



GCE EXAMINERS' REPORTS

**BIOLOGY/HUMAN BIOLOGY
AS/Advanced**

SUMMER 2015

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BIOLOGY/HUMAN BIOLOGY
General Certificate of Education
Summer 2015
Advanced Subsidiary/Advanced
BY1

Principal Examiner: Dr K. Dowdeswell

General comments

The paper allowed all candidates to access marks and some very good responses were seen with detailed scientific knowledge and understanding demonstrated. A number of candidates are still writing answers outside the prescribed box and not using the additional pages provided in the exam script as requested. More rarely candidates did not clearly identify which part of a question they are continuing on the additional pages making it difficult for examiners to ensure that all work is credited. Increasingly, examiners are commenting on the quality of handwriting as a difficulty in crediting marks and incorrect spelling of key terms was common.

Specific comments

1. (a) This question was answered well by most candidates scoring highly. Triose sugar was poorly identified by many candidates. Improved exam technique would assist candidates to secure marks by noticing that at least one answer required multiple responses for full marks.

(b)(i) This was answered well by nearly all candidates. A minority did not reference the necessity to heat vigorously with Benedict's reagent. Additionally a small number of candidates were unable to correctly give the correct colour change, either omitting the starting colour or giving an incorrect response entirely.
2. This question was generally well answered by candidates. Although, nucleic acids, the constituent bases and groups were not always well understood.

(c)(i) Candidates who answered this question well were able to cite the data to explain why the complimentary base pairings were not equal. Too many candidates did not relate their answer to the information provided despite being able to correctly identify the correct nucleic acid.
3. (a) This question was answered well by nearly all candidates. Some confused extrinsic and intrinsic. A significant number of candidates made reference to peripheral / surface proteins, which was not credited.

(c) Weaker candidates failed to recognise the importance of the fluid mosaic model in explaining their answer, incorrectly discussing methods of transport such as facilitated diffusion and diffusion to explain movement into the cell. Reference to the phospholipids moving in the bilayer was common and whilst not incorrect was not credit worthy as a knowledge that proteins are able to move needed to be implicit. Good candidates described the structure of the

fluid mosaic model well and cited that the arrangement of the proteins was different from that seen before the cells were merged due the ability of proteins to move. Candidates that commented that the proteins were randomly arranged without making reference to a change in arrangement prior to fusion did not secure this mark point.

4. (a) Many candidates failed to identify that there would be no centrioles present in a plant cell; subsequent reference to spindle fibres being formed from these organelles gained no credit. Correct reference to lower plants was acknowledged by a minority of candidates but was not relevant in answering this question. Some candidates incorrectly made reference to DNA condensing or shortening, confusing the processes of chromosomes condensing with DNA supercoiling. Incorrect reference to chromosomes joining by a centromere occurred frequently.
- (c) Candidates often omitted to use the data and refer to both graphs. Candidates also emphasised the occurrences in the garlic grown in water (control experiment) but failed to include specific reference to the garlic grown in vincristine which was inferred in the stem of the question.
5. (c) Candidates' responses were commonly vague, failing to recognise the link between water movement into the cell and the different pressures exerted on the different cell components. Responses that included reference to cellulose rarely indicated a correct understanding that the rigidity created by cellulose also made it inelastic and that this property enabled the cell wall to contribute to the pressure potential.
6. A significant number of candidates used the terms specificity and complimentary interchangeably when describing the active site and enzyme. Greater accuracy of the use of these terms to correctly describe enzyme activity should be encouraged. Incorrectly describing an active site as denaturing, rather than the enzyme was not credited. Further confusion describing the action of the competitive inhibitor was also evident.
 - (a) Nearly all candidates were able to recognise correctly that the reaction rate was increased. Many candidates referenced how the enzyme reduced the rate of the reaction, which did not address the question. Few candidates identified the biological link to an enzyme.
 - (b)(i) Candidates often made incorrect reference to 35°C as the optimum temperature for these enzymes and were not able to recognise that there was a benefit to all three enzymes performing below their optimum but collectively producing better activity. It was important that the candidate realised that 35°C is the temperature at which all three enzymes work relatively well. Candidates that merely commented on all three enzymes working at this temperature failed to recognise that all three enzymes could also be classified as working at a number of different temperatures, but not as effectively and therefore failed to gain credit.
 - (b)(iii) Weaker responses discussed the enzymes having different optimum temperatures rather than discussing enzyme specificity.

- (b)(vi) This question was answered well by many candidates. Candidates that correctly related their answer to the enzymes in the washing powder noted that all three enzymes denatured causing the active site to change shape. Weaker candidates listed all bonds present in tertiary structures as being broken at 60°C or discussed the effect of temperature on enzymes generally without relating their responses to the question. Correct use of scientific descriptions of the enzyme denaturing, causing a change in the shape of the active site resulting in no successful collisions or enzyme-substrate complexes being formed should be encouraged. Correct recognition that all enzyme substrate complexes would be prevented was essential for this mark. Rarely candidates used abbreviations, such as ESCs, which were not accepted.
- (c)(i) Strong responses used the data available from the question to support their commentary, using key terminology correctly. Many candidates incorrectly stated that the isoleucine has the same shape as the active site. Candidates understood the principles of competitive inhibition well, with only a minority confusing this process with non-competitive and bonding of the inhibitor at an allosteric site. A significant number of candidates incorrectly stated that the bonding of the competitive inhibitor would permanently bind to the active site and lost marks by stating that no enzyme-substrate complexes would be formed, rather than fewer. Good answers correctly identified that addition of more threonine/substrate would reduce the effect of the inhibitor. Too many candidates failed to relate their answers to this question, giving a generic answer rather than including specific molecule names from the flow chart. Some candidates incorrectly referred to the substrate threonine having a similar shape to the active site.

