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Examiners' Report Summer 2008

GCE

GCE Biology (8040/9040 & 8042/9042)

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* 6103/02 W1 Written alternative to coursework is only available to International centres.

6101 Unit 1 Examiners' Report

Maximum mark 60

Mean mark 31.4

Standard deviation 11.4

General comments
Questions 1, 2, 4, 6(b), 7(b), 7(c)(i),(ii) and (iii) and 8(a)(ii) were relatively high scoring. Questions 3 (centrioles), 5, 6(a)(i) and (iii) and 8(b)(i) and (ii) were low scoring.

Question 1
Many candidates gained at least three out of the four marks available. There was no obvious indication that one particular statement was more problematic than the others.

Question 2
This was a straightforward question, allowing the majority of candidates to gain at least four marks. Some, however, described the triglyceride having one fatty acid and three glycerol molecules. There was also a significant number of references to hydrogen bonds, rather than ester bonds.

Question 3
Most candidates were able to name the structures correctly and gain two marks. The drawing of centrioles, however, was very variable both in quality and the way that they were represented. The mark scheme took into account the latter point. Quite a few candidates also included the spindle fibres in their drawing. The description of a lysosome was generally good, but there were quite a few answers that just described them as a membrane bound organelle, which is a statement that could be applied to many organelles. Examiners saw references to lysosomes as cells and also phrases describing them as spherical molecules.

Question 4
In (a), it was pleasing that most candidates were able to draw the cell to the correct size. A good number also showed the correct shape but fewer gained the third mark because their representation of the nucleus did not contain any nucleoli. A small number of candidates attempted to draw several cells and did not indicate which was cell A. Part (b) was a high-scoring question with the majority knowing that the 'head' was hydrophilic and the 'tail' was hydrophobic. Fewer candidates could describe the orientation of phospholipids in relation to water and simply stated that 'heads face outwards and tails face inwards'.

Question 5

This question was a good discriminator. In (a), good candidates were able to score all three marks for clear comparisons of the cell cycle, but it was much more common for examiners to see answers that compared DNA content instead of the cell cycle. When candidates did correctly describe the cell cycle of cell A as being shorter than the cell cycle of cell B, their next statement quoted incorrect times from the graphs. These showed that candidates mistakenly thought that the cell cycle was only the part of the graph that involved the increase and decrease of DNA content. In (b), many candidates thought that this was part of mitosis, rather than preparation for mitosis. A significant number of answers described replication of organelles, or cells, rather than replication of DNA. Candidates also frequently focused on the daughter cells being genetically identical to the parent cell, rather than emphasising that they had the same quantity of DNA. A significant number of candidates failed to select the end stages of mitosis to describe in (c) and instead gave an account of the whole of the process.

Question 6

In (a)(i), many answers were restricted to just the positive colour changes. It was clear, however, that knowledge of these tests was poor. Some described starch as a non-reducing sugar and others seemed confused between reducing and non-reducing sugars. Part (a)(ii) was generally well answered but some just summarised the process as 'this is the test for a non-reducing sugar' and failed to give any explanation. Part (a)(iii) proved difficult. A commonly-seen error was the statement that the green colour indicated a non-reducing sugar. Some candidates described B as 'a strong sugar' and made no reference to the concentration of the sugar. In (b), it was common for examiners to be able to award full marks. A disappointing aspect was the number of candidates still referring to 'equal amounts', rather than equal volumes, and therefore not gaining marking point 1 or 2. Others stated that biuret reagent should be heated.

Question 7

In (a), answers ranged from clear, detailed descriptions to those that were confused between transcription and DNA replication. There was often a lack of clarity, particularly when trying to describe complementary base pairing. Many described mRNA pairing up with DNA. Some answers implied that the whole DNA molecule unwinds and that both strands act as templates. There were also inaccurate descriptions of the roles of enzymes with helicase and RNA polymerase involvement being confused. Some answers also referred to DNA polymerase, instead of RNA polymerase. A significant number of answers went on beyond the production of mRNA and described the molecule leaving the nucleus and attaching to a ribosome. Part (b) was generally well answered with many candidates gaining all three marks. Poorly expressed answers sometimes let candidates down; for example it was not always clear whether amino acids were attached to tRNA, mRNA or to the ribosome itself. All sections of (c) proved straightforward to the majority of candidates.

Question 8

The most commonly awarded marks in (a)(i) were for knowing that immobilised enzymes can be re-used and that they do not contaminate the product. Both of these statements were usually linked to the idea of cost saving. Sometimes the candidate did not refer to the product and stated that the enzyme did not contaminate the substrate. This did not gain a mark. Other commonly seen answers were those that attempted to describe the enzymes as being more stable to high temperatures. Quite often the explanation did not match the advantage. There were many good answers in (a)(ii), with the majority describing the production of lactose-free milk and making an appropriate reference to lactose intolerance. Other suitable uses, commonly described, were the production of ice cream and the production of milk for cats. Many answers in (b)(i) focused on the lock and key hypothesis of enzyme action and failed to use the graph. Others compared the two lines on the graph, despite the question only asking about cyanidase in solution. Poorly expressed answers referred to the 'line' or 'graph' changing and not to the production of formic acid. Many candidates inappropriately referred to the rate between 70 and 100 minutes being constant, whereas the reaction had stopped and no more formic acid was being produced. Answers in (b)(ii) were generally poor. Many candidates referred to a lower surface area of enzymes. Some even suggested the enzyme had to break down the gel to get to the substrate or that the gel might act as an inhibitor.

Maximum mark 60

Mean mark 33.7

Standard deviation 11.5

General comments

This proved to be quite an accessible paper, which gave candidates opportunities to show what they knew and to apply their knowledge and understanding of Unit 2. In general, question 5 was high-scoring, whereas question 6 was often rather poorly answered. The quality of the answers to the other questions was variable. There was a tendency to answer some questions in general terms, or to digress from the subject of the question. It is important, therefore, that candidates consider the question carefully before writing their answer. As an example, many answers to 8(c) included irrelevant information on the transport of carbon dioxide.

Question 1

Most candidates were able to name follicle stimulating hormone (or FSH) correctly, but the answers to the other parts were more variable.

Question 2

In (a), the majority of candidates correctly named the red blood cell, but cell B proved to be more difficult for candidates to identify correctly. In (b), there were many descriptions of the shape of the cell, but this was less often acceptably qualified with an explanation of how this is related to function. For example, the shape of the cell was frequently related to the transport of oxygen, or to the presence of haemoglobin, rather than linked to a comment about the diffusion of oxygen (or carbon dioxide). However, many candidates gained both marks here for a reference to the flexibility of red cells and their ability to pass through capillaries. The answers to (c) were very variable, from those with no specific information, to those with detailed accounts of the roles of named white cells. Weaker answers tended to be generalisations, such as 'they secrete antibodies'. Credit was given for a general reference to phagocytosis of microorganisms but, for further marks, candidates were expected to relate the function to a named white cell. Candidates who described the roles of lymphocytes, neutrophils and monocytes generally gained full marks.

Question 3

In previous years, questions relating to the formation of tissue fluid have suggested that this is a topic that candidates find difficult. In (a), many of the answers described the formation of tissue fluid, essentially repeating information given in the stem of the question, rather than attempting to relate the structure of a capillary to the formation of tissue fluid. Some of the descriptions of the structure of a capillary were imprecise; for example, it should be noted that 'it is one cell thick' or 'it is thin' are not considered to be worthy of credit. Examiners expected a reference to the wall of the capillary being made of a single layer of flattened cells, or an equivalent accurate description. Credit was also given here for a reference to the presence of pores, and to the permeability of the capillary wall. Relatively few candidates referred to the basement membrane.

In (b), however, the majority of candidates appreciated the relative size of protein molecules in relation to the permeability of the capillary wall and gained credit. There were also some good explanations in answers to (c), relating the change in plasma protein concentration to the reduced osmotic effect. Some candidates attempted to explain this in terms of a water potential gradient, but answers did not always make it sufficiently clear as to how the protein concentration affected the water potential, or the solute potential, of the plasma.

