BIOLOGY

Paper 9700/01
Multiple Choice

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

General comments

The mean score was 24.9 (62.25%) and there was a very good spread of scores, the standard deviation being 6.25. Nine questions were answered correctly by 75% or more of candidates – **Questions 14, 15, 16, 17, 19, 27, 29, 35** and **37**. Five questions were difficult; 40% or fewer candidates answered **Questions 3, 26**, and **36** correctly.

Comments on specific questions

Question 1

The relative difficulty of this item was due to many candidates failing to appreciate that you would need to use the lowest magnification in order to see the most cells. A surprising number of candidates chose the combination that gave the highest magnification.

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Question 2

Many of the less able candidates did not know that chloroplasts contain DNA.

Question 3

Many candidates did not realise that prokaryotes would have lost the cell wall. Both mitochondria and prokaryotes have a circular chromosome. Mitochondria and prokaryotes do not possess endoplasmic reticulum, but both possess ribosomes.

Question 4

From the diagram, candidates should have measured the shortest distance from the alveolar air space to inside a red blood cell. This should be 7.5 mm, convert this to micrometres and divide by 2500.

Question 6

Weaker candidates were unable to identify that **B** represents cellulose, which is a structural polysaccharide.

Question 7

Fewer than half the less able candidates knew that only collagen and deoxyribonucleic acid contain carbon, hydrogen, oxygen and nitrogen.

Question 8

Candidates found this challenging. Although the structure of fructose is not specified in the syllabus, the structure of α-glucose and β-glucose is specified. Therefore, the correct answer of **C** could be easily worked out.

Question 10

A change in the sequence of amino acids would cause a change in the primary structure of a protein. The overall sickle cell shape of red blood cells is a consequence of the haemoglobin molecules becoming insoluble in water and forming fibres in low oxygen conditions. This change is reversible and so the secondary, tertiary and quaternary structure of the molecule is unchanged.

Question 13

Only the more able candidates understand that the movement of water will be from the least negative Ψ to any more negative Ψ.

Question 18

Many candidates found this difficult. From the information provided, it can be deduced that chromosomes have telomeres and these promote DNA replication. However, each time a chromosome is replicated the telomere is not completely replicated. Therefore, the telomeres will get shorter each time a cell divides until they run out, thereby stopping division. Therefore, **A** is the only possible answer.

Question 20

The individual units of a nucleic acid are nucleotides, which are joined by the sugar phosphate backbone. Many less able candidates thought that the peptide bond was correct.

Question 22

The more able candidates were able to convert the tRNA code to the mRNA code and then express this as the DNA code.

Question 25

Less able candidates were unable to differentiate between the functions of xylem (to carry water) and phloem (to carry sucrose).

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Question 26

Most candidates found this question difficult, with an almost even split between each possible answer. If the muscle is resting, there will not be a Bohr shift to the right so **B** and **C** are not possible. As blood leaves the muscles, the partial pressure will be low and the % saturation will also be low. Therefore, **D** is correct.

Question 28

Many of the less able candidates were unable to identify **C** as the correct answer.

Question 29

This was answered correctly by virtually all candidates.

Question 30

A significant number of candidates did not appreciate that mucus glands in the trachea would become enlarged due to the effects of tar.

Question 36

Many candidates found this difficult; the most popular answer given was **B**. However, all three factors are increasing the spread of malaria. Global warming is increasing the areas where *Anopheles* mosquitoes may live and breed.

Question 38

Less able candidates continue to find the nitrogen cycle difficult to understand.

Question 39

Many candidates of all abilities were unable to distinguish the meanings of the terms habitat, niche and trophic level. The description given only allows a definition of the trophic level.

Question 40

A significant number of less able candidates incorrectly thought that the largest amount of energy was either used in growth, repair and reproduction, or lost in faeces. Most energy is lost as heat from respiration.

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Location Entry Codes

UNIVERSITY of CAMBRIDGE
International Examinations

As part of CIE's continual commitment to maintaining best practice in assessment, CIE has begun to use different variants of some question papers for our most popular assessments with extremely large and widespread candidature, The question papers are closely related and the relationships between them have been thoroughly established using our assessment expertise. All versions of the paper give assessment of equal standard.

The content assessed by the examination papers and the type of questions are unchanged.

This change means that for this component there are now two variant Question Papers, Mark Schemes and Principal Examiner's Reports where previously there was only one. For any individual country, it is intended that only one variant is used. This document contains both variants which will give all Centres access to even more past examination material than is usually the case.

The diagram shows the relationship between the Question Papers, Mark Schemes and Principal Examiner's Reports.

Question Paper	**Mark Scheme**	**Principal Examiner's Report**
Introduction	Introduction	Introduction
First variant Question Paper	First variant Mark Scheme	First variant Principal Examiner's Report
Second variant Question Paper	Second variant Mark Scheme	Second variant Principal Examiner's Report

Who can I contact for further information on these changes?
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BIOLOGY

Paper 9700/02

AS Structured Questions

General Comments

There were, as in previous sessions, many encouraging responses from well prepared candidates. Several candidates and occasionally whole Centres did however produce disappointingly low scores. **Questions 2(b)(i), 3(c)(ii), (d)(ii), 5(b)** and in particular **4(b), (c), (d), (e)(i)(ii)** did cause difficulty, even sometimes for the more able candidates. Some part questions required extended prose in response.

Several candidates continue to lose marks by not using their knowledge and understanding to answer the specific question set. For example, in **Question 2(a)**, where several candidates described the mechanisms of water transport rather than the "pathways taken by water".

Again, in **Question 5(b)**, candidates often gave a description of the importance of water to organisms rather than explaining how hydrogen bonds between water molecules gave water properties that make it an ideal environment for many organisms.

Impreciseness in responses was demonstrated by several candidates. For example, **Question 1(a)(i)**, describing the nucleus in **fig. 1.1** as being large (rather than lobed) in cell **A** compared with small (rather than not lobed / round / spherical) in cell **B**.

Several candidates continue to ignore the use of bold type face. For example, in **Question 1(a)(i)**, "**visible structural** differences" and in **Question 5(a)**, "with a tick (✓) or a cross (✗).

Candidates should be encouraged to take note of the mark allocations given in brackets in composing their answers and to write within the lines provided.

Differentiation between candidates was evident. No candidates appeared to be handicapped by lack of time. There were very few sections left unanswered by the majority of candidates. There were more than sufficient marking points available for candidates to demonstrate their knowledge and understanding.

The use of previous papers and mark schemes, alongside in depth revision, would obviously improve the scores of many candidates.

Some areas of the specification were tested in a different way with a few questions requiring candidates to draw from different strands of the specification, for example, **Questions 1(a)** and **(c)**. Candidates need to read questions carefully and think about which learning outcome is being tested. In addition, candidates need to be able to identify those questions that require an application of knowledge and link them to a particular learning outcome.

Comments on Individual Questions

Question 1

Some candidates gained only a few marks but many others produced high scoring responses with full and accurate answers. Several found **(d)** difficult.

(a) The vast majority of candidates were able to complete the table to show three **visible** structural differences between cell **A** (phagocyte) and cell **B** (plasma cell) in **fig. 1.1**. The commonest responses compared the shape of the nucleus, the quantity of the rough endoplasmic reticulum and the number of mitochondria. As mentioned under 'General Comments', some candidates referred to **structural** differences not shown in **fig. 1.1**, for example, several candidates referred to the smooth endoplasmic reticulum or gave endoplasmic reticulum / granular cytoplasm rather than

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rough endoplasmic reticulum, or were as indicated, imprecise in their comparisons. The nucleus in **A** was often described as distorted, curved, misshapen or squashed rather than lobed.

(b) A pleasing number of candidates were able to calculate the magnification of the cells in **fig. 1.1** as x5900-6100, appreciating that magnification = size of image / actual size. Several candidates did not show any working or did not give an answer to the nearest whole number. A number of candidates inappropriately measured the drawings for both the cells shown and produced a magnification for each. Candidates should appreciate that where a scale bar is given measuring the image is not required, only the scale bar needs to be measured in this case 60 mm (i.e. 60,000 μm) so 60,000/10 = x6000. There were numerous problems with unit conversions. A surprising number of candidates could not convert 6 cm to 60,000 μm. However, the proportion of candidates who got this calculation correct appears to have improved on previous years.

