Questions matter

A-level
Biology

7402/1 Paper 1

Report on the Examination

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General comments

This was an accessible paper. The mean of the mark distribution was significantly higher than the mean achieved in 2023; the standard deviations were similar. Most students scored at least one mark in each of the 10 questions set in this paper. They demonstrated some relevant knowledge and understanding in all areas of the specification covered in the paper.

Students made good use of the subheadings provided in many questions, aiding how they structured their answers. Except for the answer to Question 09.3, in which students tended to give long descriptions of trends shown in the data, there was noticeably less use of additional pages compared with last year.

01.1

Most students correctly named ‘ester’ as the bond in a triglyceride molecule and almost all knew the bond was formed by a condensation reaction. ‘Glycosidic’ was a common error for the name of the type of bond.

Identifying the group in glycerol and in fatty acid molecules used in ester bond formation was the most discriminating part of the question. Many incorrectly identified ‘H’ from a ‘C–H’ group of glycerol and joined it with ‘OH’ of the carboxylic acid in the fatty acid. Others circled an ‘OH’ group in both molecules and so failed to show that water is removed from the molecules in the condensation reaction.

01.2

Nearly all students correctly identified stearic acid as the saturated fatty acid.

01.3

Many students demonstrated good knowledge by correctly identifying saturated and unsaturated fatty acids in the table, and made a successful link to the information about melting points. Examiners noted many good examples of answers in which the relationship was described with clarity, often going further to suggest why fatty acid structure affected the melting point.

Correct answers referred to carbon double bonds. Some, otherwise good, answers described changes in the number of hydrogens but failed to achieve the mark by referring to hydrogen *molecules* in a fatty acid’s structure rather than to atoms or to hydrogen. Some students had also clearly not read the question carefully and referred to boiling points instead of melting points.

01.4

A good level of knowledge about the process of phagocytosis was demonstrated in many answers. Students’ ability to link relevant aspects of their knowledge to the context of this question, however, was more limited. Some students assumed that the fatty acids in the broth were antigens and that the phagocytes mounted an immune response to these fatty acids.

Answers frequently mentioned that there was increased fluidity of cell(-surface) membranes without going further to say that the membranes contained more unsaturated fatty acids. Instead, students tended to repeat information from the question, to confirm that the cells contained more unsaturated

fatty acid. Examiners looked to award MP2 for a clear reference to the cell(-surface) membrane, so answers that referred only to the 'bilayer' did not achieve this mark.
Comments made about the engulfing step in phagocytosis often gave recall of what happens to phagosomes and lysosomes in phagocytosis without developing ideas on how increased membrane fluidity would make engulfing easier.

02.1

This question proved to be a challenge to many. Answers tended to lack detail; only about a fifth of students achieved all three marks.

Students demonstrated sound knowledge of the basic definitions both for facilitated diffusion and for active transport, but often without enough detail to achieve marks. For active transport, the idea of carrier proteins was often omitted or there was an incorrect reference to the involvement of channel proteins. 'Transport proteins' or simply 'proteins' was offered by some, rather than channel or carrier proteins, in the facilitated diffusion definition.

Descriptions of molecules moving down or up a concentration gradient were generally accurate. Relatively few described incorrect movements such as going 'along' or 'with' a gradient, or from a low concentration gradient to a high concentration gradient. Many also incorrectly referred to facilitated diffusion as an active process or one that required ATP.

A failure to identify that charged molecules moved in these transport processes was observed in many answers.

02.2

The structure of microvilli is not well known.

Few gave a valid description of microvilli as folds of cell membranes. Often, answers made a vague reference to folds on the surface of villi. Many confused microvilli with villi, describing structures of multiple cells sitting on the ileum lining. In addition, descriptions which gave microvilli as 'membrane structures inside cells' were common and many students gave 'increased surface area' as a structural feature. In addition, some located microvilli in lung tissue or described cilia.

02.3

There is a common misconception that emulsification occurs to form micelles, and that emulsification involves hydrolysis reactions rather than 'micelles are formed by association with bile salts'. In fact, the process of emulsification was not relevant to the required answer, but students often described it.

