BIOLOGY

Paper 9700/01
Multiple Choice

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

General comments

The mean score was 27.9 (69.75%) and there was a good spread of scores, the standard deviation being 6.7. Six questions were answered correctly by 80% or more of candidates – **Questions 7, 12, 18, 20, 33** and **39**. Only one question was difficult; 40% or fewer candidates answered **Question 19** correctly.

Comments on specific questions

Question 1

Weaker candidates were unable to express nanometres in the correct 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, with 10^{-9} being nanometres.

Question 2

Weaker candidates did not appreciate that enzymes, which are proteins, are synthesised on the rough endoplasmic reticulum.

Question 3

Only the more able candidates realised that the wavelength of light has no effect on magnification, but that using a longer wavelength would decrease the resolution.

Question 4

The most common error was incorrectly identifying the xylem and phloem.

Question 5

Many candidates did not realise that the vacuole enclosed by a tonoplast is clearly visible using a light microscope, but the other three features could only be seen because of the higher resolution of the electron microscope.

Question 8

Many weaker candidates did not recognise this molecule as cellulose.

Question 10

Many candidates did not know that ethanol dissolves phospholipids.

Question 13

Only the more able candidates were able to determine the correct response. A surprising number incorrectly thought that **Z** represented the energy gained by the product.

Question 14

Weaker candidates continue to have difficulty understanding the effect of inhibitors on enzyme reactions.

Question 15 and 25

Weaker candidates continue to have difficulty with the concept of more and less negative water potentials.

Question 19

Over half the candidates incorrectly identified ‘chromosomes uncoil’ as the first event. In fact in this sequence it should be the last event.

Question 21

The less able candidates incorrectly thought that mRNA or amino acid was the end product of translation.

Question 22

A number of candidates thought that mRNA has a site to which a specific amino acid attaches.

Question 24

Weaker candidates continue to have difficulty with the concept of more and less negative water potentials. Additionally, they thought that sucrose moves by diffusion.

Question 28

Many less able candidates did not seem to understand that each haem group can combine with one oxygen molecule (which is two oxygen atoms). Therefore the correct answer was **B**.

Question 29

The most able candidates knew that the systolic blood pressure was the maximum blood pressure in the arteries.

Question 32

Only the more able candidates knew what was meant by the term ‘epidemiological evidence.’

Question 34

Nearly 40% of candidates thought that cholera could not be passed directly from parent to child. Any infected parent could pass the bacterium to their child if they did not clean their hands.

Question 35

Many less able candidates knew that cholera could be cured by the use of antibiotics, but also thought that they could be used against the viral disease, smallpox.

Question 40

Those candidates who knew that herbivores are primary consumers, realised that the correct answer was **C**.

BIOLOGY

Paper 9700/02

AS Structured Questions

General comments

As usual, there were encouraging responses to all 6 questions from the well prepared candidates, with good use made of previous papers and mark schemes. Some candidates, and sometimes whole Centres, produced disappointingly low scores and even the more able candidates occasionally had some difficulty with **Questions 1(b)(ii), 2(a)(ii), 2(b)(ii), 3(a)(i)** and **(ii), 4(d), 5(b), 5(d)** and **6(a)**, several of which required extended prose in response.

Some candidates continue to lose marks by not using their knowledge and understanding to answer the specific question set. For example, in **Question 2(b)(ii)**, several candidates answered in terms of how the shape of the haemoglobin dissociation curve helps in the uptake of oxygen by haemoglobin to form oxyhaemoglobin, rather than its dissociation to deliver oxygen to respiring tissues.

Again, in answer to **Question 5(d)**, it was obvious from many answers that candidates were explaining why TB had not been eradicated despite the existence of antibiotics, rather than explaining, as required by the question, why vaccination had been ineffective.

Often candidates were far too imprecise in their responses, for example, in **Question 3(b)**, where some candidates gave general effects of the presence of hazardous substances in burnt tobacco, for example referring to carcinogens causing cancer, rather than causing mutation.

Candidates did not always demonstrate awareness of the use of bold type face in questions, for example, in **Questions 1(a)**, "structural features ..... **not** shown by eukaryotic cells", **Question 2(a)(ii)**, "**both** tertiary structure and quaternary structure" and **Question 3(a)(i)**, "describe **and** explain two features ..... **visible** in Fig. 3.1". There were candidates, as mentioned, who named eukaryotic features in **1(a)**, failed to specify which features linked with the appropriate structural term in **2(a)(ii)** and identified features of xylem vessels not visible in the electron micrograph in Fig. 3.1.

As mentioned in previous reports candidates should try and write within the lines of the paper and take note of the mark allocation given in brackets.

There were few common misinterpretations of the rubric, although in **Question 1(a)** a significant number of candidates gave structural features, e.g. a nucleus, presence of mitochondria, 22 nm. ribosomes which are present in eukaryotic cells and not shown by prokaryotic cells when the reverse was required. In **Question 2(b)(ii)** many candidates explained the S-shaped curve in terms of increasing the saturation of haemoglobin to ensure that oxygen could eventually be delivered to respiring tissues.

Candidates would significantly improve their scores if they prepared and revised in depth and endeavoured to use appropriate scientific terminology.

There were sufficient marking points to allow candidates to demonstrate their knowledge and understanding. Differentiation between candidates was evident. All candidates appeared to have had sufficient time.

Comments on individual questions

Question 1

Although some candidates failed to gain more than a few marks, there were high scoring responses to this question, though many candidates found **(b)(ii)** difficult.

(a) A significant number of candidates were able to state three structural features of prokaryotic cells not shown by eukaryotic. The commonest responses referred to the lack of organelles, smaller ribosomes and no nucleus. Where cell wall was given, there was no mention of murein/peptidoglycan. Others referred imprecisely to the infolding of the plasma membrane without naming the mesosome, or to slime (an alternative to capsule) surrounding the cell membrane, rather than the cell wall. Pili and flagella were often given. As already mentioned, some candidates named structures only found in eukaryotic cells, having not read the question carefully.

