

BIOLOGY

Paper 5090/11
Multiple Choice

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

General

As usual, a report must remind all candidates to “read the question” – and this refers to all the words of the question and all the options. Many simple errors could be avoided by doing so. An example in this paper is **Question 18**, where options **A**, **B** and even **D** may be true, but the stem specifically refers to lactic acid. The nitrogen cycle still remains the least well known part of the syllabus.

These questions were well understood and posed few problems: **4**, **7**, **12**, **13**, **21**, **23**, **25**, **29**, **31**.

Comments on individual items

- 1 This section of the epidermis is a tissue because it is a collection of similar cells.
- 2 A sucrose concentration of 0.0% will allow the potato pieces to absorb water by osmosis and increase in mass, thus eliminating options **A** and **D**. **B** is wrong since the potato mass decreases at first but then increases.

- 3 Neither osmosis nor diffusion require energy directly. They are passive and movement is due to concentration differences.
- 5 Magnesium ions are in chlorophyll molecules. A lack of magnesium prevents the green colour developing and such plants are yellow before they die.
- 6 At X, increasing the light increases photosynthesis, so light is limiting. At Y and Z the CO₂ levels remain the same despite increasing the light, so CO₂ is limiting.
- 8 The question refers to the longitudinal muscles, which are labelled and stippled in the diagram. The region labelled 2 has its circular muscles contracted. Their antagonists are relaxed.
- 9 Salivary amylase acts in the mouth. Pancreatic amylase acts in the ileum.
- 10 Starch is not transported in vascular tissue. Sucrose and amino acids are only found in phloem.
- 11 Only the 25 year old is likely to be menstruating and thus needs most iron for replacement of haemoglobin. They are also likely to be most active.
- 14 The left side of the heart is labelled and the wall of the right ventricle is clearly thinner, so blood is sent to the lungs through tube 2. Tube 3 must be the aorta.
- 15 Substance R passes from the red blood cell to the plasma cell, so it must be oxygen. P passes from the tissue cell to the plasma and must be CO₂.
- 16 During phase X, the external intercostals and diaphragm muscles relax. The ribs fall and the thorax gets smaller. The lungs' elasticity also contributes to the movement of air out of the lungs.
- 17 Cilia will not trap bacteria, since they are covered by a thin layer of mucus, which does.
- 18 Training increases tolerance of lactate, so the anaerobic phase of an activity can be prolonged.
- 19 Option **B** refers to egestion. Excretion is defined as being the removal of waste products of metabolism, which are mainly water, urea and CO₂.
- 20 Ruling out the cerebellum and kidneys, leaves **B** as the key.
- 22 Blood glucose control is hormonal and involves adrenalin and insulin, amongst others.
- 24 Lifting the body from X to Y is due to the biceps contracting. The shoulder, which is the ball and socket joint, rotates.
- 26 All cells have a membrane and cytoplasm. Fungi, many bacteria and plant cells have a cell wall. Bacteria do not have a true nucleus with a membrane.
- 27 Both production processes are anaerobic and produce lactic acid from lactose, so the pH will fall.
- 28 Option **A** refers to the harmful effects of dangerous insecticides, such as DDT.
- 30 Candidates seemed to be guessing this one. **B** and **D** are opposite effects involving atmospheric nitrogen. Nitrification involves the change from nitrite to nitrate. A good clue to the key would be that decaying material, including urea, often smells of ammonia.
- 32 Acid rain (option **A**) is due to SO₂ and SO₃ – not nitrates, which are essential for fertility, since they lead to the formation of amino acids and hence proteins.
- 33 In 1 (the anther) and 3 (the ovule), meiosis (reduction division) will occur and produce the gametes.
- 34 All three tissues in a germinating seed are active. Mitosis in the tissues of the plumule and radical is obvious, whereas the biochemical activity in the cotyledons is less so. Starch hydrolysis, transamination and protein synthesis are perhaps the most obvious and will require mitochondrial respiration.



- 35** Sperm deposited on day 10 will still be viable on day 13. Eggs ovulated on day 15 are still viable on day 17, so the fertile period extends for 7 days.
- 36** Vessel X takes blood to the placenta from the foetus, therefore it will have more CO_2 and urea than vessel Y.
- 37** Only the alleles I^A and I^B are codominant over the recessive allele I^O . A person who has blood group A could be $I^A I^O$.
- 38** If insulin is produced from transplanted human genes it will be the same molecule and just as effective (option **A**). Bacteria that fail to produce insulin will not be used (option **B**). The dose of insulin given is measured by its effectiveness on the measured blood sugar level (option **C**).
- 39** Statement **B** is correct. Misreading the others may account for the errors in this question, which is largely a test of understanding this fundamentally important language.
- 40** Unusually, the answer (**A**) is zero! No green leaves will form in the dark. Another route to the key is that half of all the seeds were grown in each condition and 430 seedlings developed in the light, so about 400 were grown in the dark, all of which are accounted for as having cream leaves.



