GCE

Applied Science

Advanced GCE **A2 H575/H775**

Advanced Subsidiary GCE **AS H175/H375**

OCR Report to Centres

June 2013

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.

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This report on the examination provides information on the performance of candidates which it is hoped will be useful to teachers in their preparation of candidates for future examinations. It is intended to be constructive and informative and to promote better understanding of the 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

Overview

Centres are continuing to support this applied science qualification and numbers for the single award AS and single award A2 continue to show a steady increase. It is also apparent that there are a number of new centres this year.

The combination of portfolio and traditionally examined units offers candidates a qualification which provides the opportunity for combining factual learning and understanding with skills-based research and practical work. The examined units continue to provide a suitable challenge for candidates at both AS and A2 level and it is pleasing to see an increase in numbers for the A2 physics unit, Working Waves.

Portfolio Assessed Units

In general, candidates are performing well on the portfolio units although there is evidence of over-marking of candidates work at the higher end. Centres are giving mark band 3 when the work does not meet the criteria for high level AS or A2 standard. Candidates are demonstrating student-centred learning, however centres are encouraged to teach candidates research techniques and how to use the Internet to extract, select and use the required information. Staff should be working towards encouraging candidates to reference their sources correctly and using their own wording in the portfolio rather than cutting and pasting sections from the Internet. It is essential that portfolio work relates to the assessment criteria for each unit but also covers the specification. Centres are encouraged to annotate work and indicate competence of candidates in practical work in order to support the assessment given. Several centres are still not stepping up the level of experimental work to beyond GCSE and in these cases candidates were not able to access mark band 3 at AS level. Vocational and work contexts should be evident and traditional practical work should be adapted to have a vocational link or purpose.

Some excellent high quality work was evident throughout the units at A2, however all candidates need to be showing a step up from AS; work for the higher levels needs to show evidence of independent study with research being supported by good scientific understanding and knowledge. All practical work should show evidence of safe working with the inclusion of suitable risk assessments. Evaluative discussion should show a mature and critical approach. The portfolio work varied from teacher-directed work to candidates working independently. Candidates should be encouraged to show independent thought and investigative work at this level. A2 assessment was often generous, especially at the top of the mark bands; the correct level of scientific understanding was not always evident for the marks awarded at the higher levels.

Examined Units

The numbers of entries for G622 for this June session has increased from last year and the paper was accessible to the candidates. A number of objective items were incorporated to support those candidates who struggle with some of the more open-ended items which are now a feature of the AS series. This seemed to enhance the level of access for a wider range of candidates.

For G623/01the planning exercise, the overall performance of the candidates was generally of a similar standard to that of previous sessions. The marks ranged from 3 – 21 out of 25. For the planning task centres are asked to ensure that candidates read the instruction brief carefully to avoid misinterpretation. Many candidates investigated the effectiveness of different substances in changing pH (tea, coffee, cola, HCl, citric acid etc.) which was not appropriate to the task. 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 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. It is most important that Centres strictly adhere to the final submission deadline, as published by OCR. It is also noteworthy that candidates cannot resubmit G623/01 work from previous sessions, if they are retaking this module.

G623/02 marks ranged from 1 to 39 out of a total of 45. 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 Q1(f), Q2(c), Q2(d), Q3(a), Q3b(ii), Q4(b) and Q4(e). There was no evidence of candidates failing to complete the paper due to lack of time. There was no common misinterpretation of the rubric. The overall performance still varied between centres. Centres either had a good range of marks or had many poor scripts. It was disappointing that few candidates could correctly calculate the magnification of the cell in Q4(c).

In G628 it was clear from the answers that candidates were well prepared for questions 1 and 2, which were based on the pre-release material. There is still a need for some candidates to read the questions carefully. In some instances candidates responded with good material but unfortunately this was not relevant to the question. In general, numerical answers are now being answered better but there remains a significant minority for whom percentage calculations prove difficult. The examiners felt that graph work showed an improvement from recent examinations. As mentioned in previous reports, one of the weakest areas in the responses is in the design of candidates' own experiments. It is not expected that candidates will have tried the particular experiment but they should be able to apply their own background knowledge when solving the problem. This too, was an area where candidates did not read the question carefully enough. In general, the responses to question 3 were weaker than the answers given to questions 1 and 2. It seemed that some candidates could not apply their knowledge to new situations.

Numbers for G625, the working waves unit, continue to increase with most candidates attempting most of the questions. Good answers were seen, indicating both knowledge and understanding of this physics unit. There was some evidence of confusion between some of the devices included in the specification. This was particularly evident in question 7 where candidates did not always distinguish clearly between image intensifying screens, grid, narrow beams and filtration of X-rays. Similarly, some candidates confused monomode and graded-index optical fibres. Reasonable attempts were made at both calculations, although, as in past years, some struggled with powers of 10.

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

General Comments

For this AS qualification, 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**

All samples requested for moderation are chosen electronically and moderators found that for the majority of centres, the requested portfolio work was returned efficiently with appropriate Centre Authentication forms and this was appreciated. Good practice was seen by centres where staff had supplied relevant task and assignment sheets and URS cover sheets which were fully completed with clear teacher comments and page number references, enabling easy location of the relevant work. More centres this session, however, supplied candidates' work which was not organised, had missing centre and candidate numbers and no page referencing or annotation. This makes moderation increasingly challenging and these centres are asked to review their administration procedures. In addition, there were many clerical errors found by moderators. This often occurs following internal moderation by the centre, and centres do need to ensure that the final marks decided upon are accurately recorded.

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. Grade A work needs to be detailed and accurate. All researched information should be suitably selected and referenced. Work given full marks at mark band 3, should be free of any minor errors and supported by scientific content which is suitably presented.

It is essential for this AS course that practical work shows progression from GCSE. Centres where scaling has occurred for AO3 need to review their practical provision to ensure candidates are covering the specification requirements and can access the full range of the assessment criteria. Centres also need to take care that when giving full marks at mark band 2, all the criteria in that strand are met at the appropriate level; in several instances, work was covered but at quite low levels. Grade A work should be accurate and show understanding of researched material taken from the Internet. Also, work 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.

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.

Several centres are now accredited and are sampled over a three year period. 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, that OCR is informed. It is important that centres do encourage their candidates to follow the guidance given in this report. OCR offers a free coursework consultancy service to support the assessment; details are available from the OCR website. Advice will always be given on the suitability of assignment ideas that centres may wish to offer.

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 the impact the 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

AO1
For both AO1a and AO1b, centres are advised to refer candidates to both the requirements of the specification and the assessment criteria for their four surveys and the in-depth study.

- For AO1a candidates need to use the specification. Each survey needs to include:
  - the products made or services offered
  - the type of work that takes place
  - an identification of the science involved
  - information on Health & Safety constraints and guidance used in the organisation.

- Candidates need to be suitably selective in the information used and not present lengthy reports.
- 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.
- Candidates need to ensure that their choice of organisations is suitable to cover sufficient science.
- It is not advisable to focus surveys on job roles e.g. forensic scientists, nurses etc.

- For AO1b candidates need to use the specification. 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 be used for the requirements of AO1c.

- Centres should try and give candidates more guidance to improve the quality of the selection, presentation and the level of the science identified.
- 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.

AO2

- For AO2a, candidates need to use the specification. The report which can be linked to the in-depth study needs to include:
  - benefits of the core business to the society
  - the contribution of the organisation 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 was much improved for this strand in many centres and candidates were covering many of the bullet points.
- For AO2b, the assessment guidance states a number of complex and straightforward calculations should be completed. Appendix C, Page 129 of the specification, gives guidance on the range of mathematical skills which may be covered during this A level course.
- If the data produced for practical work does not allow candidates to fulfill the higher mark bands then data can be supplied. However, it is not advisable to produce a number of stand-alone calculations. If this is necessary, they could be presented in the form of a task sheet, which perhaps would be completed by a technician in the workplace.
- For AO2b, mark band 3, work should be correct and answers given to the appropriate degree of accuracy with correct significant figures. Errors are still commonly seen here. Just the completion of one titration calculation of molarity is insufficient evidence for mark band 3.

