GCE

Applied Science

Advanced GCE A2 **H575/H775**

Advanced Subsidiary GCE AS **H175/H375**

OCR Report to Centres June 2017

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

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

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

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

General Comments:

The candidates for this session were the final cohort of the two year A level Applied Science qualification. Numbers were lower than usual but even so a wide range of levels of portfolio work was moderated. Credit again is given to those staff and candidates who used the assessment criteria and specification content appropriately and consequently work was assessed at the correct level. Some high quality research and practical was apparent and candidates had demonstrated their enthusiasm for these units by completing detailed and interesting portfolio work.

Work produced by candidates assessed with full marks needed to reflect A grade work at AS. This was not always the case and it was sometimes necessary to reduce marks in the moderation process. Appendix A, page 93 of the specifications, gives the performance descriptions for AS work. The quality of much of the practical work was better in both the level required and accuracy of the presentation, however there was still generous assessment particularly for AO3 G621 Analysis at Work.

Where Centres are offering the A2 qualification they are advised to ensure practical skills offered at AS allow candidates opportunity to build on these for the A2 investigative work in G627. Repetition and limited opportunities of the range of practical skills completed by the candidates was still evident in some centres.

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

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

Units **G620** and **G621** are taken by all candidates who complete the single AS qualification. Candidates completing the double AS qualification need to choose two units from **G624, G625** and **G626.** More candidates now are focusing just on the single award. Both the double and single qualifications will be available for certification until 2018.

The samples for moderation were again selected electronically and the moderation process ran very smoothly. The URS forms were completed by centres although some were seen that were incomplete. It is essential for moderation that comments and page references, are included in order to support the location of the evidence. Internal moderation although not mandatory is highly recommended where more than one member of staff has assessed candidates' work. The majority of portfolio work seen was stapled or collated with treasury tags which allowed moderators to easily read and locate the work. Annotation of candidates' work in the form e.g. AO1 - 6 (i.e. the assessment criteria reference) was also included in the majority of work seen and this is also appreciated. Several clerical errors where the marks sent to OCR were not the same as the marks on the URS were again evident this session.

Please note that the date for the final series in which units **and** certification will be available for GCE Applied Science is June 2018. *Resits will be available in June 2019.*

Comments on specific units

G620 Science at Work

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

The assessment requirements for the specification include:

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

AO2 evidence of 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.

Almost all candidates have now demonstrated that they are able to produce a researched survey on four science based organisations. Most have produced structured surveys by using guidance from the specification i.e. the products made or services offered; the type of work**;** the science involved; health & safety constraints. Lengthy reports however are still evident from higher level candidates but for **AO1a** it is selection and quality, not quantity that needs to be focused upon, particularly for full marks. Centres should encourage candidates to review work which contains historical facts, general information about organisations, job advertisements and location all of which may be interesting but not relevant. Several centres are still encouraging candidates to research from a range of sources. Where material has been taken from site visits, talks from professionals as well as web based information these surveys were much more focused with purposeful scientific information and relevant health and safety guidelines. Recording of references used although not a requirement of AO1a is good practice.

For **AO1b,** the in-depth study needs to include: an explanation of what is produced or details of the service offered; information about the organisation including the number and range of staff employed; details on the scientific job roles; some explanation and detail of the science involved; any further specific detail on research, quality control; details and specific links of health and safety laws and regulations. Several high quality thorough researched in-depth studies were evident and high level assessment was supported. The use of more than one web-site resource and either primary or secondary sources was good to see. Independent work needs to be evident. For mark band 3 assessment, some evaluation and justification of the use of the material used, is needed. This was missing or very generic in many scripts. Some very good detailed science was however much more evident this session, well done to those candidates and centres. There were still some candidates producing more than one 'in-depth study' this is not required. Assessment of two is not a requirement. Candidates need to be producing ONE comprehensive researched study focused on ONE organisation.

For **AO1c** more generous assessment was seen this session where candidates giving links with their chosen organisations were being given mark band 3 marks and work was not demonstrating a comprehensive knowledge and understanding of health and safety laws and regulations. Where assessment ranged from 3-5 marks work tended to reflect the level and quantity of work produced. Several lower level candidates did again successfully complete a research task using the detail given in 3.1.1 'The Importance of Health and Safety' from the specification which allowed them to show some knowledge of a range of health and safety laws and regulations. There were still some very good reports and detail completed by some of the higher achieving candidates.

AO2a work tended to be generously assessed this session. Candidates just covering the bullet points set out in the specification were being awarded mark band 3. Work in many cases was

very brief and did not demonstrate a comprehensive and thoroughly researched study of the impact of ONE organisation on society focussing on all the issues stated. The requirements included: benefits of the core business to the society; contribution to the economy; details on waste management and environmental issues (where appropriate); ICT uses (where appropriate); details on the effect on the community of employment, transport issues and reasons for the position of the organisation. Much of the work seen was reflective of 3-4 marks.
Centres however are still continuing to assess generously **AO2b.** The assessment guidance states a number of complex and straightforward calculations should be completed. Reference Appendix C Page 129 of the specification gives guidance on the range of mathematical skills which may be covered during this A level course. If the data produced for practical work does not allow candidates to fulfil the higher mark bands then data can be supplied. For **AO2b** mark band 3, work should be correct and answers given to the appropriate degree of accuracy with correct significant figures. Errors are still commonly seen here. Just the completion of one calculation that was completed in the practical work or repetition of the same calculation is insufficient evidence for mark band 3.

The **AO3** practical work offered this session was again improved in many cases. It is advisable that candidates learn different skills in this unit and it is therefore not advisable to carry out practicals demonstrating the same techniques.

Candidates need to 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, although it needs to have some vocational link. Research is usual to support this, but it needs to be relevant and not just 'cut and paste' interesting research vaguely linked to the topic investigated. Risk assessments are now included and are generally suitably working documents, but several are still generic and lengthy with unnecessary and repetitive information. Relevant information on chemicals is needed with particular focus on the concentration used in the actual experimental work.

For **AO3b,** recording needs to be thoroughly checked by candidates to ensure accuracy, inclusion of correct units and correct significant figures. Candidates need to be providing evidence of accurate recording, either by repeats or comparison with staff or other candidates' results. 5-6 marks were given when work was not accurate and units were missing and observations were far from being detailed. Candidates need to be much more careful in their recording and results, measurements, observations need to be presented in suitable tables where the reader is clear on the outcome. Results are still being just stated in a conclusion at the end of the work.

The advice again is that in **AO3c** much more accuracy is needed in processing and graph work. Many graphs are still being poorly drawn with in appropriate scales and units missing from labelling of axes. Answers from calculations need to be quoted with the correct numbers of significant figures. The inclusion of an evaluation does not automatically mean mark band 3. Candidates need to review the level of evaluations, much more scientific detail is needed to support basic evaluative comments made.

G621 Analysis at Work

This unit is mandatory and candidates again should to be demonstrating progression from level 2.

The assessment requirement for the specification include:

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

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

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

In **AO1** most candidates had completed research for strands **AO1a, AO2b** and **AO1c** on a range of suitable organisations; retail stores, supermarkets, schools, universities and service industries as well as some production/manufacturing organisations but the level of the work and the size of the reports varied immensely. Some candidates just included 'cut and pasted' material which related to energy savings needed, or environmental decisions made by organisations. The energy policies were in many difficult to find and again environmental policies were mixed in with energy costs and savings. Much of the work seen reflected mark band 2. Several candidates however did produce evidence which demonstrated that they had worked hard to understand their research and consequently produced suitable reports. Generous assessment tended to occur where candidates had produced many pages of extracted material from web based research, but work was not structured and the evidence to support each of the strands was difficult to find. Candidates need to explicitly state the energy policy so the reader is clear how energy and cost savings and environmental impacts are linked. It is not the job of the moderator or the teacher to track the required information with no identification from the candidate. Some excellent work however was seen where both energy policies were well selected and stated and candidates had evaluated ways in which the chosen organisation had limited their energy consumption, well done to these candidates.

Work for **AO2a** continued to demonstrate that candidates are now producing evidence which reflects the required criteria. Descriptions and comparisons of large scale and small electrical generation from two chosen sources work was completed by the majority of candidates. Care still needs to be taken to ensure that mark band 3 work reflects candidates' own understanding as well as covering the requirements of the assessment criteria. Work needs to be both suitably detailed but selective.

Work, however, for **AO2b** was still generously assessed at the higher levels. Higher level candidates need to be showing independent research and not just rewriting or using work provided. A range of energy values and fuel/energy costs was evident in most candidates' work seen but even for mark band 1 candidates should be displaying energy values and costs as well as completing calculations. For mark band 2 candidates need to be showing evidence of their own research. Assessment still tended to be generous for this strand in many cases.

