Questions matter

A-level
Biology

7402/2 Paper 2

Report on the Examination

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General Comments

Like last year, this exam paper proved very effective in terms of producing a wide distribution of marks. There was no evidence of any general misinterpretation of questions, although there was some misinterpretation of data. A few students ignored the advice provided in some questions not to include parts of the specification in their answers. Consequently, their answers contained irrelevant information. Apart from question 08.3, involving serial dilution, questions related to the assessment of practical skills were generally well answered. As usual, the performance of students on questions involving calculations varied considerably. Nevertheless, all apart from question 09.3 proved to be effective discriminators. Many of the questions on this paper were good discriminators.

Generally, students displayed good recall of knowledge but could not always apply this information. This was evident in the responses provided to the different parts of question 7. Most students showed an understanding of electrophoresis and the role of restriction endonucleases but relatively few could apply this information in a novel context. The marks obtained for questions 07.1, 07.2 and 07.3 were considerably below expectations. As on previous exam papers, probability values caused difficulties for students. In question 06.2 a significant number of students misinterpreted the probability values and scored zero.

The imprecise use of scientific terminology prevented some students from accessing mark points. Fortunately, this year, there were fewer references to 'signals/messages' rather than impulses, 'amount' rather than volume, or 'level' rather than concentration. Unfortunately, references to 'results being significant/not significant' remained frequent.

Question 1

01.1 This question was a reasonably good discriminator. Approximately 41% of students obtained both marks and approximately 47% one mark. Parts A (mitochondrion), B (presynaptic membrane/neurone) and D (synaptic gap/cleft) were named correctly by most students. Part C (vesicle) was often incorrectly named as acetylcholine, neurotransmitter, calcium ions or ribosome. A significant minority of students named D as 'synapse' or 'neuromuscular junction'.

01.2 This question was an excellent discriminator, the most effective discriminator on the paper. Approximately 7% of students obtained maximum marks and approximately 74% at least one of the four marks available. Several students included the events prior to the release of acetylcholine in their answers. Many students obtained mark point 1 for referring to the diffusion of acetylcholine across the synaptic cleft. Weaker responses sometimes stated that vesicles moved across. Although the binding of acetylcholine to receptors was appreciated by many students, the location of these receptors was less well known. A significant number of students referred to 'muscle' rather than sarcolemma or postsynaptic membrane. The binding of acetylcholine was usually linked to the opening of sodium ion channels, but some students omitted to refer to the entry of sodium ions. A few students suggested that the binding caused the entry of calcium ions. Mark point 4, relating to the release of calcium ions from the sarcoplasmic reticulum, was credited infrequently. Some students suggested that calcium ions moved into the sarcoplasmic reticulum. Despite the wording of the question a few students included the events following the release of calcium ions.

01.3 This proved to be an excellent discriminator, especially for a question with a tariff of two marks. Approximately, 50% of students obtained at least one of these marks. Slightly more students

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gained mark point 1 than mark point 2. The most frequent correct response for mark point 1 was to state that during hyperpolarisation the inside of the neurone is 'more negative'. Several alternative ways of describing this were credited, including giving a numerical value below the resting potential. Many students mentioned that the entry of chloride ions or loss of potassium ions caused the more negative charge in the neurone. However, students were less successful in explaining how this change in charge inhibited synaptic transmission. Weaker responses referred to 'calcium ions' or referred to sodium ions leaving the neurone. Others referred to 'more sodium' rather than 'more sodium ions' being required for depolarisation. Consequently, only approximately 18% of students obtained both marks.

Question 2

02.1 Approximately 45% of students correctly carried out this calculation and provided the answer in standard form to obtain both marks. Approximately 22% of students obtained one mark as they completed the calculation but unsuccessfully converted the units or did not provide their answer in standard form. Common incorrect answers included 81 600 (20% of 2 = 0.4, then added to 2 and multiplied by 34), 1.3×10^{-2} or 13.6 (which is 20% of the original length of 68 µm). This question was an effective discriminator, especially for a calculation.

