OCR
Oxford Cambridge and RSA

GCE

Applied Science

Advanced GCE A2 **H575/H775**

Advanced Subsidiary GCE AS **H175/H375**

OCR Report to Centres June 2014

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.**

Assessment this series was more secure than last year with more centres assessing each strand within the accepted tolerances. There was however, still generous assessment, where the higher mark bands were awarded and at the lower end. Centres must ensure that work assessed at mark band 3 is reflective of A/B grade work at AS. Although in most cases work covered the requirements of the criteria, the level of work did not demonstrate higher level scientific knowledge, competent use of research or comprehensive detailed evaluative work. Centres need also to ensure that candidates are covering the criteria even when mark band 1 marks are awarded. There was quite a lot of centres awarding mark band 2 when work was of a low level. Credit should be given to those staff and candidates who are using the assessment criteria appropriately and consequently work is being assessed at the correct level.

The samples for moderation were selected electronically and moderators found that the majority of work was returned efficiently with appropriate Centre Authentication Certificates. There were however 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. Good practice was seen by 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 also quite commonplace this session.

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 and review the level of their assessment decisions. Work at the level of Grade A 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 scientific content which is suitably presented.

Several centres had acted on comments written by moderators and had worked to ensure that the practical skills of their candidates were showing progression from GCSE. Centres still 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. Work at the level of Grade A should be accurate and show understanding of

researched material taken from the Internet. Work also should be suitably referenced and presented. Centres are advised to spend time with candidates teaching research and referencing techniques, and presentation. 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.

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 that they are entering candidates and if there is a change in the staff named for the accreditation OCR is 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.

Comments on specific units

The guidance on the units 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.

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 organisations; one in depth study; work on health & safety laws and regulations

AO2 evidence of impact organisation 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

For AO1a candidates need to include in each survey: the products made or services offered; the type of work that takes place**;** an identification of the science involved and information on health & safety constraints and guidance used in the organisation. Good practice is seen where centres offer a range of research techniques to their candidates. These can include visits, visiting speakers, and the use of leaflets, as well as web based research. Surveys where candidates had gathered their own primary information, tended to be much more focused on the requirements and selective in their presentation. For mark band 3 the material researched needs to be detailed but concise, lengthy 'cut and paste' information from different web sites is not the requirement for the higher mark bands. Centres need to ensure that their choice of organisations is suitable to cover sufficient science.

For AO1b the in-depth study needs to include: explanation of what is produced or details of the service offered; information about the organisation including the number and range of staff employed; further details on the scientific job roles specifically related to the chosen organisation; some explanation and detail of the science involved in the organisation; any further specific detail on research, quality control; details and specific links of health and safety laws and regulations which can also be used as part of AO1c requirements. A range of organisations were studied: zoos, breweries and the health service were still very popular. Engineering firms, airports, bakeries, dental surgeries, water authorities as well as large chemical industrial and pharmaceutical organisations. Again it was good to see photographs of visits and 'science in action', however, although research may have been carried out in a group during a visit, all candidates need to write their own individual report. Centres need to prepare candidates on what they need to find out before their visit to ensure they gather sufficient information to cover both the requirements of the criteria and the specification. It is also a good idea to have a backup for any candidates who may be absent from a visit. 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 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.

For AO1c candidates need to be showing their knowledge and understanding of relevant health and safety laws linked to the organisations by stating the names and how they are used. Some good work is now being seen by candidates with suitable links showing specific use for the various organisations. For lower level candidates the use of an additional task where a report is completed on a range of health and safety laws and regulations stated in the specification will help them cover the requirements for mark band 1 and 2. Just linking a particular law to an organisation does not automatically support mark band 3. How the organisations comply with relevant legislations is required as well as a comprehensive knowledge of laws and regulations and why they are needed.

The report for AO2a can be linked to the in depth study or to a different organisation, which ever the centres choose 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 organisation. Assessment for this strand this session tended to be generous at the top end where full coverage of all the specification requirements was not fully detailed. Mark band 3 requirements state 'a comprehensive and thoroughly researched study of the impact of one organisation on society focusing on all issues'. This was not demonstrated by many reports seen.

For AO2b the assessment guidance states a number of complex and straightforward calculations should be completed. Reference 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 fulfil 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 titration calculation of molarity is insufficient evidence for mark band 3.

The AO3 practical work offered this session did seem on the whole to encourage progression from GCSE. Simple chromatography experiments were not as widespread and more centres were assessing AO3a more realistically. The range of work covered 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. Candidates need to carry out two practical activities which can be chosen by the centre but they need to show vocational links. Centres are not advised to include several experiments and expect moderators to choose the best. The practical work chosen does not necessarily need to link to the organisations 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. Risk assessments need to be suitably focused on the specific hazards and risks of the experimental work carried out by the candidates and should be used as working documents. A lot of generic and unnecessary information on unrelated hazards and risks is still being seen. It is advisable that candidates learn different skills in this unit and it is therefore not advisable to do practical's demonstrating the same techniques.

For AO3b recording needs to be thoroughly checked by candidates to ensure accuracy, units and correct significant figures. Quite a lot of overly-generous 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 and units were missing and observations were far from being detailed. Candidates need to be much more careful in their recording.

In AO3c processing skills in graphs and calculations were evident but much more accuracy is needed for the higher mark bands. Graphs were often poorly drawn with in appropriate 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.

G621 Analysis at Work

This unit is mandatory and candidates need to be demonstrating their research skills in ensuring they select and understand suitable material for an energy policy of a chosen organisation. Practical work needs to show organisational skills and an understanding of the analysis requirements set by the specification. Overall, assessment tended to be more generous for this unit than for G620: centres were awarding mark band 3 for work which was not reflective of A/B level at AS. Care needs to be taken that candidates are selective in their research, clearly focus on the assessment needs, and for practical work accuracy and the inclusion of the appropriate advanced science knowledge is needed to support the higher practical assessment .

The assessment requirement for the specification include:

AO1 information showing an energy policy and energy usage of an organisation 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 a wide range of energy policies was seen and although there is no guidance to how the candidates research this work, centres need to be aware that where candidates are almost left to their own devices, work tends not to be structured; candidates often included environmental policies rather than focusing on the energy policy of the organisation. Centres are advised to review the web sites that candidates are accessing, to ensure that energy policy information is easily accessible. 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. Candidates need to use their research to extract the relevant information and then compose their report. It is not up to the assessor to find references to AO1a, AO1b and AO1c somewhere in 10 pages of a report. Mark band 3 work needs 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 organisation limit their energy consumption. It was also noticeable this session that all candidates were not stating what is meant by energy efficiency and hence work was not reflective of the assessment criteria.

