BIOLOGY

Paper 5090/11

Multiple Choice

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

General

As in previous years, the questions which required analysis, rather than just pure knowledge were well answered by the more able candidates. Centres should remind candidates to read the questions carefully including all the words of the questions, the stem and all the options.

Comments on individual items.

Many candidates found questions 1, 8, 9, 24, 27, 32, 38 and 39, which were largely knowledge–based, presented few problems.

2 Options B and C are diffusion and D is mass flow, so the key must be A. Glucose may diffuse from the gut if there is less in the blood than the gut, but since all glucose is eventually absorbed, it must be against the concentration gradient and so must be active transport.

3 The line labelled P shows no uptake until the concentration exceeds a particular value, which must be that inside the cells. Above this, the uptake of the poisoned plant is directly proportional to the

external concentration, so is due to diffusion. The line N shows uptake even from very low external concentrations so must be due to active transport.

4 The denatured enzyme molecule, which is largely protein, is a significantly different shape when the temperature is raised to 70^0C.

5 The palisade and spongy tissues contain the chloroplasts – hence the key is A. The xylem (option B) is non cellular. Label D is the nucleus of a non-photosynthetic epidermal cell.

6 Nitrate is used to convert carbohydrates to amino acids, which are used to build proteins. With no proteins, growth will be slow.

7 Photosynthesis will reduce the CO_2 content, so by 12.00 the indicator will be purple.

10 Pepsin is active in the stomach and the duodenum. Trypsin is active in the small intestine, where protein digestion to amino acids is completed.

11 Wilting is due to water loss exceeding water uptake, so turgor is lost.

12 The easiest clues are the xylem in the central part of the stem (labelled 4), which will become the wood of the older stem and the woody core of the root – labelled 6.

13 The pulmonary vein, carrying blood from the lungs, must have the lowest CO_2 content. All other veins carry blood to the heart and thence to the lungs.

14 Just before time X, the ventricle pressure has dropped below that of the aorta, so the semi-lunar valves must have closed. Since the ventricle pressure is still above that of the atrium, the bicuspid valve cannot yet have opened.

15 After two hours, digestion will still be taking place and so glucose will still be being absorbed and taken to the liver.

16 Options A and B are using oxygen. Option D represents photosynthesis. CH_3-CH_2-OH is ethanol.

17 Breathing out occurs when the diaphragm and the external interposal muscles relax and the rib cage falls. During exercise, the internal intercostals are also used, forcing air out of the lungs.

18 During period V to W, a whole breath in and out occurs. W to X is less than half an inhalation.
X to Y is about half an exhalation, which is completed during Y to Z.

19 The CO_2 gradient would still be maintained if the alveolar walls were dry and thicker. The supply of CO_2 to one side and its removal from the other side are both needed.

20 Options A, B and C all have a factor which increases its initial effect, which is positive feedback.

21 The increase of blood sugar level by adrenaline is usually well known.

22 The candidate becomes smaller in bright light and the line only falls after 35 seconds.

23 Since it is usually well known that adrenaline increases the heart rate and insulin promotes the conversion of glucose to glycogen, the question depends upon knowing the effects of the female hormones. The pituitary does produce FSH, but ovulation is due to LH.

25 Alcohol is wrongly thought to be a stimulant in options C and D. It lowers awareness and slows responses.

26 Anaerobic respiration of lactose produces lactic acid, which lowers the pH.

28 Organism 1 must be a green, photosynthetic plant, so 3 is a herbivore, but both 1 and 3 are eaten by 2.

29 A single tree supports many insects, which are eaten by fewer birds, which carry many fleas, so 3 must be the pyramid of numbers. The mass of the fleas is very small, so 2 must be the pyramid of mass.

30 The arrow P represents feeding, while S is absorption. Both Q (decomposition or ammonification) and R (oxidation) are due to bacteria.

31 Negative stems are always emboldened but can be more difficult. Candidates must understand that "vector" means carrying from one host to another. The important point is that a female mosquito can carry the parasite and feeds on more than one person. Where the eggs are laid does necessarily contribute to the spread of malaria. If mosquito saliva did not stop blood from clotting, a female could only feed once and could not inject infected blood into a subsequent person.

33 The stem and the graph state dry mass, so any increase must be due to photosynthesis.

34 Pollen grains (1) and unfertilised ovules (3) are haploid. Structure 2 is a fertilised ovule, since the pollen tube has entered it.

35 Option B was oddly popular, although the better candidates realised that exchange of nutrients, gasses and wastes occurs at the placenta, where the foetal and maternal bloods have a thin, common barrier.

36 Cell Y is a genetic copy (mitosis) of X, so contains 8 chromosomes. After meiosis, cell Z is haploid.

37 Alleles are alternate forms of the information of a gene. Tt shows that the two alleles for the single gene are different.

40 Artificial selection occurs when one or both parents are chosen by the breeder – as in cattle husbandry (Key B). Options A and D refer to naturally occurring results. Option C is an example of biological control,

BIOLOGY

Paper 5090/12
Multiple Choice

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

General

This proved to be a more straightforward paper in many ways, with few surprises, but with an obvious gap in candidates' knowledge of the hormones of pregnancy. As in previous years, the questions which required analysis, rather than just pure knowledge were well answered by the more able candidates. Centres should remind candidates to read the questions carefully including all the words of the questions, the stem and all the options.

Comments on individual items

Many candidates found questions 1, 2, 5, 8, 9, 12, 13, 15, 18, 21, 22, 23, 25, 28, 29, 33, 39 and 40 which were largely knowledge–based, presented few problems.

3 The line for chloride shows that its uptake is independent of the oxygen supply, whereas nitrate uptake must require oxygen until the mechanism reaches its maximum.

4 Starch is added to each tube, so the iodine test result will be black if the enzyme is active. Only tube shows hydrolysis. Option D was oddly popular.