02.2 Three out of four students identified the correct statement describing the changes in length in a sarcomere when a myofibril contracts.

02.3 Despite only approximately 5% of students obtaining maximum marks, this question proved to be an excellent discriminator. Approximately 83% of students obtained at least one of the four marking points available. Mark point 2, relating to fast fibres using anaerobic respiration or slow fibres using aerobic respiration, was frequently credited. However, a significant minority of students simply referred to 'working anaerobically/aerobically' which was not accepted. Mark point 1 required a comparison between fast fibres and slow fibres in terms of their speed of contraction or period of use. A significant minority of students only referred to one type of muscle fibre, making this mark point inaccessible. Students who did obtain this mark often referred to the different types of exercise the muscle fibres were used for.

Many students appreciated that glycogen could be converted to glucose. However, fewer students referred to glycogen as a store of glucose or to the hydrolysis of glycogen to glucose to obtain mark point 4. Some students gained this mark by using the term glycogenolysis. Weaker responses often referred to 'glycolysis', 'glycogenesis,' 'glucogenesis' or various combinations of these terms. Very few students obtained mark point 3. Better responses did refer to only 2 ATP being produced in anaerobic respiration but did not suggest that this was less than in aerobic respiration. Students who did achieve this mark point often referred to 'fast fibres producing ATP quickly'. Unfortunately, some students referred to 'energy being produced' which was not credited. Nevertheless, almost 24% of students were able to obtain three out of four marks and approximately 54% obtained at least two marks.

Question 3

03.1 This two-mark question was not really an effective discriminator. Approximately 93% of students obtained at least one mark and approximately 43% both marks. The vast majority of students were able to correctly describe the relationship between the percentage of light absorbed and the rate of photosynthesis. However, students were less successful when describing the

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relationship between the colour of light and the rate of photosynthesis. The most common error was to omit referring to one of the colours, quite often green light. Some responses which included green light simply stated it was reflected without any reference to photosynthesis. A few answers only referred to wavelength and did not refer to colour at all. There were also a few responses which referred to respiration instead of photosynthesis.

03.2 This was another two-mark question that was not an effective discriminator. Again, approximately 93% of students obtained at least one mark and approximately 57% gained both marks. Light intensity, temperature and carbon dioxide concentration were most frequently given to gain two marks. The 'amount of light' or the 'amount of carbon dioxide' were not accepted. The 'pH of the soil' and 'nutrient/nitrate/phosphate content' were common incorrect responses which were ignored. Other less frequent responses included 'air movement' and 'oxygen concentration' – these were rejected.

03.3 This question proved to be an excellent discriminator. Approximately a third of the students obtained all three marks and just over 80% of students gained at least one mark. Approximately 20% of students obtained one mark for this question. There was some variation in how this was achieved. Some of these students correctly identified ATP and reduced NADP as the products of the light-dependent reaction, but then incorrectly described their roles in the light-independent reaction. Others referred to reduced NAD rather than reduced NADP but then correctly referred to the reduction of GP to TP.

The only mark achieved by some students was the role of ATP in providing energy for a reaction. A significant number of students suggested that ATP provided phosphate, which was ignored. It was surprising to find a significant number of students referring to reduced NADP causing *oxidation* of GP to TP. Although the chemical name of GP was not required as it is abbreviated in the specification, students were penalised if they named it incorrectly, eg as glucose-3-phosphate. Weaker responses often referred to molecules involved in glycolysis and/or the link reaction, eg pyruvate and acetyl co-enzyme A.