Work for AO2a however was noticeably better this series with more candidates describing and comparing large scale and small electrical generation from two chosen sources. The work was much more selected and relevant. 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. Some comparison tables seen were very brief and clearly directed by the centre, this does not fully meet the requirements for work reflective of mark band 3. Even for mark band 2 candidates should be describing and comparing and demonstrating good research skills and evidence of selection. There was quite a lot of overly-generous assessment for this strand at the top end.

Evidence of energy values and fuel/energy costs was better but higher level candidates need to be showing independent research and not just rewriting 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.

AO3 again is where centres are still giving candidates full marks where work is not at all reflective of A grade standard AS practical work. Not only does the practical chosen need to show clear progression from GCSE but all recorded work needs to accurate and supported by the appropriate scientific reasoning. Any evaluations also need to be of a suitable high level. This was not the case in many reports moderated. The following guidance is again emphasised.

- 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 standard work.

Centres are not really advised to just let candidates photocopy practicals from G620 and use again with G621. Although this is allowed, 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

G624 assessment was not as good as in previous sessions. Work seen seemed to be a lot of cut and paste and not accurate. Understanding was not clearly demonstrated in many of the candidates' samples moderated and although candidates were preparing both an inorganic and organic compound observations were very brief as was the analysis of the compound produced.

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 of 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 synthesised, purified and analysed.

It is important that candidates chose suitable organic and inorganic compounds, candidates' work was seen where no organic compounds were studied and elements rather than compounds were researched. Commonly chosen compounds included for inorganic compounds: sulfuric, hydrochloric acids, sodium hydroxide, sodium chloride, copper sulphate, ammonia and ammonium salts, carbon dioxide and sodium carbonate. For organic a range of alkenes, alcohols, aldehydes (alkanals) and ketones (alkanones) haloalkanes, esters and carboxylic acids as well a number of polymers. These do allow candidates to cover the requirements of AO1a and AO1b. For AO1c 11 marks are available and therefore candidates need to be producing a detailed account of two chosen compounds one of which is made from oil. It is advisable to choose two different compounds from those used in AO1. More time needs to be allocated to this section to ensure the research is suitably used to produce a detailed account. Work for this strand was often very 'cut and paste' or did not show the depth of knowledge and understanding needed. Good practice was seen where candidates had clearly used the assessment criteria and had suitably structured their reports under the bullet points listed in the assessment criteria. Again 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, rather than excessive cut and paste material taken from the internet. This strand was disappointing in several portfolios moderated.

Assessment for AO2a was generous as many centres just awarded 3 marks where candidates had only completed yield calculations using data from candidates' preparations. This needs to be supported by calculations of costs in chemical production. Mark band 3 candidates should be demonstrating independent skills in calculating and work should not be directed by the centre.

For AO2b manufacture of ammonia and ethanol were the most common industrial processes researched and described this session. For AO2b candidates need to not only fully address the requirements of the assessment criteria but ensure that for the higher mark bands their account demonstrates accurate selection of researched material and work shows understanding of the chemical principles involved. Additionally for mark band 3 the report needs to include at a high level a discussion of the social economic and environmental impact of the product chosen this was not sufficiently detailed. 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.

Centres are continuing to generously assess AO3a. In addition to candidates completing the practical work, reports need to give evidence of suitable selected research and a detailed and accurate risk assessment. Candidates need to be aware of the requirements at the different mark bands: research and preparation for mark band 1; research, preparation and analysis for mark band 2; research preparation, purification and analysis and risk assessment for mark band 3. Evidence of this was not clear. Good practice is seen where candidates' research and reference each section for both compounds prepared. Recrystallisation is needed as 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. 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. 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 by their candidates.

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.

For AO1a research work needs to show selected information of a range of techniques explaining the need to record and preserve a crime scene. This can be incorporated with AO1b but where this occurs candidates need to check that work is suitably detailed and explained. AO1b needs to show suitably selected work to cover chemical, biological and physical techniques. Spelling, punctuation and grammar need to be assessed within the requirements of AO1b.

For AO1c mark band 3, candidates' work needs to include the need for an ethical code, as well as a range of relevant information on ethical issues in forensic work. Centres need to work on ensuring a range of information of ethical issues are discussed. This is an area where assessment tended to be generous, just a mention of the need for an ethical code does not automatically mean a candidate reaches mark band 3. AO2a case study work seems much better than in the past. Good practice was seen where reports were well structured and covered information listed in the criteria on both evidence and proof.

For AO2b centres continue to struggle on a range of calculations; standard calculations can include a range of Rf values for mark band 1, refractive index calculations and bullet projectiles for mark band 2 and 3. Candidates however need to show the ability to complete calculations independently. A great deal of directed work is still seen.

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 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 moderated this session from this unit was not of the usual standard for this unit.

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.

Leaflets for AO1a seen which were not clearly focused on the requirements on the specification, but were just composed of 'cut and paste' material. Centres were over assessing and awarding mark band 3 when work was not reflective of a detailed knowledge of understanding the facts and principles. The following guidance needs to be emphasised again:

- For AO1 guidance leaflets and not reports are required. Centres are directed to the information on page 106 of the assessment criteria regarding the target audience for these leaflets.
- Candidates should be suitably selecting material for their leaflets and using the specification ref: page 33 for the content.
- Mark band 3 work needs to show detailed knowledge written where appropriate in candidates' 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, but for the higher mark bands the set of slides should be supported by explanatory notes. Some very interesting information was seen on balls, racquets, golf clubs, surf boards and cricket bats. Candidates however do need to ensure that they focus on the reasons for the choice of materials. A lot of research was seen on the history of the equipment and less 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. Candidates who have only completed one practical exercise cannot gain more than half marks. More information than just a method is required, candidates should be choosing e.g. balls/temperatures/ other 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 samples of 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

The candidates generally coped well with this paper. Very few were unable to complete the paper in the time allocated and it was relatively unusual for candidates to leave parts of questions unanswered. It was clear that the candidates had been well-prepared for the question paper and most were not challenged by the rubric of the paper. One exception related to the requirement to add X symbols to a spirometer trace in order to complete a calculation. Some candidates worked through the calculation correctly but failed to add the symbols to the trace. This was unfortunate.

With regards to the free-response items, allocated 6 marks each, most candidates wrote in an acceptable manner. Their responses were generally logically presented and few candidates required the additional sheet to complete such questions.

Some candidates were challenged by a hazard, risk and precaution question. It is unfortunate that some candidates mixed risks with hazards. This confusion with reference to key words or scientific terminology was not apparent in other items within the paper.

Comments on Individual Questions

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

1(b)(i) Most candidates correctly identified ATP but some referred to glucose.

1(b)(ii) Many candidates were able to describe the series of events from the right atrium to right ventricle contraction. Some were able to identify the role of the AVN and associated fibres.

1(b)(iii) This item was well-answered.

