

BIOLOGY

Paper 5090/11
Multiple Choice

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

General comments

This paper discriminated well, producing a wide distribution of marks with many candidates achieving high scores on a paper which contained some challenging questions.

Comments on specific questions

Question 5

Able candidates found no difficulty in recognising that a lack of nitrate ions would slow down growth, but for others, **C** ('The leaves wilt') was a more frequently selected answer.

Question 6

Able candidates found no difficulty in identifying the conditions being altered in the two graphs, but for others, **A** was a more frequently selected answer, showing a lack of understanding of the effect of high light levels on photosynthesis.

Question 15

This question required careful analysis and it was good to see that better candidates found no difficulty in identifying the correct blood vessels. Others were clearly confused about the blood vessels going to and from the lungs and tended to opt for **A** as the correct answer.

Question 18

Most candidates scored well on this question, but a significant number selected **B** as the correct answer, perhaps thinking that the contraction of the diaphragm forces air out of the lungs.

Question 20

This proved to be a well-answered question, with most candidates having a very good understanding of this topic.

Question 23

The way in which the ciliary muscles work is difficult to understand and weaker candidates selected the four options more or less equally.

Question 25

Most candidates selected **C** as the correct answer, showing perhaps that the final column of the table had confused them, though they should have been able to identify the significance of tolerance to high doses of heroin.

Question 30

Option **A** was a very popular distractor, probably because the link between 'dead organisms' and 'decomposition' seemed logical. However, better candidates did recognise that the only way CO_2 is returned to the atmosphere is by respiration.

Question 32

Option **D** seems to be a straightforward answer, but **A** proved to be a popular distractor, perhaps because it sounds sensible to those without an understanding of the issues involved.

Question 37

Able candidates found no difficulty in identifying the correct answer. Others tended to opt for the obvious 1:3 ratio, showing a lack of understanding of the meanings of the terms homozygous and heterozygous.

Question 39

The question was looking for the statement that is **not** correct, and some candidates may have been misled by this since **B** (the intended answer) was selected by few. Most candidates selected **A**, perhaps not understanding that this is indeed a possibility for the future.

BIOLOGY

<p>Paper 5090/12 Multiple Choice</p>
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<i>Question Number</i>	<i>Key</i>	<i>Question Number</i>	<i>Key</i>
1	B	21	B
2	C	22	B
3	C	23	A
4	B	24	B
5	D	25	B
6	C	26	A
7	B	27	B
8	A	28	A
9	C	29	D
10	C	30	D
11	A	31	C
12	A	32	B
13	C	33	B
14	D	34	A
15	A	35	C
16	D	36	C
17	A	37	A
18	A	38	A
19	B	39	D
20	D	40	C

General comments

This was a relatively high-scoring paper, with a small number of candidates gaining full marks. A few questions (25 and 31 for example) were found to be particularly straightforward and this will have contributed to these high scores, but there were also some challenging questions which many candidates were able to tackle successfully.

Comments on specific questions

Question 1

Able candidates found no difficulty with this question but many others did not understand that epidermal cells of the leaf do not contain chloroplasts, and selected **A**.

Question 7

Able candidates found no difficulty with this question but many others confused the experiment with one to test whether light is needed for photosynthesis, and selected **C**.

Question 10

Candidates found this question surprisingly difficult, since the diagram of the intestines is generally well known. Many, of all abilities, selected **D** (showing an understanding that the ileum is the longest part of the gut) but all four options were chosen by significant numbers.

Question 11

Most able candidates correctly selected **A**, but others generally opted for **D**, perhaps understanding that osmosis results in a net movement of water molecules and thinking that it might be the mechanism in this case.

Question 16

If the body temperature drops, respiratory enzymes will work more slowly, and this link was identified by most candidates, selecting **D**.

Question 21

Most candidates correctly selected **B**, but **C** was also popular with candidates of all abilities showing that they did not understand that while the brain does not participate in the reflex, the person concerned would be aware that the reflex had occurred.

Question 22

Able candidates found no difficulty with this question but many others selected **A**, probably confusing the production of urea and urine.

Question 30

Option **A** was a very popular distractor, probably because the link between 'dead organisms' and 'decomposition' seemed logical. However, better candidates did recognise that the only way CO_2 is returned to the atmosphere is by respiration.

Question 36

Almost all candidates understood that during asexual reproduction, the amount of DNA in the 'daughter' cells will be the same as that in the original 'parent' cell, and therefore that DNA replication must have taken place before cell division. A number of candidates, perhaps understandably, selected **B** rather than **C** reflecting some confusion about when this replication takes place.

Question 37

Able candidates found no difficulty in identifying the correct answer. Others tended to opt for the obvious 1:3 ratio, showing a lack of understanding of the meanings of the terms homozygous and heterozygous.

BIOLOGY

Paper 5090/21
Theory

Key messages

A high percentage of candidates were able to demonstrate a grasp of the subject matter that the paper examined. It was evident that some of the more able candidates were in possession of information that lies beyond the syllabus, but this was not creditworthy unless directly answering the question set (see **Question 7**).

General comments

The accuracy of answers was often impressive, but there are topics on which candidates would do well to spend a little more time during their pre-examination revision. Of these, the distinction between pollination and seed/fruit dispersal is an example, also the difference between an antibody and an antibiotic.

Generally candidates appeared to pace themselves well, with few indications that they were unable to complete the paper in the allotted time.

