

BIOLOGY (US)

Paper 0438/11
Multiple Choice

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

General comments

Candidates coped well with this paper. Candidates seemed well prepared for this type of examination.

Comments on Specific Questions

Question 3

This question served to indicate that there is a sound understanding of the basic fact that chloroplasts are structures not associated with animal cells.

Question 7

It requires careful thought before deciding whether any particular structure is a tissue or an organ. This question required that careful thought, which had to be related to a structure that many candidates might not previously have considered in these terms. Those who did well on the paper as a whole displayed quite impressive knowledge and understanding in selecting the correct option.

Question 17

This question revealed a fundamental misunderstanding for some candidates. A proportion of the candidates appeared unaware that the hormone insulin is carried by the blood, as they suggested that it would leave the pancreas via the pancreatic duct.

Question 20

This question emphasised the need to be able distinguish between the two types of respiration in humans, and to always read the question carefully before answering. Many candidates either confused aerobic and anaerobic respiration or did not read the question carefully enough.

Question 32

When answering questions of this nature candidates must be taught to look at all possible impacts on the food web and then read all of the possible answers carefully. The most popular answer was that to remove carnivores from a food chain would be likely to decrease the number of top carnivores, but this option clearly indicated that this would be the *only* effect. Candidates thus did not take their reasoning one step further to realise that the number of herbivores would increase, thus decreasing also the number of producers on which they feed.

Question 36

This question highlights a common area of confusion for candidates, which points to the need for greater emphasis from teachers as to the difference between respiration and photosynthesis in plants. Many candidates believed that glucose and oxygen are products of respiration in green plants.

Question 37

This question proved to be the best answered on the paper. Candidates have clearly understood the impact of a species being introduced to a new area and the idea that there would be no naturally occurring predators.

BIOLOGY (US)

Paper 0438/13
Multiple Choice

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

General comments

Candidates coped well with this paper. Candidates seemed reasonably well prepared for this type of examination.

Comments on Specific Questions

Question 8

It requires careful thought before deciding whether any particular structure is a tissue or an organ. This question required that careful thought, which had to be related to a structure that many candidates might not previously have considered in these terms. Those who did well on the paper as a whole displayed quite impressive knowledge and understanding in selecting the correct option.

Question 11

This question emphasised the need for careful thought before answering. The question asked for a characteristic, not of an enzyme, but of a *catalyst*. Many candidates opted for the answer that they are made of protein, indicating that they had mis-read the question.

Question 13

Candidates must be taught the differences in structure between the various types of blood vessel, including presence or absence of valves. Many did not realise that the renal vein was the only vessel present with valves.

Question 17

When covering the circulatory system, teachers must ensure that a common area of misunderstanding (the identity of the blood vessels entering and leaving the heart) is emphasised. That area was tested in this question, with many candidates confusing the pulmonary artery and pulmonary vein.

Question 19

In order to prepare candidates for the IGCSE Biology examination papers, it is necessary for teachers to make use of graphical information. Candidates need to be able to interpret graphical information using their biological knowledge. Such practise would have assisted candidates with this question.

Question 29

When answering questions of this nature candidates must be taught to look at all possible impacts on the food web and then read all of the possible answers carefully. The most popular answer was that to remove carnivores from a food chain would be likely to decrease the number of top carnivores, but this option clearly indicated that this would be the *only* effect. Candidates thus did not take their reasoning one step further to realise that the number of herbivores would increase, thus decreasing also the number of producers on which they feed.

Question 33

This question highlights a common area of confusion for candidates, which points to the need for greater emphasis from teachers as to the difference between respiration and photosynthesis in plants. Many candidates believed that glucose and oxygen are products of respiration in green plants.

Question 38

This question proved to be the best answered on the paper. Candidates have clearly understood the impact of a species being introduced to a new area and the idea that there would be no naturally occurring predators.

BIOLOGY (US)

Paper 0438/21
Core Theory

Key Messages

It is vital that candidates read each question carefully and carry out the task required. The command words “state”, “explain” and “suggest” each require a different type of response. The syllabus contains a glossary of terms used in science papers and this should be referred to when preparing candidates for these assessments.

It is preferable to avoid wasting time copying out part of the question stem. This was done by many candidates this series.

Candidates should be taught and learn definitions of key terms as they are given in the syllabus. Some processes, for example, transpiration, are very difficult for candidates to explain in their own words, and marks are more accessible if the correct phraseology is known.

General Comments

The majority of candidates performed well on this paper. Only a few candidates gained very low scores and a large number performed excellently and were awarded high marks. There was no evidence that candidates had found the time allowed too short. Some answers were left blank, and this seemed to be through lack of knowledge rather than lack of time.

Some weaker candidates may perform better if they try to give, for example, three distinct points in their answer to a question carrying three marks. It would appear that weaker candidates are satisfied having given one fact, when three were required. Candidates should be taught to target the length of their response and the number of response points given to the number of marks available. There were some areas where specific improvements can be made, and these will be clarified in the relevant sections.

Comments on Specific Questions

Question 1

Most candidates used the key proficiently. A few of the weaker candidates attempted to give common names for the mammals shown, ignoring the instruction to use the key.

Question 2

- (a) (i) – (iii) Candidates could extract information accurately from the graph and the majority gained full marks. Sometimes rhinoceros was incorrectly selected instead of elephant in (iii).
- (a) (iv) The majority of candidates extracted the correct information from the graph. A large number then proceeded to carry out a subtraction using their figures and not a division as was required. Identification of the correct data from the graph carried partial credit.
- (b) The relationship between body mass and heart rate was recognised by nearly all candidates. Excellent answers stated that the relationship between body mass and heart rate was inversely proportional.
- (c) The red blood cell and its function were generally well known. Although the white blood cell was usually identified correctly, candidates tended to describe its functions using unscientific terminology. Descriptions such as “fighting germs” and “defending the body against bad cells”

were not given credit. More proficient candidates were able to refer to phagocytosis or antibody production. The plasma was the least well recognised blood component and few were able to give the role of the plasma in terms of transport.

- (d) Candidates should be taught to be able to identify on a diagram the major blood vessels. The vena cava was frequently incorrectly identified as the aorta.
- (e) Many candidates achieved full marks for this question part. Better answers were in the form of an account that was sequential, as opposed to a list of unlinked statements. A common misconception for the weaker candidates was to refer to breathing rather than respiration.

