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Report on the Examination

Biology
Specification B

■ Advanced Subsidiary

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Kathleen Tattersall, Director General

CONTENTS

Biology

Specification B

Unit BYB1 Core Principles

General Comments

This paper generated a very wide range of marks. Well prepared candidates were comfortably able to gain over 60% of the available marks, and a good number achieved over 80%. On the other hand there were some whose knowledge and understanding of the content of the module was very weak and whose responses were barely of GCSE standard. On the whole, however, the standard was significantly higher than for the January paper, and it was pleasing to find that a substantial proportion of the candidature had acquired a good understanding of basic principles. Topics that were particularly well known included biochemical tests, water potential and osmosis, enzyme activity, membrane structure and active transport. Questions about cell structure, the digestive system and biochemistry were much more poorly answered.

The following indicate areas in which candidates' performance could be improved:

(i) Coverage of the specification content. It was clear that some candidates had either not learned or not revised certain topics at all, in particular the structure of the gut wall, use of starch-agar plates, ventilation in bony fish and absorption of lipids in the ileum.

(ii) Ideas of the size and nature of basic biological 'units'. As will be seen from comments on individual questions, many candidates failed to distinguish clearly between molecules and substances and larger components such as droplets, organelles and even cells.

(iii) Equipment. Candidates often penalised themselves by not apparently bringing appropriate equipment to the examination. It is expected that they will have a pencil for drawing diagrams, a ruler which can measure millimetres and a calculator.

(iv) Arithmetic working. Even though a calculator may be used, candidates should, where asked, show the steps in their working. This enables examiners to award credit for using an appropriate method.

(v) Application questions. Candidates should appreciate that about a third of the marks are based on questions that require them to use knowledge and understanding in unfamiliar situations. The information provided needs to be read carefully and absorbed before answering. It may be worth pointing out that where such a question has parts (i) and (ii) these are normally linked, and answering the first part may help clarify ideas for the second.

The quality of written communication was generally competent, although, not surprisingly, a minority of candidates were weak in this area and failed to express themselves clearly or in appropriate scientific language. A significant number ignored the instruction to use continuous prose in Section B and therefore could not be awarded credit for communication.

Question 1

Many candidates seemed to be unfamiliar with the structure of the various parts of the digestive system listed in Section 10.6 of the specification.

(a) The mucosa was accepted as a valid answer, but the examiners had anticipated that more candidates would have been familiar with 'gastric glands' when describing the structure of the stomach in relation to its functions. A disappointingly large number of candidates gave 'villi' as the answer.

(b) Only the best candidates could give two structural differences. Many resorted to functional differences, or made vague suggestions, such as 'thicker'. A surprising number confused the oesophagus with the trachea and referred to rings of cartilage and cilia.

(c) Answers to this section were better, although often poorly explained. When answering questions about adaptations, candidates should be encouraged to give a specific feature and then describe its role or advantage. For part (i), many simple gave a general feature, such as that there are muscles in the wall, rather than picking out something specific to the stomach, such as the layer of oblique muscle. Most candidates were familiar with the acid and mucus secretions and thus gained credit in the other parts of the question.

Question 2

(a) Nearly all candidates were familiar with the biochemical tests. The unwary did not study the results table sufficiently carefully and gave only lipids in part C.

(b) There were many very good answers from those candidates who understood the use of starch-agar plates. Those who had not studied this method of assay often struggled. A common suggestion was that Grain X had 'soaked up the starch'. Some candidates, probably distracted by the agar plate, assumed that bacterial action was involved, and others tried to answer in terms of osmosis or water potential. Most of those who recognised that the grain released an enzyme also appreciated in part (ii) that boiling would denature this enzyme. Weaker candidates still persist in describing enzymes as being 'killed'.

Question 3

Few candidates demonstrated a good grasp of the processes involved in the ventilation of fish gills.