AO3

A range of both acid base and redox titrations, organic preparations e.g. aspirin, rates of reactions, inorganic analysis, vitamin C testing, forensic focused analysis, optical work, colorimetry were commonly seen.

- Candidates need to carry out two practical activities which can be chosen by the centre but they need to show vocational links. They also need to show progression from GCSE.
- 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.
- 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 practicals that demonstrate the same techniques e.g. two volumetric exercises, two radioactivity measuring tasks.
- For AO3b, recording needs to be thoroughly checked by candidates to ensure accuracy, units and correct significant figures.
- Processing skills in graphs and calculations were evident but much more accuracy is needed for the higher mark bands
- The inclusion of an evaluation does not automatically mean mark band 3. Candidates need to review the level of evaluations. Assessment tended to be generous.

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.

The assessment requirements 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.

General guidance is as follows:

AO1
The energy policies seen ranged from supermarket chains, popular well-known companies, universities, public service organisations, schools and colleges.

- Candidates still need to ensure work is suitably selected on the energy policy rather than environmental policies. The policy also needs to be clearly presented and not threaded through the report in a disjointed way. Several candidates were not using their research to extract and collate the relevant information.
- 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 to limit its energy consumption.

AO2
- Describing and comparing large and small scale electrical generation from two chosen sources was much better this session and 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. For mark band 2 and 3 clear comparisons are needed, a lot of factual information was often included but detailed comparison was not always apparent.

- Evidence of energy values and fuel/energy costs was not so good this session and calculations from many candidates were missing or low level. 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
Several centres were still giving candidates 7 marks for all of their practical work when the work did not reflect the requirements of A grade work. Centres are again advised to follow the guidance given below:
- 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 correctly 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 with 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 that candidates can gain mark band 3. The level of discussion needs to reflect A/B grade work.

G624 Chemicals for a Purpose

G624 is a popular optional unit. Candidates are showing improvement in research of chemical compounds and their properties, and the ability to select appropriate technical information. Preparative practical skills have also been well demonstrated although recording of observations etc is still not adequately detailed.

The assessment requirements for the specifications now 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 and 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.

AO1

- For AO1a, chemicals used include e.g. sodium chloride, copper sulphate, magnesium sulfate etc, a range of acids and alkalis e.g. sulfuric, boric, sodium carbonate, sodium hydrogen carbonate etc, and gases e.g. carbon dioxide, ammonia. 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.
- Candidates were showing how uses depended on properties but candidates still need to show more understanding.
- Eleven marks are allocated to AO1c, which involves candidates 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.

AO2

- For AO2a, mark band 2 and 3 yield calculations using data from candidates’ preparations, need to be supported by calculations of costs in chemical production. Again, for mark band 3, candidates need to be demonstrating independent skills in calculating.
- Manufacture of ethanol, polyethene, sulfuric acid and ammonia were industrial processes researched and described.
- 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 that 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 in most cases.

AO3
Moderation generally aims to support the assessment of AO3a as this strand assesses the candidates' ability to complete their practical work. However, in addition to this, the assessment criteria require evidence of suitable selected research together with evidence of the use of a detailed and accurate risk assessment and the completion of the preparation, purification and analysis of the compounds chosen.

- For AO3a, candidates need to be aware of the requirements of 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.
- Centres generally need to work on improving the detail needed for AO3b; some good work was seen where candidates had included detailed observations, which followed through their preparations.
- Initial and final weighings and accurate recording of melting points are still not always seen.
- 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.
- 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.

Work for this unit was very variable this summer. Some candidates showed detailed research with suitable referencing and selection of the relevant information, and practical work clearly showed progression from basic chromatography and microscope work completed at GCSE. Other work seen was very basic, with brief descriptions of techniques and limited experimental work.

The assessment requirements for the specifications now 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 should be included.
AO3 - at least one forensic analysis in each of the following areas: biological, chemical and physical techniques.

General guidance is as follows:

AO1
- For AO1a, research work needs to show selected information about 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. Candidates need to be more selective in the work they include in their portfolios. Some interesting but not relevant information is often included in this section.
- 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 about ethical issues is discussed. Many scripts just mentioned DNA databases and were awarded mark band 2.

AO2

- For Strand AO2a, some very good case study work was seen but much lacked the detail required.
- Reports need to cover the following points detailed in the specification:
  – the ways in which forensic scientists ensure the quality of evidence collected and analysed is objective
  – the limitations, strengths and weaknesses of the analytical techniques used
  – an understanding of the probability of guilt and of a need to review evidence.
- For AO2b, standard calculations can include a range of Rf values for mark band 1, and refractive index calculations and bullet projectiles for mark bands 2 and 3. Candidates do need to show, however, the ability to complete calculations independently. A great deal of directed work was seen.

AO3

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

G626 The Physics of Sport

This unit gives candidates the opportunity to research the science involved in a range of sporting activities. Good work was seen where centres gave candidates the opportunity to choose sports that interest them and they were guided to suitably plan and conduct their investigations.

The assessment requirements for the current specifications now include:
AO1 - a series of four 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.
General guidance is as follows:

AO1

- 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 selecting suitable material for their leaflets and using the specification, 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

This assessment requirement gives candidates the opportunity to produce a presentation linked to sporting equipment.

- For AO2a, presentation work is needed; reports are not suitable for this strand. It is useful if centres record the outcomes of the actual presentation given by the candidates. If candidates complete PowerPoint presentations, which include limited information, these should be supported with additional notes to indicate their knowledge and understanding.

AO3

- For AO3, practical work needs to show progression from GCSE and candidates should be showing some planning. The choice of practical is left to the centre but it needs to relate to the content of the specification.
- For AO3b, candidates need to be collecting a wide range of suitable data and it needs to be suitably recorded.
- 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. This was very rarely seen.

G622 Monitoring the Activity of the Human Body

1(a) Many candidates responded well to this item, which was based on key features of X-ray images.

1(b) Most candidates referred correctly to the issues of tissue damage linked to the magnetic field of the MRI equipment and to either claustrophobic patients or the loud noise.

1(c) This item was challenging for many. The features of CAT and MRI scans were not well understood and some confusion was shown with regards to the clarity of images of bones and soft tissues. However, many were aware of the 3D nature of the images formed.

2(a) Although many candidates used the figure to recognise the thick wall and narrow lumen of the artery, some gave functional rather than structural features.

2(b) Surprisingly few candidates were aware of the oxygenated blood carried by the pulmonary vein. Some provided incorrect structural features of this blood vessel.

2(c) The prevention of backflow by these two heart valves was well-understood by many but some candidates were unable to recall the parts of the left side of the heart involved in the process.

2(d) Many candidates successfully identified the ultrasound scan for this item but some incorrectly stated one of the other scanners available.

2(e) A number of responses correctly referred to the increase in blood pressure and carbon dioxide levels in the blood. However, relatively few were able to explain the details of what is involved in this process. Some candidates considered that the carbon dioxide levels would decrease as a result of exhalation.

2(f) Many candidates did well with this item. The scaffolding provided by the question enabled them to work through the stages in the correct order.

2(g)(i) Although many candidates recalled the familiar numbers of 120/80, some were uncertain of the units involved.

2(g)(ii) The majority of candidates appreciated that the older person would show an increased blood pressure but the reason for this feature was often associated with general assumptions of stress or general weakness with older age.

2(h)(i) This item did not present a challenge for many candidates. No clear pattern of alternative responses could be determined.