Question 3

- (a) Nearly all candidates followed the instructions and placed the three ticks required. The majority of candidates were able to identify at least two correct statements about methods of birth control.
- (b) The vast majority of candidates were able to correctly identify the condom or femidom as being effective in preventing the spread of HIV. Clear explanations for this were rare and candidates should be taught that the virus is present in the semen and other body fluids. Many answers repeated the information in the question, or explained how a condom was effective as a contraceptive.
- (c) (i) Teachers should ensure that candidates understand the common methods of contraception, as listed in the syllabus. Candidates had difficulty explaining the method and used muddled terminology. The best answers gave an explanation of any method that could be used to calculate or detect when ovulation occurred to assist in the rhythm method.
(ii) The most common correct answer was the low cost of the rhythm method low cost, with religious reasons being cited very rarely.

Question 4

- (a) Generally this question was completed well, although some candidates used terms associated with the water cycle or quoted processes at random, such as osmosis or homeostasis. Candidates had the greatest difficulty in identifying process C as feeding (or nutrition or ingestion).
- (b) A wide range of correct answers were seen. Weaker candidates gave names of minerals or even the names of organs.
- (c) More able candidates could state decomposition and name a type of decomposer. The better answers then went on to include the fact that the decomposer would respire the chemicals from the zebra's body and thus release carbon dioxide into the atmosphere. Other candidates, having stated decomposition, mistakenly described the carbon as being absorbed by plants from the soil.
- (d) Many candidates gave two good examples, the most common being deforestation and burning fuels. Some candidates appeared to confuse the topic with other environmental issues and a wide range of answers appeared, including release of CFCs, the use of greenhouses and global warming.

Question 5

- (a) This question was generally well-answered. Many matched all structures and functions correctly.
- (b) Candidates should be taught all of the roles of xylem, not just water transport. A common error was to repeat water, or to give a variation on the stem of the question and state that xylem transported water from the roots to the stem.
- (c) This section was fairly well answered, with approximately equal numbers of candidates opting for starch and sucrose. The most frequent incorrect answer was glycogen.
- (d) This is an example of a question where candidates who had learnt the definition of transpiration were at a distinct advantage. They could answer quickly and accurately and pass onto the next question. The majority spent time trying to formulate their ideas and frequently gained no credit for

their efforts as the answers given were imprecise. The evaporation of water from the surface of the mesophyll cells is a point that needs reinforcing.

Question 6

Further study of the alimentary canal would benefit the majority of candidates as performance was the lowest on this question.

- (a) The position of the pancreas and the stomach were well known, but very few candidates could identify the colon.
- (b) Most candidates thought that the sole purpose of the colon was to transfer faeces to the rectum, rather than its role in water reabsorption. More candidates gained credit for the functions of the stomach and pancreas, but it was noticeable that most expressed themselves with less precision on this question than on the rest of the paper.
- (c) (i) Candidates must be taught that bile is produced by the liver and is simply stored in the gall bladder. This point was often misunderstood.
(ii) (iii) Some answers contained the correct idea of increasing surface area. In general though, there was much confusion over the action of bile. The most frequent misconception was that bile contained an enzyme that digested fats.
- (d) The process of absorption requires more thorough study. Numerous answers described digestion throughout the alimentary canal, or gave information about assimilation. The most commonly awarded mark was for absorption being into the blood or into the villus. There were few references to diffusion, active transport or the increase in surface area.

Question 7

- (a) Candidates should be taught to interpret arrows in food webs as identifying the flow of energy, rather than “what eats what” (which was not awarded credit)
- (b) Many candidates could interpret the food web and gained full marks. Less able candidates could name a producer and secondary consumer but then gave more names and not numbers for the third and fourth answers. More thorough reading of the question in this instance would have helped these candidates.
- (c) This question part was well answered, with many candidates able to identify an organism that occupied two trophic levels within the food web.

Question 8

- (a) (i) Most candidates knew that the answer was meiosis and this was spelt in a wide variety of ways. Candidates must focus on the correct spelling of meiosis, as mis-spellings could be confused with mitosis, which carries a very different meaning.
(ii) The most able candidates used the terms haploid and diploid in their answer. To gain credit, candidates needed to give the relationship, rather than simply state the number of chromosomes in a human gamete and a body cell.
- (b) This question part was answered well with many able to use the X and Y symbols and state the genotypes correctly.
- (c) (i) This was another example where the learnt definition gave candidates access to the mark. Candidates must be taught to learn and use the definitions presented in the syllabus.
(ii) This was generally answered well and many candidates gained five marks. Sometimes gametes were written with two letters, or genotype and phenotype were muddled, but it was still possible to gain marks for other parts of the genetic diagram.
- (d) Most candidates were able to correctly deduce the genotype.

BIOLOGY (US)

Paper 0438/23
Core Theory

Key Messages

Candidates should read the questions carefully to ensure that they address the question asked.

General Comments

Most candidates were able to complete all sections.

Comments on Specific Questions

Section A

Question 1

This question was about characteristics of insects and the use of a key to identify insects.

- (a) Most candidates were able to state one feature shown in the diagram that is characteristic of insects. Frequent incorrect answers were antennae and jointed legs. These features are not specifically insect characteristics.
- (b) The key was used accurately by most candidates to identify the four insects.

Question 2

This question was about the human alimentary canal and how it functions.

- (a) The majority of candidates were able to correctly label the five regions of the alimentary canal. Those who did not either muddled the small and large intestines or confused the liver and stomach.
- (b)(i) Candidates did not know the two types of muscle used to move food along the alimentary canal and many gave no answer.
- (ii) Naming the process that moves food along the alimentary canal proved difficult for most candidates. Many did not attempt an answer. Digestion was a common incorrect response.
- (iii) Very few candidates were able to describe how the muscles move food along the alimentary canal. This required the idea of antagonistic action with muscles contracting and then relaxing.
- (c)(i) Most candidates were able to write the letter **X** on the graph to show when the tablet was in the stomach.
- (ii) Candidates found that it was not so easy to justify their placement of the letter **X**. Answers needed to include the idea that the stomach is acidic.
- (iii) Reading the highest pH from the graph was straightforward for most candidates.
- (d) For candidates who were not able to identify where most digested food is absorbed, common errors were the stomach and large intestine.

Question 3

This question was about the carbon cycle and global warming.

