortion' and 'quality of life' issues. However, responses were often confused, referring to symptoms in children etc.

Q5 This question targeted the most able candidates and overall proved difficult for the vast majority of candidates. A minority gained one mark in (a) usually for reference to 'identical antibodies'. Many thought the term 'monoclonal antibody' meant molecules that fight disease or identified pregnancy/ovulation.

Few candidates interpreted the diagram and information in the stem of the question to give credit worthy explanations for (b)(i) and b(ii). In (b)(i) candidates were not specific in stating which antibody they were referring to in their response (mobile/ immobilised), and showed confusion between an antibody and an antigen.

It is recognised that this topic is one of the more demanding ones on the specification and Figure 5.1 was provided to give candidates a strong prompt around which they could build their answer. Too often, this was not made use of and candidates were discussing 'enzyme reactions' causing colour changes.

G627, G629, G630, G631, G632, G633, G634 A2 Portfolio Units

General Comments

Assessment by the Centres continues to improve with candidates producing work which is more reflective of the required standard. Please note there is a requirement to assess spelling, punctuation and grammar in the portfolio units, and opportunity to reach A* for the higher ability candidates. Work given full marks therefore should reflect A* work. Congratulations to those Centres whose assessment decisions reflected candidates' work at the appropriate A2 level. Assessment at the top end, however, was still generous in some cases. Centres do need to be reminded that work assessed at mark band 3 must reflect A/A* standards at A2, and portfolio work at A2 must show progression from AS.

All the portfolio units offered by the specification were moderated during this session. These were:

- **G627 Investigating the scientist's work**
- **G629 Synthesising organic chemicals**
- **G630 Materials for a purpose**
- **G631 Electrons in action**
- **G632 The mind and the brain**
- **G633 Ecology and managing the environment**
- **G634 Applications of biotechnology**

Again the samples for moderation were selected electronically and work was generally returned efficiently with appropriate Centre Authentication Certificates. URS forms tended to be accurately completed but it is still important to ensure that each contains detailed comments, Centre and candidate numbers and page references. The use of treasury tags and not plastic wallets is also recommended, it was good to see this year that most work was suitably presented. Annotation of candidates' work in the form e.g. AO1 - 6 (i.e. the assessment criteria reference) is also useful. Good practice continues where staff had supplied relevant task and assignment sheets and had fully annotated the candidates' work. Clerical errors where the marks sent to OCR were not the same as the marks on the URS were quite minimal.

Internal moderation although not mandatory is highly recommended where more than one member of staff has assessed candidates' work. Centres are advised to refer to Appendix A Page 93 of the specifications for the performance descriptions for A2 work and review the level of their assessment decisions.

Candidates need to be reminded that work for A2 needs to demonstrate the appropriate use of scientific terminology, correct spelling, punctuation and grammar in scientific reports. Risk assessments need to be written and used by candidates and be suitably detailed and focused on the specific experimental work. The inclusion of COSHH guidelines and pages of useful but not necessarily relevant information does not automatically reflect higher mark bands.

A grade work needs to be detailed and accurate. All researched information should be suitably selected and referenced. Work given full marks at mark band 3, should be free of any minor errors, supported by high level scientific content and be suitably presented. Candidates aiming for such high grades should be producing work which reflects independent thought and high

level scientific understanding. This was not evident in some work given high mark band 3 marks, although, some excellent high level was produced. Well done to those candidates.

There still continues to be a problem with some Centres when awarding the top mark at mark band 2. Work may cover the requirements of the criteria but the standard is not adequate. Please ensure that candidates are aware that both the assessment criteria and the content of the specification need to be used and adequately covered.

To support centres with the assessment of their portfolio work OCR offers a free coursework consultancy service to support portfolio assessment; details are available from the OCR website. Advice will always be given on the suitability of the practical work which centres may wish to offer.

Accredited Centres need to ensure that the necessary Centre Authentication form is sent to OCR for each session that they are entering candidates. If there is a change in the staff named for the accreditation OCR must be informed. It should also be noted that Centres need to be accredited separately for the AS and A2 qualification and that if accreditation is lost at A2 it is also lost at AS.

Please note that the date for the final series in which units and certification will be available for GCE Applied Science is June 2018. This means that candidates can start a 2-year course in September 2016. For further information please refer to the OCR website/Applied Science Information for centres.

Comments on specific units

The guidance given in this report again emphasises the need of Centres to refer candidates to both the requirements of the specification and the assessment criteria when they are studying these units. In addition where staff are writing assignment sheets they need to ensure that the candidates are suitably guided to ensure they cover all the requirements of the assessment criteria.

G627 Investigating the Scientists' work

Unit G627 is mandatory for candidates completing the A level qualification. This unit should show progression from the work studied in the AS unit and should include evidence to demonstrate both research skills and practical ability. Centres need to suitably prepare their candidates during their AS course to ensure that practical skills from G620 or G621 for the single award or G624, G625, G626 for the double award are built on for this unit. Wherever possible candidates need to independently develop their work and not just follow a number of provided practical set tasks. Generally work was much better this year and candidates are showing a better progression and standard in both their experimental and planning skills. There are still some Centres that are being too prescriptive and candidates are therefore not showing their ability to independently plan and investigate.

The assessment requirements for the specification include

AO1 a detailed and workable plan for one scientific vocational investigation, to include the aims and objectives, full details of experimental work with constraints under which the work will take place, and documented evidence of appropriate research.

AO2 evidence showing the tracking and understanding of the outcomes of the investigation with evidence that data collected has been processed and interpreted.

AO3 evidence to show the investigation was implemented safely and an evaluative scientific report on the outcomes has been produced.