Assessment of practical work for **AO3** was better but there was still generous assessment at mark band 3. The level of the practical work and assessment decisions have continued to show improvement, but candidates still need to work on accuracy and the inclusion of the appropriate advanced science knowledge even to support mark band 2. The guidance stated below still holds and centres need to continue to work to improve the quality and accuracy of the write ups for this unit.

- Practical work needs to be a step up from that studied at GCSE, supported with good quality observations and accurate processing.
- Higher mark band work should be supported by correct balanced equations where appropriate.
- Risk assessments need to be workable documents and for those candidates aiming for high mark bands these should show selected focused hazards and risks associated to the chemicals/equipment used. Generic statements are not sufficient at the higher levels.
- Observations for qualitative analysis are still quite weak in both detail and accuracy. Just crosses and ticks are insufficient for observations at this level. Full detail is required e.g. white precipitate, bubbles of gas which turn limewater milky.

- Candidates need to be aware of the difference between observations e.g. a white precipitate is formed and a deduction e.g. barium sulphate has been formed.
- Evaluation needs to be focused on the method and outcomes of the specific experimental work completed, not just a generic statement of the success of the work. The inclusion of an evaluation does not automatically indicate candidates can gain mark band 3, the level of discussion needs to be reflective of A/B grade work.

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

G624 Chemicals for a Purpose

Limited scripts were moderated for this unit, however some excellent chemistry was presented in the work completed by some of the candidates. Well done. Several candidates produced good portfolios of work demonstrating that they had completed both independent research skills and good experimental work.

The assessment requirements for the specifications include:

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

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

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

For **AO1a** and **AO1b**, candidates were required to choose four compounds two organic and two inorganic, for their research. This was not always evident in candidates' work. It is essential that candidates do know the difference between organic and inorganic compounds, and mixtures and compounds. Inorganic compounds could have included: sulphuric/hydrochloric acids, sodium/potassium hydroxides, sodium/potassium salts, copper/magnesium salts, ammonia/ ammonium salts, and carbon dioxide. For organic compounds: alkenes, alcohols, aldehydes (alkanals) and ketones (alkanones) haloalkanes, esters and carboxylic acids as well various polymers would all have been suitably acceptable.

Where mark band 3 marks were awarded it was good to see that candidates had used their research to link how properties depend on structure and uses depend on properties although possibly more of candidates' own words could be used to support full marks at mark band 3. Good practice is shown where a bibliography is included and work is seen with references embedded within the text. This demonstrates candidates' ability to suitably select information from a wide range of resources which are available. Use of A level chemistry text books again would possibly help candidates demonstrate use of selected research.

For **AO1c,** as there are a maximum of 11 marks for this strand the choice of the two compounds is particularly important. Candidates need to ensure that one of their chosen compounds is made from oil. This was not clearly apparent in work produced by several candidates. Centre guidance is needed to ensure that suitable compounds are chosen. For the higher achieving candidates they have in this strand the opportunity to demonstrate an understanding of higher level scientific terminology, physical and chemical properties and relevant reactions. Alkenes or

alkanes could be used as examples as they give opportunity for suitable research on structure and accessible explanations of relevant reactions.

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

For **AO2b,** ammonia was popular other examples could include nitric acid, sulphuric acid and ethanol. For mark band 2 candidates were required to give a detailed description of one industrial process which included descriptions of all the listed bullet points with the report to also include energy costs, waste products, availability and sustainability of raw materials. Much of the work seen was well structured and tended to reflect this level. Researched information is still being 'cut and pasted' and not used by the candidates. Again good practice is seen where candidates complete logically structured reports based on the bullet points listed in the assessment criteria. Referencing should be seen as well as detailed but focused work.

AO3a gives candidates opportunities to prepare, purify and analyse both an **organic** and **inorganic** compound. It is important that the two products chosen do include ONE organic and ONE inorganic. There are no restrictions of choice of product but centres are advised to ensure that candidates are able to complete all three tasks for each: synthesis, purification and analysis. Preparative practical skills have again been well demonstrated although recording of observations etc. is still not adequately detailed. Good practice is seen where candidates' research and reference each section for both compounds prepared. The following guidance is again given: recrystallisation is an example of purification and melting point will show purity but further analytical tests should also be completed where the higher mark bands are to be awarded. Initial and final weighings and accurate recording of melting points (start and finish values should be included) are required. Observations throughout the preparations, purification and the analysis need to be recorded. Processing needs to include calculations on theoretical, actual and percentage yields. For mark band 3 evidence of how the theoretical yield is calculated should be included to reflect suitable knowledge at this level. Work needs to be supported by suitably balanced chemical equations. For AO3c candidates need to show an awareness that the yield can be increased by changing conditions. Actual workable suggestions are needed for mark band 2 and a full evaluation of the methods chosen with a possible comparison of the suggestions is needed for mark band 3.

G625 Forensic Science

Limited scripts were moderated for this unit.

The assessment requirements for the specifications include:

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

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

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

The following guidance is suggested:
AO1a research needs to include information of a range of techniques with a reasoned link to the recording and preserving of the crime scene.

AO1b detailed and in-depth work is needed for the higher mark bands which need to cover chemical, biological and physical techniques. Researched work should be referenced and evidence should show its use rather than 'cut and paste'.

For **AO1c,** mark band 3 a range of information of ethical issues need to be logically discussed, with evidence of an understanding of the ethical code. Statements and information from relevant research or 'cut and paste' material is only applicable to mark band 1 & 2.

For **AO2a,** candidates should base their report on one case study and use the bullet points listed in the assessment criteria. Although candidates need to be aware that coverage alone does not automatically lead to full marks, the level of consideration of the research needs to be at a high level to support mark band 3. Good practice is seen where reports are well structured and information listed in the criteria on both evidence and proof is understood.

For **AO2b,** candidates need to be showing evidence of completing a range of calculations. Suggested examples can include Rf values, RI calculations and bullet projectiles, calculations involving concentration and dilution. Candidates work needs to show evidence of less guidance and more independent thought.

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. Higher level work needs to be supported by suitable scientific knowledge to support the interpretation of results e.g chemical equations, explained spectroscopic analysis, graphical methods, and mathematical interpretations. 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

Limited scripts were moderated for this unit. Candidates have the opportunity to research into science involved in a range of sporting activities as well as complete two linked investigative practical activities.

The assessment requirements include:

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

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

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

The following guidance is again suggested:

For **AO1,** work needs to be presented as leaflets. Candidates need to work on selective use of their research material. Candidates should be suitably selecting material for their leaflets and using the specification ref: page 33 for the content. Mark band 3 work needs to show detailed knowledge written where appropriate in candidates' own words with evidence on the linking of scientific knowledge to the chosen sport or equipment.

AO2 gives candidates the opportunity to display their research as a presentation linked to sporting equipment. They need to identify the relevant physics principles which relate to the choice of material.
Examples which can be used could include tennis, golf, squash, cricket, football equipment and balls. Skate boards, surf boards and fishing tackle are also popular choices.

For **AO3a,** candidates need to plan and conduct safely **two** investigations. Plans need to be sufficiently detailed many candidates are still only reproducing simple methods. Candidates should be choosing variables to show their planning skills. The choice of practical is left to the centre but it needs to relate to the content of the specification. Coefficient of restitution is completed by most centres and a range of other practicals covering the testing of different properties of materials and a range of optical /lens work could be chosen.

For **AO3b,** candidates need to be collecting a wide range of suitable data and it needs to be suitably recorded. Even for mark band 2 repeats are required.

Processing and interpretation of results for **AO3c** needs to show progression from GCSE work and graphs need to be well drawn with fully labelled axes. Good practice is seen where error bars are included. Again the inclusion of an evaluation does not automatically allow mark band 3 to be awarded. Conclusions need to link to the science involved and for mark band 3, the significance of the investigative work needs to be discussed.

G622 Monitoring the Activity of the Human Body

General Comments:

Very few candidates failed to attempt the items in this paper. It therefore appeared to be accessible to the majority of candidates. There were no obvious errors in relation to the use of rubric provided within the paper. Fewer candidates used the additional sheets to further clarify their responses in relation to the 2016 paper. The Level of Response (LOR) items enabled discrimination between candidates at the higher range of grades but they were challenging since many candidates did not progress beyond Level 2 responses. Some candidates demonstrated very good recall of facts in terms of physiological values and they were able to analyse data effectively.

Comments on Individual Questions:

1(a)(i) The majority of candidates appreciated that the malfunctioning heart valve would lead to a backflow of blood. Very few also identified that the valve was leaky.

1(a)(ii) The aorta was identified correctly for this item and no clear pattern of alternative responses was noted.

1(b)(i) It was understood by many candidates that the scanner cannot provide live images but some confused this item with issues of radiation.

1(b)(ii) It was surprising to observe that ultrasound was not selected as the most effective scanner for this procedure. Some candidates incorrectly selected the MRI scanner, whilst others suggested that an ECG apparatus was involved.