- (a) Completing the word equation for aerobic respiration proved difficult for many candidates. Although many made use of the correct chemicals, they were frequently not placed in the correct places. Energy was often included. Other incorrect responses included nitrogen, plants, animals, inhale, exhale and fossil fuels.
- (b) Few candidates were able to name all five processes labelled in the diagram of the carbon cycle. Some candidates left some or all of the boxes blank.
- (c) (i) Candidates found difficulty in describing and explaining two reasons for the increase in carbon dioxide in the atmosphere.
(ii) Many candidates had not read the question carefully enough and wrote about personal ways of reducing greenhouse gases, instead of suggesting a step that governments could take to try to reduce the levels.

Question 4

This question was about a woodland food chain.

- (a) (i) Many candidates were not clear that the arrows in a food chain represent the direction of energy flow. Many responses were too vague, describing feeding relationships without any consideration of energy. Others referred to energy or energy exchange without any further qualification.
(ii) Most candidates correctly related the size of the arrows to a representation of the quantity of energy. Some incorrectly suggested that the size was to do with the numbers of organisms.
- (b) Many candidates were unable to identify the amount of energy passing from the producers to the first consumers. Some incorrectly assumed that all energy from one trophic level passes to the next. Others calculated energy losses.
- (c) Nearly all candidates were able to identify the carnivores in this food chain.
- (d) Few candidates were able to account for the energy in the robins that was not passed on to the owls.

Question 5

This question was about enzymes and their action.

- (a) (i) The syllabus definition of an enzyme was not known by many candidates. Some candidates included descriptions of using enzymes to mix or break down food. Other candidates provided no response.
(ii) All possible answers were given in response to this question about the composition of enzymes. Carbohydrates was a common incorrect response.
- (b) (i) Temperature was the common correct answer with a few candidates recognising pH as another alternative.
(ii) Many responses were too vague to receive credit. Specific information about how a condition affects the activity of an enzyme was required, e.g. as temperature increases, the rate of reaction increases. Some candidates wrote about other conditions than that which they had identified in part (i).
- (c) Most candidates correctly calculated the answer. Some wrote out a correct method but then gave an incorrect answer.

- (d)(i) Few candidates were able to complete the sentences with the name of the enzyme that breaks down proteins and the name of the product of this breakdown. The suggestion that the enzyme was 'amino acids' was commonly made. All combinations of items selected from the list were seen; some candidates selected answers that were not listed.
- (ii) Few candidates recognised the significance of digestion producing smaller molecules that are soluble. Common incorrect answers included 'to make amino acids' and 'so that they can be digested'.

Question 6

This question was about inheritance.

- (a) The correct definition of pure-breeding was described by very few candidates. Common incorrect answers included breeding with the same type, breeding naturally and having a natural combination of genes.
- (b)(i) Few candidates correctly described an allele. Common incorrect answers identified an allele as a gene, a combination of genes or a chromosome, or referred vaguely to genetics.
- (ii) Many candidates correctly identified which allele was recessive and which was dominant. Some incorrectly concluded that particular types of antennae were associated with breeding faster or were connected with food. A number gave no response at all.
- (c)(i) Most candidates correctly calculated the number of beetles with short antennae. Some provided no response.
- (ii) Calculating the ratio and writing it correctly was more difficult for candidates. A variety of methods for expressing the ratio were accepted. Some candidates reversed the order of the ratio to give incorrect responses, e.g. 1:3 and 1 in 3.
- (d) This question required candidates to represent a standard heterozygous cross in a genetic diagram. Incorrect responses included using two letters for each gamete and using letters to represent the offspring phenotypes.
- (e) Candidates recognising the offspring ratio of 1:1 were able to deduce the genotype of the parent with long antennae.

Question 7

This question was based in the context of hydroponics – growing plants in a mineral solution without additional water. The questions were about what a plant needs for healthy growth.

- (a) Few candidates knew the names and functions of different plant cells and many incorrect responses and blank responses were evident. Common mistakes were to reverse the expected answers.
- (b) Many candidates were unaware of the roles of nitrate and magnesium ions in plants. Common incorrect answers included for growth (too vague), to receive sunlight and to get oxygen. Some candidates provided no response.
- (c) Few candidates recognised that the question was asking why the mineral solution needed continual replacement, rather than a description of its function.
- (d)(i) Candidates found this question difficult and many did not describe the trend shown by both sets of results.
- (ii) This question proved challenging to candidates. Few were able to link the effect of supplying air on potassium uptake, as shown in Fig. 7.2, or the effect of potassium uptake on the yield of tomatoes.
- (e) This was well answered and many candidates were able to state two factors, other than water and minerals, that plants need to grow. Some candidates restated the factors already given in the question.

Question 8

This question was about growing and breeding different varieties of potatoes.

- (a) Many candidates were able to name two features that a potato grower might want to introduce into a new variety of potato. A great variety of valid answers were seen. However, some answers needed further qualification, e.g. size is too vague since it does not imply a direction of change.
- (b)(i) Candidates answered this quite well but sometimes muddled D and B.
 - (ii) Few candidates were able to respond effectively to this question which required reference to sexual reproduction and meiosis.
- (c) Similarly, few candidates were able to provide effective answers by recognising the role of mitosis in asexual reproduction.
- (d) Most candidates selected the correct answer.

BIOLOGY (US)

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.
- Candidates should always give the specified number of responses when this is requested.
- Candidates should avoid repeating the information given in the questions.
- Candidates should be encouraged to use the correct scientific terminology. Vague terms rarely gain credit and hence words such as 'affect' and 'change' should be avoided.
- Examiners accept phonetic spelling where words are recognisable and unambiguous. Phloem in **Question 6(c)(ii)** was often misspelt, but credit can be given if there is no confusion with another term. Candidates should pay careful attention to words that can be confused, for example, glycogen and glucagon, mitosis and meiosis, antibodies and antibiotics.
- Candidates showed understanding of the differences between sexual and asexual reproduction although in **Question 5** some assumed that the nematode reproduces asexually, even though Fig. 5.2 shows the formation and fusion of gametes. In spite of studying self-pollination that leads to self-fertilisation in flowering plants, this knowledge was not always applied to an unfamiliar example.
- 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 give their answers in the form of bullet points and the information given is insufficient for credit to be awarded.
- 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 the original answer.
- 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. However, if only one short phrase that is no more than one line in length is given then it can be included immediately below the last answer line.
- Candidates should avoid writing answers initially in pencil and then overwriting in pen. Any 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 as the ink can make it difficult to read answers written on the reverse of the page.
- Candidates should attempt every question and take note of the mark allocation for each question part as a guide to how much detail is required.

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 who often responded with excellent, well written and coherent responses to the questions that required longer answers.