Comments on specific questions

Section A

Question 1

- (a) It was always likely that candidates would fail to commit themselves on which form of respiration is involved, but very few omitted to correctly qualify it as 'aerobic'.
- (b)(i) There were few problems indeed in reading the graph correctly.
- (ii) This part required careful study of the axis labels as well as accurate reading of the graph. A significant number of candidates proved unable to do so. 0.5 per cent (reading from the wrong scale), 1 per cent and 50 per cent were quite common inaccurate answers.
- (c) This question was generally well answered.
- (d) Surprisingly, few mentions were made of the fact that the seal would now be able to breathe air again and take in oxygen, even when there was a clear understanding that oxygen would allow the breakdown of lactic acid.

Question 2

- (a) This part was dealt with most competently, except by the very few candidates who believed that the insect and the plant shared the same genes for pattern.
- (b) Some candidates spoke in general terms of 'different varieties of insect' without specifying what would happen to each particular variety. Others strayed from the question by suggesting that the insects would move elsewhere to seek food, sometimes suggesting the possibility of older leaves becoming tough and thus indigestible.
- (c) Some candidates failed to make any reference at all to the genotypes of each of the varieties, and thus were unable to explain in sufficient depth exactly why a heterozygous cross would produce all

possible varieties. Otherwise this part allowed many candidates to exhibit a sound understanding of the genetics.

Question 3

- (a) Most candidates offered two correct answers, but some opted for 'light', some for 'carbon dioxide', some for 'minerals' and several for an unqualified 'temperature'.
- (b) (i) 'Water' was a popular and relatively easy mark, but it was encouraging to see thoughtful references to all other possibilities, except 'cellulose'.
- (ii) Relatively few candidates correctly opted for stage 4 as the stage at which the seedling begins photosynthesis. It was commonly believed that stage 3 was the answer as the amount of sugar has increased, missing the point that the sugar has been the result of digestion of the stored starch.
- (c) This part was well answered, with all marking points appearing regularly, except the naming of the enzyme responsible for hydrolysing the starch to sugar.

Question 4

- (a) A significant proportion of the candidates, having had no problems with counting the number of petals, seemed very unsure of exactly which structures on the diagram were the filaments.
- (b) This was a plant unfamiliar to the candidates, but the vast majority assumed that the ovary would be found in the centre of the flower, thus failing to appreciate that the part that is shown releasing the seeds is the ovary.
- (c) (i) The relatively large, open petals were often overlooked as an attraction to insects, and those candidates that did appreciate this fact did not realise that the petals would also form a landing platform for insects as they either collected or deposited pollen.
- (ii) Many candidates noted that the seeds were plentiful, small and hairy, but a large number began to describe the seeds as pollen, and then gave an account of pollination rather than of seed dispersal.

Question 5

- (a) **J** (testosterone) and **K** (insulin) were usually correctly matched to organs, though **K** was sometimes believed to be produced by the duodenum. The pituitary was often overlooked completely.
- (b) The question required a description of *how* a hormone *travels* from its production site to its target organ. However, although blood was very commonly and correctly mentioned, no references were seen to it travelling in solution, or to its movement between organs and capillaries in tissue fluid.
- (c) The functions of LH were generally well known, though specifying the ovary as the organ that it stimulates was not common. A relatively large number of candidates correctly referred to progesterone maintaining rather than thickening the uterus lining.

Section B

Question 6

- (a) Most candidates had a secure grasp of osmosis. Occasionally reference to a partially permeable membrane was omitted, and there was some confusion with water potential and concentration. This sometimes led to candidates stating that water moves *against* a concentration gradient.
- (b) All three marks were often secured with references to absorption of a named nutrient by villi against a concentration gradient.

Question 7

- (a) Many candidates secured full marks for this section, but there was a significant number who wrote only of excretion by the kidneys. It was some of these who included intricate detail on the workings of a kidney tubule, despite the syllabus stating that such detail is not required. Perhaps as a result, they did not mention excretion of carbon dioxide by the lungs, or removal of urea from the skin in sweat.
- (b) The concept of excretion in plants can be confusing for some candidates, but this part was generally competently answered. However, leaf fall as a method of excretion was rarely mentioned, and there were few references to oxygen being an excretory substance during the day, while carbon dioxide is removed only at night.

Section C

Question 8

- (a) The occasional mark was lost by the failure to make clear that *one* gene is responsible for *one* protein, but otherwise all points were quite regularly stated and high marks were often scored.
- (b) Again, candidates generally scored well in this section, the least common of the marking points being a recognition of the fact that discontinuous variation is inherited.

Question 9

- (a) Most who chose this question in **Section C** were understood the two terms. Only the better candidates referred to antibodies being proteins and carried in the blood, and a few believed that they are made by phagocytes rather than by lymphocytes. Knowledge of antibiotics was generally sound, though several failed to state that antibiotics were successful *only* against bacteria. Rarely was there mention of antibiotics being used to assist the immune system.
- (b) Perhaps surprisingly, there were few references to the relative sizes of the two organisms. However, all marking points were seen, though there was quite often confusion over the possession or otherwise of a nucleus by either of the organisms.

BIOLOGY

Paper 5090/22
Theory

Key messages

Examiners were pleased with the ability of some candidates to respond to information presented in unfamiliar contexts. There is evidence again this session however that candidates sometimes did not understand the different requirements of a question requiring a description from one requiring an explanation. Centres are reminded that candidates should be guided in the length of each of their responses by the number of lines provided and by the number of marks available. A number of questions required the candidate to study carefully and to understand clearly a significant amount of information provided by the question. It was felt by Examiners that a proportion of candidates may not have allocated sufficient time to this task prior to responding. Centres are reminded that credit will not be awarded for information re-stated by the candidate that was made available in the wording of the question.

General comments

Some very competent work was seen from the more highly attaining candidates. The parts of the carbon cycle in **Question 5** and the nervous pathway in **Question 7** were well known. The process of natural selection in **Question 4** and the named role of photosynthesis in **Questions 2** and **8** were less well known. Questions requiring tailoring and application of knowledge to a previously unseen context continued to provide more challenge for even the more highly attaining candidates.

