CONTENTS

FOREWORD

This booklet contains reports written by Examiners on the work of candidates in certain papers. **Its contents are primarily for the information of the subject teachers concerned**.

UNIVERSITY *of* CAMBRIDGE
International Examinations

BIOLOGY

GCE Advanced Level and GCE Advanced Subsidiary Level

Paper 9700/01
Multiple Choice

Question Number	*Key*	*Question Number*	*Key*
1	**C**	21	**C**
2	**D**	22	**B**
3	**C**	23	**B**
4	**B**	24	**B**
5	**D**	25	**A**
6	**D**	26	**A**
7	**C**	27	**D**
8	**B**	28	**A**
9	**D**	29	**A**
10	**A**	30	**B**
11	**A**	31	**C**
12	**D**	32	**C**
13	**D**	33	**C**
14	**A**	34	**A**
15	**C**	35	**C**
16	**C**	36	**D**
17	**D**	37	**C**
18	**A**	38	**C**
19	**C**	39	**A**
20	**B**	40	**A**

General comments

The mean score was 27.7 (69.4%) with a very good spread around the mean, the standard deviation being 6.6. The easiest items were **Questions 2**, **3**, **8**, **10**, **12**, **18**, **19**, **31**, **35** and **36**, where more than 80% of candidates answered correctly. Only **Question 39** was found difficult. All other questions performed well, with good discrimination, and few require any special comment.

Comments on specific questions

Question 21

Able candidates had no difficulty with this question while the less able showed a preference for the peptide bond.

Question 23

Not only did weaker candidates assume that the answer involved complementary triplets, they were also unclear as to whether U pairs with A or T.

Question 24

Able candidates knew how to solve this problem while weaker ones guessed at the answer.

Question 25

This was one of the few questions with poor discrimination. Too many able candidates chose option **C**, apparently unaware of any difference between passage of water through the cytoplasm only and through the cytoplasm and vacuoles.

Question 27

The popularity of option **B** suggests that many candidates were basing their answer on just one of the factors: the effect of soil water potential.

Question 37

This item had low discrimination because a relatively high proportion of the more able chose option **A**. As the antibody is broken into three fragments and not more, the two arms with their antibody binding sites, must be left intact.

Question 39

This concept is usually well known, but the option showing the transfer with the highest efficiency was twice as popular as the correct option, making this an unexpectedly difficult item. It appears that candidates did not understand what was meant by 'lowest efficiency'.

Paper 9700/02

Paper 2

General comments

There were many encouraging answers to all 6 questions especially **Questions 1**, **2**, **3** and **4** from well prepared candidates though, disappointingly, there were some very low scores and even the more able candidates had some difficulty with **Questions 3 (d)**, **5 (b)**, **6 (a)**, **6 (c)**.

As in previous sessions, candidates continue to lose marks by not answering the actual question set. For example, in **Question 3 (d)**, where candidates often gave details on other ways in which HIV is transmitted, following on from **3 (c)**, rather than in outlining the problems involved in controlling the spread of HIV in terms of educating about risks, symptomless carriers and the difficulty in providing condoms/femidoms.

Again, in answer to **Question 2 (c)**, candidates were asked to explain how the structure of triglycerides, such as tristearin, makes them more suitable for energy storage than carbohydrates, such as glycogen. Candidates often mentioned that tristearin generated more energy, had a higher calorific value, often quoting appropriate kilojoules to support their answer, but made no reference to the relevance of the structure in terms of more C-H bonds or a higher proportion of hydrogen.

Other candidates were far too imprecise in their answers. For example, in **Question 6 (c)**, candidates were asked to describe how the precise three-dimensional shape of a polypeptide is maintained. Candidates often mentioned the names of the four bonds involved, namely hydrogen, ionic and disulphide bonds along with hydrophobic interactions, but gave no detail of the groups between which these bonds are formed in order to produce a specific tertiary shape.

There were sufficient marking points to allow candidates to demonstrate their knowledge and understanding and most candidates appeared to have had sufficient time.

Comments on specific questions

Question 1

There were some high scoring answers to this very accessible first question.

(a) The vast majority of candidates named structures **A** and **C** on Fig. 1.1 as Golgi (body/apparatus) and mitochondria respectively. Smooth endoplasmic reticulum, however, was not uncommon for **A** whilst many incorrectly named **B** as a nucleus rather than as a nucleolus.

(b) In stating two places in the gas exchange system where goblet cells are found, knowledgeable candidates gave two from trachea, bronchus and bronchiole. A significant number correctly identified only one place. These candidates and the weaker ones mentioned the nose (nasal cavities, nasal epithelium) and alveoli and occasionally gave example of places where goblet cells are found other than in the gas exchange system, for example, in the alimentary canal and oviducts.

