BIOLOGY

Paper 5090/01
Multiple Choice

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

General comments

This paper produced a good spread of candidates. Their knowledge continues to be good, but the paper also produced some surprises, particularly in the topics of osmosis and diffusion. As ever, the instruction to "read the question" (eg, **Question 19**) is fundamental and should be emphasised every time a candidate enters an exam room.

Comments on specific questions

Question's 1 6 7 8 13 17 20 21 22 23 24 25 28 30 35 36 proved to be easy.

Question 2

Despite the guidance about turgidity and osmosis, many candidates did not realise that the root hair cell will take in soil water and become turgid. Hence the hair will aid support and is itself supported by the sap it contains. The question posed another problem in as much as cell Y (a xylem vessel) is lignified contains no cytoplasm or cell membrane when mature as drawn, and is incapable of taking in water by osmosis. It does, of course, provide support, but not due to turgor.

Question 3

The red cells have lost water, so liquid X must have a lower water potential than the cell cytoplasm and water will leave by osmosis. If option A were correct, the cells would have taken in water and burst.

Question 4

The theory suggests that substrate molecules fit into the active sites of the enzyme, as a key fits the shape of the lock. Hence the substrate is the starch and the enzyme is the lock.

Question 5

Those who chose option A did not realise that area P, which is labelled "white" cannot have chlorophyll, so lacks two factors, since CO_2 is absorbed in the plastic bag.

Question 9

Candidates who chose options D thought that assimilation occurs before the nutrients are absorbed from the gut.

Question 10

Whilst all the nutrients are useful, only the carbohydrate (Key A) will operate during the tennis match.

Question 11

Candidates had to decide that the nutrients are transported in the phloem and than identify the tissue labelled B. Option A is xylem.

Question 12

While water does pass from roots to leaves, (option C) this is transpiration and the question refers to translocation, which refers to sugars and amino acids.

Question 14

When the pressure in the ventricle rises above the pressure in the aorta, the semi-lunar valve is forced open. It closes as the pressure falls below the aorta pressure (option C).

Question 15

Osmosis (option D) is the movement of water. Blood is under pressure and the tissue fluid that is forced out of capillaries contains numerous dissolved materials.

Question 16

The absorption of water is a passive process.

Question 18

This diagram is becoming familiar. As the peas respire and use oxygen, the volume of gas in the tube will decrease because the carbon dioxide that is produced is absorbed immediately by the sodium hydroxide.

Question 19

Oxygen leaves the lungs by the pathway in option D, not carbon dioxide.

Question 26

Bacteria are not cells containing nuclei. Some fungi such as *Penicllium* produce antibiotics.

Question 27

The use of fermenters is a relatively new topic and is not well known. "Batch" production (which is not usually as economic as "continuous") is characterised by starting each batch afresh and the product is removed before cleaning the vessel and restarting the process.

Question 29

The biomass of the sparrowhawk is smallest and each lower trophic level will be larger.

Question 32

Sewage contains large amounts of organic matter, which is used as an energy source by aerobic bacteria. The graph of oxygen level shows that there is little aerobic activity at point 1 and the river is recovering by point 5.Option B was too popular. It shows the regions where most there is bacterial activity due to organic matter.

Question 33

Mitosis is a copying process. Key B shows two copies of the parent cell in the stem.

Question 34

All three regions of a seed are active. The cotyledons are releasing carbohydrates and the plumule (shoot) and radicle (root) are regions of rapid cell division and growth.

Question 37

To be heterozygous, there must be two different alleles of a gene. Recessive genotypes (Option D) must have two recessive alleles.

Question 40

Insulin is a protein and a gene is the information for the synthesis of a specific protein.

BIOLOGY 'O' LEVEL

Paper 5090/02

Theory

General comments

It was notable this year that no question failed to attract the occasional perfect answer. The only question posing considerable difficulties to some candidates was **Question 7**, which was sometimes not attempted either in part or in whole.

Comments on specific questions

Section A

Question 1

(a) The nucleus was the almost universal, and correct, answer to **(i)** though there were a few acceptable alternatives. The most common error in **(ii)** was to draw the cell wall *inside* the membrane. Occasionally, a vacuole was drawn within a vacuole, but full marks were common. A small but significant number ignored the rubric and drew their own cells (but the 'cell wall' mark was the only one they could not then score).