Section A

Question 1

- (a) (i) Many candidates were able to correctly identify the type of chemical. Common errors included references to 'pancreatic juice', 'insulin' and to named enzymes.
- (ii) Most candidates scored at least two of the available three marks and often all three. The most common error was identifying 'carbohydrate' rather than more specifically 'starch' as the substrate of amylase. A number of candidates omitted reference to both 'glycerol' and 'fatty acids' as the products of lipase action.
- (iii) More able candidates scored both of the available marks. Many candidates showed confusion between 'cellulase' and 'cellulose'. Many candidates incorrectly believed cellulase to be the structural component of the plant cell wall. A proportion of these candidates still gained credit for reference to 'digestion'.
- (b) Many candidates made correct reference to the acidic environment of the stomach. Fewer candidates identified specifically the 'duodenum' or 'small intestine' but instead made more general reference to the 'alimentary canal'. Repetition of information such as this which was provided to the candidate in the question was common and did not gain credit. Reference to provision of the optimum or best conditions for enzyme action was uncommon.

Question 2

- (a) (i) Examiners were pleased with the ability of many candidates to sequence the information provided. This demonstrated an ability to transfer information from one format to another and to interpret information provided in an unfamiliar context. Many candidates incorrectly implied the existence of a nervous system in the bacterium.
- (ii) Relatively few candidates scored two marks whilst many others did not gain credit. Examiners were surprised that many candidates did not make reference by name to the process of 'photosynthesis'. This was instead often loosely described as 'the production of food' which did not gain credit.
- (b) Many candidates correctly identified one of the two structures and a number of candidates gained full credit. It was common for candidates to list more than one structure for each region and for candidates to name structures that were not relevant to the context of the question.
- (c) This question reinforced evidence from previous sessions that few candidates understand fully the different sections of the nitrogen cycle. Here reference to the conversion of 'nitrogen from the air' into 'ammonium ions' was required. Centres should note that it is ammonium rather than ammonia that is a component of the nitrogen cycle. It should be noted too that nitrates are the result of nitrification rather than the result of nitrogen fixation.
- (d) (i) Many candidates did not correctly link the occurrence of photosynthesis with the production of oxygen. Many candidates incorrectly linked movement towards light with an increase in temperature and others made reference to the intake of oxygen from the environment surrounding the bacterium.
- (ii) This question offered the opportunity for lateral thinking. Examiners were pleased to see the majority of candidates scoring the available mark by offering a variety of theoretical solutions. These were often based upon limiting the entry of light, limiting the entry of oxygen, mechanisms for the removal of oxygen or of ensuring that contact between the enzyme and oxygen are limited. It was encouraging to see many candidates successfully apply biological thinking in an unfamiliar context.

Question 3

- (a) This was very well answered by the majority of candidates. Common errors included confusion between the identity of the radicle and plumule and reference to parts of a cell rather than to parts of a seed.
- (b) (i) This question was very well answered. Almost all candidates scored the available mark.
- (ii) Many candidates gained partial credit in this question. Reference to the location of a gene on a chromosome was common, as was the nature of a gene as the unit of inheritance. Reference to control of characteristics more generally rather than to control of a single characteristic or production of a single protein was a common error.
- (iii) This question was generally well answered, with many candidates scoring all three of the available marks. Some candidates incorrectly identified the genotype of the gametes which resulted in the incorrect identification of offspring genotypes. The genotype of pea plant **J** was often correctly identified, however a number of candidates did not gain credit as they also stated the phenotype. Candidates using letters other than **R/r** as required by the question did not gain credit.

Question 4

- (a) Only a minority of candidates scored the available mark. Common incorrect responses included 'continuous' and 'genetic'.
- (b) (i) This question was very well answered with a large majority of candidates scoring the available mark. A small number of candidates made reference to a 'reliance on' plants rather than more specifically to 'eating' plants and therefore did not gain credit.
- (ii) This question was very well answered with a majority of candidates scoring the available mark. Incorrect reference to 'primary' or 'tertiary' was sometimes seen.

- (c) This question was only moderately well answered. Candidates most commonly made reference to 'camouflage' and to the benefit of this in terms of 'survival'/'avoidance of predators'. Examiners were surprised that more candidates did not made reference to 'variation' or to 'mutation'. This question provided good differentiation between candidates. Centres are advised to use the published mark scheme for this question to guide their preparation of candidates to answer future similar questions.

Question 5

- (a) This question was correctly answered by the majority of candidates.
- (b) (i) The wide scope of the mark scheme for this question enabled candidates to select data from any part of the information given. Many were successful in identifying a rise/fall in the level of carbon dioxide and were able to explain this in terms of a change in light intensity and/or the rate of photosynthesis. Few candidates demonstrated a full understanding of the relative nature of the processes of photosynthesis and respiration.
- (ii) Very few candidates scored both of the available marks. Of those who gained partial credit this was most commonly for correctly drawing on the right hand side of graph. As in the previous session, centres are reminded to advise candidates to follow all instructions given on the question paper. In this case candidates were instructed to 'draw a line on the graph'. Candidates who did not follow this instruction, perhaps by drawing another graph elsewhere on the question paper as a response, did not gain credit.