2(h)(ii) Some candidates noted that the heart rate was faster but failed to refer to the values for the normal heart rate (60 – 80 beats per minute).

3(a)(i) Most candidates were able to determine the correct value of 12 breaths per minute.

3(a)(ii)(iii) There was a much greater chance for candidates to complete the correct values for part (i) than for part (ii). Many correctly referred to the values of 0.8 and 1.6 for part (ii) but concluded that the difference was 50% rather than the correct difference of 100%.

3(a)(iv) A number of candidates correctly noted that the breathing rate had increased and that the (tidal) volume had also increased, often to meet the increased need for oxygen. However, most candidates were unable to account for the changes taking place within period B.

3(v) Most candidates were able to identify the value of 10 but some were challenged by this item and gave a response of 20.

3(vi) Although this item represented a challenge for some candidates, many were able to achieve at least one or two marks for this comparison of muscle activity during ventilation of the lungs.

3(b)(i) Most candidates were able to identify the starting and ending stages. These were clear within the stages provided. However, there was some confusion about the order in terms of putting the mouth around the mouthpiece and breathing in deeply. In most cases, patients are asked to breathe in deeply before putting the mouth around the mouthpiece.

3(b)(ii) This item was completed well by a number of candidates who were not only aware of the 'highest reading' principle for the use of this equipment but were also able to recall the precise values for the normal range.

3(c)(i) Many noted that the rate of gaseous exchange would be lower but were unable to relate this correctly to the resulting change in the diffusion gradient across the alveolar membranes.

3(c)(ii) The lack of oxygen delivery to the muscles and the build-up of lactic acid was understood well by many candidates but they struggled to explain the impact on the contraction of muscles. Some candidates became quite confused and referred to intercostal muscle activity.

3(d) This item was answered well by many candidates.

4(a)(i) Most candidates were able to describe the advantages and disadvantages of such thermometers.

4(a)(ii) Alternative thermometers were identified correctly by many but some candidates referred to the same type of thermometer given in the scenario.

4(b) Sweating and vasodilation were frequently given in the response to this item. Very few were aware of the lowered metabolic rate but some did correctly describe changes to the hairs on the skin.

4(c) Many candidates were aware of the critical temperature. No clear pattern of alternative responses could be identified.

5(a)(i) This item was generally answered well and clearly by many candidates. Unfortunately, some referred to 'little' radiation rather than no radiation.

5(a)(ii) Many candidates gave a good description of the purpose of using the gel.

5(a)(iii) Most realised that treatment or medication could then be given to the patient.

5(a)(iv) Some candidates struggled to articulate a clear response. There was a general understanding that obesity affected the quality of the image but the explanation was sometimes difficult to follow.

5(b) Most candidates are well-versed in the ethical issues facing this type of elderly patient under such conditions.

5(c) Some candidates clearly understood the concept involved but failed to express the reasons in sufficient depth. The issues of contamination and preventing needle-stick injury were key to this item.

6(a) It was impressive to note how some candidates used the series of stages highlighted in this item very well in relation to this complex procedure (ELISA). Such candidates were able to obtain full marks. Some were challenged by a number of stages but were often able to correctly identify the two final stages in the series.

6(b) Although many candidates were aware that the avoidance of contamination was related to the wearing of gloves, they were unable to make the connection that the technician could provide the HIV virus from their own body. The transfer of bacteria or DNA, which was often quoted, would not be a critical factor for this test.

6(c) The concept of 'false negative' was often well-described by candidates and linked to the lack of treatment, thereby enhancing spread via unprotected sex etc. Some candidates provided an impressive response for this item.

6(d) A wide variety of antigen-based responses was given by candidates, many of which were correct. The expected response was hepatitis but it was interesting to note the range of diseases tested using ELISA products.

6(e)(i) Some candidates were not challenged by this item but many struggled. A clear pattern of alternative responses could not be determined.

6(e)(ii) A number of candidates gave responses to describe the ways in which the data provided in the scenario could be reordered, analysed or presented in a table. Some, however, gave very thorough and correct responses to this item.

G623/01 Cells and Molecules – Planning Exercise

General Comments

Task: 'Plan an investigation to find the optimum pH for maximum yield of curds produced from cow's milk compared to soya milk'.

Centres are asked to ensure that candidates read the instruction brief carefully to avoid misinterpretation of the task i.e. a comparison is made between the two types of milk, to find the optimum pH for each, which results in the maximum yields of curds. Many candidates investigated the effectiveness of different substances in changing pH (tea, coffee, cola, HCl, citric acid etc.) which was not appropriate to the task. In many centres, candidates failed to use an appropriate range of pH values in order to assess the optimum pH which resulted in maximum yields for both cow's milk and soya milk.

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 most important that centres acknowledge the existence of all the assessment criteria and ensure that candidates address all of them, in their plans. Too many candidates failed to adapt information from reliable secondary sources and reference them correctly. 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 remains a concern that plans from some centres had evidence of heavily guided and assisted work which should have been reported using the necessary paperwork provided. It is also important that centres ensure that attendance sheets are accurately completed to assist in the checking process. Centres are asked to dispatch the G623/01 Plan separately from the G623/02 Test, using the relevant dispatch labels and OCR stationary provided. It is most important that Centres strictly adhere to the final submission deadline, as published by OCR. It is also noteworthy that candidates cannot resubmit G623/01 work from previous sessions, if they are retaking this module.

The overall performance of the candidates was generally of a similar standard to that of previous examinations. The marks ranged from 3 – 21 out of 25, with the majority scoring from 10-15 marks.

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

Individual Questions

A: A minority of candidates achieved the three appropriate safety features required to score this mark. Most common reasons for this were too few safety procedures quoted, or risk assessment was generic and not specific to the experimental work carried out. This seemed to be particularly true where a centre's own safety proformas were used. In some instances, the risk assessments included chemicals/reagents that were not actually used in the method, or occasionally for the wrong, but sometimes related, practical.

B and C: Fewer than half of the candidates earned B because they either failed to include yield in their predictions, just predicting the optimum pH for curdling, or did not predict for two types of milk. Others just predicted whether cows' or soya milk would produce most curds, with no reference to pH. Few candidates included their own researched information for C, relying only on the Insert.

D – G: Most candidates included evidence of preliminary work and normally scored marks for D and F. Where D was not awarded, it was because preliminary work was not mentioned, or it was exactly the same as the main experiment, with no reason given other than 'to see if it would work'. However, some very good preliminary work was carried out by some centres, including work to narrow pH range, or to establish the best method of measuring yield, or determining the best way of achieving desired pHs. E was less frequently earned, and G was rarely awarded.

H and I: A surprisingly high number of candidates did not include any references to reputable secondary sources, in addition to the Insert. Where sources were cited, candidates failed to explain their relevance in developing the investigation and consequently the I mark was less frequently awarded. Some candidates lost the H mark for not referencing their sources in sufficient detail i.e. full title, authors, publisher and date of publication.

J and K: J was awarded in the vast majority of cases, but K less often, as two types of milk were sometimes not mentioned, or volumes and/or incubation times were not stated or there was a failure to mention how data were to be collected.

L and M: L was awarded in the majority of candidates' work although a frequently missed item was a balance to weigh product so that marking point L could not be awarded. A common error was the failure to include numbers, sizes or quantities of apparatus etc in the list of equipment which prevented the award of M.

N: This was well answered. Most candidates often referred to 'repeats' in their main method or by several columns for replicates being given in a table of results, rather than a statement of intent.

O: Very few candidates justified the need for their pH range of measurements and subsequently O was rarely awarded.

P: This was awarded to many candidates although sometimes the range used in the main method varied widely from that used in the prediction, or a single range was given, which was then inappropriate for one of the types of milk.

