BIOLOGY

Paper 9700/01
Multiple Choice

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

General comments

The mean score was 26.8 (67%) and there was a very good spread of scores, the standard deviation being 7.3. Twelve questions were answered correctly by 80% or more of candidates – **Questions 1, 2, 7, 11, 12, 14, 15, 18, 21, 25, 35, and 40**. Only two questions were difficult; 40% or fewer candidates answered **Questions 17** and **23** correctly**.**

Comments on specific questions

Question 3

Weaker candidates do not appreciate that the Golgi apparatus collects, sorts and processes molecules for secretion and that goblet cells secrete mucin making a solution of mucus.

Question 4

Active transport out of a plant cell does not involve the cell wall, which is fully permeable. A large surface area of the cell surface membrane will mean an increased number of transport or carrier proteins.

Question 5

The relative difficulty of this item reveals a poor understanding of mitosis, which is a nuclear division. Prokaryotic cells do not have a nucleus and do not divide by mitosis.

Question 6

Some candidates were confused by the use of scientific notation. It is expected that candidates should be used to writing out large numbers as a decimal number followed by a power of ten.

Question 8

Many weaker candidates did not appreciate that they were being asked what test would be used to show that the reaction was complete and selected the starch test.

Question 9

The difference between 1, 4 glycosidic links in α glucose and β glucose is poorly understood by some candidates.

Question 13

Only the more able candidates were able to determine the correct response. During the second experiment, as the temperature was increased, the enzyme would become denatured. However, the enzyme would catalyse the reaction until it became denatured. Therefore a small amount of product would be made and then the reaction would cease, but the product concentration would then remain the same. Option **B** was a popular choice, but the second graph is that for rate of reaction against temperature.

Question 17

Candidates continue to have difficulty understanding the relationship between water potential, solute potential and pressure potential. There also remains considerable confusion about the difference between more and less negative.

Question 19 and 20

The majority of candidates realised that just before prophase, each chromosome consists of two chromatids so that there would be 92 chromatids present. However, weaker candidates did not know that this was because the DNA had replicated using new nucleotides (radioactive nucleotides, in the case of **Question 20)** and each chromatid is one DNA molecule.

Question 22

The less able candidates poorly understand the mechanism of semi-conservative replication, with **Option D** being a very popular choice.

Question 23

Only the more able candidates realised that from the piece of double-stranded DNA containing 6000 nucleotides, only one strand of 3000 nucleotides is used for transcription and translation.

Question 26

The inability of many candidates to distinguish between xylem and phloem may be due to lack of practical experience in studying slides using the light microscope.

Question 28

A surprising number of candidates do not realise that phagocytes can leave the blood and are found in tissue fluid and that most plasma proteins are too large to leave the capillaries, as are the platelets.

Question 29

The Bohr Effect is linked to increased levels of carbon dioxide, which forms carbonic acid, which dissociates giving a high concentration of hydrogen ions and a low pH. Weaker candidates think that a high pH is more acidic.

Question 30

Due to difficulties with reading the graph, this question was withdrawn from the examination. However, candidates responses showed that this question was very poorly understood, with many more able candidates incorrectly choosing **Option B**. The atrio-ventricular and semi-lunar valves are both shut between points 1 and 2 and between points 3 and 4 on the graph.

Question 32

Less able candidates did not appreciate the difference between lymphocytes and phagocytes.

Question 33

A significant number of candidates incorrectly thought that tar had formed a blockage in the artery.

Question 34

Only the more able candidates realised that the only thing in common is that they all have genes. Viruses show none of the characteristics of living things, have a protein coat and no cell membrane or organelles.

Question 38

Only half of the candidates understood that the description of the tree was for its role in the ecosystem, which is the definition of a niche.

Question 39

The less able candidates selected **Options A or C**. The food web does not include inorganic material, but must include decomposers.

BIOLOGY

Paper 9700/02
Structured Questions

General comments

There were many encouraging responses to all 5 questions from the well prepared candidates, though disappointingly there were some low scores, and even the most able candidates occasionally had some difficulty with **Questions 1(c), 2(b), 2(c), 3(d), 4(c), 4(e)** and **5(d).**

As in previous sessions, candidates continue to lose marks by not using their biological knowledge to answer the question set. For example, in **Question 1(c)**, where candidates were asked to explain how oxygen and glucose move from the blood inside the capillary to the tissue fluid in the muscle, several candidates described the transport of these substances in the blood.

Again, in answer to **Question 5(d)**, many candidates, in explaining why it is important to determine the *initial* rate of reaction when investigating the effect of a competitive inhibitor on an enzyme, simply described the principles of competitive inhibition.

Other candidates were far too imprecise in their answers. For example, in **Question 5(c)**, candidates were asked to sketch a curve on **Fig. 5.1** to show the results obtained if thiourea acts as a competitive inhibitor of urease. Many candidates did not start their curve at 0 and/or did not show the curve reaching, or nearly reaching, the same plateau at a higher concentration of urea, simply drawing a curve lower than that given in **Fig. 5.1**.

Candidates should be aware of the significance of the use of bold type face in questions, for example **1(d)** with reference to the **structure** of the wall of a vein and a capillary, **2(a)(ii)** with mention of the **structure** of a xylem vessel and **3(c)** beginning **use the information in Fig. 3.1**. Candidates should also try and write within the lines of the paper. Many were using all the available blank pages and space at sides and bottoms of pages to elaborate on their answers.