6 The cuticle is not cellular, but is a waxy, water proof layer. The epidermis usually consists of transparent cells.

7 Photosynthesis will reduce the CO_2 content so by 12.00 the indicator will be purple.

10 P is described as a blood vessel, so it cannot be the bile duct (Option A). Glycogen remains in the liver (and muscles, although this is not involved in the question). Urea leaves the liver in the hepatic vein and enters the general circulation.

11 Evaporation is from the cell walls of the cells (Key D) into the air spaces between them. It will then diffuse through the stomata - option C – which was far too popular.

14 Many candidates confused arteries (carrying blood to an organ) with veins (carrying blood away).

16 When the diaphragm muscles contract, the diaphragm moves down and the lungs begin to inflate.

17 DNA is found in all three organisms, but viruses are not cellular.

19 It is usually well known that anaerobic respiration in yeast produces alcohol and CO_2. Neither is produced in humans. In both humans and yeast, glucose is used, but not oxygen.

20 The air temperature is higher than the core body temperature, so heat will not be lost unless sweat evaporates, taking latent heat of vaporisation.

24 The secretion of insulin varies with the blood glucose concentration. The glucose concentration in the blood varies slightly, but the focus of the question is on the hormone.

26 Anaerobic respiration of the lactose produces lactic acid, lowering the pH.

27 Nicotine accounts for smoking being addictive, but lung cancer is due to the tar in the smoke.

29 Producers photosynthesise, absorbing CO_2 and producing carbon compounds. Only the key, B shows this.

30 The arrow P represents feeding, while S is absorption. Both Q (decomposition or ammonification) and R (oxidation) are due to bacteria.

31 Negative stems are normally emboldened and can be more difficult. Candidates must understand that “vector” means carrying from one host to another. The important point is that a female mosquito can carry the parasite and feeds on more than one person. Where the eggs are laid does necessarily contribute to the spread of malaria. If mosquito saliva did not stop blood from clotting, a female could only feed once and could not inject infected blood into a subsequent person.

32 Global warming is melting polar ice so sea levels are rising (Key A) and some land areas are becoming dryer. Many migratory species are extending their habitats

34 Meiosis produces haploid cells from a diploid cell, so stage C is clearly correct. Option A is fertilisation.

35 Option B was oddly popular, although the better candidates realised that exchange of nutrients, gasses and wastes occurs at the placenta, where the foetal and maternal bloods have a thin common barrier.

36 Most candidates were guessing about these hormones. The most obvious peak is LH at day 14, causing ovulation. FSH secretion from day zero causes a follicle to develop and release oestrogen, although this is the hormone not shown. Following ovulation, progesterone peaks at or near day 24 and declines if pregnancy does not occur.

37 Alleles are alternate forms of the information of a gene. Tt shows that the two alleles for the single gene are different.

38 Leaves, petals and roots of the single tree will all have developed from the original zygote by mitosis and will therefore have identical sets of chromosomes. Fruits will have developed from fertilised ovules and the pollen grains will contribute different genetic material.

BIOLOGY

Paper 5090/21

Theory

Key Messages

Specific examples should be included in candidates' responses to illustrate points.

In ***Section A*** questions, information is often provided to augment the candidates' own biological knowledge. It is important to read this information carefully and then to use it in the answer.

When a named item is required, a suitable biological or scientific name should be given.

Candidates who continue an answer on a different page are recommended to note this for the Examiner.

General Comments

Most candidates presented their work clearly and tailored the length of the answers to the space provided. Most candidates attempted all of the questions, and, contrary to the rubric instructions, a few attempted both **Questions 8** and **9**. There were some excellent answers and with many candidates showing a good understanding of basic biological principles.

Comments on Specific Questions

Section A

Question 1

(a) The majority of candidates listed components from two separate groups of food.

(b) Credit was awarded for specific examples of long term effects which would lead to famine. For example, references to drought, flooding, and rapid population growth all gained credit, but just stating "rain" or "soil" did not.

(c) (i) The signs of malnutrition were well known as were the names of diseases associated with the condition.

(ii) For this response, candidates should have linked the nutrients provided in the emergency famine food with their role in the body. An answer which scored well was: "The emergency food contains protein from the powdered milk that helps in the repair and growth of tissues. Iron is also present to help in the production of blood and the vegetable oil will give energy."

Question 2

(a) It was not uncommon to find parts mentioned that bore little relationship to the reflex arc.

(b) The candidates who identified the parts of the brain were also able to describe a problem which may result from damage to each of the parts. Those who stated a function performed by a healthy brain were not credited.

(c) (i) Many candidates correctly recognised mitotic cell division.

(ii) The definition of a tissue was less well known.

(d) The best responses stated that the Y chromosome would only be found in male cells, and hence its presence in a female indicated that the donor cells had travelled to the brain and successfully reproduced. Weaker candidates only recognised the importance of the Y chromosomes and did not make any further comments.

Question 3

(a) (i) Many candidates gave excellent answers and described the types of pollination. Candidates who described the pollination between flowers of species **Q**, rather than the different plants as shown in the diagram, did not gain any credit.

(ii) This question was well answered.

(b) This was very well answered. Many responses referred to cross pollination and the need for two parents.

(c) Only a few good answers were seen, e.g. "The pollen grain starts to develop a pollen tube and the enzymes digest a path through the style. The tube grows towards the ovule and enters through the micropyle. The male and the female nuclei fuse." Many candidates had a poor understanding of the anatomy of the gynaecium as well as confusing the terms ovum, ovary and ovule."

Question 4

(a) (i) Strong candidates selected the point where the uptake and loss of carbon dioxide was zero. The weaker candidates incorrectly chose the point of maximum uptake of carbon dioxide.

(ii) References were required to both respiration producing carbon dioxide and the light levels being too low for a high rate of photosynthesis. From this the conclusion could be drawn that more carbon dioxide was produced than was used.