AO1

Please note that the research and experimental investigative work needs to be focused around a detailed and workable plan as indicated by the criteria for AO1. This was much better but more specific detail and not just repetition or generic statements must be included when planning which will support both mark band 2 and mark band 3. A diary of what was done each lesson can support monitoring but does not suitably demonstrate planning. Detail and scientific reasoning is needed for the higher mark bands. Pages of repetition or statements: 'method worked well' / 'no changes needed' /' I worked to my plan' are not sufficient to support any marks above mark band 1. Candidates need to clearly state the aim for their overall investigation so the reader is clear on what the candidate is trying to achieve. In several scripts it was difficult to find the main aim, especially where candidates had completed preliminary work. Preliminary work is useful but it needs to be suitably presented and not mixed in with plans, risk assessments and final results.

Organizational skills by the candidate are key to a good investigation. Work which was just a number of set practicals that all candidates followed, which were set out by the teacher each lesson is not demonstrating the necessary investigative work and understanding needed for this unit. If candidates need to be guided in this way they need to be assessed accordingly at the lower end. Candidates should be making decisions about which routes to take and using their knowledge and skills to achieve their outcomes. Topics seen now tend to cover the same areas e.g. preparative work mainly of organic compounds, quantitative analysis, qualitative analytical techniques, vitamin C /food and drinks and colour testing, investigations into bleaches/food/tablets using both biological and chemical methods, materials their use and properties, catalysis effects and uses (both biological and chemical) and a range of forensic and health related investigations. Evidence of repetition of the same practical work does not allow candidates to reach the higher mark bands. If candidates are carrying out surveys for use as supportive data for their practical work that is fine, but it is necessary for a wide range of experimental techniques and procedures to be completed for the higher marks to be supported. Surveys alone and collecting data from others e.g. completing memory tests or exercising etc. is not sufficient to demonstrate fully the range of investigative skills required by the candidates carrying out the investigation. Using knowledge from other A2 units studied is of course acceptable but the practical work required for this unit needs to be investigative and not repetition of practical work that has already been completed.

AO2

Some centres are still awarding higher mark bands for AO2a where candidates were just including basic generic statements about what was done and the state of the equipment used. Basic statements are satisfactory for mark band 1 but modifications with scientifically supported reasons are needed for mark band 2 and much more detailed and higher level explanation with reasoned strategies are needed for the higher mark bands. Some improvement in both candidate work and Centre assessment decisions have been seen.

For AO2b candidates need to show understanding of the outcomes of the investigation. This section needs to be completed at the end of the work and should be summarising all parts. Brief summaries at the end of each practical are only reflective of mark band 1. For the higher mark bands a discussion of the reliability needs to contain suitable scientifically supported arguments. This is high level discussion and needs to be reflective of A grade explanations. When candidates are deciding on topics for their investigations, consideration needs to be discussed about the data to be collected and the opportunity of the mathematical skills which can be demonstrated. It may be that a topic may not always offer the opportunity to the candidate to fulfil the higher marks for AO2c, but the candidate can demonstrate their skills through the other criteria. For AO2c just one complex calculation or the repetition of the same skill is insufficient for top marks at mark band 3 even if the correct significant figures are given.

AO3

Overall for AO3 work assessed at mark band 3 needs to demonstrate high level practical skills with work reflecting A/A* work at A2. The report needs to demonstrate the candidate's understanding of the science involved with accurately recorded data which supports the outcomes of the investigation. A range of processing should support the conclusions and this needs to be accurate and outcomes and findings critically analyzed. The level of the evaluation needs to show critical scientific reasoning behind the success or failure of the investigation completed. Evidence of candidates' own organization and thoughts need to be demonstrated in the work where mark band 3 is to be awarded. Preformatted tables of results repeated several times, however, accurate or precise with no description or explanation is not worthy of higher mark bands.

Generally the following guidance still needs to be acted upon:

- vocational links, are included which are fully referenced and validated
- experimental work, includes a range of techniques and different procedures
- health and safety guidance is detailed, clear and focused and clearly presented using a workable risk assessment
- the aims of the investigative work are clearly stated
- there is clear reasoning on how the work completed by the candidate achieved its aims and objectives
- any outcomes and findings are supported by a discussion of the reliability of the work carried out
- work assessed at mark band 3 should be free of any errors, which reflect independent thought supported by high level scientific knowledge and understanding relevant to the investigation completed.

G629 Synthesizing Organic Chemicals

This unit continues to be a popular optional unit, but assessment is still quite generous. Centres need to be careful that they do ensure that candidates check all their work carefully. Work seen from this unit still has many careless mistakes on formula, structure and detail which is overlooked.

The assessment requirements for the specification include:

AO1 a report or leaflet which demonstrates an understanding of organic chemistry by the correct identification and naming of functional groups, the importance of different types of isomerism and different types of reactions. An investigation of therapeutic drugs, their usage and mode of action in the body.

AO2 research on a process used to manufacture an organic compound showing an understanding of factors to be considered by the manufacturer, to include information about costs and benefits of the product ; evidence of appropriate calculations.

AO3 practical work on two organic compounds; detailing preparation and purification methods; (to include some planning); make, record and display observations and measurements; evidence of processing results (to include % yield); suitable conclusions and evaluation included.

AO1

There was a lot of high marks awarded and generous assessment was again seen at this top end. For AO1a & AO1b Centres were still awarding the full 3 marks for this strand when all of the assessment criteria were not fully covered. When there is only one overall mark for a mark band all the requirements need to be fully addressed in order to demonstrate a thorough knowledge and understanding. Candidates also need to ensure that work is suitably selected and referenced. Careless mistakes were evident even when full marks were awarded. Candidates need to work on accuracy of formula and equations. AO1c was generally well covered and some good selective and independent work was seen. Most work seen was mark band 2 as the explanations and evaluated aspect were not fully demonstrated by candidates. A lot of cut and paste information just placed into tables is still being seen, candidates must show use of their research.

AO2

For AO2a and AO2b there is still evidence of direct lifts of work from the Internet. Candidates also need to be aware of what an 'organic' compound is, some research was seen on 'inorganic' examples. In lower level candidate work, evidence for this section was often omitted or very brief.