Question 4

04.1 Approximately 46% of students obtained both marks for this question and approximately 17% gained one mark. The question was a good discriminator. Most students obtaining a mark referred to crossing the grey fly with a black fly or a fly with a homozygous recessive genotype. Fewer students referred to crossing the fly with a heterozygous genotype. Some students failed to obtain this mark as they simply suggested crossing two grey flies. Several students suggested the correct cross, but then stated that the offspring could be used to determine the unknown genotype without explaining how. Some students provided the incorrect outcomes of their suggested breeding experiment. Frequent responses which were not credited included looking at the parents or using a punnett square. Less than one percent of responses referred to alternative methods such as comparing the DNA base sequence of the grey fly with known DNA base sequences.

04.2 Approximately 55% of students obtained the mark for this question. Most students answered this question by describing the results produced if the gene was sex-linked. The most frequent correct response was that the female offspring would be grey or that no female offspring would be black. A significant number of students gained this mark for stating that the male/grey fly would only have, or pass on, a dominant/grey allele if the gene was sex-linked. A common

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incorrect response was to suggest that all the offspring (males and females) would be grey. Other incorrect responses referred to crossing over and epigenetics. Common misconceptions included the sex-linked gene being present on the Y chromosome or the Y chromosome having 'no genes'.

04.3 This question was an excellent discriminator. Approximately 33% of students obtained one mark and a similar percentage obtained both marks. One mark was often awarded for showing an understanding of 2pq but using incorrect numbers in the calculation. Usually this was shown as $2 \times 0.56 \times 0.44 = 0.4928$ or $2 \times 0.19 \times 0.81 = 0.3078$. 2pq was sometimes shown but then divided by 2, giving the answer for heterozygotes as pq. A few students gained one mark for calculating the percentage of heterozygous flies by using $1–(p^2+q^2)$ or $1–p^2–q^2$. The Hardy-Weinberg equation was sometimes written incorrectly, eg using $2pq^2$ instead of 2pq.

04.4 As usual with genetic crosses, this question was a very good discriminator. Approximately 25% of students obtained all three marks and approximately 83% obtained at least one mark. Students obtaining only one mark either gave the correct parental genotype or gained the principle mark. The principle mark was applied when parental genotypes were incorrect, but a correct dihybrid cross was produced from these genotypes. Many students who provided the correct parental genotypes then gave the correct genotypes of their offspring. This resulted in approximately 65% of students obtaining at least two marks. Unfortunately, when determining the phenotypes and ratio of the offspring, many of these students included flies which are homozygous dominant for curly wings. As stated in the question, these flies do not survive beyond the embryo stage. This resulted in incorrect ratios of 3:1 or 1:2:1 rather than the correct ratio of 2:1.

Question 5

05.1 This question assessing practical skills proved to be an excellent discriminator. Approximately 24% of students obtained all five marks and approximately 97% obtained at least one mark. Mark points 1 and 2 were generally very accessible, with most students referring to producing a grid and using a random number generator. Students attempting to describe producing a grid or using transects did not always provide sufficient detail. Weaker responses sometimes referred to 'throwing quadrats' or using 'punnett squares' rather than quadrats. Most students referred to counting the number of fat hen plants in a quadrat although a few referred to percentage cover. Unfortunately, a significant minority did not refer to a large sample size or provide a sample size of 10 or more when stating that a mean would be determined.

However, it was mark point 5 which proved most inaccessible for students. This required a description of how the (total) number of fat hen plants in the field could be determined. The clearest descriptions included the area of the quadrat, which was then divided into the area of the field and then multiplied by the mean number of fat hen plants per quadrat. Some students using this method omitted to refer to the area of the quadrat being used. Another less frequently used method was to determine the mean number of fat hen plants in a quadrat/square and then multiply this by the total number of quadrats/squares that would fit into the field. Several students simply stated that 'scaling up' could be used or did not attempt to describe this final step. Nevertheless, just over 50% of students obtained at least four out of the five available marks.

05.2 Despite only approximately 10% of students obtaining maximum marks, this question was an excellent discriminator. Many students correctly named the type of competition as interspecific.