There were sufficient marking points to allow candidates to demonstrate their knowledge and understanding and most candidates appeared to have had sufficient time. There were no common misinterpretations of the rubric.

Comments on Individual Questions

Question 1

There were some high scoring answers to this question, though some candidates found **(c)** particularly difficult.

(a) The vast majority of candidates completed the table naming cells **A** and **B** as a phagocyte and a squamous epithelial cell. The function of cell **C** (a red blood cell) was almost without exception given as transport of oxygen/carbon dioxide. A significant number of candidates stated white blood cell/macrophage for **A** and named cell **B** as an alveolus/alveolar cell/capillary. Some candidates did not give sufficient detail for cell **B,** hence 'squamous' or 'epithelium' alone. A number of candidates did however have difficulty with the diameter of cell **A** where Examiners looked for a figure of 6-8μm. Many candidates gave inflated dimensions between 25-40μm, having failed to either take measurements and calculate the precise diameter from the magnification given or note that cell **B** and cell **C** were 20μm and 7μm respectively and use this information in determining the diameter of cell **A**.

(b) Few difficulties here with most naming organelles **D, E** and **F** as mitochondria, lysosome/vesicle and nucleus respectively. Several candidates did, however incorrectly identify **E** as a ribosome. Fewer confused nucleolus with the correctly named nucleus for **F** than in previous sessions. Candidates should be reminded that nucleoplasm/nuclear sap are not organelles.

(c) In explaining how oxygen was moved from the blood inside the capillary to the tissue fluid in the muscle, many candidates made suitable reference to diffusion but not always down a concentration gradient. Many misinterpreted the question and gave accounts of the dissociation of oxygen from the haemoglobin molecule. Candidates rarely indicated that movement was through the phospholipid bilayer. The explanation with regard to glucose movement was even more disappointing – most incorrectly mentioned diffusion. Few made reference to (pressure) filtration via the pores in the capillary walls. Occasionally facilitated diffusion was correctly given but few made reference to the role of transport proteins. Active transport was mentioned by several candidates.

(d) Candidates did not always describe how the **structure** of the **wall** of a vein differs from that of a capillary. Those that did made appropriate reference to the thickness of the wall, three layers being present and the presence of valves. Weaker candidates stated that veins had *more* smooth muscle/elastic tissue or made inappropriate reference to the size of the lumen and composition of the blood. Some candidates occasionally compared the wall of the vein with that of an artery.

Question 2

There were many good answers to this question, with part **(b)** being the most difficult to answer correctly.

(a)(i) Able candidates identified elements **G** and **H** as a sieve tube/cell and companion cell respectively. Several incorrectly gave phloem, phloem tube or sieve vessel for **G**.

(ii) In describing three ways in which the **structure** of a xylem vessel differs from the **structure** of **G** (a sieve tube), many candidates made clear reference to a thicker wall with lignin thickenings, the lack of cytoplasm, the absence of cross walls or the presence of pits. Weaker candidates gave non structural differences, for example xylem vessels are dead/hollow, or compared functions i.e. transpiration versus translocation.

(b) In explaining how sucrose is transported in the phloem, excellent responses made reference to the role of the companion cells in loading the sucrose at source, with detail of the pumping out of H^+ and the co-transport of sucrose, with sucrose being loaded at the sieve tubes via plasmodesmata. Only the most able made further correct reference to the absorption of water by osmosis, build up of hydrostatic pressure and mass flow, due to a difference in pressure between source and sink, resulting from the sucrose being unloaded at the fruit. Weaker responses inaccurately referred to translocation in the sieve tube apparently by active transport or diffusion of sucrose down a concentration gradient. A few candidates wrote about the cohesion-tension hypothesis. Many candidates did not seem to be aware of the detail of translocation.

(c) Not all candidates could suggest why, with sucrose entering, summer squash fruits are not sweet. A large number of candidates believe that sucrose, a dissacharide/non-reducing sugar, is not sweet. Able candidates did however refer to sucrose being used in respiration, being stored as starch or used to make cellulose for cell walls. Very weak responses included sucrose being diluted with water, masked by salt or that little photosynthesis was taking place. Sucrose being used in growth was a popular incorrect answer.

Question 3

There were some good, clear and factually accurate answers to this question, though some candidates found **(d)** particularly difficult.

(a) Candidates were required to complete a table to show whether the statements given applied to proteins, DNA, messenger RNA and cellulose. The most knowledgeable candidates had no difficulty in correctly completing the table. Two common mistakes were to think that messenger RNA was stabilised by hydrogen bonds and that cellulose was not. More than a few candidates thought that proteins contain uracil. Furthermore a significant number of candidates did not put ticks or crosses as required and were penalised for not doing so.

(b) The vast majority of candidates correctly stated the sequence of bases at **J** as CAG (being complementary to GUC on the mRNA strand). Occasionally weaker candidates gave GTC or wrote the word 'anticodon'.

(c) In describing the role of transfer RNA molecules in translation, good candidates referred to tRNA combining with a specific amino acid carrying the amino acid to the ribosome, where the codon of the mRNA pairs with the anticodon on the tRNA, the tRNA leaving the ribosome after amino acids have joined together to form a polypeptide. The examples shown in **Fig. 3.1** were not commonly used. Several candidates confused codon with anticodon, whilst others referred to individual bases as codons. Weak responses made reference to amino acids being produced/formed at the ribosome after complementary base pairing between mRNA and tRNA. Many candidates were unable to put their ideas down in a clear, logical manner. Others impressed by naming correctly the enzymes for attaching tRNA to the amino acid and for catalysing the formation of peptide bonds, even though they were not essential for answering the question.