(b) (i) Many spoke of 'the use' of carbohydrate within tissues rather than its storage or manufacture by photosynthesis. Some referred inaccurately to 'the use of carbohydrates for photosynthesis'.

(ii) A wide variety of tissues, other than the expected liver or muscles was offered. However, those who responded correctly usually went on to refer to the storage of glycogen (though, sometimes, and incorrectly, 'glucose') in their chosen tissue.

(iii) It was often thought here that the question was linked to diet, with animals ingesting protein and fats when plants do not do so. Thoughtful, but inaccurate answers referred to enzymes being present in animals whilst not in plants and only the better candidates linked proteins with muscle cells in animals and fats with the greater amounts stored for greater activity/energy requirements in animals.

Question 2

(a) Less able candidates were inclined to give an example of a hormone, but most gave the correct answer to **(i)** and continued correctly to give 'target' in **(ii)**. A reasonably common mistake was to offer 'endocrine' (perhaps they had not read the question carefully enough) or the name of an endocrine organ.

(b) This proved a little more taxing than might have been expected. The vast majority experienced few problems, but all possibilities were offered, with **D** perhaps the most popular of the incorrect responses.

(c) (i) Although the correct person was often identified, insufficiently precise reasons were often given. Blood glucose was regularly said to be 'constant' (which clearly it is not) and surprisingly few referred to levels of blood glucose being lower than in the other two people.

(ii) There was a majority opting for the correct person (**H**) but, again, the information given on the graph was not accurately described. Reference to a steep rise in blood glucose is not important until it is stated that the level reached is the highest of the three people. Only occasional references were made to person **H** showing the *greatest* fluctuations in blood glucose.

(d) For a concept likely to be unknown to the candidates, this was extremely competently answered by a very large number of candidates. Those who did not follow the correct course, opted for the insulin passing into the gut.

Question 3

(a) Apart from the occasional confusion with anthers, this was usually correctly answered.

(b) One of the main reasons the flower was drawn was to indicate that it had large petals, a club-like, protected stigma, with anthers inside the flower and would therefore be likely to be insect-pollinated. However, several candidates (though, rarely if ever, any of the better ones) after looking at the pollen grains in the magnified diagram concluded they were smooth and would therefore be carried by the wind. Few candidates thought to explain that pollen grains would not remain attached to the insect unless they were sticky or rough.

(c) This part exposed a great deal of misunderstanding, even by some otherwise able candidates. The distinction between ovule and ovum was often not known. The pollen grain was all-too-often thought to be the male gamete. Although it was known that fusion occurs, it was often not accurately stated precisely what takes part in that fusion.

(d) Just occasionally the process at **P** was thought to be pollination or germination, but usually the answer was correct.

Question 4

(a) The only major problem here (apart from those who did not think before writing, and offered 'loss of water/evaporation from the skin'), was the use of the word *respiration.* Many clearly inaccurately believe that it is synonymous with breathing.

(b) For each part, Examiners were looking for a reference to the comparative rates of sweating and then, in each case, a reason for the difference. Often, no comparison was given and there was regularly the suggestion that sweating started and stopped. In part **(ii)** evidence was not taken from **Fig. 4.1** since several candidates stated that sweating is greater when clothed. There were few references to vasodilation. In **(iii)** it was expected that there would be reference to higher temperatures *outside* the body in sun rather than in shade that would lead to greater sweating.

(c) It was an explanation that was sought in this part, not just a statement of the relative amount of sweating. Fewer than expected made the link with a greater amount of work having to be done by the muscles, or to more energy being released by the muscles/by respiration.

Question 5

(a) (i) This was missed by some candidates and it also exposed a surprisingly high percentage unable accurately to add 98 to 202 and subtract the total from 405 – 104 was quite a common answer.

(ii) Although some thought the letters represented colours, most realised they represented genes, alleles or genotypes.

(iii) The need to obtain random results was a notion not as widely appreciated as might have been expected.

(b) (i) Most knew that red was dominant, but between a third and a half opted for cross **V**. Nevertheless, although some did not link Cross **W** with the results in **Table 5.1**, most were able to indicate that the table would give flowers of both colours as shown by **W**.

(c) (i) Several candidates failed to offer an answer to this part of the question. Nevertheless, those who attempted it often scored full marks. The main errors were of omission – either of the word 'gametes' or of the gametes themselves. Lines running straight from the genes shown in the genotypes of the parents are not considered to be indicative of the gametes produced by each parent. Some, unwisely, chose to change to different letters for their genes.