(b) Good candidates made references to the shade in a forest or to the lower light levels present and observed that species **D** saturated at a lower light level. Credit was given to candidates who quoted figures from the graph to substantiate their points.

(c) Good responses indicated how the requirements for decomposition were readily available as there would be a large amount of leaf litter, warm and damp conditions and also bacteria and fungi present. The weaker candidates did not link the factors with an increase in decomposition.

Question 5

(a) Candidates were required to give a definition of the word "gene". Many weaker candidates are confused about the relationship between DNA, gene, allele and chromosomes.

(b) The good candidates stated two different factors. Those who gave two examples of chemicals were awarded only minimal credit.

(c) The good responses showed that the candidate had used information provided in the question and their own knowledge to explain why there was a reduction in oxygen taken to the tissues. Candidates were expected to recognise and to use the word "capillary" in their answers rather than describing the "passageway". The weaker candidates tended to state an obvious factor but did not link this to the reason why it would reduce oxygen transport. It was not often appreciated that the crescent shape of the red blood cells reduces the surface area and thus reduces the rate of uptake of oxygen by the cell.

Section B

Question 6

(a) (i) Candidates need to improve their understanding of the roles of the hormones at the various stages of the menstrual cycle.

(ii) Although many candidates stated that progesterone prevented pregnancy, few suggested that this would result in stopping the release of the ovum.

(b) Some excellent answers were seen with the candidates describing the functions of the placenta and umbilical cord. Substances should be named using biological terms, e.g. glucose, urea, amino acids. Names such as food or gases were not credited. Many weaker candidates omitted to mention that blood was involved as the transport medium.

Question 7

(a) Good answers were given to this part of the question.

(b) Candidates who scored highly gave responses, with clear and precise examples, to both parts of the question. Comments such as "alcohol affects the liver" did not score, whereas "alcohol damages the liver" did, because the candidate should state what the effect is. Many answers were vague and full of generalisations e.g. "alcohol causes problems in the community". Such statements do not score until a specific example is given.

Section C

Question 8

(a) There were some excellent responses, although a few candidates confused this with the hepatic or renal vein.

(b) Again candidates who used clear and precise examples did well. The candidates who confined their answers to the role of the liver in glucose regulation were not credited. Credit could only be given for functions of named biological molecules.

Question 9

(a) Weaker candidates tended to choose this question but they found it difficult to give clear definitions particularly of a *vector*.

(b) Control of the mosquito, both in the adult and larval form, was well described, as were the measures to prevent bites.

BIOLOGY

Paper 5090/22

A2 Structured Questions

Key Messages

Section A of this paper requires candidates to make deductions and suggestions after reading and understanding situations that might not always be familiar to them. Candidates will not be expected to use knowledge outside the syllabus. There was evidence that candidates were sometimes trying to look beyond the syllabus in order to produce relevant answers, thereby overlooking some straightforward and comparatively fundamental facts.

General Comments

Some of the work seen was of a very high standard, but there were some areas where candidates found difficulty in producing factual material that was scientifically accurate, or correctly related to the question asked. It was also not uncommon for candidates to appreciate the thrust of the question, but then fail to supply sufficient information to score full credit. Credit is quite often awarded for important basic information that some candidates may feel is too obvious to be worthy of mention.

Comments on Specific Questions

Section A

Question 1

(a) (i) There was some confusion between epidermis and epithelium, and also misidentification of the epidermis as mesophyll. ‘Plant cell’ was a fairly common but insufficiently precise answer.

(ii) Apart from those who mistook a guard cell for the stoma, this rarely presented a problem.

(b) The instruction to draw guard cells ‘in surface view’ created some problems. It was common to see the cross-sectional view shown in Fig. 1.1 repeated, but with the guard cells touching. Such a representation was still able to earn some credit for labelling.

(c) Some candidates may not have been familiar with the 24-hour clock, as the stoma at 1300 hours was sometimes described as closed, while that at 0100 hours was thought to be open. Gaseous exchange was regularly mentioned, but gases were not always identified, and nor was their direction of movement.

Question 2

(a) Most candidates offered two abdominal organs, but lungs were a common inaccuracy.

(b) Those who thought of the presence and effect of HCl scored well, but others described the tough muscular walls of the stomach providing resistance to infection – or even to the penetration of the bullet.

(c) The fact that the hole would provide a subsidiary entrance and exit for air into and out of the thorax was a concept that was appreciated by only a very few candidates. Most answers were restricted to possible damage to the lungs or to the muscles responsible for the action of breathing.

Question 3

(a) (i) Apart from a few who believed that the nodules contain fungi, this part was well answered.

(ii) This part revealed a considerable degree of confusion over the activities of the nodule bacteria. Many believed that they were involved in decomposition. Many gave a fairly detailed account of all the bacteria involved in the nitrogen cycle, with no indication as to which of the facts mentioned related to the bacteria located in the nodules.

(b) Artificial selection was often mentioned, as (inaccurately) was natural selection. Genetic engineering was also often considered. However, it was commonly suggested that cross-pollination would occur between *other species* of plants. Few mentioned that the process needs to be repeated over several generations.

(c) Most candidates managed to find two factors that might be responsible for the smaller plants growing at altitude, with temperature, soil fertility and carbon dioxide being the most popular.

Question 4

(a) Apart from a few suggestions that it might be the liver, candidates were able to correctly identify organ **B** as a kidney.

(b) (i) It usually followed that a correct identification of organ **B** led to correct identification of the blood vessels. There was some confusion over arteries and veins.

(ii) A few candidates confused the left with the right side of the heart, while others mentioned all four chambers of the heart, for which no credit could be awarded.

(c) Many candidates were not able to state whether or not a particular chemical was present. Several thought that there was no urea in blood, but better candidates were able to reason their way to earn full credit. In questions of this type, it is usually expected that there will be matching statements in each pair of boxes.