Question 4

Part (a) was considered to be relatively straightforward, but the answers were surprisingly variable. Many descriptions included references to amylase and maltose only and suggested that maltose is the end product of starch digestion. A number of answers described the digestion of carbohydrates in general, including references to lactose and sucrose. Candidates who described the effect of amylase, and the subsequent breakdown of maltose, however, readily gained full marks here. The answers to (b) frequently included general adaptations of the small intestine, rather than concentrating specifically on the uptake of monosaccharides. In (b)(i), although many candidates gained one mark for a reference to the increased surface area, this was less often qualified with a mention of the increased diffusion. Similarly, in (b)(ii), there were many references to the transport of monosaccharides, but this was not always qualified with an explanation of maintenance of the diffusion (or concentration) gradient. Part (c)(i) was generally answered quite well, as many candidates were able to interpret the data and give correct comparisons between the relative rates of uptake of fructose, galactose and glucose. A number of candidates, however, incorrectly stated that fructose has the highest rate of uptake and galactose has the slowest rate of uptake. Some of the answers were also rather inaccurately worded and referred to the 'amount' of each monosaccharide taken up, rather than the relative rate. The answers to (c)(ii) were more variable, as many candidates incorrectly referred to supposed differences in the size, solubility, or availability of these two monosaccharides. There were, however, a number of good answers which referred to the availability of specific transport proteins for glucose, or to active and passive transport mechanisms.

Question 5

This was a mark-yielding question as the mark scheme gave credit, in (a), for a number of xeromorphic adaptations and suitable qualifications. In a number of cases, correct features were stated, but credit was not given for references to these features 'stopping' or 'preventing' transpiration. Candidates should note that xeromorphic adaptations reduce transpiration, rather than stopping it completely. Occasionally, candidates gave features of structures other than leaves, including roots and stems. In (b), a wide range of different structural features was included and the majority of candidates gained a mark here.

Question 6

The marks for this question were generally rather poor and suggested that many candidates were unfamiliar with the principle of a simple respirometer. In (a), a number of candidates correctly referred to using the syringe to re-set the coloured liquid in the capillary tube, but there were also many references to 'moving the air bubble', suggesting possible confusion between this apparatus and a potometer. There were many imaginative, but incorrect, suggestions for the function of potassium hydroxide solution. Many of the answers to (b), rather unexpectedly, indicated that these candidates were unfamiliar with the use of a water bath in this context. When candidates correctly referred to the maintenance of a constant temperature, it was relatively rare for this to be qualified with reference to, for example, changes in temperature affecting respiration rates, or gas volumes. Many candidates were, however, able to gain full marks in (c) for calculating the volume of oxygen taken up per minute, although some of the methods for calculating this volume were rather circuitous.

Question 7

There were some very good, detailed answers to (a), which included descriptions of the apoplast, symplast and vacuolar pathways, and references to the role of the endodermis. However, there were also some answers which included details of transport in xylem, or transport of water in a leaf. This is another example of a question in which it is important for candidates to select appropriate information for their answer, to avoid including irrelevant information, for which credit is not given. Part (b) was generally answered quite successfully. In (b)(i), many candidates correctly described the increase in the rate of transpiration from 08:00 until 14:00 and the subsequent decrease; better candidates correctly quantified their answer with a suitable manipulated, quantitative comment such as referring to an increase of 45 arbitrary units from 08:00 until 14:00. Part (b)(ii) was also answered well and most candidates were able to suggest suitable environmental factors, or changes in the stomatal aperture, to account for the change in the rate of transpiration in each of these two time periods.

Question 8

In (a), a range of values was accepted for both haemoglobin and myoglobin and many candidates correctly read the two values from the graph. Marks were sometimes lost for incorrectly reading the scale of the x-axis, giving values outside the accepted range. There were some good answers to (b), in which candidates clearly understood the role of myoglobin and included references to its presence in muscle, storage of oxygen and release of oxygen at low partial pressures. This question specifically asked candidates to describe the role of myoglobin; some answers included rather general accounts of the properties, or structure, of myoglobin. There were also several answers in which candidates appeared to be confused between myoglobin and fetal haemoglobin. Part (c) required candidates to explain the importance of the Bohr effect. There were a number of answers which repeated information in the stem of this part of the question, and then digressed into general accounts of the role of red blood cells in the transport of carbon dioxide. There were, nevertheless, a number of detailed answers from candidates who clearly appreciated the importance of the Bohr effect and were able to express their answers accurately, using appropriate vocabulary. The most frequently occurring points in the answers related to the release of oxygen, from haemoglobin, to cells and tissues (mark scheme points 3 and 5). In some cases, further details were included, but it was relatively rare to read accounts which explained that, at an increased partial pressure of carbon dioxide, the percentage saturation of haemoglobin with oxygen decreases at the same partial pressure of oxygen. This is a discriminating point: candidates who gained full marks were usually awarded mark points 1, 2, 4 and 5.

Maximum mark 60

Mean mark 26.6

Standard deviation 10.5

General Comments
Questions 1, 2, 3, 4 and 8 on this Paper were common between 6102 and 6112. There was no difference noted between the standard of the answers to these questions compared with 6102.

Questions 1 to 4
Common with 6102.

Question 5
Generally well answered. Cuboidal seemed to be the one students failed to identify and give the location of the most. The most common error was to give the general answer for location of the kidney for cuboidal, rather than the nephron.

Question 6
Most candiates gained one mark in (a) for the idea that the evaporation of sweat cools the body. By not mentioning that it is the water that evaporates, many candidates were limited to one mark here. Part (b) (i) was generally well answered but the usual confusion was that the body temperature continued to drop after the individual had got out of the bath rather than as he was getting out of the bath. Few gained the mark for manipulating data: most simply quoted the data or did not specifically state a time period over which the change occurred. In (b)(ii), for the 5 – 10 minute interval, most candidates identified that the water was cooler but few linked this to the idea of conduction. Also, some assumed that the bath was warm and as a result lost marks. Answers for the 15 – 25 minute interval were not good: most candidates thought that the body was now in a warmer environment and so picked up heat from it, rather than it being generated internally. More gained marks here for the shivering rather than the generating heat idea.

Question 7
One mark for the absorption of CO_2 was most common in (a)(i), the most common suggestion was so the volume of oxygen could be measured each breath. Accounts in (a)(ii) lacked the practical detail that would have scored more marks, such as switching on the recorder, which was very rarely seen. The most commonly awarded marks were for the reading of the results off the chart and for breathing through the mouthpiece. Marks were often lost as candidates failed to give details of a maximum breath out following a maximum breath in. In (b)(ii), many candidates correctly referred to the increased demand for oxygen but few linked this to the increased production of CO_2 and the effect this had on breathing.

Question 8
Common with 6102

6103/01 Unit 3 T1 Individual Investigation Moderators' Report

Maximum mark 32

Mean mark 21.2

Standard deviation 5.3

General comments

The current specification is close to its end. Nevertheless, the following observations may be helpful both to Centres with candidates in the current series as well as to those making entries in 2009.

Coursework at AS Level maintained a generally sound standard once again. As has been reported in the past, many candidates spend more time on investigations than is suggested in the specification. Whilst it is not necessary to devote long periods on them in order to realise high marks, those who did so generally achieved sound rewards, especially in the Analysis and Evaluation sections.

Investigations were often either on enzyme optima and the effects of substrate concentration, or entered new territory on aspects of enzyme activity. Candidates conducting unusual enzyme studies often realised marks that carried high rewards, especially in evaluation. Occasionally, coursework emanated from ecological studies.

Once more, Centres' scores more closely matched those of the moderators than in the past. Occasionally moderators raised marks – also a more recent phenomenon. Annotations and marks for sub-sections were generally relevant to the tasks and inserted into the scripts themselves, rather than on separate sheets of paper. Moderators far prefer the former approach, since it is absolutely clear where marks are awarded. Centres are reminded that appropriately annotated work received marks that are more consistent with those of moderators. Some centres used intermediate marks for sub-sections. This is not recommended: it is best to stick with scores at a particular level and then make judgements as to whether overall, intermediate marks are justified.

Moderators did see many centres where marks were absolutely spot on and where internal moderation was clearly undertaken. There are now just a few centres where marks do not reflect the standard of candidates' work, do not carry annotations and fail to apply the hierarchical marking procedures correctly. There are a few Centres, too, which mark so generously, particularly in the Analysing and Evaluating sections, that adjustments are required. In Evaluating especially, it is important to check that both strands (a) and (b) have been addressed. Often candidates neither recognise variability in their data, nor difficulties when carrying out their studies.