1(c) (i) Most candidates correctly identified the ECG apparatus.

1(c)(ii) Many candidates were challenged by this item and struggled to express the different features of the trace.

1(c)(i) Although most candidates realised that the heart beat rate was faster than normal, not many included a reference to the normal rate.

1(d)(i) Some were unable to identify the correct units, with particular reference to the 85 value, but did recall the correct units of measurement.

1(d)(ii) Relatively few candidates were able to express the feature of the artificial pacemaker in terms of no response to adrenaline.

2(a) Most were able to identify the plasma region in the image provided.

2(b)(i) Few correctly identified the increased need for energy/ATP for the muscle cells.

2(b)(ii) The vast majority of candidates responded well to this item.

2(b)(iii) For those who obtained marks for this item, their responses focussed mostly on the shift to anaerobic respiration and the generation of lactic acid.

2(c)(i) Some candidates unfortunately referred to processes rather than structural features shown in the image. Many identified the thin capillary wall but some were confused with the presence of the red blood cell in the capillary.

2(c)(ii) Some marks were obtained for oxygen uptake at the lungs via diffusion but few obtained marks for the uptake and transport of glucose.

2(d) Narrowing of 'airways' was a common response but did not give the detail required for this item.

2(e) Many were able to identify a number of the steps involved but some candidates were unsure of the taking the highest reading from three values obtained.

3(a) Most identified the closing of the air gap and the avoidance of reflection. This item was generally well-answered.

3(b)(i) It was unfortunate that so many candidates referred to the typical feature of the two techniques such as use of radiation etc. without referring to the images. This item was based solely on image characteristics.

3(b)(ii) Some marks were obtained by many for the sound waves passing through the body and bouncing off objects back to the probe or sensor. Other features of this procedure were poorly understood.

3(c)(i) The opportunity to treat the baby in the womb or soon after birth was recognised by many candidates but the impact on the mother was not fully appreciated.

3(c)(ii) Most responses included a reference to termination of the pregnancy but other aspects were generally not considered.

3(d)(i) Many were able to obtain a number of marks, related mostly to needles and the following risks and precautions. No clear pattern of alternative responses could be identified.

3(d)(ii) The use of one of the samples for comparison was understood by a number of candidates.

3(e) (i) Many responded well to this item and recognised the 24 or 28 week stages.

3(e)(ii) The link between haemoglobin and oxygen transport was well-understood but the impact of this on reduced energy levels at the muscles was not appreciated.

4(a) It was unfortunate that some candidates referred to bpm for breaths per minute because this is more commonly used as an abbreviation for beats per minute. Some of the values were not correctly recorded but no clear pattern of alternative responses was identified.

4(b) Many candidates did very well with this item and obtained 3 out of the 4 marks available.

4(c) The use of a nose clip was correctly identified by some candidates. This was also the case for the deep breathing movements undertaken.

4(d)(i) Some candidates unfortunately completed the trace with further tidal breathing at rest, rather than the trace required to show vital capacity.

4(d)(ii) Relatively few candidates used the crosses correctly on the trace or did not include them. Many failed to correctly use the graph to obtain the calculated answer.

4(d)(iii) This item was challenging for almost all candidates. There appeared to be a lack of knowledge with regards to the use of the soda lime and the impact of this on the spirometer trace.

5(a)(i) Relatively few candidates obtained marks for this item. Some, however, did correctly identify the reaction involved, leading to a colour change.

5(a)(ii) Most candidates did not appreciate that the red blood cells would mask the colour change.

5(a)(iii) The avoidance of contamination was often referred to by candidates but this response was inappropriate. The removal of reagents not involved in the reaction was not fully understood by many.

5(b) Some candidates confused this item with the false negative feature of the following item. However, many did appreciate the application of medicines when they are not needed and the psychological impact of a false positive result on the patient.

5(c) The spread of AIDS was understood by many candidates.

G623/01 Cells and Molecules – Planning Exercise

Report on the work of the candidates

Task: 'Plan an investigation to quantitatively compare the concentration of reducing sugars in one variety of white grape, after the grapes have been exposed to a range of low temperatures'.

A limited range of different methods to quantitatively compare the concentration of reducing sugars in one variety of grape juice, after exposure to a range of low temperatures was seen in this task. Many candidates used Benedict's solution and colorimetry but often failed to relate their observations to standard curves or colour standards in order to fulfil the quantitative nature of the investigation. Centres are asked to ensure that candidates read the instruction brief carefully to avoid misinterpretation of the task, i.e. a quantitative comparison of reducing sugar content in juice obtained from one variety of white grape is needed, after the grapes have been exposed to a range of low temperatures. In many centres, candidates failed to use an appropriate range of low temperature values in order to compare reducing sugar content in the grape juice.

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 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 & 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.

Comments on question paper and marking scheme

The overall performance of the candidates was generally of a similar standard to that of previous examinations. The marks ranged from 2 – 22 out of 25, with the majority scoring from 8 and 14 marks.

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

A Less than half of the candidates earned this marking point. Often when the hazard was identified e.g. Benedict's reagent, the subsequent risk (harmful/ irritant) was not stated. Some candidates included chemicals and/or equipment which were then not used in their work, so were irrelevant.

B& C Around 90% gave credit worthy predictions, but then failed to go on to earn C because candidates did not link the increase in reducing sugar content to the juice becoming more concentrated due to freezing of the water in the grapes.

D & E Responses regarding preliminary work were very centre-specific. Some centres had clearly planned and/or performed a wide range of preliminary work, whilst candidates from other centres had not addressed these strands at all. However, weaker candidates still lack clarity about the role or purpose of supporting preliminary work. In many cases, carrying out the Benedict's test or simply 'repeating' the method used later in the investigation were common descriptions and not worthy of D or E. Preliminary work MUST inform or develop the main investigation.

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 30% in detail.

H & I. About half of all candidates earned H, although some had only used 'wiki' references and a small number who gave incomplete references, mostly for books. At least two authenticated references, in addition to the OCR insert, and the relevance of the sources were required to help inform or develop the plan.

J & K The vast majority of candidates earned marking point J, mostly through the use of Benedict's reagent but fewer earned 'K' by failing to obtain quantitative data by use of a colorimeter/ calibration curve or not boiling the Benedict's Reagent.

L & M Candidates earned marking point 'L' for a list of the main items of equipment & materials needed. This was not awarded if major items such as grapes or Benedict's solution (if used) were omitted. Some weaker candidates also planned to use varieties of red grape, which was not part of the brief. 'M' was achieved by some candidates if they had indicated the number and specific size of equipment as well as volumes or concentrations of a reagent to be used.

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

O & P Some candidates chose temperatures outside the range implied by the insert, so failed to earn 'P'. Less than 15% of all candidates justified their choice of range, to enable the award of 'O'. However this criterion was awarded more frequently than in recent examinations.