BIOLOGY

Paper 5090/12
Multiple Choice

<i>Question Number</i>	<i>Key</i>	<i>Question Number</i>	<i>Key</i>
1	B	21	C
2	D	22	A
3	C	23	D
4	C	24	A
5	D	25	B
6	B	26	B
7	B	27	B
8	A	28	A
9	C	29	A
10	D	30	D
11	D	31	D
12	C	32	B
13	A	33	D
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General

As usual, this report must remind all candidates to “read the question” – and this refers to all the words of the question and all the options. Many simple errors could be avoided by doing so. The example in this paper is **Question 21**, where options **A**, **B** and even **D** may be true, but the stem specifically refers to lactic acid. The nitrogen cycle still remains the least well known part of the syllabus.

These questions were well understood and posed few problems: **1, 3, 5, 8, 9, 11, 14, 15, 17, 25, 26, 29, 30, 35, 40.**

Comments on individual items

- 2 Only the 25 year old is likely to be menstruating and thus needing most iron for replacement of haemoglobin. They are also likely to be most active.
- 4 A sucrose concentration of 0.0% will allow the potato pieces to absorb water by osmosis and increase in mass, thus eliminating options **A** and **D**. **B** is wrong since the potato mass decreases at first but then increases.
- 6 Salivary amylase acts in the mouth. Pancreatic amylase acts in the ileum.
- 7 The question refers to the longitudinal muscles. The region labelled 2 has its circular muscles contracted. Their antagonists are relaxed.
- 10 Magnesium ions are found in chlorophyll molecules. A lack of magnesium prevents the green colour developing and such plants are yellow before they die.
- 12 At X, increasing light increases photosynthesis, so light is limiting. At Y and Z the CO₂ levels remain the same and so does the photosynthetic rate, so CO₂ is limiting.
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- 39** Both processes are anaerobic and produce lactic acid from lactose, so the pH will fall.



BIOLOGY

Paper 5090/21

Theory 21

General comments

This paper tested a wide range of ability. Overall, some parts of **Section A** questions proved to be the more challenging while **Section B** answers reflected individual capability; there were however some good answers. Despite having limited biological knowledge the weaker candidates were usually able to attempt most questions.

Comments on specific questions

Section A

Question 1

- (a) (i) The ultimate source of energy (sun/light) was required, but the most frequent answer given was grass.
- (ii) The required answer was chemical, but usually a named carbohydrate was given.
- (b) (i) Following on from (a) although many correctly gave respiration, digestion/absorption were as frequent since this completed the parallel theme.
- (ii) One or two valid answers were normally given. Answers were often too vague e.g. digestion. Many used the energy released by respiration for respiration.
- (c) (i) A food web, not a chain, was required. It must have a producer and the organisms should be connected by arrows. Even good candidates sometimes defaulted on the need for arrows.
- (ii) An explanation of the energy flow was expected, but usually a description of the food web was given. Apart from an occasional reference to the relative size of ticks/oxpeckers or possible extinction of ticks, few marks were awarded. Energy references were rare.

Question 2

- (a) The effects of sweating are well understood; sweat and urine are known to have the same constituents but confusion occurs when deciding on the volume and concentration of urine (colour and smell are unimportant). Good candidates mentioned the role of the kidney but without reference to the need to keep the blood concentration constant. (Four marks are allocated to this part, so candidates should try to produce more than one idea).
- (b) The statement that 'antiperspirant blocks the sweat ducts' was repeated without making the point that this would inhibit sweating. (Statements copied from the Question Paper should not be expected to score marks.) Answers in (a) showed that the role of sweating in cooling the body is understood but this idea was not carried into (b). The effect of overheating was not given.
- (c) Despite the 'antibacterial' reference, 'many germs were killed' was not precise enough to gain credit. Soap was used to wash off odours/sweat or unblock pores. It was realised that soap would remove the smell not just mask it. Few understood or attempted to explain the role of bacteria in decomposition, and thus why they should be removed.