Section B

Question 6

- (a) A small number of candidates incorrectly identified blood vessel **P** as either the 'pulmonary artery' or the 'aorta'. Even following an incorrect identification of the name of the blood vessel, credit was often still gained by correct reference to the carriage of 'oxygenated blood'. Some candidates showed confusion between the right and left side of the heart.
- (b) Many candidates correctly identified structure **Q** and went on to gain further credit. Common incorrect responses included reference to the 'pericardium' or 'septum'. A common misunderstanding was to make reference to the muscle 'withstanding high pressure' rather than to the 'generation of high pressure' by the muscle.
- (c) A number of candidates fully and correctly identified structure **R** and went on to score all four of the available marks. It was common though for the type of valve to be incorrectly identified as either 'bicuspid' or 'semi-lunar'. Few candidates made full reference to both the action of the valve when open and when closed. The concept of valves in the heart preventing the backflow of blood was well known. As in **part (a)** some candidates showed confusion between the right and left side of the heart.

Question 7

- (a) (i) This question was well answered. The majority of candidates scored the single mark for identifying the coordinated response as a 'reflex' or 'involuntary' response. An incorrect response noted by Examiners was reference to 'negative feedback'.
- (ii) The response expected here was understood clearly by the majority of candidates. Areas which centres are advised to ensure that candidates are more fully aware of include the relative roles of the receptor and of the sensory neurone; the involvement of **only** the spinal cord and **not** the brain in some reflex actions; and the correct identity of the effector in a range of specific reflex actions.
- (b) Answers to this question were often characterised by a lack of sufficient relevant detail. Many candidates did not refer to prevention of the passage of 'impulses'. Many candidates also made incorrect reference to the involvement of the brain.

Section C

A lower proportion of candidates answered **Question 8** than answered **Question 9**.

Candidates answering **Question 8** commonly gained less credit than those answering **Question 9**.

Question 8

- (a) This question was well answered by some candidates. A number of candidates did not provide sufficient correct relevant detail to gain full credit. Some candidates provided descriptions covering both the intake of oxygen and the removal of carbon dioxide which led to only part of their response being eligible for credit.
- (b) As in **2(a)(ii)** reference by name to the process of 'photosynthesis' was surprisingly uncommon. This was again instead often loosely described as 'the production of food' which did not gain credit. Reference by candidates to 'light' alone rather than to 'light energy' was common, as was general reference to the involvement of water rather than more specifically to reaction with water. Candidates who included a correct word or symbol equation in their response were more likely to gain full credit.

Question 9

- (a) This question was well answered by most candidates. Candidates who had attained less credit on other questions were often able to demonstrate good knowledge and understanding on this question. One common incorrect response was confusion between 'osmosis'/'diffusion' and 'active transport'. Another was reference to 'inter/intramolecular' or 'intracellular' spaces rather than to 'intercellular' spaces.
- (b) The majority of candidates correctly named a factor and a relevant variation to score two of the available three marks. Explanations less often resulted in the award of credit where either 'wind' or 'humidity' was given as the named factor. Such answers were characterised by reference to 'increased transpiration' alone which was not sufficient to gain credit as it was a re-wording of information given to the candidate in the question.

BIOLOGY

<p>Paper 5090/31 Practical Test</p>

Key messages

Candidates should read instructions carefully and respond to the questions accordingly.

Candidates should read through their completed papers to check that they have answered the questions fully and to amend any errors or omissions.

Candidates should be encouraged to use sharp pencils when constructing graphs and drawings.

General comments

Scripts were legible and answers were written in the spaces provided.

Comments on specific questions

Question 1

- (a) Candidates followed the instructions, carried out the investigation and the vast majority entered all their results in the table provided.
- (b) (i) Many candidates scored maximum marks for their line graphs. They recognised that time was the independent variable and correctly plotted it on the x-axis with volume, the dependent variable, on the y-axis, labelling them correctly and fully.

In good graphs, linear scales were chosen that made best use of the grid provided. Sometimes values at the origin were omitted making the scale non-linear and losing credit.

The six values were accurately and clearly plotted by most candidates. Candidates should take care with the method they use for plotting so that the points can be clearly seen but not be over-large.

Although there was a clear instruction to join plotted points with ruled lines, a few candidates drew curves. A minority simply drew what they considered to be a ruled line of best fit instead of joining point to point. Neither could be credited.

- (ii) The question asked candidates to use their results to state the time period during which catalase activity was the greatest. This was during the first minute in nearly all cases and was usually correctly stated. Occasionally the time when the volume of suspension and foam was at its greatest was recorded which could not be credited.
- (iii) The question asked for a description of the shape of the graph. However, many candidates answered only in terms of what the shape of the curve indicated about enzyme activity rather than its actual shape. Credit was given for a good description of each candidate's own graph.

The shape of the graph was dependent on the candidate's results in (a) but in all cases showed an initial steep increase. It should be noted that 'steep' may refer to positive and negative gradients and therefore should be qualified, e.g. increasing, up, decreasing, down.

The graph then showed a negative gradient, in some cases steep, in others more gradual. In a few cases the line formed a plateau. Note that 'straight line' does not mean that the line is horizontal or has a zero gradient.

- (c) (i) Yeast was mixed with water to form a suspension and that suspension was then stirred. After the stirring, hydrogen peroxide was added. Reasons for the stirring should therefore make it clear that it was not to mix the suspension with the hydrogen peroxide. Yeast is a single-celled organism that cannot dissolve in water. Most candidates correctly recognised that the stirring was necessary to ensure even distribution of the yeast in the water. The yeast cells contained the enzyme catalase. Stirring the suspension did not activate the enzyme; it became active when in contact with the substrate, hydrogen peroxide.

Most candidates understood that different syringes were used for measuring the yeast suspension and the hydrogen peroxide solution in order to prevent cross-contamination.