7. Both answers produced quality responses from candidates.

(a) Biosensor essay

Transducer function was often confused with the electrode detecting a chemical signal. Many candidates confused the advantages of a biosensor with immobilised enzymes. The detail of the blood glucose biosensor was not required. Candidates that correctly provided the glucose oxidase reaction were credited, but this was not required for this mark point. Generic terms when referencing accuracy and sensitivity were not credited and candidates should be reminded of the need to use appropriate terminology. For example an unqualified response such as, biosensors are accurate, would not have gained credit.

(b) Organelle essay

Candidates should be encouraged to use biological terminology when writing essays. Vague references to starch grains storing energy or food did not receive credit. Many candidates thought the particles on the cristae were ribosomes and therefore incorrectly referenced the function of the mitochondria to be protein synthesis. Candidates should also be reminded that when including diagrams, clear and accurate labelling is essential. It is preferable that all diagrams are annotated. Marking points that related to a drawing were also awarded in prose form.

BIOLOGY
General Certificate of Education
Summer 2015
Advanced Subsidiary/Advanced
BY2

Principal Examiner: Mr A. Clarke

General comments

The paper allowed all candidates to access marks, but discriminated between those candidates who clearly understood the biology from those who had simply learned a collection of facts. A significant number of candidates failed to read questions carefully and therefore did not answer the question that was being asked or use the information that was provided. Quality of written communication was also an issue for some candidates.

1. This was intended as an easy introduction to the paper and on the whole the majority of candidates picked up at least 4 marks, with a few candidates misinterpreting the phylogenetic tree.
 - (b)(ii) This was very poorly answered, with about half of the candidates making reference to amino acids/proteins. Many answers gave accounts of DNA hybridisation, but the explanations given were very vague.
2.
 - (a) Only a minority of candidates picked up full marks, with the majority of candidates stating that mechanical digestion only occurs in the mouth. Most candidates stated that emulsification results in an increased surface area, however only the better candidates went on to state that this would increase the rate of digestion by lipase. Many candidates made reference to 'enzyme action' being more efficient, whilst others made references to absorption.
 - (c) The majority of candidates correctly identified the small intestine and understood that this was the region containing the soluble products of digestion, but only the better candidates stated that the tapeworm lacked a digestive system.
3. The responses here demonstrated that the majority of candidates are very good at recalling information, but they are less able to apply their knowledge. Most picked up full marks for their descriptions of expiration but lost marks in parts (a) and (b)(ii). In part (a) quality of written communication was an issue with some candidates not expressing themselves clearly enough. Statements tended to be vague, with many simply answering from memory and not making reference to the micrograph. Others failed to link the features with the appropriate adaptation for gas exchange. In part (b)(ii) the majority of responses explained why mammals needed a complex gas exchange surface, by making reference to low surface area to volume ratio of body surface and increased length of diffusion pathway.

4.
 - (a) The majority of candidates failed to read the stem of the question carefully and simply stated an advantage of asexual/sexual reproduction without explaining why it was advantageous.
 - (b) This did not prove too problematic for candidates with the majority picking up most of the marks, however only the better candidates described the difference in appearance between the larvae and the butterfly.
 - (c) The majority identified the correct species of fish, but the explanations given tended to be vague.
5. The majority of candidates picked up the marks available for questions (a) and (b), but a significant number failed to appreciate the role of the plasmodesmata in the symplast pathway. Part (c) proved problematic for the majority of candidates. Many made correct references to the role of the Casparian strip blocking the apoplast pathway. However only the better candidates gave clear explanations as to how root pressure was generated. Many of the responses included explanations involving 'cohesion' and 'adhesion' or very vague references to the movement of water across the root or up the xylem. The use of radioactive tracers also proved problematic for some candidates, who relied on their own knowledge and didn't make reference to the diagram and table. Others made reference to $^{14}\text{CO}_2$ being translocated. Only about half of the candidates got the calculation correct.
6. Candidates do not appear to appreciate the difference between myogenic and involuntary as many made reference to the 'heart functioning independently of the brain'. Many candidates also gave vague answers, such as 'generates its own heartbeat' and were penalised for poor use of appropriate terminology. Quality of written communication was an issue in part b) with many candidates unable to communicate their ideas clearly, many making references to the heart and not the atria/ventricles. Only the better candidates demonstrated that they could interpret the cardiac cycle graph. The majority of candidates could identify the closing of the valves, but showed a complete lack of understanding as to the events taking place during the different phases of the graph. The quality of answers for part ciii) were also relatively poor. Many candidates made vague references to the presence of valves preventing back-flow, without actually making reference to the closure of valves. An alarming number made reference to the wrong valve and many who correctly stated that the bicuspid valve would close were unable to give an explanation as to why.

Only a small number of candidates attempted the question on tissue fluid and the quality of responses varied. Some candidates had clearly learned the biology and scored well, whereas some candidates decided they knew more about tissue fluid than oxygen transport and scored very little for the 'lesser of the two evils'. With the majority of candidates giving accounts on the role of haemoglobin, the quality of responses varied. The better candidates gave structured accounts using appropriate scientific terminology and gained full marks, whereas other candidates clearly lacked the knowledge and gained very few marks, if any. A worrying number of candidates could not distinguish between the structure of haemoglobin and that of a red blood cell.

BIOLOGY/HUMAN BIOLOGY
General Certificate of Education
Summer 2015
Advanced Subsidiary/Advanced
BY3

Principal Examiner: Dr. C. Blake

The standard of practical work has continued to rise and problems encountered in previous years have now been largely addressed. Candidates are prepared well and the choice of investigation has enabled candidates to access all points on the mark scheme.

It would be appreciated if all the necessary documentation is sent with the scripts, some centres did not include copies of the practical information given to candidates and in some cases attendance registers were not included. It is important that a teacher signature is on the front page of each script, this is needed for mark point A(g) to be awarded to the candidate.

There were an alarming number of errors on some of the worksheets supplied from some centres, for example vols being used as a unit of concentration of hydrogen peroxide. It is important that these are checked before issue so as not to penalise candidates.