Q and R: Most candidates scored the Q mark but R was less frequently awarded. The most common responses for Q included reference to maintaining a constant temperature (although the specific temperature was not often given) and using the same volume of milk. In many cases, the control of variables was not explained with sufficient clarity to gain the R mark.

S: The vast majority earned S for a suitable table, although appropriate units were often omitted.

T: While most candidates referred to graph(s) in their plan, many did not include a suitable example or further detail. Occasional reversal of x- and y-axes prevented the awarding of the T mark.

U: In excess of 50% of candidates earned this mark, either from suggesting a calculation of a mean value, or calculating a percentage yield.

V: Few candidates produced a satisfactory conclusion, which needed to be linked to their prediction (if given). Where V was scored, this tended to be earned from annotations of an optimum pH on a graph.

W: Two appropriate sources of error were recognised by many candidates. In some cases, statements were not specific enough, e.g. 'human error in measuring' earned no credit.

X: Whilst X was earned far less frequently, some higher level candidates suggested the use of graduated pipettes or electronic/digital pH meters to obtain more precise pH values, or expanding the critical range of pH values, to gain this mark.

Y: The vast majority of candidates scored this mark.

The majority of candidates adhered to the word limit and many scripts were annotated at each 100 words as requested in Point 6 of the Notes for Guidance. A small number of candidates wrote on both sides of the paper, which is against the instructions given in Point 3 of the Notes for Guidance.

G623/02 Cells and Molecules – Test

General Comments

Marks for the paper ranged from 1 to 39 out of a total of 45. Approximately 50% of candidates gained marks between 13 and 26.

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 Q1(f), Q2(c), Q2(d), Q3(a), Q3b(ii), Q4(b) and Q4(e).

There was no evidence of candidates failing to complete the paper due to lack of time. There were no common misinterpretations of the rubric.

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

It was disappointing that few candidates could correctly calculate the magnification of the cell in Q4(c).

Question 1

(a) The great majority of candidates produced sound descriptions of slide preparation and gained at least 2 out of the 3 available marks. Many candidates made more than the required three valid points, often correctly naming stains they had probably used themselves, e.g. iodine. Some candidates had not read the question carefully, and wasted their time explaining how to use the light microscope i.e. securing the slide on the stage, focusing etc.

(b) Most responses correctly identified the nucleus although 'ribosome' did appear on a number of scripts.

(c) Full marks were not often awarded. However, many candidates earned two marks for the advantage and disadvantage points, but then simply repeated the statement rather than giving an explanation, e.g. 'specimens have to be dead....they have to be dead for you to see them'. Disadvantages were less well known and in this case, the explanations were rarely worthy of the second mark.

(d) Answers were frequently too vague to earn credit, e.g. intestines, rather than the pancreatic duct, blocked, and vague statements about poor digestion, absorption, and lack of nutrients were given.

(e) This was generally well-answered. Most frequently earned marks were for the dilemma of abortion, and the inaccuracies of the test. Weaker candidates sometimes offered the phrase 'testing.... is playing God' without qualification, and earned no credit for this.

(f) Very few students scored this mark.

Question 2

(a) This was not answered well. A significant minority of candidates offered no answer, some just offered C, H or O, a few possibly confusing it with nucleic acids and offering A or G. Very often the -NH2 and –COOH groups were written incorrectly.

(b) Condensation reaction and peptide (/covalent) bond were known by many candidates. However, some confusion between hydrolysis and condensation was observed, with the most common error being ester bond instead of peptide. Dipeptide, and even polypeptide bond responses were credited under 'benefit of doubt'.

(c) The ELISA test was not generally well known by the majority of candidates. The most frequent incorrect answer was biuret test since, although candidates recognised that they were looking for the presence of a protein molecule, they did not link it with the specificity of the monoclonal antibody (ELISA) test.

(d) Relatively few candidates gained 3 or more of the 6 available marks for the completion of fig. 2.2, but the vast majority attempted all parts. 'Amino acid' and 'DNA' were by far the most common correct responses; confusion between 'transcription/ translation' and 'mRNA/ tRNA' was very apparent.

Question 3

(a) 'Starch' and 'biuret' were relatively well known and some inventive spellings of 'biuret', were credited where possible. Often with one reagent missing from 'ethanol and water' and the 'non-reducing sugar' answer, candidates failed to gain these marks. A few candidates suggested Sudan III as a reagent used to confirm the presence of lipid, but the result would not be a 'white emulsion'. Candidates are asked to read all the information given in the question carefully in future sessions.

(b)(i) This was well-answered.

(b)(ii) Again, whilst this was well-answered, there was a tendency for some marks to be gained for the 'factors' section of the table rather than for the first three features. Some candidates failed to earn credit by offering 'concentration' without saying of what, for 'factors affecting enzyme activity'. Students should be discouraged from using imprecise language such as 'amount' or 'level' when they mean 'concentration'. Most common responses for 'factors' were temperature and pH.

Question 4

(a) This was well-answered; the most frequent correct response being 'leukaemia'.

(b) Most candidates identified an appropriate organelle but very few indicated that the latter was present in 'large' quantities. However, the vast majority of candidates earned a minimum of one mark for stating a correct function of a named organelle, even when they had not given the idea of 'more' for the other mark.

(c) Overall, this was not answered well. Although many candidates stated the formula for calculating size and magnification, they failed to apply it correctly and measured various dimensions of the cell in Fig. 4.1 instead of using the scale bar given.

(d) A significant number of candidates recognised the 'counting of dead cells' as a factor leading to inaccuracies in results achieved using a haemocytometer. However, a common incorrect response, 'human error', was seen in a significant number of papers.

(e) There were many excellent answers to this question, where centres had clearly covered 3.4.4(d) of the specification in depth and detail. In those cases, even lower ability candidates often earned 1 – 2 marks. However, there were instances where otherwise able candidates were clearly describing the use of a haemocytometer. It remains a concern that unfortunately a high proportion of candidates displayed little, if any, knowledge of the Coulter counter.

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

General Comments

For this A2 qualification, 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**

All samples requested for moderation are chosen electronically and moderators found that for the majority of centres, the requested portfolio work was returned efficiently with appropriate Centre Authentication forms and this was appreciated. Good practice was seen by centres where staff had supplied relevant task and assignment sheets and URS cover sheets which were fully completed with clear teacher comments and page number references, enabling easy location of the relevant work. More centres this session, however, supplied candidates' work which was not organised, had missing centre and candidate numbers and no page referencing or annotation. This makes moderation increasingly challenging and these centres are asked to review their administration procedures. In addition, there were many clerical errors found by moderators; this often occurs following internal moderation by the centre, and centres do need to ensure that the final marks decided upon are accurately recorded.

Generous assessment of work aiming for higher mark bands continues to be a problem with several centres. 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 for 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 and 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.

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

Assessment also tended to be generous at the higher end of mark band 2, where there was a range of marks that could be awarded. Where the higher marks are awarded, work should cover all the requirements of the assessment criteria and suitably link with the specification at this level.

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 that centres may wish to offer.

Several centres are now accredited and are sampled over a three year period. 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, that 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 now a requirement to assess spelling punctuation and grammar in the portfolio units, and the opportunity to reach A* for the higher ability candidates.

G627 Investigating the scientists' work

This unit is mandatory and candidates need to be demonstrating progression from AS in their ability to set up an investigative task and provide evidence of their own decision-making in the choice of routes in their practical work. Centres need to prepare their candidates suitably during their AS course, to ensure that practical skills from the AS portfolio units are built on for this unit. Wherever possible, candidates need to develop their work independently and not just follow a number of pre-set practical tasks.

The assessment requirements for the specifications include:

AO1 - a detailed and workable plan for one scientific vocational investigation, to include the aims and objectives, full details of experimental work including details of the 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 the data collected has been processed and interpreted;
AO3 - evidence to show that the investigation was implemented safely, and an evaluative scientific report on the outcomes produced.