Centres need to note that even for mark band 1:

For AO2a candidates need to

- produce information on a process used to manufacture an organic compound
- identify most of the factors needed to be considered for a safe AND economic process
- show selection of appropriate sources AND present information clearly and for AO2b
- candidates will find and use information about some of the costs and benefits of the organic compound and its manufacture: individuals; companies; society.

Just the inclusion of the cost of chemicals listed from catalogues is not sufficient even for the lower mark bands. Higher level work for these strands needs interpretation and evaluation as well as detailed coverage of the requirements. For AO2c candidates aiming for the higher mark bands need to show their ability in a range of mathematical skills, just a statement that candidates have worked independently does not automatically mean mark band 3 can be gained. The Centre needs to ensure that candidates have access to more than one set of calculations. Again just the inclusion of simple or a complex calculation linked to preparative work and research, directed by the teacher and covered by all candidates in the same way is not reflective of high level work suitable for A grade candidates. This continues to be over assessed.

AO3

Centres' assessment of AO3a should not automatically give candidates 8 marks if they have just completed the preparative and purification work. Candidates need to ensure that they have completed the full requirements of the criteria. Evidence of planning is needed for mark band 2, with independent planning for mark band 3, as well as a written justification of the reasons for using the techniques. Compounds need to be chosen to allow candidates to demonstrate the variety of techniques which are available in preparation and purification of organic compounds. These can include e.g. refluxing, distilling, extraction, filtering under pressure, and recrystallization. Up to 26 marks can be gained from practical work and hence between 25 to 30 hours should be allocated to AO3 work. Several well-chosen preparations were evident; examples included aspirin (not necessarily recommended if candidates have completed this at AS), ethyl ethanoate, various haloalkanes, ethanol, ethanoic acid, benzoic acid, iodoform (triiodomethane) and paracetamol.

Risk assessments need to be workable documents. They need to be sufficiently detailed but relevant to the experimental procedure but not so many pages that they are unrealistic to use during the practical activity.

For AO3b candidates need to record detailed observations for both the preparations and the purifications as well as weighings of both reactants and products. Processing of results needs to include calculations of both actual and theoretical yields. Independent work should be demonstrated here not structured worksheets with gaps for numerical values. These were still seen. Evaluation needs to be detailed and focused on the techniques used, sources of errors and reaction route. Again even for mark band 2 explanations need to be suitably related to outcomes and supported by suitable scientific knowledge. Evidence for this strand was often very low level.

Some Centres had taken advice given in their previous moderation reports and work was assessed to the correct standard. Again work assessed with full marks should have NO errors and be A* level at A2.

G630 Materials for a purpose

This unit still has a limited entry, and assessment was quite generous especially at the top end. Some excellent posters and practical reports however were sampled.

The assessment requirements for the specifications include:

AO1 Information (poster/leaflet) on structure of a polymer/ metal/ceramic or glass/composite

AO2 one case study where candidates are required to select materials for a stated purpose; calculations to include tensile stress and strain, the Young's modulus and toughness by using graphical methods.

AO3 evidence to show the following 3 sets of experimental work: a. design and use a testing device/plan/results; b. report and results from tests on samples that have been work-hardened, annealed and tempered; c. completion of experimental work on electrical conductivity or specific heat capacity.

AO1

For AO1a candidates still need to work on understanding how the structures related to their physical properties. Cut and paste was still very prominent throughout AO1.

AO2

Again some high level work was seen for the case study with candidates clearly aware of the requirements of the assessment criteria. Bullet points listed were covered, however centres need still to be aware that the step up from mark band 2 to mark band 3 is in the justification, both in the shortlist of possible materials and in the use of the data in why the choice meets the objectives of the decision. Decisions need to be supported by suitable published scientific data. Centres need to take care they do not over assess this strand. There is ample opportunity for candidates to demonstrate mathematical skills in this unit for AO2b. Please note however that candidates need to complete calculations on: tensile stress and strain, the Young modulus and toughness from a given graph of force against extension and cross sectional area of sample, just for mark band 1. Evidence of accuracy and giving answers to the correct number of significant figures is needed for the higher mark bands. In addition candidates need to be demonstrating their own understanding and competence in these mathematical skills.

AO3

There are plenty of opportunities in AO3 for candidates to demonstrate their practical abilities. All candidates need to show evidence of

- safe working on a testing device
- simple testing showing samples have been work-hardened ,annealed, tempered
- completion of either an experiment to measure the electrical conductivity OR the specific heat capacity.

It is advisable that candidates are provided with the assessment criteria for each AO3 strand for the practical work they are covering to ensure that they cover the requirements of each criterion. Just the completion of the practical activity does not in this case automatically allow candidates access to mark band 2. For AO3b a report is required to support evidence of completion of the tests. In addition a full discussion and evaluation relating to whether or not the treatments have produced the expected results. Estimations of uncertainty of results and evaluations compared to data values are needed to support 8-10 marks.

G631 Electrons in action

This unit also has limited entry, and a range of scripts were seen. Some excellent work was produced and Centres where candidates were gaining higher marks should be congratulated on what is a very challenging unit. Well done to these candidates. Candidates however, aiming for top marks at mark band 3 in this A2 unit need to be showing work which reflects independent thought, evidence of a thorough knowledge and understanding of electrochemical theory, high level explanations supported by suitable planning of all the experimental work needed to fully complete the requirements of AO3a,b and c at mark band 3.

The assessment requirements for the current specifications include:

AO1 a report outlining the principles and application of electrochemical changes, to include research into the production of electric currents and metals.

AO2 a comparison of commercial cells; calculations to include the EMF of cells and quantity of charge

AO3 practical investigations into the measurement of EMF of cells and mass of copper formed in copper plating.

AO1

Full coverage of the relevant requirements of the specifications reference 3.12.1; 3.12.2; 3.12.3 (pages 51 – 53) need to be appropriately covered and tracked by the candidates, again this was completed but evidence of their organisational skills and understanding was not always apparent. Good practice was seen where candidates had completed written reports with appropriate side headings and demonstrated use and selection from their research. The higher level candidates should be explaining and giving detail which is in their own words. Even for mark band 2 explanations needs to be clear with the use of correct scientific terminology.