Whilst many previous reports outlined aspects that caused differences for candidates between centre and moderator, the Principal Moderator does so again, with additional comments on new features.

Planning

Most centres train their candidates by suggesting headings for sub-sections, which assist in fulfilment of strand (b) to the highest level. However, this year there was excessive use of tabulation when listing variables, apparatus and its justification, and safety. This was very formulaic in some cases.

The major weakness in Planning concerned biological knowledge once again. Candidates need to provide short, appropriate accounts of the biology that underpins hypotheses. If these are at A Level standard, then 6 or even 8 marks may be awarded. It is very beneficial to focus on the variable investigated and to research this thoroughly. Many candidates spoilt their introductory comments by adding descriptions that carried little relevance and reduced their score on P(a) to below 6.

Implementing

Moderators changed very few marks. However, when this occurred it was (as last summer) for three main reasons:

- absence of I(a) or I(b) marks
- inappropriate accuracy
- insufficient data.

If tables are poor, for whatever reason, moderators may well reduce marks where centres suggest I(a) and (b) of 8. However, where centres do not provide any evidence for these sub-sections, especially where an investigation is not only very simplistic with data that suggest lack of precision, but also shows poor tabulation, moderators have no choice but to award Planning marks based on evidence placed before them, which is the table.

With regard to data collection, Principal Moderators emphasise at standardisation the need for consistency and precision. Moderators will not award high marks for data that do not conform to the instruments used. If they are not very precise, candidates will not gain high marks by providing data that suggest otherwise. Moderators must also see evidence of considerable data collection. Where repeats may not be reasonable, as in many ecological studies, moderators will not insist on repeats for high marks, but where there are only a few values of a variable – as is typical in enzyme studies – more than one repeat is expected.

Analysing

Fewer multiple graphs were seen once again this year. Most of those presented were carefully drawn, with accurate plots and correct format. This enabled candidates to access trends and patterns related to their initial hypotheses. Unfortunately, rather too often (especially where investigations proceeded to a foregone conclusion with enzyme optima and the like) trends were very rudimentary indeed. Really interesting detail was omitted which, had it been included, would have enabled higher marks both in strands (b) and (c).

Evaluating

As always, this was the weakest section. Candidates did, however, increasingly focus on A(a). They attempted to describe variability and reliability, but the reason for producing range bars was often misunderstood. Nevertheless, candidates are now much better at addressing this strand than those at the start of the specification in 2000.

Once again, lack of sensible difficulties linked to specific investigations is of great concern. Moderators are very familiar with most of the investigations undertaken and the likely difficulties that arise from them. Some candidates did not recognise that they were experiencing difficulties with their measurements, though these must have arisen with the techniques that they used.

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Maximum mark 32

Mean mark 15.3

Standard deviation 5.0

General comments

A very wide range of marks appeared in this June's paper. Many candidates achieved high scores on Question 1 and a greater number on Question 2 than in the past. With regard to this second question on stomatal opening, some candidates were well prepared in terms of experimental design, constructing tables and graphs relating to this design, and suggesting limitations and further work. A minority tried unsuccessfully to adapt a previous investigation and its mark scheme to the current question and another minority were not well informed at all and it was, therefore, not unusual to find very low marks indeed.

Question 1

This was set in the context of bee visits to grapefruit flowers. Parts (a) and (b) were particularly well answered.

Part (a) generated many clearly designed tables, with correctly calculated means for the number of bee visits during four days. A large majority attained maximum scores, but the rest lost marks for a number of reasons, the most common of which related to labelling and calculations. Either units were included in the cells of the table (not exclusively in the headings), or totals were calculated (instead of means), or means were rounded up to whole numbers. Nevertheless, it was unusual for any candidate to lose more than two marks on this part. In (b), the vast majority did reasonably well with neatly drawn line graphs, which were correctly formatted and labelled. The data lent themselves to more than one format, but most candidates plotted points and drew lines between them. Some better ones amongst them lost marks through inadequate labelling of the vertical axis, since there was often no reference either to a mean, or to time for collection of data. However, more frequently, low marks originated through careless plotting and poorly drawn lines. Parts (c) and (d) presented some difficulty, especially (d). Many candidates understood the need for describing a general trend at the outset and for manipulating data in (c). However, more specific trends within data were either poorly described, or omitted. For example, the third point in the mark scheme referred to the 'greatest decrease in bee visits between 500 and 1000 metres', but often responses were either too vague, or inaccurate. A significant minority of candidates gained nothing since they simply described the data, point by point, without doing anything with them. Part (d) answers often lacked specificity, both in the general sense and from not taking sufficient note of the question. Many candidates wrote about difficulties when recording bee visits or about problems associated with the weather. Examiners required some definition as to the difficulty and to the weather. The question was about bee visits to grapefruit flowers, but many referred to grapefruits rather than to the flowers themselves.

Question 2

As outlined in **general comments** above and in the January 2008 report, these planning questions are realising higher overall scores than in the past. Many scripts showed evidence that candidates knew the correct procedures and wrote a logical and convincing account. They understood how to present data that were, importantly, linked to their proposed method.

Points raised in the January report are repeated here once again, since candidates are losing marks through inadequate detail. Examiners do not award marks for vague comments and in this respect Centres may find the following comments helpful. In some Centres, there is a need for improvement in basic design skills. For example, candidates are advised to use *volume* instead of amount, provide a suitable range for the independent variable and omit qualifications to quantity such as *approximately, around* and *about. Amount* appeared on fewer occasions than in January, though other common vague expressions occurred just as frequently.

Part (a) enabled many candidates to realise maximum marks. All points on the mark scheme appeared, but answers most commonly carried mark points 2, 3, 4, 5, 6, 7, 10 and 11. Often candidates did not standardise their leaves sufficiently at the outset (mark point 1), failed to place them in the dark (mark point 2), and counted stomata, but failed to state where specifically (mark point 8). Repeats *per se* were not rewarded, since they needed to be on each leaf (mark point 12), nor was the use of a microscope, without identifying the magnification used (mark point 9). As always, candidates were rewarded for detail and well trained individuals scored highly. A minority, however, were not well prepared. These candidates obtained marks for basic control ideas even if their method was not appropriate. Some tried to adapt previous mark schemes to their needs with very, very limited success. Others made the design so complicated that answers to (b) failed to produce many marks. There were just a few whose investigations measured transpiration rates and whose accounts carried very few points that were creditworthy in the context of the question. There were three marks for (b) and many achieved maximum scores. The keys to success are to present raw data based on the plan (so that if repeats are to be conducted these must be shown as table headings), to draw a correct type of graph with axes the correct way round and to label it correctly. In the January report, candidates were advised to design a table and to draw their proposed graph, but not to describe these features in prose. In June 2008, Centres and candidates acted on this advice, which is pleasing. As in the past, (c) presented many candidates with the most significant challenge on this paper. Most candidates recognised that it would be difficult to judge stomatal opening (mark point 1 on limitations) and that further work could be carried out on different species (mark point 2). Limitations most frequently described were mark points 2 and 5 and better candidates recognised that chloride ions also possibly had an effect (mark point 4), which gave them the opportunity to use different potassium salt solutions as further work (mark point 1). Once again, many responses on limitations were not relevant to this investigation and those that were often included corrections to the plan. This is a common feature, especially for low scoring candidates. If these are put as bullet points in the plan, even as retrospective ideas, they will improve marks on (a).

Maximum mark 38

Mean mark 19.8

Standard deviation 6.5

General comments
This paper produced a wide range of responses on most questions. It was pleasing to see that very few candidates left blank spaces and most were able to gain some credit on most sections of the questions.

Question 1
Part (a) proved to be quite a testing question. Although most candidates were able to make some reference to the source of organic material or to an energy source, only the better candidates gave complete answers which emphasised the differences. There were many vague references such as 'external sources of energy' for autotrophs or 'ready made food' for heterotrophs. Candidates should be reminded that when comparisons or differences are expected, they should make a clear statement that includes both sides of an answer. For example 'autotrophs can make organic compounds but heterotrophs cannot' would not be creditworthy. Most candidates gave acceptable answers to at least two or three of the sections in (b). The most common error was to confuse 'parasitism' with 'mutualism' in (b)(ii) and (b)(iii).