(d) Candidates were required to explain how the structure of an antibody, such as the anti-toxin for choleragen, makes it specific for one substance. Only the most able candidates made appropriate reference to the variable region of the antibody having a complementary shape to the choleragen, so providing a binding region for the antigen. Few clearly explained the nature of this specificity in terms, for example, of the sequence of amino acids in the primary structure, or indeed the R groups on the amino acids in the polypeptide/protein of the antibody causing folding.

Many answers consisted of inaccurate generalised answers involving antibodies reacting with anti-toxins and repeated use of the word specific from the actual question and references to 'lock and key' and receptors. Several candidates gave inappropriate detail of antibody production including reference to B lymphocytes, plasma cells and memory cells. Weaker candidates confused antibody, antitoxin and antigen and misused the words structure and shape.

(e) The very best candidates, in explaining why cholera remains a significant infectious disease in some parts of the world, did make clear reference to the lack of sanitation, contamination of water supplies, poor hygiene and lack of health education. There were occasional appropriate references to the lack of rehydration therapy and the absence of an effective vaccine by some candidates. Weaker responses were characterised by reference to unclean/dirty rather than contaminated water. Water was often said to be infected. Only rarely did a candidate refer to bacteria living in the gut where the immune system is ineffective or the significance of natural disasters in some parts of the world. Some candidates stated that *Vibrio cholerae* is found in the liver. Others wrote about antibiotic resistance and mutations.

Question 4

A sound response by many candidates, although **(c)** caused some difficulty.

(a) A pleasing number of candidates were able to calculate the magnification of the electron micrograph in **Fig. 4.1** as x 30,000 $^{+}/_{-}$ 100. Some candidates did not appreciate that magnification = size of image/actual size e.g. (1.5 cm) 1500µm/0.5µm and gave a figure way above/below x 30,000. Several candidates did not use the scale bar, alternatively measuring the length of the chloroplast on the electronmicrograph, dividing by 1.5 and multiplying by 0.5.

(b) The two most stated features correctly mentioned by candidates visible in **Fig. 4.1** that identify the organelle shown as a chloroplast were the presence of starch grains and grana/thylakoids/internal membranes. Only occasionally did candidates refer to appropriate shapes and lengths. Weaker responses were characterised by reference separately to both grana and thylakoids or stating grain/granule with no mention of starch. Several incorrectly wrote about the chloroplast envelope, stroma, circular DNA and 70S ribosomes.

(c) In suggesting why chloroplasts use phosphate ions, only the most knowledgeable candidates made reference to the synthesis of ATP, nucleic acids, phosphorylated sugars or phospholipids. A significant number of candidates incorrectly mentioned chlorophyll synthesis or simply stated 'in photosynthesis'.

(d) Candidates were asked to explain how amylose and amylopectin are formed from glucose in plant cells. Good explanations made reference to condensation reactions and 1:4 glycosidic links in both amylose and amylopectin producing a helical unbranched amylose chain, whilst amylopectin was branched by means of 1:6 links. Weaker responses indicated a straight chain in amylose due to 1:4 links and a branched chain in amylopectin due to 1:6 links (no 1:4 links being present). Many did not mention α glucose. Some candidates thought amylose was made of α glucose and amylopectin of β glucose.

(e) In stating three functions of the water stored in the vacuoles of plant cells, the majority of candidates made suitable reference to water being needed for photosynthesis. A significant number also mentioned the need to maintain turgidity. Only the most able candidates made mention of hydrolysis reactions or as a solvent for ions. There were many weak responses involving water for cooling in transpiration and transport of substances, such candidates ignoring the word 'vacuoles' in the question. Few mentioned that stored water would push chloroplasts to the edge of the cell.

Question 5

A significant number of candidates produced disappointing answers to this question, which involved data interpretation in **(b)** and an understanding of inhibition in both **(c)** and **(d)**. Candidates found **(d)** particularly difficult.

(a) Many candidates were able to describe how urea from fertilisers becomes available to plants as nitrate ions, with correct reference to nitrification/oxidation, mentioning the conversion of ammonia to nitrite and nitrite to nitrate involving the bacteria *Nitrosomonas* and *Nitrobacter* respectively. Weaker candidates referred to urea to nitrate and mentioned denitrifying or nitrogen fixing bacteria as being involved.

(b) **(i)(ii)(iii)** Able candidates were able to match the 3 statements given, to the reaction mixtures 1 to 6 in **Table 5.1** and correctly answered by naming reaction mixtures 6, 5 and 3, although several candidates in **(b)(iii)** incorrectly matched this statement with reaction mixtures 2 and 3. Candidates were informed prior to **(b)** that there had been an increase in pH in reaction mixtures 1 *and* 2, the reaction being faster in 1 than in 2.

(c) Candidates were asked to sketch a curve on **Fig. 5.1** to show the expected results if thiourea acts as a competitive inhibitor of urease. The best candidates produced a curve starting at 0, lower than the curve produced when the inhibitor is absent, but reaching/almost reaching the same plateau at higher concentrations of urea. A significant number of candidates had their curve meeting the original curve too early or plateauing out well below the original curve.

