BIOLOGY

Paper 5090/11
Multiple Choice

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

General Comments:

Questions 4, 6, 9, 10, 21 and **23** were all answered correctly by a large proportion of the cohort. However, other items discriminated well between candidates and the paper as a whole produced scores ranging from that which would be expected by guesswork to almost full marks.

For **Questions 8, 15, 17, 22, 24, 25, 39** and **40**, many of the candidates were evidently guessing at the answers.

Comments on Specific Questions:

Question 1

Surprisingly, the most popular wrong answer was the belief that the vacuole stains blue-black with iodine solution.

Question 2

Most candidates were confident with this well-known demonstration of osmosis.

Question 7

Fewer than half of the candidates got this right. The commonest error was to choose the exact reverse of the correct answer.

Question 8 and Question 15

These questions presented candidates with some quite complicated information to analyse, and therefore created problems.

Question 11

Many candidates believe that phloem only transports substances downwards.

Question 16

This was the most difficult question on the paper. The most popular answer was A, but candidates had not noticed that oxygen was now available and therefore anaerobic conditions had ceased.

Question 17

This question (on energy and organisms) proved more difficult than expected.

Question 18

Even some of the better candidates thought that carbon monoxide, rather than nicotine, is the main cause of increased heart rate when smoking.

Question 19

The kidney dialysis machine is not well understood.

Question 20

Many candidates did not realise that a sensory receptor was labelled, and so chose C.

Question 26

A surprisingly large number of candidates thought that viruses have cells.

Question 28

Less able candidates believed that plants absorb carbon dioxide for use in respiration.

Question 29

Some candidates were unsure whether the herbivore in the food chain was a consumer or a decomposer.

Question 30

Unsurprisingly, this question (on the nitrogen cycle) proved difficult.

Question 32

Few candidates were able to link the burning of fossil fuels to acid rain and the acidification of the lake.

Question 33

Candidates found the interpretation of this experiment difficult.

Question 35

A common error was the belief that sperms are no longer produced after a vasectomy.

Question 36

Less able candidates forgot that the embryo begins mitotic divisions in the oviduct.

BIOLOGY

Paper 5090/12
Multiple Choice

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

General Comments:

Questions 5, 8, 9, 14, 28 and **33** were answered correctly by a majority of candidates. However, other items discriminated well between candidates and the paper as a whole produced scores ranging from what would be expected by guesswork to almost full marks.

For **Questions 10, 11, 16, 22, 23, 24, 25, 27, 32** and **40**, many of the candidates were evidently guessing at the answers.

Comments on Specific Questions:

Question 1

Surprisingly, the most popular wrong answer was the belief that the vacuole stains blue-black with iodine solution.

Question 2

Most candidates were confident with this well-known demonstration of osmosis.

Question 3, 4 and **5**

These questions worked well in discriminating between candidates.

Question 6 and **7**

It was pleasing that the more able candidates, at least, were able correctly to interpret the information supplied.

Question 16

Candidates may have had difficulty in interpreting the diagram in this question on the breathing muscles, which created problems.

Question 17

This question (on energy and organisms) proved more difficult than expected.

Question 19

Less able candidates did not recognise the role of blood vessels in temperature control.

Question 20

As in previous years, candidates found the focusing mechanism of the eye to be a difficult topic.

Question 26

A surprisingly large number of candidates thought that viruses have cells.

Question 29

Over a quarter of candidates thought that energy is recycled in ecosystems.

Question 31

Unsurprisingly, this question (on the nitrogen cycle) proved difficult.

Question 34

This question showed that mitosis and meiosis are not well understood.

Question 35

A common error was the belief that sperms are no longer produced after a vasectomy.

Question 36

Less able candidates forgot that the embryo begins mitotic divisions in the oviduct.

Question 37

Fewer than half of candidates got this genetics problem right.

Question 39

The definition of a gene was not well known.

BIOLOGY

Paper 5090/21

Theory

Key Messages

The candidates who score high marks are those who have a good retention and understanding of biological knowledge. They read the questions carefully and adapt their knowledge to answer the question which has been set.

General Comments

Most candidates presented their work clearly and they tailored the length of their answers to the space provided. Candidates who continue an answer on a different page are recommended to note this for the Examiner.

As this is a knowledge-based subject, candidates who have not learnt the basic definitions and principles are unable to achieve high grades. Each question is usually based around a specific topic, but the focus of each sub-question may be different. Candidates should read each part of the question very carefully. For example, in **Question 1** most of the question was concerned with a rise in body temperature, but in 1 **(c)** the question asked related to the effects of a fall in body temperature. Some candidates did not reflect this in their answers.

Comments on Specific Questions

Section A

The questions in ***Section A*** are designed to test the interpretive skills of the candidates. They are required to use and adapt the biological knowledge gained during the course to answer the questions.

Question 1

(a) Candidates were expected to use clear label lines to identify the specific structures. Those who chose to label the sweat duct or nerve fibre did not receive credit.

(b) (i) The majority of answers recognised that there had been a rise in temperature.

(ii) Many candidates gained credit by recognising that sweat had been lost. Less common was a clear reference to the increased size of the blood vessel.

(c) (i) The naming and identification of the arteriole were not commonly seen. Many chose to name and label the capillary instead.

(ii) Good answers were those that included an effect and then its result. For example “constriction limits the blood flow to the skin, so less heat is carried by the blood and so less heat is lost from the skin by radiation”.