Some centres still consider that a percentage dilution of a stock solution is the same as a % of a stock solution; a solution containing 90% of a stock solution is concentrated, a 90% dilution of a stock solution is weak! Some candidates gave a range of dilutions of the independent variable in the form of a % dilution of the stock but considered that the higher the % dilution the stronger the solution.

Aim / prediction

The majority of candidates clearly identified the two variables and linked them with direction. Some errors were made in making a generic statement such as 'as the enzyme concentration increased the rate of reaction increases' with no reference to the enzyme or substrate being used. When using filter paper discs or potato discs some candidates did not state that it was the time for the disc to rise to the top or through a certain distance which was penalised.

Design

The independent variable was usually clearly stated and a suitable range given. Candidates identified the dependent variable but some omitted the unit.

Suitable controlled variables were usually given but units, again were sometimes not given. Size was sometimes given without reference to diameter or thickness. Silly errors when referring to size were sometimes seen, in one centre, filter paper discs 1mm in diameter were popular.

Many candidates still state that repeat readings are needed to improve accuracy or to ensure reliability but there has been a general improvement in the understanding of these terms.

The need to set up a suitable control experiment is well understood and candidates are able to carry out a suitable risk assessment although there is still a lot of acidic hydrogen peroxide about.

Results

Results tables are much improved and the majority of candidates access all the available marks, but they should be reminded that the calculation of the mean is checked and therefore more care should be taken and figures rounded correctly.

It continues to be quite rare to get a candidate who achieves full marks for the graph. Errors include, inappropriate scales, inaccurate plotting, omission of the word 'mean' on the Y axis and failure to put a figure at the origin.

Analysis

Clear and accurate general trends were usually stated, except in the case of those candidates who were using % dilution of the stock solution. In some cases the trend was a figment of imagination and bore no resemblance at all to the actual results.

Sound comments regarding consistency and accuracy were usually given and candidates were able to give logical methods to improve accuracy but some candidates insisted on giving an improvement which had already been used.

Valid conclusions relating back to the original prediction were usually clearly stated and accurate.

Further work

Many candidates failed to identify the new independent variable but most candidates did identify two controlled variables and in most, but not all cases, one of these was different from those previously used. Expected results were clearly stated but occasionally sketch graphs were given with no labelling and often time was indicated on the Y axis even when a typical rate plot was drawn. Candidates still seem obsessed with the magic 37°C, it is not the optimum for all organisms on the planet!

Microscopy

Drawings have improved but drawing to the correct proportion has not. The tunica intima is never going to be the same thickness as the tunic media and neither is the thickness of the epidermis in a leaf going to be the same thickness as the palisade mesophyll layer. The thickness of the epidermis in a leaf is never going to vary by up to 4 times along its length. Lines showing a dimension in the form of an epu. are there for a reason and will be checked. Label lines are often inaccurately drawn, they should end at the centre of the tissue layer. Labels should be spelt correctly it is not palisade mesophyl or palacade mesophyll or palace mesophyll. It is not enderthelium, adventita or even looman. There were some centres where there was a recurrent spelling error, source material should be checked.

BIOLOGY
General Certificate of Education
Summer 2015
Advanced Subsidiary/Advanced
BY4

Principal Examiner: Ms. F. Cowie

General comments

The scripts showed a range of marks, from those showing little or no knowledge and understanding though to the really top class. Exam technique and the usual 'not reading the question' lost many marks, despite the fact that some biological knowledge of the specification was evident. There was much less sloppy terminology this year, with only the occasional jumping of electrons and synapses firing.

As might be expected the questions involving straight recall were well answered by the majority – many seem to have learned the teachers guidance notes off by heart! Although this strategy easily answered some questions (3b(i), 4d, 6b) and, of course, both essays it did not help much with the application questions or those requiring the knowledge to be manipulated in some way.

Specific comments

1. Mostly full marks, although often with lots of crossing out and large diagrams of motor neurones on the page.
2.
 - (a) Few got both marks – mainly because of confusion with eutrophication and not having a sensible source of the nitrate on farmland.
 - (b) Some confusion over bacteria and their functions, here – lots of *Azotobacter* and *Rhizobium* which was not relevant. Some very good answers for the explanation with full details.
 - (c) Weaker scripts wanted the land drained to allow the roots to breathe, but many scored both marks for a sensible suggestion about promoting nitrification with oxygen or the reverse argument plus increasing crop yield.
3. Candidates found this question one of the most difficult on the paper.
 - (a) The spelling of facultative was most inventive. Basically take the 'fac' and the 'ive' and place random u's, a's, t's and l's and hope it is right. In fact, many lost a mark here because they had made words up or simply missed out letters or syllables. Obligate was slightly better. As might be expected some mixed up their aerobes and anaerobes.
 - (b) This was largely well done, although many simply stated 'glycolysis, using substrate level phosphorylation' and did not take it that step further to explain how NAD would be regenerated or the final product.