1(c)(i) The QRS area of the trace was recognised by many candidates.

1(c)(ii) Most candidates recalled that the blood pressures were 60 and 80 mmHg. No clear pattern of alternative responses was seen.

1(c)(iii) This item was correctly completed by many candidates, who realised that two fingers are placed at the wrist etc. and that the pulse was recorded for a period of time up to 60 minutes.

1(d)(i) Although many suggested that the older person may not recover from the operation or that he may obtain an infection, relatively few considered tissue rejection.

1(d)(ii) The vast majority of candidates correctly proposed that the heart transplant could be carried out on younger patients but the issue of anxiety/stress associated with this procedure was not appreciated.

2(a) This form of sentence completion item clearly provides the scaffolding required for some candidates. Many responses achieved 3 or 4 marks. A few candidates were unable to obtain the first marking points because they stated anaerobic rather than aerobic respiration.

2(a)(ii) This Level of Response (LoR) item was completed well by many candidates up to Level 2 marking. Most were unable to progress to Level 3 and to use the image shown in Fig.2.1 to relate features such as thin capillary wall, short diffusion distance and closeness of the red blood cell to the capillary wall within their responses. However, many correctly referred to diffusion and concentration gradients.

2(b)(i) Relatively few candidates were able to complete the calculation correctly. There was no evidence of a common fault in the calculation.

2(b)(ii) It was encouraging to see correct values for male and females but some did not complete the link with the value calculated in 2(b)(i). Some candidates, unfortunately, did not include appropriate units for at least one of the two values involved. This prevented them from achieving marks.

2(b)(iii) Many candidates calculated that the value for breathing rate was 12 but some were unable to obtain the second marking point because they did not refer to breaths per minute (or a correct alternative). It was unfortunate that some referred to beats per minute or bpm.

2(b)(iv) The vast majority of candidates correctly noted that the breathing rate would increase during exercise. This was a most accessible item.

2(b)(v) Although many realised that the rate of gaseous exchange at the lungs would increase and that the muscle contraction would be stronger (or work harder), relatively few appreciated that this would link to more oxygen delivery or a greater rate of aerobic respiration.

3(a)(i) The problem of contamination for the nurse and patient was rarely identified fully. Many did, however, correctly note that the surgical gloves may reduce contamination for the nurse. Some unfortunately considered that the gloves would reduce the chance of a needle-stick injury.

3(a)(ii) This item was based on the placing of a blood/sample in contact with the biosensor. This step would be followed by taking a reading. Some candidates confused this item with the use of clinistix.

3(a)(iii) The majority of candidates appreciated the use of a sharps/yellow/correctly-labelled bin.

3(b)(i) The pairing of statements to propose distinguishing features proved to be challenging for many. Although some candidates noted a correct feature for Type 1 diabetes they were unable to follow this through with a complementary statement for Type 2.

3(b)(ii) There was some uncertainty about the value of monitoring a patient's diet prior to visiting a diabetes clinic. Relatively few candidates realised that it was important to identify glucose/sugar intake in the diet. However, the idea of using the information to form a plan or to give advice was correctly identified by some candidates.

3(c) It was surprising to see that the principle of establishing a zero/fasting level was overlooked by many. The concept of avoiding the impact of unknown glucose/sugar levels in the food on test results was not fully appreciated.

3(d) This Level of Response (LoR) item was accessible for many candidates, again, up to Level 2. It was considered that the provision of an explanation was important to progress on to Level 3. Whilst the stem of the item clearly stated that an explanation of the changes in Fig.3.1 data was required, it was also noted that details of hormone action were not. Relatively few candidates progressed on to Level 3 marking.

4(a)(i) The principle of ionising versus non-ionising radiation was not fully appreciated. However, many candidates did well with this item and correctly referred to many of the features listed in the expected answer. It was not considered that the cost/price of the scanners was appropriate for this comparison.

4(a)(ii) A number of candidates repeated earlier statements from 4(a)(i) with regards to images of bone and soft tissues, without linking this to the damage referred to in this item. It was interesting to see that some candidates realised that the MRI scanner would also reveal internal

bleeding; a feature often described in TV programmes based on A&E departments. This was creditworthy.

4(a)(iii) General risk statements for X-rays were not sufficient for the cell/DNA damage or mutation anticipated as correct responses. This prevented candidates from achieving marking points, even though they may have appreciated effective ways of minimising the risks. Many candidates correctly considered the risks of hearing loss or tissue damage (related to metal objects/implants).

4(b)(i) This form of objective item provides sufficient scaffolding for candidates. Many were able to obtain full marks for this item. No clear pattern of alternative responses could be identified.

4(b)(ii) Many candidates realised that the lower position of the vertebral column (at the base of the image) confirmed that the patient was lying on their back. Other features such as the location of the heart, sternum and lungs were less-frequently included in responses.

5(a)(i) This item was based on the application of a list of physiological readings and values presented in the specification. It included factual recall in a different context. Many correctly recalled the typical temperature range and the units for blood pressure were occasionally correct. However, the units for peak flow were often expressed as dm^3 rather than dm^3min^{-1}.

5(a)(ii) The definition of peak flow often referred to expiration (or equivalent) but was occasionally confused with maximum expiratory volume or, in some cases, with vital capacity. The feature of fastest rate or with greatest force was often overlooked.

5(b)(i) Many candidates incorrectly focussed on the athlete in terms of recent meals, exercise levels etc., rather than on the principles of applying a pad/cuff, setting the equipment to zero etc. The context of making sure that the readings were valid, may have been challenging for candidates.

5(b)(ii) The majority of candidates realised that blood pressure would increase but the following explanation generally failed to include references to heart contraction or the control of this activity.

5(b)(iii) Confident and clear responses were provided for this item. A common-sense approach to the risk of the strip falling off due to sweating proved to be successful. Some were also able to express the fact that core/internal temperature would not necessarily be recorded effectively by this form of thermometer.

5(c)(i) There was some confusion about the purpose of taking three blood samples in this context. Many realised that one sample may be retained/stored for future use. The other features of testing one and retesting (using a second sample) were not usually considered.

5(c)(ii) The ELISA test was often selected correctly. No clear pattern of alternative responses could be identified.

5(c)(iii)1 The impact of performance enhancing drugs was understood by most candidates.

5(c (iii)2 The impact of diseases such as hepatitis was also identified correctly.

G623/02 Cells and Molecules – Test

General Comments:

The overall standard of candidates' work was generally slightly lower than that in previous examinations.
Each of the questions, and the paper as a whole, achieved good differentiation between candidates of varying ability. Questions which targeted the A/B grade boundary were within Q2(b)(i) and (ii); Q2(c); Q3(c); Q4(b); Q5(a)(i)(ii) and (iii); Q6(c).
There was no evidence of candidates failing to complete the paper due to lack of time. The frequency of 'no responses' was very low; where they occurred was mainly 3(b) and (c), 4(b) and 6(c). There was no common misinterpretation of the rubric, and practically the only instances where the extra pages were used was when an answer had been completely crossed out and re-started there.

Comments on Individual Questions:

Q1(a) Food tests were quite well known, although some candidates missed one or other of the two components of sample B.

Q1(b) The majority answered 'ethanol' correctly, but some omitted 'water' so didn't earn the mark, but descriptions of the result – usually 'milky' – were well done.

Q1(c) and (d) These parts of the question were based on part f of section 3.4.3 of the specification. The structure of triglycerides in part (c) was less well known, and there was some confusion about what constitutes an unsaturated fatty acid, some candidates choosing both saturated fatty acids in Fig 1 instead. Of the candidates that correctly identified Z, some were not precise enough with their explanation – 'has a double bond' or 'has a carbon double bond' was not enough. No candidates chose to identify the C=C bond by annotating the diagram, which would have been credited.

Q1(d) Very few candidates earned the mark for part (d), the presence of a phosphate group, offering suggestions such as 'smaller', and some offered functions of the cell membrane, which did not address the question. (It is good exam technique, though, for so many candidates to take a guess rather than leaving a blank here).

Q2(a) In part (a) there was confusion between condensation and hydrolysis reactions, and between ester and glycosidic bonds, although a good number of candidates earned the second mark for stating 'covalent bond'.

Q2(b) Part (b) was aimed to be a discriminator; in fact only a couple of candidates recognised that hydrolysing the fatty acids would lower the pH, and none earned a mark for part (ii).

Q2(c) In part (c) a minority of candidates recognised that triglyceride concentration was the limiting factor, but some offered more than one factor, and so lost the mark. Not all of those who correctly identified the limiting factor could go on to give an explanation.

Q2(d) In (d), it was apparent that many candidates had not appreciated that the rate graph was the result of a series of experiments, and talked about a single reaction stopping because all the substrate had been broken down.