Question 2

(a) (i) The technical term, antagonistic, was asked for and the majority of candidates gave this answer.

(ii) Many mentioned the contraction and relaxation of the opposing muscles, but only a few stated that the muscles can only contact so the opposing muscle was needed to restore the bone to its original position.

(iii) Heart muscle was the usual answer. Candidates who gave examples containing multiple muscles, e.g. tongue, did not receive credit.

(b) Most candidates gave correct answers for the arm joints and gained maximum credit. The few who suggested the knee as an example of a hinge joint were not rewarded.

(c) An excellent answer was seen for this part-question: "In this joint the ball is on the humerus and the socket on the shoulder, but in the artificial one the ball is attached to where the socket was, that is the shoulder and the socket is attached to the humerus. The "ball and socket" have been reversed."

Question 3

(a) This question was well answered.

(b) Most candidates correctly gave fibre or roughage as their answer.

(c) The candidates who gained maximum credit showed an excellent understanding of digestion. The bonds holding the units were broken, the amino acids, glucose, fatty acids and glycerol were drawn in the correct vessel and the basic breakdown products were clearly labelled.

(d) (i) This was also well answered by most candidates, but those who included undigested food molecules and fatty acids could not be credited.

(ii) Most candidates were able to gain maximum credit by mentioning that products were carried in the blood of the hepatic portal vein. Very few mentioned that these molecules are soluble, so they dissolve and are carried in solution.

Question 4

(a) The expected answers were carbon monoxide, carbon dioxide or soot (carbon). Those who answered by referring to nitrogen containing compounds or water were not credited.

(b) The candidates who answered well realised that the question required references to both the absorption of water from the soil and its subsequent loss to the atmosphere. A good answer was "Trees absorb water from the soil by osmosis through the root hairs. Water travels in the xylem to the leaves and escapes through the stoma by transpiration". Candidates who addressed only one part of the cycle could not achieve maximum credit.

(c) There is still confusion between excretion and egestion so that urea is frequently lost in the faeces. Few candidates mentioned that decomposition of the faeces occurred or that urea could be broken down. In the factory, waste products from combustion would include some oxides of nitrogen which would react with water to produce acid rain.

Question 5

(a) (i) Most candidates answered correctly.

(ii) Most suggested a suitable temperature and gave the units (^{o}C). Candidates found it hard to express a reasoned explanation. A good answer was: "At a lower temperature the enzymes in the leaves are less active and so the rate of the enzyme controlled reaction is slowed down. So the rate of photosynthesis is slower."

(b) As the experiments were performed at two different carbon dioxide concentrations and temperatures, the X axis should be labelled light intensity. The good answers made reference to light energy being needed for photosynthesis, and by looking at the graph stating that the increase in light intensity increased the rate of photosynthesis until a plateau was reached.

Section B

Questions 6 and **7** require a more straightforward recall of information learnt during the course.

Question 6

(a) The function of the xylem is well known and most candidates gained maximum credit. The answer: "the function of the xylem is to transport water and ions from the root to the leaves of the plant" is succinct and gained maximum credit. References to lignin providing support were equally valid.

(b) Had this question been asked with reference to storage and use in a human the candidates would have answered well. In a plant the principles are exactly the same. The insoluble food must be made soluble, then transported to where it is required. Once there, specific examples of the molecules' use in growth should be given. An excellent answer was: "At night no photosynthesis occurs. The starch and protein stored in the roots are then converted to sucrose and amino acids, respectively and transported to the shoot through the phloem vessel. The molecules diffuse into the growing cells. The sugar is used in respiration to provide the energy for growth. The amino acids are used to make proteins for the new cells".

Question 7

(a) Some good answers to a straightforward question. Most candidates made the point that the uptake was against the concentration gradient. The answers for uptake in plants were good, although references to glucose in humans were not so common.

(b) (i) This was well answered by nearly all the candidates.

(ii) Confusion between breathing and respiration caused many candidates to fail to gain credit. As respiration occurs within the cells the answers should have reflected this. An excellent answer was: "Glucose and oxygen pass through the cell membrane by diffusion from the blood. The waste product of respiration, carbon dioxide, leaves the body as it diffuses from the blood into the alveoli."

Section C

Candidates are expected to answer only one question in this section. No additional credit is given to those who attempt both questions.

Question 8

(a) This question required the candidates to define meiosis and then explain why it is important. Several candidates gave very good answers, for example: "meiosis is a reduction cell division, halving chromosome number from diploid to haploid. Meiosis is used in the formation of gametes which will fuse to form a diploid cell. This allows there to be genetic variation in the offspring as the chromosomes are obtained from different parents."

(b) Some candidates still confuse pollen, seeds and fruits, so in this answer the descriptions of pollen dispersal were not credited. The good answers were those which stated adaptations and then explained why they were advantageous, for example "the seeds have wings which increase their surface area which increases their air resistance so they are blown far away from the parent plant. This reduces the competition between the parent plant and the new seedlings"

Question 9

(**a**) In this question candidates found it difficult to express their ideas clearly. Often well-labelled diagrams would assist and would enable the candidate to show the possible difference in shape of the pyramids. The concept that the pyramids referred to the total organisms at each trophic level was not often stated.