- (ii) This proved to be a challenging question. As the candidates had carried out the investigation themselves it was expected that their answers would relate to their practical experience and some did answer in that way. They noted that it is not easy to measure the volume of foam which has an uneven upper surface or to add solutions and start timing simultaneously.
- (d) Designing this experiment using the method described involved ensuring that the only variable was temperature and that others e.g. volumes of yeast and hydrogen peroxide, and time period allowed before measuring volume, were the same at all temperatures. Many candidates correctly recognised this. More candidates correctly referred to 'volume' rather than 'amount'.

That the experiment should be conducted at different temperatures was often correctly stated with better candidates giving a range of suitable temperatures in °C. Credit was given to those who described how those temperatures would be maintained e.g. by using water-baths.

For the experiment to be valid, fresh substrate (hydrogen peroxide) and enzyme (catalase in yeast) should be used for each selected temperature. Placing yeast and hydrogen peroxide in a test-tube that was then placed in a water-bath and gradually heated up could not, therefore, be credited.

A minority of candidates erroneously assumed that heat was generated as hydrogen peroxide was broken down and that the temperature within the test-tube as the reaction occurred was to be measured.

There were too many who did not design an experiment but explained that increasing temperature caused increased movement of molecules so that more 'collisions' occurred between substrate and enzyme resulting in more product. Such answers did not relate to the practical question asked and could not be credited.

Question 2

- (a) Many candidates produced drawings of a good size, with clear, clean lines drawn with a sharp pencil and no shading. Representing the correct proportions of the specimen proved more difficult. Too many candidates did not follow the instruction to label a seed.
- (b) (i) The majority of candidates measured the length of AB accurately. However, there were those who mis-read their rulers to record e.g. 41 mm instead of 46 mm and those who did not know how to read a ruler e.g. 40.6 mm instead of 46 mm. A few candidates recorded their measurement in centimetres although mm was given on the answer line. Only if those candidates had included cm in their answer did they receive credit.
- (ii) Although the measurements of most candidates were accurate, some did not follow the instruction to draw a line. A few candidates drew lines that were not in a similar position to AB in the photograph, even vertical lines, which could not be credited. If the instruction is to draw a line between A and B then vertical marker lines at A and B alone are not sufficient; neither can lines extended beyond A and B be credited. Again, a few candidates recorded their measurement in centimetres although mm was given on the answer line and only if those candidates had included cm in their answer did they receive credit.

- (iii) Many candidates calculated the magnification of their drawing correctly. A few divided the measurement of the photograph by the measurement of their drawing and therefore received no credit. Others incorrectly multiplied their answers by 100, presumably thinking of percentages. Care should be taken when rounding numbers to reduce the number of decimal places shown on calculators.

Candidates should be aware that magnification is a value that has no units.

- (c) (i) The majority of candidates correctly identified the Benedict's test as the one requiring heat. Those who referred only to the reducing sugar test could not be credited because none of the tests had been identified as such. References to the biuret and iodine tests received no credit.
- (ii) The candidates were provided with the conclusions reached after carrying out three food tests and were asked what observations had led to those conclusions. Many knew that for Benedict's solution to give a positive result green, yellow, orange or red would be seen. The negative result for a test with biuret solution would have been that the blue solution remained unchanged but fewer candidates recorded the correct colour. 'Remained unchanged' was an insufficient answer as no initial colour of biuret solution had been stated. Similarly with iodine solution, a reference to yellow/brown was required. References to biuret solution turning blue or iodine solution turning yellow/brown could not be credited because the original colours of the solutions would not have not changed.
- (iii) A high proportion of candidates correctly stated that the apple contained reducing sugar, or a named reducing sugar, but not protein or starch. Incomplete answers mentioned only the presence of reducing sugar, omitting the results of the other two tests.

A few candidates referred to the presence of sucrose which, although a sugar, could not be credited as it is a non-reducing sugar and the result of the Benedict's test would have been negative.

Some answers indicated that candidates are not always clear about the relationship between sugars and carbohydrates. Carbohydrate is not an alternative word for sugar. All sugars are carbohydrates but not all carbohydrates are sugars.

- (d) (i) The emulsion test for fat was known by many candidates but there were those who incorrectly applied Benedict's, iodine or biuret solutions.

Although many knew that ethanol (or alcohol) should be added to the apple, some also added water at the same time. Time should be given for any fat in the apple to dissolve in the alcohol and then add that alcohol to water when a cloudy, white emulsion is seen if fat is present. A few candidates stated that a white precipitate is formed which may indicate that either they do not understand what a precipitate is or that they had not actually carried out the test themselves and seen the positive result.

- (ii) The key word in this question was 'must' i.e. which safety precaution should be uppermost in the mind of the investigator when carrying out this test. Only a minority of candidates received credit, for stating that there should be no naked flames nearby because of the flammability of ethanol.

BIOLOGY

<p>Paper 5090/32 Practical Test</p>

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- (iii) The question asked for a description of the shape of the graph. However, many candidates answered only in terms of what the shape of the curve indicated about enzyme activity rather than its actual shape. Credit was given for a good description of each candidate's own graph.

The shape of the graph was dependent on the candidate's results in (a) but in all cases showed an initial steep increase. It should be noted that 'steep' may refer to positive and negative gradients and therefore should be qualified, e.g. increasing, up, decreasing, down.

The graph then showed a negative gradient, in some cases steep, in others more gradual. In a few cases the line formed a plateau. Note that 'straight line' does not mean that the line is horizontal or has a zero gradient.

- (c) (i) Yeast was mixed with water to form a suspension and that suspension was then stirred. After the stirring, hydrogen peroxide was added. Reasons for the stirring should therefore make it clear that it was not to mix the suspension with the hydrogen peroxide. Yeast is a single-celled organism that cannot dissolve in water. Most candidates correctly recognised that the stirring was necessary to ensure even distribution of the yeast in the water. The yeast cells contained the enzyme catalase. Stirring the suspension did not activate the enzyme; it became active when in contact with the substrate, hydrogen peroxide.

