

**Applied Science**

Advanced GCE A2 H575/H775

Advanced Subsidiary GCE AS H175/H375

**OCR Report to Centres**

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**June 2012**

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, OCR Nationals, Functional Skills, Key Skills, Entry Level qualifications, NVQs and vocational qualifications in areas such as IT, business, languages, teaching/training, administration and secretarial skills.

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

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

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

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

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## Overview

The AS and A2 Applied Science qualifications continue to attract candidates from a wide range of both traditional and more vocational level 2 backgrounds, with each qualification offering an interesting and progressive route to study science to a higher level. The examined units continue to challenge candidates, however, performance this series indicated evidence of a wide range of skills and knowledge from the candidates and it was encouraging to note the high level of scientific language adopted by the more able.

### Coursework

A moderation report is provided for each coursework unit and centres are encouraged to follow any guidance suggested, especially if the assessment decisions of the centre were not in agreement with the external moderation. Where candidates are aiming for full marks at mark band 2, work needs to reflect coverage of all the assessment criteria at the appropriate level, not just coverage of the requirements. Centres also need to ensure where the top mark band is awarded that the quality of the work produced by the candidates reflects 'a' grade standard either at AS or A2. Internal moderation is necessary and is particularly important where candidates have been taught by a number of teachers.

It was again noted that candidates' portfolio work at A2 showed a marked improvement in research skills, evidence of independent working and more selective use of the Internet, although, more accuracy and precision is still needed for the higher level work. There is a requirement to assess spelling, punctuation and grammar in both the portfolio and externally assessed units, and there is the opportunity to reach A\* for the higher ability candidates. Work assessed at the top of mark band 3 should not be showing errors.

### Question papers

The plan for G623 (*Cells and Molecules*) again gave candidates the opportunity to use the skills they gained from their portfolio work and 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 and is in a logical order. Limited guidance is expected from staff during initial discussion of the tasks and centres also need to ensure that they allow and encourage independent thinking from the candidates. For the externally assessed test the overall performance of the candidates was generally of a similar standard to previous examinations.

Centres need to note that the A2 papers G628 (*Sampling, Testing and Processing*) and G635 (*Working Waves*) contain some part-questions that include Stretch and Challenge. These aim to test the ability of the candidates to demonstrate a deeper knowledge and understanding of the subject, to show ability to present a logical development of ideas, and to apply their knowledge to unfamiliar contexts.

For G628 (*Sampling, Testing and Processing*) candidates were generally focusing their responses using information gained from study of the pre-release material. Candidate answers also indicated a greater awareness of the requirements of this unit than in previous years, although there is still a need for some candidates to read the instructions more carefully for each question and to ensure that they use precise scientific language in their answer. As noted on previous occasions, candidates should look at their answer to numerical questions to check if the answer obtained is sensible.

For G635 (*Working Waves*) numbers continue to rise with evidence of weaker candidates able to find some sections which they could successfully answer and more able candidates demonstrating their greater knowledge and skills.

The terms *spatial* and *thermal resolution* introduced in the 2009 amendments to the specification and the difference between binary and digital numbers continue to elude a number of candidates.

Recall of the formula required for the calculation, and substitution was well done but many candidates were let down by their inability to convert MHz to Hz and/or answer to four significant figures.

### **A level reform**

Over the last year, the future of A levels has received extensive interest. Ofqual is currently running a consultation to seek views from higher education, employers, learned societies, colleges, schools and others.

There is a link to all the relevant consultations, debates and reports at <http://social.ocr.org.uk/groups/science/conversations/level-questionnaire-and-level-reform> (also see <http://social.ocr.org.uk/groups/science/conversations/level-timelines>). We would strongly encourage teachers to contribute to the consultation (11 September deadline).

### **Keep up-to-date with developments in GCE Applied Science**

The OCR community, [www.social.ocr.org.uk/groups/science](http://www.social.ocr.org.uk/groups/science), is a useful reference point to help keep teachers up-to-date with GCE Applied Science (and science in general). I would strongly recommend visiting the site and registering.

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

### **General Comments**

Work selected for moderation reflected coverage of all the AS units. Overall, a range of marks was seen; however, assessment was much more generous this series than in previous years. The portfolio units moderated were as follows:

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

Many 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 series that they are entering candidates for and if there is a change in the staff named for the accreditation, OCR must be informed.

More centres were scaled than in previous years, as many centres were over-generous in the assessment of their candidates' portfolio work. Research work assessed at mark band 3 often did not show suitable selection and understanding by the candidates and the referencing was not sufficiently precise or focused. Work assessed at mark band 3 in many cases did not reach the necessary standards required by the assessment criteria i.e. work was not sufficiently detailed and accurate and evaluations not at a high enough level for A grade work. Centres need to be aware of this for future submissions; care needs to be taken by the candidates to ensure that the level of the work reflects a full and detailed understanding of both the assessment criteria and the content in the specification. Candidates' portfolio work needs to show the use of accurate terminology, correct spelling, punctuation and grammar and this needs to be reflected in high level reports, especially where mark band 3 is awarded.

In addition, it is essential that practical work shows progression from GCSE. Centres where scaling has occurred for AO3 need to review their practical provision to ensure candidates can access the full range of the assessment criteria. OCR offers a free coursework consultancy service to support the assessment. Advice will always be given on the suitability of the practical work which centres may wish to offer. Details are available on the OCR website.

Most portfolio work was well organized and presented using treasury tags which allowed moderators to easily read and locate candidates' work. Centres are advised not to include candidates' work in plastic pockets or ring binders.

Moderation Manager, an online electronic administration tool, was used to select the samples for moderation, and moderators found that the majority of centres returned the requested samples and appropriate Centre Authentication forms efficiently; this was appreciated. However, there are a significant number of centres where the URS forms were not attached and work was not labelled with either the centre or candidate numbers. Increasingly, there are a large number of centres who had recorded the candidates' marks inaccurately.

Comments and page references on the URS forms again support the moderation process and aid moderators in locating the work. Guidance on the URS forms does recommend this. Annotation using the assessment code e.g. AO1(a) on the candidates' work supports the moderation process.

The majority of the candidates are carrying out a wide range of interesting research both on the internet and by actual visits, but the recording of the referencing needs to be much more detailed. The practical work needs to show a vocational link, usually supported with suitable reasons on why the experimental work needs to be performed, but care needs to be taken that candidates are recording their experimental results to the required precision and accuracy. Risk assessments have been of a variable standard but they need to be suitably focused on the specific hazards and risks of the experimental work carried out by the candidates and are used as working documents, a lot of generic and unnecessary information on unrelated hazards and risks were seen.

Centres need to take care that when giving full marks at mark band 2, all the criteria in that strand is met at the appropriate level. In several instances, work was covered but at quite low levels. A grade work should be accurate and show understanding of researched material taken from the internet. Work should also be suitably referenced and presented. Centres should be advised to spend time with candidates teaching research and referencing techniques, and presentation.

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.

## G620 Science at Work

This unit gives candidates the opportunity to carry out independent research on a range of organisations and to be aware of the importance of science within these organisations. Candidates also carry out two practical activities which can be chosen by the centre but they need to show vocational links. The practical work chosen does not necessarily need to link to the organisations studied for AO1 and AO2.