Many students ignored the requirement to describe how vitamin A, as an intact molecule, was absorbed into cells. They gave descriptions of lipid digestion and, for example, had monoglycerides mixed with bile salts and fatty acids diffusing over cell membranes. Although these answers missed the point of the question, examiners credited explanations that included references to digested lipids/vitamin A up to a maximum of two marks, for achieving any two of the available marking points.

Many answers continued after the vitamin was absorbed into cells, sometimes with lengthy descriptions of processing inside the Golgi apparatus and the production of chylomicrons.

Other common misconceptions included micelle movement to the cells lining the ileum by diffusion, and micelles, as a unit, 'diffused across' cell membranes. Quite a few answers included co-transport, with sodium ions using protein pumps rather than simple diffusion.

03.1

Knowledge of the mechanism used to breathe in was good. Many answers correctly referred to changes in the volume and pressure of the thoracic cavity, but relatively few gave enough detail to describe how the changes occurred. Many successfully identified the involvement of external intercostal muscles, but relatively few linked this action to movement of the ribcage. Examiners were lenient when answers made a correct reference to external intercostal muscle action and to rib cage movement when these ideas were not closely linked in continuous prose. These quite vague answers still achieved a mark if rib-cage movement was not wrongly linked to action by the diaphragm.

Examiners noted quite a few examples of students missing a mark by referring to non-specification, generic terms such as the 'chest' or 'chest cavity' rather than to 'thoracic cavity'. In addition, some answers correctly mentioned the action of external intercostal muscles and the diaphragm, but often only linked these ideas to 'pulling the diaphragm down' and so missed MP2.

Some answers considered only the route taken by air when inhaling, quoting trachea, bronchus, bronchiole and alveoli. These answers achieved no marks.

03.2

This question discriminated well.

Many students demonstrated they had good knowledge of using optical microscopes, referring to light 'passing through' a specimen to observe structures. Few went further, to address the importance of using a thin slice of tissue. Students often repeated what the question described, eg 'light would pass through the tissue because it is a thin slice'. They did not, therefore, mention that a thin slice contained a single layer or a few layers of cells/tissue.

A mark was not awarded for valid descriptions of practical procedures using optical microscopes, because these ideas were not relevant to the question. Examples included 'use a thin slice so the coverslip will lie flat', 'so that the specimen does not touch the objective lens' or to 'stain tissue easily'.

Many incorrectly suggested that using thin slices of tissue would improve the resolving power or magnification of optical microscopes.

03.3

Approximately two-thirds of students identified the tube correctly as a bronchiole. Incorrect answers included reference to an alveolus, bronchus, trachea, capillary and artery.

03.4

This question discriminated well.

Many students demonstrated they had secure knowledge of the formula required to change the magnitude of a measurement and used their mathematical skill to change the subject of the equation. They also converted mm to µm correctly. Consequently, many scored full marks.

Examiners observed answers given for all the combinations required for one mark.

03.5

The uncertainty associated with taking a measurement using a ruler was not well known, but many were able to successfully calculate a percentage error from the uncertainty they had determined.

Examiners noted that an uncertainty of ± 0.5 (mm) with a percentage error of 12.5% was a frequent answer. This achieved only one mark because the uncertainty was calculated for a single point on a ruler with a 1 mm graduated scale, but it was not the uncertainty of a measurement taken between two points (required in this question). In these instances, the mark was achieved for correctly calculating a percentage error using an incorrect uncertainty value.

Similarly, many gave an uncertainty of ± 2 (mm) because they had not halved the smallest graduation on the ruler's scale, but they had doubled their uncertainty which did consider that two measurements were required when using a ruler. Some students identified the uncertainty as ± 0.5 (mm) and doubled it when they determined percentage error, so their uncertainty was incorrect, but the percentage error was correct.

04.1

Three-quarters of all students gave 2 as the correct number of different types of monosaccharides in molasses.

04.2

Students' knowledge of the biochemical test for reducing sugars is very good.