Question 3

- (a) Two appropriate factors were usually selected but the explanations often lacked accuracy. The water loss should be by transpiration or evaporation. The heat and light of sunlight must be treated separately. Some confusion exists as to what is low/high humidity and any reference to diffusion or concentration gradient was rare.
- (b) Many found this question difficult. The question itself explained the graph, but the time factor was significant: perhaps the 'warm, dry climate' reference was overlooked. Once the early temperature difference was noted a second mark often followed, however they were not good answers.
- (c) The usual mark, if scored, was for the idea that only water would be evaporated or transpired. Some took water from the soil but nowhere were the separate xylem and phloem 'systems' recognised.

Question 4

- (a) (i) This part was quite well done.
- (ii) There were few references to the coordinated movement of the cilia or to the direction of the resultant passage of the mucus. The most frequent error was a reference to 'cilia trap dirt/bacteria'.
- (b) (i) Careful reading of the question was needed here. Few interpreted the drawings correctly, though later in (ii), alveoli were known to break down. Uncertainties led to letters (a) and (b) being altered not rewritten, resulting in an unmarkable outcome.
- (ii) Many candidates could score three marks here confidently, the usual references were to cancer, broken alveoli/emphysema or breathing difficulties. Good candidates who offered full explanations often overlooked the named organ and effect. The reduced surface area was noted, but sometimes mucus, not tar, coated the alveoli.

Question 5

- (a) Cell F was identified as a root hair or the cell wall.
- (b) (i) Magnesium was well known, but rarely were nitrates thought to be needed for chlorophyll.
- (ii) Usually 'nitrates' were given with occasional reference to phosphates. The main loss of marks was due to a reference just to 'nitrogen' without mention of ions.
- (c) (i) Active transport/uptake was very well known even by the weaker candidates.
- (ii) This question was found to be difficult. Diffusion, and concentration reference if not already given, were usually the only marks awarded. There was much confusion of osmosis and diffusion, the ions were said to 'osmose' in. This route was said to be quicker, easier, and have no requirement for energy. Neither the passage through the cell wall, nor the permeability of the cell wall, were considered.

Section B

Question 6

- (a) It was necessary to first define 'pollination'. Often no source of pollen was given. The idea of the same plant /different plant usually correct, although sometimes the reference was to reproduction not pollination. Few involved flowers so the finer point of 'same or different flower on the same plant' was lost, though mention of same species was frequent. Some references to genetic variability, or lack of it, were seen.
- (b) There were some very good accounts, though they were the exception. The course of events was basically correct but answers were inaccurate in the detail. The most common error was to use the pollen grain as the gamete; it rarely germinated and it travelled down the style into the ovary (which it entered via the micropyle) and took part in fertilisation. It was not always clear that the ovule (if

named) was in the ovary. The mark for falling flower parts was rare. (It seemed that some answers were learned and incorrectly reproduced, rather than that there was any real understanding.)

Question 7

There were those who were unable to attempt this question, others scored all the marks. The parts of the brain, on occasion, were mismatched with their functions. The question was precise in its requirements, descriptions of appearance or anatomy were superfluous.

- (a) Cerebrum: usually at least three valid functions were given.
- (b) Cerebellum: that it is concerned with posture and balance was known by most candidates, but there were no references to instinct.
- (c) Hypothalamus: there were few mentions of homeostasis, regulation of body temperature was given by most candidates, answers concerning osmotic or glucose control were with reference to the body not the blood.

Question 8 Either

- (a) This question was well answered. There was absorption into the villi and the amino acids travelled to the liver in the hepatic portal vein, but there was no reference to them being in solution in the blood plasma.
- (b) Deamination was usually correct but the fate of the useful parts of the molecule received less attention than waste urea. New proteins were rarely made (though there was occasional reference to making new cells), the carbohydrate residue was stored as glycogen but not used as a respiratory substrate. The urea passed to the kidney for excretion and most of the marks could be gained following its path from the liver to the urethra, but excretion via sweat was ignored and blood vessels were not named. There were however, some excellent and accurate answers.

Question 8 Or

This was the preferred option but it was not answered as well as **Question 8 Either**.

- (a) Usually only the cell division mark was awarded; few were genetically identical or maintained the chromosome number.
- (b) There were regular references to growth and repair, but if reproduction was mentioned it was rarely qualified as being asexual.
- (c) The reference to parents and offspring did not always trigger the response that it was sexual reproduction that should be explained. The terms meiosis and mitosis were used interchangeably. If mitosis was mentioned it was not related to asexual reproduction. The average candidate scored marks for haploid or 23 chromosomes, fertilisation, restoration of diploid number or 46 chromosomes. References to gametes or the type of reproduction involved were rare. There were some good answers but this question was often chosen as a last resort, to poor effect.