(c) In describing the modes of action of both cells in defence against infectious diseases, able candidates made appropriate reference to, for example, the engulfing of bacteria, the formation of phagocytic vacuoles and the use of enzymes provided by lysosomes to digest the pathogen, though many were not clear about the fusion of the lysosome and the phagocytic vacuole. It was pleasing to see several candidates referring to **fig. 1.1** and the presence of the RER and Golgi apparatus in producing proteins and packaging antibodies respectively, when explaining the role of plasma cells in the defence against infectious diseases. Only a handful of candidates indicated that antibodies are released into the plasma. Weaker responses made reference to the engulfing of antigens (antigens stimulate endocytosis) / infectious diseases / infected cells by phagocytes and gave no indication when describing the role of plasma cells of specificity between antibodies and antigens. Some answers to the mode of action of the plasma cell began with long and detailed accounts of antigen presentation, T-cell activation and cloning to eventually arrive at the humoral response. Many described the various actions of the different types of antibody produced.

(d) In explaining why the antibiotics used to treat TB are taken in combination over a long period of time, many but not all able candidates clearly understood that there was less chance of resistance by bacteria to several antibiotics and that there was a need for long term use to ensure that all the bacteria were killed. Only the most able candidates understood that this was difficult because the bacteria are slow growing and often hidden inside cells protected from antibiotics. There was the usual confusion by weaker candidates regarding antibiotics and antibodies, resistance and immunity and inappropriate reference to the disease tuberculosis (rather than bacteria) developing resistance and even to vaccines. Others wrote about the logistics of treatment rather than the biology of what was occurring.

Question 2

There were good responses to this question, though **2(a)** and **2(b)(i)** caused difficulty for some candidates as mentioned under 'General Comments'.

(a) In describing the pathways taken by water as it moves from the soil into the xylem of the root, the best candidates referred to water moving into the root hair, along the walls of cortical cells / apoplast or via the cytoplasm / symplast pathways to the endodermis where the Casparian strip ensures symplastic movement on the way to the xylem. Few mentioned passage cells or described the actual pathway into the xylem. Weaker responses confused apoplastic with symplastic or solely referred to the vacuolar pathway which is probably negligible, with descriptions of mechanisms, involving osmosis and water potential, rather than pathways. Many referred to roots rather than root hair cells and gave accounts of the movement of water up the xylem with details of the cohesion-tension theory. A surprising number of candidates referred to the active uptake of water by root hairs.

(b) (i) In explaining why transpiration is considered to be an 'inevitable consequence of gas exchange', excellent responses made reference to the fact that when stomata are open for entry of CO_2 / release of O_2, that water vapour will at the same time diffuse out. Weaker candidates' responses did not address the question, merely explaining how water, rather than water vapour was lost in transpiration, whilst many inappropriately mentioned the dry environment and the need to keep cool with open stomata, in attempting a response. Not all candidates appreciate that evaporation involves loss of water vapour from the damp cell walls of the spongy mesophyll into the air spaces and not the movement of water vapour out through the stomata.

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(ii) Again, in explaining how the leaves of *Nerium oleander* are adapted to reduce water loss, many candidates appropriately referred to epidermal hairs (not spines) or stomatal chambers (not sunken stomata), reducing air movements and retaining water vapour, so reducing diffusion gradients, though not all appreciated that this was between the intercellular air spaces and the air in the cavities. Several candidates referred imprecisely to the stomata themselves having hair-like projections. Weaker candidates did mention the thick cuticle and the presence of stomata only on the lower surface but with little explanation of how these adaptations reduced water loss. **Fig. 2.2** was often misinterpreted as a whole leaf section with candidates referring to a rolled leaf as an adaptation in *N. oleander* to reduce water loss. Several candidates listed all the features of xerophytic leaves including needle shaped leaves and ignored the references to *N. oleander* in **fig. 2.1** and **fig. 2.2**. Some candidates thought the position of the veins was of significance.

Question 3

There were many encouraging answers to this question, though responses to **(d)(ii)** were disappointing.

(a) (i)(ii) Many candidates were able to clearly state the names given to the levels of organisation shown by the whole polypeptide and region **X** as tertiary and secondary / α helix respectively. Occasionally quaternary or globular was given for **(a)(i)** and helix for **(a)(ii)**. Organ and tissue were occasionally given by candidates who misunderstood the phrase ‘level of organisation’.

(b) No significant difficulty here with many candidates naming the part of the enzyme where the reaction occurs as the active site. Weaker responses included reference to binding / variable site.

(c) (i) Many candidates were able to state precisely the nucleotide sequences for the mRNA and the DNA in completing **fig. 3.2**, demonstrating their understanding of the principle of corresponding / complementary nucleotide bases. However, several candidates gave CUU (rather than CTT) for the corresponding nucleotide bases in DNA complementing GAA in mRNA.

(ii) Only the most knowledgeable candidates could explain why the human gene for lysozyme may have a different nucleotide sequence from the answer given by the candidate in **(c)(ii)**. Few made reference to a degenerate code in which there can be more than one triplet for each amino acid. Most confined their answer to stating that there were several mRNA codons for the same amino acid and did not use their understanding of the relationships between the triplets in the DNA sequence (gene) and the complementary mRNA codons, the result of the transcription of DNA, in fashioning a response. Several candidates made reference to mutations in the human gene or simply wrote about the different bases (A, T, C, G and U). Weaker responses often made no reference to ‘triplets’ or ‘codons’, referring instead to ‘the nucleotide sequence’.

(d) (i) Candidates were asked to use the information in **fig. 3.3** to describe the effects of different concentrations of lysozyme on *Escherichia coli* and *Staphylococcus aureus*. The best answers described in words or with suitable data the differences in changes in percentage of bacteria still alive as the concentration of lysozyme increases – often using comparative figures with data from both axes, though not all candidates could correctly read the values from the graph and often failed to quote units. Many answers included too much data with no real evidence of understanding. Weaker candidates still incorrectly invoke the concept of a time element, using phrases such as rapid decrease and slow decline in their descriptions when referring to the curves rather than a steeper decrease and shallower decline. ‘Rate’ was commonly mentioned. Weaker responses often included some explanation of the different effects shown in **fig. 3.3** when this was required in **(d)(ii)**. Nevertheless many candidates now know how to answer such a question and there were many good answers.

(ii) In suggesting a possible explanation for the different effects of lysozyme on *E. coli* and *S. aureus*, few candidates disappointingly did not refer to different polysaccharides / peptidoglycans in the cell walls with different shaped molecules requiring complementary shaped active sites for the enzyme to effectively hydrolyse the glycosidic bonds, when attempting to explain the different effects. There were many references to resistance to lysozyme, to different glycosidic bonds and inappropriate reference to *E. coli* and *S. aureus* as substrates. Occasionally, however, able candidates suggested that *S. aureus* had a protective capsule or produced a competitive enzyme inhibitor. Some candidates thought that the explanation was related to the bacteria having different temperature optimums. There were also accounts that simply included some of the descriptive mark points credited in **(i)** above.

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Question 4

There were very few encouraging answers to this question, with most parts causing many candidates difficulty, even though it largely directly tested learning outcomes on ***section G*** of the specification, similar questions on some of these areas not having been examined before.

(a) In stating what is meant by *double circulation*, the most able candidates referred to blood passing through the heart twice during one circuit of the body. Some candidates did mention pulmonary and systemic circulations but not always with reference to the heart. There was confusion amongst many candidates with regard to one "circulation", one "cycle", one "cardiac cycle". Weaker responses included reference to deoxygenated and oxygenated blood, to two sides of the heart and to blood circulating around the body twice.

(b) Many candidates did not clearly explain why the wall of the artery is thicker than the wall of the vein, with no appropriate references to withstanding high(er) blood pressure or maintaining blood pressure. Many simply stated that blood in an artery had a high pressure. Infrequent reference was made to there being more elastin / collagen / smooth muscle present to explain why the wall of the artery was thicker.

(c) In <u>suggesting</u> one role for the pre-capillary sphincter muscle shown in **fig. 4.1**, only the most knowledgeable candidates answered in terms of constriction / dilation to, stop / reduce or allow / increase the flow of blood to the capillaries. Most candidates simply referred to controlling blood flow to the capillaries. Few made reference to the shunting of blood to meet the body's needs, for example, the diversion of blood from the skin when cold. Many wrote about the sphincter reducing blood pressure.