Q2(e) However, in part (e) the vast majority of candidates correctly gave temperature and pH as being two other factors which would need to be controlled.

Q3(a) In (a) the majority of candidates correctly identified P and Q as a mitochondrion and Golgi apparatus, although SER occurred occasionally instead of Golgi. (Most candidates gave the plural 'mitochondria' instead of the singular 'mitochondrion', but were still credited for that response.)

Q3(b) The calculation required in part (b) was very poorly done, with only a very few candidates earning two marks, in spite of many writing out the 'triangle' formula used to do the calculation.

Q3(c) In part (c) 'ribosome' and 'chloroplast' were identified by most, but SER less commonly given.

Q3(d) Part (d) was very well answered, with 'cost' and 'seeing live cells' being the most frequent responses.

Q4(a) This question was based on parts a and b of Section 3.4.3 of the specification, and was very poorly answered; few earned two marks for part (a), the most common answers being 'habitat' and 'sweating', and some candidates stated properties of water rather than functions, for example 'heats up slowly'.

Q4(b) Only a very few candidates earned all four marks for part (b), but many earned one mark for saying that osmosis is the movement of water through a partially permeable membrane. 'Semipermeable' was accepted, although this is no longer the preferred designation.

Q5(a) In a(i) the concept of specificity was rarely appreciated, and so in a(ii) 'complementary shape' was not stated. A few candidates earned a mark for giving the 'lock and key' idea, but the reason, tertiary structure, was not seen.
Quite a number of candidates earned both marks in part a(iii), but there is still some confusion between antigen and antibody.

Q5(b) Surprisingly, few candidates were able to suggest two appropriate issues in part (b), the most frequently seen were the idea of whether or not to have children, and informing other family members.

Q6(a) and (b) In (a) and (b) knowledge of the haemocytometer and Coulter counter were often confused, part (b) being the better answered of the two.

Q6(c) In (c), only a very few candidates were able to name both the eyepiece graticule and the stage micrometer, with the former being the better known of the two.

Q6(d) In part (d), references to cells rather than nuclei often lead to a failure to earn this mark. 'Larger nuclei' was the most common correct response.

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

General Comments:

A wide range of levels of portfolio work have again been sampled and assessment decisions from centres, although still generous at mark band 3, have continued to improve.

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

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

Portfolio work at A2 must show progression from AS in both research techniques and experimental skills. Candidates need to be reminded that work also needs to demonstrate the appropriate use of scientific terminology, correct spelling, punctuation and grammar in scientific reports. Risk assessments need to be used by candidates and be suitably detailed and focused on the investigative work. The inclusion of COSHH guidelines and pages of useful but not necessarily relevant information does not automatically reflect higher mark bands. It is also necessary for candidates now producing work at A2 level to carry through referencing techniques demonstrated in their AS work. A fully detailed reference should allow the reader to be able to access the information used, directly from the reference quoted, a bibliography also supports good practice or identification of references at appropriate places throughout the text. Work given full marks should reflect A* work. This was not always the case and it was sometimes necessary to reduce high level marks in the moderation process. Appendix A, page 95 of the specifications, gives the performance descriptions for A2 work. Centres are advised to be aware of these standards.

The samples for moderation were selected electronically and the moderation process ran smoothly. The URS forms were completed by centres although some were still seen that were incomplete. It is essential for moderation that comments and page references, are included in order to support the location of the evidence. Internal moderation although not mandatory is highly recommended where more than one member of staff has assessed candidates' work. The majority of portfolio work seen was stapled or collated with treasury tags which allowed moderators to easily read and locate the work. Annotation of candidates' work in the form e.g. AO1 - 6 (i.e. the assessment criteria reference) was also included in the majority of work seen and this is also appreciated. Several clerical errors where the marks sent to OCR were not the same as the marks on the URS were evident this session.

Please note that the date for the final series in which units **and** certification will be available for GCE Applied Science is June 2018. *Resits will be available in June 2019.*

Comments on specific units

The guidance on the units given in this report again re- emphasise the need of centres to refer candidates to both the requirements of the specification and the assessment criteria.

G627 Investigating the Scientists' work

Candidates' work produced for this unit needs to show progression from that studied at AS level. Topics chosen need to allow candidates opportunities to investigate rather than to just follow set procedures. Work tended to show improvement this session both in the level of experimental work and the standard of the reports written. Although some excellent work was seen at the higher end, centres still need to be careful that this work is not too structured by the teacher. Candidates aiming for higher marks need to be able to demonstrate independent thought and the ability to develop their own practical work. In addition work awarded with full marks at mark band 3 needs to be free of errors with evidence of high level scientific knowledge and understanding to support the investigation completed.

The assessment requirements for the specification include:

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

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

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

AO1
Candidates need to demonstrate that they can increase their practical competence and organisational skills when producing a detailed and workable plan for **AO1**. Holistic planning for the investigations are now seen by most candidates but many are quite brief and repetitive. Some candidates, however, are still producing a diary of events rather than evidence of the planning of what they aim to achieve. Centres are still being over generous when awarding mark band 3 for both **AO1a and AO1b.** More specific experimental and selected and referenced researched material and detailed time information needs to be included to support both mark band 2 and mark band 3. The majority of candidates are now stating the aims and objectives for their investigation, but the work at all levels needs to be supported by information which shows understanding of the scientific principles involved. Some very good work was seen but in some cases tended to be a set of practicals that candidates followed. Opportunities should be offered to show independent thought processes to allow candidates to decide which routes to take and how skills and scientific research can be suitably applied.

There seemed less evidence of repetition of the same practical work this session and several centres introduced preliminary work to support how their main investigation proceeded, which is good to see.

Topics covered were again similar to past years and in most cases gave candidates opportunities to investigate AS topics further and carry out different experimental techniques and procedures. Work included, e.g. investigations into: organic preparative work- linked with qualitative and quantitative analysis, product/vitamin C testing – linked with various analysis both practical and research based, rates of reactions both biological and chemical – linked with catalysis and industrial processes, health related investigations – linked to sports centres, diets and monitoring methods. Materials and their uses – linked with a range of different practical work to investigate properties, care needs to be taken that practical offered for this topic is at A level standard. It needs to be emphasized that candidates wishing to access the higher marks bands need to be given opportunities to show they are competent in a range of experimental procedures using different techniques and can work independently. In addition candidates need to check that any research on vocational links, are fully referenced and validated, and health and safety guidance is detailed, not repetitive clear and focused.

AO2

For **AO2a,** most of the work seen tended to be more mark band 2 than mark band 3. Even for mark band 2 candidates need to show evidence of monitoring their plan, how the plan has been followed and include any changes to be made with reasons. The step up to mark band 3 is in the detail and explanation of any strategies to be used. Basic generic statements about what was done, the time allocation, and the lack of equipment, are satisfactory for mark band 1 but modifications with scientifically supported reasons are needed for mark band 2.

For **AO2b,** the discussion of the reliability of the investigation needs to be supported by suitable scientific treatment of arguments and candidates should be showing their understanding of their outcomes of the investigation. This section needs to be completed at the end of the work and should be summarising all parts. Brief summaries at the end of each practical are only reflective of mark band 1. For the higher mark bands a discussion of the reliability needs to contain suitable scientifically supported arguments. This is high level discussion and needs to be reflective of A grade explanations.

For **AO2c,** just the completion of possibly a % yield calculation or a volumetric exercise is insufficient to support mark band 3. There was still generous assessment for this strand. Candidates need to consider how much data can be collected in their chosen investigation and what mathematical skills which can be completed. Several centres included calculations of errors, included error bars in graphs and % error calculations which supported the accuracy of the outcomes. Some good work was seen by these candidates. It may be that a topic may not always offer the opportunity to the candidate to fulfil the higher marks for AO2c, but they can demonstrate their skills through the other criteria.

AO3

Moderation does aim to support centre decisions particularly for **AO3a** where assessment is covering candidates carrying out experimental work, but their chosen investigation needs to be able to fulfill the needs of the assessment criteria. Mark band 3 needs to reflect the ability of candidates to have completed a wide range of experimental techniques and procedures, safely skillfully, accurately and independently. All practical work needs to be supported by detailed risk assessments that the candidates have produced, several generic or standardized risk assessments tended to be inserted into candidates' work this session. Again a significant amount of the work seen was much more reflective of mark band 2 than mark band 3. Overall **AO3** work assessed at mark band 3 needs to demonstrate high level practical skills with work reflecting A/A* work at A2.

For **AO3b,** even for mark band 2, candidates need to be producing a logical and accurate report of the outcomes of their investigation with evidence of understanding of the scientific concepts used. Again assessment at mark band 3 tended to be generous as many reports were not supported by evidence of understanding of high level scientific knowledge. The inclusion of research stating any applied implications does not automatically give candidates 6 marks. Centres need to take care that the reports completed by candidates are reflective of A2 work, this was not the case for much of the lower level work.