BIOLOGY

Paper 5090/22

Theory 22

General comments

Some extremely competent answers were seen to all questions. Though some parts of questions were somewhat challenging, they discriminated well between candidates of differing abilities and no question failed to make a significant contribution to the process of assessment.

Comments on specific questions

Section A

Question 1

- (a) (i) Insulin was the almost universally correct answer. Other responses included the occasional reference to ADH, adrenalin and testosterone.
- (ii) The only inaccurate answer that appeared with any regularity was liver as the site of insulin manufacture. Some confused the functions of insulin with those of glucagon or adrenalin and several confused the terms glucagon and glycogen, but conversion of glucose to glycogen and reduction of blood glucose concentration were usually mentioned. It was quite common to read answers that implied that insulin alone was responsible for the control of blood glucose concentration.
- (b) (i) This was well answered, with just the occasional mention of the inaccurate 'chromatin'.
- (ii) Again, correct, apart from a very few mentions of DNA.
- (c) (i) Most managed to think of at least a couple of the requirements for culturing the yeast. A 'constant' temperature or pH were sometimes mentioned, which failed to gain credit and several became confused and spoke of the need to add bacteria to the culture.
- (ii) Some candidates appeared to misread 'identity' and described how they would 'identify' the carbon dioxide produced. Lactic acid was a fairly common, inaccurate suggestion.

Question 2

- (a) Some candidates appeared to make a guess and some used free-hand or carelessly-ruled lines to arrive at answers outside the accepted range. Almost all remembered to give the units.
- (b) (i) Many referred to the rapid decrease in the concentration of nitrate ions without saying that they started at a high level. Good candidates referred to the high concentration of nitrates, the production of amino acids or proteins and protoplasm production, but references to rapid cell division, that the plants may not yet be fully grown or that there was less competition were very rare.
- (ii) Adding more nitrates or implying that the light intensity or carbon dioxide concentration should be increased were usually the only points made. Several spoke improbably about adding 'nitrogen' and others, vaguely, about adding 'fertilisers'.

- (c) Despite a reference to decreasing the rate of respiration in the question, there was a common suggestion that it was really the rate of photosynthesis that was being decreased. Thus, references to reduced rates of active transport, protein and protoplasm manufacture were seen only from the better candidates. Energy was often, and unacceptably, referred to as being 'produced'.

Question 3

- (a) This was generally competently answered. Water, iron and vitamins were regularly correctly described, though some who gave named vitamins quite often confused their importance. Calcium was sometimes mentioned – but this appears in the table and was therefore not a correct answer to the question and iron was often thought to strengthen bones.
- (b) A large proportion made the correct link between saturated fats and their deposition on the walls of blood vessels.
- (c) A major and quite common error here was to refer to the existence of antibiotics rather than antibodies in a mother's milk. Many also talked of strengthening the mother / baby bond which is not a function of the milk. Several failed clearly enough to state that the milk contains *all* the required nutrients, and in the *correct proportions*.

Question 4

- (a) This was usually correct, though a few gave specific examples rather than the general term.
- (b) There was more guesswork used in this question than any other on the paper. **C** was often mis-identified as a touch receptor or a sweat gland or sebaceous gland, whilst **D** was often a capillary. The unacceptable 'messages' was sometimes given instead of 'impulses', and the impulses quite often were travelling in the wrong direction.
- (c) The statement about alcohol causing the muscles of the artery walls to relax was often ignored, leading to answers relating to loss of muscular co-ordination and drowsiness caused by alcohol consumption. Even when it was realised that the question related to blood flow to the skin, dilated blood vessels were often said to carry less blood. Only the very best candidates answered this question with confidence.

Question 5

- (a) This rarely presented any problems.
- (b)(i) The nucleus was fairly often suggested, but generally answers were correct.
- (ii) Candidates showed a sound grasp of plant cell structure and were usually able to suggest three or four accurate differences between the cell shown and a palisade cell.
- (c) Candidates often confused the term *mitosis* and *meiosis*, and many suggested that the phenotype (rather than the genotype) of the cells remains unchanged. Very few went on to say that clones experience reduced natural selection and therefore a minimal rate of evolution. Many incorrectly thought that if daughter cells had the same number of chromosomes, they would be identical.