(a) It was clear that most candidates were aware of the countercurrent principle, but few were able to apply it to the diagram or explain it clearly. Although it was often stated that water flows in the opposite direction to the blood, the commonest answer showed the arrow going from the artery to the vein. Many did gain one mark in part (ii), but only better candidates explained clearly that the countercurrent ensures a concentration difference is maintained along the length of the capillaries in the lamella, and that this in turn maintains a diffusion gradient. Those who attempted to reproduce a simple diagram of a capillary with numbers to represent concentrations often gave absurd patterns which would result in oxygen entering at one end and then leaving again at the other.

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(b) Calculation of the rate of ventilation caused problems for many. Common errors included misreading the scale on the graph, taking the time of one cycle as 1 second and multiplying by 60 instead of dividing. Only better candidates were aware that fall in pressure results from the lowering of the floor of the buccal cavity.

Question 4

(a) Most candidates recognised the organelle as a chloroplast, although some suggested 'mitochondrion'. Rather few could correctly name the thylakoids or granum. Many simply gave 'chlorophyll', which is not the name of a 'part', and frequently answers such as endoplasmic reticulum or Golgi body were put forward.

(b) A good proportion of candidates correctly calculated the length of the chloroplast, although quite large numbers multiplied by the magnification. Converting to micrometres caused difficulties for many. It was disappointing that so many took little care over the measurement. Even allowing for slight variations in the accuracy of rulers, it was obvious that some had not ensured that they were measuring the maximum length. At this level, examiners expect candidates to measure to the nearest millimetre, and those who just gave 12cm as the measured length could only obtain a maximum of 1 mark for the method.

(c) The structural features of chloroplasts were not well known, and only better candidates gave a structure and its function, such as the stacking of the thylakoids to maximise light absorption, or even the large amounts of chlorophyll for the same purpose. Weaker candidates often gave features of the whole organelle, such as its ability to move, or of the palisade tissue. A number of common misconceptions were revealed, such as that starch is stored in the chloroplasts 'to provide energy for photosynthesis'.

Question 5

This question was well answered by most candidates, and many gained full marks. It is clear that most understand the principle of water potential, and it was pleasing to find that the majority could correctly describe increasing concentration of solutes as making the water potential more negative and understand what this signified.

(a) The arithmetic was the area that caused most problems. The examiners expected the ratio to be expressed as a ratio and not just as a single number. Inevitably, in part (ii) many used the wrong figures or got them the wrong way round.

(b) In part (i) the majority appreciated that the method ensured that the volume of potato used was the same in both beakers, and that the only variable was the surface area. Weaker candidates suggested that the small cubes gave 'more accurate results' or enabled the experimenter to 'get an average'. The other parts were well done.

Question 6

This question required candidates to absorb unfamiliar information and apply their knowledge to provide an explanation. Weaker candidates often latched on to odd key words and failed to read the short passages carefully.

(a) There were many very good answers from candidates who noticed that the introduction stated that non-competitive inhibition was involved. Others often gave the standard answer about the active site being occupied by molecules of similar shape.

(b)(i) Answers to this part were disappointing, with many candidates making wild suggestions, such as 'starch', 'bacteria' or 'white cells'. Better candidates did use their knowledge of membranes and appreciated that protein receptors would be the most likely agent.

(b)(ii) Those who read the passage carefully and realised that all the relevant information was given produced some excellent answers. Some, however, assumed that, since antibodies were used, bacteria or viruses must be involved. Others got hold of the general idea of targeting cancer cells only, but misapplied the information, for example by suggesting that the linamarin or the cyanide was bound to the membrane.

Question 7

Most candidates gained some marks on the straightforward recall parts of the question, but the examiners gained the impression that the biochemistry, digestion and absorption of fats are less well known and understood than those of carbohydrates and proteins.

(a) The examiners were surprised that so many candidates did not know what is meant by a 'tissue'. Often it was described as being a thin layer, presumably by analogy with commercial products.

(b) Most gained 1 mark for the general principle that a triglyceride molecule consists of three fatty acids linked to a glycerol molecule. However, many were unclear as to exactly how the links are made. The great majority realised that the process involved is condensation.

(c) Most candidates could describe the relationship, although a number carelessly referred to lowering of the boiling point. Only the best candidates gained two marks for the second part. Those who realised that the triglycerides would be liquid at body temperature often assumed that this would make them easier to break down or to be ''used for energy'. Others tried to provide an explanation in terms of the double bonds. There were, however, some good answers from candidates who appreciated possible advantages in terms of mobility or smoothing the contours of the skin.