(b) (i) No great difficulties here, the majority of candidates stating growth, repair and replacement, occasionally giving asexual reproduction, as three roles of mitosis in plants. Some candidates inappropriately referred to the growth of cells and the repair of dead cells, rather than tissues or to reproduction unqualified. There were references to elongation (rather than growth). This can be the result of vacuolation. Other candidates did not seem to understand 'roles' and simply stated in various ways the maintenance of genetic uniformity/stability. Some candidates concentrated on roles in specific plant cells and structural areas. Others ignored the rubric and listed more than three roles.

(ii) In explaining why cells produced by mitosis are genetically identical, able candidates referred to semi-conservative replication of DNA (as opposed to just DNA replication) with base pairing, each polynucleotide acting as a template, the resulting identical (sister) chromatids separating in anaphase, with daughter cells having the same genotype/alleles/DNA. Many simply stated that the daughter cells had the same diploid number of chromosomes as the parental cell. Some candidates used up all the available answer lines in describing how mitosis differs from meiosis, with much reference to no synapsis/crossing over/independent assortment, in explaining the lack of genetic variation in the daughter cells. Several candidates described the stages of mitosis and concluded that it produced identical cells

Question 2

There were several good responses to this question, although **(a)(ii)** and **(b)(ii)** caused some candidates difficulty and resulted in low scores.

(a) (i) Sound answers named **A** as haem/prosthetic group as the site of attachment of oxygen in haemoglobin with a majority of candidates stating in addition that the oxygen binds to the iron ion/Fe^{2+}/FeII, in haem. Weaker candidates referred to **A** as an active site and many had oxygen binding to iron.

(ii) In explaining why a molecule of haemoglobin has both a tertiary and a quaternary structure, only the most able candidates respectively mentioned the folding of polypeptide chains to give a complex 3D shape and that there was more than one polypeptide. Few referred to the folding of secondary structures/alpha helices in explaining tertiary structure. Many candidates simply described the structure of the haemoglobin molecule without any specific link to the terms *tertiary* and *quaternary*. There were many incorrect references to the twisting and bending of polypeptides and even to 'polynucleotides' being folded. Others made vague references to the haemoglobin molecule itself being folded, listed all the bonds involved, for example hydrogen, ionic and hydrophobic interactions, as referring to *tertiary*, whilst some linked the four haem groups and the four R group interactions with *quaternary* structure.

(b) (i) The vast majority of candidates were able to accurately read the graph and state the percentage saturation of haemoglobin with oxygen at 4 kPa and 12 kPa as 58 and 100 per cent respectively.

(ii) This proved difficult for some candidates. They were unable to clearly explain that, for a small decrease in partial pressure from 6 to 2 kPa, the range of partial pressure of oxygen in respiring tissues, there is a large change in % saturation of haemoglobin with oxygen, so helping in the delivery of oxygen to the tissues. The better candidates often used percentage figures taken from Fig. 2.2 to support their explanations. Several candidates inappropriately made reference in their answers to an increase in the partial pressure of carbon dioxide in the tissues. Others, as mentioned previously, referred to the increased saturation of haemoglobin as the partial pressure of oxygen increased from 2 to 6 kPa, often giving details of the distortion of the haemoglobin molecule and its ability to take up oxygen. The question referred to the delivery of oxygen to respiring tissues and required reference to the unloading of oxygen/dissociation of

(oxy)haemoglobin, rather than the collection of oxygen at the lungs and its subsequent transport to the tissues where the oxygen is unloaded.

(c) Most candidates understood that an increase in the concentration of carbon dioxide would produce a dissociation curve to the right of the existing curve given in Fig. 2.3, though not all accurately sketched a curve with the same shape beginning at 0 and ending at 95+%. Many candidates produced a curve far too far to the right of the given oxygen haemoglobin dissociation curve. A significant number of candidates had the two curves merging before 100%, whilst others sketched a curve which did not clearly begin at the origin. Several sketched a curve completely to the left of the one given.

Question 3

There were some encouraging answers to this question, though all parts caused many candidates difficulty.

(a)(i) In describing and explaining two features of xylem vessels visible in Fig. 3.1 which are adaptations for the transport of water, only the most able candidates made some reference to hollow tubes/no cell contents offering little resistance to the movement of water, wide tubes allowing large volumes to be transported or thickened walls preventing collapse (under tension). Weaker responses simply referred to xylem vessels with lignin (not visible in Fig. 3.1) in their walls or to xylem vessels being dead. Where thickened walls were given they were often said to prevent 'bursting' rather than to prevent collapse (under tension) of the xylem vessel. Some candidates thought the thick walls were adaptations to give mechanical strength. Many candidates identified appropriate features but gave inappropriate explanations, for example hollow tubes, to allow mass flow. Many candidates ignored the word 'visible' and gave features which they could not see, such as pits and the absence of cross walls.

(ii) Many candidates did not understand the mechanisms involved in the movement of water in xylem vessels, as was shown by their often inappropriate use of terms such as water potential, concentration gradients, diffusion, osmosis, active transport, cohesion, adhesion, capillarity and evaporation, all of which were mentioned in a variety of biologically incorrect explanations. Only the best candidates referred appropriately to the evaporation of water from mesophyll cell walls, to the importance of water potential gradients in the leaf, explained the role of cohesion and adhesion of water molecules, with water being 'pulled up' under tension, whilst referring to transpiration, pull and stream/column. Mass flow mentioned by many candidates is a mechanism that required explanation. Even the most able occasionally found it difficult to sequentially explain the role of the above mechanisms. Some of the better candidates still consider that water in the xylem is under a positive pressure (rather than tension) with water moving from a region of high hydrostatic pressure to a low hydrostatic pressure. Several inappropriately gave details of the uptake of water by roots and its passage across the root to the xylem vessels, giving unnecessary detail of the apoplast and symplast pathways.