(c) Candidates were required to use label lines and the letters **P** and **G** to indicate on Fig. 1.2 the positions of: **P** – a peptide bond and **G** – a glycosidic bond. A number of candidates ignored instructions and indicated **P** or **G** on the actual bonds, whilst others gave label lines to all the peptide and glycosidic bonds. The best candidates had **P** to a line between 2 amino acids and **G** to a line between 2 sugars or between the first sugar and the amino acid. Only rarely did candidates transpose the label lines and letters.

(d) In describing the role of mucus in the gas exchange system, the majority of candidates made suitable reference to the trapping of dust and bacteria, and thereby protecting the alveoli against damage and pathogens, with the mucus being swept away by cilia movement. There were many vague references to lubrication, moistening of incoming air and description of phagocytic action in the stomach on swallowed mucus.

(e) In stating one function of glycoprotein in cell surface membranes, knowledgeable candidates referred to the stabilising of the membrane structure forming hydrogen bonds with water molecules. Many more correctly mentioned their role in cell adhesion and as receptor molecules, though several candidates referred to receptor cells. Only occasionally was reference made to cell surface antigens. Weaker candidates confused glycoproteins with transmembrane proteins and incorrectly indicated that they were involved in the movement of substances across the membrane.

Question 2

There were many good answers to this question, with candidates finding parts **(c)** and **(e)** being the most difficult to answer correctly.

(a) Here candidates were asked to describe how phospholipid molecules were arranged in a cell surface membrane. This was clearly understood by the majority of candidates. There were many detailed accounts with references to the bilayer, the hydrophilic heads facing to the outside of the cell and the cytoplasm with the hydrophobic parts facing inwards towards each other. Many candidates successfully used the space provided for a simple, annotated diagram in answering this part question. Several weaker candidates confused 'hydrophilic' with 'hydrophobic', drew phospholipids with only one tail and referred to glycoproteins in their answers, believing them to be phospholipids.

(b) In stating 2 ways, visible in Fig. 2.1, in which phosphatidylcholine differs from tristearin, many candidates made suitable reference to the presence of phosphate and two fatty acid chains. Several referred to the unsaturated fatty acid in phosphatidylcholine and more unusually to the presence of choline and nitrogen. Few made reference to fatty acids of different lengths. Two tails unqualified was a common answer from weaker candidates.

(c) Only the most able candidates were able to clearly explain how the structure of triglycerides, such as tristearin, makes them more suitable for energy storage than carbohydrates such as glycogen. They made mention of repeated CH_2 units, a more highly reduced structure, and occasionally referred to triglycerides being stored in a compact form.

Weaker candidates limited their responses to more energy being released and only a minority of able candidates referred to more energy per unit mass or quoted suitable comparative figures. Many incorrectly wrote about insulation, solubility and osmotic inactivity or referred to the different amounts of water produced in respiration.

(d)(i)(ii) In using the data in Fig. 2.2, from an enzyme investigation, almost all candidates were able to state the times when lipase was added and the reaction ended as 5 minutes and 9-10 minutes respectively, though weaker candidates stated that the lipase was added at 0 minutes with the reaction ending at 20 minutes.

(e) In explaining why the pH decreases during the reaction described, good answers made reference to the production of fatty acids by hydrolysis of triglycerides. Several candidates simply mentioned an increase in H^+ ion concentration. Weaker candidates indicated that both fatty acids and glycerol as products caused a decrease in pH, whilst others incorrectly stated that water from hydrolysis with a pH 7 was responsible for the increase in acidity.

(f) In sketching on Fig. 2.2 the results expected from the second investigation described, the best candidates clearly indicated a steeper decrease from 5 minutes levelling off at pH 7.0. Many ignored the statement "lipase was added as before" and sketched a line starting from time 0 minutes, whilst others had the curve levelling off at a pH above or below pH 7. A minority did the graph at the bottom of the page.

Question 3

There were some excellent answers to this question, with part **(c)** often scoring full marks.

(a)(i) A pleasing number of candidates gained both marks, being able to show their working (e.g. 13 mm divided by 100,000) and therefore calculate the actual size of a viral particle as for example 130 nm. However many candidates did not appreciate that size of the specimen = size of image/magnification and so the calculation was beyond them. Some candidates could not transform the value received from a correct calculation into nm. A significant number of candidates had problems with 10^- values. It would have perhaps been appropriate to convert the size of the image from 13 mm to 13,000,000 nm before dividing by the magnification of 100,000. Some candidates expressed the answer in units other than nanometers.

(ii) Good/high, resolution was the stated property given by better candidates in explaining why the electron microscope makes it possible to view clearly very small objects, such as viral particles. Weaker candidates answered solely in terms of increased magnification.

(b) In suggesting why an infected T lymphocyte that is producing HIV particles has a higher demand for amino acids, many candidates made suitable reference to the cell having to produce viral proteins, though other candidates indicated incorrectly that amino acids are required for DNA replication. Weaker candidates suggested that increased antibody production resulted in a higher amino acid demand or made vague reference to the production of viral particles.