Most achieved two marks for describing a valid method using heat and Benedict's reagent along with red (colour) as the correct positive result. Some missed the Benedict's mark by referring to aspects of the non-reducing sugar test procedure. Others omitted the 'heat' step in the procedure, often by only referring to 'use a water bath' with no indication that the water bath was heated.

The requirement to explain the result expected from testing a molasses sample was achieved less often. Relatively few gave the correct answer, ie that the presence of glucose and/or fructose was the reason for the expected positive result. Some tried to do this by mentioning sucrose, and they missed the mark because sucrose is a non-reducing sugar and would not be detected. Others listed the different colours obtained using the Benedict's test, which incorrectly suggested there would be a variety of end points from the test.

Some students correctly identified sucrose as a non-reducing sugar, but also said that the presence of sucrose would stop the Benedict's colour changing. They had forgotten that fructose and glucose were also present and would determine the colour.

04.3

Nearly all students attempted this question. It was generally answered well, which demonstrated they were proficient in calculations that used proportions. Many students gave a correct answer of 1.62 or 2 whole tablespoons.

A small number of students gave answers of around 32 (the number of tablespoons required to satisfy total energy requirements, rather than the energy requirements from free sugar alone).

Many students calculated the correct answer of 1.62, then rounded this down to 1.5 or 1 tablespoon. This demonstrated incorrect mathematical rounding of 1.62, and it would not 'reach' the energy requirement tested in this question.

04.4

This question discriminated well.

Approximately 12% of students achieved full marks; they gave concise explanations which made good links to osmosis principles set in an unusual context.

Some accurately recalled a definition of osmosis without mentioning water potential (which is the knowledge required by the specification) or failed to link their osmosis definition to the context. Many referred to relative differences in water 'concentration' between the molasses solution and water, rather than use water potential differences.

In addition, some answers showed a clear understanding of water movement in the apparatus but did not identify whether it was the air or the solution that had changed in volume, so missed MP3.

The most discriminating part of the answer was observed with MP2. This required students to link their knowledge of partially permeable membranes to the animal bladder and identify the direction of water movement. Many achieved only some of these requirements and so did not achieve that mark.

04.5

This question challenged students to analyse the design of a practical procedure and suggest a change to that procedure. Well over half of all students achieved at least one mark, which demonstrated they had some skills in this area of understanding.

Those who did not manipulate the numerical data could still achieve one mark for understanding that the decrease in air pressure resulted from a reduced water potential gradient. They most often did this by referring to a dilution of the molasses. Those with higher order analytical skills went a step further. They calculated a 5-fold decrease in pressure and then linked this idea to a 5-fold decrease in molasses concentration. Others achieved the same level of understanding but referred to a reduction in air pressure to 20%.

When zero marks were awarded, it was often because students had changed the composition of the water, rather than the composition of molasses. They also suggested changing the permeability of the bladder or using a tube with a different diameter, but neither of these ideas involved changes made to the molasses, which was what the question required.

05.1

This question produced a good spread of marks and was generally well answered. Relatively few scored zero.

Knowledge of chromosome condensation and of chromosomes becoming visible in prophase was widespread and often the only marks achieved. The attachment of spindle fibres was less well known, and some suggested it happened only in metaphase.

The idea that chromatids or chromosomes move to each pole is known by many, but few mentioned that the centromere splits in anaphase.

Chromosome behaviour in meiosis, such as the separation of homologous chromosomes and crossing over, was suggested incorrectly by some as being stages in mitosis.

05.2

This question tested knowledge of the mitotic index calculation of Required Practical 2. It discriminated well.

Most students knew the formula and successfully applied it to the context shown in the Figure. Some failed to achieve the mark because they calculated mitotic index as a percentage (so multiplying by 100). Since the y-axis in the Figure referred to the mitotic index as a proportion, and the figures ranged between 0 and 1, a percentage calculation was not relevant.

Some referred to ‘counting the number of visible chromosomes’ when they needed to count the number of cells with visible chromosomes. Some used information from both axes of the Figure with expressions such as, ‘cells in mitosis ÷ distance from root tip’. None of these suggestions achieved a mark.