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The most common incorrect response was intraspecific. A full range of other incorrect responses was provided including 'direct', 'allopatric' and 'spatial'. Surprisingly, a significant number of students didn't name the type of competition. The reduction in available nitrates was mentioned more often than lack of phosphates, although sometimes both were included. Most students linked these nutrients with the correct organic compound. The most frequently named molecules were DNA, RNA, ATP, amino acids and proteins.

Weaker responses only stated that growth would be affected. Fewer students referred to competition for light but, again, this was often linked to less growth rather than reduced photosynthesis. Some students mentioned competition for light, which was not credited. Approximately 78% of students gained at least one mark for this question.

05.3 Approximately 25% of students obtained one mark for this calculation and approximately 42% obtained two marks. Students obtaining one mark did so in a variety of ways. One mark was awarded when the final answer was not in kg but the number sequence 669 or 67 was shown. An answer of 0.012 kg was also awarded when the number of fat hen plants (550) was not taken into account. An answer of 8.47/8.5 kg resulted when the percentage of viable seeds was not included. Omitting the mean mass of a seed gave an answer of 8.69. When the maximum number of seeds per plant was not included, an answer of 3.35×10^{-4} kg resulted. This range of acceptable answers for one mark contributed to this question being a very effective discriminator.

Question 6

06.1 This question, which assessed AO1 (knowledge and understanding), proved to be an excellent discriminator. Approximately 28% of students obtained all five marks and approximately 84% obtained at least one mark. There were some excellent responses which succinctly covered all the mark points. Most students mentioned the release of electrical activity or impulses from the SAN to gain mark point 1. It was pleasing to note that there were very few references to 'signals' or 'messages'. Most students mentioned that the impulses were passed on to the AVN. However, a significant minority omitted mark point 2, ie the stimulation of atrial contraction by impulses from the SAN. Many students mentioned the role of the AVN in relaying the transmission of impulse, but the delay was not always included. Better responses then correctly described the impulses travelling via Purkyne tissue in the bundle of His to stimulate of the ventricles.

Weaker responses displayed considerable confusion over the role of the different structures in coordinating regular contractions of the atria and ventricles. These responses often confused the SAN with the AVN and incorrectly described the pathway of electrical activity through the AVN, Purkyne tissue and bundle of His. A few students described the cardiac cycle and obtained one mark. Some weaker responses ignored the instruction not to include the autonomic nervous system in their answer.

06.2 Unfortunately, many students associated the higher probability values in Table 2 with an increased risk of AF. These students incorrectly concluded that high LDL (low-density lipoprotein) is the highest risk factor for developing AF. They also concluded that age, hyperthyroidism and high blood pressure are low risk factors. Consequently, these responses scored zero. However, approximately 52% of students were able to obtain at least one mark on this question. These students correctly concluded that a high LDL concentration is not a significant risk factor. They often gained another mark for stating that age, hyperthyroidism and

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high blood pressure are significant risk factors. Unfortunately, in many instances one of these marks was disqualified as the answer referred to 'the *results* being significant or not significant' Responses which indicated that '*results* were due to chance or not due to chance' were similarly penalised.

Some responses suggested that hyperthyroidism was not associated with an increased risk of AF or that all four factors significantly increased the risk of AF.
Approximately 11% of students obtained maximum marks. These students correctly interpreted the probability values for two marks but also indicated that high blood pressure was the most significant risk factor. Some students obtained maximum marks by correctly referring to whether the null hypothesis would be accepted or rejected. Despite many students misinterpreting the probability values, this question was a good discriminator.

Question 7

07.1 The responses to this question were very disappointing, with approximately 14% of students obtaining two marks and approximately 12% of students obtaining one mark. The most common errors included 3 bands (experiment 1) and 4 bands (experiment 2), and 3 bands (experiment 1) and 6 bands (experiment 2). These incorrect answers often had the second bar in the same position in both experiments. However, it was evident from the vast range of banding patterns produced that most students had considerable difficulty with this question. Some students produced vertical banding patterns. Students who could not interpret the two experiments shown in Figure 4 were unable to determine the number of bands produced. Consequently, they could not obtain either mark point. Almost 12% of students did not even attempt this question, the highest percentage on the paper.