AO2

For AO2a, some good work was seen for this strand. But candidates need to take care that for the higher marks both quality and quantity of research is at the appropriate high level. Candidates need to present their research of commercial cells to show selection and use of their research. A lot of ‘cut and paste’ was evident. For all mark bands candidates need to compare cells for construction and method of producing the electric current, resources used in production, efficiency, safety and environment effect, sustainability and use. A challenging strand. For AO2b

there were again gaps in the coverage. Please check candidates are completing calculations of: Emf of cells; quantity of charge; mass of products and in addition for all mark bands evidence of research and use of data to compare the efficiency of commercial cells. Generous assessment was evident again for this strand.

AO3

For AO3, some of the practical work again was of high quality and reflected the requirements of the specification and the assessment criteria. All candidates need to: show evidence of planning suitable experiments, this again was not always evident. The minimum requirements include investigations of changing a condition on the Emf of a cell AND the mass of copper deposited during electrolysis

Higher mark band work needs to include an explanation of any practical techniques which will improve results. This was often not fully supported by suitable scientific reasoning. Again the work needs to reflect high level A2 work.

G632 Mind and the Brain

This continues to be a popular unit with an increased number of candidates now producing suitable evidence which matches the assessment criteria requirements. Improvement on assessment for AO3 was quite evident this session. Care however needs to be taken that assessment isn't too generous between mark band 1 and mark band 2. Some lower level work was seen that was not always reflective of mark band 2.

The assessment requirements for the specifications now include:

AO1 the production of two sets of fact sheets designed to raise mental health awareness, one set on stress and illness and the second set on research methods employed in the study of the healthy and damaged brain

AO2 an evaluation of the scientific methods and techniques used in the study of mind and brain, together with a consideration of associated ethical issues and evidence of statistical research

AO3 the design and safe execution of a simple experiment to investigate one aspect of cognitive function and an investigative study on memory.

AO1

Fact sheets and leaflets for AO1a are now being produced by most candidates rather than reports. Good practice is shown where evidence is targeted at the appropriate audience and includes suitable illustrations, work is detailed but has selected content and evidence of references are summarised. Where reports were seen it tended to be at the higher mark bands. The key to work which reflects mark band 3 is that it shows detailed but understandable selected research suitably designed to raise mental-health awareness and is well presented for the target audience.

AO2

For both mark band 2 and mark band 3 for AO2a candidates need to show understanding of the methods, used in studying the brain. Again use of researched material is needed and quality, showing selection, rather than quantity is the key to higher marks. Some very lengthy scripts were seen for this work, this shows conscientious and hard work from the candidates but not necessarily mark band 3. Candidates are advised to read carefully the requirements of mark band 3. All the criteria for this strand need to be fully covered showing how methods are used in confirming hypotheses regarding normal brain function and in the diagnosis of brain disease. Work seen was generally mark band 2. Some good discussion work with evaluation for and against methods used in studying the brain, which reflected research and understanding, was

seen for this topic this session. Well done to those candidates and the work the Centres had done to prepare the candidates on this quite challenging topic. Centres need however, to take care when assessing AO2a and AO2b that they do not over assess at the lower end, even for 2 marks (mark band 1) candidates need to show a basic knowledge and show evidence of selection. A lot more research and understanding is needed to support mark band 2 assessment criteria requirements. AO2c does ask for a fact sheet detailing statistical evidence and this was evident on more scripts again this session, but still not all. Assessment continues to be generous for this strand as repetition of one statistical test was automatically awarded mark band 3. Centres are asked to ensure candidates read carefully the requirements for this strand at all levels.

AO3

The detail and range of data required for AO3 showed some improvement this year. But many candidates still need to extend the cohort of their testing if they are aiming for the higher mark bands. 26 marks are available for AO3 and therefore candidates need to spend the appropriate time in their experimental work (25-30 hours). Centres are encouraged to follow the guidance given below:

- Candidates aiming for the higher mark bands need opportunities to extend research for their practical work to ensure a wide range of data can be collected, (10 candidates from the class does not offer suitable statistical evidence for an A2 investigative practical).
- Participants of the investigations need to complete suitable risk assessments with evidence that they have been used.
- AO3c work was often not reflective of high level A2 work, again coverage of all the key statements are needed: recording precisely a detailed data set, display of data accurately in a range of ways and to collect sufficient data to complete simple statistics on their results.
- AO3d needs a basic evaluation just for mark band 1 and the further coverage needs to be supported by suitable scientific reasoning and analogies.

G633 Ecology and Managing the Environment

This also is a popular unit and candidates produce work which reflects their interest and enthusiasm in this topic. Assessment has been generous at both top and bottom ends, so Centres need to ensure that candidates are fully covering the requirements of the assessment criteria to the appropriate standard.

The assessment requirements for the specifications now include:

AO1 a knowledge and understanding of the effects of change on ecosystems and biodiversity, describing ecological succession and researching the effects of agricultural practice, human habitation and greenhouse gas production

AO2 information on scientific moral and ethical reasons for preserving ecosystems and species diversity; descriptions of methods used to manage ecosystems and to preserve species diversity with information on the success of a project managing one ecosystem; calculations on ecological data.

AO3 a planned investigation of an ecosystem; with relevant observations made and recorded; data displayed, interpreted and results related to the occurrence and distribution of the species within the ecosystem.