05.3

Many students identified a negative correlation in the data, or they described a relevant trend, but did not make it clear that the correlation was ‘strong’ or ‘significant’.

Examiners looked for conclusions that made a link between the ‘P’ value, a ‘correlation’ (or relationship) and ‘chance’. Many answers made correct references to ‘P’ and ‘chance’ but missed the mark because they linked these to ‘differences between results’ or used the incorrect idea that ‘results are due to chance’. In addition, students incorrectly compared the ‘r’ value to the ‘P’ value, eg ‘since P > r, the results are significant’. Examiners commented that they had observed similar weaknesses in students’ ability to draw suitable conclusions from a statistical test in previous exam papers.

A valid reference to rejecting a null hypothesis was contained in many answers.

05.4

This question tested students’ ability to link what they knew about the cell cycle to the information given to them about the proportion of cells in mitosis at various locations from a root tip.

Examiners observed many answers in which students did not appreciate that there are two stages in a cell cycle: mitosis and interphase (G1, S and G2). Consequently, answers tended to refer to changes in the proportion of cells doing the cell cycle rather than to focus on the proportion of cells in mitosis or in interphase.

Many answers provided only a description of trends shown in the Figure, eg ‘mitotic index decreases as distance from the root tip increases’. These students had not made a link between mitotic index and the number of cells in mitosis or in interphase.

Approximately half of all students did refer correctly to a trend where ‘more cells are in mitosis when closer to the root tip’. They had, therefore, made a suitable link. Often these answers were developed further using the precise analysis of the Figure, noting that at ≥ 2 mm no cells are in mitosis or that all cells are in interphase (but the latter wording was observed less frequently in answers).

MP2 was achieved successfully by a very small number of students because few considered interphase was a stage of the cell cycle.

06.1

Examiners observed many misconceptions about the structure of mRNA and tRNA. For example:

- mRNA has uracil, but tRNA has thymine
- mRNA is single-stranded, tRNA is double-stranded
- mRNA is a single helix, tRNA is a double helix
- tRNA contains exons.

Many students described mRNA as ‘single-stranded’ and compared it with tRNA’s clover-leaf shape when, in fact, the correct comparison would be to mRNA’s straight structure.

Some missed marks because they failed to give comparative statements, even though a blank table was used to direct students towards making comparisons. For example, different structural features were included on a single table row. Another common invalid statement was mRNA has codons, but tRNA does not (which is not a comparison at a suitable level). Many incorrectly described mRNA as short and tRNA as longer. Another example of answers lacking detail was seen with references to ‘tRNA has an amino acid’ rather than mention the ‘amino acid binding site’.

06.2

The great majority of students identified the correct amino acid sequence. This demonstrated their good skills to extract relevant information from tables and their understanding of the principles associated with the genetic control of protein synthesis.

Some incorrect answers included:

- Lys Ala Arg – where students had used AAA GCC CGC, the complementary base sequence from Figure 6
- Phe Arg Gly and Phe Arg Ser – where students had identified a mutation in the third base triplet shown in Figure 6.

06.3

This question tested students’ ability to link ideas about the effect of a mutation on the process of protein synthesis. Many did this very well, achieving three or four marks.

Almost all students identified the mutation correctly as a substitution mutation. Some went on to ignore the other details shown in the question. Instead, they gave often lengthy accounts based on an assumption that mutations always produced changes in a protein's primary structure. These descriptions were based on the recall of information and had no relevance.

Answers that achieved two marks usually referred to the substitution mutation and that the changed base sequence still coded for Arg. This demonstrated the students' good ability to use information taken from two Figures and a Table. Many went on to provide additional details of relevant protein structures to achieve MP4.

The identification of the changed DNA triplet proved to be a good discriminator. Correct answers identified the original base sequence (GCC) and the changed base sequence (TCC). However, many quoted mRNA bases, such as CGG and AGG, or C is changed to A.

Many students reported that base sequences 'produced' amino acids rather than 'coded for' amino acids. These answers did not achieve a mark for MP3. In addition, some students referred to the 'degenerate code of amino acids', rather than the 'genetic code being degenerate'.