AO1

- For AO1a, centres are advised to ensure that all candidates write a holistic plan for their chosen investigation. A diary of what was done each lesson can support monitoring but is not suitable for coverage of AO1a. It is also important that candidates clearly state the aim of their overall investigation so the reader is clear about what the candidate is trying to achieve.
- The work for this unit is not just a set of practicals that candidates follow; it needs to show the thought process of deciding which routes to take and how skills and scientific knowledge learned and researched can be suitably applied. Evidence of repetition of the same practical work does not allow candidates to reach the higher mark bands.
- Candidates need to investigate AS topics further and carry out different experimental techniques and procedures e.g. different types of preparative work, quantitative analysis, qualitative analytical techniques, research and questioning techniques. Examples covered included vitamin C, food testing and analysis, acid preparations, analysis and testing, organic compounds (common usage, preparations and analysis with various comparisons), investigations into bleach using both biological and chemical methods, uses and properties of materials, biological and chemical catalysis effects and uses, and a range of forensic investigations. Research and use of questionnaires can be used to support investigative work but evidence of experimental procedures needs to be included.

AO2

- For AO2, centres need to check that monitoring does not include just basic generic statements about what was done, the time allocation, weather conditions and the state of the equipment used.

- For AO2a, mark band 3, candidates need to be providing explanations of strategies used to overcome any deficiencies or constraints of the plan. The discussion of the reliability, again, needs to be supported by suitable scientific treatment of arguments.
- For AO2c, just one complex calculation or the repetition of the same skill is insufficient for the award of top marks at mark band 3.

AO3

- Conclusions and evaluations need to be collated for the complete work rather than given at the end of each experiment.
- The evaluation needs to show the critical scientific reasoning used to determine the success or failure of aspects of the investigation that has been carried out.

Good investigations include the following:

- Vocational links, which are fully referenced and validated.
- Experimental work, which includes a range of techniques and different procedures.
- Health and Safety guidance, which is detailed, clear and focused.
- Clear reasoning on how the investigation achieved its aims and objectives, supported by a discussion of the reliability of the work carried out.
- A written report which is accurate and suitably detailed.

Centres also need to be aware that when awarding full marks at mark band 3, particularly in this unit, work should be free of any errors; it also needs to be 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 and although assessment was sometimes generous, selection and use of chemical research did show improvements this session. There was also more accuracy in the use of formulae and equations.

The assessment requirements for the specifications now include:

AO1 - a report or leaflet which demonstrates an understanding of organic chemistry by the correct identification and naming of functional groups, and showing the importance of different types of isomerism and different types of reactions; the assessment also requires 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; there should also be evidence of appropriate calculations;
AO3 - practical work on two organic compounds, detailing preparation and purification methods (to include some planning), making, recording and displaying observations and measurements; evidence of processing results (to include % yield), making suitable conclusions and evaluations should also be included.
It is hoped that centres found the general guidance provided in last year's reports useful as improvement has been shown.

In this session it was found that:

AO1

- Evidence produced by candidates generally linked to the requirements of the specification and not to class notes.
- Isomerism was still not well covered; explanations are needed even for mark band 1.

- Candidates need to ensure accuracy when writing organic formulae and equations, although, generally, this had improved since last year.
- Explanation of reaction types needs to link to the specific organic compounds and not be generic. Inorganic examples were still seen. Quality of explanations as well as increased number is also needed for mark band 3.
- Some good selective and independent work was seen for AO1c; generally this was mark band 2.

AO2

- There is still too much evidence of direct lifts of work from the internet. Research work on a process used to manufacture one organic compound needs to be suitably selected and all the assessment criteria for mark band 3 need to be covered at the appropriate level. Some work seen was very basic. Just coverage is insufficient to award mark band 3.
- For AO2a and AO2b, more work on medicinal drugs was seen but again explanations and evaluative discussion need to be at a much higher level for mark band 3.
- Again, one set of calculations is insufficient to support mark band 3. 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.

AO3

- Preparations of aspirin, ethanoic acid, benzoic acid, iodoform (triiodomethane), paracetamol, various esters, alkanals and alkanones (aldehydes and ketones) were seen. Candidates need to show evidence that they are confident in using a range of techniques. Centres need to check that the choice of preparations enables candidates to show that they are confident in carrying out a range of techniques. Preparation of nylon is too basic. It is also necessary for candidates to purify and techniques such as re-crystallization, distillation, or solvent extraction could be used.
- Risk assessments need to be workable documents. They need to be sufficiently detailed and relevant to the experimental procedure but not so lengthy that they are unrealistic to use during the practical activity.
- Detailed observations need to be recorded for both preparations; this continues to be over assessed. Much more detail is needed on the recording of both observations.
- Processing of results needs to include calculations of both actual and theoretical yields. Independent work should be demonstrated here and candidates should not be provided with structured worksheets with gaps for numerical values to be inserted.
- 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 the appropriate scientific knowledge. Evidence for this strand was often very low level.

Up to 26 marks can be gained from practical work and hence between 25 to 30 hours should be allocated to AO3 work.

G630 Materials for a purpose

This unit still has a limited entry, however this year some very innovative work was seen by several candidates in the case study. The assessment requirements for the specifications include:

AO1 - a presentation or poster that outlines the 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; and using graphs to determine the Young's modulus, and toughness;
AO3 - evidence to show the following three 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:

AO1

- Candidates were improving their reports by including less 'cut and paste' material although centres are giving higher marks for quantity rather than quality.
- The work for mark band 3 still needs to show that candidates can describe the structures of the materials chosen. Limited evidence was seen which showed candidates' understanding of relating the structures of the materials to their physical properties.

AO2

Some excellent work was seen on a range of case studies from a number of centres.

- For AO2a, it is important that all the bullet points are covered even where mark band 2 is being awarded. For this strand, 10 marks are available and candidates need to be showing suitable justification of their chosen shortlists as well as reasons for their final choice. Decisions need to be supported by suitable published scientific data.
- For AO2b, although calculations reflected the requirements of the assessment criteria, errors were still seen for mark band 3 and answers were not always given to the correct number of significant figures. Candidates need to check their answers.

AO3

Generally, a suitable range of practical work was seen, supported by some clear and logical reports.

- Some centres, however, need to check the requirements of the assessment criteria to ensure their candidates cover the correct number of practical activities. The testing device needs to test either hardness or an impact (toughness).
- For AO3a, evaluations that score high marks need to be detailed and indicative of high A2 level work.
- For AO3b, there needs to be a full discussion and evaluation relating to whether or not the treatments have produced the expected results.
- For AO3c, reasons are required to support estimations of the uncertainty of their results and there needs to be an evaluation of their results compared to data values to support 8-10 marks.

G631 Electrons in action

Some very good scripts were seen this session although assessment at the higher end is still generous. Candidates aiming for grade A in the A2 unit need to be working independently and demonstrating a thorough knowledge and understanding of electrochemical theory and practical work.

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.

General guidance is as follows:

AO1

- For AO1a, in order to demonstrate a thorough knowledge and understanding of the principles of electrochemical change, candidates need to be guided towards the relevant requirements of the specification listed in 3.12.1; 3.12.2; 3.12.3 (pages 51 – 53). Coverage of this work can be integrated throughout the unit but a tracking system is needed to ensure full coverage if it is not presented as a separate research project.

- For AO2a, comparisons are needed and the bullet points listed below need to be included:
  – construction method and method of producing the electric current
  – resources used in production
  – efficiency
  – safety and environmental effect
  – sustainability and use.

- For AO2b, there were some gaps in the coverage; centres should check that candidates are completing calculations for:
  – EMF of cells
  – quantity of charge
  – mass of products.