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 The majority of candidates earned 'S' for a table of results, but the overall quality was poor. Marks were often lost, however, due to omission of appropriate headings and/or units. 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 calibration graph although marks were lost for incorrect labelling or lack of relevant units on the axes.

U Well answered. 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.

V This was rarely given, for either a statement about colour intensity linked to reducing sugar content at different temperatures, or correct statements about absorption/ transmission data from a colorimeter.

W This was awarded infrequently since candidate statements were too vague to be credit worthy. Often ‘human error’ without further clarification or equipment was ‘not precise enough’, ‘mistakes made when measuring’ were common responses.

X This was awarded to about 30% candidates but where attempted, there were often vague statements about more repeats, doing all the tests on the same day, or being more careful. Whilst the inclusion of repeats helps to improve reliability, it does not address improvements in accuracy or validity.

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

Report on the work of the candidates

The general standard of candidates' work was broadly similar to that in previous examinations. Marks ranged from 1 to 36 out of a total of 45. Approximately 50% of candidates gained marks between 11 and 25

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 Q1(c); Q1(d); Q1(g); Q2(a) Q2d; Q3(a);

There was no evidence of candidates failing to complete the paper due to lack of time. There was no common misinterpretation of the rubric. It is pleasing to note that very few 'no responses' to sub-questions were evident on this paper.

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

Comments on question paper and marking scheme

Q1. (a) and (b) These were well answered; Most candidates gained the mark for (a) by referring to greater magnification or resolution. The most credit worthy response for (b) was for using the 'electron beam' marking point.

Q1(c) This was not answered well; too many candidates are still using GCSE terminology of air/oxygen 'particles' rather than reference to obstruction by air 'molecules'/ dust or microbes.

Q1(d) Structures A (Golgi) and B (nucleus) were frequently identified correctly (although some candidates thought A was rough endoplasmic reticulum), but functions were less frequently given. This was especially true for 'nucleus', where candidates often quoted 'controls the cell'; storage of DNA/chromosomes/ genes without further clarification, or even 'the brain of the cell'.

Q1(e) This was well answered; the most frequent chosen reasons being cheapness of the light microscope and the ability to observe living cells and more than one cell within the field of view.

Q1(f) This question was well answered; the vast majority of candidates earning at least 1 mark, and frequently full marks, possibly as a result of carrying out slide preparation practical work. Fixing was rarely mentioned but references to 'staining' and 'exclusion of air bubbles' were normally included.

Q1(g). Many candidates were awarded at least 1 mark for this section although some weaker candidates stated leukaemia as a possible diagnosis, despite the rubric in the question stem. Many gained 1 mark for at least one piece of evidence to support their diagnosis, although candidates from some centres referred to 'cells' rather than comparative changes of the nucleus.

Q2 (a) Few candidates achieved full marks. Most candidates scored marking points for recognising the cells had changed in size and/or shape due to water loss, (a pleasing minority correctly used the term crenated), some added that the process was by osmosis, but very few achieved the higher level marking points of explaining events in water potential terms. Occasional use of inappropriate terminology was seen (e.g. flaccid cells a term applicable to plant cells, not animal cells) as well as 'exploding cells'

Q2(b) Approximately equal numbers named the haemocytometer and the Coulter Counter. The majority also gave an appropriate advantage for their chosen method and so gained both marking points in this section.

Q2(c) As in previous sessions, many candidates found the calculation difficult. Candidates who were awarded 1 mark for correctly subtracting 80 from 150, sometimes failed to earn the second mark by going on to divide by 80 instead of 150. Of those approaching the calculation correctly, a significant number lost the second mark by wrongly 'rounding up' their answer. Most earned at least 1 mark for part (ii) for correctly identifying Patient 3, but then failed to give the complete reason for their choice – identifying a high white cell count as an indication of leukaemia.

Q2(d) This was not answered well, with some apparent confusion between the eye piece graticule and the stage micrometer in evidence.

Q3(a) The vast majority of candidates were awarded at least 1 mark, but then failed to earn the mark for quoting correct rate data, in spite of the rubric instructing them to 'use data'. Instead many candidates tried to explain the graph in terms of enzyme theory, which was not required in this section.

Q3(b) Some very elegant answers were given, which clearly followed through the sequence of events during exposure of enzymes to high temperatures, with some candidate responses hitting more than the three points maximum for this part of the question. However, it is disappointing to note that weaker candidates are still quoting enzymes as being 'killed' rather than denatured!

Q4 Both sections (a) and (b) were the areas of the paper where candidates performed most successfully. The vast majority of candidates earned 3 or more, many 6 or 7, and a few full marks in section (a). However, the accuracy in which candidates spell key words needs to be an area for improvement in future sessions.

Q4(b) This section was well answered. Those candidates who gave 'ethanol also remembered to add 'water' to earn the mark. A few candidates mis-spelt ethanol as ethanal and some candidates 'hedged their bets' when answering the observation if test is positive section by putting 'brown/black' for starch and blue/lilac for protein.

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

General Comments

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**

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.

Assessment this session was more secure than last year with more centres assessing each strand within the accepted tolerances.

The samples for moderation were selected electronically and moderators found that the majority of work was returned efficiently with appropriate Centre Authentication Certificates. There were however 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. Good practice was seen by 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 also quite commonplace this session.

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. Work at the level of Grade A 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 which is suitably presented. Candidates aiming for such high grades should be producing work which reflects independent thought and high level scientific understanding. This was still not evident in much of the work given high mark band 3 marks.

Guidance that A2 work needs to be sufficiently detailed and accurate, and showing appropriate use of scientific terminology, correct spelling, punctuation and grammar which should be reflected in their scientific reports is still appropriate. Risk assessments written and used by candidates need to be suitably detailed and focused on the experiment, and not generic giving basic laboratory safety rules. The inclusion of COSHH guidelines does not automatically reflect mark band 3.

When awarding mark band 2 where there is a range of marks offered work needs to cover all the requirements of the assessment criteria and suitably link with the specification at this higher level. Many centres were being overly generous and automatically awarding the top mark of the mark band, this was a problem with many middle band marked work.

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 and if there is a change in the staff named for the accreditation OCR is 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. It is essential that portfolio work at A2 shows suitable progression from the AS work studied in year one of this course. There is a requirement to assess spelling punctuation and grammar in the portfolio units, and the opportunity to reach A* for the higher ability candidates. Work therefore given full marks should reflect A* work.

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

This unit is mandatory and candidates need to be demonstrating progression from AS, the ability to set up an investigative task and evidence of their own decisions in choice of routes in their practical work. Centres need to suitably prepare their candidates during their AS course to ensure that practical skills from G620 or G621 or G624,G625,G626 if the double award is taken 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.