(d) Parts (i) and (ii) were generally well known. Answers to part (iii), however, were usually very weak. Many candidates appeared not to have covered this topic, and they merely suggested that the products of digestion pass directly into the blood. Some answered a different question, about the adaptations of the intestinal wall for absorption. Of those who had some idea, the point that most commonly gained credit was reference to the lacteals or lymph vessels. Only the best candidates could provide more detail, such as the formation of chylomicrons.

(e) A much greater proportion of candidates was familiar with the role of bile, and there were many good answers to this part. A significant minority thought that bile contains enzymes that digest triglycerides, and a fairly common error was to state that 'bile emulsifies fats into smaller molecules'. Better candidates pointed out that gallstones would reduce the rate of lipid digestion, but not stop it altogether. Marks could also be gained for reference to the role of bile in neutralising stomach acid, but relatively few mentioned this.

Question 8

Cell membrane structure and transport through membranes was well known, and many candidates obtained full marks, or almost full marks, on this question.

(a) There were many excellent accounts which gave details of the arrangement of phospholipids and described the types of protein found in the membrane. Some candidates failed to read the question carefully and concentrated on functions.

Considerable numbers placed much emphasis on explaining why the structure is called 'fluid-mosaic'. Credit was awarded for structural features shown on a clearly labelled diagram, but or often diagrams were scrappy little sketches with no or minimal labelling.

(b) Most candidates were familiar with the distinction between the three methods of transport, although often they failed to explain in enough detail how the substances actually pass through the membrane. Most recognised that diffusion is movement from high to low concentration, but surprisingly few mentioned that this results from random movement of molecules or that the oxygen can pass directly through the phospholipid bilayer. References to the concentration gradient were not always clear, for example in phrases such as 'along' or 'across' the gradient. Descriptions of facilitated diffusion and active transport were generally fuller, although some spoiled their accounts of facilitated diffusion by stating that energy is required. The major omissions were references to changes in shape of carrier proteins and explanation of why energy is required for active transport.

Unit BYB2 Genes and Genetic Engineering

General Comments

There was evidence that the majority of candidates were well prepared for the examination, but many failed to do justice to themselves by consistently failing to read the questions carefully or failing to take note of the mark allocations. Thus, many candidates merely gave descriptions, rather than explanations or gave one point where the mark allocation indicated that two or even three were required. There was a general tendency to confuse terms, which have similar pronunciations.

Question 1

(a) The majority of candidates gained maximum marks but some confused bases with nucleotides.

(b) Most candidates obtained one mark for correct multiplication, but a majority could not convert micrometres to millimetres. The most common incorrect answer was 9.86.

(c) Better candidates usually obtained full marks but weaker candidates often gave structural points or functional points, but failed to relate structure to function. It was that one fundamental feature of DNA, that the sequence of bases acts a code, that was rarely seen.

Question 2

(a) The calculation was poorly answered. Many candidates got preoccupied with the mathematics and failed to give a ratio. Others only calculated one of the volumes. Significant numbers of candidates used diameter rather than radius. It was surprising that only a minority realised that 4π and 3 cancelled out leaving only a ratio of $2^3 : 10^3$ to calculate.

(b) Significant numbers answered this part in terms of movement of the sperm, ‘ the sperm needs to swim a long way’ being a common answer. Where candidates did realise that the egg cytoplasm carries food reserves, they were frequently vague as to what this food was used for. The weakest candidates answered in terms of ‘provides room for the baby to grow’.

Question 3

(a) This was generally well answered in terms of metaphase, but there was widespread confusion between chromatids and chromosomes in descriptions of anaphase.

(b) A majority of candidates gave the number of chromosomes correctly, though a minority gave answers in terms of the human number, 46 and 23. Candidates found difficulty in deciding whether or not the nuclei U and W had similar alleles. Most did not realise that mitotic divisions after meiosis do not produce variation.

Question 4

(a) Most candidates eventually got round to mentioning cloning, but often via tortuous routes.