(c) The three most stated ways in which HIV is transmitted were sexual intercourse, infected blood products and from mother to foetus/across the placenta. Correct answers given by some candidates included the sharing of hypodermic needles and via breast milk. Less well answered responses described using unsterilised equipment without indicating contamination or sharing. The majority of candidates scored 3 marks.

(d) In outlining the problems involved in controlling the spread of HIV, only the better candidates were well able to clearly respond in terms of the difficulties in testing people's HIV status as many are symptomless carriers. Several referred appropriately to the problems involved in providing condoms, screening and treating blood and, of course, the lack of education about the risks. However weaker candidates incorrectly interpreted the question and were satisfied with giving additional transmission mechanisms to those already given in response to part **(c)**.

Question 4

Overall, a sound level of response. Part **(a)** was least well understood.

(a) A surprising number of candidates found it difficult to clearly explain fully why the mammalian circulatory system is described as a closed double circulation. For several double circulation involved blood flowing through the lungs twice, rather than the heart, and only the better candidates indicated that the blood passes through the heart twice during one cycle. Incorrect responses included reference to the separation of oxygenated and deoxygenated blood or the ability of the heart to send blood to two different destinations with one beat. Some candidates mentioned pulmonary and systemic circulations without any reference to the heart itself. Many candidates did refer to a closed circulation as one in which blood travels inside blood vessels. There were vague references to blood not being in contact with the organs or to the outside of the blood system. Several candidates, having described double circulation at length, did not address closed circulation.

(b) The vast majority of candidates were able to state one advantage and one disadvantage of mature mammalian red blood cells having no nuclei, making suitable reference to more space for more haemoglobin to carry oxygen and the inability of the cell to divide. Only rarely did candidates give alternative answers such as the advantage of being able to change shape and move through capillaries and the inability to carry out protein synthesis and repair. In stating an advantage, a significant number of candidates made inappropriate reference to increased surface area or surface area to volume ratio, or made vague reference to the disadvantage of the cell in not being able to control its activities.

(c)(i) Mitosis was almost universally given as the type of nuclear division that occurs at V with only occasional mention of meiosis.

(ii) Not all candidates were aware that tissue W was the bone marrow. Incorrect responses included the lymph nodes, blood, spleen and thymus gland.

(iii) Most candidates gave antigen as the term to describe foreign molecules on the surface of the measles virus that stimulate an immune response, though pathogen and even antibody were not uncommon.

(iv) Some difficulty here with only the most able candidates naming both cell **X** and molecule **Y** as a plasma cell and antibody respectively. Weaker candidates often named cell **X** as a macrophage, a killer T cell, B lymphocyte or effector cell.

(v) The very best candidates named cell **Z** as a memory cell and correctly described its role in the secondary response with reference to such memory cells remaining in the body, recognising the *same* virus/antigen on a subsequent occasion, with more rapid production of antibodies in response, so preventing symptoms and disease. Weaker candidates referred to the recognition of a pathogen or a disease. There were surprisingly very few references to the term 'secondary response' and even fewer to 'immunological memory'.

Question 5

A significant number of candidates produced disappointing answers to this question which involved data interpretation. Many candidates displayed a lack of understanding of the difference between 'describe' and 'explain'.

(a) By far the majority of candidates understood and explained why eight cubes of side 1 cm x 1 cm x 1 cm were used in this experiment with appropriate reference to them having the same mass/volume as the larger cube. Common errors were to write about replicates or the need to be able to take averages.

Weaker candidates made vague references to control/fair test.

(b) In describing the results shown in Fig. 5.1, several candidates appreciated the rapid rise in mass for the first 3 hours with a slower increase between 3–25 hours before levelling out. Several candidates also made a comparison referring to the larger percentage increase of the 8 cubes and quoted data to support this. However, a large number of candidates made general statements in describing the results with incorrect reference to time and usually with no supporting data. Where data was given it was often inaccurately read from the graph in Fig. 5.1. There was very little evidence of the use of a ruler to gain x and y value readings from the graph. Surprisingly some candidates referred to minutes, even seconds, rather than hours in their responses. A high proportion of candidates wrote about water absorption and many weaker responses were characterised by an explanation of the results, which was required in **(c)**, rather than the description as required in **(b)**.

(c) In explaining, in terms of water potential, why all the cubes of yam gained in mass, the vast majority of candidates made suitable reference to osmosis, water potential gradients and partially permeable membranes. Some candidates still persist in referring to a semi-permeable membrane and water concentrations. A few candidates answered this part question in a purely theoretical way and not in the context of yam cells. Several candidates continue to refer to less and greater water potential rather than lower and higher.

(d) Only able candidates made reference to the greater surface-area:volume ratio in explaining why the percentage increase in mass for the eight cubes of side 1cm was faster than that of the cube of side 2cm, often referring to 6:1 as opposed to 3:1. They did not however always clearly explain that this meant that more water per unit time (at least initially) would enter the cells by osmosis. Few, if any, appreciated that the outer cells of the large cube may have become fully turgid and so restricted the inner cells from absorbing water and increasing their mass. Weaker responses solely referred to the cubes of side 1cm having a greater surface area for uptake of water by osmosis with no reference to volume. Several candidates simply reworded the question.