(d) Few candidates could accurately describe with reference to **fig. 4.1** the role of capillaries in forming tissue fluid. The majority of weaker responses made no mention of pores / gaps (rather than holes) and those candidates that did often referred to pores in the capillaries rather than pores in the capillary wall and even fewer referred to pores between the endothelial cells. Few indicated that components of plasma such as water / ions / glucose move out, with a description of pressure filtration due to differences in hydrostatic pressure between blood and tissue fluid. Most answers referred to a thin capillary wall which plasma itself diffused across due to high blood pressure and became tissue fluid. 'Leaking' and 'seeping' were commonly seen. Many understood that red blood cells and large plasma proteins could not leave the capillary but did not state what components of the plasma were actually filtered out. No candidates wrote about pinocytosis. Several candidates gave additional information regarding the return of tissue fluid to the blood system when the question asked about the formation of tissue fluid.

(e) (i) Few candidates clearly understood the relationship between plasma and tissue fluid and the differences between them. Candidates often failed to notice that the question was asking about plasma and described ways in which blood (not plasma) differed from tissue fluid, with inappropriate reference to presence / absence of red blood cells / white blood cells / platelets. What was required was an understanding of the differences in terms of, for example, protein / plasma proteins, glucose and fat <u>levels</u>, or suitable reference to carbon dioxide and oxygen <u>concentrations</u> or the relative water / solute <u>potentials</u>. Many candidates who correctly listed substances in the plasma / tissue fluid such as glucose and proteins failed to state that there was more / less of these substances in the plasma / tissue fluid respectively. Many candidates gave differences such as 'blood enclosed in vessels' or 'tissue fluid bathes cells'.

(ii) A significant number of candidates could not name the fluid in vessel **Z** as lymph. Several named the actual vessel as a lymph vessel or duct, even lymph node, and there were many references to plasma, blood and tissue fluid.

Question 5

A sound overall response, though a number of candidates produced disappointing answers in **(b)**.

(a) Many candidates were able to correctly and almost fully indicate in **Table 5.1** which of the statements given applied to the four named molecules – haemoglobin, DNA, phospholipids and antibodies. The majority of candidates correctly placed a tick or a cross in the table for molecules that contained iron or phosphate. Fewer knew that only DNA replicates. Fewer still knew whether or not the molecules above were stabilised by hydrogen bonds. Many did not appreciate that

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antibodies do have hydrogen bonds. The commonest mistake was in not knowing that phospholipids do contain nitrogen, for example, phosphatidylcholine, where the nitrogen is in the choline portion of the phospholipid, as indicated in a recent past paper where the structure of the above phospholipid was drawn out.

(b) As mentioned under General Comments, a significant number of candidates generally described the importance of water in / to organisms with inappropriate references to transpiration, cooling and blood as a liquid, rather than how the presence of hydrogen bonds between water molecules gives water properties which make it an ideal environment for organisms to live in. Only the most able of candidates clearly linked the presence of hydrogen bonds and the properties of high boiling point and high specific heat capacity, or the idea of a liquid which is present over a wide range of temperatures to provide buoyancy and an environment with a stable temperature. Occasionally correct reference was made to surface tension and surface dwellers, ice and insulation and upwelling currents. Many candidates incorrectly referred to strong hydrogen bonds rather than hydrogen bonds providing a strong attraction / cohesion between molecules. Others were imprecise stating “water is cohesive” rather than referring to “cohesion between water molecules”. A few candidates gave accurate details of the hydrogen bonding – slight –ve / +ve charges on the O and H respectively, allowing water molecules to be polar with appropriate reference to water as a good solvent.

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Paper 9700/02

AS Structured Questions

General comments

Questions 2(b), 3(d), 4(a) and **5(c)** had several marks attached to each of them and most candidates were not able to gain many marks from these, hence the low scores, despite making a reasonable attempt elsewhere. Generally all questions were attempted. There was no evidence that candidates ran out of time to complete the paper.

Comments on individual questions

Question 1

(a) (i) Mostly correct although the mark was not always awarded when the bracket extended out considerably further than the phosphate heads into the receptor protein.

(ii) Most answers were too vague: 'membrane moves', 'membrane is fluid' and 'looks like a mosaic pattern'. There were few candidates that wrote specifically about the phospholipid or protein components.

(iii) Generally 0 or two marks awarded. Those who scored well had a good knowledge of antibody structure, with the most common points being the disulphide bond, the variable region and the antigen binding site. Weaker candidates often referred to 'active sites' and 'lock and key'. Some wrote about antibody action and ignored the receptor molecule.

(b) Many candidates showed a good understanding of topic but lost marks through a lack of detail, for example, 'T killer cells killed pathogens', 'T helper cells release a chemical which stimulates macrophages', 'B lymphocytes stimulated'. A number of candidates knew that T helper cells release cytokines but quite a few thought that T helper cells produced antibodies. A few wrote that T-cells were phagocytes.

(c) Most candidates were able to gain at least one mark with a reasonable description of 'retaining cell contents'. There were many that wrote about transport but few that elaborated with information about the proteins or mechanisms involved so they were unable to score.

Question 2

(a) (i) Usually well answered and generally showing a good knowledge of the two molecules – glycogen and amylose. Weaker responses often referred to beta 1.6 links in glycogen.

(ii) Surprisingly few noted the compact nature of glycogen. Although many knew that glycogen was insoluble, they did not link this to 'no osmotic effect', preferring instead to state that it would not leave the cell (ora 'glucose soluble so will diffuse out and will be lost'). The reactive nature of glucose was stated by a few. A common answer was to simply state that as glycogen was a large molecule composed of glucoses then it would provide more energy.

(b) Most candidates struggled with this one. The improvement noted in biochemical knowledge in **(a)(i)** was evident in a number of scripts, where candidates had neatly (and correctly) written out the condensation reaction to form glycosidic bonds, but sadly this did not score as the question required a hydrolysis reaction. Others just drew out the structure of alpha glucose. Where candidates had attempted to answer the question, about half had removed glucose from the right

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hand end: generally they did manage to score, for example, for breaking the bond and using water. Only a few managed to gain 3 marks.

Question 3

(a) The majority of answers gave descriptions with no explanations. An understanding of limiting factors was not evident but there were a number of candidates who had a good understanding of active sites not being filled at lower substrate concentrations and saturated at higher. Most of these however did not use the data provided.

(b) Most candidates were able to gain at least one of the two marks, having generally lost a mark with a plateau that was too high. About 25-30% gained both marks. Several candidates produced curves to the left and above the given curve in **fig. 3.1**.

(c) This was well answered by many and appears to be a topic that has been well learnt. 'Structure' is still being used instead of 'shape' when referring to the inhibitor and active site in describing competitive inhibition.

(d) This question caused considerable confusion. When candidates come across a question that incorporates practical elements, many do not seem to be able to transfer their practical skills into answering a theory question. Few responses referred to setting up different concentrations of substrate and using the same concentration of inhibitor. Attempts that were made tried to alter inhibitor concentration. Some candidates wrote that they would see what this would do to the enzyme, as if they had some highly technological microscope. Very few noted that they would measure the rate of reaction. Graphs that were sketched included a range of incorrect curves, ranging from normal distribution curves to a repeat of the curve shown in **(b).** A minority of students gave sufficiently good answers to score 1 or 2. At times, benefit of doubt marks were awarded where it was clear that more knowledgeable candidates had attempted to describe a procedure to show their choice of inhibition given in **(c).**

(e) Most answers simply stated 'stretches and recoils during breathing' and lost their marks with a lack of qualification with no reference to inhalation and exhalation. Quite a few understood 'prevents bursting of alveoli'.

(f) Approximately half got this correct, albeit with a range of creative spellings of the word 'emphysema'. The most common incorrect answer was 'lung cancer'.

Question 4

(a) Despite very similar questions occurring in previous sessions, this produced some disappointing responses. Some candidates had not read the question and gave accounts of the mass flow theory. Others had made an attempt to learn previous mark schemes but gave a confused version of events. Many knew that active transport and diffusion were involved, but made no clear reference to ATP being provided by mitochondria (for pumping out of H^+) or to sucrose diffusing down a concentration gradient (into the sieve tube). A number understood that movement of hydrogen ions allowed the co-transport of sucrose, but the term 'co-transport' was not used very often.