  Additionally, for all mark bands, there should be 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. Candidates aiming for the higher mark bands need to:
  – show independent ability to plan suitable experiments to cover AO3a
  – include an explanation of any practical techniques that will improve results
  – include detailed accurate risk assessments to support safe working.

  All candidates should be showing evidence of individual planning and should not just be following set experiments. Diagrams can be used to support planning and understanding.

G632 Mind and the brain

This continues to be a popular unit with an increased number of candidates now producing suitable evidence that matches the assessment criteria requirements. Assessment, however, still remains generous for calculations AO2c and for 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.

General guidance is as follows:

AO1

- For AO1a, sets of fact sheets or leaflets need to be targeted at the appropriate audience and include suitable illustrations and evidence of references used. The key to work which reflects mark band 3 is that it shows detailed but understandable research, suitably designed to raise mental-health awareness. Candidates should not be submitting lengthy reports.

AO2

- Selection is important when presenting evidence for AO2a. There is a vast amount of information available on methods of studying the brain but both mark band 2 and mark band 3 need candidates to show understanding of the methods; candidates therefore need to use their research to demonstrate their understanding in their reports rather than just inserting material lifted directly from a range of websites.
- For AO2b, mark band 3, comprehensive discussions are required with evidence of statistical research; again, an understanding of this needs to be shown.
- For mark band 2, work on moral and ethical implications of brain research needs to reflect the statements given in the assessment criteria; a comprehensive discussion and conceptual considerations are needed. Centres are advised to spend time with candidates in discussion work on this topic.
- AO2c does ask for a fact sheet detailing statistical evidence. Some brief statements were seen but assessment is often generous for this strand. Repetition of one statistical test does not automatically mean that mark band 3 has been achieved.

AO3

26 marks are available for AO3 and therefore candidates need to spend the appropriate time on their experimental work (25-30 hours).Some generous assessment was seen where centres awarded mark band 3.

- 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. Collecting data from 10 students does not offer suitable statistical evidence for an A2 investigative practical
- Participants of the investigations need to be fully aware of the tests that they are completing and that evidence is provided of risk assessments used.
- For AO3c, coverage of all the key statements is needed. It is important to record precisely, collect a detailed data set, display data accurately in a range of ways and collect sufficient data to use simple statistics to analyse results.
- AO3d needs a basic evaluation just for mark band 1, and the work in the other mark bands 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. Some excellent work was seen, which indicates candidates' 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 and interpreted, and results related to the occurrence and distribution of the species within the ecosystem.

General guidance as follows:

AO1

- Assessment was sometimes generous. AO1a research work assessed at mark band 3 needs to show that the candidate has a thorough knowledge and understanding of the relationship between the organisms, their physical environment and each other in ecological succession. The candidate should demonstrate independent research and the candidate's report should be clearly organised so it can be understood by the reader. Work should not be just 'cut and pasted'. Some good work was seen but really only worthy of the mark band 2 assessment criteria.
- For AO1b, mark band 3, all the assessment criteria need to be covered at a high level. Presentation needs to be clear, logical and easy to understand. Evaluations need to be at an appropriate high level with suitable justification included to gain an A grade. All parts of the assessment criteria needs to be covered for mark band 3.

AO2

- For AO2a, mark band 1, candidates need to identify moral and ethical reasons for preserving ecosystems and species diversity; where marks for bands 2 or 3 are given, candidates need to know how to explain and evaluate their reasons.
- Where high marks are awarded, reports need to clearly show a range of methods used to manage ecosystems and preserve species diversity. Some interesting work was seen but candidates did not sufficiently interpret both the qualitative and quantitative data relating to the success of the project chosen.

AO3

- Candidates generally produce a lot of data from their practical investigations in this unit, but care needs to be taken that over-assessment does not occur because of quantity rather than quality.
- Candidates need to be showing their ability to plan investigative work of an ecosystem. Although field trips are to be encouraged, individual data collection needs to be supported.
- Pages of results which had not been collated were commonly seen.
- Although moderators aim to support AO3a, as this is assessing the candidates' practical skills, for the higher mark bands AO3 needs to be supported by explanations for using a range of techniques and equipment and reasons for repeated measurements; this was not always seen.

- For AO3c, data needs to be displayed in a range of different ways. Kite diagrams are often seen to support data display, but accuracy needs to be maintained for mark band 3.
- Conclusions at mark band 3 must show suitable interpretation of results and be related to the occurrence and distribution of species within the ecosystem studied.

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. Well done to these candidates. Centres, however, do need to take care that over-assessment does not occur. For mark band 3 strands, work needs to be accurate, well-referenced and suitably selected. For mark band 2 and mark band 3, all parts of the required assessment criteria need to be completed to the required high levels. There should be minimal errors and the work focused at the appropriate target audience.

The assessment requirements for the current 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 - a description of how successful DNA technology is in food production, with suitable conclusions based on evidence found; financial/ statistical evidence involving calculations should also be evident; a consideration of the moral and ethical issues, and the impact of legislation associated with using genetically modified food plants should also be included;
AO3 - a practical investigation into enzyme technology, including the production and use of an immobilized enzyme; the construction of a bioreactor and the effect of temperature on enzyme activity should also be included.

General guidance as follows:

AO1

- For AO1, many candidates had completed a range of research and had selected and presented the required information in logical and well-presented formats. Candidates need to be producing public information booklets, so the information included needs to be clearly and logically presented and targeted at the correct level. Scientific knowledge needs, where appropriate, to be supported by related diagrams.

AO2

- For AO2a, mark band 3, candidates need to select the relevant information and to give comprehensive evaluations of how successful recombinant DNA is in solving problems associated with food production.
- For AO2b, 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.
- For AO2b, a summary of the moral, ethical and environmental issues concerning the use of DNA technology in GM plant production should be seen for mark band 2, as well as an 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 on their experimental work (25-30 hours).

- Risk assessments need to be included to support safe working practices.
- For AO3a, candidates need to be producing a clear plan of action at all levels. This was not always evident in several candidates' work. Evidence of a candidate's planning needs to be seen for mark band 3.
- Contingency work, where selected repeats are carried out with reasons, could also support top marks being awarded.
- AO3c, mark band 3 should demonstrate the collection of sufficient data from candidates to enable statistical analysis to be completed. Some of the graphs produced were not worth the marks they had been given.
- Care needs to be taken that suitable immobilised enzymes are prepared and used, and appropriate practical work is carried out to obtain quantitative results.
- For AO3d, candidates need to use their findings from the experimental work to produce suitable conclusions and interpret the 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 quality of the evaluations needs to be considered carefully by many centres. At present, many candidates are being credited with band 3 marks when they are not meeting the requirements for this band.

G628 Sampling, Testing and Processing

General Comments

The number of candidates taking this examination was around 700, which was a similar figure to both June 2011 and June 2012.

Many marks were in the range 35 to 60 (out of 90). This was an improvement on recent examinations, where the range was lower. There were fewer candidates with scores of less than 30. The number of candidates scoring more than 60 remains small, although there was an increase on the June 2012 figures.

It was clear from the answers that candidates were well-prepared for Questions 1 and 2, which were based on the pre-release material. There is still a need for some candidates to read the questions carefully. In some instances, candidates responded with good material but unfortunately this was not relevant to the question. In general, numerical answers are now being better attempted but there remains a significant minority for whom percentage calculations prove difficult. The Examiners felt that graphical work showed an improvement on that seen in recent examinations.

As mentioned in previous reports, one of the weakest areas in candidate performance is when candidates design their own experiments given a basic outline of what is required. It is not expected that candidates will have tried the particular experiment but they should be able to apply their own background knowledge when solving the problem. This too, was an area where candidates did not read the question carefully enough. For example, in Question 1 (c), candidates were asked to start with a solution of sodium nitrate and explain how they would obtain sodium nitrate crystals from it. Many candidates started with solid caliche, rather than its purified solution, giving irrelevant material and, thereby, losing time.