AO1

The guidance tends to be similar to previous sessions in that AO1a research work assessed at mark band 3 needs to show that the candidates have a thorough knowledge and understanding of the relationship between the organisms, their physical environment and each other in ecological succession demonstrated by independent research from the candidate and should be clearly understood by the reader. Work still consists of a lot of 'cut and paste'. Much of the work was mark band 2 as candidates have completed these requirements but tend not to demonstrate thorough understanding. Some good work, however, was seen this session with candidates demonstrating clear understanding with evidence of use of taught material and not just independent research. AO1b for mark band 3, all the assessment criteria need to be covered at a high level. Presentation needs to be clear and logical and easy to understand, evaluations need also to be at an appropriate high level to reflect A grade A2 work with suitable justification included. All parts of the assessment criteria need to be covered for mark band 3. Good practice was seen where candidates had structured their reports with side headings taken from the assessment criteria: the effect of agricultural practice; human habitation; greenhouse gas production on ecosystems and biodiversity. Some over assessment was seen where 'cut and paste' coverage was completed.

AO2

Work for AO2a was very varied, work was suitably assessed where candidates had discussed scientific, moral and ethical reasons for preserving ecosystems and species diversity and then gone on to work independently on their research. For AO2b some interesting projects were described and data interpreted but candidates need to ensure that they interpret both qualitative and quantitative data relating to the success of the project chosen. Again where candidates had gone on visits or gained their research from environmental and project coordinators work was well understood and described. This practice can be recommended if possible.

AO3

Some very good practical write-ups were evident this session. Well done to those candidates. Work was much more streamlined and focused on the requirements of the assessment criteria. This is good to see and it is hoped that Centres will continue to guide their candidates to include just the relevant evidence to cover the assessment objectives. For AO3a candidates had worked to include explanations of reasons for using a range of techniques and equipment and reasons for repeated measurements, care however, still needs to be taken to ensure that the level of the explanations are at the appropriate A2 level requirement. They need to be supported by the appropriate scientific reasoning and not just generic or basic statements. It is also important that candidates do work to show independent recording of their own results, some very directed work was seen for AO3b from some candidates. Candidates need to show evidence of 'relevant' observations and therefore need to have opportunities to complete this. For AO3c the displaying of data needs to show a range of different ways, kite diagrams are often seen to support data display, but accuracy needs to be maintained for mark band 3 work. Although candidates may have worked in groups to gather their data again independent data recording and displays are needed. The level of interpretation and conclusions were very varied with some candidates showing detailed evidence relating to the occurrence and distribution of the species investigated. It is however, necessary to bring all the separate measurements and data for a final conclusion. Even for mark band 1, data collected needs to be interpreted and related to the occurrence and distribution of species within the ecosystem studied.

G634 Applications of biotechnology

Some excellent high level work was seen this session from candidates, however, care still needs to be taken where full marks are awarded, to ensure that there are no errors and work fully covers the criteria at a sufficiently high level. Work needs to be suitably succinct but showing high level scientific understanding.

The assessment requirements for the specifications now include:

AO1 the production of an information booklet to include information on the science of genetic engineering and the use of recombinant DNA technology in medicine or agriculture.

AO2 description of how successful DNA technology is in food production with suitable conclusions based on evidence found; financial, statistical evidence involving calculations; consideration of the moral and ethical issues and the impact of legislation associated with using genetically modified food plants.

AO3 a practical investigation into enzyme technology (including the production and use of an immobilized enzyme); to include the construction of a bioreactor and the effect of temperature on enzyme activity.

AO1

For AO1 long detailed reports are not required to cover AO1a. Candidates need to be presenting their research as a public information booklet, with work suitably targeted at the correct audience, and focusing on the content stated in the specification. Scientific knowledge needs, where appropriate, to be supported by related diagrams. Assessment tended to be generous where full marks were awarded but several Centres were awarding 3 marks where work was really only reflective of mark band 1.

AO2

For AO2a candidates need to ensure that they describe how successful recombinant DNA is in solving problems associated with food production and even for mark band 1 draw a suitable conclusion on the benefits of the technology. General information of benefits were often seen with work not focused on problems. For AO2b for mark band 3, candidates not only need to show independent competence but also need to be demonstrating a range of mathematical skills linked to this area of study. If there is insufficient data from their experimental work further statistical analysis can be completed on researched data. Over assessment was often seen for this strand. Limited or no statistical analysis was evident. For AO2b a summary of the moral, ethical and environmental issues concerning the use of DNA technology in GM plant production evidence should be seen for mark band 2 as well as explanation of two controls placed on scientists. A fluent explanation is needed for mark band 3 in addition to an evaluation of the controls chosen.

AO3

A good range of practical work for AO3a was seen in portfolios moderated. Most Centres were considering both the specifications and the assessment criteria to ensure that candidates carry out measurements from a constructed bioreactor, using an immobilised enzyme system, on factors affecting their bioreactor. Less work on yeast was encountered. This session there was some over assessment in AO3a as high marks were awarded where evidence of candidates producing a clear plan of action on their own was not evident. Candidates own planning needs to be seen for mark band 3. Contingency work allowing selected repeats with reasons could also support top marks being awarded. AO3c mark band 3 should demonstrate the collection of sufficient data from candidates to enable statistical analysis to be completed. Graph plotting in some instances was quite poor for A2 level work. Accurate plotting and fully labelled axes are needed, even where the lower marks are awarded. For AO3d candidates need to use their findings from the experimental work to produce suitable conclusions and interpretation of results. For mark band 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. The level of the evaluations is showing some improvement and Centres should continue giving guidance and support in teaching candidates the requirements of high level evaluations.

G628 Sampling, Testing and Processing

General Comments

Many total marks, as in previous years, were in the range 30 to 60 (out of 90). The number of candidates who gained scores below 20 and above 60 remains small. Candidates continue to prepare well for questions 1 and 2, which were based on the pre-release material. As noted in previous reports the numerical questions were generally answered competently but there does remain a significant minority of candidates for whom simple arithmetic procedures, for example the use of percentages, proved difficult. The question that involved graph work was answered better than in recent papers.

In past papers one of the weakest areas of candidates' work is in the design of simple experiments and this trend was again seen in this paper. Answers to the question about the viscosity of glycerine solutions was generally sound but in many cases, lacked clear details. The other design question was about the spread of the horse chestnut leaf miner moth from Europe northwards through the United Kingdom. Many candidates performed poorly in answering this question, even though details of this problem had been clearly pointed out in the case study material.