A range of processing should support the conclusions and this needs to be accurate and outcomes and findings critically analysed. Conclusions and evaluations need to be collated for the complete work rather than given at the end of each experiment. The level of the evaluation needs to show critical scientific reasoning behind the success or failure of the investigation completed. Evidence of candidates own organisation and thoughts need to be demonstrated in the work where mark band 3 is to be awarded. Mark band 3 criteria has been included to challenge the higher performing candidates and to allow them to demonstrate both independent thought and higher level of scientific understanding. For **AO3d,** mark band 3 candidates should have in their investigation been given opportunities to be allowed to select the appropriate processing and critically analyse the results. The evaluation needs to show evidence of a high

level critical evaluation and reasoning behind possible amendments. Statements such as all instructions were followed and the sample was prepared / repeat two or three times is not at the appropriate level to support mark band 3. Minimum work was seen at this high level but well done to those candidates where marks were supported.

G629 Synthesizing Organic Chemicals

A full range of marks from above 45 to below 5 were moderated this session, with several candidates gaining marks above 40. Although there was some generous assessment some very good work was produced by candidates. Some lower scoring candidates however failed to show understanding of A2 chemistry and work showed much 'cut and pasted' material.

The assessment requirements for the specification include:

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

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

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

AO1

Although there was still a lot of generous assessment at mark band 3, work seen for **AO1a and AO1b** was often of a good quality for mark band 2. There seemed to be less evidence of careless errors and cut and paste material for the higher level candidates and the majority of formula and equations were better presented. Much more emphasis has been put on the importance of isomerism for **AO1a.** For **AO1b** candidates still need to be focusing on particular functional groups, which was not clear for many candidates. Mechanisms were included and higher level work had shown improvement, although inorganic examples are still being seen. **AO1c** was generally well covered and some good selective and independent work was seen. Some excellent detail and evaluative work was presented in a minority of cases. A lot of work and scientific understanding for the strands of **AO1** need to be achieved even for mark bands 1 and 2.

AO2

Aspirin and alcohol were popular choices and although work was possibly not always mark band 3, candidates had provided evidence to cover an adequate range of factors needed to manufacture the compound chosen. Candidates still need to be aware that even for mark band 1: they need to clearly present information on their chosen manufacturing process, identify most of the factors needed to be considered for a safe AND economic process and show use of sources and for **AO2b**, they need to find and use information about some of the costs and benefits of the organic compound and its manufacture: individuals; companies; society. There tended to be some generous assessment where candidates were awarded 4 marks (mark band 3) when work only covered the depth and detail to support mark band 2.

For **AO2c**, candidates aiming for the higher mark bands need to show their ability in a range of mathematical skills, just a statement that candidates have worked independently does not automatically mean mark band 3 can be gained. The centre needs to ensure that candidates have access to more than one set of calculations. Again just the inclusion of simple or a complex calculation linked to preparative work and research, directed by the teacher and covered by all

candidates in the same way is not reflective of high level work suitable for A grade candidates. This continues to be over assessed.

AO3

Care needs to be taken again that over assessment doesn't occur for **AO3** just because candidates have completed two practical preparations. Up to 26 marks can be gained from practical work and hence between 25 to 30 hours should be allocated to **AO3** work. Centres need to be aware that in order to gain 9-10 marks for **AO3a** candidates as well as the skilful and safe completion of both the preparation and purification of their chosen compounds, they also need to be showing evidence of: independent planning; justifying the reasons for using their chosen techniques and the independent production of a suitably detailed risk assessment. Compounds need to be chosen that are suitable for both preparation and purification. Preparations of aspirin, ethanoic acid, benzoic acid, iodoform (triiodomethane), paracetamol, various esters, alkanals and alkanones (aldehydes and ketones) were seen. Candidates need to show evidence that they are confident in using a range of techniques. Risk assessments need to be workable documents. They need to be sufficiently detailed but relevant to the experimental procedure but not so many pages that they are unrealistic to use during the practical activity. Excessive information was often seen for risk assessments which is not practical to use in the completion of the practical work.

For **AO3b** detailed observations need to be recorded for both preparations, this continues to be over assessed. Much more detail is needed on the recording of both observations throughout the preparation as well as measurements of masses/volumes of reactants used and products made. For **AO3c** processing of results needs to include calculations of both actual and theoretical yields. Independent work should be demonstrated here. For **AO3d** evaluation needs to be detailed and focused on the techniques used, sources of errors and reaction route. Again even for mark band 2 explanations need to be suitably related to outcomes and supported by suitable scientific knowledge.

G630 Materials for a purpose

This unit still has a limited entry although a full range of work was sampled with marks ranging from above 45 to below 15.
The assessment requirements for the specification include:

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

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

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

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AO1

For **AO1a and AO1b** candidates generally completed suitable research on polymers, metals, ceramics and composites and much of the work tended to reflect mark band 2. Although work covered the requirements, care again needs to be taken by the centres that high quality is maintained for mark band 3. In order to achieve the higher mark bands it is expected that candidates will relate the properties to the structures, explaining why and demonstrating a high level of scientific understanding. It was often felt that candidates simply stated what the structure of the material was and then stated what properties it has.

AO2
Work presented by the majority of candidates indicated that they are working to the requirements of the assessment criteria and are covering the bullet points listed and was appropriately assessed. However, in order to obtain top marks the level of detail and scientific understanding must be of a high enough standard to represent A/A* grades at A2 level and for **AO2a,** studies must demonstrate the use of published data, e.g. identifying what the actual tensile strength is and not simple stating that the material is very strong. In addition, for mark band 3, alternatives should also be discussed. As stated in previous reports the step up from mark band 2 to mark band 3 is in the justification both in the shortlist of possible materials and in the use of data in why the choice meets the objectives of the decision.

Mathematical requirements for **AO2b** are generally covered well in this unit with evidence of complete calculations on tensile stress and strain. Young modulus and toughness from a graph of force against extension and cross sectional area of sample, however is not always fully completed. Please note this calculation is a requirement for mark band 1. Evidence of accuracy and giving answers to the correct number of significant figures is needed for the higher mark bands in addition candidates need to be demonstrating their own understanding and competence in these mathematical skills.

AO3
AO3a (Use and design of a testing device), AO3b (Tests: Work hardened, annealed, tempered), AO3(electrical conductivity or specific heat capacity). From the limited work seen most candidates had written appropriate and logical reports, with adequate safety precautions included. A suitable range of practical work was completed and results and repeat readings were collected as stated. Mark band 3 work however needs to be reflective of an A grade and should show detail in the explanations as well as a higher level of scientific understanding through the discussion generated in an evaluation that not only states reliability or performance of a particular material but explains why in detail. A brief introduction to the theory as well as the technique to be used and why, and results tables / graphs should with titles or short descriptions describing exactly what the results represent with detailed and accurate processing would also support the higher marks.

For **AO3a**, even for mark band 2 candidates should be demonstrating use of an unaided plan for the development of their testing device. For **AO3b** for mark band 2 a comparison of treated and untreated samples or for mark band 3 an evaluation relating to whether or not the treatments have produced the expected results. For **AO3c** even for mark band 2 in addition to experimental work with repeat readings, calculations and estimate the uncertainty of their result are required.

G631 Electrons in action

This unit had limited entry. Much of the work indicated a good level of understanding and many candidates had clearly worked extremely hard on this challenging physical chemistry unit and produced some very interesting work. Assessment decisions were more in line with the standards required although care still needs to be taken where full marks at mark band 3 are awarded.
The assessment requirements for the specification include:

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

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

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

AO1
Guidance is as previously stated in that full coverage of the relevant requirements of the specifications reference 3.12.1; 3.12.2; 3.12.3 (pages 51 – 53) need to be covered and tracked by the candidates. Much of the work seen demonstrated candidates had worked to cover the requirements of the specification however the detail and depth of understanding did vary, although generally assessment by the centres was supported. Understanding of the principles of electrochemical change giving a wide range of examples of the applications was not evident for all candidates even though higher marks were awarded. The higher level candidates should be explaining and giving detail which is in their own words.

For **AO1b**, extensive research was seen by many candidates on the application of electrochemical changes in the production of an electric current and extraction of metals by electrolysis. Work was seen where information was also linked to the production of an electric current using **AO2a** research on commercial cells which was good to see. Candidates who are aiming for top marks at mark band 3 in this A2 unit need to be showing work which reflects independent thought, evidence of a thorough knowledge and understanding of electrochemical theory. This was evident in several of the scripts moderated.

AO2
For **AO2a**, candidates still need to take care that for the higher marks both quality and quantity of research is at the appropriate high level. Candidates need to present their research of commercial cells to show selection and use of their research. A lot of 'cut and paste' was again evident. For all mark bands candidates need to compare cells for construction and method of producing the electric current, resources used in production, efficiency, safety and environment effect, sustainability and use. A challenging strand.