Question 6

The standard of responses in **(a)** and **(c)** were generally disappointing. It was a good discriminating question. Molecular biology appeared to be a weak area for many candidates.

(a) In explaining how a globular protein differs from a fibrous protein, such as collagen, several candidates referred to globular proteins being compact and soluble with the best candidates making additional reference to hydrophilic groups pointing outwards. Some referred to the metabolic functions of globular proteins, acting as enzymes and hormones. Weaker candidates frequently used words such as round and circular in their answers, and had proteins coiling rather than the polypeptide chains. Several candidates gave long accounts of the types of bonding making up the tertiary structure of a globular protein or wrote about the quaternary structure of haemoglobin.

(b) Surprisingly some candidates found it difficult to use the information in Table 6.1 to complete the sequence of amino acids at the beginning of P globulin. The fact that different codons can code for the same amino acid may have surprised some candidates and led to indecision despite the position of some of the amino acids already being given in the sequence. Overall, however, the response was very good, although a few candidates left this question blank.

(c) Candidates were asked to describe how the precise three-dimensional shape of a polypeptide is maintained. A significant number of candidates were aware of the bonds involved, hydrogen, ionic, disulphide and hydrophobic interactions, though several could give no more than two types. Very few knew or could clearly explain where these bonds were formed, in producing a polypeptide with a precise tertiary structure e.g. hydrogen bonds between polar groups and hydrophobic interactions between non-polar side chains. For many ionic bonds occurred between charged groups and disulphide bonds between sulphurs. Several candidates gave a complete account from primary to secondary to tertiary structure. A few candidates gave a description of how the structure is maintained in extreme conditions of pH and temperature.

Paper 9700/03
Practical 1

General comments

The quality of answers was high from many Centres with a significant number of candidates scoring well over half marks from a total of twenty five.

The paper appeared to discriminate very well between candidates, allowing the vast majority of candidates to demonstrate their knowledge and practical skills. Very few candidates scored less than eight marks.

There was no evidence that any candidates suffered due to a lack of time.

Comments on specific questions

Question 1

This question was either answered very well indeed or quite poorly. It was clear which candidates were familiar with the procedure for testing the activity of the enzyme amylase with starch. Candidates that were familiar with the procedure performed much better on this question.

(a)(i) Examiners were given considerable leeway in marking this question and awarded marks for any indication that A2 reacted faster than A3 and that A3 reacted faster than A1. Even if candidates had failed to use the correct procedure in **(ii)** some candidates were able to score in this section.

(ii) Answers to this section were widely variable. Good candidates realised that fixed volumes of starch were added to each of the different amylase solutions and that these were then dropped onto the iodine at regular fixed intervals. Candidates who did this always gained full marks. Unfortunately far too many candidates added the enzyme to the iodine and then added the starch. As iodine is an enzyme inhibitor this procedure could not possibly work in a satisfactory way. Candidates who used a procedure that could not work were not awarded any marks on this section.

(b)(i) Nearly all candidates managed to score on this section by correctly calculating the rate of reaction.

(ii) Most candidates scored the full four marks for this question. However, there are still far too many candidates who are losing marks for failing to master the skill of plotting graphs. At this level candidates should be able to plot graphs correctly and accurately. Common errors included plotting the axes the wrong way round, error in plotting individual points, failing to give units in the axes labels, and extrapolating the line of best fit through zero. All of these errors lost marks.

(iii) This section was not well answered as many candidates failed to understand the command word 'explain' and instead simply described what happened. It is most important that candidates are trained to look at the command instruction when answering a question. In this case failure to do so lost many candidates both marks. Good answers referred to active sites and collisions between molecules.

(c) Most candidates performed much better on this question and referred to using an enzyme of the same concentration at different temperatures and then recording the time for complete hydrolysis to take place.

Question 2

(a)(i) Candidates were asked to draw four cells only and most did. One mark was awarded for following this instruction. However, there were still too many candidates who drew a cluster of cells that lacked clarity. Candidates should be aware that simply drawing lots of similar cells poorly is no substitute for drawing a few cells well. Credit was also given for quality of drawing, having cells touching but some spaces between them and having a very irregular shape.

(ii) This was not done well by most candidates and is clearly a skill that needs practice. Credit was given to those candidates who measured several cells and calculated the average size even if they failed to obtain a correct answer at the end of the question. Good candidates managed to get a reading between 10 – 15 µm for the mean width of a nucleus.

(b)(i) Most candidates managed to score one of the two marks for this section. The second mark was usually lost for identifying a feature that could also be seen with a light microscope. The question specifically asked for features that could not be seen on the microscope slide. Credit was therefore given for mitochondria, golgi body, EPR, ribosomes, glycogen granules, membranes, vesicles or a lysosome.