There was less emphasis on instrumental methods in this paper but it remains clear that for some candidates this is still a difficult area, even though the questions posed are very limited in their demand.

The responses to question 3 were often weaker than the case study based questions 1 and 2. A few candidates found it hard to finish in the time allocated or perhaps gave up before the final few questions in this question about sodium carbonate.

The examiners felt that a number of hand-written papers were difficult to read, and that some candidates had not used calculators to answer questions, resulting in inaccurate answers to an otherwise sound calculation.

Comments on Individual Questions:

Q1(a) The word 'temperate' was in the pre-release material but a number of candidates could not describe it in a clear way.

Q1(b)(i) The meaning of the term 'anaerobic' gained credit for nearly all candidates.

Q1(b)(ii) Gas-liquid chromatography or its variants was the accepted answer but this was not always seen.

Q1(b)(iii) This was poorly answered. Many candidates did not read the question clearly enough.

Q1(c)(i) In general this graphical question was well done and many candidates gained both marks.

Q1(c)(ii) Most candidates scored well here. It was important to state whether the factor to be changed had increased or decreased.

Q1(c)(iii) Nearly all candidates mentioned the need for a comparison to be made.

Q1(d)(i) The need for a risk assessment was an easy mark for many candidates.

Q1(d)(ii) The account lacked the volume of water needed and how long to boil the mixture. Most candidates gained marks for both these points.

Q1(d)(iii) Many candidates missed the need for an increased concentration and simply wrote 'more solution(s)'.

Q1(d)(iv) Some candidates wrote that oxygen is removed rather than oxygen is excluded. Few candidates mentioned that carbon dioxide is denser than air. In general knowledge of the use of carbon dioxide in extinguishing fires was weak.

Q1(e)(i) The word concentration was seen as important and candidates who wrote 'quantity', 'amount' or 'volume' did not gain credit.

Q1(e)(ii) Most candidates stated that the next stage was in vivo testing.

Q1(f)(i) This basic calculation gained a mark for nearly all candidates.

Q1(f)(ii) Most candidates gained both marks for reasons that recommended the microwave method.

Q1(g) This longer question carried a maximum of six marks and the marks awarded varied widely. Some candidates concentrated on the moths and neglected to focus on the effects that they cause on horse chestnut trees and the need to study new areas (moving northwards) over a period of time.

Q1(h)(i) Many candidates carried out this calculation correctly and obtained 210(g).

Q1(h)(ii) Although 24(mg) was often seen, a number of candidates gave 16(mg).

Q1(h)(iii) 'The temperature' and 'how long to heat' were the most popular correct responses.

Q1(h)(iv) Most candidates wrote that 93(g) would remain after one week and gained credit.

Q1(h)(v) Questions that require the changing of units seem to cause trouble and very few correct answers were seen in the scripts.

Q1(h)(vi) Questions on previous papers have focussed on the differences in effectiveness between systemic and contact insecticides and it was surprising to see that many candidates struggled to obtain both marks.

Q2(a) This question referred candidates to the pre-release material and provided an easy starter mark about the second case study.

Q2(b)(i) Although many candidates gained both marks, the examiners required that 'straightforward' needed qualification.

Q2(b)(ii) Nearly all candidates correctly wrote that a disadvantage of the OMEGA process was that it had two stages.

Q2(b)(iii) A number of candidates had clearly not researched the merits of vacuum distillation and provided vague answers that gained no credit.

Q2(c)(i) Many candidates could not state that infrared spectroscopy provides information about the covalent bonds present in a molecule.

Q2(c)(ii) A number candidates commented that dish A had a larger surface area. The examiners felt that many other candidates knew this fact but could not express themselves clearly.

Q2(c)(iii) The examiners felt that a precise answer was needed for this question. As a result answers such as 'look in a book' or use the 'internet' were seen as too vague.

Q2(c)(iv) This was a difficult question and only a minority of candidates wrote that the temperature or air movement were important factors to be considered.

Q2(d) This was a straightforward graph question and many candidates correctly wrote 33%.

Q2(e)(i) The dangers likely to be encountered when using glycol were well known.

Q2(e)(ii) Few candidates realised that only a burette or a graduated pipette will be able to read a volume to the accuracy required. Many 'beakers' and 'measuring cylinders' were seen.

Q2(e)(iii) Although many candidates wrote 26.21, the unit was also required and a number of candidates lost this mark as a result.

Q2(e)(iv) The estimate of the density of the 40% was often correct but the explanation was sometimes unconvincing.

Q2(f) It was surprisingly difficult for candidates to score both marks in this question. This was partly due to vague answers such as 'cost' and 'faster' not being qualified.

Q2(g)(i) The dangers of using sodium hydroxide and of possible spitting were well known.

Q2(g)(ii) The common correct answers were 'how much water to use' and its 'temperature'.

Q2(g)(iii) Many candidates stated that they would use a spoon or a spatula, although 'decanting' was also a popular acceptable response.

Q2(g)(iv) The need to clean up and dispose of waste materials were seen as important features to carry out after the experiment, but some candidates gave 'risk assessment' (that should have been carried out at the start).

Q2(h) This proved to be a difficult question. Some candidates mentioned the need to acidify the mixture but fewer wrote that this change of pH needed to be monitored.

Q2 (i) This was the second of the longer questions. Of the choice given, the 'ball-bearing method' was by far the most popular. The range of marks given was very wide with some candidates apparently not having really prepared for this question although simple methods for studying viscosity such as this were mentioned in the pre-release material. Common omissions included not repeating tests and failing to use glycerine solutions of different concentrations, as well as not identifying any weaknesses in their method.

Q2(j) Most candidates correctly stated the problem of the over-production of glycerine.

Q2(k)(i) '(Relative) molecular mass' was provided by an increasing number of candidates when compared with recent similar questions.

Q2(k)(ii) GLC provides different retention times. A number of candidates confused GLC with paper chromatography / TLC and wrote Rf values as their answer.