The answers provided to the question on chromatography showed an improvement on past assessments but the basic questions on spectroscopy revealed that, for many candidates, this topic remains a mystery.

In general, the responses to Question 3 were weaker than the answers given to Questions 1 and 2. It seemed that some candidates could not apply their knowledge to new situations. There was some evidence that the paper may have been a little long, as some candidates appeared to have given up before they reached the end of this final question.

Comments on Individual Questions:

Question 1

(a)(i) This was an easy first mark. Most candidates mentioned the danger from falling rocks.

(a)(ii) The examiners expected a definition of ‘impervious’ in this instance to mention that liquids could not penetrate the material.

(a)(iii) Most candidates gained a mark for eye protection or, more rarely, reinforced footwear.

(a)(iv) Masses of between 10g and 2kg were seen as acceptable for being used in tests.

(a)(v) In general, candidates provided sensible suggestions for the additional label details.

(a)(vi) Most candidates realised the need to avoid contamination or loss. Some candidates suggested that the samples would be affected by gases in air, not realising that they had been in place for millions of years,

(b)(i) Many candidates recognised that the variation in colour of the samples meant that were not homogeneous. (b)(ii) Nearly all candidates provided a suitable method for removing dust.

(b)(iii) The meaning of the word 'deliquescent' was well known.

(b)(iv) The mass of water absorbed by the sample was invariably correct but few candidates could do the ratio sum that followed.

(b)(v) Very few candidates stated that the solution would remain colourless, as the yellow material was insoluble.

(b)(vi) The examiners felt that this graphical question was well done, with many candidates gaining the full credit of four marks.

(c) This was the first of the two longer questions. Candidates were asked to describe an experiment to obtain sodium nitrate crystals from the solution described in (b)(v). A large number of candidates started with the impure solid (caliche), which was not required. It was rare to see candidates gaining the full six marks, despite 10 valid points that could score. Some candidates heated the aqueous solution to 350^{o}C, forgetting that water boils at 100^{o}C. In general this question was poorly answered with many essential stages missing.

(d)(i) The need for a risk assessment before starting the practical work was well-understood.

(d)(ii) This question asked both for the area where this should be carried out and why this was necessary. Some candidates did not state that toxic gases were involved.

(d)(iii) Although most candidates calculated the correct mass of iodine, many could not then give the percentage to the required three significant figures.

(d)(iv) The need for cleaning / washing was well understood.

(e) Many candidates could not relate parts per million with grams per kilogram.

(f) This was an accessible question for most candidates, who correctly gave 30g followed by 70g.

(g) Few candidates could state the purpose of an indicator in a titration. Although this was not an acid-base titration the examiners accepted 'neutralisation' on this occasion.

(h)(i) This question on graphs was done well, with most candidates plotting the points correctly and then drawing a suitable line of best fit.

(h)(ii) Some candidates did not understand what was meant by extrapolation and did not continue the line to the x axis. Of those who did, most were then successful in reading off the percentage of iodine present in the soil sample.

Question 2

(a)(i) The examiners were looking for 'pick it and then test it'. Both these points were not always provided.

(a)(ii) The meaning of representative sampling was clearly understood by nearly all candidates.
(a)(iii) The article stated that a new flush grew every 10 days, but some candidates failed to realise that this fact was provided.

(a)(iv) Very few candidates realised that storage in wet conditions would lead to decay or fungal development.

(b)(i) Many candidates suggested three valid factors and gained full credit.

(b)(ii) Although the majority of candidates realised that this time of the day would represent the optimum time for use of the insecticide, there were clearly some who had not read this section of the article.

(b)(iii) There were a number of reasons why planters should record their results and nearly all candidates gave a valid response.

(b)(iv) The need for an increase in the frequency of spraying or using a higher concentration of insecticide were the commonest correct answers.

(b)(v) Nearly all candidates answered this well.

(c)(i) The internet or relevant scientific books were the commonest correct answers.

(c)(ii) Most candidates realised that the volume of insecticide solution was insufficient for covering one hectare. Some candidates became muddled by the units given.

(c)(iii) Many scripts showed that candidates realised that the insecticide needed time to take full effect or that it should not be present when the tea was picked.

(c)(iv) The need for safe storage or disposal was generally recognised.

(d) Many candidates gave the correct answers of 300 000kg followed by 75 000kg.

(e)(i) Many answers correctly described the zeroing of the colorimeter using distilled water.

(e)(ii) This was the second of the longer questions and gained a similar response in the way in which it was answered to Question 1 (c). In general, this was a little better answered but some candidates used 'tannins' rather than a teabag. The question asked candidates to use a teabag but many candidates chose to use more than one.

(e)(iii) Candidates often had trouble in suggesting the shape of this graph. The examiners expected a curve of decreasing gradient.

(f) Most candidates suggested, correctly, that dichloromethane is toxic or simply that the use of carbon dioxide is safer.

(g) The use of biodegradable material for the teabag was generally recognised.

(h) Although a number of candidates found that 93% of the caffeine had been removed, they could not then do the second stage in this calculation.

Question 3

(a)(i) Many candidates stated that a larger surface area would be present if the cloves were crushed.

(a)(ii) 'Condensation' or 'gas to liquid' provided an easy mark for most candidates.

(a)(iii) Some candidates suggested that a build- up of pressure might occur in the flask and gained a mark. In too many cases this was followed by 'steam will escape to relieve the pressure', without realising that the tube was in the water, and water rather than steam would be lost. A few candidates thought that tube **B** was a thermometer.

(a)(iv) Most candidates gave a disadvantage of a batch process.

(a)(v) The use of a separating funnel was unfamiliar to many candidates although the way in which it worked could be worked out from the diagram.

(a)(vi) Although many candidates mentioned the need for the use of a fume cupboard, very few mentioned the apparatus needed and the way in which evaporation should occur.

(a)(vii) Many candidates gained both marks for the TLC chromatogram.

(a)(viii) Very few candidates stated that the chromatography should be repeated with a different solvent.

(a)(ix) It was uncommon for candidates to write that the molecular ion will provide the relative molecular mass of the compound.

(a)(x) Only a few candidates realised that infrared absorption spectroscopy gives information about the covalent bonds present in a compound.

(b)(i) This was an accessible mark for nearly all candidates. Most suggested that it was an anomaly and should be rejected or the test repeated.

(b)(ii) Many candidates did not notice that the answer was to be given to three significant figures and did not give 82.0%.

(c)(i) This was an accessible mark for many candidates, who demonstrated how to read from a graph.

(c)(ii) Fewer candidates stated the assumption that had been made in the drawing of the graph.

(d)(i) There were many candidates who gained at least 2 of the 3 marks available. The volumes of hexane and of ethanol were the most popular responses.

(d)(ii) Surprisingly there were very few candidates who suggested recovering or re-using the solvent.

G635 Working Waves

General Comments

Most candidates attempted most of the questions.

There was some evidence of confusion between some of the devices included in the specification. This was particularly evident in Question 7 where candidates did not always distinguish clearly between image intensifying screens, grid, narrow beams and filtration of X-ray. Similarly, some candidates confused monomode and graded-index optical fibres.

Reasonable attempts were made at both calculations, although, as in past years, some struggled with powers of 10. However, in Question 6 (b), many correctly calculated the total number of photons that would be emitted over the period of 18 hours if the sample continued to emit at the same rate but this was not what the question asked.

Comments on Individual Questions

1 (a) A majority of candidates scored 2 or 3 out of the 4 marks. The variety of permutations in answers suggests that a number were guesses. Many different ways of expressing increase, decrease, stays the same, were accepted. Some, otherwise high-scoring candidates, either did not to notice "brighter" or did not recognise its relationship to amplitude.