Question 2
In (a), a straightforward statement that defined eutrophication as the nutrient enrichment of water was expected. Many candidates did not appreciate that the term applies only to this initial enrichment and tried to include descriptions of the consequent effects. It was disappointing that many candidates could not perform the relatively straightforward calculation in (b)(i) correctly. The most common errors were dividing the difference by 7000 instead of 800, or using 7000 as the increase. In (b)(ii), most candidates stated that the extra nitrates would increase growth in the algae. Only the better candidates related this to the use of nitrates in protein synthesis. Many candidates picked up one mark for a reference to the death of the algae when nitrates stopped being added, but relatively few could relate this clearly to the limited supply of nutrients. The idea of more competition for light was given by many candidates. Candidates who gave either a straightforward account of the food chain effect, or of the effect of increasing decomposition, usually gained full credit in (c). However, there was a surprisingly high number of candidates who confused some basic biological facts. Many references to 'fish being unable to photosynthesise due to lack of light' and 'algae using up oxygen in their photosynthesis' were seen. The mark scheme for (d)(i) allowed for the fact that many candidates may have experienced this type of estimation in a terrestrial habitat. Overall, it was a high-scoring question. Part (d)(ii) proved difficult for many candidates and, with hindsight, it may have been due to the way that it was worded. However, most candidates were able to make a reasonable reference to either biomass taking account of the differences in size or vice versa for numbers. Candidates who assumed that biomass does not give inverted pyramids could not be credited.

Question 3

Part (a) was answered correctly for all three processes by most candidates. Similarly, (b) was answered well by most candidates. The most common errors included not appreciating the actual units when reading figures from the graph and not being careful enough when referring to the years. Part (c) was answered reasonably well by most candidates. However, some candidates gave descriptions of the reasons why increased carbon dioxide may lead to global warning. Most candidates were able to explain the term 'greenhouse gas, in (d) and give an acceptable example. The most common errors were to refer vaguely to light or rays being absorbed in the descriptions. Sulphur dioxide was the most common incorrect example that was given. Coal was named by almost all of the candidates in (e). It should be noted that petrol, or any other oil product, were not accepted. In (f), there were many straightforward, acceptable definitions. Many candidates gave very vague answers which attempted to define the word 'sustainable' without any reference to the idea of energy or renewable crops. Part (g) was answered well by most candidates, who gained full credit. Some candidates misread the graphs completely and reversed all of the effects of planting willow. Other candidates did not pay sufficient attention to the key and confused which bird was which.

	Core information for: Option A	Option B	Option C
Maximum mark.....	40	40	40
Mean mark.....	20.4	20.2	20.9
Standard deviation	7.1	6.7	7.1

Question 1
Surprisingly, few candidates scored full marks on this question. Most candidates could name glucagon, although there was the usual confusion with glycogen and most could give a function of adrenalin. Many candidates named ADH instead of oxytocin and very few were precise enough in stating which part of the pituitary gland produced LH.

Question 2
This question was generally well answered with many candidates scoring 4, 5 or 6 marks. Some very good definitions of a metabolic pathway were given and, in some cases, candidates wrote answers that included all three of the possible marking points.

Question 3
In (a), candidates wrote about the absorption of light by rod cells and the dog being able to absorb more light as they have more rod cells present, but some failed to write about the significance of the dogs being able to see better in dim light as a result. In (b), many candidates wrote what they knew about cone cells and rewrote the information given to them in the stem of the question without actually using the information to answer the question actually being asked. Part (c) was well answered with only the weakest of candidates not scoring full marks. The mistakes made included confusion with chlorophylls, the misquoting of the numbers by those candidates who tried to name P_R and P_{FR} as P_{660} and P_{730} respectively and stating that P_{FR} was converted to P_R at night or in the dark when it absorbed far red light.

Question 4
Mixed responses were seen to (a). Some candidates did not look at the diagram carefully enough and named Bowman's capsule as the glomerulus and there was some confusion over the mechanism of glucose reabsorption. The calculation in (b) caused very few problems, but the comparison of the effects of high and low ADH on the changes in solute concentration as the filtrate flowed through the nephron was not well done, even by the better candidates. As in previous years, many candidates were still not writing comparative answers, instead writing two separate descriptions: this does not score them any marks. The majority of candidates had not read the question properly and compared the levels of solute at each point along the nephron rather than the changes that occurred between regions. In general, the explanations given for the higher solute concentration, resulting from high ADH, were concise and straight off the mark scheme; answers frequently scored all three marks.

Question 5

A wide range of responses was seen: very few candidates left the question totally blank and very few responses scored zero. The weaker candidates tended to write everything they knew about the topic and scored the more general marks for details about myelination (mark points 11 and 12) and synapses (mark points 13, 14 and 15). Stronger candidates wrote separate sections on each of the three neurone types and scored highly. A number of candidates drew some reasonable diagrams of the different neurones and those who fully labelled these were able to score many of the marks from the diagrams alone.

Common errors included:

mp1: stating that the sensory neurone detected the stimulus
using the terms 'messages' or 'signals'
stating that the impulse was transmitted from a receptor or the effector

mp2: expected confusion with the other types of neurone

mp4: stating that the relay neurone connected the sensory neurone to the motor neurone

mp6: suggesting that the relay neurone is myelinated

mp7: using the terms 'messages' or 'signals', although these were allowed if the candidate had already been penalised for this in mark point 1

mp8: expected confusion with the other types of neurone or vague answers that stated that the cell body was on the end

mp12: impulse jumping between the nodes

mp13: only making reference to synaptic knobs being present on the ends of the neurones without naming the synapse, or making it clear that there is a gap between one neurone and the next.

	Option only	Core + Option
Maximum mark	30	70
Mean mark	15.4	36.2
Standard deviation	5.2	11.4

Questions 1 to 5
Questions 1, 2, 3, 4 and 5 on this Paper were common between all option papers. There was little difference between the standard of the answers to these questions compared with the other two options.

Question 6
Generally a well answered question.

Question 7
This question was also well answered. In(a), many candidates could describe selective and indicator media and some went on to state their uses. Part (b) scored highly by those candidates who had read the question carefully and explained why *Clostridium, Nitrosomonas* and *Nitrobacter* could not grow and not just explained why *Azotobacter* could grow. Some candidates lost marks because they only repeated what conditions were needed by each genus of bacteria to grow, without linking the information back in to the question.

Question 8
Some very good answers were seen for (a); many candidates have an in-depth knowledge of the production of penicillin and a good understanding of batch fermentation and its use in the production of secondary metabolites. A common error was to state that *Penicillium* is a bacterium. Other errors included the expected confusion between batch and continuous fermentation, poor expression in stating that nothing is added to the fermenter and the misquoting of values for pH and temperature. Details were given for downstream processing by a number of candidates which is a little beyond the specification, but these candidates did get credit if it was clear that the penicillin was in the culture fluid. Few candidates read the question properly for (b)(i) and, as a result, did not describe how a total cell count could be obtained and the percentage viability subsequently calculated. However, many candidates picked up three marks by naming dilution plating as a method for obtaining a viable cell count, giving some details of the methodology and for stating the need for aseptic technique. The second part of (b) caused many problems and very few candidates scored maximum marks. Again, comparative comments were not made by a number of candidates. Mark point 1 was rarely awarded as candidates talked about the immediate effects of antibiotic X, failing to realise that the x axis variable is concentration and not time. This was also a problem in mark point 3, as candidates referred to the gradients of the lines as though they represented rates and wrote about the faster effects of antibiotic Y. The marks that were usually awarded were mark points 4 and 6, although some candidates forfeited these marks by reading values from the graph inaccurately.

Question 9

In (a)(i), the mark points most commonly awarded were the first and fourth. Those candidates who did try to describe the relationship further tended to describe the numbers of bacteria in relation to pH without making suitable time references. There was an alarming number of candidates who tried to quote and manipulate figures wrongly. Part (a)(ii) saw a variety of responses. There were still candidates taking logs of log values and misreading values from the graph. It was encouraging to see that past papers and mark schemes had been used by many Centres to advise students, as a lot of truncated answers were seen. Answers to (b) were variable and not as good as seen in the past. Some candidates could give accounts of mixed starter cultures and the symbiotic relationship that exists, in detail that goes beyond the specification. Others clearly had some idea of the role of bacteria in yoghurt production but wrote clumsy responses that lacked specific detail. Examples include coagulation of milk, and not milk proteins; thickening of milk and not of the yoghurt; and the bacteria causing the pH to drop.