(b) Large numbers of candidates did notice that the top of the fruit tree had been removed, and went on to state that the tree would produce two types of fruit. Where they realised that the roots of the plum tree might be important, candidates frequently answered in terms of the roots feeding the branches.

Question 5

Parts (a) and (b)(i) were generally answered correctly, but in (b)(ii) candidates frequently failed to state that the codon was located on mRNA. There were widespread misconceptions in (b)(iii) including 'tRNA is double stranded'; 'mRNA has a double helix'; 'RNA has an amino acid binding point but mRNA does not'; 'tRNA has only three bases'. Where candidates knew structural differences they frequently failed to compare the nucleic acids, answering only in terms of one of the nucleic acids.

Question 6

(a) This was generally answered correctly, though weaker candidates often gave polymerase.

(b) Almost universally correctly answered.

(c) Most candidates remembered to mention electricity or charge, but some concentrated entirely on the mass or the size of the strands.

(d) The majority of the candidates failed to answer in terms of the probes attaching to the DNA fragments, and complementary base pairing. Weaker candidates usually thought that an X-ray picture would be taken, or that the probes would stain the fragments.

Question 7

(a)(i) The majority of candidates understand the action of endonucleases and ligases, but weaker candidates often spoiled their answers by stating that 'the gene is cut out of the nucleus' or 'the bacterial cell is cut open'. Relatively few candidates referred to disrupting the mammalian cell to remove DNA, or to treating the recipient bacteria to take up the engineered plasmid.

(a)(ii) Significant numbers of candidates referred to fermenters, many preferring 'vats'.

(b) Parts (i) and (ii) were generally well answered, but in (ii) weaker candidates continue to answer in terms of amino acid synthesis rather than sequencing. In answer to part (iii) few managed to apply their knowledge of the treatment of CFTR to suggesting the involvement of membrane proteins.

Question 8

This question was intended as a discriminator for the more able candidates and it certainly achieved its purpose.

(a) Large numbers of candidates answered in terms of CFTR having missing bases or nucleotides, not realising that CFTR is a protein. Many gave prepared answers in terms of the symptoms of the disease, rather than referring to protein structure. Where candidates did remember that CFTR is a protein, they frequently went on to refer to its 'active site'.

(b) Weaker candidates often failed to refer to identical genetic material or to identical genes.

(c) Many candidates referred to 'injection' without stating how this would be achieved, or gave vague references to 'vectors'.

(d) Perhaps because this was the last question on the paper, and involved application, most candidates scored low marks. Very few appeared to have read the information that was given to them.

(d)(i) Few reasonable suggestions were seen, most being on the level of 'it would be less harmful'.

(d)(ii) Better candidates usually gave good answers in terms of marker genes but weaker candidates frequently answered in terms of acquiring immunity.

(d)(iii) The majority of candidates seemed to have missed the phrase 'using cells from human embryos in this way' in the stem of the question and therefore failed to score any marks. Where examiners awarded marks, these were often for statements about 'embryo right' or 'unknown side effects'. There was an almost universal impression that the cells are taken from an embryo which then proceeds to full term. As a consequence almost all the candidates referred to 'damaging the baby', 'cloning of whole humans', 'designer babies', and stated that 'we must not play God'.

Unit BYB3/W Physiology and Transport

General Comments

There was a considerable range in the quality of answers on this unit test. Some candidates displayed excellent recall of factual knowledge and demonstrated good analytical skills. These candidates were well prepared for the test and showed a level of understanding above that normally associated with module tests on physiology. However, it was also evident that a significant number of candidates had not thoroughly prepared for this exam as indicated by their superficial knowledge of basic physiological processes. This was particularly the case in Question eight where examiners invariably commented on the inability of weaker candidates to recall basic factual details of plant physiology. The role of stretch receptors in the maintenance of breathing and the effect of respiration on the shape of the oxygen haemoglobin dissociation curve (Question seven) were also poorly understood. Not surprisingly, many candidates had difficulties with questions involving analysis of data particularly where calculations were required.

Nevertheless, the majority of candidates attempted all the questions and displayed a level of understanding beyond that of a sound GCSE candidate. Overall, most candidates were able to express their ideas in a scientific manner and gained the mark for Quality of Written Communication.