(b) The vast majority of candidates could name three hazardous substances found in burnt tobacco but not all could precisely describe one effect of each on the body. The most able candidates referred to carcinogens causing mutations (rather than cancer) and carbon monoxide combining with haemoglobin to form carboxyhaemoglobin (rather than stopping oxygen reaching the body). Tar and nicotine were often named and their effects described appropriately, for example damaging cilia and increasing heart rate respectively. Several candidates referred inappropriately to heart attacks, lung cancer and strokes. A considerable number insisted on giving more than the required one effect and perhaps expected the Examiner to choose a correct response (often at the end) from a list that included incorrect effects.

Question 4

There were many encouraging answers to the whole of this question, especially in **(b)**.

(a) The vast majority of candidates referred correctly to the sino-atrial node/SAN rather than the pacemaker in being the source of the electrical activity in the heart. The AVN, medulla oblongata and brain were occasionally given. Some candidates gave electrocardiogram having misread the question.

(b) Many candidates correctly explained how the heart is coordinated so that the ventricle contracts after the atrium has contracted. There were appropriate references to the SAN sending out impulses which spread across the atria, to the non-conducting tissue, which prevents the wave of excitation reaching the ventricles, a delay allowing the atria to contract/ventricles to fill. The role of the AVN in 'relaying' the impulse to the Purkyne tissue and to the apex of the ventricles was clearly understood by many. Weaker candidates referred to electrical messages, pulses or signals, had Purkyne tissue involved before the AVN, or misunderstood completely what the question required and explained how blood circulates through the heart with reference to the opening and closing of the appropriate valves.

(c) In accurately calculating the heart rate, the majority of candidates stated 60/0.8 = 75 (beats min^{-1}). Several candidates however demonstrated considerable inaccuracy in the reading of the electrocardiogram (ECG) shown in Fig. 4.1 in attempting the calculation, and values ranged widely. Examiners allowed 0.78 to 0.8 seconds as the time taken for one complete heart beat. Candidates are advised to think about whether their calculation gives a physically possible answer.

(d) In explaining why the pressure of the right ventricle is much lower than the left ventricle, many candidates made reference to the ventricle only having to pump blood a short distance from the heart to lungs or a longer distance around the rest of the body if referring to the left ventricle. Many candidates made both points. Few however made any reference to relative resistance to flow from either of the ventricles and even fewer to the force required to generate the respective pressure. Some candidates did refer appropriately to the relative thickness of the ventricle walls, though several still inappropriately stated that this is to withstand the pressure generated. A few candidates incorrectly compared pressures and wall thicknesses in atria and ventricles.

Question 5

A significant number of candidates produced disappointing answers to this question, in particular in parts **(b)** and **(d)**.

(a)(i) In naming the organism that causes tuberculosis, weaker candidates made occasionally incorrect reference to bacterium, virus or microbe, and even the better candidates occasionally referred to *Myobacterium* (rather than *Mycobacterium*) in their answer. Several candidates still demonstrate inappropriate use of upper and lower case letters. **M** is required for *Mycobacterium* and **t** for *tuberculosis*/**b** for *bovis*. Some candidates named the genus only.

(ii) In explaining how TB is transmitted from an infected person to an uninfected person, many candidates did refer to sneezing/coughing/breathing out, though not all mentioned the aerosol/air droplets when referring to inhalation by the uninfected person. Several candidates referred to bacteria being inhaled. As in a previous session exam paper, some candidates had not read the question sufficiently carefully (the question referred to transmission from an infected person to an uninfected person) and mentioned transmission via cows/unpasteurised milk. Some candidates continue to confuse TB with HIV/AIDS and described sexual transmission.

(b) In explaining the advantage of expressing the number of cases and number of deaths (from TB) as 'per 100,000 population', the most able candidates referred to the total populations of the WHO regions as being very different, and so this measure allowed a fair comparison, though few indicated that this would show where the impact of TB was greatest. Very few candidates made reference to being able to calculate the incidence/prevalence rates. Weaker candidates made general reference to making the figures easier to read and understand or more accurate/reliable. Many candidates thought Table 5.1 represented percentages or that 100,000 people were surveyed in each area.

(c) Some candidates had difficulty in using the information in Table 5.1 to outline the reasons why TB has a greater impact on the health of people in some regions than in others. Good answers made reference to TB being a disease of poverty with people living in overcrowded conditions/close proximity and often where the high levels of HIV infection weaken the immune system to this opportunistic disease. Other appropriate answers made reference to the relative effectiveness of TB control regimes and the difficulties of accessing and using antibiotics to control TB in some regions. Weaker responses were often characterised by general references to the availability of medicines, lack of money, poor sanitation and hygiene. Even good candidates were imprecise in their answers. They referred in general to poor countries with overcrowded populations rather than

poor people living in overcrowded accommodation. Few used comparative data to support statements regarding the infection rates in different regions.

(d) In explaining why TB has not been eradicated even though a vaccine has been available since 1921, a few candidates confidently referred to the vaccine being ineffective, not always giving lasting protection with no worldwide vaccination programme being in place, as there was for smallpox. Occasionally, a candidate did refer to the difficulty of carriers/symptomless people and that the bacterium can remain in the body for a long time often as an intracellular parasite. This was a question regarding the effectiveness of vaccines in preventing TB but there were many answers which contained explanations based on the difficulties of treating TB infection with antibiotics, with reference to resistance, cost and length of treatment. From the answers given it would seem that many candidates either misunderstood/misread the question or are not clear as to the difference between vaccines (prevention) and antibiotics (treatment). Several candidates simply restated what they had given in response to **(c)**.

Question 6

A sound level of response from many candidates but relatively few gave clear, precise answers.

