BIOLOGY

Paper 0438/11
Multiple Choice

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

General comments

All questions were accessible giving an indication that the subject matter had been well learnt and correctly applied.

Comments on Specific Questions

Question 5

The properties of xylem were not widely known, with a proportion of candidates confusing it with phloem. Those who did know that xylem is a dead tissue were clearly the better candidates in the test as a whole.

Question 6

Many good candidates realised that the DNA strand in a bacterial cell is not a true nucleus.

Question 9

To arrive at the correct answer, candidates had to recognise the cell from the drawing, and then function.

Question 12

Candidates found it challenging to link separate pieces of knowledge. First they had to understand that DNA codes for a protein, then know that lipase is an enzyme and enzymes are made of protein.

Question 18

While a photomicrograph of this magnification may not be entirely familiar to all candidates, the majority of candidates managed to deduce that cell Y was a white blood cell and that it produces antibodies.

Question 21

There are certain areas of biology where candidates often exhibit confusion. One of those is exactly when, during 24 hours, a plant photosynthesises and when it respires. On the evidence of this question, a large number believe that plants respire only at night. Knowing that humans, as living organisms, respire all the time, should offer a way of learning that plants, also living organisms, do the same.

Question 23

For those who knew that urea is a breakdown product of protein, this question linked excretion with liver function and diet. The most common mistake was to believe that urea is derived from mineral salts.

Question 30

This was a genetics question presented in a manner that was not familiar to candidates and thus required careful reading, and thought, before answering. The question did not ask for what *could be* the case, but what **must** be the case. This was not recognised by the majority of candidates, making it one of the more difficult questions on the paper.

Question 35

Many candidates confused a pyramid of biomass with a pyramid of numbers.

Question 38

The topic of food chains is one that is traditionally well understood. This question soundly supported that fact making it the easiest question on the paper.

BIOLOGY

Paper 0438/13
Multiple Choice

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

General comments

There were no questions that proved generally too difficult for the candidates taking this paper, and marks ranged from around what might be expected to be complete guesswork (10) up to a maximum of 40. One or two traditional confusions were seen (**Question 22**) as well as some common misunderstandings (**Question 24**).

Comments on Specific Questions.

Question 6

Most candidates recognised that xylem does not convert light energy to chemical energy but many candidates confused xylem with phloem and suggested that it carries sucrose.

Question 7

A small percentage of otherwise very successful candidates did not appear to believe that xylem is present in leaves, or, that muscle is found in the intestine.

Question 13

Candidates found it challenging to link separate pieces of knowledge. First they had to understand that DNA codes for a protein, then know that lipase is an enzyme and enzymes are made of protein.

Question 17

While a photomicrograph of this magnification may not be entirely familiar to all candidates, the majority of candidates managed to deduce that cell Y was a white blood cell and that it produces antibodies.

Question 22

There is an often-seen mistake amongst candidates at this level that urea is produced *in* the kidneys rather than removed from the blood *by* the kidneys. Over half the candidates made that mistake in this question.

Question 24

For those who knew that urea is a breakdown product of protein, this question linked excretion with liver function and diet. The most common mistake was to believe that urea is derived from mineral salts.

Question 32

This was a genetics question presented in a manner that was not familiar to candidates and thus required careful reading, and thought, before answering. The question did not ask for what *could be* the case, but what **must** be the case. This was not recognised by the majority of candidates, making it one of the more difficult questions on the paper.

Question 33

Many candidates confused a pyramid of biomass with a pyramid of numbers.

Question 37

The topic of food chains is one that is traditionally well understood. This question soundly supported that fact making it the easiest question on the paper.

BIOLOGY

Paper 0438/21

Core Theory

Key Comments

Candidates should be made aware of the need to read the questions thoroughly and to take note of each question's demands.

General comments

There were a significant number of candidates who did not attempt all parts of all questions but this did not appear to be linked to a lack of time to complete the paper. There were some candidates who showed very limited knowledge and understanding of some topics from the syllabus. There was virtually no evidence that there were candidates who did not find the paper demanding in at least some of its aspects. Responses to various sections of questions revealed certain misconceptions and misunderstandings. There was evidence in a number of places that candidates had not read the questions carefully or thoroughly enough. Unfortunately there were more examples this year of candidates whose written work was difficult for Examiners to interpret as its legibility was poor.

Comments on specific questions

Question 1

Very few candidates offered definitions of either of the named terms, both of which are clearly stated in the syllabus. Many either described a balanced diet or gave statements that were really related to eating and this was clearly discounted by the wording of the question. Respiration was clearly confused with either gaseous exchange within the lungs or with breathing which again was the contrasting term in the question. This question rarely resulted in candidates gaining more than half the available marks.

Question 2

Candidates often seemed to alter correct responses for wrong ones as if they could not accept that all the additions to the table were identical. In particular, many suggested that alcohol does not cause damage to the liver or that it did not act as a depressant. In **(b),** many of the responses were non-specific e.g. it damages your health or it affects the lungs. The effect of carbon monoxide was least well known and the addictive effect of nicotine the best known. Candidates were expected to state a logical site for a cancer caused by tobacco tar and not simply quote "cancer" unqualified.

Question 3

Candidates overall, seemed unfamiliar with the parts of the alimentary canal that carry out particular functions. The commonest correct response was in **(iii)** and the most erroneous responses were in **(iv)**. Responses in **(b)** suggested that many candidates did not know the role of digestive enzymes and those who did understand their role often linked lipase to the breakdown of proteins. A number of answers suggested that the role of this enzyme was to digest lipase itself. Some candidates concentrated on the role of enzymes in general. In **(c)**, the internal structure of the tooth was poorly known with both **S** and **T** being identified as enamel, although many identified calcium, phosphate and fluoride as essential minerals needed for healthy teeth. In part **(iii)**, many candidates linked the cause of dental decay to bacteria in the mouth but often went no further than this in their answer. Some however did link the bacteria to the production of acid from sugary food remains and the erosion of the enamel by this acid. Far too many responses stated that sugar itself, or eating sugary foods, was the direct cause of the decay. Many candidates did realise that poor dental hygiene also plays a role in the processes leading to dental decay.

Question 4

Most candidates were able to identify parts **A** and **B** of the flower but far fewer recognised **C** as often misnamed as a stigma, or **D** as the ovule or ovary. In **(b)** the definitions of pollination were expressed with very few relating the transfer of pollen to movement between the anther and stigma. Ma candidates commented on shape, and colour of insect pollinated flowers as well as the possession of nectar and a scent. However, there was evidence in the responses that a significant number of candidates treat the term 'flower' as if it is synonymous with plant and thus their responses gained little credit. Among the responses, there were some that listed features of wind pollinated flowers and simply stated that insect-pollinated flowers did not have these. This unfortunately, did not answer the question. In **(c)** most candidates realised that the lightness of the pollen allowed it to be carried further by even light winds but far fewer recognised that the large amounts produced increased the chances of pollination occurring. In both **(b)(i)** and **(c)** there were a significant numbers of responses that muddled fertilisation with pollination with many candidates using the two terms as if they were interchangeable.