Question 5

(a) The majority opted for ‘fermentation’, and duly gained credit. The alternative (biotechnology) did not appear as often as might have been expected.

(b) Many did not appreciate that the water shown flowing towards the fermenter at **G** never actually enters it, although many appeared to believe that it did. This was an example of taking care to carefully read both the question and the information given before attempting to answer.

(c) Those who made the link between the references to pH/temperature and enzymes quickly obtained the available credit. Those who realised only that unsuitable pH and temperature could kill the microorganisms were less well rewarded.

(d) Several failed to look carefully at Fig. 5.1, which might have prevented suggestions that **H** is used to introduce air. The need to introduce microorganisms (through **H**) was often overlooked, although many mentioned the need for sterilisation.

Section B

Question 6

(a) Most answers included sound information on how each of the conditions mentioned is controlled and thus modified to provide optimum conditions for photosynthesis, growth and therefore maximum crop production. The points least regularly made were those that were in addition to the requirements for photosynthesis, namely the provision of blinds to reduce excess entry of light, artificial light that can maintain optimum conditions for 24 hours per day and that the building provides shelter from adverse climatic conditions. Several candidates referred to the exclusion of pests, but did not continue the point to discuss the advantage of an enclosed space when it comes to treating pest infestations. A significant number of candidates believed that putting the plants in a building ‘created the greenhouse effect’.

(b) Mention of seeds in the question led a significant number to talk about seed dispersal, and overlook the importance of pollination being restricted only to the plants in the building, and even then, in the absence of pollinating agents. Credit was often lost because of reference to being unable to pollinate with other *species* rather than with other varieties of the *same* species.

Question 7

(a) This question offered the candidates the opportunity to display their knowledge of a balanced diet and the uses of each component. Many extremely sound answers were given. It was also a question that rewarded accurately-learnt facts, and several failed to do themselves justice in this area. There was confusion between the functions of vitamins C and D. Carbohydrates were often said to be used in respiration, but the objective of that use, energy release, was sometimes overlooked. Nevertheless, full credit was often awarded.

(b) (i) Although the link between carbohydrate intake and the concentration of glucose in the blood was surprisingly often missed, many candidates found two relevant points to make and thus score full credit for the section.

(ii) Again, full credit was often awarded, but the most common area of error was either to omit reference to which type of blood vessel significantly suffers from atheroma, or to specify the wrong type of blood vessel.

Section C

Question 8

(a) The definition of a hormone had been faithfully learnt by most of the candidates. It was common to see mention of destruction in the liver omitted, but this did not prevent full credit being scored. The most significant error was from those who chose to describe an example of a specific hormone, thus failing to provide a definition.

(b) This is an area of the syllabus that candidates are always likely to find a little difficult to learn, and express accurately. Those who had mastered the topic were able to score highly. However, many showed confusion over the female hormones, where they are produced, and what functions they perform. Oestrogen and progesterone were often treated as if they were one hormone, and many answers were given combining their origin and functions, which consequently failed to gain credit.

Question 9

(a) A minority of candidates wrote about the circulatory system in general rather than capillaries in particular. Many made the common error of saying that capillaries are one cell thick (rather than that being a property of the capillary walls). It was rare to see mention of the concept of a decrease in blood pressure as blood passes along capillaries and only slightly more common to see mention of the permeability of capillary walls or the passage of plasma/tissue fluid through them. Otherwise, all points were scored and the section was generally well answered.

(b) That white blood cells are part of the immune system was a point made only by the better candidates, but it was not uncommon for candidates to use the terms ‘lymphocytes’ (a word that does not appear in the syllabus) and ‘phagocytes’, and then confuse their functions.

(c) It was commonly known that platelets are involved in the process of blood clotting, but sometimes descriptions of how clotting occurs were very inaccurate. Candidates’ use of terms and processes, again not mentioned in the syllabus, quite often gave rise to inaccuracies.

BIOLOGY

Paper 5090/31

Planning, Analysis and Evaluation

Key Messages

The main objectives of this paper were to test the application of practical skills and techniques as well as biological knowledge. Requirements for doing well included in Question 1, a clear understanding of the absorption of small and soluble molecules across the digestive system by investigating the movement, or otherwise, of starch and glucose through Visking tubing. In Question 2, key requirements included measuring the pH of food items such as fresh milk and yoghurt, using universal indicator paper, and concluding how and what bacteria produced yoghurt from milk within a known time scale.

General Comments

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

Comments on Specific Questions

Question 1

A - solution of 10% glucose and 1% starch

(a) Descriptions of how to carry out a test for reducing sugar were very well done with frequent and correct responses given to heating with Benedict's solution in a water bath for safety with positive colour changes to green/yellow/brown (qualified)/orange/red. The occasional error either omitted reference to heating in a water bath or involved the use of iodine instead of Benedict's solution.

(b) Candidates were asked to fill a length of Visking tubing with **solution A** followed by rinsing the outside with clean water. The tubing was then placed in a large test-tube of clean water (Fig. 1.1), samples of which were immediately tested for reducing sugar and starch and also after 20 minutes. Reponses overall in Table 1.1 were excellent with candidates recording correct colour observations for negative results with starch and reducing sugar together with a positive colour reaction with reducing sugar after 20 minutes.

(c) When asked to explain these observations after 20 minutes, the best answers included reference to diffusion of reducing sugar/glucose from a higher to a lower concentration with no energy required, in addition to confirming that starch could not pass through the tubing due to the larger-sized molecules. Weaker answers either repeated the results of tests carried out in **(b)** or that osmosis had occurred involving movement of water across a concentration gradient without mentioning diffusion.

(d) In response to giving reasons as to which part of the digestive system might be represented by the Visking tubing, many very good answers simply stated the ileum or small intestine as the correct region with subsequent absorption of glucose /reducing sugar/soluble molecules into the blood system. Incorrect answers focused on sites of absorption such as the liver, mouth, stomach or in some case the urinary bladder and kidney.