The assessment requirements for the specification include:

- AO1:** record of four surveys of science based organisations; one in depth study; work on health & safety laws and regulations
- AO2:** evidence of impact organisation has on society; calculations on provided data or data obtained from experimental work
- AO3:** two practicals with a vocational context with recorded processed and evaluated results

### AO1

Centres are advised to refer candidates to both the requirements of the specification and the assessment criteria for their surveys and in-depth study. The survey work needs to show candidates' ability to select suitable information and for mark band 3, candidates should be presenting detailed and concise information about four science based organisations of their choice. Centres need to make sure that sufficient guidance is given to candidates to ensure that they choose organisations with sufficient science for them to describe and discuss and also ensure they have the opportunity to research sufficiently to enable them to explain the nature of the work carried out. There was minimum evidence of evaluation and justification of the research material. Assessment tended to be over generous at the higher levels of the mark bands. Centres should try and give candidates more guidance to improve the quality of the selection, the level of the science identified and presentation, especially where candidates are aiming for mark band 3. For AO1c mark band 3, candidates need to produce evidence to show that they understand how their chosen organisations comply with the necessary laws and regulations, so specific links need to be targeted; assessment was again often generous for these higher mark bands.

For AO1, the following general guidance is recommended:

- Candidates complete four surveys with one of these used as a base for the more detailed in-depth study.
- 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.
- Surveys should not include excessive 'cut and paste' material.
- The text of the survey should, where appropriate, use candidates' own words or suitable selection from their research. Lengthy detail is not required as this work is intended to be an overview of different organisations.
- 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 and quality control

- details and specific links to health and safety laws and regulations which can be used for the requirements of AO1c.
- The in-depth study at mark band 3 is a comprehensive research study where information is selected and clearly and logically presented. Some evaluation and justification of the use of the material needs to be included also, supported by comments on the validity of the sources candidates have used.

## AO2

Many candidates were not producing sufficiently detailed work to reflect the requirements of the specification for AO2a. Candidates can link AO2a with their in-depth study, but the work for this strand needs to be focused on the following bullet points:

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

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

## AO3

Practical tasks chosen should show progression from GCSE and have a vocational link. Simple chromatography of inks as a stand alone practical or flame tests or simple measurements of exercising are not showing progression from GCSE. It is advisable that candidates show their competence in different skills in this practical work. It is also not advisable to do practicals demonstrating the same techniques e.g. two volumetric exercises.

Good practice was seen where candidates are linking practical activities to a vocational context, consequently giving a reason for the completion of the practical work. A range of volumetric exercises, chemical preparations, physical testing of materials, catalytic work, vitamin C testing, forensic focused analysis, optical work, and several practicals linked to units G622 and G623 were seen. It is important that practical work is reflective of AS standard and consequently should show a step up from practical work covered at GCSE. Candidates still need to ensure that for mark band 3 all relevant observations or measurements are made and accurately recorded with the appropriate precision. Many errors of significant figures and omissions of units were seen, even when mark band 3 was awarded. Processing skills in graphs and calculations were clearly evident but units are still missing from graphs and scales are poor. Centres are encouraged to support their candidates to improve these skills. Evaluation of practical work assessed at mark band 3 needs to reflect A/B grade work, which includes using an appropriate scientific discussion. Candidates need to spend more time in ensuring accuracy of their work, many careless mistakes and omissions were commonly encountered.

## G621 Analysis at Work

This unit gives candidates the opportunity to research energy policies of organisations, as well as considering energy efficiency and environmental impacts. Their research can also form the basis for calculations. This unit also offers the opportunity for candidates to extend their level 2 practical techniques on analysis and to do a third practical which can be based on any part of the specification content of this unit. This gives the opportunity for candidates to complete enthalpy of combustion practical work or work on energy.

The assessment requirement for the specification include:

- AO1:** information showing an energy policy and energy usage of an organisation with a consideration of energy efficiency and environmental impact
- AO2:** study of large scale and small scale generation to include energy transfers with data and calculations to show a comparison of fuel costs
- AO3:** three practical analyses - one qualitative analysis, one quantitative and a third investigation with results processed and interpreted

Work on energy policies was very varied this series and some centres were generously assessing this strand. Candidates need to select the appropriate information and present it clearly. The use of university energy policies formed a good basis to cover the assessment criteria, and those candidates that used supermarket chains also had an abundance of information on which to base their reports; however, care needs to be taken that suitable selection of material takes place and the focus is on the energy policy.

General guidance is as follows:

### AO1

- Candidates need ensure work is suitably selected on the energy policy rather than environmental policies. Although this is quite difficult in some organisations (as website information can be extensive), candidates will not be penalized if the energy policies of their chosen organisation is quite brief as long as they accurately record and suitably select 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 their energy consumption.

### AO2

- Describing and comparing large scale and small scale electrical generation from two chosen sources is showing improvement and work is much more selective 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 bands 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 are now being given with candidates carrying out appropriate mathematical calculations using this data. This continues to improve, however, for mark band 3, candidates need to be showing evidence of their skills over a number of complex calculations.

### **AO3**

Several centres were giving candidates 7 marks for all of their practical work when work was not reflective of the requirements of 'A' grade work. Centres are advised to follow the guidance given below.

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

## G624 Chemicals for a Purpose

This unit is now the most popular of the optional units. It gives candidates the opportunity to extend their chemistry knowledge from previous level 2 work and study the preparations, properties and actions of examples of chemicals which are commonly used. Practical work is focused on laboratory preparations and centres can give candidates the opportunity of preparing both inorganic and organic compounds.

The assessment requirements for the specification include:

- AO1:** a description of two examples of inorganic and two examples of organic chemical compounds, discussing their chemical structure, properties and uses and a detailed account of two compounds, one of which is made of oil
- AO2:** relevant research of one industrial process that involves the use of a catalyst; a report that includes an understanding of the social, economic and environmental impact of the product selected
- AO3:** a sample and account of the preparation of two products that have been synthesized, purified and analyzed

The range of chemicals chosen for research ranged from inorganic on commonly used salts (sodium chloride, copper sulfate magnesium sulfate etc.), a range of acids and alkalis (e.g. sulphuric, 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. Centres need to ensure that the choice of compound will enable the candidates to understand the chemistry required to cover the requirements of AO1a and AO1b. For AO1c it is advisable that candidates choose two further compounds and are aware of the full extent of the required assessment criteria. Detailed explanations of the relevant reactions are required where mark band 3 is targeted.

General guidance is as follows:

### AO1

- For mark band 3, details are needed on how the properties depend upon the structure and how uses depend upon the properties. Assessment was generous as candidates were not using their researched material appropriately.
- 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.
- Candidates could do research and practical work to support the understanding for this section and this could link to AO3 if required, but where this occurs candidates need to ensure that the bullet points in the assessment criteria are fully covered.

### AO2

- For AO2a mark bands 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 calculations.
- Manufacture of ethanol, polyethene, sulphuric 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 work shows understanding of the chemical principles involved. Additionally, for mark band 3, the report needs to include at a high level discussion of the social, economic and environmental impact of the product chosen.

### **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 requires evidence of suitable selected research and evidence of the use of a detailed and accurate risk assessment as well as the completion of the preparation, purification and analysis of the compounds chosen.