Most candidates attempted all the questions and almost all completed the paper within the time available. Some handwriting, however, was difficult to read.

Questions often require candidates to use the data provided to support a description of a trend or pattern from a graph or a table. In **Question 2**, candidates were expected to study a table of information about three types of milk. Many candidates did not make best use of the data available.

The definitions for the term *enzyme* in **Question 2(d)** were generally much better than those given for *respiration* in **Question 4(a)**. The definition of the latter must take into account that it encompasses both aerobic and anaerobic respiration.

Comments on specific questions

Question 1

Many candidates scored well on this question, giving good answers about eutrophication in part **(b)**.

- (a)** Most candidates were able to score highly on this question. The most common correct answer was fertilisers for phosphate, with many correctly giving factories or industry for sulfur dioxide. Very few candidates referred to natural sources of the pollutants, such as volcanoes for sulfur dioxide and background radiation for ionising radiation. A few incorrect answers gave herbicides as sources of phosphate and 'damages the ozone layer' for the effect of ionising radiation on the environment.
- (b)** Overall, candidates scored well on this question, with many giving more than five of the expected answers. Despite some weaker candidates missing the point and describing bioaccumulation or climate change, very few candidates scored no credit at all. Common errors involved confusion between bacteria that were thought to be responsible for the algal bloom and the idea that a covering of algae reduced the absorption of oxygen from the air at the surface of the lake. Some candidates described how aquatic organisms would die, but either this was not explained or it was attributed to the high concentration of carbon dioxide.
- (c)** Most candidates identified one or two of the expected answers. Many candidates lost credit because their answers were too vague. For example, some stated that 'less fuel' could be used and 'less sulfur dioxide' should be produced. They also suggested impractical solutions, such as 'close down factories' and 'don't use cars', or referred to incorrect biological solutions, such as 'plant more trees' or 'use less pesticides or fertilisers' or 'produce less methane'. The last answer illustrates the problems that candidates can have with correctly linking the pollutant, its source and its environmental effects.

Question 2

This question covered several topics from **Sections II** and **III** of the syllabus. Some candidates forgot that the question was centred on cattle and wrote about humans, particularly in part **(b)**.

- (a)** There were many excellent answers to this question. Many candidates were awarded full credit for giving a well annotated genetic diagram, usually incorporating a Punnett square. Less successful answers omitted to identify that males are XY and females are XX, or stated that males are XX and females are XY. Some stated that males were YY and females XY and others used different letters and then confused sex determination with monohybrid crosses using terms such as *dominant* and *recessive* in their answers. Although implied by the Punnett square or criss-cross lines in the diagram, very few candidates stated in words that fusion of gametes is a random process. Candidates should note that genetic diagrams are much clearer and easy to follow if they include a Punnett square. However, Punnett squares should be prefaced by the phenotype and genotype of the organisms being crossed and followed by a list of the genotypes and phenotypes expected to show how a ratio is derived.
- (b)** A significant number of candidates misread or did not appreciate that the question was referring to AI in cattle and subsequently went on to describe AI in humans or IVF in humans or cattle. Candidates who gained some credit in this question by identifying that the sperm should be placed in the oviduct or uterus, rather than the vagina or cervix, often did not explain that AI should happen at around the time of ovulation. The more able candidates appreciated and could explain the need to isolate the sperm carrying the X chromosome.
- (c)** A significant number of candidates simply quoted a list of nutrients using general terms such as 'more or less than' or gave a list of figures for each nutrient. When figures were quoted, they were usually correct. A few candidates omitted or made errors with units.

Candidates who explained clearly the advantages of formula milk over cow's milk produced good answers for iron and vitamin D. They either gave their roles in the body or stated that they prevent anaemia and rickets respectively. Fewer candidates were confident in their description of vitamin A which was often mentioned, sometimes as part of a list but less well described, with few candidates describing its role in the immune system. A small number of candidates commented on the idea that formula milk was closer in composition to human milk than cow's milk, or identified nutrients

that were similar in composition. Relatively few remarked on the problems that infants might encounter with attempting to digest a high protein feed.

- (d) Almost all candidates gave clear, confident definitions and many were awarded full credit for giving one carefully constructed sentence which included the term *biological catalyst*. Enzymes as proteins and their role in a reaction were also well known by the majority of candidates. Some very well prepared candidates made references to the active site of an enzyme and to the role of enzymes in lowering activation energy.
- (e) A significant number of candidates clearly and logically explained the results, appreciating that test-tubes and Petri dishes 1 and 3 related to the effect of pH on lysozyme, test-tubes and Petri dishes 1 and 4 to the specificity of lysozyme, and test-tubes and Petri dishes 1 and 2 to the effect of temperature on the activity of lysozyme. Furthermore, they linked their explanations to the effect on the growth of bacteria in each test-tube. Candidates who attempted to explain the results in terms of the bacteria rather than the lysozyme gained some credit. For example, some gave answers such as 'bacteria prefer an acid pH to grow'.

Of the three sections the most problematic appeared to be the explanation of enzyme specificity. The term *denatured* was well known and used correctly in the first and third parts of the question. There were frequent descriptions of results rather than explanations, and a number of candidates only gained credit for a description of 'no growth of bacteria in test-tube 1' as they showed no understanding of the investigation. Very few candidates recognised the significance of test-tube 2 as a control to show that lysozyme is responsible for the lack of growth in test-tube 1.

- (f) Many candidates identified the general idea that antibodies gave protection from pathogens or from disease. There were relatively few clear explanations of passive immunity or detailed knowledge of the functions of antibodies. Little reference was made to the diseases, either generally or by name, suffered by the mother and the subsequent benefit of her antibodies to the child. There was an element of confusion of the function of antibodies in relation to phagocytosis, where antibodies were often stated to 'engulf bacteria'.