For **AO2b**, candidates need to be completing calculations of: Emf of cells; quantity of charge; mass of products and in addition for all mark bands evidence of research and use of data to compare the efficiency of commercial cells. A range of calculations was seen this session, and generally assessment decisions were supported.

AO3
High level explanations supported by suitable planning of all the experimental work is needed to fully complete the requirements of **AO3a,b and c** at mark band 3.

Most candidates completed a suitable range of practical work; methods were detailed and a range of data was collected and adequately displayed. However all candidates need to: show evidence of planning suitable experiments, this again was not always evident. The minimum requirements include investigations of changing a condition on the Emf of a cell AND the mass of copper deposited during electrolysis. . To achieve mark band 3 for **AO3c** candidates must interpret the results in detail and draw conclusions for both experiments showing they have evaluated the procedures and suggested alternatives. Portfolio work produced by candidates studying this unit showed good progression from AS, although for high mark band 3 more independent thought and structure needs to be encouraged.

G632 Mind and the Brain

Portfolio work produced for this unit continues to indicate candidates' enthusiasm and interest in this topic. Some excellent work was moderated with many centres now organising candidates to be able to collect a range of suitable data for **AO3**.

The assessment requirements for the specification include:

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

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

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

AO1

Most candidates are showing evidence that they are now working with both the assessment criteria and the specification content and are for **AO1a** producing fact sheets or leaflets containing detailed but selected research with language suitable for the target audience. Well done to those candidates who achieved high marks for this strand.

For **AO1b**, content of 3.13.2 'Exploration of the healthy and damaged brain' needs to be used and for the higher mark bands work needs to be sufficiently detailed but again focused on the requirement of a fact sheet to raise mental awareness. Work assessed at a high level needs to show understanding and selection from a variety of sources. Overall these were not as detailed and as well presented as for AO1a. Much of the work seen was mark band 2 and assessment was supported.

AO2

For both mark band 2 and mark band 3 for **AO2a** candidates need to show understanding of the methods, used in studying the brain in both experimental and clinical settings and generally research for this strand was extensive again more reflective of mark band 2.

AO2b assessment tended to be generous in many cases. Discussion of moral and ethical implications of brain research is needed even for mark band 2. Work presented for comprehensive discussions of moral, ethical and conceptual considerations associated with the various methods employed in brain research, tended not to be of a suitable depth. Work for mark band 3 requires candidates to demonstrate an ability to identify the preferable methods for investigating a particular research question with an evaluation both for and against the methods chosen. The detail in coverage of the moral and ethical considerations needs also to be discussed in detail. The addition of statistical evidence to brief reasons of why it is not ethical to research certain methods of brain research does not automatically give candidates mark band 3. There were however a number of candidates who presented work which covered all the criteria at the higher level. Well done to those candidates.

AO3

For **AO3**, the majority of candidates had suitably researched memory and used suitable memory tests. Although a number of portfolios were seen where memory tests were not used in the investigative study. Work seen in the organisation and the range of participants used continues to improve by many candidates and hence the data collected allows appropriate and useful statistical analysis. The guidance given previously still needs to be worked upon: participants of the investigations need to complete suitable risk assessments with evidence that they have been used, although more copies of letters/risk assessments / guidelines were included within the portfolio work this session which was good to see.

For **AO3c,** coverage of all the key statements still need to be completed: recording precisely a detailed data set, display of data accurately in a range of ways and to collect sufficient data to complete simple statistics on results.

For **AO3d**, candidates not only need to draw conclusions from the outcomes of their research problem but explain their results and make real-life applications where appropriate. Evidence however was seen by candidates on the use of secondary sources to support their findings.

AO3e needs a basic evaluation just for mark band 1, in addition examples of how their work could be improved upon with advantage and limitations identified for mark band 2 and for the top marks a much higher level of evaluation linked to experimental design, modifications and further research supported by suitable scientific reasoning and analogies.
Overall interpretation and discussion at assessment levels mark bands 1 and 2 were generally supported for research problems chosen.

G633 Ecology and Managing the Environment

A full range of levels were moderated with some excellent work seen. Care still needs to be taken that assessment particularly for full marks covers the criteria at a level to reflect A2 A* work. Assessment tended to be generous in work with overall marks of 40 and above.
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.

AO1
The criteria **AO1a** in this strand relies upon an understanding of succession and how the organisms interact with each other throughout the stages. There was considerable good work seen with many candidates demonstrating clear understanding of the relationship between the organisms. Work from the majority of candidates showed good research skills but more descriptive work on succession could often raise the level from mark band 2 to mark band 3. Much of the work seen was mark band 2 and this was suitably assessed by centres. Candidates completed evidence for **AO1b** on agricultural practice, human habitation and greenhouse gas production on ecosystems and biodiversity but again coverage was not suitably detailed in all areas to warrant mark band 3. The inclusion of a brief evaluation and statements justifying the choice of the information chosen does not automatically give mark band 3. At mark band 3, candidates should aim for more than a repeat of the same phrase to justify their choice of each source.

AO2
For **AO2a**, moral and ethical discussions were included by candidates but these were often very brief and more reflective of mark band 2 than mark band 3. Identify and explain is needed for mark band 2 and evaluation of reasons given by the candidate is needed to support full marks.

For **AO2b**, methods used to manage ecosystems and preserve species diversity were described but limited interpretation of data relating to the success of the chosen projects was seen. Assessment tended to be generous for this strand, full coverage of the assessment criteria needs to be covered at a high level to support mark band 3.

For **AO2c**, the majority of candidates completed suitable statistical analysis on the range of data collected but where mark band 3 is claimed candidates must clearly 'demonstrate their understanding of the significance of the outcomes', which wasn't always the case.

AO3

There was again some good evidence of interesting investigative work both inland and on the coast with a wide range of sampling techniques used both in the field, and in follow-up analyses using lab-based practical work. Well done to those candidates. Moderation aims to support the practical skills to cover **AO3a**, however in addition, evidence for mark band 3 needs to explain the need for repeated measurements and detail on why the range of techniques and equipment were used. Although group work is apparent in this unit it is important that candidates do work to show independent recording of their own results. Care also needs to be taken that risk assessments produced by candidates cover all techniques used and are useable documents, several pages of generic information and interesting although not needed information is not required.

For **AO3b**, candidates need to show evidence of making and recording 'relevant' observations and therefore need to have opportunities to complete this. Work was seen which mentioned measuring of different factors, but offered no data. Data was not always recorded to the appropriate precision and for **AO3c** just tables of results were also seen in several reports and higher marks were awarded which were not justified. The ecological data needs to be displayed accurately in a range of ways even for mark band 2. Kite diagrams are often seen to support data display but candidates should be encouraged to check these before final submission, as frequently axes lacked labels and/or scales, or occasionally axes were transposed. In these circumstances, mark band 2 would be a better fit than mark band 3. Composite kite diagrams were drawn by some candidates which was an effective way of displaying data to give an overall 'snapshot' of the distribution of a large number of species. For **AO3d**, most candidates interpreted their results and gave with some link to their occurrence and distribution. Discussions on conclusions relating to the occurrence and distribution were often more at a level reflective of mark band 2.

Evidence indicated that many candidates had obviously worked with interest on this topic.

G634 Applications of biotechnology

A good range of work was again seen and moderated and centre decisions were generally supported. Well done to all those involved. Some high level work was produced which was assessed at the correct level. Much of the evidence produced demonstrated candidates had put a great deal of effort into their work. The inclusion of photographs, research activities and positive evaluations supported a variety of interest in this topic.

The assessment requirements for the specifications now include:

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

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

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

AO1

Many of the booklets for **AO1a** and **AO1b** could still benefit from a greater selection of the detail needed, however several good and relevant references were recorded and used with work suitably targeted towards the correct audience. 'Cut and paste' researched information is still

apparent but much more evidence of understanding was demonstrated, particularly in mark band 2 work.

AO2

The main focus of **AO2a** is how successful recombinant DNA is in solving problems associated with food production. For mark band 2, evidence generally was focused on two specific examples but again conclusions need to be drawn on the researched evidence of how the technology has been used in solving problems. General information of benefits was still seen with work not focused on the outcomes of solving problems. There is quite a step up in the requirements of work for mark band 3 in that 'a comprehensive evaluation of the success of the chosen examples' is required. Candidates in addition need to clearly reference their evidence and summarise their main findings. Some evidence of this was seen.

For **AO2b**, for mark band 3, candidates not only need to show independent competence but also need to be demonstrating a range of mathematical skills linked to this area of study. If there is insufficient data from their experimental work further statistical analysis can be completed on researched data. Work assessed at mark band 2 and below was generally supported.

For **AO2c**, 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. Assessment again was generally supported.