(ii) An indication of what would appear on *all six* sides of each cube was required – as given in the question. Several gave only one or two letters for each cube.

Question 6

(a) It was pleasing to see many totally accurate answers to this part. Detail was precise and all relevant points were regularly made. There was, however, a disturbing feature in that a significant number of candidates did not have a clear grasp of what a hypothesis is even though they tried to fit the expression into their answers.

(b) Several began their story after the optimum temperature and thus scored their marks only for a description of the denaturing of the enzyme. Even a number of good answers failed to link the effect of increased temperature with the lock and key idea. Other answers, again, gave excellent detail with reference both to the effect of increased temperature of the enzyme in general and to its effect on the active site in particular. Stating that the enzyme can no longer operate was often omitted and phrases like 'it stops the hypothesis' indicated how uncomfortable some candidates were with the rather difficult term.

Question 7

(a) This part revealed an important and costly confusion between the terms *antibiotic, antibody* and *analgesic.* Detailed accounts of how white blood cells are involved in antibody production and the way in which antibodies are involved in bacterial elimination did not attract credit. Even those who did not make this error sometimes spoke of antibiotics being used to relieve pain with aspirin sometimes being offered as an example. There was often a definite statement that antibiotics are of use only in treating bacterial infections, but some spoke of their use against viruses, giving viral infections such as influenza as examples of the diseases in question.

(b) Unfortunately, for several candidates, the large-scale manufacture of antibiotics was a very hazy area. Weaker candidates spoke of factories and pharmaceutical manufacturers, with no details of the process. Others gave most detailed accounts with all basic aspects of manufacture well-covered though there is a comparatively widespread belief that *Penicillium* is a bacterium. A few confused antibiotic manufacture with SCP production, and with insulin manufacture by bacteria during genetic engineering procedures. It was not uncommon to read intricate details of batch and continuous production, but then fail to find anything about extracting and purifying the antibiotic

Question 8 Either

(a) This part was generally well-answered. Occasionally, it was mentioned that light, rather than light *energy,* is trapped by the chlorophyll. The importance of chlorophyll in the production of a carbohydrate was sometimes omitted, though maximum marks for the part were often scored. There was the predictable confusion between chlorophyll and chloroplast.

(b) Again, this was a well-answered part. However, there was a tendency to talk of the root hair being largely (if not totally) responsible for the conduction of substances *inside* the plant, with no reference to the importance of the root hairs in the process of absorption from the soil. There was confusion between osmosis and active transport (the latter not uncommonly being said to be responsible for water uptake). The large surface area concept was very regularly mentioned, but much less often was it explained that the increased surface area allows more rapid uptake of materials. Some of the less competent answers spoke only of roots rather than root hairs.

Question 8 Or

(a) Although full-marks were common in this section, answers often showed the candidates' failure to think carefully about what they were saying. Clearly they knew that haemoglobin absorbs oxygen, but many failed to mention that it has to be able to do so quickly and its purpose is then for the carriage of oxygen, as oxyhaemoglobin, to the cells.

(b) Again, the large surface area concept was well-known, but many failed to say exactly where the villi are and what they absorb. There was no credit for merely structural references to capillaries and lacteals as they fell short of an explanation of the *importance* of the villi as required by the question. Very occasionally, they were said to be important for digestion but absorption was then not mentioned.

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Paper 5090/03

Practical Test

General comments

There were again many instances of candidates losing marks by, quite simply, not following instructions. These were sometimes as obvious as not labelling their drawings when a 'large, labelled drawing' was requested, or in not once mentioning the term 'water potential' when an explanation in these terms was expressly required. A few candidates penalised themselves by straying outside the syllabus and making inaccurate statements such as to suggest the use of dilute hydrochloric acid for initial hydrolysis in the test for reducing sugars – confusing this test with the one for non-reducing sugars.

Comments on specific questions

Question 1

(a) (i) Testing two foodstuffs, F1 and F2, for starch and for fat was investigated here. The materials provided were popcorn, labelled F1, which did not contain fat, while F2 was a similar breakfast cereal that had a high fat content. Candidates were required to carry out the test for starch on each of them but the test for fat was not required, the result being printed in Table 1.1. on the question paper. Conclusions were required, to complete Table 1.1. The main error here was in not referring to the results of the fat test; the conclusion for starch alone was not acceptable.