- For AO3a, candidates need to be aware of the requirements at the different mark bands:  
research and preparation for mark band 1;  
research, preparation and analysis mark band 2;  
research preparation, purification and analysis and risk assessment 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 weighing 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

Centres showed good practice where work was selected, referenced and directly linked to the coverage of the assessment criteria. Evidence showed understanding of candidates' research work by either summarizing in their own words or suitably referencing the work within the text supported candidates explanations. A range of practical activities was seen. Some of the most popular seen were microscopy, chemical analysis, fingerprinting and cast making, and refractive index investigative work.

The assessment requirements for the specification 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 visualize forensic evidence, including ethical considerations.
- AO2:** a report on a forensic case study on evidence and proof; work that demonstrates the use of calculations to support forensic measurements or observations.
- AO3:** at least one forensic analysis in each of the following areas - biological, chemical and physical techniques.

Care needs to be taken of generous assessment for this strand. Candidates need to be aware of the high levels skills needed to be demonstrated when they are aiming for the top marks. Work needs to show a thorough understanding of the scientific knowledge involved. The collation of a number of extracted reports from a range of websites does not indicate this. As well as coverage of all the bullet points of the assessment criteria, the work has to be at the appropriate level.

General guidance is as follows:

### AO1

- For AO1a research work needs to show selected information for 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. Work was generously assessed for this strand.
- 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.

### AO2

- For AO2a good case study work should include relevant information linked to the following bullet points:
  - the ways in which forensic scientists ensure the quality of evidence collected and analyzed 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, refractive index calculations and bullet projectiles for mark band 2 and 3.

**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 refractive index of glass. Some higher level work was supported by chemical equations and a range of explained spectroscopic analysis.
- Mark band 3 candidates need to ensure detailed processing and interpretation of their results and a discussion of their significance.

## G626 The Physics of Sport

This unit gives candidates the opportunity to research into science involved in a range of sporting activities. Work for AO1 needs to be presented in the form of guidance leaflets and AO2 gives candidates the opportunity to produce a presentation linked to sporting equipment. Practical work again 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.

The assessment requirements for the specification 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 that 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, leaflets rather than reports are required. Centres are directed to the information on page 106 of the assessment criteria regarding the target audience for these leaflets.
- Candidates should be suitably selecting material for their leaflets and using the specification reference (page 33) for the content.
- Mark band 3 work needs to show detailed knowledge written, where appropriate, in candidates' own words with evidence of the linking of scientific knowledge to the chosen sport or equipment.

### AO2

- For AO2, a 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, candidates need to show that they can plan two investigations. Centres are directed to the information on page 36 of the specification. Practical work needs to show a progression from GCSE but the choice can be determined by the centre.

# G622 Monitoring the Activity of the Human Body

## General Comments

Candidates generally coped well with this paper and were able to complete all items in the time allocated. Relatively few candidates failed to follow the rubric of the paper. A number of candidates used the additional page available at the end of the paper to complete replacement answers or to extend their responses from the main section of the paper. The range of candidate scores was from 11 to 82, indicating the spread of skills and knowledge demonstrated. It was encouraging to note the level of scientific language adopted by the more able candidates and that, with the exception of a challenging item based on the ELISA test, many candidates responded well to the extended-writing items.

## Comments on Individual Questions

### Question No.

- 1(a)** Many candidates responded well to this item and had a good understanding of the values and ranges for various physiological measurements. No alternative pattern was observed for incorrect responses.
- 1(b)** Although most candidates realised that the equipment was the sphygmomanometer, some confused this with the spirometer.
- 1(c)** The majority of candidates described the detection of the pulse using two fingers at the wrist. Most used 30 or 60 seconds as the recording period. It was possible for candidates to obtain full marks if they referred to the use of a digital sphygmomanometer or the more-recently developed clip placed on the finger tip.
- 1(d)(i)** This item was well-understood by many candidates and, although they may have miscalculated the answer to part 2, they were able to support the increase in peak flow with data extracted from the graphs.
- 1(d)(ii)** Some candidates found this item to be straightforward, others confused the direction of air flow between expiration vs inspiration.
- 1(e)(i)** This item did not present a problem for many candidates.
- 1(e)(ii)** 'W' was correctly identified by most candidates.
- 1(e)(iii)** Many candidates realised that the trace for reading B was the product of exercise or showed a deeper/more frequent breathing pattern.
- 2(a)(i)** Most candidates have a sound knowledge of the structures in the heart but some were unsure of the type of valve at label D.
- 2(a)(ii)** The delivery of deoxygenated blood at the vena cava was appreciated by many candidates but the channelling of blood into the (right) atrium was understood less. Most realise that the valve stops the backflow of blood.
- 2(b)** The creation of greater pressure in the left ventricle was often linked correctly to the thick ventricle wall, although some candidates expressed this in a slightly confused manner. Most realised that the blood travels to the rest of the body from this region of the heart.

- 2(c)** The problem with the valve was often correctly associated with backflow but the concept of poor oxygenation of the blood was not appreciated.
- 2(d)(i)** Some candidates knew that the hormone was adrenaline but this was not the case for all.
- 2(d)(ii)** If adrenaline was correctly identified, many candidates were in a position to state that it enhances the rate of heart contraction. This use of the SAN as the target site for this hormone was generally not understood.
- 2(e)** Many candidates did well with the item. No clear pattern of alternative responses was noted.
- 2(f)** Candidates were often able to achieve some marks for this item but few were able to do very well. Many were able to state a clear function for all four techniques.
- 3(a)** Some candidates were unable to explain the principle of X-rays with regards to bone vs soft tissues. It was noted that some incorrectly assumed that the muscle tissue did not absorb any X-rays.
- 3(b)** It was surprising to observe many abdominal organs quoted for this item. Relatively few candidates appeared to understand that the heart is located, along with the lungs, within the rib cage.
- 3(c)** Many candidates did well with this item. It appeared to be accessible to most.
- 3(d)** This item enabled candidates to respond correctly to the associated risks and safety precautions. It was encouraging to note many correct links with named hazards.
- 4(a)** Although many candidates realised that insulin injections were needed for this item, some did not give a full explanation to the intake of much lower levels of glucose etc.
- 4(b)** Some candidates were able to name a condition and describe the change in levels of either red or white blood cells. Some were slightly confused but did obtain a mark for the condition.
- 4(c)(i)** Most candidates obtained full marks for this item. No clear pattern of alternative responses could be identified
- 4(c)(ii)** Many candidates realised that a sample of blood must be taken but they did not appear to realise that the sample is divided into two and that one of them is then analysed in a laboratory. Some were able to name the specific test or equipment used for the analysis.
- 4(d)** This was a challenging item for the majority of candidates. The presentation of the order of stages was difficult for most and some critical stages were missing. This meant that a number of candidates obtained few marks because the ELISA test, as outlined, would not work.
- 5(a)(i)** The process of aerobic respiration was well-known to many candidates.
- 5(a)(ii)** Most realised that ATP was the correct response.
- 5(a)(iii)** Most also realised that lactic acid was the correct response.