07.1

This question discriminated well.

Many students produced neat tables with ruled lines, using clear and informative labels and correct calculations. Others achieved full marks although the presentation was untidy.

When only 1 mark was awarded, it was almost invariably for showing a suitably labelled column on the left of the table for the independent variable. It included reference to 'variety', 'type' or 'apple' along with D/E in the heading.

The mark for labelling the figures for the dependent variable was less often achieved. Most answers contained a correct unit, but the box containing the label did not always extend to cover all the information, so leaving some numbers without a unit. In addition, the label with time and its unit often covered other table headings, not only the recorded times. These answers did not achieve MP2. Some answers failed to achieve the mark by showing the unit both in the headings and against numbers in the body of the table.

Examiners observed tables in which the times were presented as they appeared in the question, with no attempt made to convert them into either minutes or into seconds. Some students converted the times correctly but failed to calculate an accurate mean. A large number also did not show mean times to one decimal place.

Some students processed the data and presented it as a bar chart.

07.2

Most students successfully linked their knowledge of the factors affecting enzyme activity to the results of the investigation. All the alternative marking points shown for MP1 were observed, both in relation to variety D and to variety E.

Some failed to appreciate that longer times for the tissue to turn brown equated to slower reactions and these answers achieved no mark. Students incorrectly surmised that the speed of the reaction meant D had ‘more substrate’ or ‘better enzyme’ and got the activity of the enzyme the wrong way round. Some responses discussed temperature, or the enzyme not being such a good fit – the active site being deficient in some way, in the variety tested.

Few students mentioned enzyme-substrate complexes being formed when they had successfully identified there was more PPO or substrate in variety E, so achieved only one mark.

07.3

This question proved to be accessible to students and discriminated well.

One mark was awarded if students realised that a shorter time for the tissue to change colour was produced by a faster reaction. However, some misunderstood the context and described slower reactions produced by shorter times.

The answer given most frequently to achieve 3 marks referred to increased temperature providing more kinetic energy and a faster reaction. Some incorrectly referred to an increased temperature lowering an enzyme’s activation energy rather than it enabling enzymes to reach the activation energy more readily. Others gave ‘temperature’ for the change in method without stating the direction of the temperature change.

Cutting or slicing the cube without changing tissue mass or volume was often observed. These answers tended to focus on how the changed method produced a bigger surface area to volume ratio of tissue without always going further to explain it would also bring more enzyme/phenol into contact with oxygen. Some students referred to a method in which surface liquid was removed from apple tissue to enable air to reach the cells. They failed to appreciate that PPO and phenol would be present in the surface solution, so removing them by ‘drying the apple’ would slow the rate of brown pigment production.

07.4

This question did not discriminate well.

Almost as many students identified alternative D as identified the correct answer, alternative B. The question was designed to assess students’ ability to interpret the design of a practical procedure (AO3) that utilised familiar apparatus and techniques. Those who gave alternative D had failed to appreciate that light would not pass through a solid cube of tissue, therefore, that technique would be unsuccessful.

Approximately 10% of students gave alternative A or alternative C.

08.1

This question assessed students’ knowledge of artery structure in relation to its function. Fewer than 40% of answers achieved a mark, showing this topic is not well known.

Most answers referred to muscles and to elastic tissue in the artery wall, but few gave enough detail to explain how the named structure affected artery function.

Some referred to thick walls withstanding high pressure, but the mark was not available without also mentioning muscles... Many said ‘muscles’ in the artery wall pumped blood; it is a common misconception. Muscle action in vasoconstriction was frequent, but this response happens in arterioles, not in the aorta. Muscles ‘maintaining’ blood pressure was also a common answer, but this idea should be associated with the role of elastic tissue, rather than with muscles.

Few mentioned both stretch and recoil as the action of elastic tissue, so gave only half a story. Usually, reference was made to recoil only, and this was often explained incorrectly as increasing blood pressure or preventing wall damage rather than to smooth or to maintain pressure.