(b) This was not well answered. Most candidates did not start their descriptions with light energy and photosynthesis or with a reference to animals obtaining their energy by eating plants. Examples of the ways in which energy was lost were few and far between. An excellent answer was: "Energy is gained from the sun by light to produce glucose which can help to form amino acids and proteins. The animals eat this and in turn these can be eaten by another animal. Energy can be lost when urea is excreted, during locomotion and as heat energy. It is also needed for active transport of ions and in reproduction."

BIOLOGY

Paper 5090/22

Theory

Key messages

It is expected that candidates will have acquired a good basic level of biological knowledge enabling them to answer the questions. Some of the questions require analysis of data, others to recall and recount facts; if, however, the underlying biological principles are not understood, the answer becomes confused.

General comments

A number of candidates found the start of the paper challenging, but went on to gain more credit in the second part of ***Section A*** and in ***Sections B*** and ***C***. It is important that the answers should be neatly written, concise and accurate in their detail, including the correct use of biological terminology in context where appropriate. There were some candidates who did not study carefully the wording in the stem of the question and hence did not actually answer the question asked. It can be helpful to candidates if they are given accurate definitions of the major physiological processes to use for reference.

Generally the rubric was followed except in ***Section C*** where some candidates attempted both **Questions 8** and **9**, and did not cross out the unwanted answer. There was no evidence to suggest that the time allowed was insufficient.

Comments on Specific Questions

Section A

Question 1

(a) (i) This question was answered correctly by many candidates. The most common incorrect answer was “artery”.

(ii) Few candidates were able to correctly deduce that a valve was responsible. A common incorrect answer was “blood clotting”.

(b) Few candidates gained full credit in this part of the question. Those who did correctly draw valve flaps sometimes did not draw them touching. A significant number of candidates did not draw a diagram in LS and often the conventions for correct drawing of biological diagrams were not followed. A proportion of candidates did not attempt this part of the question.

(c) Many candidates correctly identified that there would be no blood flow in the vessel. Those who were able to go on to describe the reasons for this often went on to gain maximum credit for this part of the question. There was confusion in some answers regarding the direction of blood flow and the relevant roles of the fingers and valves present. A number of candidates referred to the blood vessel as an artery, rather than a vein, and thus were unable to gain maximum credit.

(d) Answers often included irrelevant information and many candidates did not appreciate the increase in blood flow caused by the rod being repeatedly gripped. Several candidates made incorrect reference to muscles in the blood vessel walls while others thought that gripping the rod would reduce the blood flow, leading presumably to their answer to part **(a)**.

Question 2

(a) Many answers were based on the effect on the tuber rather than the cells. There was significant misuse of biological terminology such as “denatured cells” and “killing cell walls”.

(b) This part of the question was well answered by most candidates; a proportion, however, referred to “conversion” rather than the more specific “breakdown” or “digestion” of the substrate.

(c) (i) Many candidates correctly stated “fermentation” or “anaerobic respiration”, although some referred to “aerobic respiration” or simply “respiration” and thus did not gain full credit. Many candidates also provided a correct equation. Some candidates named incorrect reactants and/or products (usually oxygen or water) and thereby limiting their success on this question. Other incorrect responses included the mixing of words and symbols within the same equation.

(ii) The majority of candidates correctly identified fungus or yeast. The most common incorrect answer was “bacteria”.

(d) Few candidates gained maximum credit. The nature of a ‘sediment’ appeared to be not well known by many candidates, whose answers most commonly referred to the production of an increased amount of alcohol.

Question 3

(a) (i) The identity of both cells was well known by the majority of candidates.

(ii) Many candidates correctly understood the increased surface area provided by the cell’s shape for the absorption of water and mineral ions. A number of candidates made incorrect reference to the absorption of water by active transport, which did not gain credit.

(b) This part of the question was well answered with all cells being correctly identified using the key by a significant number of candidates. Cells 2 and 5 were sometimes confused and therefore identified and **J** and **K** instead of **K** and **J** respectively.

Question 4

(a) The large majority of candidates correctly named photosynthesis and so scored the mark available.

(b) Many candidates made reference to the idea of a factor being “limited” with this most commonly being linked to space, carbon dioxide or minerals. Lack of correct supporting detail meant that few candidates went on to gain credit for the role of named mineral ions on the plant.

(c) Many candidates scored well on this part question, although credit was limited without reference being made to either or both photosynthesis and respiration.

(d) The concept of “recycling” water within the jar appeared to be well understood by a significant number of candidates. The details of this, in particular the production of water during respiration, were much less commonly included in answers.

Question 5

(a) The majority of candidates were able to gain credit on this question.

(b) Many candidates wrote lengthy answers to this part question that did not always gain much credit. The concept of natural selection appeared to be understood by a significant number although the term itself was less commonly used. The most commonly awarded marking points were those associated with camouflage and the effect of predation on population numbers. There was some incorrect use of the term species, evident where candidates referred to the different coloured varieties being different species.

(c) (i) Many candidates answered in terms of phenotype rather than in terms of changes in genotype and therefore did not gain credit in this part of the question.

(ii) Many candidates were able to identify that a change in phenotype would be the result of the change in **(c)(i)** having occurred. A significant number of candidates repeated one of the two original phenotypes identified in the question, however. The concept of a changed phenotype being an advantage in terms of protection against predation was correctly seen in many answers.

Section B

Question 6

(a) Many candidates made correct reference to the loss of water and to the cooling effect generated. Reference to the epidermis was rarely seen in even very good candidate answers.

