General comments

The paper produced a range of marks from 0 to 93 and correct responses were seen in all parts of all questions. The essay takes up most of the factual recall (AO1) marks for the paper. Almost all of the rest of the paper has to test application (AO2) and How Science Works (AO3) and this makes it challenging for many students.

Many examiners commented on the poor handwriting of large numbers of students. There were also many students who appeared to have used a colour of ink that produced very faint script on the online marking system. Examiners can only mark what they can read. If a student has handwriting that is perceived to be a bit difficult to read on paper, it will be harder to read in a scanned, online form.

There were several questions where many students failed to use information or data provided in questions, even when told to do so. It appeared that they frequently failed to read the stems of questions carefully enough, even when words were emboldened. A number of questions involved (simple) logical steps that could only follow from appreciation of the content of the stems of questions.

It was pleasing to note that in questions with a perceived ‘How Science Works’ component, stock answers appeared to be less prevalent than in previous years. It was evident that some students gave answers triggered by certain words in questions, rather than what was required.

Question 1

(a) This required factual recall of components of the sarcomere. Just over 50 percent obtained all three marks. Students who failed to score often had the correct names but associated with the wrong function.

(b) This proved very challenging to many and almost 40 percent failed to score. Some excellent answers were seen. These students understood that myosin molecules are bound tail to tail so that their heads can pull actin filaments towards the centre of the sarcomere and thus shorten the sarcomere. Obviously, if the tails fail to bind to each other, this will not happen; in fact, the myosin molecules would move rather than the actin. Many students simple wrote about the sliding filament theory but without relating this to the question.

Question 2

(a) Most students found (a) accessible, just over 60 percent obtained both marks and very few got 0. Some students drifted into how release of LH is controlled, rather than how LH is involved in control.

(b) Nearly half of students obtained 3 marks, for using the information in Figure 2 as instructed. Some students failed to mention either the hypothalamus or the testes and scored 2 marks. A minority got confused between inhibition and stimulation. A few tried to use recall of material not in the figure and failed to score at all.
(c) Those who understood the figure had little trouble with (c) and just over half obtained both marks. Some failed to note that taking the male contraceptive pill would keep a man’s testosterone concentration high.

Question 3

(a)(i) The examiners wanted a statement that a mutation could make the gene inactive and that this would lead to uncontrolled, or very rapid, cell division. About half of students obtained both marks. Some students did not mention cell division but just stated that a tumour would grow; apparently taking ‘growth’ to mean cell division. The examiners did not accept these terms as equivalent. Some students got into long explanations of how a mutation could lead to a faulty protein and eventually got the first mark point for an inactive gene. Some of these failed to score because they wrote about mutations leading to the production of faulty amino acids.

(a)(ii) A large majority of students managed to convey the idea of the genetic code being degenerate.

(b) Very few students obtained all three marks in (b). This was because they didn’t address the reference to ‘this antibody’ in the stem. The examiners were looking for an observation that ‘this antibody’ will have a specific tertiary structure, or binding site, or variable region. Some of those who did consider this aspect, failed to score because they referred to a specific ‘active site’. Many students obtained two marks for suggesting that the antibody binds either to the receptor (protein), or growth factor, and this prevents growth factor binding to its receptor.

Question 4

(a) The examiners were looking for ideas about how the use of the questionnaire may affect reliability of data about the smoking habits of the parents. Many students included at least one suggestion about the design of studies using questionnaires and these were not credited.

(b) About a fifth of students obtained 3 marks in (b) and half obtained 2 marks. One of the commonest mistakes was a reference to standard deviations, when it clearly states in the table that standard errors are given. These references to SDs were ignored. Another common statement was that the data or results were significant, rather than the difference in the results. All results are significant, in that they are what happened. In this final A2 paper, the examiners expected students to understand this.

Interestingly, the stem of the question makes reference to ‘a large number of school students’ being recruited. This was one question when a mark was awarded if a student noted that this large number would make these data more reliable. Very few students did this.
(c) About a quarter of students obtained 3 marks in (c). There were five mark points and it tended to be a question of how many students thought to mention. Relatively few wrote about methylation possibly preventing a transcription factor from binding. Many made some reference to blocking RNA polymerase; but some wrote about DNA polymerase. There were also many references to blocking of complementary base-pairing. Unfortunately, some disqualified the mark by stating that thymine would be in mRNA. This was another question where some failed to score because of references to the wrong amino acid being made. If the students read the stem carefully, they would have seen that methylation prevents transcription; i.e. no mRNA is made. Some students wrote incorrectly and at length about faulty mRNA, different amino acid sequences and proteins with the wrong tertiary structure.