(b) Many gained at least one mark for 'increased surface area' and quite a few went on to either note that this gave a large surface area of membrane or that it allowed more pumps to be present.

(c) (i) Usually well answered, often with appropriate reference to a higher resolution and the ability to see structures not visible (for example, ribosomes) or detail of structures just visible (for example, mitochondria) with the light microscope.

(ii) Candidates were asked to describe the appearance of the phloem sieve tubes when viewed in longitudinal section. Some gained one or two marks for sieve plates and/or sieve pores even though the rest of the description was poor, with infrequent reference to peripheral cytoplasm and the relative lack of organelles, for example, no nucleus / few mitochondria. Many noted that they had companion cells. Unfortunately quite a few wrote that sieve tubes were hollow.

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Question 5

(a) Generally only one mark was gained for the first marking point, the transmission of the causative agent by the *Anopheles* mosquito. A requirement for warm temperatures for the parasite to complete its life cycle was not known, with most candidates noting that the mosquito needed the tropical climates. One or two thought that the mosquito itself caused the disease.

(b) (i) Either 2 or 0 marks, but with many getting the full two marks. Some candidates did show an understanding of the principles but gave 46 and 23 as their answers. Other incorrect answers appeared to be guesswork.

(ii) This was not particularly well answered, despite there being evidence of some understanding of the need to halve the chromosome number, retaining the diploid number at fertilisation and so preventing the chromosome number doubling each generation. Few made reference to variation and meiosis. The lack of scientific terminology and attention to detail lost many candidates their marks.

(c) Very few gained more than two marks. Despite a similar question occurring in a previous session, many candidates gave answers linked to the difficulty in administering vaccines. Few made references to the eukaryotic *Plasmodium* having many antigens or to the parasite living inside cells hidden from antibodies.

Question 6

Although there was a lot of information to assimilate, this question was very well answered by many candidates. Such candidates correctly selected appropriate processes that occur during the nitrogen cycle and matched them to the stages **B** to **F** as shown in **fig. 6.1**, often gaining all five marks.

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BIOLOGY

Paper 9700/04

A2 Structured Questions

General comments

This paper was thought to be challenging in parts but provided a very good range of marks with good candidates being able to score highly. Overall the marks were higher than last year.

Candidates from some Centres had been thoroughly prepared but others struggled to recall basic factual material or to apply their knowledge appropriately. It was evident that some candidates had not prepared themselves properly for questions on some parts of the syllabus, particularly **Questions 5** and **8**. The better candidates had no problems with the more straightforward questions such as 1, 6 and 7. Many candidates are still not reading the command words carefully and tend to not distinguish between *describe* and *explain*. Consequently, although sometimes much knowledge has been displayed by the candidate, few marks are awarded because the candidate has not answered the question.

Neatness of presentation has been improving steadily over the past few years with very little writing in the margins this time.

Unfortunately the numerical ability of candidates seems to be declining, many candidates having problems with the short calculation in **Question 4(b)(ii)** and extracting data from graphs correctly. This was not evident in the most able candidates who were even able to correctly interpret the log linear plot in **Question 4(c)(i)**.

Comments on specific questions

Section A

Question 1

(a) The majority of candidates were well prepared and able to supply two differences between the DNA of eukaryotic and prokaryotic cells. In some cases all eukaryotic and prokaryotic points were reversed suggesting that more care is needed in answering the question. A common misunderstanding was that 'naked' was sometimes used incorrectly to describe the lack of enclosure in a nucleus rather than the lack of histone covering.

(b) This question proved to be well answered with habitat destruction, shortage of food and a detail of man's activities the favoured correct answers.

(c) Candidates have clearly taken note of past papers in answering this question. Most responses included references to enclosure in zoos or national parks with the possibility of captive breeding programmes.

Question 2

(a) (i) The fact that this was a channel involved in the transport of chloride ions was usually stated. It was expected that reference would be made to the channel normally moving these ions out of the cell. Alternatively the use of ATP in the functioning of the protein could have gained credit.

(ii) The presence of the glycoprotein or carbohydrate chain on the external face was usually correctly noted. A surprising number of incorrect references were made to glycolipids, despite the clear chain of hexagons in the diagram.

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(b) (i) The idea that the recessive allele only showed an effect in the phenotype when homozygous was usually well described. Very few candidates also explained the meaning of 'allele' as a form or variety of a gene.

(ii) The symptoms of cystic fibrosis were well known and described in some detail.

(c) Many candidates gave muddled answers, referring to plasmids and reverse transcriptase. Few correctly noted that the allele would be attached to the genetic material in the virus or that it would be delivered when the virus binds to the cell and passes its genetic material into the host cells.

(d) (i) Many candidates made the mistake of assuming that translation would stop occurring rather than stop when the 'stop' codon was reached. Incorrect answers mentioned that DNA replication was wrong, therefore a wrong base was inserted. Candidates would be well advised to read the question carefully.

(ii) The advice given above also applies to this question. Some candidates were unsure how to answer this question and incorrectly commented on ethical issues or large scale production of the drug and even carried on answering the previous question. Three marks could easily have been gained by stating that the drug could be taken orally, that it had no side effects and that it was readily taken up by cells.

Question 3

(a) The structural features of sorghum that help its survival were well known, such as deep roots and leaves that can curl, and most candidates scored well. A few candidates misinterpreted the question giving detail of C4 plants and structures preventing photorespiration.

(b) (i) The idea of the abscisic acid concentration peaking at day 7 was usually noted but many candidates failed to quote any figures. Often insufficient care was taken in reading the graph with figures for stomatal resistance quoted instead of those for abscisic acid. Better answers attempted to *explain* as well as *describe*, correctly relating changes in water potential to changes in abscisic acid concentration.

(ii) Frequently stomatal resistance was simply linked to watering, providing an inadequate explanation. Appropriate answers related it to water potential or abscisic acid concentration with some detail of how these two factors were linked to the mechanism of stomatal closure.

(c) Most candidates realised that the changes in **(b)** related to stomatal closure. Here it was necessary to link this to the reduction of water loss by transpiration and many were able to do this. A common mistake was to state that stomatal closure prevented water loss rather than reduced it.

Question 4

(a) Many candidates were able to give a detailed description of the process of producing monoclonal antibodies. A surprising number thought that the antibody rather than an appropriate cell was fused with the myeloma cell and a few missed the point altogether by describing the formation of recombinant DNA.

(b) (i) It was pleasing to see candidates readily quoting figures here. Most were able to indicate the relative effectiveness of the various treatments.

(ii) The commonest mistake made in the calculation was to divide the increase of 1.4 by 2.0 instead of by the Herceptin only figure of 0.6. This was despite the fact that the increase in bar length on the graph could clearly be seen as more than twice the size of the Herceptin bar. Consequently a surprisingly small number of candidates were able to give the correct answer.

(c) (i) Many responses did not answer the question which concerned the effect of increasing the doses of X-rays. Comparisons were often made between the treatments at a particular dose rather than observing the overall trend. The general decrease in cells surviving as doses increased was required, together with the fact that there is a greater decrease in the presence of Herceptin.

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(ii) The attachment of Herceptin to the receptor site on cancer cells was often noted but few candidates referred to the immune response being triggered or that it might enter and kill the cancer cell. The idea that it might enhance the effectiveness of the X-rays was occasionally suggested.

Question 5

It was clear that this question examined an area of the syllabus that was not as familiar to the candidates as other areas. Consequently this question was a good discriminator.

(a) The sites of secretion were usually correct although some candidates omitted 'anterior' for the pituitary gland.
The target tissues were mostly known except where candidates referred to the wall of the uterus instead of the lining or endometrium for progesterone.
The action of FSH was not always clearly given as stimulating development of the follicle. More correct descriptions of the action of progesterone were seen, either increasing the thickness of the endometrium or its role inhibiting FSH or LH secretion.

(b) The inhibition of FSH or LH secretion, prevention of ovulation and implantation, together with hostility of cervical mucus to sperm were well known. References to the effect being on the hypothalamus or anterior pituitary or the fact that a negative feedback system operates were rarely seen.

Question 6

This proved to be a very accessible question with many candidates scoring close to full marks.