Question 5

Very few candidates were able to link the rise in the human population in the last two centuries to improvements in medical care, improvements in water supply and sewage or improvements in the production and supply of food. Many answers simply suggested that more reproduction took place. Answers dealing with the social implications of the population rise were far stronger with most dealing with the problems of increased demand for raw materials, energy and fuels, food supply and increasing pollution. In both parts of **(b)** responses were often very vague and showed little knowledge or understanding of the topics. Although a significant number of candidates realised the risk of mutations and cancers from the radiation only a very small number recognised that radioactive materials can enter food chains or that their radioactive properties decline slowly over many centuries. Candidates recognised the disease causing potential of untreated sewage but often did not develop their responses any further.

Question 6

In both parts **(a)** and **(b),** the majority of candidates gained credit. In **(c)**, candidates often made one of two errors, either having one level of the pyramid larger than the one below it or muddling the labelling of the middle two layers, insects and insect-eating birds. Those who drew their pyramid as a simple triangle eliminated the first of these potential errors. There were some pyramids that were inverted compared to the conventional version; it is normal to have the producers at the base of the pyramid. In **(d),** there were significant numbers of responses where the name of the method of nutrition was given as 'producer or even 'oak tree'. In describing photosynthesis, candidates should realise that simply stating that the plant uses various chemicals is inadequate. The carbon dioxide and water are involved in a chemical reaction whose products are glucose and oxygen and that the energy for this to happen is light.

Question 7

In **(a),** candidates found it very difficult to state clearly the meaning of the terms, allele and gene. The former being an alternative form of a gene and the latter a length of DNA. In **(b)**, although many candidates were able to identify the genotypes for individuals 2 and 5, in part **(ii)**, and individual 3, in part **(iii)** they seemed unable to offer an adequate explanation as to why the allele for tasting PTC was dominant. In family trees the clue lies in the appearance in one generation of the recessive phenotype when it is not present in the generation before it. In this case, individual 5 cannot taste PTC while both of his parents can. Thus both parents must have the allele for not-tasting PTC in order to pass it to their son but this allele is not expressed in their phenotype so it must be hidden by the dominant allele, for tasting PTC.

Question 8

Many candidates simply stated whether **F**, **G** and **H** were arteries or veins, with varying degrees of accuracy, when they should have named them as the question demands. In **(b)**, candidates were expected to state differences between the blood entering and leaving leg muscles, not state which vessels the blood is flowing in. Differences should make it clear what the state of the blood is in both, at entry and departure, including factors such as the blood pressure, oxygen concentration, carbon dioxide concentration, glucose content or temperature. Stating that blood entering the leg muscle is at high pressure is inadequate unless there is a comment on the pressure on leaving, or the use of a comparative such as 'higher'. In **(c)**, the answers showed very little knowledge or understanding of the advantages of the double circulation. There were many responses that suggested that if one circulation failed the other could take over or that it could assist in times of high demand. Candidates seemed unaware of the delicate nature of lung tissue and the value of a

lower circulation pressure in the pulmonary circuit and also the need for a much higher pressu e the oxygenated blood to all parts of the body where a greater resistance to flow occurs.

Question 9

The definitions of excretion often seemed to confuse excretion with egestion and included references to faeces. Faeces are not normally considered to be an excretory material unless it is made clear that it is the excretory substances within the faeces, such as bile pigments, that are being considered. Also, many definitions did not make it clear that it is the removal of materials from an organism. Unfortunately errors and misconceptions in **(a)** often had an effect on the answers in **(b)** with the anus, rectum or small intestine being quoted as excretory organs. Many substances given as examples were rather vague and should have been much more specific e.g. urea, water, carbon dioxide or mineral salts rather than exhaled air, urine or sweat. In **(c)**, most candidates named an excretory substance of plants with many recognising both oxygen and carbon dioxide as correct examples. However , some candidates naming oxygen as an excretory substance in humans.

BIOLOGY

Paper 0438/23
Core Theory

Key Messages

Candidates need to be aware that unintelligible writing cannot gain credit.

Candidates should be encouraged to read the whole question with care before beginning their response.

General Comments

There were a significant number of candidates who failed to attempt all parts of all questions but this did not appear to be linked to a lack of time to complete the paper. A number of candidates showed very limited knowledge of major parts of the syllabus including the processes of fat digestion and excretion. There was evidence of careless reading of the question, especially in **Questions 4, 7** and **9**. In some cases the standard of English and the handwriting of the candidate made it almost impossible for the Examiner to make logical sense of the response.

Comments on Specific Questions

Question 1

Many candidates appeared not to know the classification of the two classes of flowering plants. Even the term monocotyledon did not seem to suggest the presence of one cotyledon. Some may have been confused by the term eudicotyledon that is now used in this syllabus. Part **(b)** usually produced at least one correct response. In **(c)**, very few candidates identified the diagram as a section through a root although they very often correctly labelled the xylem and phloem. Many knew that the xylem transported water but few could suggest a second function. A significant number confused the functions of the xylem with those of the phloem.

Question 2

It was expected that candidates would use both their general knowledge and the relevant areas of the syllabus when answering this question. It was set out in two sections to guide candidates but many ignored this. The use of agricultural machinery allows many agricultural processes such as ploughing, sowing and harvesting of crops, irrigation and drainage to be carried out more rapidly and efficiently thus increasing crop yields. The second section was about the use of fertilisers, not insecticides or herbicides, which many chose to write about. There was clearly confusion by candidates between these terms. More careful reading of the question might help candidates to produce creditworthy responses.

Question 3

Knowledge of the female reproductive system, and especially the placenta, was very poor. In **(a)(i)**, of those who recognised the term zygote most knew it was formed from the ovum and the sperm but many talked of the gametes meeting without mentioning fusion. Some appeared to think that the sperm entered the ovary and fused with the whole organ. There were also a significant number of candidates who described the human female gamete as the ovule, a term only used in reference to a structure in the ovaries of plants. In **(ii)**, very few candidates mentioned division of the zygote to form a mass of cells or implantation in the lining of the uterine wall. In **(b)(i)**, there were some sensible suggestions given for the two blood systems being separated such as incompatible blood groups or the risk of transferring pathogens. The risk of blood loss at birth was not an acceptable response. Part **(ii)**, was clearly not understood by many candidates. Those who did realise that they were expected to compare the roles of the placenta with those of the small intestine, lungs and kidneys in the adult, showed very limited knowledge of the placenta. The placenta transfers the products of digestion and oxygen from the maternal blood to the fetal blood and transfers carbon dioxide and

waste nitrogenous material in the reverse direction down a concentration gradient. Thus it is [illegible] which absorption and diffusion occur. It does not digest food or breathe for the fetus. Most can[illegible] make sensible suggestions in **(c)**. The commonest were avoiding smoking, drinking alcohol, tak[illegible] prescription drugs and dietary modifications.

Question 4

Knowledge of the effects of sulfur dioxide was very vague. Some candidates mentioned acid rain and its effects and a few candidates mentioned smog. There were some who tried to link this with global warming or the destruction of the ozone layer. In **(b)**, it was surprising how many candidates could not interpret the data shown by the graph correctly and many were unable to extract the relevant data and complete the calculation correctly. Most seemed unable to link the presence or absence of lichen **M** to the possible concentration of sulfur dioxide that would decrease with distance from the industrial site in part **(iii)**. There were a significant number of responses to **(iv)** in which the total number of lichens, calculated by the candidates, was divided by 20, as if the answer required was to be presented per metre squared rather than for the whole 20 m^2 area. This suggests candidates did not read the question carefully enough.