- 5(a)(iv)** Some candidates were apparently confused by this item and were unable to identify the energy released from combustion. Alternatively, some were able to obtain full marks for this item.
- 5(a)(v)** Many candidates appreciated that aerobic respiration takes place in the mitochondrion and anaerobic in the cytoplasm. However, some candidates were quite confused and provided answers such as muscle tissue.
- 5(b)** The majority of candidates had a good understanding of the different processes requiring energy.
- 5(c)(i)** The responses to this item were occasionally mixed with those required for item
- 5(c)(ii)** Relatively few candidates correctly described a condition in the respiratory and circulatory systems.
- 5(c)(ii)** Many candidates correctly described the reduction in the availability of oxygen but few linked this to aerobic respiration in the muscle cells/tissues.
- 5(d)** A number of candidates found this item to be challenging. Although they could correctly identify one advantage or disadvantage for the CAT scanner or MRI scanner, they struggled to describe two such features for each marking point.

## G623/01 Cells and Molecules – Planning Exercise

### General comments

Centres are asked to make certain that candidates read the instruction brief carefully to avoid misinterpretation, i.e. to ensure that there is a comparison of solute potentials in two chosen cultivars of potato in their Plan. Many candidates investigated percentage change in mass in a range of sucrose concentrations and consequently estimated the water potential of the cells when there is 0% change in mass. Few candidates had appreciation of the existence of pressure potential of the cell at this concentration and consequently incorrectly assumed that the water potential of the external solution was equal to the solute potential of the cell. This assumption can only be assured when cells have demonstrated incipient plasmolysis or when 50% of cells that are counted, have plasmolysed.

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 and is in a logical order.

Limited guidance is anticipated from subject staff during initial discussions of the task. It is also important that centres ensure that attendance sheets are accurately completed and that scripts are in candidate order, to assist in the checking process. Centres are asked to dispatch G623/01 Plan separately from G623/02 Test, using the relevant dispatch labels and OCR stationary provided.

The overall performance of the candidates was generally of a similar standard to that of previous examination series. The marks ranged from 2–20 out of 25, with the majority scoring from 11–16 marks.

### Marking point comments

#### **Risk Assessment**

**A** This was awarded to those candidates who could identify at least three different potential hazards from glassware/electrical/chemical/sharps, in this low risk investigation. Few candidates included three appropriate points in sufficient detail to gain the mark. Many simply listed general safety comments without considering the actual procedures or equipment involved in this experiment. A few centres used standard forms which cued candidates into identifying relevant hazards, risks and control measures. Some candidates continued to copy generic risk assessments from the internet, without appreciating that this has to be a working document, related to the Plan.

**B** This was awarded if a relevant comparative statement was made with reference to solute potential in two named cultivars of potato. Weaker candidates described water uptake/water loss from cells or gave long descriptions of water potential, consequently **B** was not credited.

**C** Awarded if the prediction was clearly justified and scientifically correct, using knowledge based on osmosis and plant water relations.

**D–F** Evidence of relevant preliminary work was seen in this series to award 'D' and the majority of candidates gained 'F' with a reasonable justification. Many candidates used onion or rhubarb tissue in the preliminary work, without justification or an appreciation of fair testing. Weaker

candidates still lack clarity about the role or purpose of supporting preliminary work. Preliminary work **MUST** inform or develop the main investigation. Approximately half of the candidates described their preliminary work to score '**E**', but rarely '**G**' for doing so in sufficient detail.

## G623/02 Test

### General comments

Centres are asked to dispatch the G623/01 Plan separately from the G623/02 Test, using the relevant dispatch labels and OCR stationary provided.

The overall performance of the candidates was generally of a similar standard to previous examination series. Marks ranged from 1 to 40 out of a total of 45, with the majority scoring from 10 to 25 marks.

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

It was disappointing that few candidates could calculate the percentage of guanine bases in DNA, given that 38% of bases were adenine in Question 4(b).

### Comments on individual questions

#### Question 1

- (a)(i), (ii)** These sections were attempted by the majority of candidates and many scored 1 out of the 2 marks available. Some candidates, however, chose to describe electron microscopy which was not credit worthy in **(a)(i)** and **(a)(ii)**.
- (a)(iii)** Although few candidates scored all four of the available marks, many produced reasonably detailed accounts of slide preparation and gained 2–3 marks.
- (a)(iv)** This was answered well although weaker candidates failed to make the link between the increase in magnification in the stem of the question and those organelles that can only be viewed using electron microscopy. RER, Golgi and mitochondria tended to be popular correct responses. Their roles were also known by the majority.
- (b)** This was generally well answered although reference to white and red blood cells in some responses from less able candidates did not gain marks.
- (c)** Many candidates gained full marks in this section although a significant number offered '*anaemia*' and '*leukaemia*', having thought the cells to be blood cells in **(b)**.
- (d)** This was not answered well. Few candidates scored more than 1 mark. It was apparent that candidates who had experience in using a haemocytometer did better than those who had not.

#### Question 2

- (a)** This was well answered although a minority of candidates hedged their bets by linking each property to more than one statement of importance.
- (b)** This question was not well answered. Most candidates stated specific bonds in a named biological molecule, e.g. peptide. Responses lacked understanding of the importance of carbon and its bonding in biological molecules. Few candidates appreciated the nature of the covalent bonds which may exist between carbon atoms as stable single, double or triple bonds or the fact that carbon atoms can form long chains or large carbon rings.

### Question 3

- (a) Both '*hydrolysis*' and the type of bond (glycosidic) were recognised by the majority of candidates.
- (b) Very few candidates appreciated that invertase hydrolyses solid sucrose to liquid fructose and glucose, once the chocolate surround is added. Most candidates gave a general description of enzyme action and consequently the mark was rarely awarded.
- (c)(i), (ii), (iii) It is pleasing to note an improvement in candidate's responses to chemical tests for reducing and non-reducing sugars. These sections were generally answered well with Benedict's reagent given for (c)(i) and hydrochloric acid with an appropriate alkali named in (c)(ii).
- (d)(i) There were many alternative spellings of Biuret in this section.
- (d)(ii) Some candidates just stated the '*emulsion*' test without further reference to the addition of a lipid sample to absolute ethanol and water. Whilst many candidates could correctly describe their observations, a few candidates described a '*precipitate*' which could not be credited.

### Question 4

- (a) Some very good answers were noted in this section. Many candidates correctly used the key words from the text box to achieve at least 6 out of the 9 available marks.
- (b) Approximately one third of candidates scored full marks in this section. Marks awarded tended to be either 2 or 0 since many responses failed to show any working.
- (c) Whilst the concept of protein synthesis in outline only is stated in the current specification, it was disappointing to note that very few candidates had any understanding of the triplet code and consequently the award of the mark was only seen on rare occasions.

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

## **General Comments**

Work selected for moderation reflected coverage of all the A2 units. Overall, a range of marks was seen. However, centre assessments were much more generous this series than previously. The portfolio units moderated were as follows:

- **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**

Many centres are now accredited and are therefore sampled over a three year period. Accredited Centres need to ensure that the necessary Centre Authentication form is sent to OCR for each series that they are entering candidates. Furthermore, if there is a change in the staff named for the accreditation, OCR must be informed. It should also be noted that Centres need to be accredited separately for the AS and A2 qualifications.