AO3

The range of practical work completed this session tended to fulfil the requirements of the assessment criteria and link to the specification requirements 3.15.4 'Enzyme Technology'. E.g. the practical investigation immobilisation of yeast and lactase was a good example of collaborative planning, and the use of the 'bubble-loggers' allowed for replicates and the generation of data for statistical analyses.

For **AO3a**, candidates need to show a plan of action, and work at higher levels should show evidence of candidate's own planning, this still needs to be worked on at all levels. Moderation aims to support the practical skills assessed by the centre for **AO3b** but please be aware that for mark band 2 repeated measurements must be evident and for mark band 3 candidates need to explain the use of a range of techniques and equipment.

Marks for **AO3c** were generally supported at all levels with candidates collecting sufficient data to enable statistical analysis to be completed. The level of both manual graph plotting and computer generated graphs were varied but there was improvement in labelling and better scales. Accurate plotting and fully labelled axes are needed, even where the lower marks are awarded.

For **AO3d**, candidates need to use their findings from the experimental work to produce suitable conclusions and interpretation of results. For mark band 2, candidates need to check that as well as interpretation of results and basic conclusions, the advantages of using bioreactors and enzyme immobilisation are included. Assessment of evaluations continues to improve and centres should continue giving guidance and support in teaching candidates the requirements of high level evaluations.

G628 Sampling, Testing and Processing

General Comments:

Many total marks were in the range 30 to 60 (out of 90). This is a similar range to that seen in the last few examinations for this unit. The number of candidates who scored below 25 was again small, but there continues to be relatively few candidates who are able to achieve a total of 60 or more marks. There was strong evidence that candidates had prepared well for Question 1 and 2, which were based on the pre-release case study material. The examiners felt that, in general, a number of candidates did not cope so confidently with numerical questions when compared with previous examinations. The use of percentages and proportion sums continue to cause difficulties for a minority of those who took this paper. In addition, as seen in recent examinations, questions involving deductions from graphs continue to prove a stumbling block for some candidates.

In recent papers the examiners have noticed that questions involving the design of simple experiments have proved difficult for many candidates. This trend was again noticed in this paper and a number of candidates, when answering question 3 could not describe the heating of the mineral chalcopyrite to high temperatures in a satisfactory way. The other longer question in this paper asked candidates to describe the simple distillation of a flammable solution. The responses seen were often very disappointing, with completely closed systems being drawn or the apparatus being open at the heating end. Some candidates used a Bunsen burner to heat the mixture, which is not acceptable for a flammable mixture that initially boiled at 69^{o}C.

Many candidates continue to be at a loss to answer simple questions involving instrumental methods, for example mass spectrometry and infrared absorption spectroscopy.

The responses to question 3 (not based on case study material) were often of a similar standard to the responses seen in questions 1 and 2. There was little evidence that candidates had to rush to finish the paper in the 90 minutes allowed.

The examining team continue to be concerned that some answers are very difficult to read and sometimes an element of untidiness was also evident, which made it more difficult for the examiners to award credit.

Comments on Individual Questions:

Question No.1

(a) The word ‘drupe’ was in the pre-release case study material and most candidates could describe this fruit in a precise way and then gave a correct example.

(b)(i) Many candidates gave an adequate answer for this novel method of collecting coconuts from trees.

(b)(ii) The reasons for collecting samples from different trees was well understood.

(b)(iii) A number of candidates suggested valid answers, which included differences in size, colour and mass.

(c) Many candidates gave the correct answer and its unit, although a few muddled the units.

(d)(i) Surprisingly, a significant number of candidates wrote that a solution of pH 5.5 was alkaline, and then went on to add more alkali in part (ii).

(e)(i) Many candidates could not give an acceptable value for the density of the sugar solution, given the table of data. It was hoped that the answers would be given to three decimal places, as in the table, but this was not always seen.

(e)(ii) Very few candidates could suggest the use of a graph, let alone describe its axes.

(f) (i) The need for writing down the results of tests was well known.

(f)(ii) The examiners expected that the bottle would be washed and dried. Relatively few candidates realised that the bottle needed to be dry before its next use.

(f)(iii) Although the mass of water and the mass of coconut water were often seen, it was less common to see that candidates had managed to use the figures to calculate the density of coconut water.

(g)(i) The answer to this simple calculation was 86.3g but many candidates did not read the question properly and used all four coconuts in their sum, rather than coconuts 1,2 and 3.

(g)(i) Some candidates suggested 'incomplete drying' or 'unripe/overripe coconut' but it was uncommon to award both marks. A number candidates wrote that coconut 4 was over dried, presumably by not looking carefully enough at the figures provided.

(h) Many candidates obtained both marks for this calculation but some did not quote their answer to the required 3 significant figures.

(i) Although 6.68kg gained a mark for most candidates, it was less common that credit was obtained for the second stage, giving an answer of 2.75 dm^3.

(j) (i) This was the first of the longer six mark questions, where the examiners were looking for the quality of written communication in the responses. The questions asked candidates to describe a simple distillation method for a flammable mixture. In general the answers were often disappointing. Major errors concerned a completely closed system, a system which was left open at the heating end, and not being aware of the risks of fire (and the steps needed to reduce these to a minimum). Although many candidates showed a condenser, the water flow was often shown the wrong way round. It was unusual for a candidate to gain full credit for their response.

(j)(ii) Most candidates gained at least one mark, often for stating that no more distillate would be observed.

(j)(iii) Very few candidates could suggest a method of making the process a continuous process rather than a batch process.

(j)(iv) The correct percentage of coconut oil in the solution was often provided.

(j)(v) Very few candidates could use the equation to find the density of pure coconut oil.

(k) The examiners were expecting HPLC as the preferred answer. Few candidates gave this response, although GLC / GC were quite acceptable. 'Chromatography' was considered to be an inadequate answer to gain credit.

Question No. 2

(a)(i) Many correct answers were seen for this question. The commonest error was to omit the double bond between the carbon atoms.

(a)(ii) This was an easy question for many candidates, who provided an advantage and a disadvantage of method 2, when compared with method 1. Some candidates thought that hydrogen was produced in the reaction

(a)(iii) A large number of candidates realised that high pressures were not attainable in most laboratories.

(b) An easy question for many, who correctly related the stretching rate and the extension.

(c) Some candidates did not realise that urea-formaldehyde is a thermosetting polymer.

(d)(i) The need for an initial risk assessment was understood by nearly all candidates.

(d)(ii) Many candidates gained full credit for choosing two ways to make a 'better' glue.

(d)(iii) Although this was thought to be a straightforward question on testing the strength of glues, it was often answered badly. Although it was felt that the candidates knew the answer, they often could not express their ideas clearly.

(e)(i) 'To ensure thorough mixing' was a common correct answer.

(e)(ii) Very few candidates could write what was meant by 'crosslinking' in polymer science.

(e)(iii) 'Add an alkali / or more borax' were common answers that gained credit.

(f)(i) Candidates were generally aware of the need to check for clean and correctly assembled apparatus before starting the experiment.

(f)(ii) The expected reason for the cotton wool plug was 'to reduce the risk of fire' but this was seldom seen and a number of other answers sometimes gained credit.

(f)(iii) Very few candidates could identify factors that might have given a reduced yield of the monomer and the steps that needed to be taken to remedy this problem.

(f)(iv) Mass spectrometry continues to be a mystery for many candidates and the response 'it gives the relative molecular mass' was uncommon.

(g)(i) A filtrate is a liquid and should be poured down a sink or drain but many candidates assumed that it was a solid and placed it in a bin.

(g)(ii) More candidates realised that infrared spectroscopy was the instrumental technique needed than gave an adequate answer for the question on instrumental techniques in (f) (iv).

(g)(iii) The examiners were expecting some kind of muslin or a sieve as the answer. Some candidates suggested using filter paper to filter 25 dm^3 of a mixture.

(h)(i) Although many candidates could use the graph to gain the first mark, fewer could then multiply their answer by 20 to gain the second mark.

(h)(ii) Although many candidates realised that the graph started to curve at a particular point, many could not give an adequate answer for where on the graph this occurred.

Question No. 3

(a)(i) The most acceptable answer was related to health and safety and this feature gained a mark for many candidates.

(a)(ii) The reasons for wearing eye protection and gloves were well known.

(a)(iii) Many candidates did not realise that, as the samples had been exposed to the weather for a long period of time, it was unlikely that they would be affected by storage.

(a)(iv) Small samples contain very little copper and this would make analysis very difficult. Some candidates thought that the percentage of copper in small samples was different from the percentage in large samples. This was a difficult question for many candidates.

(a)(v) The details to be written on sample bottles gained both marks for nearly all candidates.

(a)(vi) The need to prevent cross contamination was well understood.

(a)(vii) Removing dust and other particles from the sample before use was an easy mark.