Question 5

Most candidates could not name the enzyme involved in fat digestion or the products of this process. Most did not realise that the fatty acids produced in digestion would lower the pH of the mixture. In **(b)**, most completed the graph. In **(c)** the responses suggested that few had understood the role of bile in aiding the more rapid digestion of fats. Some candidates recognised that in the second investigation the colour of the indicator would change more rapidly but the optimum temperature would remain the same.

Question 6

This question was very poorly answered. Some candidates realised that reactions are speeded up by the presence of enzymes or by an increase in temperature, but knowledge of anaerobic respiration in yeast and human muscle cells was almost non-existent as was the use humans make of anaerobic respiration of yeast. Many of the responses given did not make any sense within the wording of the paragraph.

Question 7

Throughout part **(a)**, a significant number of candidates referred to pollination although the question was about fruit and seed dispersal. Those who read the question carefully usually gained most of the available credit in this section. In **(i)**, a number of candidates thought fruits developed from the seed or gave vague responses such as 'the flower'. In **(ii)**, many referred to hooks, or to the edible (juicy) outer regions but other features such as a conspicuous colour or smell were mentioned less frequently. In **(iii)**, many suggested the presence of wings as another mechanism of dispersal. Suitable agents such as the wind, water or explosive mechanisms were also creditworthy responses. In **(b)**, pollination was the most common correct response. Candidates should be aware that insects are not normally agents for seed dispersal.

Question 8

This was the highest scoring question for many candidates. In spite of the instruction, a few candidates tried to name species at each trophic level and a few reversed the positions of the producer and the carnivore, but most gained full marks. A number of candidates could not manage the basic calculation. Most recognised photosynthesis as the process used by organism **A**. A number of candidates failed to identify ways in which energy is lost at each tropic level. The method could have included respiration, excretion, egestion and, for some organisms, loss of heat energy to the environment. Various processes involving movement such as hunting, walking etc. were also considered adequate. Vague suggestions such as 'keeping alive' were not considered adequate for credit.

Question 9

Many responses to this question showed insufficient understanding about the processes that go on in the kidney. Many candidates did not understand the graph which showed how the relative concentrations of four substances changed as blood passes through the kidney. Candidates should know that blood passes from the renal artery to the renal vein, but a significant minority read the graph back to front. 'Explain the difference', means that the difference must be clearly stated, and then in each case the reason or reasons for the difference given. In **(a)**, it was expected that responses would describe the drop in concentration of urea in the blood as it passed from the renal artery to the renal vein and relate this to the filtration of

substances in the kidney. Part **(b)**, required a description of the changes in the relative con of oxygen and carbon dioxide and these changes to be related to respiration within the kidney. required candidates to note the fall in the concentration of glucose as blood entered the capillaries subsequent rise as glucose is reabsorbed. Many candidates failed to refer to the graph or to make the information it contained. It is recognised that the kidney is a difficult subject for many candidates, they should have been able to interpret the graph and thus gain a creditable score.

BIOLOGY

Paper 0438/31
Extended Theory

Key messages

- Candidates should always take time to read the questions carefully. All the information and data provided should also be studied carefully as candidates are often asked to interpret the information provided to gain full credit.
- Candidates should always give the specified number of responses requested in a list and no more. Where more than the stated number of responses is given, any incorrect responses are penalised as being contradictory. This rule also applies to questions where only one answer is required.
- Candidates should avoid repeating the information given in the questions in their answers as this is a waste of time and space.
- Candidates need to be encouraged to use the correct scientific terminology. Vague terms rarely gain credit. For example words such as 'affect' and 'change' often need further explanations.
- Examiners accept phonetic spelling where words are recognisable and unambiguous. However, candidates should show careful attention to words that can be confused; for example, trophic and tropic, mitosis and meiosis, ovum and ovule.
- Candidates should be encouraged to write their answers to the longer questions in continuous prose. Lists and phrases that do not link together the appropriate scientific concepts are unlikely to gain much credit. Some candidates write answers in the form of bullet points. If these are full sentences then there is rarely a problem, but often they are not and the information given is not sufficient for the award of credit.
- Incorrect answers must be clearly crossed out and the correct answer should be written alongside or just above the first answer. Where an answer is a single letter or number, it is particularly important that candidates do not write on top of an original answer. Where it is not possible to confirm what letter or number is written no credit can be awarded.
- Answers that are continued in blank spaces or on additional paper must be clearly numbered. At the end of the answer space provided, candidates should state where to find the rest of the answer.
- Candidates should avoid writing initial answers in pencil and then overwriting in pen. Any feint pencil markings that were missed during this process are unlikely to be sufficiently clear to gain credit. Candidates should also not use thick felt tip pens. The ink on one page can make it difficult to read answers on the back.

General Comments

This was an accessible paper allowing candidates across the full range of ability to demonstrate what they knew. There were some more challenging and stretching questions for the most able. The Examiners were pleased to see that most candidates had attempted all the questions. Almost all completed the paper within the time available. Some handwriting, however, was difficult to read.

There were some excellent well written and coherent responses to the longer answers.

Candidates did not seem well prepared to use data to support a description of a trend or pattern from a graph or a table. Often, candidates who quoted figures did not read them accurately from the graph and often omitted to include the units after each figure.

Comments on specific questions

Question 1

This question asked candidates to identify the structures of the gas exchange system shown in Fig. 1.1. It proved a good start for most candidates. Almost all candidates calculated the mean volume of air correctly in part **(b)(i)**. Describing and explaining the differences between oxygen and carbon dioxide in the air samples collected from the girl before and after exercise provided more of a challenge.

(a) Many candidates gave the correct answers in Table 1.1. Common errors were to give **F** and **J** as the bronchus, **K** and **B** as the trachea. Sometimes it was difficult to distinguish between the letters **E** and **F** when **F** was written on the line. It was rare to find more than one letter given in each box. If more than one answer was given, then no credit was awarded.

(b) (i) Most candidates calculated the mean volume of air per breath correctly and wrote the answer in Table 1.2. If candidates gave the answer in the space for working, but did not rewrite it in the table, then credit was given. 375 and 37500 were common incorrect answers. A few candidates did not attempt this question and some tried something far more complicated than adding up and dividing by 4.

(ii) The Examiners expected candidates to recognise that the rate of breathing had increased after exercise. Some candidates lost a mark here by giving a change shown in Table 1.1. Depth of breathing was ignored by the Examiners so if they wrote 'depth and rate of breathing' they were given credit. There were many references to heart rate which did not answer the question.

(iii) The most common gases given were argon, hydrogen and water vapour. The Examiners accepted the names of all the rare gases and any air pollutants, such as carbon monoxide and sulfur dioxide. Nitrogen, sulfur, carbon dioxide, oxygen and any 'inert' gases were not given credit.