Most candidates understood that different syringes were used for measuring the yeast suspension and the hydrogen peroxide solution in order to prevent cross-contamination.

- (ii) This proved to be a challenging question. As the candidates had carried out the investigation themselves it was expected that their answers would relate to their practical experience and some did answer in that way. They noted that it is not easy to measure the volume of foam which has an uneven upper surface or to add solutions and start timing simultaneously.
- (d) Designing this experiment using the method described involved ensuring that the only variable was temperature and that others e.g. volumes of yeast and hydrogen peroxide, and time period allowed before measuring volume, were the same at all temperatures. Many candidates correctly recognised this. More candidates correctly referred to 'volume' rather than 'amount'.

That the experiment should be conducted at different temperatures was often correctly stated with better candidates giving a range of suitable temperatures in °C. Credit was given to those who described how those temperatures would be maintained e.g. by using water-baths.

For the experiment to be valid, fresh substrate (hydrogen peroxide) and enzyme (catalase in yeast) should be used for each selected temperature. Placing yeast and hydrogen peroxide in a test-tube that was then placed in a water-bath and gradually heated up could not, therefore, be credited.

A minority of candidates erroneously assumed that heat was generated as hydrogen peroxide was broken down and that the temperature within the test-tube as the reaction occurred was to be measured.

There were too many who did not design an experiment but explained that increasing temperature caused increased movement of molecules so that more 'collisions' occurred between substrate and enzyme resulting in more product. Such answers did not relate to the practical question asked and could not be credited.

Question 2

- (a) Many candidates produced drawings of a good size, with clear, clean lines drawn with a sharp pencil and no shading. Representing the correct proportions of the specimen proved more difficult. Too many candidates did not follow the instruction to label a seed.
- (b) (i) The majority of candidates measured the length of AB accurately. However, there were those who mis-read their rulers to record e.g. 41 mm instead of 46 mm and those who did not know how to read a ruler e.g. 40.6 mm instead of 46 mm. A few candidates recorded their measurement in centimetres although mm was given on the answer line. Only if those candidates had included cm in their answer did they receive credit.
- (ii) Although the measurements of most candidates were accurate, some did not follow the instruction to draw a line. A few candidates drew lines that were not in a similar position to AB in the photograph, even vertical lines, which could not be credited. If the instruction is to draw a line between A and B then vertical marker lines at A and B alone are not sufficient; neither can lines extended beyond A and B be credited. Again, a few candidates recorded their measurement in centimetres although mm was given on the answer line and only if those candidates had included cm in their answer did they receive credit.

- (iii) Many candidates calculated the magnification of their drawing correctly. A few divided the measurement of the photograph by the measurement of their drawing and therefore received no credit. Others incorrectly multiplied their answers by 100, presumably thinking of percentages. Care should be taken when rounding numbers to reduce the number of decimal places shown on calculators.

Candidates should be aware that magnification is a value that has no units.

- (c) (i) The majority of candidates correctly identified the Benedict's test as the one requiring heat. Those who referred only to the reducing sugar test could not be credited because none of the tests had been identified as such. References to the biuret and iodine tests received no credit.
- (ii) The candidates were provided with the conclusions reached after carrying out three food tests and were asked what observations had led to those conclusions. Many knew that for Benedict's solution to give a positive result green, yellow, orange or red would be seen. The negative result for a test with biuret solution would have been that the blue solution remained unchanged but fewer candidates recorded the correct colour. 'Remained unchanged' was an insufficient answer as no initial colour of biuret solution had been stated. Similarly with iodine solution, a reference to yellow/brown was required. References to biuret solution turning blue or iodine solution turning yellow/brown could not be credited because the original colours of the solutions would not have not changed.
- (iii) A high proportion of candidates correctly stated that the apple contained reducing sugar, or a named reducing sugar, but not protein or starch. Incomplete answers mentioned only the presence of reducing sugar, omitting the results of the other two tests.

A few candidates referred to the presence of sucrose which, although a sugar, could not be credited as it is a non-reducing sugar and the result of the Benedict's test would have been negative.

Some answers indicated that candidates are not always clear about the relationship between sugars and carbohydrates. Carbohydrate is not an alternative word for sugar. All sugars are carbohydrates but not all carbohydrates are sugars.

- (d) (i) The emulsion test for fat was known by many candidates but there were those who incorrectly applied Benedict's, iodine or biuret solutions.

Although many knew that ethanol (or alcohol) should be added to the apple, some also added water at the same time. Time should be given for any fat in the apple to dissolve in the alcohol and then add that alcohol to water when a cloudy, white emulsion is seen if fat is present. A few candidates stated that a white precipitate is formed which may indicate that either they do not understand what a precipitate is or that they had not actually carried out the test themselves and seen the positive result.

- (ii) The key word in this question was 'must' i.e. which safety precaution should be uppermost in the mind of the investigator when carrying out this test. Only a minority of candidates received credit, for stating that there should be no naked flames nearby because of the flammability of ethanol.

BIOLOGY

<p>Paper 5090/61 Alternative to Practical</p>

Key messages

This paper tests the ability to understand and apply a range of practical skills. Candidates should have experience of practical work, including biological tests and experimental design. Candidates should be able to select suitable apparatus for an experiment, be aware of potential hazards and be able to suggest appropriate safety measures.

General comments

The number of marks awarded overall covered the whole range of those available and it appeared that candidates had sufficient time to complete the paper. There were few instances of questions that were not attempted.