(ii) Most candidates managed to score the final mark by referring to the greater resolving power of the electronmicroscope.

Paper 9700/04

Paper 4

General comments

The paper appeared to be of the correct standard producing a range of marks from below 10 to well over 50.

Candidates seemed to have had enough time to complete the paper and there was no general evidence of questions being missed out.

Comments on specific questions

Section A

Question 1

(a) Most candidates correctly identified 'matrix of mitochondrion'. Common mistakes mentioned just 'mitochondrion' or 'cytoplasm'.

(b) Many candidates missed the link reaction and only dealt with the Krebs cycle despite being told to mark all the places where decarboxylation and dehydrogenation occurred. Despite this omission, this was quite a high scoring question.

(c) It was pleasing to note that most candidates were able to score some marks here, many obtaining a maximum three by stating that 'reduced NAD was oxidised in the ETC'. Credit was also given for a correct mention of regeneration in anaerobic respiration.

(d) This question proved difficult as many seemed unfamiliar with the term 'substrate level phosphorylation' and many candidates made contradictory statements. A common error was a comparison of the number of ATP molecules produced by the two processes.

Question 2

(a) Although this was a straightforward 'genetic diagram' question it was disappointing to see so many poorly presented answers with stages unidentified. Candidates should be encouraged to use appropriate headings such as 'parental genotype' and 'gametes' etc. If the gametes are placed in a logical order in a punnet square then a logical pattern emerges. Some candidates still do not realise that it is essential to link the genotypes produced by the punnet square accurately to their corresponding phenotypes. The final stage of the explanation required a link back to the data and a comparison with the 9:3:3:1 ratio. This was frequently not given.

(b) Most candidates were able to state that yellow shrunken grains would be homozygous recessive or were able to describe this condition. The term 'gene' was sometimes incorrectly given instead of allele.

(c) Many candidates scored full marks here by following the steps shown in the table. Some candidates made errors in completing the entries for the yellow and shrunken grains or did not realise that the total chi-square is obtained by adding up all the individual values.

(d) The wording of this question appeared to cause trouble for some but for most candidates did not pose a particular problem. Candidates were required to state a value 'greater than 0.5' to gain credit. Some candidates seemed unfamiliar with the use of the probability table and simply identified the critical chi-square value.

(e) A number of candidates stated 'the result was due to chance' and 'the result was not significant' when, in each case, it is the deviation from the expected that is not significant.

Question 3

(a) A large number of candidates did not score as they failed to mention 'volume' or 'moles'. A common mistake was to refer to the 'amount' of carbon dioxide and oxygen. Some merely referred to carbon dioxide being evolved and oxygen taken in. A few got the ratio upside down and this then penalised them in part **(b)(ii)**.

(b)(i) A majority correctly gave $18CO_2$ and $18H_2O$.

(ii) There were many correct answers but some put 18 ÷ 18 = 1 which, although it did not score here, did allow for a possible error carried forward mark in part **(b)(iii)**.

(iii) There was a range of answers here from correct ones like lipid and fat to incorrect ones such as protein and glucose.

(c) Not many candidates scored two marks. The most common correct answer was less hydrogen and less C-H bonds. The last three marking points were rarely given.

Question 4

The data for this question was quite extensive and was frequently misread by candidates who found the extraction of information very demanding.

(a) This was the better answered question and most candidates were able to mention lack of food, large beaked birds surviving as the large beaks were able to open the large seeds. Some were able to then state that the large beaked birds were able to pass on this characteristic.

(b) Many different answers were given here but few referred to the abundance of seeds in normal years or that the extreme phenotypes would be selected against. Incorrect answers mentioned 'small beaked birds, having small seeds to feed on, survived whilst the larger beaked birds died out' or 'plenty of large and small seeds hence birds developed body size and beak size to suit the food they fed on'.

(c) There were a relatively small number of correct answers mentioning 'geographical isolation, allopatric speciation or different environmental conditions'. Many candidates did not realise that the data was not necessary in order to answer this question and largely depended on their knowledge of speciation.

Question 5

(a) This was a reasonably well scoring question as a large number of candidates had a good understanding of genetic engineering. Most referred to 'restriction enzymes', 'specific base sequences' and 'sticky ends'. Only a few were able to give named examples of the enzymes.

(b) All marking points came up, the most common being 'complementary base pairing' and 'ligase'. Very few mentioned 'phosphodiester bonds'. A frequent misunderstanding was using the same restriction enzyme to cut the human insulin gene when in fact reverse transcription is used.

(c) Most candidates were able to score two marks with 'cheaper', 'fewer allergies/side effects' and 'ethical issues' being the most common answers.

Section B

Question 6

(a) This section was generally done well. Good answers were characterised by precise and often short responses. Many were able to correctly mention the large surface area of the leaf, the arrangement of palisade cells and their internal details and link these to efficient absorption of light. Likewise thin leaves, airspaces in the spongy layer and stomata were frequently linked to gas exchange.