07.2 Again the responses to this question were very disappointing with similar statistics to question 07.1. Approximately 16% of students obtained two marks and approximately 11% of students obtained one mark. Many responses did not answer the question and simply described how DNA fragments were separated by electrophoresis. Students gaining only one mark did refer to using DNA fragments of known sizes/lengths. However, they did not compare their position/distance/ banding with the unknown DNA fragments. Some students referred to using data bases of known DNA lengths. Other methods included the use of DNA probes, optical and electron microscopes and centrifugation. Almost 8% of students did not attempt this question, one of the highest percentages on the paper.

07.3 As this question assessed one of the experiments related to question 07.1, it is not surprising that it was not well answered. Approximately 37% of students correctly gave 4 as the answer. Common incorrect responses included 2, 3, and 5. However, it was clear that some students simply chose a random number, eg 10, as their answer. The question was a poor discriminator.

07.4 Conversely, this question proved to be an excellent discriminator. Approximately 81% of students obtained at least one mark and approximately 61% obtained both marks. Although not required, many students described the role of restriction endonuclease in cutting out a gene. However, most then referred to its role in cutting the plasmid and/or producing 'sticky ends'. The mark for the role of restriction endonuclease was awarded more frequently than for the role of DNA ligase. Although many students did correctly describe the role of DNA ligase, weaker responses did not. Some students suggested that this enzyme creates 'sticky ends' or cuts the plasmid or even cuts the gene. However, there were some excellent answers which included all

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the alternatives for both mark points, providing comprehensive descriptions of the roles of both enzymes.

Question 8

08.1 This question was not really an effective discriminator. Approximately 92% of students obtained at least one mark and approximately 17% obtained both marks. Most students obtained mark point 1 for stating that increasing IAA concentration resulted in increasing cell wall plasticity. Some of these students also knew that IAA activated the enzymes involved in increasing plasticity. A few students had difficulty with negative indices on the axes for IAA concentration. These students incorrectly believed that cell wall plasticity decreased as the IAA concentration increased, ie 10^{-8} was a higher concentration than 10^{-5}. Relatively few students gained mark point 2 for explaining that the increase in cell wall plasticity allowed cell elongation. Several students mentioned cell wall elongation but did not link this to plasticity. Often, these responses stated that IAA caused cell elongation, but did not explain how.

08.2 Approximately 26% of students gave the correct answer of 570% to obtain 2 marks. However, this answer could also be obtained by using the cell wall plasticity values. If this was the case, the student was penalised one mark for using the incorrect axis. Approximately 20% of students obtained one mark. Most of these students correctly calculated the percentage increase but did not give their answer to 2 significant figures. One mark was also awarded to students who used the incorrect axes on Figure 6, but correctly performed the calculation and gave their answer to 2 significant figures; this occurred infrequently.

08.3 The responses to this question were very disappointing, although it was a reasonably effective discriminator. Approximately one in five students obtained this mark. It was not uncommon to see responses such as 'dilute with water' with no indication of the volumes required of stock solution and distilled water. When volumes were specified, they were often multiples of 10, 100 or 1000, eg 1 cm^3 and 100 cm^3. Some answers provided percentages; others appeared to be randomly generated, eg 7 cm^3 and 3 cm^3. Most correct answers used 1 part of the stock solution of GA and 99 parts of distilled water to produce the 10^{-3} mol dm^{-3} solution. Fewer students suggested the two-step process of 1 part stock to 9 parts distilled water, followed by 1 part of this to 9 parts water to produce the 10^{-3} mol dm^{-3} solution. Some responses, although correct, would have resulted in large quantities of the 10^{-3} solution, eg 100 dm^3!