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.

For AO1a the research and experimental investigative work needs to be focused around a detailed and workable plan as indicated by the criteria (AO1). Several brief generic/ calendar type information sheets were written by candidates. This may be suitable for the lower mark bands but is not sufficient for mark band 3 coverage. Many centres were awarding mark band 2 for candidates when work was only mark band 1. Even for 2 marks candidates need to cover the full requirements listed. A diary of what was done each lesson can support monitoring but does not suitably demonstrate planning. Candidates need to clearly state the aim for their overall

investigation so the reader is clear on what the candidate is trying to achieve. Work was seen which was just a number of set practicals that candidates followed and this did not show their ability to investigate and decide what to do next. They need to 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. Candidates need to ensure that they are providing evidence of investigative practical work and not just following a set of procedures supplied by the teacher. Research and use of questionnaires can be used to support investigative work but evidence of experimental procedures needs to be included.

Assessment was generous for AO2a as centres were awarding higher mark bands where candidates were just including basic generic statements about what was done, the time allocation, school closures 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.

For AO2b candidates need to interpret the outcomes of the investigation and discuss its success, even for mark band 1. 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 level 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.

For AO3, work assessed at mark band 3 needs to demonstrate high level practical skills and scientific knowledge, well recorded data which supports the outcomes of the investigation and with a detailed explanation of why this has been completed. Processing needs to be both accurate and critically analysed. Conclusions and evaluations need to be collated for the complete work rather than given at the end of each experiment. The level of the evaluation needs to show critical scientific reasoning behind the success or failure of the investigation completed.

Generally in the write up for this unit the following guidance still needs to be acted upon: vocational links need to be included which are fully referenced and validated; experimental work needs to include a range of techniques and different procedures; health and safety guidance needs to be detailed, clear and focused. The candidate should give clear reasoning on how the investigation achieved its aims and objectives supported by a discussion of the reliability of the work carried out. Work assessed at mark band 3 should be free of any errors, and needs to reflect independent work with evidence of high level scientific knowledge and understanding relevant to the investigation completed.

G629 Synthesising Organic Chemicals

This unit continues to be a popular optional unit, although candidates are still not checking accuracy of their chemical knowledge and ensuring selection in their research.

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.

Work moderated this session did not seem to reflect higher quality work as it did previously. There was a lot of high marks awarded but generous assessment was seen at this top end.

AO1a was particularly lacking in the explanation of the importance of isomerism with relation to the difference in properties between the isomers. Centres were still awarding the full 3 marks for this strand when all of the assessment criteria was 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. AO1c was generally well covered and good selective and independent work was seen, generally however work seen was mark band 2. For mark band 3 explanations need to show candidate understanding and not cut and paste information.

For AO2a and AO2b there is still too much evidence of direct lifts of work from the internet. Distillation of oil is not suitable, work needs to be a manufacture of an organic compound e.g. ethanol was commonly chosen. Again too many centres were awarding 4 or 5 marks. Candidates were describing the factors needed to be considered but the work was more ‘cut and paste rather than interpreting the information, to answer the question ‘why these factors are needed’. Again even for mark band 1 candidates need to fully research a manufacturing process. Assessment was generous for this strand.

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.

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 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. The preparation of nylon does not really demonstrate candidates’ higher level practical skills and is not recommended. Compounds need to be chosen to allow candidates to demonstrate the variety of techniques which are available in the preparation and purification of organic compounds. These can include refluxing, distilling, extraction, filtering under pressure,

recrystallisation. Up to 26 marks can be gained from practical work and hence between 25 to 30 hours should be allocated to the AO3 work. Several well-chosen preparations were evident. These included aspirin (not necessarily recommended if candidates have completed this at AS), ethyl etanaoate, 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. 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.

G630 Materials for a purpose

This unit still has a limited entry, and assessment was quite generous as candidates are still not showing their understanding of the structures or properties of the different material chosen. The work for the case study however was good in many scripts seen.

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.

In this session it was found that:

For AO1a centres are still giving higher marks for quantity rather than quality, with a lot of the work at mark band 3 not showing candidates understanding of how the structures related to their physical properties. Cut and paste is still very prominent for AO1. Some high level work was seen on a range of case studies from a number of centres. Good practice was seen when candidates were given the opportunities to choose their own purpose for selected materials.

For AO2a it is important that all the bullet points are covered even where mark band 2 is being awarded. 10 marks are available for this strand and candidates need to be showing suitable justification of their shortlists chosen as well as reasons for their final choice. Decisions need to be supported by suitable published scientific data. Please note that even for 7 marks work covering all the bullet points needs to be at a high scientific level. For AO2b, although the level of calculations was good in many candidates' work, not all candidates were covering the stated requirements. Even for mark band 1 for this strand candidates need to complete calculations on tensile stress and strain, the Young modulus and toughness from a graph, etc. Centres need to check this for future submissions. Even when candidates had fully covered the requirements errors were still seen and answers were not always given to the correct number of significant figures. Candidates need to check their work against the requirements of the criteria.

For AO3 practical requirements, some centres need to check the requirements of the assessment criteria to ensure their candidates cover the correct number and type of practical activities. The testing device needs to be designed and test either hardness or an impact (toughness). Reference page 114 Unit G630 Assessment evidence grid. This was not always covered correctly. 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. 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. Just the completion of worksheets does not reflect this. In addition a full discussion and evaluation relating to whether or not the treatments have produced the expected results. For AO3c EITHER electrical conductivity OR specific heat capacity need to be included in the portfolio, several candidates completed both. This is fine but only one is required for assessment. 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. This is a challenging unit and candidates need to show their understanding of what is a difficult topic. Mark band 3 and higher level mark band 2 was often generously assessed, work needs to show that candidates understand their research and this needs to be selective and not repetitious.

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.

Candidates aiming for A grade standard in this A2 unit need to be showing work which reflects independent thought suitable selection and evidence in their reports which demonstrates a thorough knowledge and understanding of electrochemical theory. Candidates were generously assessed where work was just taken from several internet sites but was not sufficiently used by the candidate to demonstrate focused coverage of the requirements of the specification. For AO1a and AO1b 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. 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.

For AO2a, some good work was seen for this strand however candidates should not automatically be gaining 7, 8 marks for just providing more than one example. Again detailed explanations are needed. Comparisons cover construction and method of producing the electric current, resources used in production, efficiency, safety and environment effect, sustainability and use.

For AO2b, there were this series some gaps in the coverage: centres need to 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.

For AO3, some of the practical work seen was of high quality and reflected the requirements of the specification and the assessment criteria, although this series some was seen that actually did not suitably cover the requirements, experimental work finding the EMF should be using two half cells and for the electrolysis of copper sulfate candidates should be changing conditions; this was not always completed. All candidates need to show evidence of planning suitable experiments, this again was not always evident. Higher mark band work needs to include an explanation of any practical techniques which will improve results. Diagrams can be used to support planning and understanding, several hand drawn diagrams were seen which were not reflective of high level recording.