- (c) This part was slightly more challenging but far too many struggled to determine the optimum temperature, despite a range being acceptable. Reading figures off the graph and using the scale correctly is a basic GCSE science skill. It was rare to get three suitable suggestions as to where these microorganisms could be found, despite a number of alternative answers. 'Cold, warm and hot places' are really not suitable suggestions for A level biologists. Most identified slow enzyme activity as being a problem, although few mentioned other problems with transport proteins or that freezing of cell contents could cause cells to burst. Far too many lost sight of the fact that these are small microorganisms, so suggested build-up of heat causing enzymes to denature, or that they needed thick insulation/fur.
4. (a) and b) were good, with most getting full marks. There was some problem in following the maths instruction, but this was fairly rare. However, getting the right measurements was a different matter. Again a very basic pair of measurements and it was surprising how difficult that proved to be. Both c) and d) were done well in the majority of scripts.
5. Most candidates struggled with this question.
- (a) Two marks available here, the reason for air in the first place i.e. it contains oxygen for aerobic respiration, and it has to be sterile to prevent contamination. Not many got both marks; same with the C and N source, with far too many wanting to add nitrates to the fermenter. For (iii) and (iv) there needed to be an explanation of how the pH was controlled, not just copying from the diagram 'using the pH control reservoir'. Full answers for (iv) were rare and many wasted time explaining that the fermenter would need heating up at the start when this was not the question and the diagram only shows a cold water inlet.
- (b)(i) There was much confusion, with numbers between 36 and 120 hours, although some had minutes and others no units at all. Most identified enzyme synthesis as being the reason for the high level of protein synthesis.
- (iii) This was incorrectly answered by many, giving a detailed explanation as to why penicillin is produced after 36 hours. The question asked why it is not produced in the first 36 hours, so giving a knee jerk response on penicillin production did not gain full marks.
6. Both (a) and (b) were well done by those who knew their kidney histology and function. Part (c) proved rather more problematic. Many explained correctly that amino acids in excess are deaminated and the amino/amine group converted to urea. However, they did not extend the explanation to include the fact that with lower urea there would be less toxic urea to remove or that with a non-working kidney it would prevent urea build up. A similar explanation was needed for salt and part (c) proved to be a good discriminating question. (d) was well done by those who knew their kidney work.

7. This also was a good discriminating question.
- (a) Here, the candidate was expected to explain how organophosphates affect a synapse and cause the symptoms given. It did not require an explanation of the normal functioning of a synapse and many wasted time doing just this. Better scripts gave totally logical and well explained descriptions of the toxic effect of organophosphates and how the symptoms arose from this effect; a real pleasure to read.
 - (b) This question simply asked for suggestions and any sensible ones gained credit. Far too many repeated the effects of organophosphates from part (a) and too many described excitatory drugs. Top scripts routinely scored all four marks.
8. The essays proved almost equally popular and, as they were straight recall, most scored full, or close to full marks. Some were not so easy to follow and got confused, but it was rare for candidates to score less than four marks.

BIOLOGY/HUMAN BIOLOGY
General Certificate of Education
Summer 2015
Advanced Subsidiary/Advanced
BY5

Principal Examiner: Mr. B. Hughes

General comments

The paper allowed all candidates to access marks.

The quality of written communication was again an issue for some candidates. They were reminded of the necessity for good English and orderly presentation on the front of the examination paper, but a significant number lost marks because they give incomplete answers.

Specific comments

1. (a)(i) Most candidates correctly recognised P as 'stigma' but a few gave 'anther' or did not offer an answer.
- (a)(ii) This was also well answered, but some candidates lost the mark by giving the name of the structure instead of the substance.
- (a)(iii) Candidates with poor knowledge of this topic suggested a variety of functions for the substance, including 'provides nutrition for the plant' and 'waterproofs the petals'.
- (b) The majority of candidates were able to give simple descriptions of transfer of pollen from the anther to the insect in part I and from the insect to the stigma in part II. A small minority gave detailed descriptions of pollen formation across parts I and II and dehiscence without mentioning pollen transfer.
- (c) This was less well answered. In part (c) (i) only a small minority of candidates realised that the anther in drawing I and the stigma in drawing II were in contact with the same part of the insect. Many candidates gave general features of insect-pollinated flowers such as 'brightly coloured petals' or 'anthers are inside the flower' and therefore did not address the 'same species' part of the question.

More candidates were successful in part (c) (ii), however a significant number incorrectly answered that the anther and stigma were in different positions even though, at the point of transfer, they are in exactly the same position.

- (d) Most candidates knew that pollen formation takes place in the anther for part (d) (i) though some gave 'ovule', 'embryo sac' or 'ovary'. Most also gave 'meiosis' for part (d) (ii) but some gave incorrect spellings or 'mitosis'. Relatively few candidates gave the correct number of chromosomes in all three nuclei in part (d) (iii) answers ranged from 40-20-10 to $10-5-2\frac{1}{2}$. In part (d) (iv), most candidates were able to give a description of the function of the generative nucleus but there were some inaccurate descriptions of the function of the tube nucleus including, 'forms the pollen tube' or 'contains enzymes'.
2. (a)(i) This was a straightforward genetic diagram of a dihybrid cross and most candidates scored full marks on this part. However, some arrived at a correct punnet square without correctly identifying the gametes. A small minority were clearly completely unable to understand genetic diagrams.
- (a)(ii) Most candidates were able to count the numbers of the required phenotypes in their punnet squares but were not able to correctly express proportions. Those that used percentages or fractions were usually successful but some attempted ratios and gave 3:16 instead of 3:13 for example.
- (a)(iii) Some candidates gave the overall proportion of brown noses $\frac{1}{16}$ but the question asked for the proportion of yellow offspring so the correct answer was $\frac{1}{4}$.
- (a)(iv) This required the simple observation that all chocolate Labradors would have brown noses but many candidates wrote that they would have brown skin but black fur and they were given credit for that. Some candidates gave answers in terms of genotypes which are not observable.
- (b)(i) The great majority gave the correct genotype.
- (b)(ii) Many candidates who correctly used the terms 'back cross' or 'test cross' were awarded the mark. However, some used a correct term but then went on to incorrectly describe it for example 'cross her with a heterozygous male'.
- (b)(iii) 'Homozygous black' was a popular incorrect answer but although these will always give black pups the genotype cannot be guaranteed from the phenotype.
3. (a)(i) The great majority of candidates gave an acceptable answer for the purpose of meiosis, though some lost this mark because they wrote 'to produce variation' without specifying genetic variation which is expected at A level.
- (a)(ii) Some candidates gave the vague answer 'reproductive organs' and alarmingly 'penis' and/or 'vagina'.
- (b)(i) Most candidates correctly labelled X, centriole and Y spindle fibres. There were some who confused centriole with centromere. A significant number did not offer an answer for this part.