(a) In defining the term *ecosystem*, several candidates referred to a community (of organisms). Not all, however, referred to the abiotic factors (the physical environment) or emphasised the interaction between organisms, and between organisms and the physical environment. Many candidates failed to qualify 'environment'. Several candidates incorrectly mentioned the interaction between "living and non-living things". Only the better candidates referred to the ecosystem being self-contained. Where candidates gave another example of an ecosystem, this was not usually to illustrate a point in their answer. Statements such as 'another example of an ecosystem is a "large bush", "a desert" or "the world" were common.

(b) Candidates were asked to explain why 'big, fierce animals' are rare in ecosystems. Some candidates failed to recognise the link between the question and the syllabus (energy flow). Able candidates understood that these secondary/tertiary/top of the food chain consumers require much energy and with little energy being trapped by producers, and energy being lost between trophic levels along the food chain, numbers of top carnivores would be relatively few. Only occasionally did candidates answer the question in terms of fierce animals needing a large habitat to provide sufficient food and the need to be fierce in maintaining their territories, to competition and the effect of hunting and poaching. Some candidates considered rarity as being essential to maintain the stability of the food chain, if there were too many they would eat all the herbivores and the producers would overproduce.

(c) The Examiners were looking for some reference to legumes having *Rhizobium* in their root nodules, carrying out nitrogen fixation and therefore not being dependent on nitrate ions in the soil in explaining why leguminous trees grow well in the nitrogen-deficient soils of many tropical islands. A few able candidates made additional reference to ammonium ions being used by the plants to make amino acids for growth and reproduction. Some candidates inappropriately gave details of nitrogen fixation in the soil or referred incorrectly to nitrifying bacteria in the root nodules of legumes. Weak candidates had nitrogen fixation in the root (rather than root nodules) or, as some thought, in the legumes, gave abbreviated accounts of the nitrogen cycle and considered lightning to be an important source of fixed nitrogen in tropical islands. Very rarely was mention made of mycorrhiza in candidates' explanations.

BIOLOGY

Paper 9700/31

Advanced Practical Skills 1

General comments

The majority of Centres returned the Supervisor's report with their results, which is important to ensure that candidates are not penalised for any problems encountered with the practical.

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. It is hoped that the trend of drawing what can actually be seen down the microscope will continue. Marks are not awarded for additional details, which cannot be observed. Unfortunately, too many candidates did not turn over to attempt the high power drawing. Centres are reminded that candidates should be made aware before the examinations that 'Turn over' at the bottom of the page means that the paper continues.

Centres are reminded that this paper is skills based and that candidates should be made aware of the skills that may be assessed. These skills are clearly explained in the syllabus, for example graph plotting. Following instructions and then answering the question carefully are very important in gaining the marks.

Centres are also reminded to make their candidates aware of the importance of the use of relevant numbers of significant figures, and that this applies in all situations, including where calculations are being made i.e. that the number of significant figures is generally no more than those used in the data. For example, if the number of eyepiece graticule units is a whole number, then the answer should also be in whole numbers.

Candidates are reminded that some assessments are for their reasoning of how to make a calculation, so that where they are asked to show their working, it is their working which is important.

Comments on specific questions.

Question 1

(a) (i) It was clear that the vol unit used for hydrogen peroxide was unknown to many candidates, and therefore this was ignored.

However, hydrogen peroxide was required in the heading and the mark was lost if this was repeated in the body of the table.

It was pleasing that most candidates were able to gain the mark for the single table drawn with clear cells.

(ii) The main error was not selecting the most significant error in the experiment carried out, which was either the problem of the bubble size or rate of release, or the problem of making the apparatus air tight.

(iii) Candidates need to know the difference between improving accuracy by having more concentrations, and improving the reliability by repeating the experiment and providing practical methods of keeping variables constant, such as the use of a buffer or water-bath.

(b) (i) Many candidates did not appreciate that it was important to keep the volume the same for each original piece of potato and then to obtain different surface areas by cutting each piece into a different number of pieces. Many candidates did not score the mark for explaining practically how they would achieve this, for example by using a cork borer or scalpel.

(ii) It is important that candidates appreciate the difference between a control for an experiment and the control of variables. A control in this case should have been to use boiled potato tissue to show that it was the enzyme in the potato which catalysed the production of the gas from the hydrogen peroxide.

(iii) It was pleasing that many candidates were able to draw the graph with the *x*- and *y*-axes orientated correctly and labelled with units, to use an easy scale e.g. not 30 to 2 cm, to plot the points accurately as crosses or dots in circles, and then draw the line as a smooth curve through each point or join each point with a ruled line. Awkward scales were penalised and this meant that the plotting could not be awarded either. Examples of the scales most likely to be needed are in the syllabus section on practical skills. The plotting of points is also described in the syllabus and will in future be applied so that candidates using large 'blobs' and not a dot in a circle or a cross will not be able to gain the plotting mark.

(iv) and **(v)**
These were marked together as some candidates only described the relationship clearly in **(v)**. It was disappointing that only the more able candidates explained the relationship in terms of there being more active sites which could then form enzyme-substrate complexes. Some candidates thought there was only one active site, whereas there were actually many and the larger the surface area the more active sites would be exposed.

(vi) Generally, so long as the scale chosen was easy, the candidates correctly read off the value. However, candidates must be aware of the appropriate number of significant figures e.g. where a 2 mm square represents 4 then it is only possible to estimate to half a square, that is in values of 2 with any certainty.

(vii) Better candidates realised from the information that they needed to divide 40 by their value from **(b)(vi)**. Again the number of significant figures needed to be taken into account i.e. whole numbers being divided requires an answer in whole numbers. The most common mistake was to divide into 1.

(c) In answering this type of question candidates need to think carefully about what is being varied and how to vary it. Two marks were awarded for giving examples of five temperatures not below 5° C and not above 80° C in even divisions and to use a water-bath to keep each temperature constant. Marks were awarded for keeping other variables constant such as the volumes of the potato extract and hydrogen peroxide, concentration of hydrogen peroxide or repeating each measurement. Candidates should avoid the use of 'amount' as it is expected that they should be able to suggest appropriate volumes.