Section B

Question 6

- (a) The phrase in the question 'in the air' was overlooked by many candidates, who simply gave a theoretical account of photosynthesis without describing how the products reach the site of the reaction. Even when stomata and, perhaps, intercellular spaces were mentioned, there was often no reference to the carbon dioxide having to dissolve. A few thought that water enters through the stomata, and even otherwise good answers did not mention that the process occurs in chloroplasts nor did they name the carbohydrate that is manufactured. There were detailed accounts of the light and dark reactions that scored the available marks but included more detail than was expected of candidates at this level.



- (b) This was disappointingly answered. Only a select few knew that carbohydrates are transported in the phloem as sucrose. Many said that starch was the translocated chemical – thus overlooking its insolubility. Indeed, few thought to mention that the carbohydrate would be carried in solution, or that an enzyme-controlled reaction would be necessary either to render the carbohydrate suitable for transport, or for storage in the root. Almost none referred to the carbohydrate having to enter or leave the phloem tubes.

Question 7

- (a) This question might have appeared difficult to candidates, but many clearly grasped the principles involved and gave sound answers. Some avoided the possible pit-falls by simply suggesting that the newly-arrived insects would die. True, this *could* happen and credit was given, but the thrust of the question was a description of what would happen as the new species became integrated. There were some descriptions of food webs with little relevance to this example. References to the effect on the producers as they may have become the food for existing herbivores was rarely mentioned and the possibility of the new species bringing disease was usually overlooked. Some thought the new arrivals would breed with existing species.
- (b) This was quite well answered. Aesthetic considerations as well as possible effects on food webs and on the ecosystem were regularly mentioned. Mentions of the use of species to provide medicines or, eventually, possibly to provide cures for disease were not as common as might have been expected.

Question 8 Either

- (a) Over-detailed accounts of clotting sometimes lead to confusion, and references to scabs were surprisingly rare. Vague terms such as 'protection against dangerous particles' were not accurate enough to score. Otherwise, there was a sound understanding of the action of white blood cells with the functions of lymphocytes and phagocytes being usually correctly described, and this section often scored highly.
- (b) This part was surprisingly inaccurately answered. It was simply a question on features of an artery – a pulse beat and carrying oxygenated blood. However, many candidates spoke of feeling faint or sick or in pain, and the blood was described as 'being under pressure' – which would apply to blood leaving a vein also – albeit a lower pressure.

Question 8 Or

This question was often very well answered. However, details of the specific actions of named teeth were usually missing and the starch was not always digested either to a product or to the correct product (glucose appeared occasionally). Villi, as the site of absorption, were sometimes omitted as was reference to glucose entering the capillaries and to digested fats entering the lacteals. The journey was sometimes continued unnecessarily along the hepatic portal vein. Only the very best candidates realised that there is a comparatively small amount of protein in potato that needs to be digested and, just occasionally, there was no reference to fat digestion at all.

BIOLOGY

Paper 5090/31
Practical Test 31

General comments

In this paper, the Examiners set out not only to test biological knowledge but also knowledge and experience of practical work and the use and application of practical skills and techniques. Hence, candidates were tested on their ability to follow instructions, make accurate observations and record them in words and drawings, take measurements and perform simple calculations.

It was pleasing to see that food tests were well known and generally scored well. Similarly, most candidates carried out measurements and calculations well, with units clearly stated. In addition, graphs were generally well drawn.

Comments on specific questions

Question 1

Specimen **S1** was a piece of under-ripe banana and specimen **S2** was a piece of ripe banana.

- (a) (i) Green as opposed to yellow colour of skin, smooth and rougher, firmer and softer, difference in size were examples of observable differences. Difference in smell was noted by a few – bringing a different sense into use.
- (ii) The starch based observations were well made, yielding two marks quite readily.
- (b) (i) The Benedict's test for reducing sugars was well known. Less commonly mentioned points were the preliminary preparation, usually 'mashing' the fruit, and heating in a water bath.
- (ii) The table was generally well completed with satisfactory results recorded..
- (c) The correct testing for starch and reducing sugar enabled the majority of candidates to comment on the different amounts of the carbohydrates in the two samples and to infer the change from starch to sugar as the fruit ripened.
- (d) (i) Candidates were less certain in describing how the pieces of banana were affected by the air and by dilute acid. The discolouration by dark patches, in both samples in the air compared with little obvious change in the acid were the expected observations.
- (ii) Some reference to the effect of exposure to oxygen and to response of enzymes to pH changes was anticipated. A number of candidates also mentioned continuing ripening of the fruit.
- (iii) When an outline plan of an investigation is requested the answer should be based on practical, experimental details. In this case a sequence of solutions with a series of different pH values should have been the basis. 'Acid, alkaline and neutral ' solutions was accepted as a minimal statement. Samples of the two specimens should have been placed in these solutions, possibly for a similar period to that mentioned in (c), 15 minutes, before being examined. Uniformity of conditions, such as temperature, and replications are additional points.