(d) In explaining why it is important to determine the initial rate of reaction when investigating the effect of a competitive inhibitor on an enzyme, only the most knowledgeable candidates clearly understood that the initial rate of enzyme reactions is always fastest, getting across the idea that maximum substrate is only available initially. Few appreciated that the maximum difference in rate between the two reactions is only initially, since with time the same end point is reached with no difference in rates. Even the most able candidates had difficulty in expressing themselves clearly. Many thought the question referred to the investigation shown in the graph and did not appreciate that the question was about *each* reaction mixture that is set up in order to plot points on the graph. Weaker candidates simply gave a brief description of competitive inhibition or stated the need for an initial reading with which to compare the effect of the inhibitor.

BIOLOGY PRACTICAL AS

Paper 9700/03
Biology Practical

General comments

The paper was accessible to the majority of candidates, who demonstrated good knowledge and understanding of those practical skills that were tested. The paper also discriminated well between weaker and more able candidates whilst at the same time allowing all candidates to demonstrate their ability in answering questions. It was pleasing to see that the trend in drawing less text book diagrams continued and most candidates made a genuine attempt to draw what they saw and interpreted well what they saw through the microscope. This is to be applauded. There was no evidence that candidates ran out of time and almost every candidate completed every question.

There was however an unfortunate increase in the number of Centres that may well have incorrectly prepared solutions. It was clear from the answers given by some candidates that in some Centres the glucose solutions had the wrong concentrations. However because the Centre appeared not to have pre-tested the solutions their error went undiscovered. Even though Examiners make every attempt to award credit whenever possible, it is inevitable that some candidates will suffer when this happens. Centres are strongly advised to pre-test all practical activities and reagents.

Comments on specific questions

Question 1

This question proved to be accessible to most candidates who performed well. Tests on the solutions and sample material produced accurate results for most candidates.

(a) (i) Most candidates scored at least one mark on this section. Credit was given for either boiling the solution or heating to above 80^{o}C, and adding at least equal, or excess of Benedict's solution. Candidates who simply stated that they added Benedict's solution and heated, failed to score.

(ii and iii) Candidates answered this section well giving good observations and showing clearly how the relative concentrations varied in their conclusion. The marks were awarded for correct comparisons about the relative concentrations.

(iv) Once again candidates scored well. Those candidates who either tested incorrectly prepared solutions, or who made an error in the testing were not penalised and error carried forward marks were awarded, based on their answer to part **(a)(ii) and (a)(iii)**.

(b) (i) Most candidates tested the potato and onion tissue correctly and gained full marks. Although the concentrations varied slightly from Centre to Centre, candidates were credited for showing glucose present in the potato and relatively, even more in the onion.

(ii) This part proved tricky for some candidates who either failed to realise that they had to compare the results of the sample tissue with the set solutions, or only compared one of the tissues. Some candidates wrote a sequence of concentrations and were credited. Any errors from part **(a)** were carried forward so that candidate's answers were marked according to their responses in part **(a)**.

(c) Good answers to this section tended to be Centre specific where candidates had been taught how to do controlled experiments. Credit was given for heating for the same time, at the same temperature, and using the same amount of material. Candidates who wrote "use about the same amount of onion tissue" were not credited. These are potentially easy marks provided candidates are taught how to answer the question.

Question 2

It was clear that some Centres spend more time teaching candidates the skills of how to make good biological drawings, than others. However, most candidates made an attempt to draw what they saw and there were relatively few 'textbook' diagrams.

(a) (i) Candidates were credited for the quality of their drawing, showing two distinct layers to the correct scale, and a crinkled inner lining. Credit was also given for providing at least one correct label. Weaker candidates failed to notice the crinkled lining and produced sketchy diagrams not to scale. Drawing appears to be a skill that many candidates have not mastered. The evidence suggests that many candidates need more practice and guidance as to what is an appropriate drawing.

(ii) Many candidates attempted to calculate the magnification of their drawing by calculating the magnifying power of their microscope. More able candidates realised that they needed to measure the actual width of their drawing and the specimen and divide the size of the drawing by the size of the specimen. Candidates were sometimes confused by using different units for each of the measurement which naturally produced inaccurate results. Centres would be well advised to train candidates in the skill of determining magnification and also in the skill of estimation so that candidates can alert themselves to simple errors of scale. Centres are asked to explain to their candidates that it is important to show exactly where they have measured their own drawing to enable their magnification calculation to be checked.

(b) Many candidates produced good answers to this question. However, all too often, candidates failed to read the question and wrote about theoretical differences rather than visible ones and thus failed to score. Good answers included the artery wall being thicker, t5he vein lumen larger, the artery having a more rounded shape, the artery having two layers and the artery having a crinkled lining. The observations and explanations were each awarded one mark. It was pleasing to see that there were very few cases of candidates confusing the artery with the vein.

BIOLOGY

Paper 9700/04

Reports

General comments

- The paper was of the normal standard producing a wide range of marks from below 10 to almost maximum marks.
- There was a larger number of candidates scoring high marks than in previous papers. However the success of candidates was very much Centre based.
- Candidates seemed to have enough time to complete the paper and there was no general evidence of questions being missed out.
- Candidates were able to demonstrate knowledge and understanding in this paper.
- Questions that proved to be particularly good discriminators were **2(a)(ii)** , **3(b)** and **3(d)**.
- **Question 4** was accessible to most candidates and was well answered.
- In **Section B**, **Question 6** was chosen by the majority of the candidates and scored highly.