(a) Most candidates were able to identify adenine and ribose from the diagram. Common mistakes were to refer to the base as adenosine and the sugar as pentose.

(b) Some candidates wrote only about the release of energy on the removal of phosphate groups in turn. Energy production appeared in a number of scripts rather than energy released or made available. Some recognised that ATP is a small, soluble molecule but often this was linked to transport around the body rather than diffusion within the cell. The fact that ATP supplies energy to a range of reactions and processes and that this occurs in all organisms was mentioned by many candidates.

(c) Many candidates were able to state precisely where ATP can be synthesised in either the mitochondria or chloroplasts as well as the general cytoplasm.

Question 7

(a) Some candidates did not always select the most obvious position for their labels; it was noticed that a few candidates thought the term capsule applied to the complete corpuscle; however the majority were able to succeed.

(b) Most candidates had no difficulty in naming anti-diuretic hormone or ADH, although there were some references to adrenalin and insulin.

(c) (i) Many candidates stated that proteins are large molecules which cannot pass into the filtrate, however, the fact that the basement membrane acts as the filter was not seen so frequently.

(ii) Whilst many candidates referred to reabsorption in the proximal convoluted tubule, a number incorrectly explained the absence of glucose in the urine in terms of the molecule being useful to the body in respiration and therefore not excreted.

(iii) Many recognised that urea is more concentrated in the urine but several explanations were given in terms of urea being toxic.

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Question 8

A large minority of candidates made no serious attempt at this question suggesting a lack of familiarity with this topic. Many seemed unfamiliar with 'dihybrid' crosses and the use of superscripts as part of the symbol for an allele confused some candidates. Credit was given to candidates who had made a minor error early on in their answer but who had then gone on to correctly apply their knowledge of genetics.

Question 9

(a) This was generally well answered although it is worth noting that some candidates are still not referring to ribulose bisphosphate correctly. There were many answers using the words diphosphate and biphosphate. The most common mistake for **part (iv)** was to mention reduced NAD rather than reduced NADP.

(b) This question proved to be testing for some with several describing the graph rather than explaining it. Many candidates were able to score two marks but full credit was rarely awarded. A frequently encountered misunderstanding related to the occurrence of the light independent reactions. These do not start after the light was switched off but continue until the products of the light dependent reactions are used up when the reactions cease.

Section B

Question 10

This was the most favoured question in ***Section B*** with some very good and complete answers. A few candidates did not restrict their responses to the appropriate parts of the question.

(a) Credit was awarded to an appropriately annotated diagram. Some candidates confused sensory and motor neurones but were still able to score marks based on the common features. Some candidates located dendrites at both ends of the neurone but most were familiar with the axon, myelin sheath and nodes of Ranvier. Further detail was often not forthcoming and nuclei in the Schwann cells, named organelles in the cell body and large numbers of mitochondria in the terminal branches were rarely seen.

(b) Many candidates produced very complete answers. In some cases candidates included synaptic transmission and the maintenance of a resting potential both of which were irrelevant to the question. Many were able to state the sequence of events, with only a few confusing the direction of flow of the two ions. There were a lot or correct mentions of local circuits, action potentials only at the nodes, saltatory conduction, one-way transmission and the significance of the refractory period.

Question 11

This was not as popular as **Question 10** but was frequently attempted by better candidates.
Some candidates totally misunderstood the meaning of isolating mechanisms and artificial selection in the context of this question.

(a) Only a small number of candidates were able to use specific examples of allopatric and sympatric speciation with the level of understanding expected at this level. Whilst many referred to differences in selection pressures, few explained the outcome in terms of populations being unable to interbreed so that there was no gene flow between the populations, natural selection would produce a change in allele frequencies and, over many generations, the two populations would no longer be able to interbreed if brought together, and would be two separate species.

(b) Artificial selection involves man choosing or selecting organisms with desirable traits as the parents, crossing them and selecting offspring with the desirable features, repeating this over a number of generations. Credit was given for the use of a suitable example of both organism and feature and also for details of the breeding technique. It was interesting to note that having chosen cows with high milk yield as their example some candidates then described the interbreeding of two cows! Some reference to increase in the frequency of the alleles for the desirable features with the possible loss of hybrid vigour, or inbreeding depression, would have received due credit.

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BIOLOGY

Paper 9700/05
Planning, Analysis and Evaluation

General comments

Overall, candidates appeared to find this paper more challenging than 2007. In particular, candidates did not demonstrate a critical approach to experimental design, data collection and presentation or to considering the validity of conclusions based on data. For many candidates statistical analysis, especially the use of probability tables presented a problem. Although the majority of candidates attempted to answer all the questions, poor use of scientific terminology and use of vague words such as 'amount' often meant that relatively straight forward marks were not achieved. Candidates should be encouraged to use precise terms and units when considering experimental procedures, In some cases, although it is clear that candidates have an understanding of the biology, their answers lack sufficient precision, for example, statements using phrases such as 'it affects' or 'an effect on' without any further explanation. Other candidates did not appear to have read the question carefully enough and so answered a different question to that asked. For example, in **Question 3(b) (ii)**, candidates were asked to comment on the alleles of the gene, the vast majority referred to genes of the individuals.

Comments on specific questions

Question 1

Few candidates gained more than 4 marks for this question.

(a) Although most candidates were aware of the variables which should be controlled, many did not gain credit as their answers were too imprecise. As noted in previous reports, general statements such as amount, needs to be qualified by specific units and size by the dimension concerned. Examples of imprecise answers were amount of antibiotic or agar and size of the well. The most common errors were to control the concentration of the antibiotic, which was the independent variable or the area of inhibition, which was the dependant variable. Other errors included counting the number of bacteria added and adding additional nutrients to the agar.

(b) (i) Many did not recognise that the data presentation was reversed from the usual and so described a decreasing, rather than an increasing trend. Although this was credited, it tended to influence the approach to **part (iii)** which for some candidates restricted their answers.

(ii) Answers to this part of the question were very varied. Many candidates did not appear to have read the information carefully enough to realise that there was only one set of results, so that it was not possible to determine if any of the results were anomalous. Many candidates also wrote extensive descriptions of each of the listed results without considering the overall results for each species. Better answers referred to the general trend shown by the results and the results that did not appear to fit the trend. A few candidates also made reference to possible errors in adding antibiotics or bacterial cultures. Most candidates had difficult in explaining why the specified results may not have been anomalous. In some cases this appeared to be related to the interpretation of the trend as a falling rather than a rising pattern, so candidates failed to recognise that the trend may have still been increasing or reaching a plateau. The most common error was to refer to resistant bacteria developing in the populations, suggesting a misunderstanding of the experimental design. In other cases candidates tried to make comparisons between species. Poorer answers often concentrated on the procedure of the experiment, suggesting a misconception about the meaning of anomalous results. These candidates often gave reasons for the results being different, rather than why they were considered to be different. For example, faults in setting up the experiment, such as not mixing the agar properly or leaving the agar plates too long. The reasons for the results not being anomalous was then the reverse of the previous answer, essentially, the experiment had been carried out correctly.

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Question 2

Candidates often achieved fewer than half marks for this question for two main reasons. Many of the candidates did not appear to be familiar with the technique of using epidermal strips to study stomata and consequently described inappropriate experiments. Many candidates were also uncertain in the use of statistics.

(a) (i) While many candidates realised that the independent variable was the location of the epidermis surface, some answers were expressed too poorly for credit, for example, the surface area of the epidermis and the size of the epidermis strip. Similarly, there were candidates who realised that the stomata were the dependant variable, but failed to state it was the number of stomata. Candidates should take care to make precise statements about the variables that they are asked to identify from a question.

(ii) The majority of candidates gained one or two marks in this question, but as already noted there were a very large number who did not seem to be familiar with this practical procedure. Better answers referred to using epidermis from both sides of the leaf and related this to the data table. Candidates often failed to realise that they were expected to relate their answer to the data given, so they did not specify the number of epidermal strips used or the number of leaves. Credit was given to candidates who used leaf impressions instead of epidermal strips. Poor use of language resulted in many candidates referring to leaf strips rather than epidermal strips. Poor understanding of the technique resulted in many candidates either mounting whole leaves on microscope slides to observe the stomata or alternatively stating that 1 mm^2 sections of epidermis could be cut and used to make a slide. Finding the area of the observed section using the area of the field of view was rarely mentioned neither was a method of finding the number of stomata per mm^3. Credit was given if candidates explained how a mechanical stage and a graticule could be used to measure 1 mm^2. However, some candidates referred incorrectly to using a graticule to obtain the size of the stomata or to work out a magnification.