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. Assessment however still remains generous for calculations AO2c and practical work AO3.

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.

Candidates are generally improving their presentation and content of the sets of fact sheets / leaflets for AO1a. 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. The key to work which reflects mark band 3 is that it shows detailed but understandable research suitably designed to raise mental-health awareness. There are still centres where candidates are submitting lengthy reports. This is not the requirement of this strand.

For both mark band 2 and mark band 3 for AO2a candidates need to show understanding of the methods used in studying the brain. Just the inclusion of material lifted directly from a range of web sites is not reflective of mark band 3. Candidates are advised to read carefully the requirements of mark band 3. All the criteria for this strand needs 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, but again not always 5 marks. Assessment of this strand needs to be reviewed by many centres for future assessment decisions.

For AO2b, candidates' work in many cases was only mark band 1, centres are required to spend time with candidates discussing moral and ethical implications of brain research. High level reports reflecting discussions of this topic were rarely seen. For AO2b mark band 3 work, comprehensive discussions are required with evidence of statistical research, with an understanding of the research question. It is advisable again for candidates to carefully consider the requirements of the criteria for this strand. AO2c does ask for a fact sheet detailing statistical evidence and this was evident on more scripts this session. Assessment is often generous for this strand as repetition of one statistical test was automatically awarded mark band 3; again candidates need to carefully refer to the requirements of the assessment criteria.

The problem regarding the detail and range of data required for AO3 continues. 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 is needed and collection of 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

Candidates are continuing to produce work which demonstrates their skills in both research and practical, however, those being assessed with top marks at mark band 3 should be showing independent research skills and a high level of individual evaluation work. There is still some generous assessment by many centres for this unit, as candidates are producing lengthy reports which are not showing high level skills. Work was seen which indicates candidates' continued enthusiasm with this topic.

The assessment requirements for the current 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.

The guidance tends to be similar to previous sessions in that assessment is generous. 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, which is demonstrated by independent research from the candidates. 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. AO1b: again for mark band 3 all the assessment criteria needs 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 needs to be covered for mark band 3. For AO2a mark band 1 candidates need to identify moral and ethical reasons for preserving ecosystems and species diversity, candidates tend to be showing this but they are not explaining the scientific , moral and ethical reasons for preserving ecosystems and species diversity. Good

practice was seen by candidates who had been clearly directed to the requirements and completed reports with suitable content and side headings. 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. Where candidates had gone on visits or gained their research from environmental /project coordinators work was well understood and described.

With AO3, much more organisation of the outcomes of the practical investigative work is still needed. Candidates continue to produce a lot of data from their practical investigations in this unit, but care needs to be taken that overly generous assessment doesn't occur based on quantity rather than quality. They need to be showing their ability to plan an investigative work of an ecosystem. Although field trips are to be encouraged, individual data collection needs also to be supported. Pages of results which haven't been collated were again very common. Although moderators aim to support AO3a, as this is assessing the candidates' practical skills, for the higher mark bands this needs to be supported by explanations of reasons for using range of techniques and equipment and reasons for repeated measurements. This was again not always seen. Explanations to support this strand need to be supported by the appropriate scientific reasoning, not just generic statements. 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, independent data recording and displays are needed. Many conclusions seen were of a low quality and several just repeated results. 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

Many of the centres' work seen indicated that candidates had been well supported in this unit and consequently good quality work was seen. Centres however do need to take care that candidates are correctly covering the requirements for AO3. Centres are asked to consider 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.

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.

General guidance is as follows:

For AO1 many candidates had completed a range of research but some had not focused on the science of genetic engineering or had not presented it as a public information booklet, there was a lot of cut and paste which did not target the required audience. Several long and detailed

reports were seen which although reflected hard work by the candidates, work was not suitably focused to reflect mark band 3. Scientific knowledge needs where appropriate to be supported by related diagrams. Where candidates had combined AO1a and AO1b, work was not always suitably detailed to reflect the higher marks.

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, they need to 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. Overly generous 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:

26 marks are available for AO3 and therefore candidates need to spend the appropriate time in their experimental work (25-30 hours). For AO3a candidates need to be producing a clear plan of action at all levels. This was not always evident in several of the candidates' work moderated. 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. Not all candidates had prepared immobilised enzymes and not all work assessed at high levels had suitably covered the requirements of the assessment criteria and mark band 3. Candidates need to ensure that, in their planning, they are aware of the full practical requirements.

AO3c mark band 3 should demonstrate the collection of sufficient data from candidates, to enable statistical analysis to be completed. Some graphs produced were not reflective of high level marks. 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 need to be reviewed by many centres: higher level work needs to be submitted at mark band 3.

G628 Sampling, Testing and Processing

General Comments

The number of candidates taking this examination was around 750, which was a similar figure to the last three year's summer examinations.

Many marks were in the range 30 to 60 (out 90). This range too, was similar to recent examinations. The number of candidates gaining scores greater than 60 remained low. It was clear from the marking that candidates were well prepared for questions 1 and 2, which were based on the pre-release material. In general numerical questions were answered competently but there remains a significant minority for whom percentages and the use of standard form proves difficult. Some candidates continue to show weaknesses in graphical questions, particularly in the use of gradients.

One of the weaker areas in candidates' responses is in the design of experiments, given a basic outline of what was needed. In this paper the experiment to study the stretching of rubber bands showed a good approach, but some details were lacking. The other experiment was concerned with finding the melting point of lanolin. This question was answered with less success, perhaps because this was not an experiment usually encountered in their laboratory.

As noted in past reports, questions involving chromatography and instrumental methods such as mass spectroscopy and infrared absorption spectroscopy, showed a lack of clear understanding.

The responses to question 3 were often weaker than the responses to questions 1 and 2 (which were based on the pre-release material). In a few cases there was some evidence that the paper was a little long or that some candidates had given up before they reached the end of this final question.

Comments on Individual Questions

Q1 (a)(i) Most candidates were able to state the meaning of quarantine, as related to the article.

(a)(ii) Nearly all candidates gained at least one mark for the disadvantages of using a contact fungicide.

(a)(iii) The important points were avoiding skin contact and inhalation.

(b)(i) Chromatography was the expected answer. Some candidates chose distillation, which was also an acceptable answer.

(b)(ii) Most candidates chose a bar chart or a pie chart.

(b)(iii) Some students did not combine the two percentages to give a figure that was greater than 50%.

(b)(iv) Many candidates did not recall that the technique was infrared spectroscopy.

(c) Most candidates gave the correct answer of 5m but some unrealistic values were also seen.