(b) Candidates whose answers compared the two processes directly point by point tended to gain more credit than those who wrote separately about each process. A number of candidates demonstrated an incorrect understanding that sweating only occurs during exercise. There was confusion in some candidate's answers about which process occurs in animals, and which in plants.

Question 7

(a) There were many excellent answers to this part question; a number of candidates confused the process of respiration with that of ventilation, however.

(b) Overall, the standard of responses to this question was found by Examiners to be disappointing. Answers tended to be generalized and lacking in correct detail, for example reference to "pure" or "clean" blood was sometimes seen. Many candidates incorrectly referred, sometimes at length, to "glucose" and occasionally to "amino acids", for which there was no credit. The term "osmoregulation" was occasionally seen in candidate answers. The terms "homeostasis" and "tissue fluid" were rarely seen by Examiners.

Section C

Question 8 was the much less frequently answered optional question in ***Section C***

Question 8

(a) There was significant evidence from candidate answers of teaching beyond the syllabus, which led them to provide answers that were often confused and hence gained little credit. Many candidates were unclear as to the nature of the male gamete and there was confusion evident between words beginning with the letter 'o' such as ovule, ovum, ova and ovary.

(b) Many candidates wrote answers that did not directly address the question asked and hence often failed to gain significant credit. A significant number of candidates wrote long descriptions of the female reproductive system or of each hormone involved in the menstrual cycle. Few candidates restricted their answer to the correct statements that would go on to gain them maximum credit. As in part **(a)** of this question, there was often confusion and a lack of clarity when attempting to use correct biological terminology in an appropriate context.

Question 9 was the much more frequently answered optional question in ***Section C*** and was the optional question on which candidates tended to gain more credit.

Question 9

(a) Many candidates had been well prepared to answer this part question and went on to gain maximum credit. A significant number of candidates, however, responded with answers that demonstrated a significant lack of knowledge and a wide range of misconceptions regarding the prevention of HIV spread. These included the avoidance of sharing of clothes and food with an infected person and the use of the contraceptive pill. A not insignificant number of candidates wrote incorrectly that the mosquito was a vector of HIV.

(b) The overall standard of answers to this part question was generally disappointing, with a significant number of candidates performing poorly. Many candidates did not name the 'mosquito' as the vector of malaria, thereby failing to score what had been intended as easy credit. Large numbers

of candidates provided correct details concerning preventative measures taken against the vector but did not explain the effect of each named measure on the vector as was required by the question. As a result, many candidates did not, unfortunately, gain credit for some correct information included as part of their answer.

BIOLOGY

Paper 5090/31

Practical Test

Key Messages

The main objectives of this paper were to test not only biological knowledge with emphasis on structure and function, but also the application of practical skills and techniques. Requirements for doing well include, in **Question 1**, a clear understanding that warm blooded animals need to avoid heat loss to maintain a constant internal body temperature and in cold weather animals tend to crowd together in groups. **Question 2** relates to an understanding of the rate of transpiration in the leaves of non–woody shoots with or without access to water and **Question 3** considers comparative structural features of human teeth with those of the dog and how these features are adapted to the feeding habits of the dog.

General Comments

The questions tested the ability of candidates to follow instructions, make and record accurate observations using written and drawing skills, take measurements and construct tables for the input of data. The ability to accurately plot and evaluate tabulated data was also tested. Candidates appeared to have more than sufficient time to complete the paper.

Comments on Specific Questions

Question 1

(a) Candidates were presented with a series of test tubes containing hot water, each representing animals, in an investigation on heat loss in warm blooded animals. Test tube **A** represents one isolated animal (Fig. 1.1) with test tube **B** surrounded by seven tubes, one of which is labelled **C** to represent an animal in the outer group (Fig. 1.2). Candidates were asked to construct a table to include the temperature of water at the start with an additional five readings taken at two minute intervals for each of test tubes **A**, **B** and **C**. In first class answers the table was constructed with ruled clear lines and three columns appropriately labelled plus six rows containing six temperature readings over time. Units were recorded at least once and temperature shown to decrease in time in **A**, **B** and **C**. Less creditworthy answers, on the other hand, not only lacked units and ruled clear lines, but also omitted recording the first reading.

(**b)(i)** For plotting results on the grid provided, the best answers correctly labelled the axes as time on the X and temperature on the Y axes, used linear scales with units denoted and showed good use of the grid. Plots were of good quality with clear lines or lines of best fit. In addition, lines were identified by label or key. Less creditworthy responses invariably lacked axis labels and line drawings were incomplete.

(ii) Many excellent candidates did describe a decrease in temperature or heat loss in all three tubes and the temperature fell fastest in **A**, the least in **B** and intermediate in **C**.

(iii) When asked to suggest and explain two ways of improving the methodology undertaken earlier, low level responses were more frequent as candidates suggested, without qualification, measuring temperature at exactly the same time or increasing the time span. Some excellent answers did appreciate that replication to increase reliability, or identifying error by calculating mean or average values, should be undertaken. Also water should be at the same temperature / volume at the start to ensure the same amount of heat was available to be lost. In addition all tubes should be maintained under similar conditions to prevent external factors influencing the rate of heat loss.

(c)(i) Test tube **B** surrounded by seven tubes including **C** was correctly identified by most candidates as representing the animal which more easily maintained a constant body temperature.