Q3(a)(i) The answer to this question was to collect glassworts. Some candidates stated that it was sodium carbonate that was being collected.

Q3(a)(ii) There were a number of acceptable answers to this question but a certain amount of qualification was needed to obtain credit. For example, 'drowning' was insufficient in itself.

Q3(a)(iii) The need for representative sampling was well known.

Q3 (b)(i) Most candidate realised that deterioration would occur if the samples were left to the next day before analysis.

Q3(b)(ii) The need to reheat materials to obtain a constant mass remains a mystery to many candidates.

Q3 (b)(iii) Many candidates could not state the meaning of the word 'homogeneous'.

Q3 (b)(iv) Distilled is pure and free from the impurities present in tap water. This was often not stated clearly enough in the candidates' responses.

Q3(b)(v) Very few candidates realised that the extra washing removed any remaining soluble material.

Q3(b)(vi) This was generally quite well done with most candidates gaining one mark for the correct extraction of data.

Q3(c)(i) Most candidates realised why hard hats needed to be worn at the mine.

Q3(c)(ii) The need to avoid contamination was an easy mark for nearly all candidates.

Q3(c)(iii) This was a difficult question and very few candidates mentioned that the sample would give realistically meaningful gravimetric results or that there was enough material for several tests.

Q3(c)(iv) Most candidates mentioned a missing feature from the sample label.

Q3(c)(v) This percentage calculation gained a mark for most candidates.

Q3(c)(vi) This was a difficult final question and it was unusual to award the first mark for 0.91 or 1.27 and only a very few obtained both marks.

G635 Working Waves

General Comments:

Candidates again lost marks by not reading questions properly, although this was perhaps not quite as common as in recent years. For example in question 7(f)(iii), answers involving reducing the hazards or explaining to patients that hazards were not very great did not answer the question which asked for a justification "despite the hazards".

Comments on Individual Questions:

Question No. 1

Q1(a) Many correct answers. Some incorrect ones omitted "per sec" or referred only to pitch. Others thought it was a measure of loudness or the periodic time. Some mentioned the sound heard

Q1(b) Many presented the correct equation and substitution, but very few successfully used the right number of significant figures. Many answered to 2 or 3 significant figures, not realising that 4 was appropriate because the information given was to 4 significant figures. Others attempted to answer to 4 significant figure but failed to round up the last figure.

Q1(c) Few achieved all three marks. A number described oscillating longitudinal movement but ignored the instruction to describe one cycle, therefore very few mentioned the return to resting state position.

Some answers missed the point of the question. Of these, some described nodes and antinodes, some attempted to define displacement, some referred to energy.

Q1(d)(i) Many fully correct answers. Some scored only one of the two marks because they failed to use the term pitch, or to correctly state which was higher. Some did not score at all, describing a difference in loudness.

Q1(d)(ii) "Half" and "quarter" were not accepted on their own. Some answered by giving values of the two frequencies or multiples or fractions of them. Although the question clearly asked candidates how much lead or lag there was, some simply stated "leads" or "lags".

Question No. 2

This question was successful in achieving a wide spread of marks. The first two parts were the simplest and tended to have more correct answers, otherwise there were no perceptible trends. Some candidates' understanding of the electromagnetic spectrum appeared to be the wrong way round.

Question No. 3

Q3(a)(i)&(ii)Well answered as in previous years.

Q3(b)(i)&(ii)This was also well answered, and responses have improved in recent years. Among the incorrect answers, some only gave one of the two words, some put temperature instead of thermal. Although slight mis-spellings were condoned this was not possible if an incorrect word such as "specific" for "spatial" was used.

Q3(c) Most students identified it needed to be closer but very few were able to explain why. Simply stating that there were half the number of pixels was not enough as the fact

that the sensors were the same size is also important. 8.0m was a common wrong answer (multiply instead of dividing by 2) as was 1.0m (obtained by mis-applying the inverse square rule). "Twice as close" was an inelegant but understandable answer. "Closer" was seen on a number of scripts and did not answer the question "how close?"

Q3(d) Many candidates who correctly distinguished between spatial and thermal resolution in part (b) were unable to apply that knowledge and gave answers relating to the spatial proximity of the objects. Hardly any mentioned resolution or pixel density (px/cm). "Engineering" examples such as leaking pipes had clearly been learned but candidates generally failed to suggest measurement of small temperature differences, in fact high temperatures were often suggested. Comments about the needs of the rescue team often referred to the survivors, but not always to their surroundings. Although body temperature was often quoted, few attempted to suggest a thermal resolution value as required by the question. Fewer still gave answers much larger than 100mK. Some may have not understood this unit.

Question No. 4

Q4(a) Many identified the risks such as electrocution, but some simply identified the materials involved or that glass is waterproof, without identifying the hazards, or alternatively, the advantage of electrical isolation.

Q4(b)(i) This question was generally well answered. The most common reason for failing to score the "coherent" mark was stating that the bundles are ordered, but omitting to extend the definition of coherent to ‘throughout’ or ‘at both ends’ that this order is maintained from end to end. Some answers failed to score because they described the signal carried and not the fibres.

Q4(b)(ii) Many gave correct answers. Both alternative reasons ("cost" and "order does not matter for illumination") were common seen. Incorrect reasons included electrical safety. A minority thought that coherent fibres were needed.

Q4(c) This section tested for a high level of understanding of fibre optics. Many did not demonstrate this, and thought that the model was accurate. At best, these candidates recognised that a sudden change in refractive index occurred in both the model and the fibres. Only the best candidates clearly stated that the model was incorrect and identified that the refractive indices were the wrong way round in the model, quite a few discussed overall structure of an optical fibre, e.g. 2 layers of glass and 1 buffer layer. Others talked about TIR occurring in both the model and the fibre. Some answers referred to the sizes of the steps in RI rather than which was larger.

Q4(d)&(e) These Sections tested a good understanding of total internal reflection.