Section A

Question 1

(a) Almost all of the candidates were able to correctly give 'cytoplasm', though several mentioned 'cytoplasm of the mitochondrion' or 'mitochondrion'.

(b) Most candidates were able to note that the hexose would have two phosphates added to it to become hexose bisphosphate. Common mistakes were 'fructose phosphate' and 'glycerate three phosphate'.

(c) It was pleasing to note that most candidates were able to score two marks here, many stating that the hexose needed to be phosphorylated in order for it to be activated.

(d) A number of candidates described lactate production in muscles despite 'yeast' being highlighted in the question. Others wasted time outlining what pyruvate did **not** do. Those candidates who were on the right track clearly outlined alcoholic fermentation. A common error was the misspelling of ethanal and ethanol.

Question 2

(a)(i) It was encouraging to note that many candidates were able to cite figures from the graph and use them effectively to describe the shape of the curve. Many scored full marks on this question. It was disappointing to note that some candidates still do not seem to be able to distinguish between 'describe' and 'explain' and consequently mixed up parts of **(i)** and **(ii)**.

(ii) This question proved to be quite discriminatory with only the more able candidates scoring four marks. Many were able to note the difference in carbon dioxide concentration between the two curves and then state that carbon dioxide was limiting as the curves levelled off.

(b) Most candidates were able to state two factors that could increase the yield and scored full marks.

Question 3

(a) Whilst many candidates were able to correctly identify structure A, they lost the mark by referring to it as the 'basal' instead of 'basement' membrane.

(b) Two marks were awarded for the drawing of one arrow and it was disappointing that many candidates, some of whom failed to draw an arrow at all, did not carry out this task correctly.

(c)(i)(ii) This question was very accessible with most candidates able to name 'glomerular filtrate' and then go on to state those large proteins and cells would be unable to enter the renal fluid.

(d) Many candidates discussed the need for a high blood pressure in the glomerulus or the need for the basement membrane to act as a partially permeable membrane. Only the better candidates were able to cover both and score full marks.

Question 4

This was a high scoring question.

(a) 'Acetylcholine' was given by the majority of the candidates though some just referred to 'neurotransmitter'.

(b) Many good descriptions were given here and consequently many candidates scored full marks. A common error was to state that calcium ions had entered the membrane rather than the neurone. Many candidates wasted time by continuing to describe the action of acetylcholine after the presynaptic membrane had secreted it.

(c) The most common error here was again the mention of vesicles in the membrane rather the presynaptic neurone.

Question 5

(a) Most candidates correctly stated the parental genotypes as AaBb and went on to correctly draw a punnet square. It is worth mentioning that a large proportion of candidates still fail to link offspring phenotypes with the genotypes they have calculated. This usually loses them a mark.

(b)(i)(ii) Whilst this was a quite accessible question many candidates managed to reverse the conditions and state that homozygous dominant people would die from sickle cell anaemia and the homozygous recessive people would catch malaria.

(c) Many answers discussed the effects of the homozygous condition on individuals, which were already answered in part **(b)**. Others described the effect of the malarial parasite on the red blood cells of a heterozygote but did not mention that they would be resistant to it. Only the better candidates scored all three marks.

Section B

The overwhelming number of candidates opted for question 6 and weaker candidates tended to choose **Question 7**

Question 6

(a) This section was generally done well. Good answers were characterised by a well-learned sequence of the events that occur when there is a rise in blood glucose concentration. Many candidates obtained full marks.

(b) This section scored slightly lower marks due the fact that Examiners were looking for more precision in the answers. Marks were lost if the candidate referred to ADH acting on the walls of the collecting duct rather than the cells or their membranes. Some still gave descriptions of the effects of the loop of Henle when it was clearly not relevant to the question.

Question 7

(a) It seems that this topic is not very well remembered and this was characterised by many answers being very vague and unscientific. Instead of giving a description of natural selection many candidates spent a lot of time describing the behaviour of brown and white rabbits or the peppered moth.

(b) Candidates displayed more knowledge in this section and many were able to give an example of gene mutation and the consequences of it. Only the better candidates were able to mention a chromosome mutation and go on to describe its effects.

BIOLOGY PRACTICAL A2

Paper 9700/05
Biology Practical

General comments

The paper proved to be accessible to the vast majority of candidates who demonstrated good understanding, knowledge and practical skills. The paper discriminated well between weaker and more able candidates and the overall quality of responses was very high. There was no evidence that candidates ran out of time and almost every candidate completed every question.

However, due to a printing problem, an error in ***Section (b)*** resulted in a loss of five marks with the paper being marked out of 25. This decision was taken to ensure that all candidates were treated fairly enabling them to perform as well as possible on the paper and not be penalised for an error that was not their fault.

Comments on specific questions

Question 1

This question proved to be quite challenging for the majority of candidates. Excellent high scoring answers were rare. Clearly this is one area of the syllabus, which requires more time spent when teaching in order to ensure good understanding by the candidates.

(a) This section was generally well done. Tables of results were clearly drawn and headed. Credit was given for candidates taking five sets of readings, using the correct headers of distance with units, showing the mean calculated within the table, and then calculating the mean correctly. Common errors included only taking four readings, not calculating the mean, or calculating the mean outside the table. Calculations were almost always performed correctly.

(b) This section was not marked due to a printing error in the question.

(c) It was clear that many candidates had not previously seen a respirometer with a compensation tube. Vague answers such as “it would make the readings more accurate” were not credited. Credit was given for a correct reference to controlling changes due to temperature or pressure.