(ii) This section, dealing with animals crowded together in a group to maintain body temperature in cold weather, was often left unanswered, except for a minority of excellent answers referring to insulation or lowering of the surface area (for heat loss) to volume ratio and noting that less heat was radiated / lost to the environment. Incorrect answers focused on heat being generated from the bodies of animals with heat becoming trapped.

Question 2

D- leaves of a non-woody shoot (Impatiens or celery) in water; E – similar but left out of water

(a) Candidates were asked to describe two differences between **D** and **E** and the best answers showed that the leaves of **D** were firm to touch and remained at an angle to the shoot whereas those of **E** were limp, wilting, shrivelled and drooping / falling down from the shoot. Weaker observations simply recorded differences in colour.

(b)(i)(ii) Candidates were asked to place cut ends of shoots **D** and **E** in a container of blue water (with 0.1% methylene blue solution) for five minutes. Using a knife or scalpel, transverse cuts were made every 5 mm and the number of sections for each shoot, which showed some blue colour, were counted in order to calculate the distance the coloured water had travelled up each shoot. The Supervisor's report was first checked to assess the results of each Centre, although generally the number of sections and the distance the blue coloured water had moved in mm were greater in **D** than in **E**.

(iii) The best answers confirmed that either transpiration, evapotranspiration, evaporation or capillarity were processes involved in causing the blue coloured water to move up the shoots. Weaker answers invariably suggested that osmosis/ active transport were responsible and that the water potential in **E** was lower than **D.**

(iv) First class answers suggested that transpiration occurred and water was lost at a faster rate in **D** because of the larger leaf surface area than **E** and that the stomata were closed and the guard cells were flaccid in **E**. Incorrect answers included reference to diffusion gradients with **E** requiring more water than **D**.

Question 3

Fig. 3.1 – Diagram of teeth arrangement in human and dog

(**a)(i)** When asked to complete Table 3.1 to describe some features of human teeth, many excellent candidates described the shape of the incisors as chisel –like, flat, straight and even, with pointed / sharp canines and uneven / rough / cusped molars. The root structure of canines and premolars was correctly described as single compared with the molar being double/triple or multiple.

(ii) The majority of answers did describe the main function of incisors as cutting / biting compared with molars whose function is crushing / grinding. Some weaker and incorrect answers deduced that incisors were used for holding / tearing.

(b)(i) When asked to list three differences between the teeth of dogs and humans, the best answers showed that the dental formula in dogs was more / 38 v 32 / 19 v 16, the canines were larger and more pointed/sharper and there were more premolars, which as in the case of molars, were also of different sizes / shapes compared to being similar in humans. The last molar in dogs is also smaller whereas all molars in humans are similar in size. In some excellent answers, molars were described as uneven/pointed in dogs and flatter in humans. In addition the idea that molars in dogs have double (or single) roots compared with triple (or double) roots in humans was highlighted and that dog premolars have double compared with single roots in humans. Weaker answers either omitted to mention any of these comparisons or generally stated differences in sharpness of teeth without differentiating the various types of teeth.

(ii) The functions of the canine teeth in dogs were, in many first class answers, correctly referred to as piercing, holding, gripping, killing, ripping and tearing. The occasional invalid answer confused canines with incisors by referring to biting.

(c) Using Fig. 2 which shows the outline of some human teeth, candidates were asked to identify plaque caused by the action of bacteria on food trapped between the teeth. The best answers identified plaque as carefully shaded areas between the teeth and at the boundary of the gum. Weaker answers showed full shading of the teeth surfaces as well as the gum boundary.

BIOLOGY

Paper 5090/32

Practical Test

Key Messages

The main objectives of this paper were to test not only biological knowledge with emphasis on structure and function, but also the application of practical skills and techniques. Requirements for doing well include, in **Question 1**, a clear understanding that glucose, and especially sucrose, influence the activity of yeast and, in particular, the process of respiration / fermentation and, in **Question 2**, that enzymes in seeds break down insoluble starch to reducing sugar which is then used for germination / growth / respiration and release of energy. In **Question 3**, candidates should appreciate that air pollution reduces the occurrence of black spot disease on leaflets from rose bushes.

General Comments

The questions tested the ability of candidates to follow instructions, make and record accurate observations using written and drawing skills, take measurements and perform simple calculations. The ability to accurately plot and evaluate tabulated data was also tested. Candidates appeared to have more than sufficient time to complete the paper.

Comments on Specific Questions

Question 1

Solution A - 10% glucose in water; B - 10% sucrose in water

(a) (i) (ii) Candidates were asked to study the activity of yeast in test tubes containing **A** and **B** by counting the number of bubbles of gas that are released after one minute from an open tube placed below the water surface in a beaker of water. This procedure was most satisfactorily undertaken by the majority of candidates who described differing effects of **A** and **B** on the number of bubbles produced, which generally increased in **B**.

(b) (i) (ii) Creditworthy answers named carbon dioxide as the gas released to form bubbles and stated that it can be identified by its changing of lime water to a milky/chalky colour or by using a hydrogen carbonate indicator with the colour changing from red to yellow. Incorrect answers to **(b)** implied that oxygen or hydrogen had been released.

(iii) The majority of candidates understood correctly that respiration or fermentation was responsible for the production of carbon dioxide.

(c) (i) When asked why the test tubes containing **A** and **B** were shaken between counts in **(a)(i)**, the best answers either stated that this prevented the yeast settling or that mixing well will lead to a uniform distribution of yeast. In weaker responses, reference to dissolving or increasing the rate of reaction between yeast and each of **A** and **B** was frequently mentioned.