Very few answers mentioned that the smoothness of the endothelium reduced friction and even fewer referred to protein in artery walls. Some mentioned epithelial tissue rather than endothelial tissue.

08.2

This question required students to interpret information from a Table in relation to the risk of tears and link these ideas to information they were given about aneurysms. It did not discriminate well.

A few achieved full marks using succinct language and high precision. A significant number of students failed to achieve marks by not mentioning aneurysms, they wrote only of the ‘risk of tears being high’. This meant they had described a trend in the data without including any analysis in the context of aneurysms.

Many commented on the large increase in the risk of aneurysms when aorta diameters reached more than 4.5 cm. It also meant that they had taken careful notice of the ‘>’ symbol used with the aorta measurements.

Some students realised that the data gave them information on the numbers of people at risk; so, ‘few people are at high risk of tears/aneurysms’ was a correct answer observed relatively frequently. Examiners eased the challenge of the mark scheme here by not insisting on the mention of both the risk of tears and the risk of aneurysms to achieve that mark.

Many, who noted the small number of people with a very large aorta, went on to incorrectly suggest that the low number of people in this category represented a small sample when, in fact, the cohort used in the investigation included well over 3000 people.

A small proportion of students recognised that the context did not assume that a tear in the artery lining always produced an aneurysm. These students showed clarity in their understanding of the context at a high order.

08.3

The equation was successfully rearranged to determine stroke volume by well over three-quarters of all students. Examiners commented that this mathematical skill was demonstrated by a bigger proportion of students than equivalent questions in previous exam series. What is more, students did this successfully despite the lengthy introduction given in setting the scene for the context.

Many students took this one step further to correctly calculate the percentage change in stroke volume. Some missed this mark by using the diseased heart’s stroke volume in the denominator, obtaining answers of –55% rather than –35%. Many incorrectly rounded the –35.3448 to be –35.4. Some did not achieve the second mark because they miscalculated 120 × 0.58 as 69.9, not 69.6 and obtained an incorrect answer of –35.6%. Some students found an incorrect difference between stroke volumes, eg 69.6 – 45 = 24.9 (instead of 24.6).

The mathematical error of rounding the answer down to one significant figure in the final step of the student's calculation was identified by a small proportion of students. Other frequently observed, but incorrect, suggestions were to:

- subtract the healthy heart's stroke volume from 100 (which did not determine a percentage change)
- calculate the percentage change using the diseased heart's stroke volume rather than the healthy heart's stroke volume.

09.1

The mark was achieved by most students.

Common wrong answers included:

- ignoring the 'mating call' category, so gave 780 as the answer (776 advertisement calls + 4 rasping calls)
- using the percentage of mating calls (ie 2.5%) as the number of calls made in a population of 800 frogs
- determining the percentage of mating calls made as 1.5% or 0.5% rather than the correct proportion of 2.5%

09.2

Nearly two-thirds of students answered the question correctly, often using additional and relevant information such as add 'sexually active' females. Common incorrect responses included:

- add males
- use hormones (EE2) or food to change male frogs' behaviour
- decrease the number of females
- add more frogs
- add frogs of a different species
- reduce the (area of) habitat.

09.3

This question was designed to test students' understanding of courtship as a necessary precursor to successful mating, used in a context where information was to be extracted from two tables and set in an example of frog breeding. Parts of the answer were accessible to many students and the question discriminated quite well.

One mark was awarded when answers demonstrated that the information suggested fewer offspring would be produced. Most students went further to correctly explain this was the result of less time spent in courtship. For many, these were the only marks achieved. Poor use of the heading in Table 7 meant some students referred incorrectly to 'fewer females' in courtship rather than 'less time' in courtship.

The use of information shown in Table 6 was less successful. Often it involved nothing more than quoting figures from the Table or describing trends in the data. Valid explanations required students to notice percentage differences in the types of frog calls and link these to information shown in the bullet points. So, for example, 'fewer advertisement calls' did not achieve a mark, but 'fewer advertisement calls leading to fewer females being attracted (to males)' did achieve one mark. Students were more successful linking ideas from rasping call data than they were from using advertisement call data. Some successfully identified the percentage difference in mating calls by analysing the data in the Table, again without always linking the calculated percentage difference to information shown in a bullet point.