Scaling this series was more evident than previously, as many centres were over generous in the assessment of their candidates' portfolio work. Centres are advised to refer to Appendix A (page 93) of the specifications for the performance descriptions for A2 work, in order to ensure secure matches between the marks awarded and their candidates' performance. Scaling of the higher mark bands was due, in the main, to candidates credited at this level not demonstrating the necessary standards required by the assessment criteria for this standard, i.e. work was not sufficiently detailed and accurate, with insufficient data at a high level of precision and reliability. Research work assessed at mark band 3 often did not show suitable selection and the high level independent understanding needed by the candidates aiming for A grades at A2. Centres need to be aware of this for future submissions and care needs to be taken by the candidates to ensure that the level of their work reflects a full and detailed understanding of both the assessment criteria and the content of the specification. Candidates' portfolio work needs to show the use of accurate terminology, correct spelling, punctuation and grammar, especially where mark band 3 is awarded.

Moderation Manager, an online electronic administration tool, was used to select the samples for moderation, and moderators found that the majority of centres returned the requested samples and appropriate Centre Authentication forms efficiently; this was appreciated. Good practice was seen by centres where staff supplied relevant task and assignment sheets and URS cover sheets were fully completed with clear teacher comments accurately supporting the marks awarded. Page number references enable easy location of the relevant work and support the moderation process. There were still a number of clerical errors found by moderators.

It is important that centres encourage their candidates to follow guidance given from the moderators' reports supplied in previous series. This is essential if standards are to be maintained and enable secure matches to higher performance descriptions. It is also 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 there is the opportunity to attain A\* for the higher ability candidates.

A grade work needs to be detailed and accurate. All researched information should be suitably selected and referenced. Centres need to be aware that when awarding full marks at mark band 3, work should be free of any minor errors and needs to reflect independent work with evidence of high level scientific content and understanding.

Risk assessments written and used by candidates need to be suitably detailed and focused on the experiment, and not generic, simply giving basic laboratory safety rules. The inclusion of COSHH guidelines does not automatically reflect mark band 3.

Assessment 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 the assessment. Advice will always be given on the suitability of the practical work which centres may wish to offer. Details are available on the OCR website.

## G627 Investigating the Scientist's Work

This unit gives candidates the opportunity to carry out independent research and to plan and carry out an investigation on a topic which shows progression from their AS work. It is hoped that centres prepare their candidates in the practical skills required during their AS course. Investigations should, wherever possible, allow candidates to develop their work independently and not just follow set practicals.

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 with constraints under which the work will take place, and documented evidence of appropriate research.
- AO2:** evidence showing the tracking and understanding of the outcomes of the investigation with evidence that data collected has been processed and interpreted.
- AO3:** evidence to show the investigation was implemented safely and an evaluative scientific report on the outcomes has been produced.

Good practice was seen where candidates were given the opportunity to investigate 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. Centres are encouraged to include evidence that candidates had actually carried out the practical work with further evidence that they had completed and used risk assessments. A statement written on the candidates' work is sufficient or, alternatively, a certificate of completion of practical. Good practice was seen where Centres had clearly indicated the routes the candidates had taken and the opportunities available. Evidence of repetition of the same practical work does not allow candidates to reach the higher mark bands. Candidates need to show evidence that a wide range of experimental techniques and procedures has been accurately and independently completed. Research and use of questionnaires can be used to support investigative work but evidence of experimental procedures needs to be demonstrated for the higher mark bands.

Higher band work needs to show evidence which includes:

- 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.

Evaluations need to focus on the whole investigation, not just single experimental tasks, and where suitable amendments are included the level of discussion supporting these needs to be high, if mark band 3 is to be awarded.

Centres need to be aware that when awarding full marks at mark band 3, particularly in this unit, work should be free of any minor errors, and needs to reflect independent work with evidence of high level scientific knowledge and understanding relevant to the investigation completed.

## G629 Synthesising Organic Chemicals

This unit is now the most popular of the optional units. However, assessment was generous again at the top of the mark bands. Candidates have the opportunity to build on the work from AS by researching into organic chemistry and understanding the benefits and disadvantages of the wide range of organic compounds we use in today's society. Practical work allows choice of organic preparative work.

The assessment requirements for the specifications include:

- AO1:** a report or leaflet that demonstrates an understanding of organic chemistry by the correct identification and naming of functional groups, the importance of different types of isomerism and different types of reactions; an investigation of therapeutic drugs, their usage and mode of action in the body.
- AO2:** research on a process used to manufacture an organic compound showing an understanding of factors to be considered by the manufacturer, to include information about costs and benefits of the product; evidence of appropriate calculations.
- AO3:** practical work on two organic compounds; detailing preparation and purification methods (to include some planning); make, record and display observations and measurements; evidence of processing results (to include % yield); suitable conclusions and evaluation included.

Presentation of research showed an improvement on previous submissions and only a limited number of centres were now including candidates' notes, rather than selected research. However, for AO3b, AO3c and AO3d candidates still need to improve the level of work to reflect the requirements of the assessment criteria.

The general guidance still needs to be as follows:

**AO1:**

- Evidence needs to be focused on the requirements of the specification.
- General notes do not need to be included.
- Information on all bullet points for AO1a is needed, i.e. naming and identification of functional groups with structures, as well as an explanation of isomerism even for mark band 1.
- Candidates need to check accuracy when writing organic formulae and equations.
- Explanation of reaction types needs to link to the specific organic compounds and not be generic.

**AO2:**

- Research work on a process used to manufacture one organic compound needs to be suitably selected and clearly recorded.
- For AO2a and AO2b, work on brewing and alcohol allows a good vocational link and the opportunity to consider safety and economics of manufacturing the product. Other examples could include haloalkanes, esters and medicinal drugs.
- AO2b needs to focus on costs and benefits to individuals, companies and society associated with the manufacture of the selected organic compound.

**AO3**

- 26 marks is available for the practical work and hence between 25 to 30 hours should be allocated to AO3 work.
- Preparations of aspirin, ethanoic acid, benzoic acid, iodoform (triiodomethane), paracetamol, and various esters can be used.
- Risk assessments need to be workable documents that are accurate and sufficiently detailed.
- Detailed observations need to be recorded for both preparations.
- Processing of results includes calculations of actual and theoretical yields.
- Evaluation needs to be detailed and focused on the techniques used, sources of errors and reaction route.

## G630 Materials for a Purpose

This unit is not as popular as other units. However, it does give candidates the opportunity to research a range of materials and complete a wide range of practical work. Candidates are still presenting a great deal of cut and paste information which does not provide evidence of their understanding. Posters that are seen during moderation do seem to indicate candidates' interest and engagement in this topic.

The assessment requirements for the specifications include:

- AO1:** Information (poster/leaflet) on structure of a polymer/ metal/ceramic or glass/composite
- AO2:** one case study where candidates are required to select materials for a stated purpose; calculations to include tensile stress and strain, the Young's modulus and toughness by using graphical methods.
- AO3:** evidence to show the following 3 sets of experimental work:
- design and use a testing device/plan/results
  - report and results from tests on samples that have been work-hardened, annealed and tempered
  - completion of experimental work on electrical conductivity or specific heat capacity.

### General guidance is as follows:

#### AO1

- Candidates need to ensure that they show understanding when extracting research information on structures of the materials chosen. Material extracted directly from the internet needs to be adequately referenced to indicate it is not the candidates' own words.
- The quality of the work for mark band 3 needs to fully reflect candidates' ability to describe the structures of the materials chosen. Limited evidence was seen that candidates understood how to relate the structures of the materials to their physical properties.