Question 2

(a) Most candidates correctly gave 100 as their answer.

(b) (i) There was no mark for this but the value was given a mark for its correct use in **(b)(iv)**.

(ii) This needed a comparison to explain that the extra magnification of the stage scale resulted from the objective lens.

(iii) Ideally candidates should have used the value from **(a)** to calculate the value in micrometres by dividing 100 by their value for **(b)(iii)**. This is because the unit used for microscopes is micrometres. The candidates should also again be made aware that dividing whole numbers should give an answer in whole numbers. Candidates were not penalised on this occasion for the use of millimetres.

(iv) Candidates generally showed the correct working using their value from **(b)(i)** and multiplying it by their calculated value from **(b)(iii)**.

(c) Candidates need to be aware that it is important to only draw what is asked for in the question and to look carefully at what they can see in one quarter of the section, for example five to seven vascular bundles should have been drawn. Some candidates are still not aware that no cells should be drawn and the drawing should occupy at least a third of the space provided. Proportions are also important especially observing the spacing of the vascular bundles, which were much nearer to the epidermis than the pith. Some candidates failed to observe the pith and a few did not realise that this was a stem and not a leaf. It was also very obvious that there were large and small vascular bundles. Candidates need the opportunity to explore different slides and practise drawing what they see. There was a pleasing improvement in the standard of drawing with pencil with clear and unbroken lines.

(d) There were some very good drawings of the correct cells, a minimum of three, (a phloem sieve tube with two adjacent cells), and a maximum of eight.

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

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 thicknesses, shapes and relative sizes.

BIOLOGY

Paper 9700/32

Advanced Practical Skills 2

Question 1

(a) Credit was given to candidates who described the Benedict's test for a reducing sugar. Those who recognised the need to heat to between 80°C and boiling point and use a volume of Benedict's reagent equal to, or greater than that of the test solution gained a mark. Those who recorded the meaning of the test as being for 'a reducing sugar' were awarded a further mark.

Marks were lost when candidates stated that the test was for a specific sugar, such as glucose or sucrose.

(b) (i) Candidates who had been prepared in the skill of constructing a meaningful table using collected data scored high marks. Frequently units were written in the body of the table and +/– symbols were not recorded to show loss or gain in mass. In these cases marks were lost.

(ii) Many candidates had an insecure grasp of the concept of determining the uncertainty of data. In this case, with the available scale, +/– 0.5 mm was the answer. It could also be expressed as a percentage of the measured length.

(iii) An error in measuring length could have been made because of the limitations of a rule with mm units or because the edges of the potato strips were not straight. Parallax errors were also possible if the rule's divisions were not viewed exactly at right angles.

(c) (i) A vague answer, such as "use a controlled temperature" was not accepted. There should have been a reference to a water bath or a thermostatically controlled environment using an air conditioner or incubator.

(ii) Those candidates who read the question carefully and identified sources of error rather than methods of improvement scored full marks.

(d) (i) The answer should have been calculated correctly and expressed to one significant decimal place i.e. either –8.8 or –8.7. The most common error was to record the answer as –8.75. This does not conform to the requirements of the AS and A Level syllabus specifications.

(ii) Most were able to recognise the anomalous reading in the data and stated that it should be discarded or that the procedure for 0.8 mol dm^{-3} should have been repeated.

(iii) Again, the correct procedure for plotting graphs should have been followed, as stated in the syllabus. Those who lost marks often did so because they chose scales which were impossible to use to plot points accurately within half of a small square on the grid. Points should be made as small crosses or dots within circles. Most obtained the mark for drawing a line of best fit.

(e) The suggested improvements, needed as an answer, included using a wider range of sucrose concentrations within stated limits and replicating the procedures.

(f) This proved to be the most difficult item on the whole paper. It discriminated the more able candidates who took note of the carefully constructed question. Candidates should have recognised that the stated hypothesis was only true within a certain range of sucrose concentrations. So the hypothesis required qualifying by stating the range within which it was true and the range in which it was not true. It was rare to allocate full marks here.

(g) Full marks were often given to the responses to this question. The most common correct answers were “to repeat the experiment”, “to increase the concentrations of the solutions” and “to cover the Petri dish”.

Question 2

(a)(i) This was generally well done by candidates who had been trained to draw clearly and accurately. Compared to previous years, it was pleasing to see fewer shaded diagrams or attempts at drawing cells in this plan diagram. If the correct number of layers in the trachea were shown together with cartilage (not labelled) as a complete or incomplete C-shaped structure, credit was given.

(ii) There are still candidates who have a tenuous grasp of the method used to calculate the magnification of drawings using a microscope. The simple principle of diameter of the drawing/diameter of the specimen = magnification was not always used. Consequently, in many cases, two potentially easily obtained marks were lost.

(b)(i) In living cartilage, chondrocytes fill the lacunae. Each cell has granular cytoplasm and a nucleus. During histological preparation, however, the chondrocytes always shrink away from the margins of the lacunae. Credit was given to those who recorded these features in clear line drawings. Most drew lacunae and the nuclei but did not include the cell membrane or cytoplasm correctly. Expected labels were any two from *nucleus, cytoplasm, cell membrane.* Full marks were rarely given.

(ii) Those who recorded the comparisons as a table scored high marks but other ways of recording comparative statements were accepted as long as the diffences were visible. Therefore credit was not given to those who used “text book” terms which could not be distinguished on the slide or photomicrograph. e.g. the various tunicae or the vasa vasorum associated with the blood vessel or goblet cells in the trachea.

(iii) The observation which related the movement of materials to the function was the lumen or space within the two structures. Most were able to score this mark.

BIOLOGY

Paper 9700/04
A2 Structured Questions

General comments

This paper was the first in the new format for this cohort and so it is difficult to compare it directly with previous papers, although the layout was very similar to the old paper 4. It was, however, thought to be slightly harder than the previous paper 4 but provided a very good range of marks with good candidates being able to score highly.