(iv) There were many good answers to this question. Partial credit was awarded for a description of the differences in the air samples. Candidates often did not use the data to illustrate the differences in the composition of the two samples. Some candidates compared oxygen with carbon dioxide within one sample. The explanations were often poorly expressed. Candidates tended to write about the reasons why oxygen is always required in the body and why carbon dioxide is always removed, rather than addressing the requirements of exercise. Answers often explained that oxygen is needed for respiration and the release of energy, instead of stating that more oxygen is needed after exercise to repay the oxygen debt or because the rate of respiration has increased as more energy is required. In questions on exercise it is often important to use the word 'more'. The concept of oxygen debt was known by many candidates, although rarely explained well. Many candidates did not distinguish between air and oxygen. The Examiners occasionally read that during exercise more air is required, or that muscles require air for respiration.

Many candidates wrote that carbon dioxide is a product of anaerobic respiration in muscle. They should be reminded of the word (and balanced chemical) equations for anaerobic respiration to see that it is not.

Question 2

Energy flow through ecosystems from Section IV of the syllabus was tested in this question. Part **(b)** proved to be a very easy question for most candidates.

(a) (i) Many candidates were successful in identifying **L** and **N** from the energy flow diagram in Fig. 2.1. The Examiners ignored 'plants' and 'carnivores' so that answers such as 'plants, producers' or 'producers (plants)' gained the mark for **L**; similarly, 'carnivores = secondary consumers' and 'secondary consumers (carnivores)' also gained credit. 'Plants' and 'carnivores' unqualified by the names of the correct trophic levels did not gain any credit.

(ii) There was some confusion over the concept shown by the relative sizes of the boxes, **L** to **O**, in Fig. 2.1. Many realised that the boxes represented the energy within each trophic level. Some stated that they showed the decrease in energy from trophic level to trophic level. Both answers were credited. Incorrect answers were: 'biomass', 'number of organisms', 'pyramid of numbers',

'size of the population' and 'amount of energy transferred'. The latter is shown in th the arrows between trophic levels.

(iii) There was plenty of scope for candidates to gain full credit for this question if they looked ca at the figures. Few quoted the figures to state that all the energy obtained by the tert consumers at level **O** is accounted for by the energy loss from this trophic level. Many stated tha energy is lost in the food chain with answers often illustrated by statements that 10% of the energy entering a trophic level is passed to the next or by the statement that 90% is lost. Many mentioned that animals in trophic level **O** would be too big and fierce and therefore would not have any predators. Some used examples such as lions, tigers, vultures and large snakes that have no predators. Many just stated 'it was at the top of the pyramid' so could not have any predators without offering any explanation The question was often answered as what trophic level **O** received rather than what could be passed on to any potential predators. Few pursued the argument to say that this would mean a population of predators would be small or struggle to survive. Some candidates simply stated that energy stops at the tertiary consumer level.

(iv) Many candidates gained full credit for stating that **P** represents loss of energy by respiration to the surroundings or to the atmosphere. Answers that gained full credit often stated that this is energy lost as heat. A number of candidates stated that this represented energy *used* in respiration. There were also incorrect references to plants, decomposers and to the nitrogen cycle.

(b) This was probably the easiest question on the paper. Candidates explained that the loss of animals from trophic level **M** would have effects on the populations of all the other trophic levels. Answers were often well written. The few candidates who did not gain credit here read the food chain the wrong way round, thinking that **L** fed on **M**. Of those candidates who did not achieve full credit for this question, many showed poor expression. For example, they wrote 'a decrease in the numbers of **N** would affect **O**', rather than, 'a decrease in the numbers of **N** will lead to a decrease in the numbers of **O**'. Many mentioned **N** and **O** becoming extinct which was accepted.

Question 3

There were many full and accurate descriptions in part **(c)(i)** of the graph in Fig. 3.2. However, many candidates did not follow the advice given in the question to give the results from the graph in their answers. Many of those that quoted figures often misread them from the graph and/or did not include units. Some of the answers to part **(d)** contained some impressive detail of the events of fertilisation.

(a) Many candidates gained full credit for identifying the organs described in Table 3.1 and shown in Fig. 3.1 Common errors were to identify the ovary as **S** rather than **T** and to confuse the uterus and the oviduct. Some candidates wrote 'ovule' or 'ovum' for ovary. The Examiners accepted uterus lining and uterus endometrium but rejected uterus wall, since the site of implantation is in the lining not in the wall. There were many different spellings of Fallopian – many of these were accepted by the Examiners if they were phonetic. The Fallopian tube or oviduct was often referred to as the ovary duct which was not accepted.

(b) (i) The target organ for FSH was given as the ovary or ovaries on many scripts. Common errors were to give the follicle, which is not an organ, and the uterus. Also quite a few gave the pituitary gland, which is the source of FSH, possibly because they did not understand the term *target organ*.

(ii) Candidates who misidentified the organ in part **(i)** usually lost another mark by giving an incorrect function for FSH. In this case the error carried forward rule was not applied to answers such as these. Successful answers gave the effect of FSH as stimulating the growth of a follicle or of an ovum and stimulating the secretion of oestrogen. Many candidates stated that FSH stimulates ovulation which was not accepted. Some did not gain any credit because they stated that FSH stimulates the secretion of oestrogen *and* progesterone. Also quite a few said that FSH causes menstrual bleeding, or gave general statements such as 'it increases fertility'.

(c) (i) Candidates who gained full credit often did this with three descriptive comments and one data quote or with two comments and two data quotes. Many candidates did not give any figures from the graph. The Examiners did not award any marks for use of figures unless 'arbitrary units', or simply 'units', were used at least once. Credit was only given to descriptive comments and figures if the relevant days were identified. Some candidates expressed answers poorly giving descriptions in terms of concentrations 'at' specific days rather than describing changes in concentrations between certain days. Some candidates gave an explanation in terms of the events

of the menstrual cycle, rather than a description of the changes in oestrogen levels
3.2.

(ii) Most answers gave good definitions of the term *ovulation*. Unfortunately, some candidates
that this is the release of an *ovule* rather than an *ovum*. This error often appeared in part **(d)**
well. Some referred to the production or maturation of an ovum rather than its release.

(d) Many candidates did not gain many marks for their descriptions of fertilisation. In many cases, this was because they described events that occur *after* fertilisation and if they gained any credit, it was for using the term zygote. A common error was to state that a zygote forms after the fertilised egg has divided several times. Many answers started with an embryo and described the events of implantation and beyond. Candidates who read the question carefully easily gained full credit often giving impressive detail. Some candidates gave details of the process of *in vitro* fertilisation which were not required.

(e) (i) The syllabus gives a suitable definition of the term *chromosome*. It was surprising that few answers quoted this definition. Some candidates gave the syllabus definition of the gene and others wrote about the importance of chromosomes or the numbers of chromosomes in different cells. Some stated that chromosomes are cells.

(ii) Many candidates gave 46 or 23 pairs as the correct number of chromosomes in a cell of a human embryo. 2, 23, 24, 32, 34, 42, 47, 48, 64 and 92 were all seen.