The quality of drawing in parts (b), (c) and (d) showed the usual range, some very poor indeed. Even with quite poor drawings, most candidates were able to show that there were two chromosomes in each cell and that one was larger than the other to gain the first marking point for both diagrams. Locating the chromosomes with their centrioles on the equator which had been drawn for them was less well achieved with the Metaphase II diagram. Some candidates chose to ignore the given equator and drew one of their own at right angles, they were not penalised for this if they correctly located the chromosomes on their equator. Poor quality drawings prevented candidates showing the correct re-combinations in the drawing of the cells produced.

Quality of drawing was not the only problem in part (c), there was evidence of lack of understanding here. Some candidates drew the chromosomes aligned in non-homologous pairs, some drew the chromosomes in the same positions but with crossing-over having taken place in the smaller pair, and some drew both pairs having changed places across the equator.

Most candidates recognised that the chromosomes were drawn at a stage before crossing-over in part (d) (i); some lost the mark because they omitted to specify **first** prophase. Almost all other stages were given as incorrect guesses at the answer.

To gain both marks for part (d) (ii) candidates were expected to show non-sister chromatids crossing-over and exchanging fragments. Some candidates lost the first mark for drawings showing the chromatids 'kissing' but not crossing over; some lost the second for making no reference to exchange of pieces.

A significant number of candidates did not attempt any part of (d); apart from these, most correctly answered part (d) (iii).

4. (a)(i) This was meant to be an easy lead in to the rest of question 4, and proved to be so; though some candidates did lose this mark through careless errors, and some made no attempt to answer it.
- (a)(ii) Most candidates made some reference to base pairing but many were vague and showed poor quality of written communication, failing to make the key point that they are sticky because of unpaired bases.
- (a)(iii) Some candidates name the bacterium instead of the enzyme in part (a) (iii) showing they had not read the question accurately; some gave an incorrect choice of enzyme.
- (b)(i) Most candidates knew something about plasmids. Candidates who lost this mark did so because of poor quality of written communication; some described plasmids with vague references to vectors.
- (b)(ii) There were similar issues to part (a) (ii), vague references to bases, omitting the key point about the complementary relationships.
- (b)(iii) Two incorrect enzymes were commonly named: 'endonuclease' and 'DNA polymerase'.

- (c) This showed centre differences; some centres' candidates gave detailed accounts of introns and exons, though even in these centres some candidates described them the wrong way round; in other centres candidates had limited understanding. Common incorrect answers included 'exons are bigger than introns', 'introns are bigger than exons', 'they are more negatively charged' again with 'they' being equally introns or exons. Where candidates referred to STR or VNTRs there was confusion.
- (d) Many vague answers were given here, candidates cannot expect to be given a mark for 'the patterns are the same' at A level.
- (e) Similarly, answers given to part (e) (i) were unclear and some candidates failed to communicate the key point that the method produces multiple copies of the sample rather than just more DNA. Some candidates gave details of the method including temperatures etc. but this does not address the question.

Part (e)(ii) was generally well answered, although all of the enzymes candidates encounter in this and other units were seen as incorrect answers including ligase, endonuclease and RNA polymerase.

- 5. (a)(i) A surprising range of vague and inaccurate answers were seen considering the number of times this question has been asked before.
 - (b)(i) Most candidates were able to describe links between beak shapes and food types and the relationship between CaM and beak length in part (b) (ii) though there was some confusion with beak width and depth.
 - (c)(i) A significant number of candidates attempted to use adaptations and natural selection to answer this despite the question asking about the early generations.
 - (c)(ii) At this level candidates are expected to explain specific examples of evolution in terms of a gene pool model. Some candidates gave vague, GCSE type descriptions of evolution in general terms with no reference to the CaM allele.
 - (d)(i) Most candidates made reference to the ability to produce fertile offspring but some candidates used imprecise language failing to indicate that they were referring to breeding within one type of finch or between types.
 - (d)(ii) Although most candidates got the first marking point by referring to geographic isolation, it was relatively rare for them to go on and accurately explain why that led to speciation for the second marking point. Again, there were examples of poor quality written communication.
6. Quality of written communication was also an issue in parts (a) (i) and (ii).
- (a)(i) Here, some quoted the guidance notes. Some started their answer with, 'How efficient a plant is at...'. Many made no reference to light or light energy.

- (b) (i)(ii) Both generally well answered.
- (c)(i) The majority of candidates were able to calculate efficiency, though mistakes were frequently made by those who attempted to give their answer in standard form.
- (c)(ii) It was very rare for candidates to be awarded 2 marks, the most common error was omitting to convert values from km^2 to m^2 .
- (c) (iii) This was relatively poorly answered. Apart from the usual problems with quality of written communication, some weak explanations were offered which missed the key point about energy lost between trophic levels, for example, 'you can keep more crops than cattle on the same area.'
- (c) (iv) A significant number of candidates recognised emissions of methane and extra carbon dioxide for the first marking point but neglected to explain their role as greenhouse gasses for the second.
- (c)(v) Fairly large numbers of candidates lost the mark, for one of two main reasons, either neglecting to mention photosynthesis or balancing carbon dioxide uptake by sugar cane against emissions during production rather than emissions during combustion of the biofuel. A small minority suggested that there are no emissions when biofuels are burnt.
7. Fairly equal numbers of candidates chose each of the options and both were generally well answered with good detail. However, the quality of written communication was an issue for a number of candidates in both options.
- (a) The main problems with this option were confusion between the different forms of RNA and neglecting to explain transcription and translation locating them clearly in the nucleus and cytoplasm respectively.
- (b) The main problems with this option were confusion between or inaccurate descriptions of the terms capacitation, acrosome reaction, and cortical reaction. Some candidates located the processes of fertilisation, and implantation incorrectly. Some suggested fertilisation took place in the uterus or even the vagina, some described a zygote being implanted. There was also confusion between zygote and blastocyst. A significant number of candidates described a blastocyst as a blastocyte,

BIOLOGY/HUMAN BIOLOGY
General Certificate of Education
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Advanced Subsidiary/Advanced
BY6

Principal Examiner: Dr. M. Izen

- Centres are thanked for submitting scripts within the deadline.
- It is useful to include any introductory or method sheet used by candidates.
- Scripts should not be placed in plastic wallets or cardboard folders.
- Candidates should be reminded that they should write in ink throughout and only use pencil when drawing. In accordance with JCQ regulations, Tippex should not be used.