Question 3

- (a) (i) Many candidates stated here that glucose concentration in the blood increases because a meal had been eaten or absorbed recently. They often stated that it would be a meal high in sugar or in carbohydrate. Other expected answers, such as references to adrenaline, glucagon, dehydration or loss of water were also seen. As the breakdown of glycogen was included in Fig. 3.1, this was not enough to be awarded any credit.
- (ii) Again, reference to storage of glycogen was not sufficient. Candidates who stated that the person would be hungry or were fasting or suffering from starvation gained credit. Writing about not eating sugar, starch or carbohydrate for a while was not credited as this suggests that other foods were still being eaten with no effect on the glucose levels.
- (iii) A frequent incorrect answer was the pancreas. Others included adipose tissue, the gall bladder, stomach and 'under the skin'.
- (b) A frequent error was a statement that the brain, or part of it such as the hypothalamus, monitors the concentration, rather than the pancreas. Another was that insulin directly carries out the conversion of glucose to glycogen. Very few candidates mentioned the role of enzymes in that conversion or the ideas of homeostasis or negative feedback. Good answers included these concepts and some even referred to beta cells in the islets of Langerhans, which was more detail than expected at this level. Some candidates unnecessarily explained how a decrease in blood glucose concentration is controlled.
- (c) This part was generally answered well. Credit was lost for stating that the water flow was reversed into the red blood cells with consequent bursting. Confusion arose between the concentration of solute, water concentration and water potential. Concentration is fine for solute diffusion, but osmosis should be described in terms of water potential not 'water concentration'. Some candidates contradicted themselves because they included plasmolysis in an otherwise correct description of red blood cell shrinkage.

Question 4

Definitions of respiration in part (a) rarely showed any understanding of the two types of respiration. Very few reflected the definition given in the syllabus. Answers to questions on respiration and exercise varied, although few explained that at the beginning of exercise there is an increase in muscle contraction leading to an increase in the release of energy from respiration.

- (a) Many candidates did not give the expected definition of *respiration* giving instead many vague or inaccurate answers. No credit was awarded for giving an equation as that was not required by the question. Many answers included the idea that energy is 'produced' during respiration; this idea was not credited. Most candidates correctly included 'release of energy', but often failed to link this to respiration as a series of reactions, or even as 'a reaction' that takes place inside cells. Although many referred to the breakdown of a named nutrient this was not enough to gain them full credit. Some candidates confused respiration with gas exchange.
- (b) Many candidates scored most of the available credit for correctly stating that the biceps contracts and the triceps relaxes. Many interesting spellings of the muscle names were seen, but credit was given so long as they were recognisable. It was rare to find references to the biceps pulling on a tendon that is connected to the radius. More able candidates gained credit for correct references to flexion. Many wrote about the hand 'bending' closer to the chest as a result of contraction of the biceps, which is not the action of this muscle.
- (c) (i) Few candidates gave answers thorough enough to gain full credit. The link between increased muscle contraction and the need for more oxygen was not always logically explained. Although some did mention aerobic respiration, most answers just stated that energy and respiration 'had to carry on'. A significant minority of candidates inappropriately discussed anaerobic respiration in this question, often in more detail than they subsequently described in (c)(iii). There were many candidates who indicated that oxygen and energy were needed for exercise, but no indication that more of this was needed than would otherwise be the case, and hence little or no credit could be awarded.
- (ii) This should have been quite straightforward but was often poorly answered. Many candidates extended the line on Fig. 4.3 before decreasing it. This question was omitted by a significant minority of candidates, perhaps because they did not read carefully enough and so did not realise that they needed to complete the graph.
- (iii) A large number of candidates gained full credit. Some very good, detailed answers were seen. However, many candidates did not realise that this question was about oxygen debt and the breakdown of lactic acid, and instead wrote vague answers about it taking time for the breathing rate and/or the heart rate to slow down. Some candidates made incorrect references to 'anaerobic breathing'. Some candidates provided a description of anaerobic respiration and lactic acid production in part (c)(i), but then gave only a brief response here.

Question 5

Many candidates struggled with this question. The unfamiliarity of a question based around nematodes, combined with the fact that several different syllabus sections were tested in the same question, increased the difficulty for all but the most able candidates.

- (a) (i) Most candidates were able to find the genus of the nematode from the information given, and most took great care to copy this exactly. Frequent incorrect answers were 'elegans' and the full binomial. 'Annelid' was a common incorrect answer.
- (ii) There were many good answers to this question and the majority of candidates were able to give at least one correct structural feature. Candidates should take care, when they are asked for two answers and given two spaces, to write no more than one answer in each space. Common incorrect responses included 'segmented' and 'slimy'. In general, absence of a feature, such as absence of legs, is not a good choice when stating structural features. Most candidates gained credit for 'unsegmented', expressed in a variety of ways.

- (b) This was a relatively low-scoring question. Nevertheless, many answers gained some credit for the idea that nematodes prevent the accumulation of waste material. Others correctly stated the idea that they help to recycle nutrients, although very often attempts at detailed descriptions of the recycling of specific nutrients were incorrect. An example is carbon dioxide, which would have been an obvious choice given the ideas in **Question 4**. Credit was available for stating that nematodes release carbon as carbon dioxide which is then available for photosynthesis. A few gave relevant answers referring to energy flow, but references to 'energy cycling' were not accepted. Most candidates, however, made only one correct point, reiterating one idea rather than moving on to something new. Very few candidates gained full credit for this question.
- (c) Some excellent answers were seen, but only the very best were able to gain credit for all three sections. Few applied their knowledge of self-fertilisation in flowering plants from **Section III** of the syllabus to the information provided in Fig. 5.2.
- (i) The majority of candidates incorrectly stated that *Caenorhabditis elegans* reproduces asexually apparently forgetting that reproduction involving gametes and fertilisation is sexual, even if there is only one parent. However, many did state that the reproduction of *C. elegans* involves male and female gametes from the same individual, and that this would mean that all of the genes (or alleles or DNA) in the offspring came from a single parent. A few pointed out that meiosis, used in the production of the gametes, would produce a small amount of variation between these gametes, and some also mentioned that mutation could produce variation. Several candidates suggested that, as nematodes have so few features anyway, there is not much scope for variation, but this was not credited. Another incorrect answer was that the small number of chromosomes of *C. elegans* would mean that there were not enough different genes to provide any variation. There are in fact over 20 000 different genes that code for proteins.
- (ii) The majority of candidates used the information to calculate the haploid number as 6. Many, however, doubled 12 to obtain an incorrect answer of 24, and numerous answers gave 23, presumably remembering the haploid number of humans.
- (iii) There were some excellent answers to this question, but these were in the minority. For the first section, good answers clearly stated that at **P** gametes are being formed and that this involves halving the chromosome number to produce haploid cells. Some went on to explain why this was necessary in terms of maintaining the correct diploid number in the zygote. However, although many answers used at least one of the correct terms, these were often not in a sentence that made any sense. In particular, it was often not clear that the process involved the *formation* of gametes and many candidates implied that the gametes were dividing by meiosis, rather than being formed by it. Many stated that 'meiosis occurs in fertilisation'. Some simply quoted the definition of meiosis that they had learnt, without attempting to apply it to this specific context. In general, this part of the syllabus appeared to be poorly understood by most candidates. For **P**, common incorrect responses were 'meiosis is due to fertilisation'; 'it is fusion of egg and sperm to produce a zygote'.
- The second section, about mitosis, was answered a little better than the meiosis section. Many candidates stated that growth was now taking place, and that two identical copies of the cell were required each time mitosis occurred. Some also stated that this division involved a diploid cell dividing to form more diploid cells. Again, there were numerous answers that simply quoted the definition of mitosis, without relating it to the context as required. For **Q**, common incorrect responses were 'asexual reproduction', 'cell division' and 'the zygote can now perform cell division on its own'. Candidates tended to write about mitosis producing 'duplicate cells', rather than producing *identical* cells. A better response would have been to say that the cells are *genetically identical*.
- (d) This was generally answered entirely correctly, with most candidates able to state that DNA is found in the chromosomes in the nucleus. Not all candidates appeared to notice the mark allocation and gave only one answer, which was usually the nucleus.