(ii) The principal of the fat test was not widely understood. It was expected that an alcoholic solution would be prepared from the specimen, with some indication of breaking up and stirring the material in the ethanol. Ideally, a few drops of water should then be added to the clear solution, which would go cloudy as an emulsion was formed. Many candidates poured the solution into water and this was accepted. However it was common practice to add oil or fat in preparing the initial solution – no doubt a reflection of a demonstration in class.

It was surprising how many candidates described tests other than the ethanol emulsion test recommended in the syllabus. A grease spot on paper, use of Sudan III and even a saponification routine were seen.

(b) (i) A wide range of results was recorded in Table 1.2; these were accepted, provided that there was a record in all six boxes and that the starting temperatures were close together and below the final temperatures. A few records were spoiled by misplacement of the decimal point with e.g. 2.4^{o}C being recorded for a reading of 24^{o}C.

(ii) Substitutions in the formula were generally well carried out, with just a few misplaced decimal points.

(iii) It was widely known that fat contains more energy than carbohydrate and this was often related to the higher yield of F2. However, the mention of fat triggered in some candidates the idea of heat insulation!

(iv) This, more open ended section was satisfactorily answered by references to repeating the procedures to obtain an average, some form of insulation or lid, or by suggesting some means of getting better contact between the burning material and the test-tube of water.

Question 2

(a) Differences in size, smoothness and hardness were usually perceived.

(b) (i) Again some preliminary cutting or grinding was expected so that the reducing sugar would be released, forming a solution. This solution should then have been heated with Benedict's solution, preferably in a water bath as prescribed in the syllabus. Observations were not required at this stage. A significant number described the test for non-reducing sugar, as already mentioned. It was also common to find that a reference to placing the test-tube in a water bath tended to assume that the water was hot.

(ii) Result and conclusion were well known.

(a) Again, as already indicated, a major fault here was not to answer in terms of water potential; references to concentration, tonicity and diffusion were not acceptable. However, many candidates were able to describe osmosis and state that the consequent movement was limited to water. Some, however, referred to 'water potential entering the tissue'.

(b) The specimen for this section was a slice of cucumber fruit.

(i) Drawings were generally large and clear though a few attempted to show a degree of perspective, which was not necessary. Nor was shading, though this was not penalised unless done untidily, obscuring detail. Pericarp, (epicarp was allowed), and seed were readily labelled, but only a very few labelled a vascular bundle, despite them being clearly visible.

(ii) This was an attempt to encourage accurate use of a hand lens and the majority were able to draw a single seed and its funicle, with the detail that can be observed quite readily.

(iii) This was the familiar exercise in calculating the degree of magnification of a drawing. It entailed ruling a line on the drawing to indicate clearly where the measurement was taken, which was by no means always done. The line was often drawn obliquely across the drawing, or across the width as opposed to along the length, which would have provided a larger, more manageable figure. The line should then have been measured accurately, preferably in mm. (units should be clearly stated). The corresponding part of the specimen should then have been measured. The length of the drawing should next be expressed over that of the original and the result should be given to not more than two decimal places. Rounding up or down should not exceed 0.2 in the final expression.

'Times 2.4, 2.4 times or × 2.4' are acceptable expressions. A significant proportion of answers were spoilt by the inclusion of units, like '× 2.4 mm.', or by measurements that were obviously inaccurate.

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5090/06

Alternative to Practical Test

General comments

It was our intention, as usual in this paper, to recognise and to reward those candidates who showed evidence of having taken part in, or at least witnessed, meaningful practical work. There were again many instances of candidates losing marks by, quite simply, not following instructions. These were sometimes as obvious as not labelling their drawings when a 'large, labelled drawing' was requested, or in not once mentioning the term 'water potential' when an explanation in those terms was expressly required.

Comments on specific questions

Question 1

(a)(i) It was necessary to refer to both starch and fat in each of the two boxes in Table 1.1; many answers were confined to the positive result in each case.

(ii) The principal of the fat test was not widely understood. There were many instances in which the test material was first dissolved in water. It was expected that an alcoholic solution would be prepared from the specimen, with some indication of breaking up and stirring the material in the ethanol. Ideally, a few drops of water should then be added to the clear solution, which would go cloudy as an emulsion was formed. Many candidates poured the solution into water at this stage and this was accepted. It may be that it is difficult to provide ethanol that is sufficiently free of water for a clear solution of fat or oil to be made.

The use of iodine solution in testing for starch was well known but frequently it was thought necessary to describe how this was carried out on a green leaf during an investigation of photosynthesis.