Candidates have responded well to advice given previously and the use of scientific terminology is much improved.

Centres should ensure that candidates have access to all the available marks:

- If a range of values for the independent variable is given in the method sheet, candidate cannot score Db.
- If the microscope calibration is provided, candidates cannot score C1-C3 in the Microscopy section.
- If methylene blue concentration is quoted as per cent, unless the term “per cent” is qualified as g/100cm³ or percentage of a stock solution, candidates may not be able to access marks in the Planning or Further Work section.
- Field studies provide ample opportunity for individual work, and group experiments are rarely necessary. Centres should ensure that they instruct candidates in such a way that access to all marks is possible. Past mark schemes show how this may be done.

Planning / Prediction

Biological explanation will not gain credit here. A complete but simple statement of the aim and prediction only is required.

Design

Independent variable

- If the light intensity is to be varied, the independent variable is the light intensity, not “the change in light intensity”.
- Light intensity is measured in lux. It is changed by altering the distance of a lamp, measured in mm. The independent variable is that which is plotted on the axis, so it is the distance of the lamp. The value of $\frac{1}{d^2}$ is proportional to the light intensity but not equal to it. Its units are mm⁻².
- Centres are reminded that neither a diagram of the apparatus used nor a description of the method is required.

Dependent variable

- If a number of bubbles is being counted, it should be explained that a number does not have a unit.
- Some experiments use sodium hydrogen carbonate as a source of carbon dioxide in experiments involving photosynthesis. It is important not to omit the word sodium as other hydrogen carbonates may behave differently and the cation will affect the RMM and thus the significance of any concentration quoted.
- In an experiment using hydrogen carbonate indicator, the reaction may continue after the allotted time, while other readings are made. It is appropriate to place the waiting samples on ice. Placing them in boiling water to denature enzymes and stop biological activity is not adequate, because carbon dioxide will come out of solution and the indicator will darken.

Controlled variables: A factor kept constant is “controlled” variable”, not a “control” variable”. It is disappointing how many candidates still do not make the distinction. Room temperature may not be cited as a controlled variable, because it cannot be controlled, even if it is monitored.

Control experiment: A suitable control, inactivating a biological component, must be described.

- If light intensity is the independent variable, performing the experiment in darkness is not a control.
- If alginate beads are used, the biological material must be boiled and cooled prior to making the beads.

It is important to stress that the control experiment will be done under the same conditions, and to give an example of what is remaining constant. Just quoting factors that will be kept constant is not enough.

Hazards: The main hazard should be described.

- Taking care with glassware, hot lamp bulbs or with water and electricity is considered to be a general lab rule and should only be cited if there is genuinely no other more significant hazard.
- Biological material, such as yeast, is potentially hazardous as it may be allergenic, as are latex gloves.
- Methylene blue and sodium hydrogen carbonate are irritants.

Results

- It is expected that the raw data provided in the Results table is the candidate’s own. If this is not the case, the candidate’s own contribution must be highlighted, either by the candidate or in an accompanying note, and an explanation given as to why some of the data has been collected by others.
- Candidates should be sure to use an appropriate number of decimal places in recording their readings. Times to less than one second cannot be accurately determined and should not be quoted. Although callipers are correct to ± 0.01 mm, measuring the width of a halo around an antibiotic disc should be quoted to ± 1 mm, as the zone is not uniform and precise in outline. The examiners accept means to one more decimal place than the raw data, but the number decimal places must be consistent.
- Many candidates omitted “Mean” from their y-axis label
- Range bars should be drawn with a small bar at each end, to distinguish their ends from the grid of the graph paper and from the data points which are plotted. They should not be drawn with an X at each end.

Analysis

Trend

- A trend should summarise the effect of the independent variable on the dependent variable. It is not a description of individual data points. As a summary it should describe the entire graph, including any special points such as an optimum temperature or pH, and any significant change of gradient. If the results are such that there is no clear trend, this should be noted.
- Candidates do not forfeit marks for unexpected results, but may if they do not accurately describe those results.
- If the data points are approximately linear, non-linearity should not be claimed.
- Suitable words should be chosen. Describing an increase as “massive” or “incredible” does not provide scientific information. “Large” is better.

Reliability

- The reliability or consistency of raw data should be described. It should be related to how similar the repeats are for each value of the independent variable. The marking criteria require a discussion of consistency, not variability, and so vocabulary should reflect this.
- Range bars represent the distribution of readings around the mean. Candidates should choose their words carefully when referring to raw data (their readings) or the processed data (means). The word “results” is generally too vague to be useful.
- The readings are the primary information and they determine the length of the range bars. A value judgement should be made, so it should be stated “the range bars were short reflecting the good consistency of the readings” not merely “the range bars reflect the good consistency of the readings”.
- If readings for the same value of the independent variable are not consistent, reliability should be described as “low”, not “questionable”.
- Range bars should be described as “long” or “short”. They are not “wide”, “narrow”, “close together” or “level”. They do not “touch”.
- In current usage, the word “reproducibility” refers to the practical conduct of the experiment and not to the readings. The words “reliability”, “consistency” and refer to the data. The range of raw data and the overlap of readings at different values of the independent variable have no bearing on whether or not the reading is “true” or “accurate”. Bathroom scales that weigh 5 kg too light provide a useful analogy, on which you weigh the same every day. The readings are reliable because they are always the same, but they are not accurate.