Question 6

This question was straightforward for many candidates. Credit was often lost because answers included contradictory material, such as stating that transport of sugars occurs in the 'xylem and phloem'.

- (a) Most gave the correct answer given to three decimal places, although the Examiners accepted answers that were rounded up to whole numbers or to one or two decimal places. The most common error was to omit the units.
- (b) Very few candidates gained full credit for this question. Many called the bacteria 'nitrifying' and the body of the answer was related to nitrates and/or nitrites. Others stated that the bacteria protect the plant from infection by pathogens, such as fungi and bacteria. Even if the correct role was given for these bacteria and nitrogen gas was included, the product was rarely correct. Only a very few stated that the ammonia or ammonium ions produced are converted to amino acids.
- (c) (i) Most candidates gained full credit here for stating that carbohydrate is produced by photosynthesis from carbon dioxide and water or using light as a source of energy.
(ii) Many gained full credit for referring to the transport or translocation of sucrose in the phloem from the leaves. Some referred incorrectly to the xylem as the transport tissue and others to 'xylem and phloem' which did not gain credit. The spelling of phloem was generally good, although misspellings such as the most common, 'pholem', were credited. Candidates who stated that sucrose diffuses into the nodule generally did so in addition to the other expected points.
- (d) Many scored full credit for a statement about active transport. Again those who gave further detail by referring to carrier proteins had already given the other expected answers. The most common errors were to describe adaptations of root hairs and to explain the uptake in terms of diffusion, or even osmosis, rather than active transport.

BIOLOGY (US)

Paper 0438/33
Extended Theory

Key Messages

- Candidates need to read questions carefully and follow all the instructions given to them. Answers should also be read and checked to avoid careless errors. Examples include not including units in a numerical answer or a data quote.
- Candidates should give only the specific number of responses requested in a list. This includes questions where only one response is requested.
- Candidates need to be encouraged to use the correct scientific terminology. Vague terms rarely gain credit and hence words such as 'affect' and 'change' should be avoided. Although phonetic spelling is generally accepted where it is unambiguous, careful attention should be paid to words that could be confused, for example mitosis and meiosis.
- Candidates need to be able to explain biological principles correctly. The use of scientific terminology in the wrong context will not gain credit. On occasion, a limited command of English impedes the ability of a candidate to explain concepts adequately, but most often candidates do not pay enough attention to their expression of the biological principle. For example in **Question 3(e)** many candidates wrote that energy is produced, rather than energy is *released*.
- Candidates should be encouraged to write in continuous prose for longer answers. Lists and phrases that show no demonstration to link the ideas to the appropriate scientific concept will not gain credit.
- Answers that are continued in blank spaces or on additional paper must be clearly numbered. Additionally, candidates need to make reference to the continued answer in the answer space provided for that question. However, if only one short phrase (no more than a line) is required to complete an answer, this can be included immediately below the last answer line.
- Candidates should avoid writing initial answers in pencil and then overwriting in pen. Any pencil markings that were missed during this process are unlikely to be sufficiently clear to gain credit and may obscure the inked answer. Candidates should also not use thick felt tip pens. The ink run through can affect the clarity of the answer overleaf. Incorrect answers must be clearly crossed out and the correct answer should be written alongside or just above the first answer.
- Candidates should attempt every question and appreciate that the number of marks available for a part is also the minimum number of points that should be written.

General comments

Particularly challenging on this paper were the structure and function of the kidney in **Question 5** and natural selection in **Question 4(d)**.

Those candidates who did not read the instructions before planning their answers tended to lose credit through misinterpretation. Some candidates found it difficult to interpret the information provided and use it to construct their answers. However, well-prepared candidates with a detailed knowledge of the topics were able to convey their understanding.

Comments on specific questions

Question 1

- (a) Many weaker candidates seemed unfamiliar with the difference between 'genes' and 'alleles', describing the organisms as having *similar* genes, whereas what is key to the DNA of a species is that it will contain the *same* genes, although possibly similar alleles. References to 'similar genetic information' were too vague.

- (b)(i) Mitosis and spore production were the most commonly credited points for this question on fungal reproduction. Although this topic forms part of the Core syllabus, very few candidates were sufficiently well-prepared to elaborate on the sequence of events such as the formation of vertical hyphae, the production of spores within a sporangium and spore dispersal. There were also incorrect references to pollen grains and to seeds.
- (ii) The most commonly seen correct answers to this question on the advantages of asexual reproduction included the fact that it is a fast method of reproduction as only one individual is involved so that there is no search for a partner and no production of gametes. Those candidates who did not restrict their thinking only to reproduction of fungi, where spores are often widely dispersed, extended their answers to include some of the more commonly stated advantages of asexual reproduction.