Question 4

Part **(a)** was a question typical of Papers 5 and 6. It was surprising that candidates were not better prepared to make a drawing of a photograph of a specimen. Very few candidates could transfer information from the photograph to their own drawing. If drawn correctly, candidates often had the labels the wrong way round. Part **(c)** proved one of the most challenging questions on the paper. It tests the second bullet point in the Supplement section of learning outcome 7.1.3.

(a) Many candidates drew the distribution of vascular tissue in a cross section of a root or stem from memory rather than following the instructions. Of those that attempted to make a drawing of the position of the xylem and phloem, few identified the xylem and phloem correctly. There were some excellent drawings of the cell detail of the xylem although marks were awarded if the areas occupied by the two tissues were shown by dividing the shape of the vascular bundle into two or drawing outlines to show the position of the xylem to the right of the phloem. Even well drawn responses labelled the xylem to the left of the phloem.

(b) Sucrose was often identified as the carbohydrate transported in the phloem. Glucose, sugar, starch, glycogen and amino acids were often given instead. Some candidates gave two responses, one right and one wrong. In this case no credit was awarded.

(c) This question on transport in the phloem proved difficult. Some candidates were confused between the roles of xylem and phloem. They often wrote about the movement of water and minerals at different times of the year. These answers also stated that water and nutrients move both upwards and *downwards* within the plant. Candidates who wrote about the movement of sucrose stated that it moves up and down the stem but omitted to give the destinations, such as roots, flowers, fruits and seeds. Some candidates stated that substances moved in the phloem are sent *to* leaves so that they can carry out photosynthesis. The terms *source* and *sink* were used by many candidates with the best making good use of these terms applying them to leaves, storage organs, flowers and growth regions. Answers revealed many misunderstandings about plant biology, such as fruits growing underground. Many stated that sucrose moves downwards in winter. Many did not state the conditions relevant to winter and summer or related movement to photosynthesis or the stage of growth. Some included good descriptions of movement in phloem after seeds have germinated. Some stated that carbohydrates were absorbed from the soil. The most common misconception was that sucrose was moving down in the winter to feed the roots and back up in the spring / summer to 'feed' the leaves or to provide sugars for photosynthesis.

(d) Definitions of transpiration often gained full credit. Candidates referred to evaporation and the loss of water through stomata in leaves. Only the best candidates stated that water evaporates from the surfaces of mesophyll cells and that water loss occurs by the diffusion of water vapour through stomata. Common errors were to answer part **(e)** here and describe the movement of water in the

transpiration stream. Omitting vapour from their explanation a common error. Thi
given in the syllabus so it was surprising that more candidates did not gain full credit h
confused transpiration with translocation.

(e) The most successful answers to this question on movement of water through plants began stating that transpiration is responsible. Candidates explained that transpiration pull involving the cohesion between water molecules within xylem vessels is responsible for the movement of water up tall plants, such as the rattan palm. The Examiners decided to award credit for cohesion and adhesion if these terms were also explained. Many gave the terms and either they did not say what they meant or got them the wrong way round. Many answers began by describing the movement of water from the soil, through roots hairs and the cortex into the xylem in the root. No credit was given for this. Movement of water up the root and stem was often explained in terms of a water potential gradient. Some candidates, unfortunately, went on to say that this involved osmosis across partially permeable membranes, which is incorrect. Candidates appeared to confuse movement from soil to root hair with movement in the transpiration stream.

Question 5

Many candidates appeared not to have read the information provided about the experiment on the digestion of fat very closely. Many answers to parts **(b)(i)** and **(ii)** showed that candidates had not used the information before **(a)(i)** and applied it to the description of the experiment. Neither had they used it in interpreting the results shown in Table 5.1. The roles of bile salts in emulsifying fats and lipase in digesting fat are in ***sections 6.3.4*** and ***6.3.5*** of the Core syllabus.

Colours given in Table 5.1 often led to confusion with other tests. For some, blue meant the iodine test and orange meant the test for reducing sugars. It was good to see in **(a)(ii)** almost all candidates reading the question carefully and only giving the pancreas once.

(a) (i) Very few answers to this question gained full credit. Many candidates wrote about the features of enzymes without picking out the facts that enzymes are catalysts that speed up reactions. This means that reactions can occur within organisms at low temperatures instead of the high temperatures required for uncatalysed reactions to occur. A few candidates stated that enzymes lower activation energy. Many answered this question by drawing on their knowledge of digestion without making two or three general points about the importance of enzymes.

(ii) Many candidates selected pancreas, stomach and salivary glands from the list to identify the organs that secrete the three enzymes. Common errors were to select the gall bladder and the liver for lipase and protease. Most candidates linked amylase to the salivary glands. All three are secreted by the pancreas; most candidates followed the instructions and only gave the pancreas once. Lipase was the one they were most likely to get wrong.

(b) (i) Many candidates identified tube **D** as the control. The Examiners did not accept 'control variable' given by some candidates. The control variables are the temperature (40 °C), the time at which substances were added to the test-tubes and the time for the reaction to occur (5 minutes). Presumably the volumes and concentrations were also standardised although the information does not give these details. The control tube is used to see if the differences in colour or pH of the tubes are due to the action of the lipase and bile. (Tube **D** is missing both lipase and bile. Other tubes had one or the other.) Many candidates stated that the tube would be used to compare with the other tubes, but they did not state what aspect would be compared. Suitable answers were the colours of the indicator or the pH of the contents.

(ii) There were two interpretations of the orange colour in test-tube **A**. Some thought that the contents had an acid pH because lipase and/or bile salts were acidic. The Examiners did not award any credit for this. These candidates did not apply the information given about digestion of fat. Those who realised that lipase had broken down fat to fatty acids and glycerol tended to gain full credit for this question. Quite a few candidates thought that the orange colour was something to do with the Benedict's test for reducing sugars.

(b) (iii) Candidates who had not appreciated the roles of lipase and bile salts in fat digestion usually gained partial credit for saying what colour one of the tubes had gone and/or what this meant in terms of acidity or alkalinity. Candidates who were successful in part **(ii)** often did well here as they explained that there is no breakdown of fat to fatty acids and glycerol in tube **B** since there is no

lipase present. They explained the yellow colour in tube **C** in terms of lipase digesting f the fat since there were no bile salts to increase the surface area of the fat globules.

Question 6

There were many good answers to parts **(a)** and **(b)**. Most candidates identified an arthropod feature shown by the crab in Fig. 6.2. Future candidates using this paper for examination practice might like to know more about the hydrothermal vent crab, *Bythograea thermydron*. If so, there is information available at: http://www.ceoe.udel.edu/deepsea/level-2/creature/crab.html

(a) Many candidates identified two features of bacteria that are not shown by animal cells. Some candidates gave differences between plant and animal cells. Common correct answers were 'no nucleus', 'flagellum' and 'cell wall'. Some candidates gave detailed information about the cell wall more appropriate for A level. References to size, shape and presence and absence of cytoplasm, cell membrane and vacuole were all seen and not awarded any credit.

(b) (i) Stage **A** of Fig. 6.1 was identified as the lag phase on many scripts with stage **B** identified as the log and/or the exponential phase. Incorrect answers were 'start' and 'growth', 'non-growth phase' and 'reproduction phase', 'prophase' and 'metaphase', 'mitosis' and 'meiosis'. The Examiners found it difficult to read the difference between candidates' a's and o's. Sometimes, corrections had been written over the original answer and it was hard to tell what was the final answer, lag or log.