	Option only	Core + Option
Maximum mark	30	70
Mean mark	17.7	38.3
Standard deviation	4.1	9.8

General comments
Questions 6, 7(a), 8(a), 8(b) and 9(b) were high scoring. Questions 7(b)(i), (ii) and 9(a)(ii) proved difficult.

Questions 1 to 5
Questions 1, 2, 3, 4 and 5 on this Paper were common between all option papers. There was little difference between the standard of the answers to these questions compared with the other two options.

Question 6
A straightforward question that allowed the majority of candidates to gain at least three of the four marks available. Occasionally, there was confusion concerning which vitamin deficiency caused night blindness and which caused scurvy.

Question 7
In (a), the majority gained the mark, with the most common answer being a description of mould growth. In (b)(i), many candidates totally ignored the stem of the question, which told them that raspberries showing more than 20% visible defects were not acceptable for sale. Most concentrated on comparing when visible defects first occurred. In (b)(ii), it was much more common for answers to be focused on respiration in raspberries, rather than respiration in microorganisms.

Question 8
Part (a) was well answered and examiners were often able to award all four marks. Many candidates were able to describe the changes seen during ripening and could go on to give details about the causes of the changes. Again, many understood the action of enzymes on pectin leading to a softening of fruit; and the effects of chlorophyll, carotene and lycopene leading to a change in colour of fruit. Part (b), which required candidates to describe changes seen in a graph, proved to be straightforward for most candidates. Some described changes during fruit development first, and then changes during fruit ripening; others described changes in pH first and then changes in sugar concentration. Either approach could gain full marks and frequently did. Some candidates did not look at the command word in the question and instead tried to explain the changes in pH and sugar concentration. This usually resulted in loss of marks because their answer did not give an adequate description of the changes. Part (c) of this question was based on a prescribed practical, but relatively few could give sufficient detail to gain all of the available marks. Some did not seem familiar with testing sweetness and instead gave details of the Benedict's test.

Question 9

Part (a)(i) required candidates to read values from a bar chart and then calculate a percentage change. Although most successfully read the values as 38 and 10, it was disappointing that so many then divided by 38 and not by 10. Part (a)(ii) was poorly answered, with surprisingly few being able to describe relationships clearly. It was, therefore, rare for examiners to see suitable explanations for these relationships. In (b), the majority could state that callipers would be used and could also name two suitable sites on the body. Many gained all three marks, but some answers tried to relate the skinfold measurement technique to calculating a person's BMI.

	Option only	Core + Option
Maximum mark	30	70
Mean mark	16.2	37.9
Standard deviation	5.0	11.2

Questions 1 to 5
Questions 1, 2, 3, 4 and 5 on this Paper were common between all option papers. There was little difference between the standard of the answers to these questions compared with the other two options.

Question 6
The majority of students correctly identified that stroke volume increases due to training. However, the responses to the other parts of the question were mixed. Many thought that the size of the heart did not change and there was much confusion with both heart rate and recovery rate. 'Heart rate increase with exercise' was a common response, as was 'the recovery time decreases with more training'. The latter, although correct, does not answer the question.

Question 7
There were some really good answers to (a), almost straight off the mark scheme. However, others lacked the preciseness of answer to score full marks. Common errors were references to 'one cell thick' rather than to the fact that the cells were thin. Also candidates talked in terms of absorption or uptake rather than diffusion or gas exchange. Some also confused the surfactant with the layer of moisture. Part (b) was generally answered very well with the majority of candidates scoring full marks. There were good descriptions of the stretch receptors in the bronchioles and of the responses shown by the medulla and respiratory centres. However, some candidates described how ventilation was controlled, rather than the rate of ventilation; and others went into great detail about the Pons, pneomotaxic and apneustic centres. No additional marks were given for this extra detail, as these regions can not work independently of the medulla and reparatory centres, so candidates giving these extra details correctly had already picked up the full marks. Many made reference to CO_2 levels but failed to tell us that they were in the blood. Others lost marks for confusing stretch receptors and baroreceptors

Question 8
Part (a) was probably the least well-answered question in the option. Many simply gave details of the cardiac cycle and how it is controlled by the SAN and AVN. Some made reference to the delay at the AVN but completely out of the context of the question. Also, some gave details of the Bainbridge reflex and carotid sinus reflex rather than the aortic reflex. Those that had learnt this and knew what the aortic reflex was scored well but others lost marks as they thought an increase in pressure required an increase in heart rate to reduce it. Also there was confusion between the sympathetic and parasympathetic nerves. Some had the sympathetic slowing heart rate and others it secreting acetylcholine.

Part (b)(i) was answered better, with many candidates scoring full marks for including 'both systolic and diastolic pressures increase linearly as cardiac output increases'. Others correctly identified that systolic increases more, but then lost marks by making reference to the rate of increase. Many good manipulations of figures were also seen here. Practical questions are never answered well and (b)(ii) was no exception. Some candidates thought that individuals needed to train for several weeks to increase cardiac output. Many stated that heart rate needed to be measured but did not link these ideas to an increase in cardiac output. Some were using pulse meters and taking ECGs rather than using a sphygmomanometer and few correctly identified how you took the blood pressure using the arm cuff. Nearly all candidates correctly stated that the diastolic and systolic pressures had to be measured but some failed to get this mark as they simply said record blood pressure.

Question 9

On the whole, (a)(i) was well answered but candidates still seem to confuse what they should be dividing by, and incorrectly divide by the larger number when looking for a percentage increase. Candidates in (a)(ii) failed to answer the question by stating the inferred relationship between the characteristics and body fat. There were many suggestions but very few descriptions. For the high blood cholesterol, only a small number of candidates seemed to have the idea that the cholesterol was ingested but rather stated that it built up in the walls of arteries. For the 'no regular exercise' the main misconception was that 'little body fat was being burned so it accumulated' and candidates missed the fact that the calories consumed were not being used let alone the stored body fat. It was evident from some responses that the candidates had not done the experiment in (b), as the stem of the question was simply rearranged to form the answer. For those that had seen and performed the experiment, full marks were more often than not gained, with some giving correctly five mark points. Sadly, few, if any, made reference to repeats from the same sites. Also some incorrect sites were suggested such as the stomach, hips and thighs.

Maximum mark 70

Mean mark 34.8

Standard deviation 10.4

General Comments
Overall, this was a high scoring question paper, with candidates scoring good marks on Questions 2, 5 and 8. However, elements of Questions 1, 3 and 4 were poorly answered. The examiners would like to stress that it is important for candidates to take time to read the questions carefully. There were numerous examples of candidates misreading questions or ignoring instructions. In many cases, time was wasted by writing responses which were then crossed out.

Question 1
In (a), most candidates managed to work out that the diploid number is 63, which meant that homologous pairing and gamete formation was not possible. Part (b) was less well answered and few mentioned the idea of barriers to prevent interbreeding between populations. Most noticed the clue of 'post-zygotic', so gained credit for the idea that fertilisation was possible.

Question 2
In (a), most opted for red grouse and gave a suitable reason linked to time and manipulated the data. However, there were some very odd data manipulations. A few tried to play safe by mentioning all four species. In (b), the majority of candidates were familiar with the Lincoln Index and gained the three marks easily. However, there were frequent references to random sampling, counting all the organisms in a given area, counting species, or inappropriate collection methods, such as use of quadrats or catching squirrels in pit-fall traps.

Question 3
This question scored very poorly. Questions on absorption and action spectra have been asked several times before, so it was surprising, therefore, that so few candidates gained full marks. There were two very easy marks for simply explaining the two terms. Few candidates linked the idea of absorption of light by pigments to the photosynthetic rate. Part (c) was equally disappointing. It did not ask candidates to describe how to carry out chromatography: instead, it asked how chromatography could be used to identify pigments. As a consequence, most candidates wasted time by describing in detail how to obtain a sample of pigment and then squashed the relevant part of their answer into the last two lines.