Question 1

This question was well answered by the vast majority of candidates with most gaining at least three marks.

(a) Most candidates correctly identified tissue A as xylem but tissue B, the endodermis, was often confused with endothelium, epidermis or phloem.

(b)(i) The vast majority of candidates referred to the cell wall. Incorrect responses included 'spaces', 'cytoplasm' and 'cell membrane'.

(b)(ii) It was pleasing to see that most candidates possess a good understanding of water potential, correctly using 'higher' and 'lower' or 'less negative' and 'more negative' to describe how water enters root hair cells from the soil. Slightly fewer candidates referred to osmosis or the diffusion of water to gain a second mark.

Question 2

This question particularly part (d) discriminated effectively between good and weaker candidates.

(a) The vast majority of candidates correctly named fluid X as lymph.

(b) Surprisingly, only better candidates stated that tissue fluid contains less protein, a significant minority of candidates referred to fat or blood cells.

(c) Although many answers referred to the heart only better candidates appreciated that the contraction of the heart produces the high hydrostatic pressure. A significant minority incorrectly referred to pumping by blood vessels.

(d) Although there were some excellent answers to this question there were also some common misconceptions. Weaker candidates linked insufficient protein in the diet to lack of protein carriers in membranes or suggested that protein carriers were required to transport tissue fluid along lymph vessels. Candidates linking protein to the water potential of blood plasma often obtained maximum marks by referring to less reabsorption back into the blood. Few candidates appreciated that the lymph system could not drain all the excess tissue fluid.

Question 3

Generally this was a high scoring question with the majority of candidates obtaining at least half marks.

(a) The vast majority correctly named the process as anaerobic respiration; common errors were 'glycolysis' and 'anaerobic exercise'.

(b) Almost every candidate gained this mark linking an increase in the intensity of exercise to an increase in the concentration of lactate.

(c) Most candidates gained at least one mark for suggesting that the 'same athlete' should run at the different gradients or that the investigation should be repeated. The idea that the athletes should have a similar fitness level or that the concentration of lactate should be measured before exercise began were also often credited.

(d) Very few candidates gained this mark for suggesting that it took time for the lactate to diffuse into the blood from muscle tissue. Many candidates simply suggested that lactate was still being produced.

(e) Most candidates linked muscle fatigue to the production of lactate but fewer candidates gained a second mark for referring to a fall in pH or for the effect of this on enzyme action.

Question 4

Very few candidates gained full marks usually as a result of problems with part (d).

(a) Most candidates correctly named structure X as a semilunar valve though weaker candidates suggested it was the bicuspid or tricuspid valve.

(b) Many candidates obtained both their marks by commenting on valve X being open and the atrioventricular valve being shut. Answers relating to the thickness or volume of the ventricle were often imprecise and failed to gain marks. Weaker candidates simply stated that the ventricle was contracting.

(c) Many answers referred to the heart becoming 'stronger' or somewhat surprisingly to an increase in the number of red blood cells. However, a significant minority of candidates did gain a mark for stating that more blood would be pumped out per beat.

(d)(i) Very few correct calculations, perhaps ten per cent of all candidates. The most common incorrect answer was 278. It was clearly evident that AS candidates have difficulty with this type of calculation.

(d)(ii) Many answers simply referred to blood supplying more oxygen to the heart muscle rather than to more oxygen and glucose or to more oxygen provision and more carbon dioxide being removed. Better candidates gained a mark for increased respiration or ATP production but frequently, less able candidates referred to 'more energy' being supplied to the muscles.

Question 5

This was the lowest scoring question on the paper with many candidates displaying a rather superficial understanding of the control of ventilation in humans.

(a) The majority of candidates obtained this mark by referring to the medulla or to the aortic or carotid bodies. Common incorrect responses included the 'lungs' and the 'brain'.

(b) Although there were some excellent answers to this question a significant number of candidates did not know the role of stretch receptors. It was not uncommon to find stretch receptors sensitive to carbon dioxide or oxygen concentrations in the blood. Candidates with some understanding of the control of ventilation often referred to 'messages' or 'signals' rather than impulses, or failed to provide sufficient detail for both marks.