Question 2

- (a) There was considerable difference in the size of specimen provided and the Examiners were careful to ensure that candidates were not penalised for this. Those who elected to draw the underside of the specimen had an advantage in most cases in that it was easier for them to show correctly the number of legs and some indication of segmentation. Candidates were expected to label their drawing, as asked in the question, with legs, eyes, segments and antennae being acceptable labels. Many, in fact knew more details of the parts of the body. It was a pity that a significant number gave no labels at all and so lost marks.
- (b) Measurement and calculation of the magnification were well carried out by most candidates. Units of length (preferably in mm) and the final answer (with a maximum of 2 decimal places) were clearly stated.
- (c) There was considerable variation in the size of the 'handful' taken from the bag! Most candidates readily followed the instructions and arrived at satisfactory answers.
- (d)(i) and (ii) Table 2.2 was almost invariably completed with a mean of 16 and the figures were readily converted into a bar chart in (ii). In labelling the bar chart the main problem that arose was in giving the numbering on the *y*-axis a suitable origin, either by starting at 0 or by indicating with a wiggly line that the numbering did not extend to 0.
- (iii) There were many good references to moisture, predators and light intensity but it was not acceptable to say that the shady habitat was 'suitable'.

BIOLOGY

Paper 5090/32
Practical Test

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- (iii) When an outline plan of an investigation is requested the answer should be based on practical, experimental details. In this case a sequence of solutions with a series of different pH values should have been the basis. 'Acid, alkaline and neutral' solutions was accepted as a minimal statement. Samples of the two specimens should have been placed in these solutions, possibly for a similar period to that mentioned in (c), 15 minutes, before being examined. Uniformity of conditions, such as temperature, and replications are additional points.

Question 2

- (a) There was considerable difference in the size of specimen provided and the Examiners were careful to ensure that candidates were not penalised for this. Those who elected to draw the underside of the specimen had an advantage in most cases in that it was easier for them to show correctly the number of legs and some indication of segmentation. Candidates were expected to label their drawing, as asked in the question, with legs, eyes, segments and antennae being acceptable labels. Many, in fact knew more details of the parts of the body. It was a pity that a significant number gave no labels at all and so lost marks.
- (b) Measurement and calculation of the magnification were well carried out by most candidates. Units of length (preferably in mm) and the final answer (with a maximum of 2 decimal places) were clearly stated.
- (c) There was considerable variation in the size of the 'handful' taken from the bag! Most candidates readily followed the instructions and arrived at satisfactory answers.
- (d)(i) and (ii) Table 2.2 was almost invariably completed with a mean of 16 and the figures were readily converted into a bar chart in (ii). In labelling the bar chart the main problem that arose was in giving the numbering on the *y*-axis a suitable origin, either by starting at 0 or by indicating with a wiggly line that the numbering did not extend to 0.
- (iii) There were many good references to moisture, predators and light intensity but it was not acceptable to say that the shady habitat was 'suitable'.

BIOLOGY

Paper 5090/61
Alternative to Practical 61

General comments

In this paper, the Examiners set out not only to test biological knowledge but also knowledge and experience of practical work and the use and application of practical skills and techniques. Hence questions tested the candidates' ability to follow instructions, make accurate observations and record them in words and drawings, take measurements and perform simple calculations. The use of techniques and apparatus in experiments and the ability to evaluate and apply data resulting from investigation were also tested. It appears that candidates had more than sufficient time in which to complete the paper.