Some students used information only from Table 7. They suggested frog breeding would increase, by explaining 'if courtship times were reduced, male frogs will (have time to) breed with more females'. Their suggestion made no reference to the overwhelming evidence in Table 6 showing that the changes in frog behaviour could only be explained if breeding decreased.

Some answers made no reference to the data or other information given in this question. These included references to habitat loss and changes to allele frequency caused by natural selection.

10.1

This question produced a high discrimination index. Answers ranged from those which demonstrated little understanding of the principles, to well-organised, concise accounts and full explanations.

The principle of homogenising tissue and filtering the suspension is well understood. For many, they were the only marks achieved. Occasionally, examiners observed answers where cell 'fractionation' was used as an incorrect description of 'homogenisation', for example 'cells are fractionated to release organelles'. In addition, some referred to the 'blending of cell walls to release organelles', but cell walls are not present in animal tissue.

Most answers contained good descriptions about the composition of the solution used to suspend organelles, but the extent to which these descriptions were adequately explained proved to be discriminating. Most answers referred to the reduction of enzyme activity in a cold solution. Many incorrectly mentioned 'damage to cells' rather than 'damage to organelles' in the context of using an isotonic solution. Many provided an inadequate explanation for using a buffer, eg:

- 'buffering prevents damage to organelles',
- 'buffering prevents organelles denaturing'.

In addition, examiners observed many answers that made a vague mention to 'using a buffer so enzymes are not affected'.

Valid explanations of how the centrifuge process isolated nuclei were either concise and accurate or they tended to waffle, and were littered with misconceptions. Many had dense structures moving away from the pellet. Others described using 'increasing spin speeds' to obtain a pellet with nuclei, which implied that the procedure was not one of differential centrifugation. Many referred to using (very) high spin speeds, which would produce a mixed pellet of nuclei and other types of organelles. Some had 'nuclei' in the final pellet.

10.2

Many students failed to focus on the role of organelles and often gave lengthy descriptions of translation or details about protein structure. In addition, many gave extensive details of enzyme involvement in phagocytosis or wrote at length about enzyme involvement in DNA replication.

Some also considered the role of the Golgi apparatus in lipid storage and lipid processing, which was not relevant to a question set on the production and release of enzymes. Some also mentioned (Golgi) vesicles transported enzymes to ‘where they are needed’ or ‘out of the cell’; these answers lacked the detail required to achieve MP6.

The mark points achieved most often were for ribosomes being the site of protein synthesis, for protein packaging by the Golgi apparatus and for vesicle involvement leading to exocytosis. Consequently, many students achieved two marks or three marks on this question.

Few referred to mitochondria as the site of ATP synthesis and fewer still referred to the role of the nucleus.

10.3

This was generally answered well, so many students achieved 2 or 3 marks.

Knowledge of ATP structure was somewhat limited, with many answers giving a simple statement such as ‘ATP is made of ADP and Pi’. Others did not achieve a mark because they:

- referred to adenine, not adenosine with 3 phosphates
- failed to mention ribose was linked to adenosine and 3 phosphates.

Since ribose is identified in the specification as a part of ATP structure, examiners did not credit answers that referred to ‘pentose’ sugar. Although examiners did not look for knowledge of named bonds in ATP, they did notice many references made to ‘glycosidic bonds’ and to ‘hydrogen bonds’. This also illustrated that knowledge of ATP structure was generally lacking.

Most students did give accurate descriptions of the molecules involved in ATP production and in ATP breakdown, but many failed to refer to ‘hydrolysis’ in the context of ATP hydrolase activity. Others confused hydrolysis reactions and condensation reactions, often writing that water was produced in hydrolysis reactions and used in condensation reactions.

Many gave irrelevant details about ATP’s role in cell metabolism, for example describing it as an immediate source of energy and not easily stored.

Mark Ranges and Award of Grades

Grade boundaries and cumulative percentage grades are available on the Results Statistics page of the AQA Website.