(d) (i) Good answers to this section were very centre specific. Many candidates failed to realise that the sodium hydrogen carbonate was providing the carbon dioxide. Indeed several candidates thought that it acted like soda lime and absorbed the carbon dioxide. More able candidates realised that the question was about limiting factors, in particular carbon dioxide. Good answers included reference to the level of carbon dioxide increasing as the level of sodium hydrogen carbonate increased and at maximum concentration some other factor, such as light, became limiting.

(ii) This question was not well done by the vast majority of candidates. Very few realised that the carbon dioxide was in solution and the oxygen gas would bubble off into the atmosphere, thus affecting the level of fluid in the manometer. Only the most able candidates scored on this section.

Question 2

This question was generally well done by the majority of candidates, who drew what they saw through the microscope rather than textbook diagrams from their memory.

(a) Most candidates made a good attempt at this diagram. Eight marking points provided every opportunity for candidates to score the maximum of six marks. Credit was given for the quality of their diagram, showing two vascular bundles, having a D shaped section, drawn to the correct scale, showing stomata on the correct surface only and drawing the endodermis, resin canals and a clearly defined cuticle. Candidates should have found the eyepiece graticule helpful to enable them to draw the specimen to the correct proportion. Weaker candidates produced sketchy diagrams that were not to scale. Drawing to scale is a skill that many candidates have not mastered. The evidence suggests that many candidates need more practice and guidance as to what is an appropriate drawing.

(b) Many candidates attempted to calculate the magnification of their drawing by calculating the magnifying power of their microscope. More able candidates realised that they needed to measure the actual width of their drawing and the specimen and divide the size of the drawing by the size of the specimen. Candidates were sometimes confused by using different units for each of the measurements, which naturally produced inaccurate results. Centres would be well advised to train candidates in the skill of determining magnification and also in the skill of estimation so that candidates can alert themselves to simple errors of scale. Centres are asked to explain to their candidates that it is important to show exactly where they have measured their own drawing to enable their magnification calculation to be checked.

(c) This proved to be a much harder diagram for many candidates to draw and they often reverted to standard textbook diagrams of stomata. Many did not use the high power of their microscope and thus failed to show detail. Credit was given for the quality of the drawing, for showing the stomata sunken, the sub-stomatal air chamber and the over-arching cuticle. Credit was also given for a correct annotation, but many candidates thought that this simply meant a label and failed to score. Good annotation referred to water vapour building up in the sunken stomata producing a diffusion gradient and reduced water vapour concentration differences that reduced transpiration

(d) Most candidates scored one mark on this section for describing and explaining how a thick cuticle reduced evaporation from the leaf. However, some candidates had not read the question carefully enough and failed to realise that they should be writing about features not visible in their diagram. These candidates lost the second mark as they simply described what they had drawn, without going on to the explanation. Other acceptable answers included a small surface area to volume ratio (compared to thin, flat leaves), the thick walled epidermal cells, the relatively few air spaces within the leaf, the small number of stomata and, acceptable but beyond what is required by the syllabus, the presence of a hypodermis (the layer of cells immediately below the epidermis, correctly commented on by a very few candidates).

BIOLOGY

Paper 9700/06
Options

General comments

Option 3, Growth, Development and Reproduction once again proved to be the most popular choice with candidates. Option1 Mammalian Physiology was also frequently chosen, while Examiners marked fewer of the Genetics option. The least attempted was Option 2, Microbiology and Biotechnology.

The standard was similar to that of recent years. The questions throughout the paper varied in difficulty so that each option offered a wide range of both straightforward and more challenging questions. It was evident that the majority of the candidates had been very well prepared for the examination, demonstrating sound factual knowledge which they were able to use in both familiar and new situations. Many excellent answers were given in response to all questions, with able candidates achieving maximum marks in many sections of the paper. Only the weakest candidates failed to attempt every section or appeared to be answering an option for which they had not been prepared.

The candidates were for the most part competent in handling data, such as the calculation of percentage difference. Examiners were also pleased to see candidates quoting figures from data to illustrate their answers.

Comments on specific questions

OPTION 1 MAMMALIAN PHYSIOLOGY

Question 1

(a) Despite the question stem clearly stating that this was a reflex arc, many candidates failed to give details of the nerve pathway involved. Overall some very good answers were seen linking the receptors in the retina with the brain via the optic nerve, together with the effect on the circular muscles of the iris.

(b) (i) The correct relationship was readily recognised although it was rarely appreciated that this was a non-linear relationship. When figures were quoted it was easy for maximum marks to be achieved.

(ii) Most realised that the liver would be breaking down the alcohol but few emphasised that this would reduce the *blood* alcohol concentration. Candidates did not link this to the number of people 'over the limit'.

(iii) Answers for this part were poorly expressed. Some responses did note that there were many false negatives even at the start or that there were some false positives at all times. Many realised that people would be wrongly accused of being over the limit or that many people over the limit would not be identified.

(c) (i) Well answered by many candidates, frequently scoring full marks.

(ii) This was well known.

Question 2

(a) Most candidates could label the muscles correctly but a significant number failed to identify the submucosa.

(b) Good responses relating to ion and water absorption were provided.

(c) (i) Many good answers were seen. However, some candidates showed confusion when describing solute potential, not appreciating that an increase in solute concentration causes a more negative or decreased solute potential. Water potential gradients should be referred to rather than concentrations. It was rarely stated that the water potential in the lumen would be lower than that of the cells.