Comments on specific questions

Question 1

- (a) This tested observation skills by asking for differences between the two specimens that could be seen, e.g. in colour and size. Some candidates wrongly recorded differences that they had deduced from what they saw, e.g. in mass and texture.
- (b) (i) The ability to read the results of an experiment and to present them in a different way was tested by the construction of a graph from data provided in a table. The majority of candidates chose correct axes, good scales and plotted points accurately but actual lines drawn were not always ruled between points or good smooth curves.
- (ii) The use of data was tested by a simple calculation that required the appropriate units of measurement to be recorded as well as the numerical result, i.e. 54 g.
- (iii) Explaining the result that had been calculated proved more difficult. Not many candidates realised that water would have been lost and even fewer that respiration would have resulted in a loss of mass through breakdown of substrate although some hinted at enzyme activity without stating how that would have caused the loss in mass.
- (c) (i) Candidates are expected to be familiar with food tests either through carrying them out themselves or by observing someone demonstrating how to do them. While there were many candidates who knew that Benedict's solution is the reagent used to test food for the presence of reducing sugars, some did not state that the food with Benedict's solution added needs to be heated, preferably in a water bath, in order to obtain a result. The colour change showing a positive result was often well described. A negative result after carrying out the starch test with iodine solution shows only the absence of starch and not the presence of reducing sugar as some candidates, incorrectly, stated. Other candidates confused biuret and Benedict's.
- (ii) Explaining how the test described might be used to demonstrate that the level of reducing sugar in a banana increases as it ripens tested the ability to plan a practical investigation. Some candidates correctly described carrying out the Benedict's test on banana at given stages of ripening and that the colour change or intensity of colour of any precipitate formed would give an indication of the amount of reducing sugar present. A few candidates suggested that measuring the mass of any precipitate formed would give an indication of the amount of reducing sugar that had reacted with the Benedict's solution. However some candidates repeated only what had been given – that during ripening starch is broken down to sugar. This does not answer the question which tests the practical application of a known technique to a new situation.

Question 2

- (a) The candidates were asked to observe a photograph of a specimen and to make a labelled drawing of it. This was not a test of artistic ability but of observation and making an accurate and precise record of those observations. The ability to follow instructions was also being tested – some candidates did not label their drawings as asked.

It was expected that drawings would be of a reasonable size to show the features observed in the proportions in which they appeared in the photograph of the specimen. Biological drawing involves clear, clean lines rather than sketchy ones and the use of shading only if that is the best way to make something really clear. Many candidates did these drawings well. The accurate positioning of appendages was also usually well done.

- (b) Calculating the magnification of a drawing in relation to the size of an actual specimen is a standard biological procedure with which some candidates seemed to be unfamiliar. Measurements taken were usually done accurately, but some candidates gave no units. Often those measuring in cm failed to record their measurement to the nearest decimal place e.g. 8 cm instead of 8.0 cm. A few candidates unacceptably recorded measurements in inches. Those candidates who correctly applied their measurements to calculate the magnification of their drawing sometimes, incorrectly, included units e.g. cm in their answer and/or omitted the x or 'times.' The use of calculators meant that some answers were given to an impractical number of decimal places.
- (c) In this question an experimental situation that the candidates may not have met before was described with sufficient information about it for them to be able to evaluate the experimental method and interpret the results.
- (i) Using a simple formula involving results given in a table proved to be within the abilities of nearly all the candidates who arrived at the correct answer of 60.
- (ii) The evaluation of the experimental method used proved more difficult for some. Many failed to appreciate that a method of estimating the size of a population of beetles through collecting small samples had been described and that there was no intention of trying to count every beetle. Some did realise that the method had its limits, e.g. captured beetles might escape from the traps or marks that had been made on them by the experimenters might be rubbed off.
- (d)(i) The addition of numbers to give totals of 50 and 80 proved straightforward.
- (ii) Many candidates were able to use the data given to suggest reasons for the comparative numbers of beetles caught in two habitats, e.g. the shady habitat might have provided shelter from extreme heat and predators as well as a good food/water supply.
- (iii) Using the data to suggest reasons why the number of beetles collected varied from day to day proved more difficult but some candidates made good suggestions, e.g. variation in weather, sudden population changes and migration in search of food.
- (iv) Some good suggestions were made as to why only beetles of the species under investigation were found in the traps. These included that the traps were designed to catch only that species, they were the only beetles living in that area or they ate any other organisms caught in the traps.

Question 3

This tested the ability to draw a simple diagram to express the relationship of bones within the fore limb of a mammal based on detailed drawings given. It was also expected that instructions given would be followed but some candidates did not use the letters given in Fig. 3.1 as asked.

- (a)(i) Many candidates drew good labelled diagrams correctly showing the position of the bones. In some, **F** of the ulna instead of **G** was incorrectly positioned next to **B** on the humerus. A small number of candidates incorrectly drew three bones aligned one after the other e.g. **AB CD FG** instead of the radius **CD** and ulna **FG** being side by side.
- (ii) Many candidates did not indicate structures that hold the bones in place on their diagrams as asked.