(e) The relatively small number of good answers correctly stated that the outside of the Visking tubing was rinsed with clean water before being placed into the large tube of water to remove sugar/glucose /**solution A** at the start of procedures. Weaker answers on the other hand implied that rinsing removed foreign matter/particles from blocking small pores in the tubing or just removed chemicals.

Question 2

(a) Using universal indicator paper and a colour chart to show the pH range, the best candidates recorded in Table 2.1 a yellow /green colour and a pH of 7/8 for fresh milk followed by an orange /red colour and a pH of 4/5 for yoghurt. When asked to stir samples and then describe any differences in the texture of fresh milk and yoghurt, correct responses showed that milk became thinner / more 'runny' compared with a thicker /creamy yoghurt. Weaker answers were less precise by describing differences in texture as soft/smooth compared with rough/hard or just indicated changes in colour.

(b) Taking into account the changes given in **(a)** and when asked to suggest how bacteria produced yoghurt with a thicker /creamy texture compared with fresh milk, excellent answers focused on bacteria producing acids or the pH reduced and additionally that acids changed /coagulated the protein in milk. Weaker replies suggested that most bacteria had reacted with enzymes in the milk and consequently the yoghurt decomposed.

(c) From Figure 2.1 showing different types of bacteria found in yoghurt, many excellent answers identified two types of bacteria, and these included spherical/cylindrical/ circular bacilli and rod /capsule-like/ tubular cocci and also that some bacteria had multiplied/divided and occasional reference to mitosis. Less precise answers described different shapes of unicellular bacteria with flagella but no nuclei.

(d) This section tested the ability of candidates to construct a graph on a grid from data given in Table 2.2. Such data showed increasing numbers of bacteria present in yoghurt over a time scale of 0 - 6 hours. Better candidates correctly labelled the X axis as 'Time/hr' and the Y axis as 'Number of bacteria/ millions' with linear scales filling at least half of the grid. Correct plots were made with a clean, neat /ruled line or a smooth curve drawn through the plots. Well drawn graphs showed that after 5-6 hours only a small increase in the number of bacteria had occurred suggesting that all nutrients/sugars had been used up or that the acidity was too high or a build-up of toxic end products from the bacteria had taken place. In weaker answers, both axes remained unlabelled and plots were incomplete or incorrectly represented. In addition vague statements were made relating to a reduction in bacterial reproduction or that most of the milk had formed yoghurt.

(e) When asked to design an experiment to study the effect of temperature on the formation of yoghurt from milk, the best answers selected the same volume/source/type of milk and the addition of the same volume /mass /type of bacteria within an acceptable range with at least 2/3 temperatures identified. The investigation also measured the time taken for the yoghurt to form or for the pH to reach a value of 4 as in Table 2.2 and that the experiment would be repeated to obtain mean values. A large number of weaker responses simply stated that low /medium / high temperatures should be selected, but no precise temperatures were identified. This was followed by stating that at unspecified optimum temperatures the rate of bacterial reproduction would increase or that fermentation had taken place. There was also frequent reference here to enzymes denaturing at higher temperatures.

Question 3

W1 – insect pollinated flower e.g. *Lobelia*, *Primula*, *Vinca* with stamens and carpel

(**a) (i)** Candidates were asked to remove some petals from **W1** to expose the reproductive structures and then make a large drawing of these structures. In many excellent answers, candidates produced good sized drawings (at least 9 cm) with clear outlines. The anthers were delimited, the filaments drawn with a double line with the stigma placed below the anthers and drawn wider than the style. The stamens, stigma and style were also correctly labelled. In weaker answers, drawings were either too small with indistinct outlines and the reproductive structures were entirely confused.

(ii) When asked to describe two visible features of **W1** that indicate insect pollination, the best answers confirmed that the flower/stamens were tubular in structure. A large stigma, together with brightly coloured / scented petals with honey guides, were also present. Many weaker answers did not mention any of these features, but focused instead on the presence of pendulous stamens with sticky small anthers containing sticky pollen for insects to touch or that the petals formed a landing platform for insects.

BIOLOGY

Paper 5090/32

Planning, Analysis and Evaluation

Key Messages

The main objectives of this paper were to test the application of practical skills and techniques as well as biological knowledge. Requirements for doing well included in Question 1, a clear understanding of the absorption of small and soluble molecules across the digestive system by investigating the movement, or otherwise, of starch and glucose through Visking tubing. In Question 2, key requirements included measuring the pH of food items such as fresh milk and yoghurt, using universal indicator paper, and concluding how and what bacteria produced yoghurt from milk within a known time scale.

General Comments

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

Comments on Specific Questions

Question 1

A - solution of 10% glucose and 1% starch

(a) Descriptions of how to carry out a test for reducing sugar were very well done with frequent and correct responses given to heating with Benedict's solution in a water bath for safety with positive colour changes to green/yellow/brown (qualified)/orange/red. The occasional error either omitted reference to heating in a water bath or involved the use of iodine instead of Benedict's solution.

(b) Candidates were asked to fill a length of Visking tubing with **solution A** followed by rinsing the outside with clean water. The tubing was then placed in a large test-tube of clean water (Fig. 1.1), samples of which were immediately tested for reducing sugar and starch and also after 20 minutes. Reponses overall in Table 1.1 were excellent with candidates recording correct colour observations for negative results with starch and reducing sugar together with a positive colour reaction with reducing sugar after 20 minutes.

(c) When asked to explain these observations after 20 minutes, the best answers included reference to diffusion of reducing sugar/glucose from a higher to a lower concentration with no energy required, in addition to confirming that starch could not pass through the tubing due to the larger-sized molecules. Weaker answers either repeated the results of tests carried out in **(b)** or that osmosis had occurred involving movement of water across a concentration gradient without mentioning diffusion.