(ii) The explanations for phases **D** and **E** often referred to limiting factors, such as food or nutrients and oxygen. Toxic waste products were also mentioned. Many candidates explained that in the stationary phase the rate of reproduction is equal to the death rate and that in the death phase the death rate is greater than the rate of reproduction. The Examiners accepted the term 'birth rate' instead of reproduction rate. Some had the idea that phagocytes, disease or antibiotics were responsible. A significant number of candidates gave 'generic' answers which included war, drought and flooding, rather than writing an answer that applied to this specific situation.

(c) (i) The features of arthropods visible in the drawing of the deep sea crab are the exoskeleton and the jointed legs. These were identified correctly by the majority of the candidates. Common incorrect answers were 'joined' or segmented legs, hard shell, segmented limbs, antennae and compound eyes despite the last two not being visible in the drawing.

(ii) The Examiners accepted two arguments for the evolution of the deep sea crab. The information provided states that there is no light in the deep sea. Some realised that there is no advantage in having a body that is red, green or brown as predators are not able to see the crabs. They then stated that a mutation may have occurred that stopped the production of any pigments. Not producing pigments saves energy and this might give these albino crabs a slight advantage over the pigmented crabs. There were some very coherent answers which included good links between the idea of mutation, differential survival and selective advantage.

The Examiners accepted an alternative argument that suggested that the bottom of the sea is covered in white sand or white rocks. This argument relies on the ability of crab predators to see their prey – perhaps by bioluminescence although more often candidates suggested that there is sunlight at these great depths so contradicting the information provided. The Examiners overlooked this if the rest of the argument used an understanding of natural selection. The candidates stated that white crabs are camouflaged and less likely to be predated. In this argument albinism provides a more obvious selective advantage. Those that gained full credit for this question mostly followed this argument.

Some candidates explained that albinism in crabs is a recessive trait and that these white crabs originate from mating between heterozygous crabs. However, there was rarely any indication as to why white crabs would increase in numbers. There were plenty who thought that the crabs went white because they did not have any sunlight to produce melanin in their shells.

BIOLOGY

Paper 0438/33
Extended Theory

Key messages

- Candidates should always take time to read the questions carefully. All the information and data provided should also be studied carefully as candidates are often asked to interpret the information provided to gain full credit.
- Candidates should always give the specified number of responses requested in a list and no more. Where more than the stated number of responses is given, any incorrect responses are penalised as being contradictory. This rule also applies to questions where only one answer is required.
- Candidates should avoid repeating the information given in the questions in their answers.
- Candidates need to be encouraged to use the correct scientific terminology. Vague terms rarely gain credit. For example words such as 'affect' and 'change' often need further explanations.
- Examiners accept phonetic spelling where words are recognisable and unambiguous. However, candidates should show careful attention to words that can be confused; for example, trophic and tropic, mitosis and meiosis, ovum and ovule.
- Candidates should be encouraged to write their answers to the longer questions in continuous prose. Lists and phrases that do not link together the appropriate scientific concepts are unlikely to gain much credit. Some candidates write answers in the form of bullet points. If these are full sentences then there is rarely a problem, but often they are not and the information given is not sufficient for the award of credit.
- Incorrect answers must be clearly crossed out and the correct answer should be written alongside or just above the first answer. Where an answer is a single letter or number, it is particularly important that candidates do not write on top of an original answer. Where it is not possible to confirm what letter or number is written no credit can be awarded.
- Answers that are continued in blank spaces or on additional paper must be clearly numbered. At the end of the answer space provided, candidates should state where to find the rest of the answer.
- Candidates should avoid writing initial answers in pencil and then overwriting in pen. Any feint pencil markings that were missed during this process are unlikely to be sufficiently clear to gain credit. Candidates should also not use thick felt tip pens. The ink on one page can make it difficult to read answers on the back.

General comments

There were some excellent answers to the questions in this paper, but overall many candidates struggled to understand the information provided and were unsure about how to answer. There was no evidence that candidates had difficulty completing the paper in the time available. Some candidates gave answers to questions that were *not* asked. They should always read the questions carefully and then adapt what they know to provide an answer. Many candidates would benefit from using the last five minutes of the examination for reading through answers looking for additional points to make and for checking their wording and spelling. For example, candidates could check the order of the points that they have made in long answers. The word 'and' should not be used in place of 'therefore' as it usually does not link points together adequately.

Candidates should have the confidence to attempt answers to questions that they are unsure about. They may gain credit that would otherwise be lost if they leave a blank space. Candidates are advised to take care when writing numerals. They should write them as they are printed to avoid any confusion between 1 and 7, 4 and 7 or 9, and between 0 and 6.

Candidates should note that the number of marks available for a part usually shows the minimum number of points that they should aim to make when answering that part.

Comments on Specific Questions

Question 1

This question covered topics from Sections I and III of the syllabus. Candidates appeared not to appreci that 'draw a food chain' meant write the names of the organisms with arrows between them. Instead they made little drawings of the organisms and in so doing omitted the producers for the estuarine ecosystem.

(a) Candidates were asked to state three features of annelids that are not shown by the nematode *Ascaris lumbricoides* in Fig. 1.1. Bristles, chaetae and hairs were allowed for the projections, but not legs or feet. Several alternatives for segments were given credit. Features that were not shown in the drawings were not given credit.

(b) Candidates were asked to state what is meant by the first part of the name *Nereis diversicolor*. Many gave genus as the answer. The Examiners also accepted 'genus part of species name'. Species, family and kingdom were examples of incorrect responses. At least one candidate tried to translate the word *Nereis* as 'sea nymph' which was certainly not the intention of the question.

(c) (i) Four aspects of the term *ecosystem* were awarded credit. 'Different species' was not considered adequate for 'all the organisms' or 'community'. 'Habitat', but not 'environment', was allowed for the given area.

(ii) Many candidates had difficulties drawing the food chain for the ecosystem when the tide was out. Many omitted the plankton and many did not draw arrowheads. One mark was awarded for putting the organisms in the correct sequence and another for showing that energy flows from food to feeder, e.g. plankton to annelid. It was not necessary to draw little pictures of the organisms, as many candidates did. This is presumably why they omitted the plankton as they did not know how to draw them.

(d) This question was about the mass spawning of palolo worms, annelids that live in tropical reefs. Most candidates missed the points about many gametes being released together increasing the chances of gametes fusing. Many wrote that the number of eggs or zygotes or embryos that could or could not be eaten by predators, rather than the proportion, is an important advantage of mass spawning.

(e) This question on meiosis attracted many good answers. The points that were missed most frequently were the two divisions in meiosis and the cells or nuclei or gametes that are produced. Many referred correctly to variation and explained that meiosis is necessary to halve the number of chromosomes.

Question 2

This was a question on limiting factors and photosynthesis. Candidates should have been familiar with the apparatus shown in Fig. 2.1 and been able to apply the principle of controlling variables to this example. Descriptions of the data shown in Table 2.1 were, on the whole, not well expressed. Describing data from a table or graph is a skill that candidates should practise.