There were a great many examples of inappropriate procedures. The most common were immersing the leaves in water and counting the bubbles on the surface of the leaf or covering the leaf surface with cobalt chloride paper and counting the number of coloured dots on the paper. Other incorrect procedures were covering the two sides of the leaf with Vaseline and using a potometer, counting the stomata with a magnifying glass or hand lens and in some cases with an electron microscope. There were also examples of photosynthometers and respirometers.

(b) Answers to this part of the question were very varied. There some candidates who gave completely correct answers and at the other extreme, candidates who seemed to have little understanding of how to approach the calculations. It is essential that candidates are familiar with the mathematical symbols used in statistical tests which as listed in the syllabus. These can be found on page 44 of the 2010 syllabus. n = number of samples and $\bar{x}$ = mean value.

Many candidates also used significant figures to a degree of accuracy inconsistent with the original data. This was evident in **(i), (b) (ii)** and **(b) (i)**. Incorrect use of significant figures was penalised once throughout ***section (b)*** and 'error carried forward' used to give credit for calculations based on the figures given by the candidates.

(i) Most candidates gave a correct answer. Some were not given credit for incorrect use of significant figures. Candidates should be reminded that their answer should be to the same significant figure as the data, in this case a whole number.

(ii) Many candidates were able to calculate a correct value. The most common error was to use the square root of the mean value instead of the square root of the number of samples. As in **(b) (i)** many candidates used incorrect significant figures, usually four significant figures instead of the three significant figures in the original data for standard deviation.

(iii) Answers to this question were also very varied and suggested that there are many candidates who are not certain how to find the number of degrees of freedom for a statistical test. Candidates who realised that the expected value was for only one side of the epidermis usually gave a correct answer. The only common incorrect answers for these candidates were 18 and 20. Many candidates however, did not appear to have read the question carefully as their answers were either 40, 39 or 38, suggesting they were calculating the value based on the data for both sides of the epidermis. Relatively common incorrect answers were 30, obtained by the calculation 30-1 and

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34, obtained by the calculation 35-1. This suggests that some candidates were using the mean value for the number of stomata on the upper or lower epidermis, rather than the number of samples. There also appeared to be candidates who were guessing as values that did not appear on the probability table such as 2 and 4 were given as answers. Some gave actual values of ***t***.

(iv) Candidates who followed the calculation and the instructions on how to present their answer usually gained all the marks. The only common error for these candidates was taking a mean value of the ***t*** values for 18 and 20 degrees of freedom. It was expected that candidate would choose the value nearest to the actual degrees of freedom, in this case 20, although the value for 18 was also acceptable. Other candidates did not follow the calculation consistently. One common error was to use a different ***t*** value from that indicated by the degrees of the freedom given as an answer in **(b) (iii)**. If the same ***t*** value was used for both calculations then 'error carried forward' was allowed for the confidence intervals obtained. Similarly, candidates who used a ***t*** value correctly obtained from incorrect degrees of freedom were allowed credit for correctly calculated confidence intervals. Candidates were not allowed marks as 'error carried forward' if they used two different ***t*** values in their calculation or used a ***t*** value from 0.01 probability. There were also candidates who did not follow the instruction about the form of the answer and used values other than the mean value, for example probability values 0.05 or 0.01 and the $\mathbf{S_M}$ values obtained in **(b) (ii)**.

Question 3

Overall this question was answered poorly, with many candidates gaining marks in **(a) (ii)** only. Candidates were expected to apply their knowledge about DNA separation using electrophoresis into a different context, but the majority made the assumption that as genetic fingerprinting was being used, the question must be about family relationships and answered accordingly.

(a) Candidates seemed to be uncertain about the control of variables in the context of a human population. As the stated purpose was to look for common patterns in human genetic variation, candidates were expected to consider how the range of variation that exists might be accommodated so that similarities could be identified. Most candidates gave answers that were more appropriate for standardising a population for a physiological study.

(i) Better answers recognised that in most studies of human populations, the larger the sample the better. Common incorrect answers were related to sampling one sex or one age group. Control of this type of variable is appropriate when physiological tests are carried out, but inappropriate in this context.

(ii) Very few candidates gave a correct answer to this question. Many candidates suggested that different ethnic groups should be separated, suggesting that candidates had not recognised that the study was looking for similarities, so that a range of ethnic groups was necessary. Other candidates appeared to be suggesting a form of eugenics involving control of marriages and 'mating' between people of the same ethnic groups. Some candidates also showed confusion between ethnicity and religious belief.

(b) (i) Most candidates gained at least two marks for this question. Many answers included additional detail not relevant to the question, including extraction of DNA and the procedure for using gene probes. Candidates who tried to explain about the effect of molecular size or charge on the movement of DNA fragments were often too imprecise, for example, 'the size affects the distance moved'. The most common errors were to describe protein separation, to use agar rather than agarose gel and to 'switch on' electricity rather than using a potential difference. A minority of candidates wrote creative accounts of passing electricity through actual fingerprints.

(ii) Many candidates misinterpreted this question so their answers were either 'why a probe is necessary' or 'how the probe can be identified'. Some candidates simply repeated the information in the introduction to the question. To gain this mark, candidates were expected to show an understanding that probes base pair with complementary sequences in specific alleles. Candidates who understood this principle often gave a partial answer referring to either the complementation or the binding between probe and allele.

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(iii) Although candidates were asked to draw conclusions about the alleles, the majority drew conclusions about the individuals. Most answers were stated in relation to genes rather than alleles. Conclusions about relationships of individuals were often based on the distribution of one allele, suggesting that candidates are not sure about how genetic fingerprinting is used to establish family relationships. Other candidates referred to the genotypes of individuals for the two genes. Some candidates restated the information in the key. Some of the better answers referred to the difference in molecular size or charge of the membrane protein alleles and muscle protein alleles. Others commented correctly on the frequency of the alleles of the membrane protein alleles and muscle protein alleles.

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BIOLOGY

Paper 9700/31

Advanced Practical Skills 1

General comments

The majority of Centres returned the completed Supervisor's report but in a very few cases the report was not enclosed with the candidates' scripts. Centres are reminded how important it is that the Examiner receives the report with the scripts, so that the candidates are not penalised for any problems encountered with the practical.

Centres are reminded that on receipt of the confidential instructions a check should be made that the instructions are for the correct practical entry, 31 and not 32, and that the equipment and materials required will be available for their candidates. As Centres receive these instructions well in advance of the examination there should be time to contact CIE so that any problems can be resolved. Centres should not change the practical requirements without first contacting CIE.

A few Centres appeared to be unaware that the order of the two alternative practicals was 9700/32, followed by 9700/31. As these practicals are alternatives, and of an equal standard, there is no advantage to candidates being entered for any particular practical. It is important that Centres clearly date the practical, particularly if they choose to take 9700/31 and 9700/32.

It was very pleasing that many candidates demonstrated that they had a good understanding of the skills required. There was good discrimination between the weaker and more able candidates, some of which were able to score over thirty marks.

For **Question 1** it was important that the Supervisor returned the results. Centres should not be concerned about the actual results as this will be taken in to account when the papers are marked.

In order for candidates to demonstrate their understanding of errors in procedures, resulting in limitations to the accuracy or reliability of the data, most practical procedures which candidates are expected to carry out will produce errors. A perfectly working practical makes it difficult for a candidate to refer to the limitations and suggest suitable improvements. Candidates should also expect that they will be asked to carry out a procedure with which they are not familiar, but make decisions about the procedure which will use techniques, such as serial dilution, with which they should be familiar.

The syllabus shows that this component has a microscope activity and it gives the required specification for the microscope lenses. It is expected that all candidates will have access to a clean, working microscope in order to complete the activity.

For the microscope question it is important that candidates have had the opportunity to become familiar with their microscope so that they know that all focussing should take place by turning the lens away from the slide so that slides are not broken. It is not acceptable for candidates to be given help to use the microscope as the use of the microscope is one of the skills being assessed.