(d) In response to giving reasons as to which part of the digestive system might be represented by the Visking tubing, many very good answers simply stated the ileum or small intestine as the correct region with subsequent absorption of glucose /reducing sugar/soluble molecules into the blood system. Incorrect answers focused on sites of absorption such as the liver, mouth, stomach or in some case the urinary bladder and kidney.

(e) The relatively small number of good answers correctly stated that the outside of the Visking tubing was rinsed with clean water before being placed into the large tube of water to remove sugar/glucose /**solution A** at the start of procedures. Weaker answers on the other hand implied that rinsing removed foreign matter/particles from blocking small pores in the tubing or just removed chemicals.

Question 2

(a) Using universal indicator paper and a colour chart to show the pH range, the best candidates recorded in Table 2.1 a yellow /green colour and a pH of 7/8 for fresh milk followed by an orange /red colour and a pH of 4/5 for yoghurt. When asked to stir samples and then describe any differences in the texture of fresh milk and yoghurt, correct responses showed that milk became thinner / more 'runny' compared with a thicker /creamy yoghurt. Weaker answers were less precise by describing differences in texture as soft/smooth compared with rough/hard or just indicated changes in colour.

(b) Taking into account the changes given in **(a)** and when asked to suggest how bacteria produced yoghurt with a thicker /creamy texture compared with fresh milk, excellent answers focused on bacteria producing acids or the pH reduced and additionally that acids changed /coagulated the protein in milk. Weaker replies suggested that most bacteria had reacted with enzymes in the milk and consequently the yoghurt decomposed.

(c) From Figure 2.1 showing different types of bacteria found in yoghurt, many excellent answers identified two types of bacteria, and these included spherical/cylindrical/ circular bacilli and rod /capsule-like/ tubular cocci and also that some bacteria had multiplied/divided and occasional reference to mitosis. Less precise answers described different shapes of unicellular bacteria with flagella but no nuclei.

(d) This section tested the ability of candidates to construct a graph on a grid from data given in Table 2.2. Such data showed increasing numbers of bacteria present in yoghurt over a time scale of 0 - 6 hours. Better candidates correctly labelled the X axis as 'Time/hr' and the Y axis as 'Number of bacteria/ millions' with linear scales filling at least half of the grid. Correct plots were made with a clean, neat /ruled line or a smooth curve drawn through the plots. Well drawn graphs showed that after 5-6 hours only a small increase in the number of bacteria had occurred suggesting that all nutrients/sugars had been used up or that the acidity was too high or a build-up of toxic end products from the bacteria had taken place. In weaker answers, both axes remained unlabelled and plots were incomplete or incorrectly represented. In addition vague statements were made relating to a reduction in bacterial reproduction or that most of the milk had formed yoghurt.

(e) When asked to design an experiment to study the effect of temperature on the formation of yoghurt from milk, the best answers selected the same volume/source/type of milk and the addition of the same volume /mass /type of bacteria within an acceptable range with at least 2/3 temperatures identified. The investigation also measured the time taken for the yoghurt to form or for the pH to reach a value of 4 as in Table 2.2 and that the experiment would be repeated to obtain mean values. A large number of weaker responses simply stated that low /medium / high temperatures should be selected, but no precise temperatures were identified. This was followed by stating that at unspecified optimum temperatures the rate of bacterial reproduction would increase or that fermentation had taken place. There was also frequent reference here to enzymes denaturing at higher temperatures.

Question 3

W1 – insect pollinated flower e.g. *Lobelia*, *Primula*, *Vinca* with stamens and carpel

(**a**) **(i)** Candidates were asked to remove some petals from **W1** to expose the reproductive structures and then make a large drawing of these structures. In many excellent answers, candidates produced good sized drawings (at least 9 cm) with clear outlines. The anthers were delimited, the filaments drawn with a double line with the stigma placed below the anthers and drawn wider than the style. The stamens, stigma and style were also correctly labelled. In weaker answers, drawings were either too small with indistinct outlines and the reproductive structures were entirely confused.

(ii) When asked to describe two visible features of **W1** that indicate insect pollination, the best answers confirmed that the flower/stamens were tubular in structure. A large stigma, together with brightly coloured / scented petals with honey guides, were also present. Many weaker answers did not mention any of these features, but focused instead on the presence of pendulous stamens with sticky small anthers containing sticky pollen for insects to touch or that the petals formed a landing platform for insects.

BIOLOGY

Paper 5090/61
Alternative to Practical

Key Messages

This paper tests the ability to use practical skills such as observation, drawing, data handling, interpretation of results and experimental design. It is important that candidates have experience of a range of practical work and demonstrate awareness of safety procedures.

When designing experiments, candidates should demonstrate awareness of the need to identify and control key variables.

All the information provided with each question should be read thoroughly, including the introductory material, such as the details of how an investigation has been carried out. This information may well be necessary for answering the questions that follow.

The credit allocation gives an indication of the amount of content expected in the answer.

General Comments

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.

Many candidates demonstrated by their answers that they do have experience of practical work, but the answers of some candidates showed a lack of such experience.

There were some excellent drawings that were clear, labelled and drawn to a good size.

When constructing graphs, candidates should ensure that axes are fully labelled, (including units), and that scales are linear. Full use should be made of the space provided.

Comments on Specific Questions

Question 1

(a) (i) This question was generally answered well. Most candidates identified Benedict's solution as the correct reagent and also suggested a suitable range of colours to indicate the presence of reducing sugar. Some candidates omitted to specify that the solution should be heated, but those who did often also referred to the use of a water bath, thus scoring extra credit for a relevant safety procedure. A few candidates did not indicate that the Benedict's solution/mixture is blue at the beginning, and thus did not gain full credit.