#### AO2

Again some generous assessment was noted here.

- The case study needs to fully focus on the requirements of the assessment criteria.
- At the higher mark bands, both the coverage of all the bullet points and the level of description and understanding needs to reflect the mark band to be awarded. Coverage on its own is not enough.
- For AO2c, although calculations reflected the requirements of the assessment criteria, for mark band 3 errors should not be present and answers must be 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, high mark evaluations need to be detailed and reflective of high A2 level work.
- For AO3b, a full discussion and evaluation relating to whether or not the treatments have produced the expected results is expected.

- For AO3c reasons need to support repeated, estimations of uncertainty of results and evaluations compared to data values are needed to support 8-10 marks.

## G631 Electrons in Action

Limited scripts were moderated this series and assessment at the higher end was again found to be generous. Candidates aiming for A grade in the A2 unit need to show work which reflects independent thought and the ability to demonstrate 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.

Although some good work was seen for this unit, it is essential that where centres are awarding full marks at mark band 3 the work is fully reflective of the work of an A grade candidate. Research needs to be selective and show independent thought, explanations should be supported by the appropriate scientific knowledge, and there should be no errors in work presented at this level.

### General guidance is as follows:

For AO1 it is advisable that candidates show separate evidence to cover this strand to ensure all the requirements are met. If this work is presented as integral to the practical, care needs to be taken that the full requirements for AO1 are covered. Candidates need to be guided towards the relevant requirements of the specifications [reference 3.12.1; 3.12.2; 3.12.3 (pages 51 – 53)] to ensure full coverage where the higher mark bands are to be attempted.

For AO2a, comparisons are needed and the bullet points listed below need to be followed:

- construction method and method of producing the electric current
- resources used in production
- efficiency
- safety and environment effect
- sustainability and use.

Some good calculation work for AO2b was seen.

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 which 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 The Mind and the Brain

This is another popular unit with candidates and some excellent leaflets for mental health awareness on stress and associated illness are produced. A good range of resources was accessed and reference information was particularly informative where candidates had reviewed the websites used. Centres still need to ensure that candidates gather sufficient evidence for their practical investigation so that they can gain higher marks for processing and evaluations.

The assessment requirements for the specifications 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:

- Sets of fact sheets / leaflets need to be produced which are designed to raise mental health awareness. They should be targeted at the appropriate audience and include suitable illustrations and evidence of references used. Candidates should not be submitting lengthy reports.

#### AO2

- Relevant information needs to be selected to produce information giving the clinical methods of studying the brain. Diagnosis of brain diseases is generally well covered but work could be supported by fully labelled illustrations. Candidates need to take care that 'cut and paste' information is used with care and suitably referenced.
- For work matching AO2b mark band 3, comprehensive discussions are required.
- 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 including conceptual considerations is needed. This section is often quite brief and centres are advised to spend time with candidates in discussion work on this topic.
- AO2c does ask for a fact sheet detailing statistical evidence. Candidates use a wide range of statistical testing on their results but additional information is still needed to ensure that higher mark bands are matched securely.

#### AO3

- 26 marks are available for AO3 and therefore candidates need to spend an appropriate amount of time in their experimental work (25-30 hours).
- Candidates aiming for the higher mark bands need opportunities to extend research for their practical work to ensure that a wide range of data can be collected.
- Participants of the investigations need to be fully aware of the tests that they are completing and evidence is provided of risk assessments used.

## 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.

The assessment requirements for the specification include:

- AO1:** a knowledge and understanding of the effects of change on ecosystems and biodiversity, describing ecological succession and researching the effects of agricultural practice, human habitation and greenhouse gas production.
- AO2:** information on scientific moral and ethical reasons for preserving ecosystems and species diversity; descriptions of methods used to manage ecosystems and to preserve species diversity with information on the success of a project managing one ecosystem; calculations on ecological data.
- AO3:** a planned investigation of an ecosystem; with relevant observations made and recorded; data displayed, interpreted and results related to the occurrence and distribution of the species within the ecosystem.

### General guidance is as follows:

#### AO1

- AO1a research work assessed at mark band 3 needs to show a thorough knowledge and understanding of the relationship between the organisms, their physical environment and each other in ecological succession, demonstrated by independent research from the candidate. Work needs to be suitably selected and accurately referenced. Work needs to be clearly understood by the reader with all scientific terms used accurately. There should be no errors in work which is given 5 marks
- AO1b: again, for 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 also to be at an appropriate high level to reflect A grade A2 work with suitable justification included.

#### AO2

- For AO2a mark band 1, candidates need to identify moral and ethical reasons for preserving ecosystems and species diversity; where mark band 2/3 is credited, 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.
- For AO2b, candidates need to be able to describe methods used in the management of ecosystems and to interpret data relating its success.

#### AO3

Candidates generally seem to put in a lot of effort in their practical investigations for this unit. The higher marked candidates need to include work to show they can produce independent detailed risk assessments with explanations of reasons why they used a range of techniques and explanations of the need to repeat. Although moderators aim to support AO3a, as this is assessing the candidates practical skills, for the higher mark bands this needs to be supported by this written evidence.

**General guidance:**

- Candidates need to include risk assessments which are detailed and workable documents.
- Practical work needs to provide candidates with the opportunity to carry out a range of experimental techniques and the opportunity to make both measurements and observations.
- Photographic evidence can be included as evidence of work carried out.
- For AO3c, the displaying of data needs to show a range of different ways; kite diagrams are often seen to support data display, but accuracy needs to be maintained for mark band 3 work.
- 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

Assessment for this unit was, again, quite generous at the higher mark bands. Where full marks are awarded in mark band 3 strands, work needs to be accurate and all parts of the required assessment criteria must be completed to the required high levels. There should be no errors and the work focused at the appropriate target audience. Work needs to be selected and show thorough understanding by the candidate; any researched material needs to be suitably referenced or used at the appropriate high level.

The assessment requirements for the specification include:

- AO1:** the production of an information booklet to include information on the science of genetic engineering and the use of recombinant DNA technology in medicine or agriculture.
- AO2:** description of how successful DNA technology is in food production with suitable conclusions based on evidence found; financial, statistical evidence involving calculations; consideration of the moral and ethical issues and the impact of legislation associated with using genetically modified food plants.
- AO3:** a practical investigation into enzyme technology (including the production and use of an immobilized enzyme); to include the construction of a bioreactor and the effect of temperature on enzyme activity.

**General guidance is as follows:**

### AO1

- For AO1, evidence on the science of genetic engineering and the use of recombinant DNA technology needs to be suitably selected to show that it demonstrate candidates' understanding. Candidates need to produce public information booklets, so the information included must be clearly and logically presented, and targeted at the correct level. Scientific knowledge needs, where appropriate, to be supported by relevant 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 a summary of the moral, ethical and environmental issues concerning the use of DNA technology in GM plant production evidence should be seen for mark band 2, as well as explanation of two controls placed on scientists. A fluent explanation is needed for mark band 3. in addition to an evaluation of the controls chosen.