(c)(i) Although most candidates referred to the increase in frequency of breathing the description of the increase in depth was often inadequate. Many described the shape of the trace using terms such as 'sharp', 'spiky' or 'less smooth' rather than referring to the pattern of breathing.

(c)(ii) Very few candidates associated hyperventilation with the role of carbon dioxide in the control of ventilation. The vast majority wrote about oxygen supplies in one way or another often suggesting that the body had a large amount of oxygen following hyperventilation and therefore did not need to breathe for some time.

Question 6

(a) A significant number of candidates did not understand what is meant by an 'organic compound' and gave 'nitrate' or 'phosphate' as an answer. However, many candidates correctly gave sucrose or amino acids as an organic compound transported in the phloem. Answers such as carbohydrate or glucose were not credited.

(b) The vast majority of candidates gained a mark for stating that organic compounds are transported in the phloem. However, fewer candidates gained the second mark by using the results of the investigation to explain their conclusion. A common error was to refer to the transport of radioactive carbon dioxide along the phloem.

(c) Most candidates correctly referred to translocation or mass flow but active transport, osmosis and transpiration also appeared.

Question 7

(a) The majority of candidates gained at least one mark for describing the role of the parasympathetic nervous system in slowing down the heart rate. Many candidates obtained a second mark for referring to the sinoatrial node. The idea of more impulses being transmitted along the neurones was rarely credited.

(b)(i) Many candidates attempted to explain rather than simply describe the changes in arteriole blood pressure during the stages of the dive. Consequently, many of the descriptions were superficial and gained one mark at most. Better candidates referred to all the stages of the dive and noted the fluctuations in blood pressure during submergence.

(b)(ii) `The majority of candidates gained a mark by referring to the presence of muscle in the wall of arterioles. However, relatively few candidates correctly explained how this enabled the regulation of blood flow to different parts of the body. A significant minority of candidates referred to arterioles pumping blood or to the presence of valves, others unfortunately did not explain how constriction or dilation of arterioles would affect the blood supply.

(c)(i) Rather surprisingly this question caused some difficulty with a vast range of answers being provided. Approximately a third of candidates obtained the correct answer of 46%.

(c)(ii) This question and part (iii) proved to be a good discriminator. Although better candidates linked an increase in carbon dioxide to the fall in pH, a significant number of candidates referred to respiration producing oxygen and attempted to link this to the change in the shape of the dissociation curve.

(c)(iii) Although most candidates realised that haemoglobin yielded more oxygen fewer candidates linked this to respiration. Weaker candidates often suggested that haemoglobin would keep more oxygen when the pH of the blood decreased.

(d) Many candidates gained a mark for referring to myoglobin as a 'store' of oxygen or to the seal being able to remain submerged for longer. However, there were quite a lot of answers that alluded to myoglobin being in the blood and transporting oxygen to the tissues. Some of the better candidates mentioned the effect of very low partial pressures on myoglobin dissociation or referred to aerobic respiration being continued.

Question 8

Answers to this question were very centre dependent. Although there were some excellent responses, a significant minority of candidates left parts of the question blank or provided answers which showed a lack of thorough revision.

(a) Despite the apparent generosity of the mark scheme for this question many weaker candidates had difficulty gaining a single mark. This task was not aided by their confusion between phloem and xylem and a tendency to discuss transport mechanisms rather than xylem structure. Conversely, better candidates encountered few problems and some gained maximum marks for simply referring to hollow vessels and the impermeability or strength of lignin. Nevertheless, this question proved to be a very effective discriminator.

(b)(i) There were very few marks awarded for describing the role of root pressure in water movement. Even better candidates had difficulty gaining more than one mark with very few mentioning active transport, the movement of ions into the xylem or the role of the endodermis. The most common scoring point was the movement of water along a water potential gradient. Many candidates limited their answer to the movement of water from the soil into root hairs followed by vague references to pressure without any explanation of how this is achieved.