(ii) This part of the question was also quite well answered, with iodine solution being identified as a suitable reagent to test for the presence of starch. Fewer candidates noted the starting colour (brown) compared with part **(a)**. A few candidates incorrectly identified the colour indicating a positive result, as being blue. There were almost no references to safety in this part, although credit could have been given if not already awarded in **(a)(i)**.

(b) Creditworthy answers referred to the removal of the solution (reducing sugar and starch) from the outside of the tube. Many candidates gave less specific answers that included the idea that the tube should be clean such as, 'to prevent contamination', 'remove unwanted substances'. This type of answer was insufficient and thus gained no credit.

(c) A significant number of candidates simply re-stated the results, noting the sampling times and indicating whether or not sugar and starch were present at those times. This was then explained by suggesting that it takes time for starch to be broken down into sugar. These answers were not creditworthy. Correct answers referred to the process of diffusion and the movement of substances from areas of high concentration to areas of low concentration. Some candidates gained credit for recognising the difference in the relative sizes of sugar and starch molecules. Credit could also be gained for recognising that diffusion is a process that does not require energy, although few candidates stated this fact.

(d) Many candidates gained credit for correctly identifying the small intestine/ileum. Some of the answers that did not score were too vague (intestine) or incorrect (large intestine). Further credit was awarded for reasoning that this is the part of the body where the absorption of digested food molecules takes place and candidates expressed this in numerous acceptable ways. Credit was also available for indicating that digested food enters the blood; fewer candidates earned this credit.

Question 2

(a) Many candidates noted that the bacteria appeared to have two distinct shapes - spheres and rods, and a good number of candidates were able to correctly name these as cocci and bacilli. Very few answers explained the appearance of the chains of bacteria in terms of division. Most candidates who attempted to explain the chains thought, incorrectly, that the bacteria were joining together.

(b) The majority of candidates correctly responded that the bacteria produce acids/lower the pH. Very few candidates appreciated that the acids change the milk protein, however, a significant number noted that the milk becomes thicker and were able therefore to score the full credit.

(c) (i) The majority of candidates correctly selected the *x*-axis for plotting the given values (time) and the *y*-axis for the variable values (number of bacteria). Most candidates correctly labelled the axes, including units.

The majority used linear scales that made use of the whole grid. Most candidates plotted the points clearly and correctly, although in a few cases points plotted as dots but not circled, were very difficult to identify once a line had been drawn.

Some candidates did not realise that a line of best fit could be a curve.

(ii) Very few candidates answered correctly in terms of there being less sugar available or that the pH was too low. The majority of candidates thought that the yogurt production must be complete. Some thought that there must have been a change in temperature that had made conditions unfavourable for the bacteria. Neither of these answers gained credit.

(d) Good answers identified the variables that should be controlled, such as the volume and type of milk used and the mass of bacteria added to the milk. Although many candidates identified temperature as the independent variable, very few suitable temperatures were suggested. Many candidates simply referred to carrying out the experiment in hot and cold conditions. Better answers identified a suitable range of at least three specific temperatures. Some candidates suggested continuous heating of the mixture, which did not gain credit.

Credit was also available for suggesting what would be measured as the independent variable. In the best answers, candidates measured the time taken for the yogurt to form, or for the pH to reach 4, and then repeated the experiment in order to obtain a mean value.

Very few candidates scored full credit on this question.

Question 3

(a) (i) There were some very good biological drawings, of a suitable size, drawn with clear continuous lines, good proportions and attention to detail.

A few poorer drawings were drawn with sketchy lines or with shading that is not required in biological drawings. Some were too small and lacked detail.

A small number of candidates did not follow the instructions and drew something other than Fig. 3.1.

A significant number of candidates labelled one or more of the stamen, stigma and style incorrectly and therefore could not be credited.

(ii) Some candidates identified appropriate parts of the flower, e.g. stigma, anthers, petals, but did not relate this to insect pollination, e.g. *large* stigma, *conspicuous* petals, anthers *enclosed within the flower*. Some detail was required for credit to be awarded.

It should be noted that scent is not a visible feature.

(b) Good answers described a method of transferring the pollen grains from the flower, e.g. by using a scalpel or brush. Some candidates placed their pollen on a white tile; whilst this is not an incorrect step, a white tile is not suitable for viewing the pollen grains under the microscope. The best answers correctly named and described the use of appropriate equipment in the preparation of a specimen slide, including adding water or a stain to the pollen grains, followed by the careful placement of a cover slip to avoid air bubbles. Further credit could have been gained by specific reference to the use of the microscope, e.g. adjustment of the magnification/focus. 'Place the pollen under the microscope' was insufficient as it merely repeated the stem of the question.

Some answers were vague and lacked the detail required to score full credit.

BIOLOGY

Paper 5090/62
Alternative to Practical

Key Messages

Candidates should take time to read all the information provided in the introduction to each question and read the questions themselves carefully before answering.

They should also ensure that they have a ruler to measure in mm.

General Comments

Many of the scripts indicated that candidates had been well-prepared for the examination and advice from previous examinations had been heeded.

In the vast majority of cases, writing was clearly legible, even when answers were too long to fit in the allocated spaces.

There were very few questions for which no answers were attempted.

The vast majority of candidates appeared to have had sufficient time in which to complete the paper.

Comments on Specific Questions

Question 1

(a) This tested the candidates' ability to use data collected during an investigation. The majority of candidates were able to calculate the changes in length correctly as 2mm and 4mm in **A** and 2mm and 5mm in **B** by comparing the lengths at 20 minutes with the initial lengths. Some candidates incorrectly compared the lengths at 20 minutes with those at 10 minutes. However, it was still possible to gain a mark for correctly indicating that the values in **A** were negative values, length having decreased. A few candidates calculated mean values for the three measurements in each, showing that they had not read the question carefully.