Candidates should also be aware of which food tests involve heating. These two tests are not among them!

It was surprising how many candidates described tests other than the ethanol emulsion test for fats that is recommended in the syllabus. A grease spot on paper or use of Sudan III were seen.

(b)(i) Table 1.2 was almost invariably completed accurately.

(ii) The substitutions were well done. Only a few failed to notice the difference in the original mass of F1 and F2.

(iii) It was widely known that fat contains more energy than carbohydrate and this was often related to the higher yield of F2. However, some believed that the difference in yield was due to difference in the mass of material.

(iv) This, more open ended section, was satisfactorily answered by references to repeating the procedures to obtain an average, some form of insulation or lid, by suggesting some means of getting better contact between the burning material and the test-tube of water or by using a smaller volume of water so that a higher temperature would be reached.

Question 2

(a)(i) Again some preliminary cutting or grinding was expected so that the reducing sugar would be released, forming a solution. This solution should then have been heated with Benedict's solution, preferably in a water bath as prescribed in the syllabus. It was, however, common to find that a reference to placing the test-tube in a water bath tended to assume that the water was hot. In other cases heating was omitted entirely.

(ii) The positive result was well known though a range of colours (mostly correct), was often given but generally not penalised.

(b) Again, as already indicated, a major fault here was not to answer in terms of water potential; references to concentration, tonicity and diffusion were not acceptable. However, many candidates were able to describe osmosis and state that the consequent movement was limited to water. Some, however, referred to 'water potential entering the tissue'.

(c)(i) Drawings were on the whole very good; labelling less so. Size and clarity of drawings were satisfactory apart from a few who overdid the shading, which was in any case unnecessary. The distinct undulations on the lower side of the photograph were usually well represented, reflecting good observation. In this particular picture the tripartite nature of the fruit was not clear so candidates had to represent the seed arrangement as they saw it, which was again satisfactory. Seed and pericarp were the expected labels and a few added funicle, placenta or loculus, thus easily providing the two labels that were required. A few drawings suffered by being too feint. A pencil that produces a clear line should be used.

(ii) This was the familiar exercise in calculating the degree of magnification of a drawing. It entailed ruling a line on both Fig. 2.2 and Fig. 2.3 to indicate clearly where measurements were taken. This was by no means always done. The lines should then have been measured accurately, preferably in mm. (which should be clearly stated). The length of the line on Fig. 2.3 should next be expressed over that of Fig. 2.2 and the result should be given to not more than two decimal places. At some point in the calculation an allowance might have been made for the fact that Fig. 2.2 was magnified x 1.5 but this was not essential on this occasion.

In the final answer rounding up or down should not exceed 0.2.

'Times 2.4, 2.4 times or x 2.4' are acceptable expressions. A significant proportion of answers were spoilt by the inclusion of units, like 'x 2.4 mm.', or by measurements that were obviously inaccurate

Question 3

This, more open-ended question was divided into sections in an attempt to assist candidates in formulating a description of a sequence of practical events, hopefully reflecting some of their laboratory experience in using a microscope. Initially a thin section of a leaf was required, but only a few used the term 'section'; they were more familiar with mounting the material on a slide, especially placing the cover glass on the specimen so as to avoid trapping air bubbles. A mounting fluid – usually water -, and a stain, often iodine may have been introduced at this point and the slide made clean and neat by blotting. By this stage many candidates had gained the five marks that were allocated so far, provided they had followed this approach.

Describing the use of a microscope was often hampered by inadequate knowledge of the names of the parts though some referred to stage and clips. The idea of adjusting the incident light by means of the mirror was sometimes mentioned but very few referred to the diaphragm as a means of light control, especially in the 'electric' type of instrument. Focussing was often alluded to though not always by name, and zooming was more familiar than reference to low and high power.

Recording observations, if mentioned, was usually by means of a drawing. Some made a table. But the marks most readily available in this section were for describing the expected occurrence of chloroplasts in spongy mesophyll, palisade and guard cells.

The mark scheme was generous to the extent that anyone following part or parts of the above sequence readily gained their ten marks. A very common fault, however, was to spend a lot of time and space in writing about photosynthesis and testing a leaf (often a variegated leaf), for starch. Only after this was slide preparation begun. Marks were awarded despite the unlikely attempt to section the soggy leaf, or even to peel off the epidermis or use the entire leaf. Only a few candidates suggested what species they would investigate.