1 (b)(i) Almost two thirds of candidates gave correct answers. "Total internal refraction" was a frequent incorrect response.

1 (b)(ii) Only about one third of candidates achieved more than one mark. Most candidates provided a diagram. Most marks were gained from the written part of the answers. Many candidates did not attempt to compare refractive indices and/or speed as suggested in the rubric. Most of those who did so, tended to know which was greater. The term optical density was acceptable in place of refractive index. "Density of glass" was not sufficient. Although the stem of the question states that the glass is uncoated, references to cladding were common.

1 (c)(i) Some candidates did not make it clear that the order of arrangement of coherent fibres is the same at both ends. Some struggled to find the right language to describe what they knew

1 (c)(ii) The most common correct answers were various forms of lighting, e.g. for display cabinets, swimming pools and Christmas decorations. Almost half were also able to give a correct reason, in many cases lack of importance of the order of the rays. A few gave "cheapest". "Ease of manufacture" was rarely seen. Endoscope was only accepted where the answer made clear that the incoherent fibres are used for carrying light to the subject.

1 (c)(iii) Endoscopes, communications and television were common correct answers.

1 (d) The specification requires candidates to have detected the light signal from an optical fibre using a photodiode. Only a small number of candidates gave the correct answer. Vague responses such as "transducer", "camera" or "light detector" were not accepted. Examples of completely wrong answers were: "LED lighting", "endoscope", "electrometer", "sphygmomanometer", "telephone", "modem", "switch", "photon", and "thermal imaging camera".

1 (e) About a third of candidates failed to score any marks, the rest achieved marks spread fairly evenly from 1 to 6. Most candidates used one or more diagrams to indicate curved paths and different path lengths. Some also used diagrams to show variations in refractive index and distorted outputs. Lack of labelling meant that the latter did not always score marks. The next most common points met were that refractive index varies gradually and the direction of this

variation. Some suggested that the refractive index varies along the length of the fibre or used unclear terminology such as density. A significant proportion recognised that in graded-index fires, all the rays arrive at the same time. Some candidates suggested that fibres arrive at the same time. The remaining points in the mark scheme were seen in some scripts. In general there was a correlation between the number of points made and the clarity with which they were expressed. Some responses, which might otherwise have merited all six marks, only received five because of ambiguities or other lapses in clarity.

2 (a)
& (b) Some transposed these two answers. Others put standing and travelling.

2(c) Hardly any candidates said up-down is polarised "because the vibrations are in *only one of many possible* (transverse/perpendicular) directions". Some referred to sound and light waves.

2 (d)(i) Almost two thirds scored 2 or 3 marks, some losing the mark for the unit, often given as $m\ s^{-1}$.

2(d)(ii) Few candidates understood that frequency is a property of the source so cannot change as the wave propagates. This then led them astray for the second mark when they used $v=f\lambda$. Very few quantified the reduction in wavelength.

2 (e)(i) Many just put highest. Some put from peak to trough.
2 (e)(ii) Very few students were able to explain this; many just assumed that the waves joined up.

2(f)(i) Most showed a phase shift but not by the correct amount. The most common error was a shift of 1/8 of a cycle of a wave instead of 1/4.

2 (f)(ii) Many shifted the wave along the axis. Only a very few drew a horizontal line.

3 (a)(i)
& (ii) Less than half correctly answered each of these questions, which tested knowledge only a little beyond their GCSE study. Incorrect answers included some that transposed the positions of UV and IR and others that placed the letters towards the extremes of the spectrum; in some cases both were shown on the same side of "visible". A small number wrote the letters incorrectly e.g. "IV".

3 (b)(i) The focus of this question was the difference between disturbed and undisturbed ground. Better candidates recognised the key point relating to different temperatures. The best recognised that disturbed ground is likely to be warmer, although a number ascribed this to the friction produced by digging. Some answers addressed only the first line of the question, describing in general terms the formation of images and in some cases the thermal images of humans sought by the police.

3 (b)(ii) Some good answers were given. Others thought spatial was related to the distance between camera and object, and thermal was related to the range of temperatures that could be detected. Credit was allowed for a reasonable explanation of the terms as well as for formal definitions which were seen much more rarely. A number of candidates displayed little familiarity with the terms.

3 (c) This question provided several clues towards the correct answer and most understood the function of the ozone layer.

4 (a) Generally well-answered. A small proportion of candidates lost marks because they ignored the instruction to use each letter only once.

4 (b) Very few obtained either full marks or no marks; a score of around 3 or 4 was common.

5 (a) A minority of candidates wrote the words in the boxes instead of the numbers. These were marked correct where appropriate. The small proportion of incorrect answers included all permutations.

5 (b) Many candidates recognised that the phone and internet cannot both be used at the same time. Some wrote this in the explanation space, but were still given credit. Some mentioned only the phone or the internet but not both. A common incorrect answer was interference. Fewer recognised that the explanation was the single available frequency. Some came close by indicating that bandwidth is limited.

5 (c)(i) This question required candidates to apply their knowledge to an unfamiliar situation. Very few recognised that the loops are a precaution in case the bridge bends or stretches.

5 (c)(ii) Loss of light was recognised by a minority as the problem. Even fewer fully understood the reason for this.

6 (a)(i) Most candidates recognised the need for sufficient time for the diagnosis. Some referred to treatment rather than diagnosis. Others referred to the "strength" or "weakness" of the tracer.

6 (a)(ii) Most were able to say something about the potential hazard to the patient or others.

6 (b) Less than a quarter of candidates gave fully correct answers and very few scored 1 or 2 marks. A very common incorrect answer was 1 080 000. This was obtained by calculating the total number of photons that would be emitted over the period of 18 hours if the sample continued to emit at the same rate. This not only failed to answer the question set, but revealed that candidates believed that the activity would still be the same after 18 hours for a material with a half life of 6 hours. A few attempted to calculate the overall half life. This demonstrated an awareness of an equation that is on the specification but not applicable for this particular question, which related to the sample in the bottle.

6 (c)(i) About a quarter of candidates recognised that the additional decline was caused by excretion, although not all could spell the word. Appropriate examples such as urine or sweat were acceptable. A number of candidates incorrectly suggested absorption by the body.

6 (c)(ii) This was generally well-answered but not always well phrased e.g. "... will end quicker", "... will deteriorate quicker".

6 (c)(iii) Around a third of candidates were aware of the correct term. Incorrect answers varied widely, including "physical half life", "effective half life", "patient half life", "half half life", "radiation detector", "less penetrative".

6 (d)(i) Just under half gave correct answers. Wrong answers included "endoscope", "CAT scanner" and "photomultiplier".

6 (d)(ii) Very few scored well on this question. Marks were most commonly gained for the bottom box where lead grid (but not just grid) was accepted as well as collimator. In general, minor spelling errors are not penalised but this does not apply when an alternative technical term such as colorimeter is given.

7 (a) Responses tended to focus solely on the benefits of X-rays with only a minority comparing these with the associated risks.

7 (b) Roughly three-quarters of candidates failed to score any marks here. Most correct answers mentioned fluorescent screens and their ability to convert X-rays into light. Many supposed that the screens blocked radiation in some way, others that they intensified the X-rays. Some answers appeared to confuse image intensifying screens with grids or narrow beams.

7 (c)(i) Many candidates knew that the grid absorbs radiation. Some, who knew that scattering was involved, believed that the grid reduced or prevented scattering, rather than removing the scattered rays.

7 (c)(ii) Many answers involved focusing of the X-rays rather than producing a sharper image.

7 (c)(iii) Answers about removing unwanted X-rays without saying why they were unwanted did not score. Only better candidates knew that the material used is aluminium and that it removes lower frequency rays. Few referred to the wide range of frequencies generated by X-ray machines or that higher frequencies are used for imaging.

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