(b) This was well answered by many candidates. They recognised that it was movement of water, and not of solution or ions as stated by some candidates, that had caused the changes in texture. The direction of movement was generally correctly stated – out of the potato tissue in A, into the potato tissue in B. Some candidates, having wrongly stated the converse, still argued that the movement they had described made the tissue in A soft and in B, hard. Many candidates made correct references to the comparative differences in the concentrations of the external solutions A and B and of the internal cell solution of the potato tissue being the reason for water movement. Many answered well in terms of differences in water potential. Better candidates went on to explain the effect of the water movement on the cells in the potato tissue to bring about the differences in texture – either decreased or increased turgidity. There were some good answers that did not mention the process of osmosis taking place – and very few references overall to the partially permeable membranes involved in osmosis. Candidates were not required to compare solutions A and B, but their effects on the potato tissue.

(c) This question required clear thinking and proved challenging to many although there were some excellent answers. The information that the skin of potato contains waterproof materials was given in the introduction at the beginning to **Question 1**, yet some candidates either did not notice it or did not recognise its significance. Very few candidates stated that, because of these waterproof materials, the length of the skin remained unchanged as it could neither absorb nor lose water by osmosis. The other cells in the strips of tissue could – lose water in **A** or gain water in **B** (as identified in **(a)** and **(b)**) – resulting in the curvatures seen in Table 1.3.

Question 2

(a) The candidates' ability to complete Table 2.1 well, depended, first, on their ability to identify the four visible structures of the two seedlings that were listed and, then, on their being able to observe any differences between them. From some answers given, it was apparent that some candidates could not distinguish between radicle and plumule, and cotyledon and testa. With the differences, there were several acceptable answers for each of the four as there were a number of observable differences in each case. Only a few candidates mistakenly described functional differences and differences that could not be seen on Fig. 2.1. Comparative statements were required e.g. radicle in bean longer, shorter in pea. Statements such as radicle longer in bean and thicker in pea are not comparative; neither is e.g. longer and smaller.

(b) (i) The lengths of the pea seedling recorded by some candidates fell within the permitted range. This showed that they had understood the instruction to measure the total uncurled length of the seedling. Some candidates did not measure the total length of the seedling but only a part of it. Only a few candidates recorded a length within the generous permitted range for the bean seedling which was more difficult to measure. Correctly expressed measurements in either mms or cms were acceptable and it was expected that the units used would be stated.

(ii) Some of the marks for the drawing were given for reading and following instructions. The vast majority of candidates made a drawing of the pea seedling as instructed; very, very few drew the bean or both pea and bean. Many made a drawing that fell within the range permitted as being of a magnification of x2, having observed that the seedling in Fig. 2.1 was actual size, x1. Marks for the quality of the drawing included the use of clear lines, clean and continuous, not sketchy, drawn with a sharp pencil, with no shading in the drawing. Shading appeared in many drawings so this mark could not be awarded. Other marks were awarded for representing the proportions of the parts of the seedling well – radicle and plumule – and for the correct shape and proportion of the testa-covered cotyledon. The shape of the testa-covered cotyledon left much to be desired in many drawings. As a labelled drawing was asked for the minimum labels required were radicle, plumule and testa. Too many candidates omitted labels altogether, presumably because either they did not know them or they had not read the question carefully.

(c) (i) Many candidates answered this well, correctly describing the biuret test for proteins. Some applied unnecessary heat to the solution which may have indicated confusion with the Benedict's test for reducing sugars. Some knew the 'word' biuret and then went on to name reagents involved in the test incorrectly. There were a few candidates who mistakenly thought that the Benedict's test, or iodine test, were tests for protein. A significant number of candidates, although stating that a mauve/purple/ lilac colour would indicate the presence of protein, did not mention that the solution initially is blue. A few candidates invalidated the test by adding protein e.g. egg white or albumen to the test-tube containing the pea.

(ii) This involved making the qualitative test described in **(c)(i)** quantitative and many candidates did this well. Good candidates recognised the need to control variables e.g. by using equal masses of pea and bean, adding the same volume(s) of reagent to both. Some correctly stated that the greater the intensity of purple colour resulting the higher protein content. A few candidates described methods comparing the calorific values of pea and bean which are not appropriate for use in this context.

(d) (i) The vast majority of candidates drew bar charts as instructed; only a few attempts at line graphs were seen. The bar charts drawn were mostly of a good scale, with the bars being neatly drawn with a ruler. Some candidates did not label both axes fully, some mis-plotted values, and some drew bars of differing widths but many candidates scored full marks for this question. Some candidates spent a lot of time shading in the bars with different patterns which is totally unnecessary.

(ii) The question asked for suggestions as to which of the fruit/vegetables 'are legumes', not 'is a legume'. Many candidates did not work out from the information given that three of the listed fruits/vegetables contained significantly more protein than the others and therefore were probably legumes – lentil, soya bean and pea. Many gave the incomplete answer of only lentil. Some candidates wrongly added others with much lower protein content to the list e.g. potato.

Question 3

This question demanded knowledge of tests regularly used in practical investigations.

The vast majority of candidates were familiar with limewater turning cloudy in the presence of carbon dioxide. A few correctly referred to hydrogen carbonate indicator solution changing colour from red to yellow in the presence of carbon dioxide.

Many candidates correctly stated that a glowing splint will re-kindle in oxygen or it will burn more brightly. Oxygen cannot re-kindle a splint that is already burning brightly.

A test for water was less well known. Better candidates described either blue cobalt chloride turning pink in the presence of water or anhydrous copper sulphate turning from white to blue. Some confused copper/cobalt/chloride/sulphate to create their own reagent. A number of candidates described breathing on a cold surface and observing water condensing – but did not explain how it could be proved that it was indeed water that had been formed. Some incorrectly thought litmus paper could be used to test for water.

Only the better candidates correctly stated that exhaled air is saturated with water vapour, or contains more water vapour than inhaled air.

A few candidates described, for each test, an experiment in which the different gases could be collected e.g. placing plastic bags over leaves to collect water vapour. This showed they had not read the question carefully.