### AO3

- 26 marks are available for AO3 and therefore candidates need to spend the appropriate time in their experimental work (25-30 hours).
- Care needs to be taken that suitable immobilised enzymes are prepared and used, and appropriate practical work is carried out to ensure that quantitative results are obtained.
- Candidates need to produce a clear plan of their practical work, in addition to detailed risk assessments. Detailed plans linked to secondary sources used to show practical work choices need to be evident for 5 marks.
- Contingency work allowing selected repeats with reasons could also support top marks being awarded.
- For AO3d, candidates need to use their findings from the experimental work to produce suitable conclusions and interpretation of results.

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- 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.
- Centres also need to ensure candidates are spending the appropriate time on AO3c and AO3d to produce sufficient in depth coverage.

## G628 Sampling, Testing and Processing

### General Comments

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

As on previous occasions, many marks were in the range 25 to 55 (out of 90), with the trend to fewer papers scoring less than 25, continuing. The number of candidates scoring 60 or more continues to be small.

The examiners were pleased to see that there were far fewer irrelevant answers and that, in questions 1 and 2, candidates generally focused their responses using information gained from study of the pre-release material. They felt too, that candidates showed a greater awareness of the requirements of this unit than in previous years. There is still a need for some candidates to read the instructions more carefully for each question and ensure that they use precise scientific language in their answer. As noted on previous occasions, candidates should look at their answer to numerical questions to see if the answer obtained is sensible.

The weakest area continues to be those questions where candidates are asked to design their own experiments, given a basic outline of what is required. Unfortunately these questions tend to carry more marks and, as a result, if little attempt is made to attempt these questions, a number of marks will be lost.

Questions about spectroscopy and chromatography continue to be done rather poorly. The knowledge that is required about these techniques is relatively basic and easy marks are often lost here.

In the past, responses to question 3, which is not based on pre-release material, have tended to be weaker than the answers to questions 1 and 2. The examiners noted that candidates scored better on question 3 in this examination than in some previous sessions.

There was little evidence to suggest that the paper was too long.

### Comments on Individual Questions

#### Question No.

1. (a) This proved harder than expected and relatively few candidates gained a mark.
- (b) (i) The location was considered to be the most important piece of information required.
- (b) (ii) The examiners felt that 'book' was inadequate and that the response should state the type of book required.
- (b) (iii) There were a number of correct answers and many candidates gained both marks.
- (c) (i) The many wrong definitions of 'nodule' suggested that a number of candidates were not prepared for this word seen in the pre-release material.
- (c) (ii) There were a number of acceptable answers here but some of the answers given were irrelevant to the question.
- (c) (iii) The examiners felt that 'cleaning' should be the first stage of the laboratory investigation.

- (c) (iv) The majority were able to plot the points correctly and draw the line of best fit, although some did not notice that there was a discontinuity in the x axis. The gradient was not drawn by the majority of candidates and even when drawn it was often calculated wrongly. Far fewer then used their gradient to calculate the density correctly.
  - (d) (i) The reasons for choosing a particular method of analysis were well answered.
  - (d) (ii) There was a greater understanding of how to calculate percentages than on previous occasions but the answer was not always given to 2 significant figures as requested.
  - (e) (i) There were many good attempts to this question. Responses needed to be linked to methods available in Neolithic times.
  - (e) (ii) Candidates sometimes used fuels that were not available in the Stone Age. Some candidates thought that chalk was a fuel.
  - (e) (iii) The use of supporting materials was clearly stated in nearly all cases.
  - (f) The definitions of 'magma' were often imprecise, although the word was mentioned in the case study.
  - (g) (i) Although many candidates measured the size of the ash particle correctly, a number could not then divide it to obtain the actual size.
  - (g) (ii) Very few candidates succeeded in doing this correctly. Candidates should look at their answer and see if it is realistic. Since the question asked for the number of particles, it must be a whole number and be greater than one.
  - (h) (i) Many candidates do not realise that 'peaks' are caused by **bond** vibrations.
  - (h) (ii) Most candidates stated that the 'peaks' increase in size as a result of the intensity of sulfur dioxide present.
- 2.
- (a) (i) This was an easy starting question and nearly all candidates gave  $35 \text{ g kg}^{-1}$ .
  - (a) (ii) Most gained both marks here but for some it seemed difficult to express their ideas clearly.
  - (a) (iii) Many candidates gained a mark from the selection of answers allowed.
  - (a) (iv) If the lid is opened then water will evaporate and the salinity will increase. Not every candidate gave this answer and there were a number who thought that the salt itself would evaporate and therefore the salinity would decrease. (a)(v) It was important for candidates to indicate that the result should be discounted rather than just stating that the test should be repeated.
  - (a) (vi) This was generally well answered but a precise answer was needed – not just to state 'weather changes'.
  - (a) (vii) A range of acceptable answers meant that most candidates gained both marks
  - (a) (viii) This proved to be a difficult calculation for many candidates and only the strongest gained the answer of  $30 \text{ g kg}^{-1}$  water.

- (a) (ix)** An easy mark for nearly all candidates.
- (a) (x)** This proved to be a challenging question, even though a range of figures was allowed in the mark scheme.
- (a) (xi)** The examiners were looking for a statement that indicated that the ‘percentage or concentration was unchanged’ but this proved to be difficult to express for many of the candidates.
- (a) (xii)** This question proved very difficult. Few candidates realised that the article mentioned density and this could a route for obtaining the measurements by an alternative method.
- (b)** The answers to this could be deduced from the article but this was not always realised, nor was the need for representative sampling.
- (c)** Very few candidates realised that salt beds on the Earth’s surface were likely to be dissolved by rain.
- (d)** Many candidates did not read the question clearly enough and obtained solid sodium chloride rather than a solution. Although there were fewer ‘no response’ answers than in previous years, many candidates did not give a detailed enough answer to obtain anywhere near the maximum mark of six.
- (e)** The examiners were expecting a reference to varying quantities of salt / impurities in the sample but this was not often given and many candidates focused on experimental errors, even though the question stated that these should be discounted.
- (f) (i)** The definition of ‘electrolysis’ proved difficult for many candidates and many resorted to describing a process in which electrolysis was used. This approach did not gain credit.
- (f) (ii)** The information needed to answer both this question and (f)(iii) were in the article and many candidates gained full marks.
- (g) (i)** Many candidates correctly wrote 5.2 g to obtain the first mark but could not then use this to obtain answers to (g)(ii) and (g)(iii).

## G635 Working Waves

### General Comments

Weaker candidates were able to find some sections that they could successfully answer and more able candidates were able to demonstrate their greater knowledge and skills.

The terms spatial and thermal resolution introduced in the 2009 amendments to the specification and the difference between binary and digital numbers continue to elude a number of candidates.

Recall of the formula required for the calculation, and substitution was well done but most candidates were let down by their inability to convert MHz to Hz and/or answer to 4 significant figures.