Question 2

- (a) A wide variety of gases that can cause acid rain were suggested. Carbon dioxide was the most popular correct answer followed by various oxides of nitrogen including nitrogen oxide. Methane was a common incorrect response with some weaker candidates apparently overlooking the word 'other' in the question and restating 'sulfur dioxide' given in the prompt material.
- (b) Most candidates obtained credit for mentioning damage to plants, but some seemed unaware that animal casualties due to acid rain live in water. General references to animals were too vague to gain credit.
- (c) Commonly seen ideas for reducing atmospheric sulfur dioxide pollution included a wide range of alternative or renewable sources of energy, such as biomass, wind and geothermal energy as well as the latest gas-to-liquid fuel technology which produces very pure petrol or diesel. Some suggestions for reducing atmospheric sulfur dioxide pollution were too extreme and impractical, for example, 'closing factories' and 'stop burning fossil fuels'. 'Filtering' in a variety of contexts also did not gain credit.
- (d)(i) Many candidates find questions that require data analysis challenging. This question involved careful study of the data in Fig. 2.1 which showed the changes in atmospheric sulfur dioxide concentrations measured in μgm^{-3} and the percentage content of sulfur in plant tissues. Candidates sometimes confused the two scales on the graph or omitted units from their data quotes so did not gain full credit for taking information from the graph. Readings for changes in the concentration of sulfur dioxide in the atmosphere should have been taken from the left hand y-axis and readings for the changes in sulfur content of plant tissues from the right hand y-axis. Often the less able candidates did not do this. Stronger candidates referred to the significant changes that occurred in 1997 reference to this particular year. More confident candidates were able to identify the most obvious points, while weaker candidates referred instead to less significant points from the graph and often did not make clear what they were describing.
- (ii) This question asked candidates to explain why the data for sulfur content was calculated as a percentage of the dry mass of the plant tissue. Only the well-prepared candidates knew that the water content of plant tissues constantly changes with variations in water uptake and water loss by transpiration. Some candidates stated that calculating the content as a percentage means that valid, or easy, comparisons can be made between samples. However, many seemed unfamiliar with this scientific concept.

Question 3

- (a) Candidates were expected to make clear the two aspects of the sensitivity definition given in the syllabus. Both aspects, the detection of a change in the environment and the response or reaction to a stimulus or stimuli that happens as a result were seen.
- (b) Most candidates gained credit for stating that a voluntary response involves thought, decision-making, choice or self-control. Many then added that involuntary responses do not involve these actions. Only partial credit could be awarded unless another aspect was given. Some candidates referred to the speed of one or other or both types of response and reflexes, occasionally with examples, were often mentioned as examples of involuntary responses. Many candidates did not give two *different* aspects in order to gain full credit. Many candidates stated that voluntary responses are 'controlled' while involuntary responses are not. This is not correct as both responses are under the control of the nervous system. Candidates who give this sort of answer need to be more precise.
- (c) Most candidates named the sensory neurone as the type of neurone responsible for transmitting impulses from a receptor. The alternative term afferent neurone was also seen. Motor neurone was a common incorrect answer.
- (d) Candidates often interpreted the information about two swimming teams in Table 3.1 correctly and gained credit for stating that the first swimmer in each team responds the slowest. Some candidates compared the first swimmers in each team which was not asked by the question; some went further to compare swimmer 2 in team A with swimmer 2 in team B and so on. Weaker candidates were not always able to select suitable data quotes; they often gave the times from the table but without the units. They rarely looked at the times for swimmers 2, 3 and 4 and stated that they were all very similar, or calculated a mean. Candidates can always carry out calculations to illustrate answers to questions like this one. It was rare to find a candidate mention that swimmer 3 of team 2 has a very different response time compared to the others.
- (e) Most candidates were able to give an effect or two of adrenaline on the human body; many candidates stated that the effect of this hormone would be to improve performance or speed. A common error was to state that energy is produced rather than released in the context of respiration.

Question 4

Candidates found the explanation of why flowering time in this species is an example of continuous variation in part (c)(ii) most challenging.

- (a) (i) Most candidates were able to state that the products of meiosis are pollen grains. A common error was to name them as 'gametes' without qualifying *male* gametes, suggesting that these candidates had not read the question carefully.
- (ii) Many candidates were able to give two features of meiosis in the context of sexual reproduction. The most common correct answers were to refer to the halving of chromosome number and generating variation. It was less common to see candidates elaborate further by explaining that meiosis ensures that the chromosome number remains constant from one generation to the next. Meiosis was frequently confused with mitosis in the answers and references to the number of chromosomes in humans (23 and 46) were given even though the question was not specifically about humans.
- (b) (i) Only candidates who gave two aspects of this definition of cross-pollination were able to gain full credit. Candidates had to state that pollen grains are transferred from anther to stigma and that they are transferred between flowers on different plants of the same species. A common omission was to state that pollen is transferred to different flowers without making it clear that the flowers must be on different plants. A common misconception was that cross-pollination involves the pollen going to plants of a different species.
- (ii) The most common correct answer to this question was the presence of large petals. Reference to the guidelines or patterns on the petals was seen less often. Because the question stated that the feature had to be visible in the photograph which was printed in black and white, references to colour were not accepted.

- (c) (i) Candidates were generally successful in suggesting an environmental reason why lilies that grow at lower altitude flower earlier than those that grow at higher altitude in the Himalayas. This attracted a wide range of acceptable answers, such as temperature, light and pressure.
- (ii) This question was rarely answered correctly, although continuous variation and discontinuous variation are key concepts in understanding genetics. Candidates found it difficult to apply what they knew about continuous variation, perhaps from investigating and displaying human heights, to times when plants flower. However, candidates did gain credit by just explaining the nature of continuous variation.
- (d) Natural selection is a topic that many weaker candidates find challenging and although some were able to state learnt phrases such as the presence of variation and mutations, only the more able candidates gave a full explanation in context. Only the most able candidates used clues from earlier in the question and suggested that this might happen if there is no exchange of pollen between plants at high and low altitude.

Question 5

- (a) Many candidates were able to identify the parts of the kidney although it was common to see at least one error. The most common correct answer was the ureter (G). The cortex (E) and medulla (F) were commonly mismatched. Another common error was to misspell ureter such that it was ambiguous with urethra. Phonetic spelling is only accepted where it is unambiguous.
- (b) Although many candidates knew that filtration under pressure is the key principle only the well-prepared candidates were able to explain this in more detail. Some candidates confused the functions of the renal capsule with reabsorption that occurs along the renal tubules.
- (c) There were some very good answers to this question on active transport. Candidates who were successful here referred to movement across the cell membrane against a concentration gradient. They often explained that this movement requires energy. Some stated that a protein carrier in the membrane is responsible for the movement. A common error was to state that substances flowed along or with a concentration gradient rather than against one.
- (d) The only substances that are reabsorbed into the blood from the fluid in the renal tubule are water and salts. Alternatives to salts that were accepted are ions and minerals. Candidates who named suitable ions, such as sodium, also gained credit. Reference to proteins, glucose and fats were not credited.
- (e) (i) The diagram of a dialysis machine in Fig. 5.1 was familiar to candidates and should have given them some help in answering these two part questions. Many candidates found completing Table 5.1 quite a challenge, although there were a number of correct combinations for each row of the table. A common error was to use the word 'normal' as one of the answers when it was not in the list of words given. This was an opportunity for candidates to work out the contents of the fresh and used dialysis fluid, in comparison with the blood before dialysis, based on what dialysis is to achieve.
- (ii) The operation of the dialysis machine was frequently confused with the function of the renal capsule, for example, some candidates wrote about the application of pressure to the blood. Apart from that needed to pump the blood into the machine no extra pressure is applied to ensure filtration. More able candidates described the differences in concentrations between blood and fresh filtrate. Full credit was gained for explaining how urea is removed from the blood by diffusion through the partially permeable membranes that separate blood from dialysis fluid. The continuous flow of blood past fresh filtrate which has no urea in it means that there is always a concentration gradient and so the urea concentration of the blood can fall to near zero at the end of the dialysis session. Many candidates wrongly wrote of various solutes moving across the membrane by osmosis.
- (f) The advantages of having a kidney transplant were well known. Most candidates described the freedom from regular dialysis sessions and the fact that recipients of kidney transplants no longer need to adhere to a restricted diet.