Question 4
Past questions have asked candidates to draw whole or part of cells, so it is surprising to see such poorly drawn diagrams. Candidates also ignored the simple instruction to label the four structures listed in the question. A surprisingly common error was labelling the cell wall and membrane the wrong way round. Plasmids were expected to be shown as a simple ring, not a double ring, nor to have contents. The food chain question could be answered in different ways. Most ignored the food chain part and launched into their usual eutrophication answer. Sadly, there is still confusion, with 'algae use up the oxygen' in the water and 'excess nitrates kill off the fish'.

Question 5
Part (a) should have been a straightforward question, but a surprising number of candidates incorrectly identified blood vessel A as a red blood cell. The subsequent answer was not then appropriate. Candidates mentioned most of the features of arteries listed on the mark scheme. Part (b) was well answered and most gained 3 to 4 marks. However, weaker candidates confused the ACE inhibitor with the enzyme, ACE, or the substrate.

Question 6
Part (a) was a straightforward question on the linking of amino acids, so it was surprising that few gained two marks. Common errors included hydrogen bonds, covalent links etc. In (b), most candidates managed to mention one of the two forms of bonds, but did not compare the relative strengths correctly. In (d), the molecular structure points were gained only by the better candidates who appreciated that the changes in the cysteine links would alter the shape of the molecule, which would then be unable to fit the receptor site in the plasma membrane of the target cells. Weaker candidates knew that the glucose levels would stay high for longer, but their explanations were poor.

Question 7
In (a), most referred to rhodopsin, and described the process of bleaching with the change in shape of cis- to trans-retinal and opsin. Better candidates mentioned the change in the permeability of the membrane and the generator potential. Part (b) was high scoring with most candidates gaining four marks. However, the question asked for an explanation and lines were provided for the answer. It was expected that candidates would draw a genetic diagram and then write an explanation. Those answers lacking the written explanation generally failed to provide sufficient detail to gain all five marks. As in previous years, weaker candidates do not understand the term 'probability'.

Question 8
This was a high scoring question with most candidates giving three suitable uses, the most common being energy store, thermal insulation, buoyancy and physical protection. Qualified responses were required, for example thermal insulation, rather than insulation.

Maximum mark 70

Mean mark 31.1

Standard deviation 9.4

Q1, Q4, Q5, Q6 and Q7 are common with 6105/01.

Question 2

Most candidates referred to production of antibodies in the rabbit's blood in (a). Many candidates also referred to the components of human blood acting as antigens. It was considered that, at this level, a precise reference would be made to the lymphocytes rather than vague references to white blood cells. Some candidates confused the terms antibodies and antigens. There were also some references to antibiotics. In (b), relatively few candidates were able to give a clear reference to the idea of obtaining a 100% standard. Vague references to 'control' were fairly common. In (c), most candidates gave descriptions that compared the degree of precipitation in the gorilla and chimpanzee with that in the gibbon and orang-utan. These candidates usually picked up at least one more mark for a reference to the degree of precipitation indicating the closeness of the ancestry or for some quantitative comparison. Very few candidates referred to the presence of common proteins.

Question 3

The majority of candidates gained one mark in (a) for reference to the pyramid giving information about the age and gender structure of a population. A very small number of candidates stated that it was in the form of a bar graph. In (b)(i), most candidates were able to state that life expectancy is higher in USA. Many candidates could also explain that the numbers surviving above the age of 75 in Uganda are extremely low in comparison to the USA. The other mark points were occasionally seen. Most candidates gained full credit in (b)(ii). Some candidates could not be awarded any marks as they did not state which country was being described. Part (c) not answered well. Candidates who gained credit usually gave a reference to the increase in both populations and/or the relative short life expectancy in Uganda still being apparent. Most candidates did not seem to appreciate that a comparison between 2000 and 2025 was expected and not just a comparison of Uganda and USA in 2025.

Question 8

The answers to this question were generally disappointing. Although most candidates were able to gain some credit, high marks were relatively rare. Store of energy and phospholipids were the most common acceptable functions. A general lack of attention to detail penalised many candidates. There were many unqualified references to insulation and protection. Many candidates included references to functions that were not appropriate to humans such as 'blubber providing buoyancy' and even 'waxy cuticles preventing transpiration'.

Maximum mark 32

Mean mark 18.7

Standard deviation 4.8

General comments
Once again, there was a wide range of interesting investigations carried out in the field and in the laboratory.

Whilst recognising the efforts candidates had made, many reports were very long. In most cases, this length was not directly related to the quality of the investigation or its final mark, but was often caused by unnecessary repetition or the inclusion of irrelevant material. Candidates who organised their reports well, with clear sub-headings which were well-matched to the criteria, were able to score high marks without the need for longer reports.

In a large majority of cases, Centre marks for planning and implementing were accepted unchanged but there was a significant minority where adjustments were necessary, especially to planning marks. The main reasons for these changes were that some plans, awarded a maximum mark, had serious limitations and, in many cases, marks awarded did not differentiate sufficiently between the varying quality seen within the Centre itself.

Planning
Examiners found no difficulty in supporting maximum marks for plans which had clearly defined hypotheses, demonstrated individual thinking about control of important variables and showed an awareness of how the data were to be analysed statistically. Not surprisingly, such plans also subsequently provided excellent opportunities for candidates to address analysing and evaluating criteria to a high level. Conversely, where plans were vague or attempted to investigate multiple hypotheses, candidates invariably found difficulty in achieving high marks in other criteria.

Implementing
It was very rare for Implementing marks to be adjusted. However, I(c)4 does require accurate tabulation and that the number and type of observations are accurately linked to the hypothesis being tested. As there is written evidence of this, a maximum mark cannot always be supported.

Introduction
Many candidates show improved skills of research and more sophisticated use of sources. There was often a good deal of relevant information quoted, but large numbers of candidates are unable to resist the temptation to record much of what they discovered in a basic list of information rather than focusing carefully on their hypothesis and attempting to explain the rationale behind it in a more selective manner. In the lower scoring sections, it was largely left to the reader to select the relevant parts.

Method
Examiners are looking for evidence to answer two key questions in this area to award M3. Does the account give sufficient detail for the reader to replicate this investigation accurately? Is there evidence in the report that all precautions that could reasonably be expected have been taken in controlling variables or amending the planned method where appropriate?

Many omitted vital details and hence could not supply the evidence required in either (b) or (c). A common example was measuring light intensity, or other abiotic factors, in ecological investigations. Clearly, use of the light meter needs a well thought-out strategy and careful execution if it is to have even a basic reliability.

Analysing
Selecting the correct graphical format still poses a challenge to many. There was a full range of variations, from reports containing more than 20 graphs yet omitting the vital presentation which actually aided analysis of the hypothesis, to the most simplistic representation of the raw data without any attempt at manipulation. Graphs are assessed in the same manner no matter what method is chosen for their production. However it would be helpful to advise those using spreadsheets, such as Excel, that compressing the vertical axes to fit them neatly into a Word document often reduces their accuracy and usefulness in analysis.

In A(b) candidates are expected to analyse their data and point out important trends rather than simply describe their numerical results in words. Statistical analysis was generally well chosen by many, but the examiners would like to reiterate that candidates must demonstrate that they understand how to apply the test statistic they calculate in making a judgement about their hypothesis at the 5% confidence limit. Where a computer-based statistical package is used, candidates must explain the meaning of the calculated values in their own words to gain credit at the higher levels.

Discussion and Evaluating
This remains the most discriminating section of the criteria. Only very able candidates meet all of the requirements in a coordinated fashion linking one section to the next. It was common to find candidates, who wrote at length on earlier criteria carrying far fewer marks, submitting very short accounts here. It would be of benefit to many candidates to ensure that they use clear sub-headings which match the criteria.

For high marks in (a), it is essential that candidates do not simply repeat details from their introduction. It is expected that they will use the information they have researched to explain various aspects of their data in an integrated way. This is a section which often reveals the candidates' level of objective scientific thinking. Weaker candidates are more concerned with making their data fit the explanation regardless of evidence to the contrary. Better candidates are able to consider alternative possibilities and show evidence of understanding the influence of other variables affecting their data collection. This leads them naturally to considering variability and possible limitations.