Common errors were reference to thin *parts* of the leaf not the leaf overall, transparent upper epidermis not cuticle and confusion or omission of what carries what and where (xylem and phloem).

(b) This section scored lower marks. A considerable number of candidates wrote at length about photosynthesis giving great detail of biochemical processes. They did not always relate this to rate of photosynthesis.

Those who wrote about carbon dioxide concentration and then light intensity (or vice versa) scored more highly than those who combined the two.

Many candidates were able to mention that the rate increased as the concentration of carbon dioxide increased and that a plateau was reached. They often illustrated this with a diagram. The equivalent information was then given for light intensity. Some were able to go on and explain the principle of limiting factors.

Question 7

(a) This was well answered with many high scores. Most were able to mention the deamination of excess amino acids to produce ammonia and then urea and that this occurred in the liver. Better candidates were also able to comment on the production of uric acid from nucleic acids or creatinine from amino acids.

(b) Candidates displayed much knowledge about the functioning of the kidney but wrote a lot of irrelevant detail because they did not read the question carefully enough. What was required was an account of how the kidney removed metabolic wastes. Most candidates picked up marks on the process of ultrafiltration but then went into great detail about the roles of the proximal convoluted tubule, the loop of Henle and the distal tubule and in so doing wasted much time. The role of ADH on the collecting duct was rarely given correctly and the release of metabolic water as part of urine was hardly ever mentioned.

Paper 9700/05
Practical 2

General comments

The quality of answers was very high from many Centres with a significant number of candidates scoring in excess of twenty marks from a possible thirty.

The paper appeared to discriminate well between candidates, allowing the vast majority of candidates to demonstrate their knowledge and practical skills. Very few candidates scored less than ten marks.

There was no evidence that candidates suffered due to a lack of time.

Comments on specific questions

Question 1

Most candidates scored well on this question, particularly if they realised the effect that a metabolic poison would have on cell membranes and the consequences that this would have for osmosis.

(a)(i) This was well answered and most candidates scored both marks. The quality of drawing was good and credit was given for using clear single or double lines close together and having the correct ratio of length to width for cells that were drawn.

(ii) Again this question was well answered. Candidates explained that the cell was turgid and the cytoplasm complete through out the cells. Most candidates scored both of the marks.

(b)(i) Very few candidates scored full marks on this section. Credit was given for any sign of plasmolysis and then an additional mark for each kind of plasmolysis shown. This resulted in most candidates scoring two marks. Credit was given for complete plasmolysis, cap plasmolysis and plasmodesma plasmolysis.

(ii) Candidates should have scored full marks on this section but most only scored two or three. The most common error was failing to mention that osmosis took place through the cell membrane. However, many gave good explanations using water potential.

(c) Few candidates managed to score this mark. Instead of describing what they saw, they attempted to explain the observation using plasmolysis and thus lost the mark. Good answers simply described the cell indicating that the contents had changed colour, were disorganised or had leaked out of the cell.

(d) This part was generally well done with candidates explaining that the cell rapidly regained turgor. This answer scored both of the marks.

(e) Most candidates scored this mark by saying that the cell failed to regain turgor. However, a significant number insisted that turgor was regained even when the metabolic poison had destroyed the cell membrane. This was a classic case of candidates seeing what they expected to see, rather than what actually happened.

(f) Candidates gave a variety of answers to this question. Good answers included that effects to cell **A** were reversible but cell **B** was irreversible as the membrane had been destroyed.

Question 2

This question was generally answered very well showing good understanding of what was happening in the photomicrograph.

(a)(i) Most candidates scored both marks for correctly identifying the five stages. Stage 1 was credited as either anaphase or telophase. The majority of errors occurred with Stage 5 as candidates did not want to answer anaphase again and gave an alternative answer.

(ii) This section was also answered well with most candidates scoring both of the marks.

(iii) Most candidates drew a good diagram but there were still too many who simply redraw a textbook diagram from memory. Spindle fibres and propeller shaped chromosomes are not what are seen in real life. Candidates were clued into this by being asked to draw a circle around the cell that they were drawing from the photomicrograph, but too many ignored this instruction. Good answers were clearly drawings at metaphase with at least three correct labels. Labels for cell membrane were not accepted as the cell membrane cannot be seen with a light microscope. Chromosomes should been distinct, and thicker than the cell wall.

(b) There were some very good answers to this section with credit being given for reference to homologous pairs, chiasma, and chromosomes pulling apart on the equator.

(c) This was also answered well by most candidates with the majority correctly referring to the root cells undergoing mitosis and describing one of the differences between the two processes.

Paper 9700/06

Options

General comments

Option 3, *Growth, Development and Reproduction*, proved to be the most popular choice with candidates. There appeared to be a slight increase in numbers attempting ***Option 1*** *Mammalian Physiology*, while Examiners marked very few of **Option 2** *Microbiology and Biotechnology*.