- (g) The reason for tissue typing was often given as avoiding rejection. Candidates also stated the role of the immune system in rejection. References to the immune system, antibodies or white blood cells were usually given in the correct context and gained credit.

Question 6

- (a) Many candidates identified **P** correctly as the atmosphere and gave carbon dioxide as the carbon compound. Fewer candidates identified parts **Q**, **R** and **S** correctly and even fewer gave correct carbon compounds. Most thought that the named compounds had to be gases and so often gave carbon dioxide for each part. **R** and **S** were the least well answered and were often left blank.
- (b) After working out that **P** was the air and **Q** was a plant, candidates needed to write a straightforward account of photosynthesis. A balanced equation as part of the answer would have gained partial credit. Full credit was available to those who described the absorption of carbon dioxide into the leaf, absorption of light and stated that reactions convert carbon dioxide and water into glucose with the production of oxygen. There were some good attempts at this question, although most omitted any reference to the absorption of carbon dioxide through stomata and its diffusion through the leaf.
- (c) The Examiners looked for one of the factors that affect photosynthesis: light intensity, light duration, carbon dioxide concentration or temperature. Credit was awarded for naming a suitable factor, stating its effect on the rate of photosynthesis and for giving an explanation of that effect. Candidates who used the term *limiting factor* in their answer also gained credit.
- (d) A wide variety of correct answers were seen. Factors could be any of those listed above in (c) but could also be providing water or nutrients, controlling humidity, providing insect pollinators and preventing pests and disease. Control devices, such as thermostats, were not credited unless they were linked to a device that could actually increase the rate of photosynthesis. An example would be a thermostat linked to heaters or ventilators.

BIOLOGY (US)

Paper 0438/04
Coursework

Key Messages

Work that is assessed for Paper 4 must be the candidates' own, unaided work, and must be certified to be so.

Work samples must be clearly marked by the assessors, and should clearly show the mark awarded for each skill, and any changes to that mark made by internal moderation.

The external Moderators need to see every worksheet that was used for assessment, presented along with their mark schemes.

Teachers should use the Coursework Training Handbook (Part 1): Guidance for advice on all aspects of the setting, marking and submission of coursework.

General Comments

This is the third year in which Centres have submitted coursework samples for external moderation. While many Centres are now assessing coursework very well, and submitting samples with all documentation complete, others still not doing what is required.

All Centres should have copies of the Coursework Training Handbook (Part 1): Guidance, available for all teachers to use. This document can be found on the Teacher Support Site, on the BES Biology pages, under the Teaching Materials tab. It should be a constant point of reference for teachers throughout the assessment process. Before submission of the coursework sample, the Cambridge Administrative Guide should be consulted by the person with responsibility for this submission.

It is absolutely essential that the work that is assessed is each candidate's own, original, unaided work. It is not acceptable for any feedback to be given so that a candidate can redraft their work, or for candidates to work together on anything that is to be assessed. Centres should include Cambridge Coursework Authenticity forms to certify that this is the case. Work that has been redrafted after feedback, or that has been produced in collaboration with other candidates, cannot be used.

Moderators like to see the work samples with full comments written on them by the teacher. There are examples of how this is done in the Coursework Training Handbook. Candidates can see these comments, but they should not then redraft the work. These comments will of course help them to improve when they are assessed on a different task later on. Such comments are also most helpful to the external Moderators, as they can see how and why the mark has been given.

It is fine for candidates to have access to the generic criteria, as they are written in the syllabus, but they should not be given the task-specific mark schemes that have been constructed. The Moderators were concerned that some Centres appeared to be allowing candidates to see their task-specific mark schemes as they carried out their assessment tasks. This is unacceptable.

For C1, the Moderators need to see evidence of how marks have been awarded. As this is ephemeral, there will be no written work from the candidates to be submitted. Centres should look in the Handbook for an example of how this evidence can be supplied.

Some Centres have large numbers of candidates, in several different teaching groups. It is acceptable in theory for different teaching groups to use different assessments. However, in practice, this is causing serious problems in some Centres, where many different tasks are being used, and it is very difficult to achieve comparability across the whole entry from the Centre. It is also often difficult for the external

Moderator to find clear evidence of which group a candidate was in and on which tasks they have been assessed. It is strongly recommended that large Centres choose a relatively small set of tasks that are used by *all* groups.

Internal moderation is essential in such circumstances. Successful internal moderation happens early – it should begin before the tasks are undertaken, by ensuring that each task and mark scheme are of appropriate standard. Using the same tasks and mark schemes for all candidates makes this relatively easy. Where internal moderation involves the remarking of candidates' work, Centres must ensure that the internally moderated mark is clearly shown on the work itself. The Handbook contains a summary of what should appear on the work samples.

Some Centres are assessing a little too generously, and a few are seriously over-marking the work. The Handbook includes some examples of work that genuinely achieves marks of 5 or 6. It can be difficult for teachers to appreciate this standard if they are not seeing work of this quality from their own candidates, so reference to this Handbook is essential. Overall, graphing skills are often very poor, and this is an area that could be greatly improved in many Centres. Candidates should always draw graphs on graphing paper, never on blank or lined paper. Ideally, use the type of graph grid that is used in Cambridge examinations, as this allows careful and accurate plotting. Candidates should not use colour for their graphs. They should always use rulers (also for constructing tables for C2). Carefully drawn results charts and graphs are an essential part of accurate and thorough presentation of results.