In (b), many more candidates now attempt to look in detail at the variability of their data, but few use this effectively to consider reliability. Comments on limitations were often disappointingly short and superficial, with a detailed consideration of the methodology employed being very limited.

Making analysis of limitations a clear focus, when undertaking some of the listed practicals from each Unit, may be helpful in improving skills in this area.

Maximum mark 38

Mean mark 16.2

Standard deviation 5.2

General comments

As in previous years, there was a significant number of candidates who placed reliance on past mark schemes above applying their knowledge and understanding to the actual questions. Whilst this approach often yields some basic marks, it also frequently limits access to the higher grades. In this paper, this was illustrated by a number of candidates who were determined to construct size class histograms in question 1, despite the clear instructions in the rubric, and a smaller number who attempted to apply a mixture of past questions to question 2.

The examiners would, therefore, like to reiterate their advice that the best preparation for this paper is for candidates to undertake real biological investigations which will provide them with opportunities to develop their skills throughout the course. Provided that these are based on interesting questions which are well-founded in A-level biology, they need not be elaborate nor require any specialised apparatus.

Question1

Although most could use the information provided in (a) to convert the data to decimal fractions, maximum marks were rare. Simple careless errors in listing the results of calculations using consistent significant figures were common. Given the straightforward nature of the most appropriate bar graph in (b), marks for this section were limited to two. Once again careless errors, such as a lack of 'mean' in the axis label, or little attempt to plot accurately the two values, were common. The examiners did not give credit to scales which did not cover the full range and hence exaggerated the differences between the means.

Most candidates now appear to appreciate the need for accurate wording in the phrasing of null hypotheses and many gave clear answers in (c). However, answers suggesting no significant difference between 'woodlands' or 'light intensities' did not gain credit. As with (c), there was some confused wording in (d) which was difficult to interpret, but in general many gained two marks.

As with the practical coursework, (e) is often a discriminating section. All of the points on the mark scheme were seen by examiners, but it was rare to find three in one answer. There were many lists of ideas from previous papers written without a careful consideration of this investigation. The examiners try to ensure that all the marks awarded in this section are carefully selected to link closely with the methodology described and therefore reward objective analysis, rather than simple recall.

Question 2

A very large majority of candidates understood what was required in this investigation and those who thought carefully about controlling variables sensibly, using the information given in the question, were able to gain maximum marks in (a). This section also includes two marks for communication, taking into account the use of scientific language and basic spelling and grammar. Those awarded both marks must also write their method account in a logical sequence that is easy to follow. Whilst the examiners accept numbered points these must have some grammatical flow rather than an unrelated list of instructions.

Part (b) is always marked with a close reference to details of the plan written in (a). This means that a number of alternatives will gain credit, provided that they are scientifically valid ways of analysing the data collected in the planned method. Similar standards of accuracy are applied to tabulation in this section as in (a), hence many who did not make reference to the unit area they had described as quadrat size, or simply listed manipulated data rather than raw data, did not gain this mark. There were a number who included means which did not have any validity, either because of their positioning in the table, or because of the type of data they listed. Similarly, those who simply named a statistical test, regardless of the measurements they suggested, would not gain credit.

There was a wider range of analysis of limitations in (c) than in question 1, which reflected a more analytical approach in better candidates, especially the recognition that ploughing might attract many predators, such as birds, and that some earthworms present might not produce casts. Suggestions for further work were more limited but many scored at least one mark in this section.

Maximum mark 38

Mean mark 18.6

Standard deviation 5.6

General comments

Synoptic questions are intended to give candidates opportunities to apply their knowledge and understanding to new and possibly unfamiliar contexts. The questions also require the integration of knowledge from different units of the specification content. It follows, therefore, that for success with synoptic questions candidates require both a sound recall of factual knowledge and an ability to apply their knowledge. As an illustration, Question 1 required the application of knowledge and understanding of energy resources (Unit 3) and an ability to interpret data in relation to the processes involved in the formation of biogas.

Both questions 1 and 2 elicited a wide range of responses. In general, 2(c) was answered less successfully, partly because many candidates did not seem to assimilate the information provided in the introduction to this part of the question.

The standard of the essays was as variable as ever, with a minority of candidates showing an ability to write a coherent, carefully thought-out piece of continuous prose. In the essays, marks are awarded for the scientific content, balance and coherence, as described in the mark scheme. For high marks, candidates are expected to include a balance of relevant material from both the AS and A2 specifications. In many cases, the essays focused on the AS content with only passing references to Unit 5, such as in sources of new inherited variation (4B).

Question1

Part (a) required recall of the components of biogas and many candidates correctly named methane and carbon dioxide. However, there were a number of answers suggesting confusion between the production of biogas and the production of gasohol; there were also a number of cases in which candidates gave named examples of domestic and agricultural organic waste materials. Part (b)(i) required candidates to describe the changes in pH as shown by the tabulated data and there were many accurate descriptions, including a quantitative reference, readily gaining both marks. One common error was to refer to an increase in pH 'after day 15', where the pH starts to increase after day 10. Part (b)(ii) proved to be a discriminating question. Some candidates were unable to gain any marks here, but there were a number of good descriptions, with references to the activity of microorganisms, the production of carbon dioxide and organic acids, and the subsequent conversion of organic acids to methane. Some candidates incorrectly attributed the decrease in pH to the production of ammonia, or other non-acidic compounds. Part (c) was answered well, with many candidates scoring full marks: all four mark scheme points were seen quite frequently. Candidates who did not appreciate that heavy metal ions may be toxic to the microorganisms in the fermenter, or that these ions act as enzyme inhibitors, tended to suggest wider environmental effects of heavy metals, with incorrect references to eutrophication, for example.

Question 2

In (a), there were some good definitions of the term allele and two marks were awarded frequently, usually for mark points 1 and 2 (or 4). Some of the answers were expressed rather poorly, such as an allele being 'a type of a gene' which, although it conveys the idea, could be worded more precisely. The majority of candidates gained one mark for the explanation of the term phenotype; relatively few indicated that this is due to the effects of both the genotype and the environment.

The majority of candidates gained two marks in (b), for showing the gametes and the resultant genotypes. However, few gave a correct probability, having failed to take into consideration that the MM genotype is lethal and that the embryo does not develop. Consequently, many candidates quoted a probability of 0.25.

Answers to (c) were very variable, with a number of candidates failing to include any relevant information in their answers. The main reason for this seemed to be that candidates did not read the information provided carefully in the introduction to this part before attempting their answers. By way of illustration, there were many references to the pigment being denatured, rather than the enzyme responsible for the production of the pigment. A number of answers attempted to explain the distribution of the light-coloured fur, rather than the distribution of the dark-coloured fur. Some candidates seemed to ignore the information completely and attempted to explain the distribution in terms of adaptation to the environment, or natural selection. Those candidates who thought about the information provided and gave a reasoned explanation based upon temperature differences, enzyme activity and the synthesis of the pigment did, however, readily gained full marks.

The majority of candidates scored well in (d)(i), often giving concise definitions of the term metabolic pathway. There were also some very good answers to (d)(ii) in which candidates gave coherent explanations, using the metabolic pathway shown to explain how a point mutation could result in an albino cat. Some of the answers, however, were not well-worded and there was some confusion between nucleic acid bases and amino acids, and between tyrosine and tyrosinase.

Question 3

This was the most popular essay and was attempted by approximately 52% of candidates. Many of these essays included the roles of producers and consumers, with the transfer of energy through food chains. They also contained references to autotrophic nutrition and the loss of energy at each trophic level. There was a tendency to digress into detailed accounts of photosynthesis, at the expense of including relevant details. The essays were frequently illustrated with references to food chains; references to food webs were relatively rarely included. Examples of ecological pyramids were often included, but not always clearly related to the topic of the essay.

Some of the accounts included vague references to 'energy losses' without further qualification. Although the two topics in the title seemed to be rather unrelated, a number of candidates attempted to describe how ecosystems are dynamic and subject to change, illustrating this with descriptions of succession. However, one fault with the A2 content was that it was frequently treated in a rather superficial way and, although terms such as seral stages, plagioclimax and climatic climax were often included, they were less often defined or explained. The majority of candidates did, however, appreciate the general principle of succession and outlined both primary and secondary succession. Some of the better essays included good details of changes in biodiversity and biomass, in relation to succession and some of these were well written, with an introduction and a conclusion to complete the account.