All options provided a range of questions differing in the degree of difficulty so the paper was able to discriminate well between candidates. As a result, candidates' marks were spread across most of the available range.

Candidates with sound factual knowledge were able to use this to interpret both familiar and new data but all candidates need to be reminded to read the question carefully to avoid inappropriate responses. In addition, candidates did not always take sufficient note of differences in examination instructions, failing to distinguish between terms such as 'describe', 'compare' and 'explain'. This basic lack of examination technique at times resulted in candidates failing to gain potentially accessible marks.

Interpreting graphical information proved difficult for some. Examiners were pleased to see candidates quoting figures in their responses but it should be emphasised that units are essential to gain credit. Practice is also needed in the describing of general trends in data, an essential skill. Too often the data is simply listed without any attempt being made to note the patterns that are evident.

Comments on specific questions

Option 1

Mammalian Physiology

Question 1

(a) Some candidates had difficulty naming **A**–**D** but in general this was answered well.

(b) Few responses indicated that the outside or ends of the bones were the location of compact bone.

(c)(i) The question asked for differences in structure, so responses describing differences in properties failed to gain credit.

(ii) Most answers referred to smoothness, reducing friction or the prevention of damage to the bone. Many candidates used the expression 'friction free' when 'less friction' was more accurate here.

(d)(i) It was pleasing to see so many candidates understanding the role of this control group.

(ii) Most responses noted reduced strength but few supported their comment with figures. Units were often lacking.

(iii) Many stated less or no oestrogen was produced with the ovaries removed. The change in the ratio of osteoclasts to osteoblasts was not appreciated, so figures supporting this idea were not seen.

(iv) Statements were very muddled. Although many candidates realised that bone strength was increased (compared to just ovaries out), it was not always clear whether a comparison was being made with this group or group E. Marks were gained for increased strength and numbers of osteocytes (estren compared to oestrogen) but it was disappointing to see few supporting figures.

Question 2

(a)(i) Few candidates were able to make this calculation.

(ii) The fact that glucose could be absorbed from the start, without digestion, was appreciated by some candidates. Many responses were muddled, the candidates failing to note that the starch in rice was simply a glucose polymer.

(b) It was expected that candidates would refer to the insulin concentration following the changes in blood glucose. Unfortunately, many responses did not mention blood glucose concentration. The idea of negative feedback was not seen.

(c) Most marks were gained here by the conversion of glucose to glycogen and its storage in the liver. Few candidates described the insulin binding to receptors on the cell membrane of the liver cell or mentioned the increased absorption of glucose.

Question 3

(a) Candidates realised its importance in controlling body temperature or the pituitary gland. Detail of how it had this effect was lacking. Although hormones released by the pituitary were sometimes named, it was not clear that it was the neurones of the hypothalamus that secreted them or which part of the pituitary gland was responsible for their release.

(b)(i) Most could correctly name this.

(ii) Despite the emphasis in the question on the transmission of information, few candidates referred to action potentials in neurones. Most realised that the optic nerve was involved but further detail was lacking.

Question 4

(a) This was generally well answered.

(b) Only a few candidates knew this occurred in the mitochondria.

(c) Many realised that the Kreb's cycle needed the NAD to pick up hydrogen.

(d) Some awareness was shown that fatty acids would not be oxidised due to lack of NAD, so these would be converted to fats. No appreciation was shown that excess fats should be converted to LDLs but that this was impossible with damaged liver cells.

Option 2

Microbiology and Biotechnology

Question 1

(a)(i) The need for a cooling jacket or other modifications was often mentioned together with an explanation. However, explanations often lacked detail while many responses simply concentrated on making things bigger.

(ii) Most responses correctly linked pH or temperature to their effects on enzymes. Other possibilities were oxygen or substrate concentration but these were not seen.

(b)(i) Correctly calculated.

(ii) Many were able to correctly calculate this.

(iii) Good candidates commented on the inaccuracy of counting large numbers of colonies and their possible overlap or the unreliability of too few colonies.

(c) Both turbidity and haemocytometry were well known, together with the problem of the presence of dead cells.

(d) The most common mistake here was not starting above zero, while the stationary phase was often unclear. Many however scored full marks.

Question 2

(a) Well understood.

(b) Many good answers selected a high optimum temperature and a suitable pH range. Fewer explained that this would save time by not needing to cool or reduce the pH after the first stage.

(c) This was well understood.

(d) Candidates should be encouraged to organise their comparisons clearly in the pairs of boxes provided. On the whole the differences were well known.

Question 3

(a) Surprisingly poor responses, with few using the correct terminology.

(b) While aseptic conditions and methods of inoculation were well known, only a few included a nutrient medium containing cadmium or the incubation conditions. A suitable method of obtaining the fungus from the leaves, the use of a range of cadmium concentrations or the isolation of spores from colonies that grew was omitted.