(d) The use of standard form and significant figures defeated many candidates.

(e)(i) The meaning of the term 'coagulation' was given correctly by most candidates.

(e)(ii) Many candidates struggled to give a reasoned answer to this question about neutralisation.

(f)(i) Most candidates calculated the volume correctly but could then not use their answer in (ii).

(f)(iii) This was the first of the 'design your experiment' questions. In general this was attempted quite well with the chief weakness being the presentation of the results.

(g)(i) Most candidates plotted the points correctly and drew an appropriate straight line in (ii).

(g)(iii) The use of graphs to calculate gradients continued to prove difficult for many candidates.

(g)(iv) Most candidates realised that experiment **D** needed to be repeated.

(h)(i),(ii) and (iii) The choice of an appropriate type of rubber and the reason for the particular choice was generally answered well.

(i) Many candidates did not state that the rubber needed to be unaffected by brake fluid.

(j)(i) Although some candidates did not relate their answer to rubber, many appreciated the need for research into fungal problems.

(j)(ii) Most answers correctly stated that the rapid polymerisation of dandelion latex was a problem that should be investigated.

(j)(iii) This was a more challenging question and proved discriminating, although there were a number of acceptable answers.

Q2 (a)(i) Few candidates suggested a suitable property that was the purpose for collection.

(a)(ii) Some candidates showed a lack of clarity about the meaning of 'homogeneous'.

(a)(iii) Most candidates gained a mark from the choice allowed.

(a)(iv) Very few candidates realised that the extra rinsing was needed to remove **all** the soluble potassium compound from the fleeces.

(b)(i) The description of 'how a centrifuge works' was generally done quite well, with 2 out of 3 being a common mark.

(b)(ii) This was the second of the 'design your experiment' questions. In general it was not answered well. Too many candidates heated the lanolin directly, although the question stated that this approach was inadvisable.

(c)(i) Many candidates could not state how mass spectrometry could confirm the presence of compound **A** in the lanolin.

(c)(ii) A number of unrealistic answers were seen as many candidates could not use standard form in a successful way.

(d)(i) Many candidates gave the correct answer of 160 mg.

(d)(ii) This was a challenging question and many candidates could not use the information to present this in a graphical form.

(e) The answer to this question was 0.00004 m. This answer was seldom seen and many candidates provided unrealistic answers for the diameter of a wool fibre.

(f)(i) Many candidates gained full credit for the three factors needed for the choice of method.

(f)(ii) Both missing pieces of information were provided by most students.

(f)(iii) It was unusual to award all four marks in this graphical question. A number of candidates failed to realise that 4.00 g was equivalent to 100%.

(g)(i) The term 'locating agent' is an important term in chromatography and many candidates gave an unclear explanation of its meaning and purpose.

(g)(ii) Most candidates gave the R_f value as the correct response.

Q3 (a)(i) There were a number of acceptable answers and most candidates chose one of these.

(a)(ii) Many candidates referred correctly to the need for a representative sample or a comparison.

(a)(iii) The necessity of avoiding injury from thorns was the most popular response.

(a)(iv) The need to maintain the same conditions for all samples was generally correct.

(a)(v) Nearly all candidates gained full credit for the correct labelling of samples.

(a)(vi) The need to clean / wash samples was generally realised by the candidates.

(b) This numerical question was challenging and few were able to calculate the correct answer.

(c)(i) This was a straightforward mark for most candidates and in (ii) most candidates were able to give creditworthy answers based on mistakes in the experimental procedure and in the calculation of the answer.

(d)(i) Many candidates correctly referred to the loss of rose oil caused by deterioration of the sample during the day.

(d)(ii) In general candidates commented on the flammability of hexane, that the extraction using carbon dioxide could be carried out at room temperature and that the latter could be recirculated. Most candidates gained at least two of the three marks available. One disadvantage of the carbon dioxide method was the need to use high pressure. Fewer candidates gained this last point.

G635 Working Waves

General Comments

There was evidence of improvement in some of the areas which had proved difficult in previous years. Questions on some parts of the specification which had been tested less often in previous examinations were less well answered.

There were several sections where candidates had lost marks because they had not answered the question set. Although, in some cases, they may not have known the answer expected, in others, more careful reading of the question might have resulted in higher marks.

Comments on Individual Questions

Question No. 1

1(a) A lot of students lacked confidence/knowledge to put down IR twice. This was, however, the most common answer because the incorrect responses were many and varied. About half gave IR as one of the answers, but in combination with one of the other regions of the electromagnetic spectrum. The answer "thermal" was given occasionally, but was not quite what was required and often given in combination with a completely wrong answer. Other incorrect answers included "middle", "bottom", "higher", "lower" (one candidate explained that they were comparing wavelengths) and numbers such as "4-5".

1(b) i to iv Except for the very few who scored all 4 of these marks, there was no apparent pattern to the incorrect answers. Most answered "sponge", "ice cream" or "plate" in a variety of orders, but answers such as "Light", "Radio waves", "X Rays" and "Gamma" were also seen.

1(c) Nearly all candidates scored at least one mark for false colours, or shades of grey, and most achieved the second mark by giving suitable examples. Some just referred to temperature rather than appearance.

1(d) The clearest answers stated that all were the same colour. Some suggested what that colour (or shade of grey) might be and this was given credit as long as it was reasonably clear that the candidate recognised that all components were that colour.

Question No. 2

2(a) A large majority correctly answered 0.5. A small number failed to score because they attempted to answer to a second place of decimals - a precision which was not possible from the scale.

2(b) Fewer than half of the candidates scored any marks. Many candidates did not following the instructions. Some either marked no 'X's, or more than one on each graph. Some did not record their readings from the graph. Other common errors included:

- marking both 'X's at the same distance
- measuring displacement rather than distance
- attempting to use $v=f\lambda$
- not knowing how to find distance travelled along the bar

Very few candidates correctly divided by 0.1 ms

2(c) Almost half answered this correctly. A common incorrect answer was that frequency was not given. Others stated that the wave is "not continuous", "(not) longitudinal", "no peaks or troughs".

2(d) i As well as the sizable minority who answered correctly, a variety of wrong answers were seen. "1.2" was given, as expected, by those who did not recognise that the length of the string is only half a wavelength for the first harmonic. "150", "104.2" and "9.6 x 10^{-3}" were given by a considerable number of candidates who by simply multiplied together or divided, the two numbers given, 125 and 1.2.

2(d) ii "Error carried forward" was allowed from (d) i, so many of those who had made a mistake in subsection i were able to get full marks here. Incorrect answers were often the result of division instead of multiplication.

2(d) iii The majority of candidates missed the fact, given in the first line, that the interval was only a quarter of a cycle. However, a number scored two of the three marks from a correct calculation of the periodic time 8 x 10^{-3} s. Many of those who did recognise that a division by 4 was required divided some other number (e.g. 2.4 - the answer to part i) by 4.