(b)(ii) Most candidates made a reasonable attempt at describing cohesion-tension but vague statements tended to restrict the number of marks awarded. Cohesion was generally understood with many candidates describing the attractive forces between water molecules and the importance of this in maintaining a water column. Adhesion between water molecules and the xylem wall was often referred to but there was some confusion by weaker candidates between cohesion, adhesion and tension. Only better candidates described the effect of evaporation on the water potential in leaf mesophyll cells and the effect of this on developing tension within the xylem.

(c) Most candidates could describe three structural features but often had difficulty in precisely explaining how these reduced transpiration. A common error by weaker candidates was to refer to the trapping of water molecules rather than humid air. A significant minority of candidates described physiological (e.g. CAM plants) rather than structural features or referred to features relating to water uptake such as extensive root systems.

Unit BYB3/C Centre-assessed Coursework

General Comments

Most centres applied the new criteria well and their marking was within tolerance. The centres also adjusted well to the changes in moderation procedure for the new specification. Documentation was generally well done; it is only necessary to complete one Candidate Record Form, even if marks come from more than one piece of work.

Generally centres were using appropriate investigations that allowed all candidates to potentially obtain full marks. Investigations into the effect of a named factor on the rate of enzyme activity or the effect of temperature on the release of pigment from beetroot tissue were the most common investigations used. These were frequently well done. The effect of sucrose concentration on the mass of potato tissue and effect of a named factor on the rate of transpiration were less common, and also tended to be less well done by candidates. The osmosis investigation was also frequently done at GCSE standard. It is essential that scientific knowledge used is at AS level standard, and therefore the change in mass of the tissue must be explained in terms of differences in water potential, if high marks are to be awarded. Explanations based on differences in concentration leading to a conclusion about the concentration of sugar in potato cells are too simple for AS level, and result in an inaccurate conclusion being made.

Some investigations used were insufficiently demanding for AS level. These were usually either GCSE investigations or ones involving the use of human subjects. Investigations involving human response also often used methods which would not give valid reliable data. Some investigations used did not allow all the criteria to be met, due to a lack of opportunity to control of relevant factors, analyse the data quantitatively or give a biological explanation of the methods to be used or the conclusions made. Sometimes high marks were awarded when insufficient data were collected, with either a lack of repeats or a small number of values of the independent variable. In most investigations which involve the effect of changing a variable, a minimum of five values should be investigated, so that a graph can be drawn and a reliable conclusion made.

It is essential that centres annotate the work to explain where particular criteria have been met and to justify why particular marks have been awarded. This is particularly important when best fit has been applied. Annotation should consist of the mark descriptor lettering e.g. A5 or C6 together with written comments on why particular marks have been awarded.

In many cases the centres included their own mark schemes. Usually these were very helpful, but sometimes they did not match the generic criteria. When there was a poor match between the criteria in the specification and the centre's mark scheme, it was usually necessary to change the centre marks. Instructions actually given to the candidates were provided by only about half of the centres. Lack of these often made the moderation process difficult.

For most investigations at AS level group work is not appropriate. Where this is necessary, it is essential that each candidate collects sufficient data individually to draw a valid conclusion. Assessment of skill B must be based on the individual contribution of the candidate, and so the data collected by the candidate must be clearly indicated in the tables of results.

Skill A

It is essential that the investigation used for assessment does not relate to a practised situation. Pilot exercises to determine the exact concentrations and amounts used to obtain reliable data should occur **after** planning and form a part of implementation. It is also important that only a minimum amount of help is given and that no group discussion takes place before the planning exercise, as candidates are expected to decide individually what values of the independent variable to investigate and which apparatus to use. Plans must be done under "supervised conditions" and written in the future tense. Where the plan is later word-processed by the candidate, no changes should be made, and the part done under supervision should either be clearly indicated or the original hand-written version submitted to the moderator.

A significant number of candidates included a scientific explanation of predictions made in their plan. This is no longer required, the plan should consist only of a clarification of the problem being investigated, the procedures to be used and the reasons for using them and the proposed data analysis.
In the marking of this skill credit was sometimes given for details of the control of relevant factors and precautions needed to obtain valid data (A6) when there was insufficient present for high marks to be awarded. The variables to be controlled need to be clearly stated, together with reasons as to how and why these factors should be controlled to meet the criteria in A4, 6 and 8. A control was often omitted from the design.