The use of photomicrographs for the candidates to draw low power plan diagrams showed that some candidates still have problems understanding that this tests their ability to draw what they see. It was important that candidates observed, and drew carefully, the overall shape. Marks are not awarded for additional details, which cannot be observed. Some candidates do not seem to be aware that marks are awarded for sharp, unbroken lines and no shading so it is important to have a sharp pencil and to have practised this skill frequently. Centres are reminded that unfamiliar material can be set so candidates need to be able to follow the instructions carefully and only draw what is required.

Centres are reminded that this paper is skills based and that candidates should be made aware of the possible skills that will be assessed. These skills are clearly explained in the syllabus, for example graph plotting.

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There was some evidence that candidates were failing to gain marks because they answered questions as if they were from a previous paper. Frequently, the questions which ask for the errors in an experiment will expect the candidate to select the most significant errors for that specific experiment. The question giving the stage micrometer and eyepiece graticule scales was not the same as the one used in the 9700/32 paper and required very careful measuring to find where the centre of the stage micrometer lines exactly overlapped the eyepiece graticule lines.

Comments on specific questions

Question 1

(a) (i) It was pleasing that most candidates organised the space into a table, carefully drew the cells and showed that they had recorded water, S1 and S2. Some candidates did not follow the instructions carefully which required 5 cells to be assessed, using the numerical estimates shown and then calculate the mean. Some candidates assumed this procedure was the same as one they had used themselves, whereas it required them to follow the instructions given. A time was deliberately not given so that candidates had to make decisions, or would give this as a significant error.

(ii) There were a pleasing number of candidates who gained full marks for both describing and explaining the results. Many clearly described the results and then explained in terms of water moving, with the correct direction, and that it moved as a result of a water potential gradient by osmosis. Some candidates did not explain that in the distilled water the cells remained turgid as there was no net movement of water so there was equal movement of water by osmosis in each direction. If candidates included references to solute potential as being the opposite of water potential, as this is incorrect, the mark for explaining water potential was not given as this becomes a contradiction. Solute potential is the same as water potential i.e. water moves from a high water potential (high solute potential) to a lower water potential (lower solute potential). However, candidates needed to explain in terms of water potential.

(iii) Candidates needed to select the significant errors. These were that cells were left for different times (or not long enough), or that the volume of solutions on the slides was different, or that there could have been evaporation from the solutions. Presence of air bubbles in the slides, or wrongly making up the solution, or contamination because the syringe was not washed out should not be significant errors as candidates are expected to be competent in these techniques. Some candidates need to be reminded that they should not improve the experiment by answering that the times should be the same but state the error which is that the times were different.

(iv) Many candidates gained two marks. The most frequent answers were for repeating each concentration but candidates must be careful to be clear that it is repeat each concentration and not repeat using a different method. Other common improvements were to use more concentrations of the sucrose and keep the time the same, or use longer times, or measuring the volume using a graduated pipette. A few candidates incorrectly thought that the slides should be stained to make it easier to observe the changes, so they had not realised that this would introduce a different water potential, thereby destroying the results. Using red onion with pigmented vacuoles is also incorrect as this is a different material.

(b) (i) Candidates should have calculated the means by correctly deciding that the value 45 for 35 °C batch 4 was an anomalous result and should not be included in the calculations. There were still a few candidates who did not round up their answer to a whole number so were incorrectly considering the required number of significant figures.

(c) (ii) It is important that candidates decide carefully which is the independent variable, temperature °C, and that this should therefore be on the x-axis.

Care should also be taken to use as much of the grid as possible with an easy to read scale and plot the points with a small cross, or dot in a circle, very carefully. The line should either be ruled point to point or be a smooth curve through all of the points unless there is an obvious anomalous result. No penalty was given for those candidates who plotted their incorrect means. The standard of graph drawing is improving.

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(iii) Most candidates successfully read off the temperature at 50% plasmolysis and included the units to gain this mark.

(d) Candidates need to read the question carefully as they were asked to draw an appropriate conclusion. Their answer should also have used the experimental data, for example, by quoting two temperatures and two percentages which showed that as the temperature increased so did the percentage plasmolysis. Some candidates correctly indicated that this was only true until the temperature at which the percentage plasmolysis reached a constant level. A few candidates incorrectly thought this was an enzyme reaction and referred to optimum temperatures.

Question 2

(a) (i) Candidates need to be aware that it is important to draw only what is asked for in the question and to look carefully at what they can see. The whole of the specimen should have been drawn using sharp, clear, unbroken lines. Close attention should be given to the shape of the outline, which some candidates ignored and appeared to be trying to draw a LP plan diagram similar to that given in 9700/32. The diagram should have shown at least eight lines (4 lines for the layers at each side of the lumen) and the cartilage drawn as an incomplete ring as shown in the photomicrograph. It was pleasing that fewer candidates incorrectly included cell details or shading.

(ii) Using the provided views of the eyepiece graticule scale and stage micrometer enabled the collection of the measurements to be checked. The most accurate scale for measurement of the lumen was the smallest divisions giving an answer of 29 or 30. This meant that the candidates should have used the same small divisions for their calibration of the eyepiece graticule using the stage micrometer. There were a number of correct positions where these two scales coincided to the middle of the stage micrometer lines. Some candidates still included mm which these figures did not represent.

The third mark was for a clear logical calculation. The candidate should therefore have started either by multiplying Z (number of stage scale divisions) by 0.1 (given as the smallest division measurement) then divided by Y (number of eyepiece divisions) and then multiplied by their measurement of the lumen in eyepiece divisions. Alternatively, dividing Z by Y first and then multiplying by their measurement and by 0.1. Candidates must show their complete working including how they have used 0.1 to gain this mark.

The final mark was for deciding on the correct units, either mm or m, based on their calculation. Metres are not a suitable unit for microscope work.

(iii) Parallax error is not a significant error when viewing directly down through a microscope to a slide. The most significant error will be in exactly identifying where the edges of the lumen start and finish or that the lumen was irregular or not straight. Alternatively, lining up the eyepiece graticule scale with the stage micrometer can be difficult and the lines on the stage micrometer appear very thick would have been correct. However, candidates must be careful not to imply that they cannot carry out the exercise, for example, the outer layer was measured.

(b) (i) It was pleasing to see that most candidates organised their space into a table or Venn diagram with clear underlined headings. Most candidates scored high marks for a clear similarity and two comparisons. Again, those candidates who had seen and compared different structures were able to apply this skill to the more unfamiliar material using the lumen as being present in both but with a difference in size, describing the difference in the shape of the lumen or the whole structure and the presence and absence of the cartilage ring. Candidates do need to realise that in a practical examination they are being assessed on their skills of observation so that uses of the specimens or details not visible in the figures, would not gain any marks. It is suggested that candidates should organise their table with a column for the feature to be compared and then a column for the description of each specimen. This prevents candidates from making vague comparisons which do not clearly give the difference of a particular feature.

(ii) The majority of candidates were able to identify that both specimens had a lumen.

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(c) There were some very good drawings and clear labelling of the group of 5 cells. This showed that the candidates had followed the instructions. Candidates which observed carefully, and included details which could be seen, such as the 'shadow' around the cells, gained full marks.

It is important that candidates have the opportunity to observe tissues and draw a few cells accurately and only include those features they can see such as the shape, size and position of the nucleus in each of the selected the cells. If candidates are asked to label, then at least two labels will be required and the specimen will enable the candidate to recognise features which they should have seen as part of their studies. Some candidates mistakenly tried to make these cells into blood cells or plant cells.

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BIOLOGY

Paper 9700/32

Advanced Practical Skills 2

General comments

The majority of Centres returned the completed Supervisor's report but in a very few cases the report was not enclosed with the candidates' scripts. Centres are reminded how important it is that the Examiner receives the report with the scripts, so that the candidates are not penalised for any problems encountered with the practical.

Centres are reminded that on receipt of the confidential instructions a check should be made that the instructions are for the correct practical entry, 31 and not 32, and that the equipment and materials required will be available for their candidates. As Centres receive these instructions well in advance of the examination there should be time to contact CIE so that any problems can be resolved. Centres should not change the practical requirements without first contacting CIE.