In (d)(i) and (e)(i) TIR does not take place, whatever the angle, because light is travelling from an optically less dense medium to an optically more dense one. The majority of answers to these sections were in terms of the angles of the rays and therefore could not score.

In (d)(ii) and (e)(ii) candidates were expected to identify that the angles of incidence are less than the critical angle and greater than the critical angle, respectively. Some answered correctly, but some incorrect answers either failed to correctly identify the angles, stated the relationship the wrong way round or that they were equal. Others referred to 90° (presumably the angle of emergence of a ray incident at the critical angle). A minority of answers to these sections resembled the answers expected for parts (d)(i) and (e)(i). A number of candidates called the incident angle the refracted angle.

Q4(f)(i) "Optical density" and "speed of light" were acceptable alternatives to "Refractive index" for the first mark. "Total internal reflection", "Core" (not a property) and "density" were among the incorrect answers. "Density" was accepted when awarding later marks for the description. More marks were scored for describing the radial and gradual variation in the refractive index than in relating the variation in shades of grey in the diagram to the magnitude of the refractive index.

Q4(f)(ii) Most candidates gained two marks by correctly drawing a curved path, but few diagrams showed the initial refraction. Some even showed a path deviating in the wrong direction and many drew multiple curves from the single incoming ray. Many candidates drew zig- zagging show the initial deviation.

Q4(f)(iii) Answers included the full range of valid points. There was a high correlation between the clarity and logic with which the answers were set out and the number of valid points identified. A number of candidates' answers focussed on the construction of the fibres or their information carrying capacities. Some described monomode fibres. Few candidates explained the problem with step index fibres as a result of different path lengths.

Question No. 5

Q5(a)(i) Generally well answered but "rural" was seen from time to time.

Q5(a)(ii) "Obstructions" or examples thereof was the most common correct answer. Many candidates failed to score the second mark, because they wrote about a large population rather than a variation in population density.

Q5(a)(iii) The hexagonal symmetry tempted a large number of candidates to draw a hexagon joining the six dots surrounding "A". This suggests a cell served by seven base stations. The conventional model of cell structures has 1/3 this area either with one base station in the centre of each cell, or more correctly with base stations at 3 alternate cell corners. However, the examiners recognised that, in reality mobile phones may link to base stations beyond those closest, (for reasons of channel availability and signal strength) and that the distribution of cells is far more random than the hexagonal model. Credit was therefore allowed on this occasion for larger hexagons.

Q5(a)(iv) Candidates were asked to apply their knowledge that adjacent cells have different frequencies and non-adjacent cells (such as A and C) may have the same frequency. Only a minority were able to do this. A number thought that all three have to use different frequencies. Some misunderstood the question and attempted to suggest radio frequency values.

Q5(b) Many scored at least one mark by quoting the letters of systems such as TDMA or their names in full, but few used the term multiplexing or demonstrated and understanding that this allows the sharing of frequencies by users at the same location. Many answers described the sharing of frequencies by users in different cells.

Question No. 6

Q6(a)(i) Many correct answers. Minor misspellings such as "frequency" and "modulation" were condoned but incorrect attempts included moderator, modification, module and multitude.

Q6(a)(ii) A majority of candidates had some idea of the meanings of these two terms but only a minority scored all three marks. Many stated that digital is binary, for which they were allowed one of the two "digital" marks on this occasion.

Q6(a)(iii) Most were able to name Amplitude Modulation, (or at least AM which was an acceptable answer). Many marks were lost by candidates who described the variation or otherwise of amplitude and frequency of AM but not FM, or who stated which property varied, but not that the other was fixed. A number drew diagrams which scored marks and in some cases gave full answers by both text and diagrams.

Q6(b) Few candidates noted that the available bandwidth is limited, but scored the mark for faster data transfer. The question asks why compression is needed for radio applications, so answers about storing more data, but omitting to mention the rate of transfer did not score.

Q6(c) Few candidates scored both marks and those who scored one, did so by mentioning frequency. The other four options in the marking scheme were rarely seen. Some candidates simply explained what sampling rate means rather than giving the factors affecting it.

Question No. 7

Q7(a) A majority of candidates put a single letter down for each question.

Q7(a)(i) Many correctly answered B, and a few scored with C.

Q7(b) Almost all answered correctly. The most common answers were X- and gamma-rays.

Q7(c) Many described harmful effects of ionising radiation, rather than showing an understanding of what the term means.

Q7(d) Many scored a mark for mentioning mutations, but fewer identified the chemical stage.

Q7(e) "Cancer" was the most common answer. "Vomiting" and "hair loss" were also often given.

Q7(f)(i) "Conventional X-rays" was the simplest and commonly given answer. CAT scans, tracer techniques and the gamma camera were also mentioned.

Q7(f)(ii) "Radiotherapy" and "killing cancers" were common correct answers. A large minority of candidates thought that chemotherapy (which does not appear on the specification for this unit) involves ionising radiation.

Q7(f)(iii) Many candidates gave the expected answer, that the benefits outweigh the risk. Others scored by phrasing this idea as preventing death. Answers involving reducing the hazards or explaining to patients that hazards were not very great did not answer the question which asked for a justification "despite the hazards".

Q7(g)(i)&(ii) Many answers suggested reducing dose in ways that would also reduce the effectiveness of the diagnosis or treatment. Many mentioned selective screening but failed to describe how this could be achieved.

Q7(g)(iii) Generally well answered. Lead aprons or screens and leaving the room were among the most common answers. Wearing a monitoring device was also accepted on this occasion although it should be noted that this does not of itself reduce dose.

Q7(h) The full range of available marks was seen for this question. The most common point was the production of a 3D image, the movements of the patient and machine were often correctly described. Misconceptions involved the supposed use of film, and confusion with MRI and with radiotherapy. Others mentioned cost, procedures and dangers of the CT scanner. Some gave reasons why a CAT scan would be used, e.g. produces clearer resolution of soft tissue, involves higher doses of X rays.

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