There continues to be improvement in the responses to questions relating to experimental design and more candidates are using precise terminology such as *volume*, rather than *amount* when listing variables to be controlled. Candidates should be aware that a purely theoretical response will not gain full credit when the question asks for an experiment to be designed.

Candidates should be aware of the difference between *describing* and *explaining* a result or conclusion.

When asked to draw a bar chart, candidates should appreciate that bars should be labelled centrally and that a value should be entered at the origin of the axis where there is a linear scale.

Comments on specific questions

Question 1

- (a) Most candidates correctly suggested that the enzyme was lipase. A few incorrect references to amylase, pepsin and lipids were given.
- (b) (i) Measuring cylinders or syringes were usually correctly named. There were a few incorrect references to beakers, flasks and test-tubes.
- (ii) The majority of candidates correctly named droppers or pipettes as suitable pieces of equipment with which to add the indicator solution.
- (iii) Many candidates gained credit for suggesting temperatures between 30 °C and 45 °C. A few candidates suggested temperatures at which the enzyme would have been denatured thus making the investigation invalid, so could not be credited.
- (iv) Candidates were asked to suggest why the test-tubes containing milk and indicator solution were placed in a water bath for 5 minutes before anything else was added. This question was generally not well answered. Some responses showed that candidates understood that all the test-tubes needed to be brought to the same temperature, but many answers were expressed in terms of bringing the test-tubes to the optimum temperature for enzyme action or to body temperature, which was not credited.

- (v) Some candidates correctly identified the need to have the same volume of liquid in each test-tube as the reason for adding water. Some wrote about the water being a control and others suggested that the water was used to dilute either the milk or the indicator; neither of these responses was creditworthy.
- (c) (i) Many candidates scored all 4 marks for completing the table. Common errors were to omit time and/or minutes in the column heading, and a few candidates erroneously wrote *seconds* for the units. In the majority of responses the colours had been entered correctly although there were a few references to incorrect colours.
- (ii) The indicator solution changed colour because the pH had changed. The change was caused by the production of fatty acids, making the contents of the test-tube more acidic. Many candidates did recognise that the conditions had become more acidic but few referred to a change in pH as well.
- (d) Both a description and an explanation were needed in answer to each part of this question. In **A**, the fat had been digested because the enzyme was present. In **B**, fat had been digested more quickly (by the enzyme) in the presence of bile salts. In **C**, there was no digestion of fat because no enzyme was present.
- Common errors were to simply repeat the colour changes, or to refer to the times taken for the colour to change.
- (e) (i) Some excellent investigations were described which showed a good grasp of experimental technique and the need to control variables. The best answers used the information provided to suggest volumes of milk, enzyme and indicator to be used and were specific about the pH values chosen, rather than just referring to adding acids or alkalis. There were still some candidates who wrote theoretical answers about pH and enzymes without any reference to experimental procedures; these responses could not gain full credit.
- (ii) It was expected that the safety precaution should relate to the investigation into pH, thus should be in the context of using acids and alkalis and the dangers thereof. Many responses were more general in nature and consequently were unable to gain full credit.

Question 2

- (a) (i) The best drawings were of a good size, drawn with clean, clear lines and with no shading anywhere; many candidates scored full marks. The majority of drawings included accurate representations of the radicle and plumule but on a number of occasions the radicle was drawn curving towards the right rather than to the left.
- (ii) The labelling of the drawing was less well done, with many cotyledons and especially plumules wrongly identified.
- (b) Virtually all candidates calculated the means correctly.
- (c) As the number of seeds per dish was fixed, the variables in this investigation were water, light and the seeds themselves, i.e. their species or age. Some candidates identified that the volume of water in each dish should be the same; fewer noted that the seeds should be as similar as possible and very few that the light intensity provided should be the same. Since the temperature was the independent variable in this investigation, it was not a factor that should have been kept constant.
- (d) The most consistently scored marks for the bar chart were for accurately plotting the mean numbers and for drawing the bars with equal widths and ruled sides. In some cases the axes were not labelled fully or the temperature values were not written centrally to the bars. The scale chosen for the mean number axis was usually linear and of a good size but in many cases there was no value given at the origin.

A significant number of candidates did not construct the bar chart correctly – attempting to draw bars relating to the mean number axis rather than the temperature axis. A few constructed line graphs despite a bar chart being asked for in the question.

- (e) The majority of candidates correctly concluded that in this investigation, the number of seeds germinating increased with increasing temperature. A few candidates stated that the seeds germinate faster when the temperature increases, despite there being no reference to time and thus no evidence to support this conclusion.
- (f) Candidates were asked to suggest two reasons why some seeds did not germinate at 30 °C; this proved to be more challenging. There were those who recognised that competition for resources, usually water, may have led to some seeds not germinating. A few correctly suggested that some seeds may have been immature or non-viable.

BIOLOGY

Paper 5090/62
Alternative to Practical

Key messages

Candidates should read instructions carefully and respond to the questions accordingly.

Candidates should read the details of described procedures carefully and try to visualise what was being done.

Candidates should read through their completed papers to check that they have answered the questions fully and to amend any errors or omissions.

Candidates should be encouraged to use sharp pencils when constructing graphs and drawings.

General comments

Scripts were legible and answers were written in the spaces provided.