Candidates from some Centres had been thoroughly prepared but many others struggled to recall basic factual material or to apply their knowledge appropriately. Examiners commented on the poor responses in general, with some questions perceived as difficult and few sections gaining maximum marks. Surprisingly **Question 6** proved to be often low scoring though on closer inspection what was really lacking was detail. The better candidates had no problems with the more straightforward questions such as **1**, **3(b)**, **8(a)**, **10** and **11(a)**. There seemed to be a general weakness in graphic interpretation, with figures commonly quoted incorrectly. More candidates than expected attempted **Question 11**, usually the weaker ones, with part **(b)** very low scoring, being mainly answered in terms of natural selection not gene expression.

Comments on specific questions

Section A

Question 1

(a) A few candidates measured the organisms incorrectly. The majority knew how to perform the calculation but there were many errors in converting centimetres to micrometres. Credit was given if the same error was carried out twice.

(b) Many candidates failed to name both kingdoms correctly. Protoctista was commonly misspelt or only identified as eukaryotic.

(c) A few Centres had prepared well for this, listing the expected prokaryotic features versus eukaryotic features (in the case of the Protoctist). However, many candidates failed to appreciate that this was required, only mentioning the presence and absence of membrane bound organelles or appropriate sizes of ribosomes at best. Very few candidates scored full marks in this section.

Question 2

(a) It was generally understood that biodiversity was shown by the variety of species present. The importance of having variation in the genetic make-up between and within species was rarely acknowledged. The idea that biodiversity involved the presence of a wide range of habitats was not appreciated.

(b) A number of vague references were made to the availability of food. This was not explained as being due to the many different types of plants, rapid plant growth or the idea of food being available all year round, so was insufficient to gain credit. A few candidates correctly described the provision of many habitats or niches.

(c) Most candidates scored well on the economic role, mentioning provision of medicines, food, timber or ecotourism. The role of maintaining a gene bank and the ways in which species were interdependent were also described well on the whole. Surprisingly few gained credit for an ecological role, as details such as nutrient recycling or maintaining a stable climate were generally poorly described. The idea of an ethical role in sustaining indigenous people was not appreciated.

Question 3

(a) Most candidates could recall the symptoms of cystic fibrosis well.

(b) Candidates were required to draw a fairly straightforward genetic diagram and this was usually answered clearly showing the genotypes and phenotypes. Common errors arose where candidates did not link the genotypes to their phenotypes or forgot to state the probability that was requested in the question. Some candidates did not give the genders of the phenotypes and a surprising number were unable to list the correct gametes. Some credit was given to candidates who had used incorrect gametes.

(c) This proved to be a good differentiator. A few excellent responses were seen describing base substitution, deletion and addition, together with their effects on the DNA code and subsequent transcription and translation but many gave insufficient detail of how the changed coding would lead to the change of amino acid sequence.

(d) (i) Most noted that the **A** bases were absent but some failed to notice the loss of a **G** base.

(ii) The lack of the amino acid coded by **AAG** was noted fairly often but few attempted further detail of the changes to the primary or tertiary structure of the polypeptide that would follow.

Question 4

(a) 'The maintenance of a stable internal environment' was expected as a general statement along with the roles of receptors and effectors in detecting a change in a parameter and the production of a suitable response to return to the norm or set point. Relatively few adequately described the role of receptors or effectors but most noted the idea of returning to the 'norm'.

(b) A lack of detail was a problem with responses here. Most candidates did not mention the enzyme being immobilised. References were made to pH changes without mentioning the release of H^+ causing a current to flow or that the current would be proportional to the concentration of H^+ or glucose. Some candidates described the alternative method using platinum electrodes to measure the change in the concentration of oxygen as it was used in the reaction.

Question 5

(a) (i) Most candidates referred to the rate rising and falling, although not all mentioned the peak at 18^o C or gave figures.

(ii) If candidates referred to enzyme involvement they were able to gain credit from describing increased kinetic energy, more collisions or denaturation above the optimum. Alternatively the effect of increased transpiration rate, closing stomata, so that carbon dioxide was less available, was also creditworthy. Reference to the effect on the light independent reaction was occasionally made.

(b) (i) Most candidates selected the right graph lines for comment and noted the difference between the peaks. While many described maize as having a greater rate of photosynthesis, some responses only referred to the difference in one half of the graph. Figures were frequently incorrectly quoted.

(ii) It was pleasing to see many candidates able to describe the anatomy of a C4 plant in some detail. The bundle sheath cells being kept away from air to prevent oxygen competing successfully in photorespiration was well described. It was rarely noted that this anatomy allows carbon dioxide to accumulate or that the light independent stage takes place here. Many comments were made about stomata but these were not generally related to effective photosynthesis.

(iii) Most responses did not link the membranes to the light dependent reaction. The idea that there would be less chlorophyll to absorb light or less surface area for light absorption was expected.

(c) (i) Most answered this correctly, although some referred to the germ of the seed.

(ii) Many candidates made contradictory statements concerning firstly oil being respired followed by when starch was respired, instead of comparing the overall energy values of the grains. It was usually noted that oil provides more energy than starch (per unit mass). Few calculated the total oil and starch as a percentage of dry mass or realised that overall sorghum would have a higher energy value, since the extra oil in maize does not outweigh the greater starch content of sorghum.

Question 6

(a) Very few candidates mentioned oocyte collection and made references to ova or eggs. Many seemed to think the sperm was injected into the egg rather than the use of motile sperm in glass with the oocytes. Only a few mentioned the selection of embryos or the size of embryos before implantation, or the need to implant more than one to increase success. Better candidates realised that the woman would need to be given hormones to maintain the endometrium.