(a) (i) Many candidates wrote about the temperature effect of the lamp, rather than keeping the light intensity constant. They did not seem to realise that the plant is insulated from the heat of the lamp by the beaker of water. The terms 'intensity' (for light), 'constant' or 'control variable' and 'limiting factor' were required to gain credit for this part.

(ii) The point of this question was that carbon dioxide is needed for photosynthesis. Sodium hydrogen carbonate releases carbon dioxide so that a good concentration is maintained. This ensures that carbon dioxide concentration does not become a limiting factor. Not all candidates provided both points needed for full credit.

(b) This part was usually well answered, with the peak rate of photosynthesis identified at 30 ^{o}C. Common errors included giving a range for the peak rate and/or the optimum temperature. They did not use the words increase and decrease to describe the changes in rate; instead, they referred to low rates and high rates either side of 30 ^{o}C.

(c) Most candidates made the points that the rate of photosynthesis increases to a peak as temperature increases and then decreases. They used this evidence to support the argument that

enzymes must be involved in photosynthesis. No candidate stated the first mar if enzymes were not involved it is likely that the rate would continue to increase. Few w destruction of active sites when enzymes are denatured.

(d) This question asked why the alga, *Cabomba caroliniana*, has grown very rapidly in Australia wh it has been introduced. Some candidates only made one suggestion although there were tw marks available. Many wrote that the temperature is more suitable or nearer to the optimum temperature without saying whether this was higher than in its original habitat or not. Some answers suggested that candidates had overlooked the aquatic habitat of these plants.

Question 3

Hormones, from ***Section II*** of the syllabus, was the thread running through this question.

(a) Some candidates named the parts of the cell shown in Fig. 3.1 instead of giving their functions. Some functions were too vague to be awarded any credit, such as **C** (the cell membrane) 'keeping the cell together'.

(b) Very few candidates gained both marks available for this question. Few stated that glycogen is insoluble and/or that glucose is soluble. Very few stated that much larger quantities can be stored if glucose is converted into glycogen than could be stored simply as glucose. Few also stated that if glucose concentrations in the blood increase then much is not reabsorbed in the kidney and is therefore lost in the urine. Correct mentions of diabetes gained credit. Some candidates stated incorrectly that glucose is a larger molecule than glycogen and therefore being less suitable for storage.

(c) (i) To gain credit, candidates had to state that glucagon stimulates liver cells to convert glycogen into glucose. 'Breakdown of glycogen' and 'make glucose' on their own did not gain any credit.

(ii) This part was generally answered very well. 'Travel in (red) blood cells' was sometimes wrongly suggested.

(d) This was also answered very well. Various spellings of the steroid hormones were accepted so long as they were phonetic.

(e) (i) Most candidates gained credit here by stating, for example, that cattle grow faster so that the animals can be kept for a shorted time. Simply stating that 'more meat was produced' gained no credit as this was given in the question.

(ii) Most candidates gained credit by explaining that cattle produce methane as a waste product. However, few of them made the link between better use of food and less waste or less methane or less carbon dioxide.

(f) Most candidates gained credit here. Some only wrote about the hormone 'affecting humans' or 'affecting cattle' without saying whether this was for the better or worse. Better answers stated that the hormone had a negative effect on the health of the animals and/or humans as consumers.

Question 4

Fig. 4.1 is an electron micrograph of a capillary. Even though the type of blood vessel was not identified in the introduction to the question, there were sufficient clues in the relative scale of the cell and the diameter of the vessel. Some candidates obviously did not read the introduction and part **(a)(i)** properly because in **(a)(iii)** they gave 'artery' or 'vein'. These contain many more cells than just the one shown in Fig. 4.1.

(a) (i) Some candidates ignored the word 'cell' in the question and answered 'nucleus'.

(ii) This part was mostly answered correctly.

(iii) Candidates should have noticed by comparison with cell **X,** that it is a very narrow blood vessel, hence a capillary. Many candidates gave 'artery' or 'vein' as their answer.

(b) This question asked for three substances that cross the wall of the capillary. 'Blood' and 'plasma' were incorrect. The key word in the question is 'substance', i.e. a chemical. The Examiners

accepted a long list of substances that could be carried in the plasma as well as carbon dioxide.

(c) (i) The answer to the calculation should have been written in Table 4.1, but the Examiners accepted answers written below the table. Clear writing of numerals was important.

(ii) This part was answered well by most candidates. However, many did not gain full credit because they did not use words such as 'more' or 'a lot of'. We respire all the time, so no credit is given for stating that 'oxygen is required for respiration during exercise'.

(iii) This question asked candidates to describe the changes that occur to increase and decrease blood flow. Candidates usually gained some credit for using the terms vasodilation and/or vasoconstriction in the appropriate sections of the answer. However, few mentioned that these processes occur in arterioles or small arteries and that the blood flow into capillaries is decreased as a result of vasoconstriction or is increased when vasodilation occurs. A common error was to say that the capillaries, or blood vessels themselves, move nearer to the skin surface during exercise, rather than that more blood flows nearer to the surface.

Question 5

This question was about reproduction in flowering plants and mammals – the two main topics in ***Section III*** of the syllabus.

(a) Candidates were asked to describe what happens between pollination and fertilisation in flowering plants. A number of candidates confused pollen grains with seeds. Many wrote about the pollen grain instead of the male gamete or the pollen grain gamete or nucleus. The ovule was confused with the female gamete or ovum. Some candidates wrote about events that occur after the formation of the zygote without gaining any credit.

(b) Few candidates scored highly on this question about the functions of the structures labelled in Fig. 5.1. The question was divided with the subheadings: protection, constant temperature, nutrients and excretion of metabolic waste. Most candidates responded well to the sub-headings, but often their answers lacked detailed information some of which should be general knowledge. The protection and constant body temperature aspects rarely attracted the points expected. Rarely did candidates state what dangers the fetus is protected from. Parts of the body that provide protection for the fetus were rarely given. The idea of blood flowing and delivering or removing heat was not given by most candidates. The nutrients and excretion parts frequently implied that maternal and fetal blood systems are united, with blood flowing between them instead of being separated at the placenta. Candidates should appreciate that nutrients and oxygen move across the placenta from maternal blood to fetal blood.

Question 6

This question looked at the relationship between numbers of predator and prey.

(a) Full definitions of the term *population* had to include the ideas that it refers to all the organisms of the same species living in the same area or at the same time. The idea of a population being a number of organisms was ignored.

(b) (i) The reasons for the decrease in voles as shown in Fig. 6.1 were usually identified well, although candidates sometimes did not state that there may have been 'more owls'. Climate change was not accepted because the time span is too short for that to have an effect.

(ii) The links between the changes in owl and vole populations were usually identified, although the idea of a slight delay between the change in vole numbers and that of owls was not mentioned by many candidates.

BIOLOGY

Paper 0438/04

Coursework

General Comments

A wide range of interesting experiments were submitted among the coursework samples. Many of these were well chosen, providing plenty of opportunity for candidates to demonstrate their achievements in each of the four skill areas. Some, however, were less successful. A careful choice is most important, as unsuitable tasks can greatly limit the marks that can be awarded.