08.4 This question was a very good discriminator. Approximately 12% of students obtained all 5 marks and approximately 91% at least one mark. Most students included at least two correct variables that should be controlled in the investigation. The most common correct variables were temperature, time and volume of GA (gibberellic acid). References to controlling the 'amount' of GA were not credited. Fewer students mentioned controlling the species or age of the plant or the diameter/thickness of the stem segments. Many responses referred to controlling light, pH and carbon dioxide concentration. These factors were ignored.

A significant number of students omitted measuring the initial and final length of segments or failed to refer to determining change in length. Consequently, they could not obtain mark point 2. Generally, only better responses obtained mark point 1. Many students did not use all 60 segments and/or failed to include distilled water as a control. It was not uncommon to see details of aseptic techniques in the methods described. A few students added nutrient agar to the Petri dishes, which was ignored. Interestingly, a number of students referred to removing the

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tips of the segments to prevent IAA affecting the results. Some responses referred to phototropism and measuring the curvature of the stem segments.

Question 9

09.1 Approximately 87% of students obtained at least one mark and approximately 50% obtained both marks for this question. It was not a particularly effective discriminator. Many students obtained mark point 1 for stating that type I diabetics do not produce insulin, or that type II diabetics do produce insulin. Some students referred to type I as being an autoimmune disease. Often lack of detail or imprecise terminology prevented students obtaining another mark. For example, for mark point 2, it was common to see 'the body is less sensitive to insulin' rather than receptors or cells being less sensitive. Similarly, for mark point 3, students often referred to 'lifestyle' rather than weight, diet or exercise (lack of) as factors linked to type II diabetes.

09.2 This was a slightly more effective discriminator than question 09.1. Approximately 22% of students obtained maximum marks, approximately 56% at least two marks and 84% at least one mark. The most commonly selected features suggested and explained were the computer-generated list, the large sample size and the variety of ages. References to the control group and the time period of the investigation were also included, but full explanations were less frequent. The fact that the participants had less than 5 years duration of type II diabetes was often mentioned, but this was not credited.

09.3 Approximately 65% of students correctly performed this calculation to obtain both marks. Approximately 14% obtained one mark. Some of these students used the wrong group size of 380 and gained one mark for performing the rest of the calculation correctly to obtain the answer of 142. Others correctly carried out the calculation of the number in remission as 79.99/80 for group P or 8.93/9 for group Q but then miscalculated the difference. Answers failing to gain a mark included just subtracting the percentage achieving remission in group Q from the percentage achieving remission in group P (42.1% – 4.7% = 37.4%). This was the least effective discriminator of the maths-based questions on the paper.

09.4 This question was a good discriminator. Approximately 5% of students obtained all four marks and approximately 75% obtained at least one mark. Many students only gave half of the information required for mark point 1. Usually this was the higher percentage in remission in group P rather than the higher percentage with weight loss. Mark point 2 required students to realise that a high percentage with weight loss in both groups achieved remission. However, most students focused on the higher percentage in group Q than in group P, not always quoting figures. The percentage achieving remission with weight gain (1.9%) was often described, although some stated 'no weight loss'. Fewer students recognised that less than 50% (only 42.1%) in group P achieved remission. Many realised there had been no statistical test but fewer included that it was needed to see if there was a significant difference between the results. Unfortunately, several students suggested that a statistical test was required 'to see if the *results* were significant'.

Despite the question stating 'Use all the information provided', many students seemed to only consider the data in Table 3 when evaluating this weight-loss programme. This was very likely one of the reasons for approximately 25% of students scoring zero on this question. Students who did comment on the design of the experiment could access mark points 5, 6, 8 and 9. Better responses noted that the volunteers had diabetes for less than 5 years (mark point 5) and/or the

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limited age range (mark point 6). Fewer students appreciated that remission is not necessarily long term or remission is not a cure (mark point 8). Very few students referred to the mass/weight of volunteers not being known at the beginning of the programme (mark point 9).