(b) (i) This question was poorly answered. Some candidates got the idea that women produce fewer eggs or fewer hormones, but many simply said eggs were not 'healthy' or the womb was not 'healthy' enough. Few mentioned 'viable' eggs or chromosomal abnormalities.

(ii) Most candidates mentioned the low success rate or the success rate decreasing with age. Others took a religious stance to the exclusion of any other.

Question 7

(a) There was some confusion about what got oxidised and reduced, but on the whole this was competently answered.

(b) (i) This should have been straightforward but again candidates seemed not to be able to describe a simple graph. Many tried to explain what was happening rather than confine themselves to a description of the graph itself and hardly any mentioned an initial 'steep' increase. It was disappointing to note that many were not able to accurately read figures off a graph.

(ii) Most candidates did well in this question although some thought that aluminium was an inhibitor despite the trend shown by the graph.

Question 8

(a) Many candidates were able to state depolarisation, repolarisation and hyperpolarisation but were unable to describe clearly what was happening during these events. A common mistake was to refer to ions going into or out of the membrane rather than the axon or neurone.

(b) Hardly any candidates seemed to understand that it is the potential difference, not the stimulus, which has to overcome the threshold value for an action potential to occur. Consequently, few candidates scored well in this question.

Question 9

(a) A surprising number of candidates thought that poverty, lack of hygiene and lack of preventive devices were the reasons for the distribution of malaria. Those who mentioned mosquitoes seldom explained that the mosquito was the vector of the disease, and a lot of them actually said mosquitoes caused malaria.

(b) Most candidates knew about the relationship between sickle cell anaemia and malaria. A large number were unable to explain the relationship in genetic terms. It was hoped that reference would be made to heterozygotes having a selective advantage and surviving malaria, and therefore passing on the recessive sickle cell allele.

Section B

Question 10

(a) Many candidates displayed an excellent knowledge of photosystems and were able to gain full marks.

(b) This question was able to distinguish between better and weaker candidates. Good candidates were able to describe the role of NADP in concise terms, while weaker ones tended to describe as much of the light independent stage as they could in the hope of picking up marks somewhere.

Question 11

(a) Many weaker candidates unwisely chose this question. While credit was given for the mention of 'crossing over' and 'independent assortment', more detail was required to gain good marks. It is disappointing that many still incorrectly refer to 'independent assortment' as 'random assortment'.

(b) Unfortunately, it was evident that many candidates had not read the question carefully enough and wrote about different phenotypes suiting different environments rather than the direct effect of the environment on the phenotype. A lot of time was wasted on descriptions of multiple alleles in rabbit coat colour and the effect of the industrial revolution on the peppered moth.

BIOLOGY

Paper 9700/05

Planning, Analysis and Evaluation

General comments

There was a wide range of performance by the candidates. Although there were candidates who showed a good understanding of the principles of planning, analysis and evaluation, there were far more who did not seem to be able to do more than basic analysis. It appears that many candidates seem to have little experience of practical work with the rigour and precision that is expected for this examination. **Question 1(b)**, for example, showed than many candidates could not suggest a simple procedure to measure rate, while **Question 2(b)** similarly indicated that that many candidates are uncertain of the difference between uncontrolled variables and design features of an investigation. It was also evident that there were candidates who could not distinguish the independent variable and dependent variable, consequently limiting their ability to answer **Questions 1(a)(ii)**, **1(b)(i)** and **2(a)(ii).** As in the June 2007 examination there also appears to be misunderstanding of terminology used for evaluation, in particular reliability, accuracy and significance.

In many Centres there was tendency for candidates to repeat themselves or write out the question before addressing the answer. Candidates should be reminded for that questions that specify a number of responses, such as **Questions 1(a)(ii), 1(a)(iii)**, and **2(a)(iii)**, only the required number are marked.

The skills used for presenting and interpreting information in graphs are required for this paper and were often lacking. For example in **Question 1(a)** many candidates reversed the axes. Mathematical skills are also required. In **Question 2(a)(i)** many candidates did not appear to know how to calculate a percentage difference and in **Question 3(b)(ii)** many did not appear to know how to use a probability table.

Comments on specific questions

Question 1

Answers to this question showed clearly those candidates who had experience in practical work. There were many who had a theoretical knowledge of some photosynthesis experiments and described these in their answer, rather than using the information given. It might be of benefit to candidates to draw sketches of the experiment based on the information in the questions so they are less likely to forget that they are dealing with an experiment rather than theory.

(a) (i) The majority of candidates knew the shape of the graph, but very many reversed the axes. Some candidates also used labels from experiments that they knew about, for example, number of bubbles of oxygen on the *y*-axis. Other candidates tried to use the pH of the solution or the colour of hydrogen carbonate indicator. However, none of these labels made reference to a time unit.

(ii) Candidates who knew that light intensity was the independent variable were usually able to suggest two ways of changing the intensity. The most common were to move a standard light source to different distances from the algal balls, or to use a light source with an adjustable intensity. Only better candidates were able to suggest a third option. Some candidates confused intensity and wavelength and so suggested using coloured filters as an option. Other candidates did not show an understanding that a range of light intensities was needed and so gave absolutes, such as ‘in sunlight’, ‘covered by foil’ or ‘in a dark room’. Candidates who were uncertain about the independent variable often described three variables other than light.

(iii) Most candidates gave a correct answer, although there were some candidates who gave very generalised answers, such as ‘to remove impurities’ and ‘to clean the balls’. Candidates should relate their answers to the specific information given.

(b) (i) Overall this part was poorly answered as many candidates did not seem to be able to suggest a simple procedure using the indicator to measure a rate. Very few candidates described an experimental set-up using both the algal balls and the expected colour change of the indicator. Given that the dependent variable was a rate, it was surprising that time was rarely mentioned. Some candidates described a different investigation, for example counting bubbles or placing potted plants under bell jars. Very many candidates simply rephrased the information in Fig. 1.1 about how the indicator works. There was also some confusion between hydrogen carbonate indicator and potassium or sodium hydrogen carbonate as a source of carbon dioxide. These candidates appeared to be trying to use theoretical knowledge about a substance with a similar name but totally different function, consequently giving confused answers about the release of carbon dioxide during photosynthesis causing the indicator to become yellow. A number of candidates stated that carbon dioxide is a product of photosynthesis.