Skill B

It was often difficult for moderators to determine why particular marks had been awarded, due to lack of annotation. A range of marks was often given but no indication of how differentiation had been determined. The table of results must have a title and clear headings with units for level 6. This mark was sometimes awarded for a table which was poorly presented and did not clearly explain what data had been collected. Level 8 was often awarded when there was no evidence of reliability, other than repeats in the table. Carrying our repeats is insufficient for the awarding of B8, as sometimes these indicate that the data are unreliable. A statement relating to precautions taken to ensure reliability should be made by the candidate, which clearly indicates that reliability has been considered..

Skill C

This skill was generally marked well. However, the lower level criteria were sometimes not covered well. In some cases there was no simple conclusion and sometimes credit was given for C4/C6 when there was not much reference to the candidate's own results. Trends and patterns and variability within the data all need to be discussed for C6. Credit was also sometimes given for C6 when the graph produced was not the most appropriate one. Generally the graph drawn should correspond directly to the title of the investigation and the conclusion made, and also be done after some processing of the data has taken place (eg. rate of reaction or percentage change in mass).
For example, in an investigation into the effect of pH on enzyme activity, the most appropriate graph is one of pH against rate of reaction.

Skill D

This skill was often overmarked and in some cases centres appeared to be using the GCSE criteria rather than the ones in the specification. Simple errors due to carelessness or lack of effort should not be awarded any credit in this skill. Similarly no credit can be given for ideas of further investigations. The effect on the limitations on the data collected (D4) was often poorly done and only a minority of candidates discussed the effect on the conclusions made (D6).
The best evaluations were made by the candidates who wrote their evaluation under the headings taken from the criteria statements.

Mark Ranges and Award of Grades

Unit/Component	Maximum Mark (Raw)	Maximum Mark (Scaled)	Mean Mark (Scaled)	Standard Deviation (Scaled)
BYB1 Core Principles	66	66	30.5	13.5
BYB2 Genes and Genetic Engineering	66	66	32.5	13.0
BYB3W Physiology and Transport	66	50	19.9	8.7
BYB3C Coursework	30	30	20.8	5.2

BYB1 Core Principles (13005 candidates)

Grade	Max. mark	A	B	C	D	E
Scaled Boundary Mark	66	43	37	31	25	19
Uniform Boundary Mark	90	72	63	54	45	36

BYB2 Genes and Genetic Engineering (18700 candidates)

Grade	Max. mark	A	B	C	D	E
Scaled Boundary Mark	66	44	37	31	25	19
Uniform Boundary Mark	90	72	63	54	45	36

BYB3 Physiology and Transport/Coursework (18908 candidates)

Grade	Max. mark	A	B	C	D	E
Scaled Boundary Mark	80	53	46	39	32	25
Uniform Boundary Mark	120	96	84	72	60	48

Advanced Subsidiary award

Provisional statistics for the specification as a whole (14772 candidates)

	A	B	C	D	E
Cumulative %	18.5	35.8	53.9	70.6	84.8

Definitions

Boundary Mark: the minimum (scaled) mark required by a candidate to qualify for a given grade.

Mean Mark: is the sum of all candidates' marks divided by the number of candidates. In order to compare mean marks for different components, the mean mark (scaled) should be expressed as a percentage of the maximum mark (scaled).

Standard Deviation: a measure of the spread of candidates' marks. In most components, approximately two-thirds of all candidates lie in a range of plus or minus one standard deviation from the mean, and approximately 95% of all candidates lie in a range of plus or minus two standard deviations from the mean. In order to compare the standard deviations for different components, the standard deviation (scaled) should be expressed as a percentage of the maximum mark (scaled).

Uniform Mark: a score on a standard scale which indicates a candidate's performance. The lowest uniform mark for grade A is always 80% of the maximum uniform mark for the unit, similarly grade B is 70%, grade C is 60%, grade D is 50% and grade E is 40%. A candidate's scaled mark for each unit is converted to a uniform mark and the uniform marks for the units which count towards the AS or A-level qualification are added in order to determine the candidate's overall grade.