Some responses only referred to the results for Group P without any comparison with Group Q. Others only stated there was a difference in percentages without specifying an increase or decrease. The sample size was considered to be too small or sometimes large enough to be representative.

Question 10

10.1 Approximately 42% of students obtained both marks and approximately 86% at least one mark for this question. The most common correct answers were mutations, environment (or selection), random fusion of gametes (or random fertilisation) and crossing over. Independent segregation (of homologous chromosomes) and epigenetics were less often given. Alternatives of the same mark point were sometimes included to gain only one mark. Examples of uncreditworthy responses included geographical isolation, reproductive isolation, allopatric speciation, changes in courtship behaviour, size, evolution and food availability.

10.2 This question was a poor discriminator. Approximately 97% of students obtained at least one mark and approximately 77% obtained both marks. Most students referred to camouflage or provided a suitable description, usually in terms of 'blending in'. Reference to hiding without further qualification were not accepted. All the alternatives for mark point 2 occurred on a regular basis. However, a few students confused prey with predator. Some students stated that due to increased survival the geckos would be able to pass on their alleles for skin colour to their offspring.

10.3 Despite only approximately 3% of students obtaining five marks, this question was an excellent discriminator. In fact, it was one of the most effective on the paper. Students had to utilise information from several parts of the passage to obtain a high mark. Approximately 14% of students obtained four or more marks and approximately 80% at least one mark.

The most frequently credited mark point was reproductive isolation (or no gene flow) between diurnal and nocturnal geckos. Almost as frequent was an explanation of disruptive selection, usually described as selection for both extremes/colours. Mutation was mentioned by a significant number of students but sometimes an incorrect context disqualified this mark point. The idea of geckos 'mutating to adapt' was not uncommon. Better responses often referred to the geckos living in the same habitat and/or being the same species. The idea of diurnal (or nocturnal) geckos being a distinct group was also mentioned in responses achieving higher marks. The idea of allopatric speciation possibly occurring due to the geckos living in different areas of the same habitat was only rarely seen. Weaker responses sometimes referred to the lack of a statistical test, repeats, or that this investigation had a small sample size.

10.4 Although this question was a reasonably good discriminator, the responses were largely disappointing. Approximately 3% of students gained the maximum three marks and approximately 49% obtained at least one mark. The question asked how a comparison of mitochondrial genes could be used. The expectation was that students would compare the DNA base sequence of the mitochondrial genes. As the geckos are the same species, the genes would

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be the same, but the alleles (DNA base sequences) would differ. Unfortunately, many students suggested that the nocturnal and diurnal geckos would have different genes and that they are different species. Students who did refer to comparing base sequences often did not refer to DNA. Students frequently referred to comparing mRNA sequences or amino acid sequences. A few students suggested comparing the banding pattern of DNA fragments, which was credited.

The responses indicated that students consider several well-established techniques as being 'new'. Consequently, the mark scheme was amended to reflect this. However, responses often named a technique but did not explain how this enabled the comparison of genes to be completed rapidly. The use of PCR to rapidly amplify genes/DNA was the most frequently credited response. Almost 11% of students did not attempt this question, the second highest percentage on the paper.

10.5 This question was a good discriminator. Approximately 7% of students obtained maximum marks and approximately 62% obtained at least one of the three marks available. Many students could describe a precaution to ensure validity in estimating the gecko population, but far fewer could provide an explanation. Consequently, responses such as 'marking should not cause harm' or 'the mark should not rub off' were not credited unless qualified. Similarly, students appreciated that re-integration of geckos into the population was necessary after being released, but most failed to mention that time was needed for the geckos to disperse.

Surprisingly, many students could not provide the correct formula to estimate the size of the population using the mark-release-recapture method. A significant number subtracted the number in the second sample from the number in the first sample, instead of multiplying the two samples. Many students referred to the second sample as the 'recaptured sample', even though it would contain geckos that had not previously been captured.

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Mark Ranges and Award of Grades

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

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