Confidence in trend

- Many did not attempt to discuss the suitability of their range bars or conflated a discussion of the overlap of the range bars with their length, thus not distinguishing between consistency in readings and confidence in the trend of means.
- Many candidates mentioned anomalous readings but to gain credit, more is needed, such as a description of whether the anomaly makes the data point high or low, and to what degree.

Inaccuracies and improvements:

- Experiments have sources of inaccuracy, not “issues”.
- When describing an inaccuracy and its improvement, if graduations are being described, examples must be given e.g. a 10 cm³ syringe graduated to ± 1 cm³ is inaccurate and volume measurement would be improved using a burette graduated to ± 0.2 cm³.
- If there are several manipulations to be performed at the same time, having a friend to help is not considered a suitable improvement in this context. Candidates are advised to consider alternative improvements.

Explanation

- This is not expected to be an essay on a theoretical topic; it is expected that candidates will give an explanation of their own results, based on their background knowledge. Candidates must be selective in what they write and irrelevance is penalised.
- Candidates should choose their words to say what they mean. When timing leaf discs rising, under different light intensities, the candidate measures the time until the discs rise, not the speed of rising, so describing them as rising “faster” at higher light intensity is incorrect. They rise sooner.
- Candidates should note that planning this section is essential as it allows thoughts to be organised before writing. The coherence of this section is assessed. Poorly structured accounts with crossings-out, paragraphs on other pages and poor spelling and handwriting are penalised.

Further Work

- Candidates are expected to change the independent variable but retain the dependent variable. If the main experiment has been about antibiotic sensitivity in *Micrococcus luteus*, testing another species of bacterium does not constitute “Further work” but is a different experiment.
- The prediction is expected to be correct. Its description should be complete and match what is shown in the sketch graph. Thus, many failed to gain a mark here, as they did not describe an expected plateau.
- In many scripts, an explanation was not given or was lacking in detail. To write that an increase will be linear “until another factor becomes limiting” is not enough.

Microscopy

- Label lines must be correctly placed i.e. within the structure being labelled, not at its outer margin.
- A low power plan does not contain individual cells and so pollen grains should not be included in a low power plan of a TS anther.
- Drawings must be made from microscope slides. Centres should be aware that it is sometimes possible to identify drawings made from Google images when they show characteristic features.
- Precision in placing line showing the distance measured is important. The measurement should be in a clearly identifiable position e.g. the minimum diameter of grey matter in a TS spinal cord.
- Candidates are penalised in the calibration section if they state that a stage micrometer unit is 1 mm, as this is the length of the graduated line, not a graduation unit.

BIOLOGY/HUMAN BIOLOGY
General Certificate of Education
Summer 2015
Advanced Subsidiary/Advanced
HB2

Principal Examiner: Dr. M. Morgan

General comments

Again, a wide range in standards was seen in the quality of responses to various questions. There was considerable variation between centres with few candidates scoring well on some areas of the specification. A lack of recall of facts or an ability to use them in their explanations cost many candidates marks. Spelling remains an issue and combined with and increasingly poor standard of handwriting resulted in some words being impossible to decipher.

Specific comments

1. Most candidates recognised the role of phagocytes and ciliated epithelium as having roles in first lines of defence but the roles of vitamin C and inflammation were less commonly understood.
2. Most candidates correctly identified the buccal cavity and stomach but were less consistent in appreciating the fact that enzymes and other secretions are added to the duodenum, not the ileum, colon, rectum or anus. The spelling of amylase was highly varied and even though the question asked candidates to name a carbohydrase, many candidates gave pepsin, lipase or trypsin as their answer. Most candidates correctly identified the reason for the secretion of proteases as inactive precursors. However, the role of buffers was less well understood. Many candidates stated '...buffers are added to maintain a constant temperature ...'. This indicates a lack of reading or understanding of the question. The role of bile in digestion (apart from maintaining pH) was well answered by candidates from some centres but was quite varied on the whole. Most candidates were able to relate the structure of the Gram negative cell wall to protection against some antibiotics. However, a shockingly high number of candidates seemed to be unable to divide 10 000 billion by 10 billion with most giving their answer as 1 000 billion.
3. The main problems faced in this question were candidates confusing the terms latitude and altitude with the result that some explanations for the lack of biodiversity at the poles included no or little oxygen! In part (d) of the question candidates need to recognise that one reason for the lack of butterfly diversity in the Sahara is the low variety of different food species present rather than just the lack of food.

4. Relatively few candidates understood that the heart contraction rate is regulated by hormones and nervous control. The role of the coronary arteries was also not well understood in general. Many candidates did not apparently understand that the coronary arteries supply blood to heart muscle; many stated that a blockage in these arteries would prevent oxygenated blood reaching the body. Similarly, it was obvious that most candidates did not recognise the left atria and ventricle on the diagram and some confused the left and right sides of the heart even though the left and right coronary arteries were labelled. For the most part answers referred to a blockage high up in the left coronary artery affecting the whole of the heart rather than the left ventricle. Some referred to a blockage at this point preventing blood flow to the left atrium. The majority of candidates were able to describe factors and treatments for atheroma but spelling of the word angioplasty was highly varied.

5. As in previous years, there was a great deal of confusion in the ability of candidates to recall information about parasites. While candidates from some centres scored high marks on this question those from other centres confused *Taenia solium* with *Ascaris* and *Schistosoma*. Many candidates stated that humans are infected with *T.solim* through ingestion of eggs from undercooked pork rather than larval forms found in the muscle of the pig. In addition, many did not know the name of the malarial parasite, *Plasmodium*, or state that it is the female *Anopheles* mosquito that is the vector. Explanations for the increased number of cases of malaria with increased rainfall were mostly good. However, some candidates indicated that mosquitoes live in water rather than their larvae, or that the larvae then reproduce in the water to increase mosquito numbers, or even that mosquitoes don't like the rain so are more likely to go inside and bite people! Again, the quality of responses seemed to be more centre based.