2(d) iv Many candidates scored only one of these two marks, presumably because they did not recognise that the second harmonic is the first overtone. Some of these answered 0.5 or 2 to both sections. Some put 2 then 0.5 (i.e. in the wrong order). Weaker answers included: 0, 3, 4, 5, 10, and words such as "more" and "less".

2(d) v Most candidates scored at least one mark by correctly joining the wire to the triangles (hopefully recognising these as nodes). Many drew the wrong number of peaks and troughs.

Question No. 3

3(a) A lot of candidates did not understand that the question is about calibration. Many incorrect responses did not answer the question, but instead gave a general statement about the usefulness of thermal imaging.

3(b) Some latitude was allowed in the mark scheme in the precision required for the initial statements of the meanings of the terms as this was intended to test at the E/U level and many knew enough about resolutions to gain the first two marks. Fewer could find a sensible application, many not being relevant to the context.

Question No. 4

4(a) Many drew r>>i. Weaker candidates drew ray "A" refracting out of the top, and "B" bending (usually downwards) as soon as it entered the fibre.

4(b) i Most obtained the mark for "core". The other mark was achieved less often, even though a number of options were accepted for the outer layer. Many interesting spellings of "Sheath" (such as "shief") were condoned. Some referred to glass/plastic/rubber.

4(b) ii This was poorly answered. A lot of answers showed a square signal, sometimes inverted, not appreciating the spreading of the waves. Some added noise. Many drew

extended repeating waveforms. Those who added upward tails to each side of the correct diagram were closer to the correct answer.

4(b) iii A number of candidates recognised that degradation or multimode distortion had taken place, but even some of those who had correctly drawn the output signal were unable to explain why. Arrival of signals/rays at different times was recognised by some as the reason. Fewer stated that this was because path lengths differed, writing that there were different paths but not referring to their lengths. Some suggested that the reason the rays arrive at different times is that they travel at different speeds.

4(c) i Some gave good points, but few addressed their response to the actual question asked in this part of the question. Many confused monomode with graded index.

4(c) ii More than half gave correct answers. A few did not score because the question required paths (plural) and they only drew one. Some drew the pattern of rays in a step index fibre.

4(c) iii Few were able to relate the bending of the rays to the gradual change in RI. Some gave part of this answer. Others were further away, e.g. "the fibre was monomode", "the signal is digital".

4(c) iv Most wrote that the speed in one type of fibre is more than in the other.

4(c) v Some candidates scored one mark for recognising that the signals arrive at the save time in graded index fibres (or the opposite in step index), but believed that this was caused by the rays having different speeds in step index and the same speed in graded.

4(d) i and iii Many correct answers here. A significant minority were apparently familiar with the types of bundle but only showed the arrangement at one end of the fibre so failed to score.

4(d) ii "Signals... mixed up", or "jumbled up" were common correct answers. Those who only stated that the fibres are mixed up were not given credit. A number thought that the signals arrive at different times rather than in different positions.

4(d) iv In general, candidates demonstrated a better understanding of the functions of the two types of fibre in an endoscope than in previous exams. A small number gave the answers the wrong way round. Some answers were related to other applications, either because the candidate was unfamiliar with this application or had not read the question.

Question No. 5

5(a) A small minority scored all 4 marks. Incorrect answers were spread across the options. It is not possible to tell whether scores one or two marks were the result of incomplete understanding or guesswork.

5(b) i Many candidates simply repeated the data given of question; few gave much analysis or further detail. Marks were often scored for recognising that with dial-up connections, the phone and internet cannot be used at the same time and that 3G uses CDMA. Some who scored the latter mark clearly confused earlier internet connections with earlier types of mobile phone system, so achieved few if any other marks. A few did use the information given to make links between data transfer speeds, frequency and wavelength. Fewer included other information, such as the types of cable used, in their descriptions.

5(b) ii Many candidates recognised that "lack of availability" was a likely reason. "Reluctance to change" and "users do not need fast data transfer" were also common correct answers. A few suggested that users might not want to use the internet at all.

5(b) iii Some would have scored better if they had referred to e.g. data rate, or information downloaded per minute, rather than simply more data or information downloaded.

5(c) The inverse square law was not well known. Many simply stated that signal strength went down as distance increased. Others gave incomplete answers such as "the signal strength drops to 1/4 when the distance increases to 2 km", with no mention of the distance having been 1 km. Many were confused and gave other reasons for lack of signal strength such as buildings and other obstructions.

Question No. 6

6(a) i Some candidates confused half-thickness with half-life so expressed their answer in terms of time. Other typical wrong answers included:

- The radiation that will go through half of the material.
- The amount of radiation that will pass through
- The thickness required to block (all) the radiation/ protect staff/for safety
- The minimum thickness of the lead screen

6(a) ii Few candidates recognised that there were two half thicknesses. Many obtained the figure 4 by dividing 10 000 by 2 500, then multiplied 0.068 by 4. In other cases it was more difficult to follow the candidate's reasoning.

6(b) i&ii This was poorly answered. Several confused ‘degree of sharpness’ to be a reference to an angle saying things like ‘the sharpness at B is 90 degrees’. Very few identified the key difference between the two examples: that the illumination gradually varies between N and O because some, but not all, of the light is blocked by the cardboard.

6(c)i Responses to questions in previous years had suggested that many candidates confuse these two terms. Answers in this paper suggested that the words are now well understood. Some repeated the words "treatment" and "Diagnosis" without explaining what they meant.

6(c)ii Many candidates recognised that the tracer was designed to identify some kind of soft tissue or blockage, but many referred to X-rays or confused the tracer with contrast media such as barium.

6 c iii Some simply stated that the (biological)/(physical) half-life is six hours. This was not enough on its own, but many also recognised that this was long enough to carry out the examination and short enough to reduce harm. Many knew that one advantage is that the material can be produce in hospital. A smaller number recognised the lack of beta particles as an advantage.

6(c) iv As well as many correct answers, the following were seen:

- Components of a gamma camera e.g. collimator, photodiode
- Other instruments from this and other units, e.g. X ray machine, CAT Scan (one of the most common wrong answers), MRI scan, Infra red/thermal imaging camera, Geiger counter/ GM tube, monitoring badge, endoscope.
- Radiogram, Radiometer, Black body radiation.

6(c) v Less than half of the candidates score any marks. The most common correct points were that the collimator is made of lead (some wrote aluminium), that it removes scattered rays (although some thought they were X-rays and that this was to reduce the radiation entering the patient) and improve image quality. Some of those mentioning holes omitted to state that these are many. Some were able to give the parallel (or even alternative) configurations of the holes.

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