(ii) As already stated, many candidates did not appear to know the difference between reliability and accuracy. A very common error was to reverse the two statements. Those candidates who knew that reliability was related to the number of measurements, often mentioned repeats but did not then refer to a mean or to a series of consistent results. Candidates who knew that accuracy was related to the method of measurement sometimes mentioned a colorimeter, but very few know how this apparatus works. A few candidates also referred to a calibration system of known carbon dioxide concentrations. A common incorrect approach was to change the method of measurement from colour to pH.

Question 2

Overall this question was not well answered, in particular part **(b)** where many candidates could not separate the experimental design features from the variables in the experiment. In general, candidates did not seem to be familiar with investigations using human subjects and thus missed the standard sources of error such as sample size, age, gender and body mass. Many candidates also did not address other common features of experimental design such as the need for repeat measurements and a range of concentrations.

(a) (i) A surprising number of candidates could not calculate the percentage difference. A common error was to use the mean reaction time after coffee for the calculation, giving a value of 13%. Other common incorrect answers were 2% and 88%. Many candidates who did the calculation ignored the instruction 'to the nearest whole number'.

(ii) Many candidates were unable to identify both the dependent and independent variable; of those who did, a high proportion reversed them. Common incorrect answers for the independent variable were subject, age, sex and temperature.

(iii) Most candidates gave two correct suggestions, but relatively few were able to give three different factors. The most common correct answers were age, gender, body mass, metabolism, previous coffee intake and state of health. The most common errors were temperature of the water, amount of coffee and reaction time. Some candidates repeated the same idea in different ways, for example, height and weight.

(b) Overall this part was poorly answered as many candidates did not get any further than identifying the different pattern of subject B. There was a tendency to analyse the individual results rather than the overall pattern. Only better answers made use of the mean values calculated in **(a)(i)**. Hardly any candidates considered the overlapping nature of the 'before' and 'after' results. Candidates who addressed the experimental design recognised that the number of subjects studied and the caffeine concentration was too limited for definite conclusions. Better answers also considered the balance in the gender and age distribution of the sample tested. There were other candidates who recognised these factors, but their answers tended to be too vague for credit, for example, 'the age is not controlled'. A few better answers also referred to the lack of repeats and statistical testing.

Question 3

It was evident from the answers to this question that many candidates had not used a chi-square test in an ecological context. Very few appeared to understand the principle of a null hypothesis and consequently found it difficult to explain their calculated values in part **(b)(iii)**. A number of candidates did not attempt any of the calculations for this question. The mark scheme for this question was operated to allow candidates to use whatever figures they had calculated for the expected values to be used as a basis for answering the

question. Examiners were looking for an understanding of how to find the chi-square value from the completed data table, how to determine the number of degrees of freedom and how to use a probability table to decide on the statistical significance of the chi-square value.

(a) (i) Only a minority of the candidates were able to state a clear null hypothesis. The majority of candidates stated a working hypothesis and then set out to test the hypothesis. Common incorrect hypotheses were, 'grazing will reduce the number of moths' and 'the moths will be affected by grazing'. Another common incorrect type of hypothesis was 'the expected and observed ratios/results will be the same', suggesting that candidates were more familiar with using chi-square as a test for goodness of fit of a frequency distribution such as a genetics ratio.

(ii) Most candidates did not appear to realise that when chi-square is used to test ecological data, it is testing that two factors are independent of each other, so the usual assumption is that there is no difference in the distribution of organisms between any of the sites from which data is collected. All that was required to obtain the expected values was a simple addition and division by three of the observed data. As most candidates were looking for a ratio the figures used for expected values were wildly variable and in many cases it was difficult to establish how these had been derived. Credit was given for correct calculations using these figures. Candidates should be encouraged to limit the number of significant figures used in presenting their answers, rather than simply copying down the entire number from their calculator.

(**iii)** Most candidates gave a correct answer, although a great many used more significant figures than was appropriate for the probability table. Some candidates incorrectly divided the total of the final column by three.

(b) (i) Answers were very variable. Candidates who showed an understanding of chi-square test usually gave a correct answer. The most common incorrect answers were 3, 6, 20 and 40.

(ii) Again there was great variation in the ability of candidates to use the probability table. Marks were allowed for candidates who had an incorrect chi-square value and incorrect degrees of freedom if they were able to use the table to state a correct probability from their figures. Many candidates, however, gave a chi-square value from the table rather than the probability, and others were confused as to whether their value indicated a greater or lesser probability than those in the column headings. It was also common to see 0.05 without any reference to greater or lesser probability.

(iii) While there were a few excellent and clearly stated answers**,** for many candidates their unfamiliarity with the concept of a null hypothesis and the meaning of statistical significance was reflected in muddled and contradictory statements. For example, common types of answer were 'the results are significant so the null hypothesis is accepted as the results are due to chance' and 'the results are not significant, so they not due to chance and so the number of moths will decrease if grazing land is increased'. For many candidates, it is likely that they were unable to explain their results as they were uncertain as to whether they were dealing with probabilities greater than or less than 0.05. Often, when the significance was correct when compared to their results, candidates then the opposite argument when discussing the consequences. There was a tendency, especially in poorer answers, to drift into an explanation of the raw data. As already stated, examiners were looking for understanding of how to interpret significance, so candidates who gave an explanation consistent with their calculations and probability value were given credit. Some of the candidates who used the symbols > or < appeared not to understand their meaning as their answers in **(b)(iii)** contradicted the symbol. For example > 0.05 in **(b)(ii)** was described in **(b)(iii)** as having a probability than less than 0.05.