(ii) Competently calculated by most candidates.

(iii) A few correct answers noted that plasma proteins were unable to leave the blood. Most concentrated on the movement of water but did not always explain that the water had moved from the blood. The idea of increased antibody production as a response to cholera infection was rarely seen.

Question 3

(a) (i) Good responses described the difficulty in accommodation linked to the inability of the lens to change shape easily. Some were able to elaborate on the poor near focussing, but many inaccuracies were seen, such as references to the lens not 'contracting'.

(ii) Most could explain the effect on vision.

(b) This presented no problems for candidates.

Question 4

(a) (i) The centrum was usually identified correctly but the neural spines were often confused with transverse processes.

(ii) Many did not recognise the dorsal side. When correctly identified, most gave an adequate reason.

(b) The majority of responses correctly compared the size of centrum or transverse processes. Some inaccuracies were seen in the comparison of the neural spines, often stated as 'larger' rather than 'longer' in thoracic. Few candidates clearly stated that the thoracic have extra articulating surfaces for the ribs.

(c) Candidates appreciated the loss of bone mass leading to reduced strength and size. A small number of responses went on to link this to loss of calcium. Some general accounts were seen giving detail of osteoblast and osteoclast activity, unnecessary in this question. The reduced bone strength leading to an inability to withstand compression and therefore retain height was rarely seen.

OPTION 2 MICROBIOLOGY AND BIOTECHNOLOGY

Question 1

(a) (i) Many responses clearly described this process.

(ii) When candidates chose the correct dilution of 10^{-4}, they could usually give valid reasons for their choice. Only a few chose incorrectly but of these some still gained credit when discussing the other dilutions.

(iii) When candidates had a sound understanding of the process this was not difficult to calculate correctly. Unfortunately there was frequent confusion shown in the handling of the factors of ten involved.

(b) This was not well done. There was little indication of depth of factual knowledge with few references made to organisms, such as appropriate bacteria or protoctista. The mark most commonly gained was for a description of the activated sludge or trickling filter system.

(c) Few good descriptions were seen. Knowledge was expected of the role of saprophytic bacteria digesting protein to amino acids followed by deamination, or the release of ammonia from urea. Some candidates did appreciate that nitrifying bacteria were then required to convert ammonium to nitrite and then to nitrate.

Question 2

(a) (i) The use of restriction enzymes were well known but the subsequent separation of the DNA fragments was rarely mentioned.

(ii) Overall poor responses were seen, with even 'transgenic' not eliciting a clear idea of cells containing DNA from two different sources.

(iii) Some candidates appreciated the idea that this enabled the selection of the transgenic cells or that only the cells with new DNA can grow when antibiotic is present. Rarely were both of these ideas given. Several responses incorrectly thought the gene was to protect the tissue from bacterial infection.

(b) (i) The majority of correct responses concentrated on the prevention of night blindness. Neither the production of cash crops nor the possibility of breeding to improve local crops was recognised.

(ii) Most gave a reduction in the risk of a relevant disease correctly here.

Question 3

(a) (i) The facts were usually well known, although some confusion was seen in the role of centrifugation.

(ii) The changed rate of cell division was understood although just being 'uncontrolled' was not sufficient on its own. Very few candidates made any reference to the 'immortality' of these cells.

(b) (i) There was very little understanding that cancer cells have different antigens from normal cells, although the specificity of the antibodies in targeting only the cancer cells was generally well known.

(ii) Very few candidates explained that the antibiotics would be delivered directly to the infected cells.

(c) The majority of candidates showed little understanding of the process, confusing HIV antibodies with anti-HIV antibodies. When the candidate clearly understood the role of antigens and antibodies, maximum marks were easily gained.

Question 4

(a) This usually scored well. A minority of candidates thought there was a capsule present so did not realise that A and B were simply the cell wall and membrane.

(b) If candidates were familiar with these differences they were clearly described but some confused answers were seen in less well prepared candidates.

(c) Most responses successfully commented on the change in population size at 220 minutes.

(d) (i) Well answered.

(ii) Most commented on the presence of bubbles but did not always clearly explain how the rising bubbles would circulate materials.

OPTION 3 GROWTH, DEVELOPMENT AND REPRODUCTION

Question 1

(a) (i) Most candidates correctly noted trends in the data and quoted correct supporting figures. Unfortunately some thought that the figures showed a decrease up to day 8 instead of 4 or a decrease from day 40 instead of 35 but generally marks were easily accessible here.

(ii) Use of store food was most commonly given as a reason. A few candidates mentioned respiration but did not amplify this with detail e.g. loss of CO_2 or that respiration would be more than photosynthesis. The majority of candidates showed no awareness that the loss of seeds, fruits or leaves would cause the change after 35 days, in many instances referring to events during early growth. Reference to dehydration of seeds or leaves prior to abscission was also credit worthy here.

(iii) Many candidates did not appreciate the difference between reliability and accuracy, the latter being an insufficient reason. Few explained that the seedlings may die or vary in their growth.

(b) (i) The variation in water content was generally well known.

(ii) Most realised that the seedlings were killed in the process. Few appreciated that the relative shortage of specimens was important here. The idea that large numbers are needed for each sample to provide a valid comparison could also have gained credit.