(a)(viii) Many candidates gained all three marks for considering why a suitable method was chosen. The use of the single word 'cost' did not receive credit as it must state to what 'cost' is referring.

(a)(ix) This was the second question where the examiners were looking for the quality of written communication. Although many candidates mentioned the need for a fume cupboard, very few stated an appropriate type of heating vessel. The temperature needed was 500-700 ^{o}C. A glass beaker or an evaporating dish is unsuitable at this high temperature. Very few mentioned the use of a crucible or other suitable container. Some used a water bath to heat the sample. In general this question was often poorly expressed with inadequate correct content.

(b)(i) Many candidates gained all three marks for recognising the incorrect experiment and describing those features that were different.

(b)(ii) 'Heating at too low a temperature' was a common correct answer.

(b)(iii) This was quite well answered but some candidates found it difficult to put their (correct) ideas into writing.

(b)(iv) Colorimetry seems to be a difficult topic for many candidates. The examiners were looking for 'no copper, no absorption' but this was seldom seen.

(b)(v) There were two marks for this question with many scripts seen that showed the first marking point correct. There were fewer candidates who gained the second mark.

G635 Working Waves

General Comments:

This is an applied subject, so it is disappointing that candidates answered some questions without reference to the context in which they were set.

For example:
In question 2 a ii candidates are asked about changes relating to figs 2.1 to 2.4, but many answers did not mention the diagrams. In Question 7 b, candidates are told more specifically to Use figs. 7.1 to 7.2, but, again, many answers did not mention them.

Question 3 b ii related to graphs given in the question but many candidates didi not refer to these.

Question 4 e asked about the advantages of optical fibres in the context of security users, but many simply listed advantages applicable to all users.

Question 7 a is about non-destructive fault finding in engineering, but many answers related to hospital applications of X-Rays.

Comments on Individual Questions:

Question No.

1 a i Well answered by majority of students. Incorrect answers often referred to X-Rays, CAT scanners or MRI scanners

1 a ii Generally well answered. Most correct answers referred to tracers, or to showing the heart etc. Incorrect answers sometimes referred to improving image quality or contrast media.

1 a iii Many correct answers. Some candidates confused radiotherapy with chemotherapy. A number could not distinguish between diagnostic and therapeutic uses. Several thought that gamma rays are used in sun beds.

1 b i Many candidates confused direction of oscillation with the direction in which the wave is travelling. Otherwise, possibly some Improvement compared with previous years.

1 b ii Very few candidates gave a full answer, but the mark was allowed for recognition that a polarising filter reduces glare or reflections.

1 c i A significant number of candidates were unable to apply GCE knowledge of the electromagnetic spectrum in an applied context. Incorrect answers were spread across the range of options.

1 c ii The most relevant property of microwaves in this application their ability to penetrate clouds, but many referred to wavelength or frequency, which although indirectly related to penetrating power was not the best answer.

1 d Many answered correctly and few lost marks for incorrect units. A large number omitted the conversion of km to m, or in some cases, did this incorrectly. Most but not all knew the formula, often using a triangle as an aid to memory.

1 e Well answered. Most candidates recognised the constancy of the velocity of electromagnetic radiation in a vacuum. Those who did not often multiplied or divided 3 x 10^8 by 10 (the wavelength given in pm) or by 10 x 10^{-12}

2 a i Generally well answered. A few swopped nodes an antinodes. A few did not get the mark because they labelled the same antinode twice – at the top and bottom of the curve.

2 a ii Some found this difficult to explain and express successfully. Some referred to amplitude or wavelength as the cause rather than frequency. Others only scored 1 mark because they did not know whether the frequency increased or decreased. Many forgot to put it in context in terms of Figures 2.1-2.4. Full marks were obtained by suitable reference to the diagrams or mention of harmonics.

2 a iii The mark was allowed for just one correct change. In most cases this was given as tension.

2 a iv This was well answered, but a significant number indicated double the amplitude. The question asked how the candidate would measure the amplitude, so the arrows should be accurately placed at the peak (or trough) of the wave.

2 b Most candidates could draw the shape but were unable to get the phase shift. A lot of showed a shift of 180^o.

3 a A majority of candidates had some idea of what a black body is but often fell short of the correct definition - most left out electromagnetic. A minority scored a mark for stating that it is a theoretical concept. Few recognised that the hole in the cube is close to but not quite meeting the requirements of a black body.

3 b i Well answered. The alternatives all received some “votes”.

3 b ii Fewer candidates than expected compared the intensities of heights of the graphs. Most attempted to compare the wavelengths and/or frequencies, but peak was rarely mentioned. In fact few referred to the graphs at all.

3 c i Very well answered, but it is worth noting that a sizable proportion of these could not spell infrared. This is a significant topic in this specification. “Infared” was a common miss-spelling which was allowed the mark. Incorrect answers included ultra violet, and various numbers.

3 c ii Marks were most commonly achieved for the following marking points: Different parts of mountains) are at different temperatures. The tops are colder than the bottom. This produces false colours.

3 c iii Only a minority gave the two expected answers of seeing through clouds and at night. Many mentioned climbers or volcanoes. Lots of wrong answers referred to searching for lost/injured people.

C3 c iv and v Defining spatial and thermal resolution still caused problems for most. |Wrong answers omitted to say objects ‘close to each other’ or temperatures ‘close together’.

4 a i Many incorrect answers included emerging rays at all angles including some apparently “reflected” by the dotted normal line, rays along the normal and more than a few degrees from exactly downwards.

4 a ii Again, incorrect answers included emerging rays at all angles. Few correctly drew both refracted and reflected rays and the mark was awarded for the former alone.

4 a iii Few candidates recognised that there is a partially reflected ray, even when TIR does not occur.

4 a iv Many scored a mark for mentioning TIR and many of these were able to correctly state the conditions for it to take place. More candidates than in the past correctly referred to the angle of incidence. In previous years many candidates had named this too vaguely. Very little discussion linking TIR and critical angles to light staying in a fibre

4 b i The proportions of “smaller and “larger” suggests that many may have been guessing. Other incorrect answers did not relate to the size of the critical angle.

4 b ii There were very few correct answers. There was almost no discussion of angles from any candidates, a lot discussed change in speed due to refractive index.

4 c Many gave correct answers and few confused the types of with each other. Incorrect answers included “coherent” and “incoherent”.

4 d Many correct answers, but all permutations were seen.

4 e The question asked about the advantages of optical fibres in the context of government /security users, but many simply listed advantages applicable to all users.

4 f Incorrect answers included “incoherent” “duplex”, “step index”, graded index”, “monomode” and “optical fibre”.

5 a i Many correct answers. Few got the two types the wrong way round. Common incorrect answers were “transverse” and longitudinal”. Others included “progressive”, “standing”, “Analogue”, “digital”, “DAB”, “patterned”, “standard”, and “sine”.

5 a ii Only a minority got both right to score the mark. Common incorrect answers were “amplitude”, “wavelength”, and “frequency”, “time period”. Others included, “grid”, “AM”, “FM”, “maximum”, “minimum” and “intensity”.

5 a ii Hardly any candidates displayed any knowledge of how dependent and independent variable should be displayed on a graph

5 b i and ii Only a minority gave correct answers. There was no discernable consistency in the responses given, suggesting that many, perhaps, had not learnt this topic.

5 b iii Few candidates were able to go beyond recognising that binary is made up of 1s and 0s, and some did not even state that.

5 c Many thought that broadband requires optical fibres.

6 a i and ii Many confused this with duplex and half-duplex.

6 b Most were able to give the initials of one of the multiplexing technologies such as FDMA and some of these demonstrated a broad understanding of what they do. Full duplex appeared here as well.

6 c Populated density and obstructions were the most commonly given correct points, followed by placing masts high up. Environmental factors were uppermost in the minds of

some candidates. Not many mentioned regulations or competitors. Hardly any mentioned more masts needed next to busy roads.

7 a i and ii This question was about non-destructive fault finding in engineering, but many answers related to hospital applications of X-Rays.

7 a iii Generally well answered. Others were on the right track but did not indicate that their example involved difference in temperature or heating. Mention of friction, for example, was sufficient for this.

7 b Few candidates used the diagrams given.

7 c Some confused filtration with the use of grids.

8 a i Most correctly identified Gamma rays and X-rays but many also ticked other boxed, particularly microwaves.

8 a ii A wide variety of answers was seen. Some who recognised that an electron was lost thought that this made the remaining atom negative.

8 a iii Most scored the mark, usually for “mutation”.

8 b Only a very small number of correct answers. Most simply divided one of the numbers given by the other.

8 c i Many correctly stated that the benefits outweigh the risks, but a sizable minority simply restated that the risk was low. Only answers including some comparison scored the mark.

8 c ii Descriptions of rotation and 3D images were the most commonly given correct points. A few mentioned gamma or even electrons. Some confused CAT scanners with MRI.

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