(ii) Responses overall were very good with candidates generally listing temperature of the water, the mass (or **3g**) of yeast and volume / concentration of the sugar solutions used as the main factors which needed to be kept constant during the laboratory procedures. The time taken to count the number of bubbles and the degree of shaking were also occasionally mentioned, although weaker answers suggested that light intensity and carbon dioxide should be constant.

(d) (i) When asked to make a drawing of a dividing yeast cell (Fig. 1.2), first class answers produced a good sized and well-proportioned drawing, with clear continuous lines, of both the parent and daughter cells and also included the nucleus and other inclusions such as the food vacuoles and mitochondria. The cell walls were also drawn as a double line. Less well–drawn examples either omitted the cell inclusions or the double line around both parent and daughter cells.

(ii) When asked to measure the line previously drawn on Fig. 1.2 and also to include a line on the drawing of both parent and daughter cells in **(d)(i)**, the best answers produced both correct measurements and calculations of the magnification, together with appropriate use of decimal places. In weaker answers both measurements and calculations were either incomplete or inaccurate.

Question 2

Solution C - 2.0% diastase solution

(a) (i) (ii) When asked to place 3 filter paper discs, previously soaked in C, on to starch paper stained with iodine in a Petri dish and then record the observations every minute for up to 5 minutes, the majority of candidates did show their observations in the three columns of Table 2.1. Only the best answers recorded colour changes on the paper surrounding the discs. Realistic measurements of the diameter of zones around the discs were usually recorded in Table 2.2

(b) (i) When asked to explain what happened to the starch around the discs, many excellent responses showed that starch had been broken down / converted to reducing sugar/glucose/maltose by an enzyme / diastase / maltase. Some weaker answers suggested that starch was denatured or had been absorbed / soaked up by the starch paper.

(ii) Many first class answers explained that seeds contain insoluble starch, which is stored in the cotyledons and must be changed to soluble products/named sugars for germination/growth to occur followed by respiration and release of energy prior to photosynthesis. This section of the question paper was often left unanswered however and, when attempted, incorrect and weaker responses focused on 'food' being stored and broken down or that starch would be converted to glucose at night during the process of transpiration.

(c) When asked how the above method could be used to compare seeds from different plants, this section was often left blank, or responses were given that iodine or Benedict's solutions should be used to identify starch or reducing sugar respectively. On the other hand, some excellent candidates did suggest that solutions should be prepared from ground seeds of different plant types using the same mass of seeds and the same volume of water, and that these should be set up on the soaked discs / placed on stained paper. The diameter of the clear zones on the filter discs was measured and compared after a similar length of time.

Question 3

(a) (b) Many excellent responses to these questions not only correctly completed Table 3.1 but also produced a bar chart with X and Y axes fully labelled and at least half the grid of both axes used with correct plots and ruled columns of equal width. Some weaker presentations either miscalculated the number of plots or mixed up the X and Y axes.

(c) When presented with Fig. 3.2, which shows another 20 rose leaflets with black spot disease but from an area with clean air, the majority of excellent answers did conclude that there were more/larger spots in the non-polluted area and that the leaflets appeared more healthy with less spots in the polluted area. Conversely some weaker answers did incorrectly record more/larger spots in the polluted area or made reference to the spots changing in size.

(d) Candidates were asked to suggest how this investigation could be improved and the best answers did mention using larger samples or more leaflets, especially if they came from leaflets of similar age/size or from the same species. In addition correct responses suggested that the investigation should be repeated with average/mean measurements taken. Incorrect and weaker answers either made reference to using a microscope or magnifying glass to check the disease or that leaflets should be examined from different study sites.

BIOLOGY

Paper 5090/61
Alternative to Practical

Key Messages

This paper tests the ability to use practical skills such as observation, data handling, interpretation of results and experimental design. It is important that candidates have experience of practical work, be familiar with biological tests such as food tests and demonstrate awareness of appropriate safety procedures.

All the information provided with each question should be read thoroughly as this information may well be necessary for answering the questions that follow.

The number of marks available gives a good indication of the amount of content expected in the answer. In questions that ask for a comparison, reference to both specimens should be made in order for the answer to be creditworthy.

It is important that candidates understand the difference between the meanings of key terms used in the questions, such as *describe* and *explain*.

General comments

The number of marks awarded overall covered the whole range of those available and it appears that candidates had sufficient time to complete the paper.

Almost all scripts were clearly legible, with answers written in the spaces provided or, if not, with clear indications of where they had been written. Candidates should ensure that any alterations to answers are clearly legible i.e. not written on top of their original answer.

It was apparent that many candidates do not appreciate the difference between *reliability* and *accuracy* in terms of experimental procedure.

Comments on specific questions

Question 1

This question was about an investigation into the loss of heat from animals' bodies. Test-tubes containing hot water were used to represent the animals. The results of the experiment were provided in a table.

(a) (i) Candidates were asked to plot the results for the three test-tubes on the axes provided. There were a number of very good graphs that were correctly orientate and where the plots were clear, precise and joined by good quality, labelled lines.

The majority of candidates correctly selected the x-axis for plotting the given values (time) and the y-axis for the variable values (temperature). In the best responses, both axes were correctly labelled, including units. In other cases, axes were not fully labelled and it should be noted that *T* and *t* on both axes is not acceptable, even with units. *M* is not an acceptable abbreviation for minutes.