(c) Many vague answers here, although a few successfully described extracting metals from low grade ores and detoxifying waste.

Question 4

(a) Generally well done. Some confusion was shown over the fact that there was a slight increase in 1998 which was not always noticed.

(b) Many candidates discussed genetic manipulation in general terms without really addressing the question. References were often made to plasmid involvement with no further detail. The role of Agrobacterium was not generally known.

(c)(i) Most responses described these as controls without distinguishing between X and Y, so few marks were scored here.

(ii) Few commented that the Bt toxin was only found in the sap but it was realised that Bt cotton gives less protection against sap sucking insects. The reduced insecticide use was noted along with the increase in yield, although few noted the dramatic nature of this increase.

Option 3

Growth, Development and Reproduction

Question 1

(a) Some candidates realised that more RNA indicated more activity of the gene, but many simply related RNA production to protein synthesis, often muddling transcription and translation in the process.

(b)(i) Too often responses only gave figures for mRNA production at each time interval without relating these to the light and dark periods. While figures gained credit, candidates should be encouraged to note more general trends in a graph, e.g. the increase in the light and the decrease in the dark, with the peak at the end of the light period in both.

(ii) Most appreciated this was a long day plant but could not always explain why from the evidence.

(c)(i) Candidates could easily gain full marks, but some still do not understand this, often thinking that red light changes to far red light rather than the forms of phytochrome interchanging.

(ii) Failure to read the question led many to comment on the advantages to man rather than to the plant species. Better answers suggested flowering when pollinators are available or at the same time for cross pollination.

Question 2

(a)(i) Most gained full marks here.

(ii) Many responses simply repeated the idea that they would swim faster. Credit was given for ideas of reaching the egg faster or that fertilisation was more likely. The viscosity link was missed, with only an occasional candidate discussing advantages when travelling through viscous mucus, such as in the cervix.

(b)(i) Responses ranged from very good to confusion with capacitation or the cortical reaction.

(ii) A few answers realised that the acrosome reaction might destroy the hooks. Credit could also have been given for noting the relationship shown on the graph but figures needed to be quoted to support this idea of the link between the acrosome reaction and numbers forming ‘trains’.

(iii) Only a few candidates explained that some sperm needed to retain the ability to fertilise the egg.

Question 3

(a) Most candidates scored full marks here. A few weaker candidates included information about non-male parts.

(b)(i) Good answers were seen.

(ii) This proved difficult for the majority of candidates. Even when they calculated the difference as 54 flies, it was rare for them to use this to correctly work out the percentage difference.

Question 4

(a)(i) Many scored maximum marks here.

(ii) When candidates appreciated the lack of genetic variation, they usually realised that this would reduce the ability to adapt to 'new' diseases or a changed environment. Very few answers noted that genetic change could only be by mutation, a rare process.

(iii) If responses concentrated on the environment candidates were able to score both marks, with ideas of the rapid colonisation by the crayfish, effective competition for scarce resources or disruption of the food chain. However, many described possible effects of the crayfish not adapting instead.

Option 4

Applications of Genetics

Question 1

(a) Many recognised this as initiating the beat and controlling its rate. Very few appreciated its myogenic property. Some attempts were made to describe how the excitation was passed to the rest of the heart.

(b)(i) This proved quite accessible.

(ii) Responses were disappointing. When it was realised that the channel would be a protein, correct statements with respect to a change of shape preventing the ion fitting were made.

(c)(i) Only very rarely were responses phrased in terms of action or resting potentials but candidates were able to access the marks by correctly quoting figures.

(ii) Many responses confused the situation in the treated and untreated cells.

(iii) Few realised that cells would either be treated in the right atrium itself or treated in vitro and returned there.

Question 2

(a) Generally well known.

(b)(i) Surprisingly few attempts were made to quote figures. Some noted the significant difference in effect between resistants and susceptibles but rarely were the effects at low and high concentrations commented upon.

(ii) Poor reading of the graph was a problem for some, while others were unable to manipulate the numbers they obtained.

(c) Very clear accounts were supplied. The idea of random mutation and its preferential selection was well known but weaker candidates still refer to the gene rather than the allele being passed to the next generation.

Question 3

(a)(i) Good responses were provided.

(ii) A readily accessible question.

(b) This was surprisingly poorly explained. A few described the use of many females, AI and surrogates in the process. Little awareness was shown of the need to use different sires and to progeny test these for their suitability to maintain genetic diversity.

Question 4

(a)(i) Often the idea of epistasis was defined well but less often was the dominant idea explained correctly in this context. Some candidates explained dominance between alleles of the same gene.

(ii) A few responses described the white flowers as colourless but most supplied the colours correctly.

(b) While candidates may need to draw all the generations involved in such crosses, they would be advised to make quite clear which generation is being shown at each stage. Some responses did not show phenotypes clearly linked to their genotypes often losing marks as a result.