The greatest problems tend to occur in C3 and in C4. For C3, it is important that the task involves the generation of quantitative data, as only then can the candidate demonstrate how well they can process these (for example, by carrying out calculations or by constructing a graph) and recognise sources of experimental error. Being able to identify which sources of error are of greatest significance is a feature of a Level 5 or 6 performance. It is important to distinguish between genuine sources of error (for example, inability to control a variable, or limitations in the measuring instruments) and human mistakes (for example, failing to start a stop clock at the right time, or misreading a scale on a thermometer). Mark schemes need to list the most important sources of error, and higher marks should only be awarded if the candidate has commented on these.

For C4, it is good practice for candidates to clearly identify the variable they will change (the independent variable), the variable they will measure (the dependent variable) and all the important variables that they will keep constant, outlining how they will do this. Doing this well is a feature of a Level 5 or 6 performance. A task that does not involve variables cannot, therefore, allow candidates to gain high marks in this task. Teachers need to devise tasks that involve investigating the effect of one variable on another.

Most teachers are aware that providing help on a worksheet with constructing results tables or drawing graphs limits the maximum mark that can be awarded. Some Centres use help sheets that can be handed out with this type of guidance, for candidates who are struggling to construct results tables or graphs on their own. This allows all candidates to complete the task, and only those who have received the help sheet are limited in the maximum mark that can be given.

Graphing skills vary widely. It is important that candidates are provided with graph paper on which to construct their graphs, and are encouraged to do this neatly, using a ruler and sharp pencil. Untidy graphs are difficult for another person to understand; communicating results and trends clearly is an important aspect of writing up an experiment. Results charts should also be clearly presented, with thought given to how easily they can be interpreted by another person.

Centres are advised to look carefully at the new Coursework Training Handbook, if they have not already done so. This can be found at teachers.cie.org.uk, on the IGCSE Biology pages, under the Teaching Resources tab.

BIOLOGY

Paper 0438/53
Practical Test

Key Comments

Candidates should be familiar with the practical procedures outlined in the syllabus.

It is always important that candidates read the questions carefully before starting to answer.

SI units should be used when appropriate for measurement.

An HB pencil should be used for drawing, labelling drawings and constructing graphs. These should occupy at least half of the printed grid.

General Comments

Questions were generally answered within the spaces provided.

Candidates attempted all questions and most showed that they had adequate time to finish the paper.

The overall performance of the majority of candidates was good.

Drawings should be arranged so the outline does not extend beyond the space available. The outline needs to be larger than the image with an accurate representation of the shape and proportion of the image. If labels are required then these must be shown to gain full marks, and the guide line should make contact with the intended structure, without a gap or an arrow head.

Graphs need to be scaled so these fit and use most of the available grid, not covering less than half for example in both dimensions. The axes should be fully labelled with appropriate units as shown in the data table. The correct choice of graph to represent the data accurately is important and in this paper candidates were required to construct a histogram.

There continues to be a lack of understanding of the difference between accuracy and reliability.

Development of planning investigations needs further practice.

Comments on specific questions

Question 1

(a) (i) The candidates were required to carry out a starch test on the pieces of starch agar jelly retained from cutting the holes in the Petri dish. This was a familiar procedure and provided the introduction to this investigation based on the activity of amylase on the starch incorporated into agar jelly. The iodine solution was dilute so the positive result was blue rather than a dark blue-black. This permitted the activity of the enzyme to continue so the disappearance of the blue colour for a positive presence of starch could be observed.

(ii) Candidates recorded the appearance of the zones around the three holes P, Q and R by drawing the zones on the outline of a Petri dish shown in Fig. 1.3; the best drawings were shaded and labelled to show a clear indication between the cleared and stained areas. It was noted that there was considerable variation in enzyme activity both within and between Centres. Many candidates indicated the appearance of a larger clear zone around P or where enzyme 1 was introduced.

(iii) The explanation was often a reiteration of the observations. Some candidate breakdown of starch within the 'clear' zone by the enzyme and continued to explain that placed into hole P was more concentrated than enzyme '2' in hole Q. Many references we to the addition of water to hole R for comparison as required for **(a)(v)**.

(iv) Many candidates identified and named the correct enzyme. There was a range of incorrect suggestions given including maltase, lipase, catalase, and protease.

(v) This question was well answered by many candidates.

(b) The use of germinating peas as a source of the enzyme to be tested to find if a similar enzyme was involved in the breakdown of starch stored in the seed, was a challenging question for candidates, even though the instructions indicated that the same method was to be followed. Some suggested that a whole geminating pea should be dropped into a hole in the agar jelly; although the enzyme would diffuse from the seed, this would take longer than if an extract had been made. The use of a controlled variable such as the same type of pea or the same temperature was mentioned by a few candidates. The idea of repetition was considered but this needed to refer to the context of why this was required not just 'repeat' alone.

(c) A pea seedling was provided by Centres that had been allowed to germinate for five days at room temperature. The drawing needed to show the whole of the seedling as an accurate, large, labelled representation on a full page of the exam paper. This permitted ample space and opportunity for candidates to demonstrate drawing skills. Although most candidates did present a well-proportioned, large drawing with a clear outline filling more than half of the available space, there are still some candidates who do not follow this instruction. Constructing the proportions of the length and width of the shoot or plumule with regard to the root radicle was not well demonstrated by many. Many drawings showed no labels. It is important that the label lines make contact with the named feature. Arrow heads or label lines are not required.

(d) (i) Based on notes of actual records of the number of peas found in 23 pods, candidates were required to complete a tally chart. Most candidates followed the instructions correctly.

(ii) This data has to be shown as a histogram. Most candidates followed this instruction spacing out the first column and then, after a gap for three data values of zero, the remaining data columns in contact. A frequency histogram should be used, not a bar chart or a line graph.

(iii) The first column with the lowest number of peas per pod should be indicated as this represents an outlier compared to the other data. This is not the most frequent value of pods with 10 seeds per pod as indicated by some candidates.

(iv) Most candidates suggested a reason for the variation of number of peas in each pod.

Question 2

(a) On part of one leg, a scale line was shown. From the measurement, most candidates ca the actual length of this part of the leg in millimetres. The error, made by a few candidates, w record the value in centimetres without correcting to millimetres.

(b) Candidates were required to link their observations to the classification of the animal and to name the group of arthropods. Some candidates named incorrect groups of animals such as insects and vertebrates. Most suggestions were correct but the spelling of Arachnid**(a)** varied. A few able candidates supported their choice by identifying two features shown in Fig. 2.1; other candidates only mentioned the number of legs but confused 'segments' with two parts of the body.

Question 3

(a) Based on Fig. 3.1 showing a photomicrograph of a TS root as viewed by a light microscope, candidates were required to identify two types of cells. Many candidates correctly identified the root hair cell but there were many mistaken cortex cells within the central vascular tissue.

(b) Knowledge of water and food tests was tested by completing the spaces in the table. Candidates were required to recall the colour changes involved to indicate either a positive or negative outcome or name the reagent to be used. Many candidates did follow the question fully but others failed to read all of the information and so confused the colours. The least well known test was for the presence of water and there was some confusion over the reagents needed for the reducing sugar and protein tests.