6. Very few candidates identified that internal lungs reduce heat and water loss; most gave descriptions about shorter diffusion distances or larger surface area or protection from infection. Many candidates had very little understanding of how the pleural membranes and pleural cavity are involved in inspiration. Again this was largely centre specific with nearly all candidates from some centres gaining full marks on this part of the question. As a general point, if a question states '...with reference to the graph...' candidates should, by now, know that they need to quote or use the information provided rather than stating, eg., '...as the graph shows...'. Confusion was seen in the role of surfactant – it does not stop lungs collapsing, lungs sticking together or even alveoli sticking together. The role of surfactant in reducing surface tension inside the alveoli was not apparent in many answers.

7. In Stage 1 following HIV infection the graph shows a classic rapid increase in viral load during the latent period of the immune response. Many candidates confused the immune latent period and a latent period in the increase in viral load. Many also stated that HIV reproduces by mitosis. Most candidates recognised that HIV destroys T Helper cells but there was some confusion over the type of T cell infected. Many also focussed on the virus becoming 'used' to the antibodies or destroying the antibodies rather than the body no longer being able to produce them. Very few candidates explained, that during the later stages of AIDS, T_H cells are no longer able to identify foreign antigen as effectively hence the reason for the inability to defend the person from non-fatal infection or cancer.

8. Fewer candidates answered the essay on classification but the standard of responses to the two essays were comparable. Again, problems in communication, and the level of detail given, cost candidates marks.
- (a) Incorrect use of terms and names was common; e.g. leucocytes, lymphocytes and phagocytes were all referred to as being responsible for phagocytosis and /or antibody production. A lack of detail was similarly frequently seen, e.g. stating that red blood cells contain haemoglobin but no mention of their role in oxygen transport. Many referred to just blood instead of plasma. In the second part of the question, there remains confusion over the terms antigens and antibodies. Also, many indicated that the antibodies against A and B antigens are produced following incorrect transfusion rather than being already present. Many candidates used the terms universal donor (often spelled doner!) and recipient but did not explain what is meant by these terms.
- (b) Most answers focussed only the naming of the taxons and kingdoms and did not indicate an understanding of the discrete and hierarchical nature of the taxons. The better candidates explained how the size of taxons and the degree of relationship between organisms in different taxons changes as you go from kingdom to species.

HUMAN BIOLOGY
General Certificate of Education
Summer 2015
Advanced Subsidiary/Advanced
HB4

Principal Examiner: Dr. C. Blake

General comments

Candidates had been well prepared for this paper and pleasing levels of knowledge and understanding were shown. There were a relatively small number of candidates but a wide range of marks was seen.

There is an increased tendency for candidates to use supplementary booklets or to squeeze an extension of a response somewhere on the paper, this 'hide and seek' approach does cause difficulty in marking especially if there is no indication at all that the answer is extended. Candidates should be reminded that they must indicate that their answer is continued and state where. They should also use supplementary booklets for such responses and not write them onto the lined paper at the end of the examination paper used for the extended prose question or any other blank space on the paper.

Specific comments

1. It was rare for a candidate to achieve full marks in this question, many assume that nitrogen fixation is the same as nitrification and an alarming number gave both terms thinking, perhaps, that we should make the decision for them. The process of denitrification was not well understood.
2. A pleasing number of candidates were able to calculate the % fall in the population and give two reasons why it would take a long time for the human population to recover. Responses often lacked detail for example 'because it takes a long time for humans to breed or sexual intercourse takes a long time in humans' were common. The comparisons between the human and bacterial population growth curves were sound.
3. It was stated by most that chloride ions move by facilitated diffusion through the membrane from a region of high concentration to low concentration and that it was a passive process. There were some who then, contradicted their response by adding that it was against the concentration gradient or that, in some cases, energy was required.

Sadly many candidates did not state that water entered by osmosis, did not recognise that a membrane was required or that it was a passive process. The absorption of sodium ions was well documented with both terms, facilitated diffusion and active transport being used.

Very few candidates stated that glucose exited the proximal convoluted tubule cells by facilitated diffusion and active transport, although this was clearly shown on the diagram.

Most candidates linked the absorption of sodium ions and glucose to water potential but very few were able to logically explain why the absorption would lead to increased absorption of water by the proximal convoluted cells.

4. The area showing the action potential was usually correctly identified and the refractory period often given as a reason for the action potential moving in one direction only. Large numbers of candidates did not state that the synaptic vesicles were only found on the presynaptic side and that this is also responsible for polarity.

Identification of the Schwann cell and axon was poor but myelin sheath caused fewer problems. The effect of curare on the transmission across the synapse was well argued.

5. All aspects of this question were generally well answered, obviously respiration has been taught well by all centres.
6. The majority of candidates linked the thickness of the actin and myosin to the banding pattern in a skeletal muscle fibre but the regions from which the TS sections through the sarcomere were taken were only rarely correctly identified.

The function of the T system in a muscle fibre was not well understood with only a few referring to the rapid transmission of a wave of depolarisation into the centre of the fibre so that all myofibrils contract at the same time. Reference to increasing the surface area was credited but few candidates accessed a second mark for the advantage of this increased surface area.

There is a very good understanding of anaerobic respiration in muscle and sound responses concerning the recycling of lactate after exercise. Very few candidates appreciated that amino acids could be used as an alternative energy source. Deamination and the production of urea was not well understood with many stating that urea is a breakdown product of lactic acid.

7. (a) This was, by far, the most popular essay, candidates had a very thorough knowledge of the symptoms of kidney failure, the modes of treatment and the ethical issues.
- (b) Descriptions of assessing the numbers of bacteria in a water sample were excellent and although only a relatively small number of candidates attempted this question, all of the points on the mark scheme were seen.



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