Comments on specific questions

Question 1

- (a) This was generally well done. Many candidates produced drawings of a good size, with clear, clean lines drawn with a sharp pencil and no shading. Representing the correct proportions of the specimen proved more difficult. Too many candidates did not follow the instruction to label a seed.
- (b) (i) The majority of candidates measured the length of the line AB accurately. However, there were those who mis-read their rulers to record e.g. 41 mm instead of 46 mm and those who did not know how to read a ruler e.g. 40.6 mm instead of 46 mm. A few candidates recorded their measurement in centimetres although mm was given on the answer line. Only if those candidates had included cm in their answer did they receive credit.
- (ii) Although the measurements of most candidates were accurate, some did not follow the instruction to draw a line. A few candidates drew lines that were not in a similar position to AB in the photograph, even vertical lines, which could not be credited. If the instruction is to draw a line between A and B then vertical marker lines at A and B alone are not sufficient; neither can lines extended beyond A and B be credited. Again, a few candidates recorded their measurement in centimetres although mm was given on the answer line and only if those candidates had included cm in their answer was credit received.
- (iii) Many candidates calculated the magnification of their drawing correctly. A few divided the measurement of the photograph by the measurement of their drawing and therefore could receive no credit. Others incorrectly multiplied their answers by 100, presumably thinking of percentages. Care should be taken when rounding numbers to reduce the number of decimal places shown on calculators.

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- (ii) The key word in this question was 'must' i.e. which safety precaution should be uppermost in the mind of the investigator when carrying out this test. Only a minority of candidates received credit, for stating that there should be no naked flames nearby because of the flammability of ethanol.

Question 2

- (a) (i) Candidates should read the details of described procedures carefully and try to visualise what was being done. Yeast was mixed with water to form a suspension and that suspension was then stirred. After the stirring, hydrogen peroxide was added. Reasons for the stirring should therefore make it clear that it was not to mix the suspension with the hydrogen peroxide. Yeast is a single-celled organism that cannot dissolve in water. The stirring was necessary to ensure its even distribution in the water. The yeast cells contained the enzyme catalase. Stirring the suspension did not activate the enzyme; it became active when in contact with the substrate, hydrogen peroxide.
- (ii) Nearly every candidate read the volumes correctly. Answers from those who did not included 30.4 and 30.9, showing an inability to read scales correctly; and careless mis-readings e.g. 33 instead of 34.
- (b) (i) Many candidates scored maximum marks for their line graphs. They recognised that time was the independent variable and correctly plotted it on the x-axis with volume, the dependent variable, on the y-axis, labelling the axes correctly and fully. There were graphs where time appeared in error in seconds instead of minutes, and m instead of min. As m is the scientific abbreviation for metre this could not be credited.

In good graphs, linear scales were chosen that made best use of the grid provided. Sometimes values at the origin were omitted making the scale non-linear and losing credit.

The six values were accurately and clearly plotted. Candidates should take care with the method they use for plotting so that the points can be clearly seen but not be over-large.

Although there was a clear instruction to join plotted points with ruled lines, some candidates drew curves. A few simply drew what they considered to be a ruled line of best fit instead of joining point to point. Neither could be credited.

A few bar charts were seen although the clear instruction for a line graph to be constructed was given.

- (ii) This question asked for the data provided to be used to state the time period during which catalase activity was the greatest – not for the time when the volume of suspension and foam was at its greatest. The increase in this volume gave an indication of the activity of the catalase. From the data provided in the table, some correctly worked out that in the first minute it increased by 17 cm³, by 12 cm³ in the second minute, by 5 cm³ in the third, by 2 cm³ in the fourth and by 0 cm³ in the fifth. The time period of greatest activity was therefore from 0–1 minute, the first minute.

Including units in answers is essential. Those who did not include minutes in their answer could not receive credit for them.

- (iii) The question asked for a description of the shape of the graph with its initial increase and then later forming a plateau. It should be noted that ‘steep’ may refer to both positive and negative gradients and therefore should be qualified, e.g. increasing, up, decreasing, down, and that ‘straight line’ does not mean that the line is horizontal or has zero gradient.

Many candidates answered the question only in terms of what the shape of the curve indicated about enzyme activity i.e. they omitted the description of the graph but did give an explanation. The graph line increased because the volume of suspension and foam increased, or because oxygen was being produced, or because hydrogen peroxide was being broken down, or because there was enough hydrogen peroxide available. Any of these answers received credit.

The graph plateaued showing that the volume of suspension and foam was not increasing, that oxygen was no longer being produced, and that all the hydrogen peroxide had been broken down – all answers that received credit. It should be noted that enzymes do not ‘break down’ or ‘get used up’ as some candidates stated, and that there was nothing described in this investigation that may have caused the denaturing of the enzyme.

In questions like this, candidates should make sure that their explanations are full and clear e.g. references to ‘it’ were often ambiguous.

- (c) Designing this experiment using the method described involved ensuring that the only variable was temperature and that others e.g. volumes of yeast and hydrogen peroxide, and time period allowed before measuring volume were the same at all temperatures. Many candidates correctly recognised this. More candidates correctly referred to ‘volume’ rather than ‘amount’.

That the experiment should be conducted at different temperatures was often correctly stated with better candidates giving a range of suitable temperatures in °C. Credit was given to those who described how those temperatures should be maintained e.g. using water-baths.

For the experiment to be valid, fresh substrate (hydrogen peroxide) and enzyme (catalase in yeast) should be used at each selected temperature. Placing yeast and hydrogen peroxide in a test-tube that was then placed in a water-bath and gradually heated up could not, therefore, be credited.

A minority of candidates erroneously assumed that heat was generated as hydrogen peroxide was broken down and that the temperature within the test-tube as the reaction occurred was to be measured.

Although the candidates were told which method to use for this experiment, a few chose to use a different one, e.g. using a gas syringe to measure the volume of oxygen produced at each temperature, which meant that they could not receive full credit.

There were those who did not design an experiment but explained that increasing temperature caused increased movement of molecules so that more 'collisions' occurred between substrate and enzyme resulting in more product. Such answers did not relate to the practical question asked and therefore could not be credited.