Most candidates used linear scales, however due to the nature of the data being plotted, starting at the origin on the y-axis resulted in a graph that covered less than the top half of the grid provided. Few candidates made good use of the whole grid.

(ii) In this part, candidates were asked to describe and compare the temperature changes in each of the three test tubes. One mark was available for stating that the temperature fell in all the tubes. A significant number of candidates did not score this mark as answers lacked precision and only referred to the temperature *changing*.

Marks were also available for making comparisons between the tubes. Some of these statements were vague and lacking in clarity. A small number of candidates calculated the temperature changes in each tube which was creditworthy, although a few did not notice that the starting temperatures were not all the same and therefore made incorrect calculations.

(iii) This question asked candidates to suggest and explain ways to improve the experimental method in order to make the results more reliable. The most common creditworthy suggestion and explanation was to repeat the experiment and then find the mean results. Other acceptable suggestions included using the same volume of water in all the tubes and also making sure that the starting temperature of the water was the same. However, few candidates provided suitable explanations for these suggestions, thus not scoring the maximum available marks.

Common non-creditworthy suggestions involved extending the investigation rather than improving the one described by, for example, adding more tubes. Others included suggestions for improving accuracy rather than reliability.

(b) (i) The majority of candidates were able to identify test-tube B as the one representing the animal that finds it easiest to maintain a constant body temperature.

(ii) Candidates were asked to suggest how animals crowding together in a group find it helpful in maintaining a constant body temperature. Very few candidates scored both the available marks here. Candidates need to understand that crowding together helps reduce heat loss to the atmosphere due to the lower surface area to volume ratio. This did not seem to be fully understood and was poorly explained. Common incorrect responses included the ideas that animals crowding together generate more heat, or crowding lets less cold in.

Question 2

(a) (i) Candidates were presented with drawings of 2 shoots cut from the same type of plant and asked to describe the differences between them. Many noted the wilted nature of E compared to D or some noted its more shrivelled nature – but rarely both.

(b) (i) The majority of candidates were able to count the number of coloured sections correctly. Some counted the numbers of coloured vascular bundles instead.

(ii) Many candidates correctly calculated the distance the coloured water had moved up in each shoot. A few seemingly tried to measure with a ruler rather than use the information given in the introduction.

(iii) This question asked candidates to suggest which process caused the coloured water to move up the shoots. Many incorrectly identified the process as osmosis. Active transport was also a frequent incorrect answer showing that the candidates do not appreciate that this process involves energy and that xylem vessels are dead, empty cells.

(iv) Many candidates identified that the process was faster in D than in E, but very few were able to relate this to the wilted nature of E, in which stomata would have been closed.

Question 3

(a) (i) This question asked candidates to complete a table showing some features of human teeth as shown in a diagram. There were many good or reasonable attempts at completing the table, although few candidates scored full marks.

(ii) The majority of candidates were able to describe the functions of both the incisors and molars in humans.

(b) (i) Candidates were asked to describe 3 features of dogs' teeth that are different from human teeth. There were many differences that could have been described but some answers were not

comparative and others not correct because the types of teeth had not been identified correctly. A few described particular teeth as being different, but did not specify those differences. Others apparently misunderstood the question and answered in terms of describing the functions of the teeth. Despite this, there were still many good answers.

(ii) Most candidates were able to suggest an appropriate function of the dog's canine teeth but some suggested bone-crushing which, just from the shape, would not be possible.

(c) Most candidates were able to shade an area where plaque would be found.

Question 4

(a) Candidates were asked how to test for glucose safely in the laboratory. There were many good answers here. The most frequent error was not to heat the Benedict's solution or not to give a safety factor. A few omitted the starting colour and a small number of candidates muddled reagents and colour changes.

(b) When asked to suggest what a positive test for glucose in the urine might indicate, a few misinterpreted the question to (re)state the end colour for the Benedict's test. Many correctly stated 'diabetes' and a few suggested a 'high blood sugar level', which was also creditworthy.

BIOLOGY

Paper 5090/62
Alternative to Practical

Key Messages

This paper tests experience of practical work and the ability to use practical skills such as observation, drawing, data handling, interpretation of results and experimental design. It is important that all the information provided with each question is read, including introductory material, such as the details of how an investigation has been carried out. That information may well be necessary for answering the questions that follow.

The number of marks available for each question gives a good indication of the amount of content expected in the answer.

It is important that candidates understand what is demanded by the different terms used in asking questions e.g. describe, explain, state and suggest.

The difference between accuracy and reliability in collecting experimental data should be understood as should the difference between improving a given method and extending it.

General Comments

The full range of marks was seen in candidates' papers.

Almost all scripts were legible, with answers written in the spaces provided or, if not, with clear indications of where they had been written.

It appears that candidates had sufficient time to complete the paper.

In general, candidates were more confident in making responses involving knowledge than in application of that knowledge to unfamiliar practical situations.

Comments on Specific Questions

Question 1

(a) This was well-answered by many candidates. They were able to use the data given to describe what the investigation had shown about the effect of glucose and sucrose on the activity of yeast. Most candidates described that bubbles of gas were released, more with sucrose than with glucose. Some observed that with both sugars the production of bubbles decreased with time. Very few candidates used the data to provide quantitative answers.

(b) (i) The majority of candidates identified the gas released correctly as carbon dioxide. Oxygen was the most common incorrect answer, but hydrogen and nitrogen were also named.