Question 4B

Approximately 42% of candidates attempted this essay. Although the topic was considered to be relatively accessible, many of the attempts were inaccurate accounts of pollination and meiosis, but without many further details. Numerous essays launched straight into descriptions of pollination and fertilisation, without including outlines of flower structure and adaptations to insect or wind pollination. It was disappointing to note that a number of candidates were under the impression that self-pollination does not result in genetic variation; indeed a number of accounts suggested that this is a form of asexual reproduction. Some of the details of the process of fertilisation were inaccurate and did not include outlines of double fertilisation. However, it was pleasing that a number of candidates clearly appreciated the importance of cross-fertilisation and included reasoned descriptions of the mechanisms for ensuring cross-pollination.

In general, genetic variation was covered less successfully. Although a number of accounts included an outline of the events during meiosis which lead to increased genetic variation, the discussions often lacked appropriate depth and details. For example, although the process of crossing over was often mentioned, it was rare to read a coherent account of autosomal linkage and recombinants in relation to crossing over. Several essays were restricted to meiosis as a source of genetic variation, but included little relevant material from Unit 5, such as mutation as a source of new inherited variation. Nevertheless, there were some good, well-written accounts including references to polyploidy and its significance in flowering plants.

Question 5H

This essay was attempted by approximately 6% of candidates only and good answers were correspondingly relatively rare. It was evident again this year that, despite the rubric being clearly stated both on the front cover and on the page with the essay titles, some candidates entered for Biology answered this question, which is intended for those taking Human Biology. Centres should remind their candidates of the rubric: those Biology candidates who answer the Human Biology essay never have the range of knowledge needed to score good marks.

There were some good accounts of the structure of amino acids and the formation of a peptide bond, and levels of protein structure, but these were in a small minority. Some of the essays failed to include any relevant material from Unit 5H at all, and some of the attempts digressed into descriptions of DNA sequencing and DNA-DNA hybridisation. It was also disappointing to read several accounts from candidates who were clearly under the impression that similarities in protein structure ‘proves that humans are descended from monkeys’.

There were, however, some good accounts with details of protein sequencing and references to haemoglobin and cytochrome, as well as serum protein precipitation, and how these provide evidence for phylogenetic relationships between primates and other mammals.

APPENDIX A
UNIT GRADE BOUNDARIES AND UNIFORM MARKS

The raw mark obtained in each module is converted into a standardised mark on a uniform mark scale, and the uniform marks are then aggregated into a total for the subject. Details of the method of aggregation are given in Appendix A.

For AS examinations, the three unit tests each have a weighting of 33.3% with a maximum of 100 uniform marks.

For the A level, the six unit tests each have a weighting of 16.7% with a maximum of 100 uniform marks.

The table below shows the boundaries at which raw marks were converted into uniform marks in this examination. The A and E grade boundaries are determined by inspection of the quality of the candidates' work. The other grade boundaries are determined by dividing the range of marks between A and E. Marks within each grade are scaled appropriately within the equivalent range of uniform marks.

In Unit 3, the A and E boundaries are determined separately on the two components Paper 01 (T1) and Paper 03 (or Paper 02 (W1) and Paper 03 for International candidates only). These marks are then added together to find the A and E boundaries for Unit 3 as a whole, and the other grade boundaries for the Unit are then found as described above. Boundaries for the B, C and D grades for each component can be calculated in the same way, but please note that these are **not** simply added together to obtain the B, C and D boundaries for the unit as a whole.

In Unit 6, the A and E boundaries are determined separately on the components Paper 01 (T2), Paper 02 (W2) and Paper 03. These marks are then added together to find the A and E boundaries for Unit 6 as a whole, and the other grade boundaries for the Unit are then found as described above. Boundaries for the B, C and D grades for each component can be calculated in the same way, but please note that these are **not** simply added together to obtain the B, C and D boundaries for the unit as a whole.

Unit grade boundaries for June 2008 can be found on the next page.

Unit grade boundaries

Unit	Maximum mark	Grade				
		A	B	C	D	E
	Uniform marks 100	80	70	60	50	40
6101 Unit 1	*Raw marks* 60	41	36	31	26	21
6102 Unit 2B	60	41	37	33	30	27
6112 Unit 2H	60	39	35	31	27	23
6103 Unit 3	70	51	45	39	33	28
Paper 01 T1	*32*	*26*	*22*	*18*	*15*	*12*
Paper 03	*38*	*25*	*22*	*20*	*18*	*16*
6103 Unit 3 (International option)	70	45	40	35	31	27
Paper 02 W1 International only	*32*	*20*	*17*	*15*	*13*	*11*
Paper 03	*38*	*25*	*22*	*20*	*18*	*16*
6104 Unit 4 Option A	70	46	41	37	33	29
6104 Unit 4 Option B	70	47	43	39	36	33
6104 Unit 4 Option C	70	47	42	38	34	30
6105 Unit 5B	70	44	40	36	32	28
6115 Unit 5H	70	44	40	36	32	29
6106 Unit 6 (Option 1)	70	47	42	37	33	29
Paper 01 T2	*32*	*24*	*21*	*18*	*15*	*12*
Paper 03	*38*	*23*	*21*	*19*	*18*	*17*
6106 Unit 6 (Option 2)	70	43	39	35	31	27
Paper 02 W2	*32*	*20*	*17*	*14*	*12*	*10*
Paper 03	*38*	*23*	*21*	*19*	*18*	*17*

APPENDIX B

The Uniform Mark System for AS and A level Unit Schemes

The result for each unit will be issued as a standardised mark on a uniform mark scale. AS subjects have a total of 300 uniform marks and A level subjects have a total of 600 uniform marks.

Tables 1 and 2 show the numbers of uniform marks required to gain each subject grade in AS and A level examinations. They also indicate the number of uniform marks in units with various weightings that will aggregate into the appropriate subject grade. These provide a guide to the level of performance in each unit.

The uniform marks shown for each unit do not necessarily represent the actual mark range used for marking. Grade boundaries are set at Awarding meetings on the basis of candidate performance on the actual mark range used. These boundaries are then converted to the uniform marks shown in the tables, with intermediate values calculated accordingly.

Table 1 – Advanced Subsidiary Subjects

Subject		**Unit Weighting**					
Grade	**UMS**	**20%**	**30%**	**$33\frac{1}{3}$%**	**40%**	**50%**	**60%**
Max mark	**300**	60	90	**100**	120	150	180
A	**240**	48	72	**80**	96	120	144
B	**210**	42	63	**70**	84	105	126
C	**180**	36	54	**60**	72	90	108
D	**150**	30	45	**50**	60	75	90
E	**120**	24	36	**40**	48	60	72

For example, a candidate for AS Biology or Biology (Human) must take three modules, all weighted at 33.3% of the subject.

	Uniform mark obtained	**Approximate level of performance**
Unit 1	65	C
Unit 2	73	B
Unit 3	80	A
Subject Total	**218**	**Subject Grade = B**

Table 2 – Advanced Level Subjects

Subject		**Unit Weighting**				
Grade	**UMS**	**15%**	**16^{2}_{3}%**	**20%**	**25%**	**30%**
Max mark	**600**	90	**100**	120	150	180
A	**480**	72	**80**	96	120	144
B	**420**	63	**70**	84	105	126
C	**360**	54	**60**	72	90	108
D	**300**	45	**50**	60	75	90
E	**240**	36	**40**	48	60	72

For example, a candidate for A level Biology or Biology (Human) must take six units, all weighted at 16.7%. The candidate in this example has four units in the bank.

	Uniform Mark Obtained	**Approximate level of performance**
Unit1	78	B
Unit 2	65	C
Unit 3	75	B
Unit 4	82	A
Unit 5	50	C
Unit 6	*	
	Partial Total in Bank = 350	

The candidate already has 350 uniform marks in the bank. If a Grade C is required in the subject, the candidate must obtain at least 10 UMS marks from Unit 6 or if a Grade B is required the candidate must obtain 70 UMS marks or more from Unit 6.

There is no rule requiring candidates to take units amounting to 30% of the examination at the time of cashing in, nor do candidates have to take all papers with synoptic assessment at the same time at their first cash in.

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