(c) Well prepared candidates clearly described the control of flowering in this short day plant. A few stated that increasing the hours of darkness increased the amount of flowering without any apparent idea that there was a critical length to initiate the process. Most correctly described the role of phytochrome although there was some confusion over the active form where candidates incorrectly thought that the active form was always P_R .

Question 2

(a) A lack of detailed knowledge was often apparent here with descriptions of all the hormones produced. Many mentioned the control of thyroxine or the development of secondary sexual characteristics. Only the best candidates gave good descriptions of the role of the hypothalamus and pituitary gland in the production of growth hormone, with few references to the involvement of the *anterior* part of the pituitary.

(b) (i) Surprisingly few candidates scored full marks here despite the relatively easy data. Most gained a mark for correctly quoting figures but not many noted the most important differences in growth patterns, such as the timing of the growth spurts. More precision was needed in following the differences in trends from year 0 to 18.

(ii) This proved a good discriminator. Many answers suggested dietary differences or genetic factors. Less common were ideas about hormonal factors or breast milk deficiencies.

Question 3

(a) Most candidates scored full marks here. A few candidates surprisingly referred to muscle tissue in relation to Q.

(b) (i) This was well done by most. Even otherwise weak candidates mostly calculated this correctly as 43.48 %.

(ii) Not many answers made it clear that the reduction in sperm production was linked with an <u>increase</u> in oestrogen concentration.

(c) A few good answers were seen but not many scored full marks. Some candidates clearly knew something about both processes but failed to compare them successfully.

Question 4

(a) (i) This was usually named correctly as asexual. A few referred to either 'budding' or 'vegetative propagation', inadequate in this context.

(ii) Many noted the large numbers of offspring produced which were genetically identical. A third mark could have been gained with more detail of cost implications or the idea of the same parent plant being used again and again.

(b) (i) A degree of confusion was often apparent here between genes, base sequences and amino acid sequences. Some candidates could describe the resulting changed base sequence which would code for a different amino acid. Few references were made to change of tertiary or active site structure. Confusion over the changes to codons/anticodons was apparent with many incorrect references to changed base triplets coding for a different amino acid to be made rather than to be used in constructing the protein.

(ii) Surprisingly few candidates scored here. Those that realised that less chlorophyll/photosynthesis would result often failed to link this with growth. The majority failed to appreciate the role of this particular enzyme and gave answers relating to enzymes in general.

OPTION 4 APPLICATIONS OF GENETICS

Question 1

(a) Most candidates knew this was an autosomal recessive disease and gave details of how it was passed from one generation to another.

(b) (i) Some answers included detail of how the DNA would be obtained (in this case not required) but most gave sufficient detail of the electrophoresis process.

(ii) This was well done.

(iii) Most realised that C would be heterozygous but did not always relate the information given about fragments to the different types of allele present.

(c) (i) Interpretation of this data proved difficult. Some failed to make the link between the changed proteins and their role in ion transport, with most simply *describing* rather than *explaining* the data. A few were able to state that CFTR with F508 was not inserted in the membrane, resulting in very low conductance. With R117H the poor conductance compared to normal was noted but not explained in terms of the mutated shape of the CFTR protein leading to a poor fit for ions or difficulty of ATP binding.

(ii) The calculation was, in general, accurately carried out.

Question 2

(a) (i) A correct straight line showing unchanged activity was usually given.

(ii) The link with vitamin K production was recognised although many incorrectly stated that none would be produced despite the evidence in Fig. 2.1. Marks were most frequently gained by noting the inhibition of VKOR, the small amount of vitamin production and the link between the vitamin and clotting. Warfarin's role as a non competitive inhibitor was not appreciated.

(b) (i) Those who concentrated on a change in DNA structure usually scored well. Most recognised that this would involve a mutation of a substituted base pair in the DNA. As a result it was understood that the changed code would result in a different amino acid in the protein forming the enzyme. An occasional mark was awarded for the change to the triplet code.

(ii) Weaker candidates failed to distinguish between parts **(i)** and **(ii)**, incorrectly describing changes to enzyme structure in (i) then failing to give the details of these changes in (ii) where it was relevant. Where candidates understood the difference in the question, marks were easily gained by changes to 1° and 3° structure or active sites no longer able to bind warfarin resulting in no inhibition or problems with vitamin K production.

Question 3

(a) (i) Better candidates appreciated the effect on chlorophyll production and hence photosynthesis. Many weaker responses simply restated that this would be lethal.

(ii) On the whole candidates correctly selected the correct genotypes and phenotypes. Common errors were the inclusion of all offspring or giving the incorrect colour of viable genotypes.

(b) (i) Many candidates only drew a diagram showing the chiasma without indicating what the effect of this would be. They could score one mark for the outer pair of alleles remaining the same but needed to show the result of the crossing over between the inner chromatids more clearly.

(ii) The decreased number of genotypes with linkage and their increase with crossing over was generally well known. It was rare for a candidate to clearly state that there would be a large number of parental types where genes were linked and a small number of recombinants as a result of crossing over. The relationship between the number of recombinants and the distance between loci appeared unknown to candidates.

Question 4

(a) Many responses included the essential processes of isolating parents, emasculating the female, bagging (preferably both before and after pollination) and hand pollination.

(b) The idea that five years was needed due to the length of life cycles was not recognised, although many responses indicated that several generations of crosses were needed. Further detail was usually absent, such as backcrossing to the commercial variety. Candidates were aware of the need for repeated selection but should always state which features are being selected each time, in this case large, sweet and black. The importance of background genes was often mentioned although this was not always well explained.