(ii) That limewater turns cloudy / chalky / white when carbon dioxide is passed through it was the simple test known by many candidates. A few described using hydrogen carbonate indicator solution which is also a suitable test. When tests are described, the colour of the solution before passing carbon dioxide through should be stated as well as the end colour.

(iii) The process was correctly identified as respiration or fermentation by the vast majority of candidates. A few considered, incorrectly, that photosynthesis or osmosis had occurred.

(c) The questions in this section related to the candidates' understanding of the experimental procedure used in the investigation.

(i) Some candidates suggested that the yeast and sugar solution had been left for 5 minutes in order for them to reach the temperature of the warm water in which they were standing or so that the reaction could begin. These were creditworthy answers. Very few suggested, correctly, that the dried yeast needed time to become rehydrated.

(ii) Common answers that could not be credited were 'to make it a fair test', 'to get an accurate result' or 'to get a suitable result'. Good candidates explained that counting the bubbles three times made the results more reliable because the mean or average value could be calculated. A few good candidates explained that the three counts helped to identify (not to prevent) errors. Many candidates could receive no credit because they considered taking three counts helped with accuracy rather than with reliability.

(iii) The test-tubes were shaken between counts because the yeast would have settled and needed to be uniformly distributed in the solution before the next count was taken. A few candidates correctly suggested this. Too many candidates did not note the significance of the 'between counts' and referred only to the mixing of the yeast and solution that took place at the very beginning of the investigation and so received no credit.

(iv) The most frequently listed correct factor was temperature. For other factors giving only one word was not enough, e.g. concentration, without making it clear which concentration was being referred to. It should be noted that correct terminology for quantities needs to be used, e.g. volume or mass and not amount. Some candidates listed factors that had no bearing on this investigation, e.g. pH, air pressure or light, which could not be credited.

(d) (i) There were some good drawings of the dividing yeast cell, showing good technique and observation. These had clear outlines, drawn with a sharp pencil with a continuous, not feathery, line. They were of a good size and showed the relative sizes of the 'parent' and 'daughter' cells in good proportion. The nucleus was drawn in the 'parent' cell and inclusions in both cells. The cell wall was also drawn.

(ii) Many candidates answered this question well and scored maximum marks. Others were unable to score some of the marks for a variety of reasons, for example: they did not follow instructions and draw a line on their drawing or drew it in a different place from that on Fig. 1.2; their measurements were inaccurate; the expression they used to calculate the magnification was incorrect; they did not take into account that the cell they had drawn was already magnified x5000; the final calculation was done incorrectly or was given units.

Question 2

(a) Candidates were asked to make three measurements and record them in a table. Many did this well and recorded accurate measurements. Credit could not be given where candidates had tried to calculate the measurements from the table given instead of actually measuring the zones as asked. Some candidates did not read the question or examine Fig. 2.2 sufficiently carefully and measured the discs instead of the labelled zones. Some candidates entered no measurements at all.

(b) (i) Many candidates correctly described using yellow iodine solution which turns blue-black or black when starch is present. As only one mark was available for this answer, both the reagent and the resulting colour change were needed. A few candidates did not know the test for starch and described using Benedict's solution, the buiret test or the emulsion test.

(ii) Good candidates answered this well. They noted the colour change around the discs and suggested that this was because the starch had gone. They then offered an explanation for that suggestion in terms of an enzyme that had diffused out of the discs and broken the starch down to form reducing sugar. Those who thought that the discs had absorbed the starch were incorrect. There were many candidates who wrote vague answers simply quoting some of the bullet points given in the introduction to the question which could not be given any marks.

(iii) The most common correct explanation given was that the substance was needed for growth or germination to take place. The better candidates explained that stored starch needs to be broken down into soluble sugars as a substrate for respiration so that growth can take place.

This proved a demanding question for many candidates. Some wrote vaguely about seed germination which was irrelevant. Others gave generic answers in terms of drawing tables and plotting a graph. These were not creditworthy. Some described methods that could be used to determine the amount of starch in seeds, e.g. adding iodine solution and seeing which seeds turned blackest, but these methods did not answer the question. Very good answers described using the method previously described to prepare solutions from different seeds, soaking filter paper discs in them and placing them on iodine-stained starch paper and, after a set time, comparing the size of the yellow zones around the discs.

Question 3

(a) This was generally well done, with most candidates recording the correct numbers of leaves with the various numbers of black spots.

(b) The drawing of the bar chart was not as well done as might have been expected. A minority of candidates either did not read the question carefully or did not know what a bar chart is; they drew line graphs. One common error in the construction of the bar chart was not labelling the axes fully, e.g. number of spots instead of number of spots/leaflet. Another was not writing the numbers 0 to 8 on the axis in the centre of the bars. Frequently, because the numbers had been written to one side, a bar was omitted in the plotting. Most candidates, however, constructed bars of equal width and used a ruler to draw them.

(c) This question asked for a description of the effect of air pollution on the disease, not for an explanation of the effect. Good candidates correctly stated that in polluted areas there was less disease as shown by fewer spots or smaller spots.

(d) A way of improving the investigation was asked for. Correct responses, including repeating the process with another twenty leaflets and taking a mean value, using a larger sample of leaflets, ensuring that the leaflets were of the same age, size or from the same type of rose bush, were examples of improving the method given to make the results more reliable. Collecting samples of leaflets from different areas or from different species of plant were examples of extending the method given, not of improving it, and could not be credited.