A few Centres appeared to be unaware that the order of the two alternative practicals was 9700/32, followed by 9700/31. As these practicals are alternatives, and of an equal standard, there is no advantage to candidates being entered for any particular practical. It is important that Centres clearly date the practical, particularly if they choose to take 9700/31 and 9700/32.

It was very pleasing that many candidates demonstrated that they had a good understanding of the skills required. There was good discrimination between the weaker and more able candidates, some of which were able to score over thirty marks.

For **Question 1** it was important that the Supervisor returned the results. Centres should not be concerned about the actual results as this will be taken in to account when the papers are marked.

In order for candidates to demonstrate their understanding of errors in procedures, resulting in limitations to the accuracy or reliability of the data, most practical procedures which candidates are expected to carry out will produce errors. A perfectly working practical makes it difficult for a candidate to refer to the limitations and suggest suitable improvements. Candidates should also expect that they will be asked to carry out a procedure with which they are not familiar, but make decisions about the procedure which will use techniques, such as serial dilution, with which they should be familiar.

The syllabus shows that this component has a microscope activity and it gives the required specification for the microscope lenses. It is expected that all candidates will have access to a clean, working microscope in order to complete the activity.

For the microscope question it is important that candidates have had the opportunity to become familiar with their microscope so that they know that all focussing should take place by turning the lens away from the slide so that slides are not broken. It is not acceptable for candidates to be given help to use the microscope as the use of the microscope is one of the skills being assessed.

The use of photomicrographs for the candidates to draw low power plan diagrams showed that some candidates still have problems understanding that this tests their ability to draw what they see. It was important that candidates observed, and drew carefully, the overall shape. Marks are not awarded for additional details, which cannot be observed. Some candidates do not seem to be aware that marks are awarded for sharp, unbroken lines and no shading so it is important to have a sharp pencil and to have practised this skill frequently. Centres are reminded that unfamiliar material can be set so candidates need to be able to follow the instructions carefully and only draw what is required.

Centres are reminded that this paper is skills based and that candidates should be made aware of the possible skills that will be assessed. These skills are clearly explained in the syllabus, for example graph plotting.

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There was some evidence that candidates were failing to gain marks because they answered questions as if they were from a previous paper. Frequently, the questions which ask for the errors in an experiment will expect the candidate to select the most significant errors for that specific experiment.

Comments on specific questions

Question 1

(a) (i) The majority of candidates gained both marks for drawing one cell with two lines for the cell wall and then labelling the nucleus and the cell wall. Those candidates who did not follow the instructions lost marks for drawing more than one cell, or not observing enough cells and focussing carefully in order to see that the nucleus could be seen.

(ii) It was pleasing that most candidates organised the space into a table, carefully drew the cells and showed that they had recorded water, T1 and T2. Some candidates failed to head the table so that it was clear what was being recorded in the table, for example, observations or specific details such as plasmolysis. Marks were awarded to those candidates who recorded their results as drawings as long as these were labelled and indicated clearly the differences observed between the three slides.

Some candidates did not realise that cells shrinking was not acceptable as the initial size of the cells could have been different.

(iii) Many candidates answered this question well including a clear explanation that water was moving by osmosis as a result of a high to low water potential and that the reason for their results was that water was moving in to the cells, or there was no net movement of water for cells in distilled water, or that in T1 water was moving out. Some candidates also explained correctly that the lead nitrate had destroyed the cell membranes because it was toxic.

(iv) Candidates needed to select the significant errors. These were that cells were left for different times (or not long enough), or that the volume of solutions on the slides was different, or that there could have been evaporation from the solutions. Presence of air bubbles in the slides, or wrongly making up the solution, or contamination because the syringe was not washed out should not be significant errors as candidates are expected to be competent in these techniques. Some candidates need to be reminded that they should not improve the experiment by answering that the times should be the same but state the error which is that the times were different.

(b) This question required that the candidate make up a serial dilution, or more concentrations, of the lead nitrate and then provide two improvements such as keeping the time the same or measuring the volume using a graduated pipette.

(c) (i) Candidates should have calculated the means by correctly deciding that the value 77 for 0.4 batch 2 and the value 35 for 0.8 batch 4 were anomalous results and should not be included in their calculations.

(ii) It is important that candidates decide carefully which is the independent variable (sodium chloride concentration), and that this should therefore be on the x-axis.

Care should also be taken to use as much of the grid as possible with an easy to read scale and plot the points with a small cross, or dot in a circle, very carefully. The line should either be ruled point to point or be a smooth curve through all of the points unless there is an obvious anomalous result. No penalty was given for those candidates who plotted their incorrect means. The standard of graph drawing is improving.

(iii) Most candidates successfully read off the concentration and included the units to gain this mark.

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(d) Candidates need to read the question carefully as they were asked to draw an appropriate conclusion. Their answer should also have used the experimental data, for example, by quoting two concentrations and two percentages which showed that as the concentration increased so did the percentage plasmolysis. Some candidates also correctly indicated that the percentage plasmolysis reached a constant level.

Question 2

(a) (i) Candidates need to be aware that it is important to draw only what is asked for in the question and to look carefully at what they can see. The whole of the specimen should have been drawn using sharp, clear unbroken lines. Close attention should be given to the overall proportions, approximately a height of no more than two thirds the length. The diagram should have shown at least three lines for the layers at each side of the lumen and an uneven line representing the innermost layer, carefully drawn all the way round. It was pleasing that many candidates gained at least three marks.

(ii) Using the provided views of the eyepiece graticule scale and stage micrometer enabled the collection of the measurements to be checked. The most accurate scale for measurement of the lumen was the smallest divisions giving an answer of 28 or 29. This meant that the candidate should have used the same small divisions for their calibration of the eyepiece graticule using the stage micrometer. There were a number of correct positions where these two scales coincided to the middle of the stage micrometer lines. Some candidates still included mm, which these figures do not represent.

The third mark was for a clear logical calculation. The candidate should therefore have started either by multiplying Z (number of stage scale divisions) by 0.1 (given as the smallest division measurement) then divided by Y (number of eyepiece divisions) and then multiplied by their measurement of the lumen in eyepiece divisions. Alternatively, dividing Z by Y first and then multiplying by their measurement and by 0.1. Candidates must show their complete working including how they have used 0.1 to gain this mark.

The final mark was for deciding on the correct units to use, either mm or m, based on their calculation. Metres are not a suitable unit for microscope work.

(iii) Parallax error is not a significant error when viewing directly down through a microscope to a slide. The most significant error will be in exactly identifying where the edges of the lumen start and finish and that the lumen was irregular or not straight. Another correct alternative is that the lining up of the eyepiece graticule scale with the stage micrometer can be difficult and the lines on the stage micrometer appear very thick. However, candidates must be careful not to imply that they cannot carry out the exercise, for example, the outer layer was measured.

(b) (i) It was pleasing to see that most candidates organised their space into a table or Venn diagram with clear underlined headings. Most candidates scored high marks for a clear similarity and two comparisons. Again, those candidates who had seen and compared different structures were able to apply this skill to the more unfamiliar material. For instance, the lumen as being present in both but with a difference in size, the cells in Fig. 2.4 were not visible but in Fig. 2.5 cells were visible or other features of the cells such as bands being present in Fig. 2.5 but not in Fig. 2.4 or pits in Fig. 2.5 but not in Fig. 2.4. Candidates do need to realise that in a practical examination they are being assessed on their skills of observation so that uses of the specimens, or details not visible in the figures, would not gain any marks. It is suggested that candidates should organise their table with a column for the feature to be compared and then a column for the description of each specimen. This prevents candidates from making vague comparisons which do not clearly give the difference of a particular feature.

(ii) The majority of candidates were able to identify that cell walls were present. However, some candidates failed to realise that chloroplasts would not be seen in these tissues and that lignin and cellulose could not be seen.

(iii) There were some very good drawings of diverse cells, which showed that the candidate had made the correct decision in drawing 5 very different cells.

Again, those who carefully observed and did not put in details, which could not be seen, such as sieve plates, gained the highest marks. Only a few candidates drew textbook drawings but a

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disappointing number drew transverse views and candidates were expected to draw what they could see.

It is important that candidates have the opportunity to observe tissues and draw a few cells accurately and only include those features they can see such as cell wall thickness, shape and relative size. It is important that candidates read the instructions carefully as a significant number of candidates failed to indicate on the figure which cells they had drawn.

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