### Comments on Individual Questions:

- 1 a** About a quarter of candidates gave fully correct answers, and a similar number scored one mark. Some candidates suggested a difference in velocity, but failed to score as they did not mention that this is only true in a medium. Some simply stated that red and blue occupy different positions in the spectrum. Others made reference to the heat emitted or reflected by coloured surfaces.
- 1 b** This was well answered by many candidates. A significant minority gave examples from the wrong end of the electromagnetic spectrum. A number scored one mark by suggesting ultraviolet and infra red, suggesting that they were either hedging their bets or had very limited understanding.
- 1 c** Similar proportions of candidates scored zero, one and 2 marks. A few gave the 'direction' answer for the 'type of field'. Others gave answers such as electromagnetic, electric, transverse, longitudinal, or sound.
- 1 d i** Less than a quarter of candidates were able to correctly answer this question. This would have been higher if answers such as 'a wave which oscillates in only one direction' had been accepted. As this could also describe a longitudinal wave it was not acceptable unless the candidate had made clear that they were referring to transverse waves.
- 1 d ii** A similar proportion correctly answered this section. Many suggested that the transmitter frequencies would be different, which missed the point of the orientation of the aerials. Others suggested that one aerial received electric and the other magnetic fields indicating an uncertain grasp of the nature of electromagnetic radiation.
- 1 d iii** Although not all candidates used the term interference they were able to correctly convey their understanding in less technical language such as signals being 'mixed up', 'disrupted', or 'caught / picked up by the wrong aerial.'

- 1 e** Most candidates correctly recalled the required equation, many using a triangle of letters as an aid to memory. The majority failed to correctly convert the frequency from MHz to Hz - many simply ignored the prefix and substituted 474.0 into the equation. Around half of the candidates scored a second mark, (given error carried forward for f) for substitution and rearrangement of the equation. Unfortunately a substantial proportion of those who correctly performed the unit conversion and substitution then presented their answer to 2 or 3 significant figures, and so failed to gain the final mark.
- 1 f** Many candidates recognised that the frequency of visible light was higher than that of the oscillator, but few identified the difficulty of adapting or designing an oscillator to work at that frequency. Incorrect answers included those who thought that light had a lower frequency than radio and references to the value of the velocity of light given in part (e) - sometimes called the frequency or wavelength.
- 2 a i** Around three quarters of candidates gave two sensible reasons, such as looking for people, hot spots, where the fire started or whether it is still burning. General statements about how thermal imaging cameras display images or see through smoke were not given credit.
- 2 a ii** Most candidates scored 2 or 3 marks, suggesting two locations likely to have contrasting temperatures (common responses: kitchen/bathroom/boiler or 'where the fire had/had not reached). Most had a general idea that different temperatures resulted in different brightness or colours. Reference to different amounts of infrared given off without mention of relative temperatures (or at least 'hotter' or 'colder') was not sufficient for the middle mark.
- 2 b** These three subsections discriminated well between candidates. The most common errors were overlapping lines, particularly at the ends, and incorrect positioning of the 'hot' and 'warm' peaks. Most drew curves with a central peak, but straight lines, drawn horizontally, vertically or sloping were seen.
- 2 c** Few candidates gave the correct answer. Many filled the two lines with lengthy descriptions. 'Resolution' and 'thermal resolution' were not uncommon responses, closer to the correct answer.
- 2 d** Previous examinations have revealed confusion by some candidates between the surface colour of an object as seen by the eye, and the false colours shown on a thermal imaging camera which depend on the surface temperature. This involves an understanding of the visible and infrared parts of the electromagnetic spectrum in section 3.16.1 of the specification with an understanding of hot body radiation and thermal imaging cameras in 3.16.2. The poor performance of a majority of candidates confirms that this remains a weakness for many. The question did successfully discriminate between the remaining candidates, the best of whom correctly compared the temperature differences in the middle and bottom rows with the thermal resolution of 2 °C. Reference to the effect of colour on surface emissivity was not expected.
- 3 a** This question proved an effective discriminator. Most if not all possible combinations were seen.
- 3 b i** Many candidates correctly identified and explained the need for coherent bundles to carry the image. Fewer explained the choice of incoherent bundles to illuminate the subject.
- 3 b ii** Correctly answered by a small majority of candidates.

- 3 b iii** Only a minority correctly explained the use of coherent bundles and fewer still the benefits of monomode.
- 3 c** Over a third of candidates failed to score on this section, but the marks achieved by the remainder were well spread out over the range 1 to 6. Many diagrams of curved ray paths were seen, and diagrams of ray paths in graded index fibres often demonstrated a knowledge of different path lengths; also, mention of different (step-index) and same (graded-index) arrival times and their effect on dispersion. Weaker candidates confused graded-index with monomode fibres and, less commonly than in past examinations, confused ray paths down a single fibre with fibre bundles.
- 3 d** Over three quarters of candidates scored some marks on this question, with reasonable numbers achieving each of 1, 2 or 3 marks. Many of those scoring full marks had memorised three of the seven advantages listed in the specification
- 3 e i** Only around a third gave correct answers. All possible letters were seen.
- 3 e ii** This was one of the least well answered sections on the paper. Candidates had little idea of the path that would be followed by a ray not entering the semicircle along a radius.
- 3 e iii** Many candidates made reasonable attempts to draw a ray such that  $r$  was at least approximately equal to  $i$ , but not always on the correct diagram.
- 4 a i** Many candidates scored 1 mark for linking binary to '1s and 0s', but most failed to demonstrate a firm grasp of the concept of digital.
- 4 b i** Well answered. A few wrote 'frequency modulator'. Various inventive guesses such as 'media' and 'mode' were also seen.
- 4 b ii** Under half scored full marks, but the marking scheme enabled many others to score 1 or 2 marks by drawing a suitable carrier wave with a constant amplitude.
- 4 b iii** A majority stated that amplitude varied for AM, but many of these failed to add that frequency is constant. Simply stating that amplitude is modulated was merely demonstrating a knowledge of the term AM and was not sufficient to score.
- 5 a** Well over half of candidates gave correct answers. Simplex was not accepted as it is commonly defined as one where signals can only ever flow in one direction (e.g. broadcast radio). This was highlighted in the June 2011 paper. Walkie Talkie / telephone are examples of applications and were not accepted. Other incorrect answers borrowed terms met elsewhere in the specification such as monomode / multimode, digital / analogue, incoherent / coherent.
- 5 b** Most candidates scored some marks, but less than half earned 3 or more out of the 6 available. The first two marks were typically gained by drawing cells and mentioning some form of multiple access technology (although this term was much more rarely seen than examples such as FDMA). Frequency re-use and its limitation to non-adjacent cells were also often mentioned, but a number of candidates thought that many more frequencies are now available and that every cell has a different frequency.
- 5 c** Answers demonstrating a thorough understanding were rare, but many scored at least one point by referring to the high frequencies used by broadband or the resulting faster data transmission rate.

- 6 a i About three quarters of candidates gave correct answers.
- 6 a ii Around two thirds of candidates scored at least one mark with a fairly even distribution between 1, 2 and 3 acceptable answers from the relatively long list in the marking scheme.
- 6 b A majority of candidates scored 3 or more. Photomultiplier was not frequently seen. Metals such as aluminium were common incorrect answers for the fourth word.
- 6 c i This section of the question was intended to test candidates' knowledge of the first stages in radiation damage by ionisation and formation of radicals. Most gave answers required in later parts of the question.
- 6 c ii This section was relatively well answered.
- 6 c iii Ideally candidates will have answered that benefits outweigh the risks, but a clear statement of the benefit of treatment was accepted. Answers about diagnosis rather than treatment were not acceptable.
- 6 d Most candidates scored at least one mark. 'Lead jacket' and 'lead wall' were common correct answers but were the same marking point. Increasing distance (leaving the room) was also often seen, as was the use of film badges, which was accepted because they may indirectly reduce exposure time (but arguably they are not a direct a means of minimising dose).

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