- (b)(i)** The structures that hold the bones in place were often correctly identified as ligaments. Incorrect answers included tendons and muscles as well as cartilage.
- (ii)** Many candidates correctly named the ball and socket joint. Others incorrectly named hinge joint or sliding joint.
- (c)** While some candidates identified the mineral salt found in bones correctly, only a few correctly identified a rich dietary source.

BIOLOGY

Paper 5090/62

Alternative to Practical

General comments

In this paper the Examiners set out not only to test biological knowledge but also knowledge and experience of practical work and the use and application of practical skills and techniques. Hence questions tested the candidates' ability to follow instructions, make accurate observations and record them in word and drawing, take measurements and perform simple calculations. The use of techniques and apparatus in experiments and the ability to evaluate and apply data resulting from investigation were also tested. It appears that candidates had sufficient time in which to complete the paper.

Many candidates, to a greater or lesser extent, did not follow the rubric and so lost marks. This was most notable in not labelling drawings when a labelled drawing was specified.

Comments on specific questions

Question 1

- (a) (i) There were many clear, accurate drawings. The most common error was to include parts other than the carpel, quite often the whole flower. As a result the carpel was not as large as it might have been, with structures like the ovules being less clearly drawn. It was enough to label only the style and stigma but, in a distinct minority, the drawing was left completely unlabelled and the labelling marks could not be awarded.
- (ii) Insect pollination was well described by many candidates though a large number described the general features of insect pollinated flowers.
- (b) This difficult question was very well attempted; diagrams were clear and labelling good. The pollen tube was clearly shown growing down the style to the micropyle and the location of the two gametes was well described. A few attempted to incorporate Fig. 1.2 which was not easily achieved. A serious error was to show the pollen grain itself descending the pollen tube.
- (c) Calyx or sepal were the parts most commonly labelled. Pericarp was sometimes mentioned, often as epicarp, which was acceptable. Funicle also occurred and provided the label went to the appropriate part, was welcomed. Placenta and loculus were other alternatives.
- (d) The investigation involving heating water with the burning food material was generally familiar. One of the six marks was awarded for a safety factor. Wearing goggles (often 'googles!'), or protective gloves was often mentioned, although a significant number of candidates made no suggestion. Standard practices like using the same masses of material from the two specimens for heating, and the same volumes of water, along with replication, were reliable points and were frequently made. Points of technique, such as heating until combustion was complete and recording the increase in the temperature of the water, with some idea of how the results could be translated, readily enabled the five marks to be awarded. Just a few answers were not relevant, describing food tests, sometimes associated with decolourising a green leaf.

Question 2

- (a) Most, though not quite all, candidates were able to state clearly an alternative type of ear lobe.
- (b)(i) The majority of candidates mentioned the more common free ear lobes and better answers went on to say that numbers were independent of gender and / or age. Discontinuous variation was a good point, occasionally made.
- (ii) The total numbers, 87 and 28, were expected, with candidates going on to say that this approximated to a 3 : 1 ratio. A few spoiled this by leaving the answer at 3.01 : 1.
- (iii) The key point to be made here was a reference, in whatever terms, to Mendel's monohybrid ratio and in really good answers this was supported by explanation in terms of alleles and genes, though there was some confusion between the latter two terms. Most were able to say that the free ear lobe condition was the dominant one.

Question 3

- (a)(i) Correct reference to Universal Indicator or a pH meter was given in the majority of answers, though a few mentioned litmus or some other reagent.
- (ii) A common misunderstanding here was to confuse the term 'thickness' with 'depth' hence an attempt to measure the mixture with a ruler. Thickness, or perhaps viscosity, should have been investigated by measuring flow, or rate of penetration when a compact object was allowed to fall through the mixture. Nothing elaborate was expected.
- (b) By far the easiest and most obvious factor to be kept constant was temperature with its effect on the rate of activity of the bacteria, or their enzymes. Other acceptable suggestions were with reference to the milk, to clean conditions preventing the introduction of foreign bacteria and reference to the concentration, or even the 'number' of bacteria introduced to the system. However, maintaining a constant pH was not a valid suggestion.
- (c) The graph was well done. The most common problem was in the labelling of the y-axis to ensure that it was correctly connected to the origin. Very few bar charts or reversed axes were seen.
- (d) Continued decrease in pH was the point usually made. Good answers went on to suggest that it would become constant after a while as activity ended as the substrate was used up. If the condition of the yoghurt was described it should have been stressed that it became more firmly set because it was already set as the final entry in Table 3.1 shows.