Question 5

(a) This proved to be one of the most discriminating questions on the paper. Just over a third of students obtained 3 marks. The examiners were looking for a reference to stretch-mediated sodium channels. This is the term used in the specification and is appropriate for this pressure receptor. Some students wrote about movement of sodium, rather than sodium ions, or did not state that they moved/diffused/flowed in. Others failed to note that this produces depolarization.

(b) About 30 percent of students obtained 2 marks in (b). As has been noted in other examinations, ratios seem to pose problems for many students. Many do not realize that a ratio should be given as something : 1. Other students did not realize that it mattered in which order the numbers were given when they were asked to give the ratio of heart rate in experiment 2 to that in experiment 3. These problems resulted in about 30 percent obtaining one mark. Many students had no idea how to calculate a ratio.

(c) Nearly 50 percent obtained 2 marks for stating that the parasympathetic slows heart rate and the sympathetic speeds it up. Very few noted from the graph that the parasympathetic has a much greater effect/influence on heart rate than the sympathetic; resulting in only 10 percent obtaining all 3 marks.

Question 6

(a) Most students realised that damage to myelin sheaths would adversely affect transmission of nerve impulses/action potentials and about 50 percent of students scored 1 mark for this. Many failed to relate this effect to effects on muscle contraction; they just said that movement would be affected. As a result, only 30 percent obtained both marks. Some answers were marred by references to ‘signals’ or ‘messages’, rather than impulses.

(b) This required some basic synoptic knowledge of membrane structure. Just over 40 percent of students correctly observed that the hydrophobic cannabinoids were lipid soluble, or would pass through the phospholipid bilayer.
(c) Many answers to (c) illustrated the importance of reading the stem of a question very carefully. The word ‘pre-synaptic’ was emboldened in the question. Despite this, a significant number of students saw 'calcium ions' and 'muscle' and wrote about muscle contraction, often in great detail. The examiners ignored this material. Amongst those who did read the question carefully, 30 percent obtained all 4 marks. Those who failed to score all the marks often got confused about where calcium ions flowed to, or what was released into the synapse; whether it was vesicles or neurotransmitter.

(d) Most students focused on harmful effects of cannabis on brain tissue or function in (d) and obtained 1 mark. Only just over 20 percent obtained a second mark by pointing out that the cannabinoids would only treat the muscle problems.

Question 7

(a) This proved more challenging than anticipated. Many got a similarity between taxis and tropism as both being directional responses. Some wrongly thought it was a response to a directional stimulus, with no reference to the type of response. The difference proved much more problematic. Most of the students who obtained a mark did so because the examiners decided to accept the generalisation that tropism occurs in plants and taxis in animals. Very few indeed referred to tropism involving growth and taxis whole-organism movement.

(b) It was pleasing in (b) to see that most students could use the figure to determine that the roots grew towards gravity and away from salt. Only a small number attempted any statement about the relative effects of the two stimuli.

(c) Students who read the stem carefully and looked at Figure 5 carefully scored well in (c). Just over half of students obtained 3 marks. All of the information needed to answer the question was given in the stem and figure. Weaker answers included references to carriers bringing IAA into cells, or greater elongation of R causing growth away from the salt. A significant minority saw the reference to ‘salt’, ignored all the information in the stem and wrote about osmotic effects and cells shrinking. No credit was given for this approach.

Question 8

(a) About a third of students correctly explained how glucagon would be involved in regulation of blood glucose concentrations in the mice and obtained 3 marks. Some students failed to mention what glucagon does, or where it acts. There were some students who got very confused between glucagon and glycogen and others who wrote about glucagon either acting on glycogen to break it down, or had glucagon broken down into glucose. This question showed weaknesses in use of language and terminology by many students.

(b) This was marked by a very large number of students who wrote about large amounts of mRNA but did not link this to large amounts of the enzyme PCK1. These answers were simply describing the results shown in the graph, not giving a suggestion about how the process is controlled. The examiners required students to show understanding that large amounts of mRNA would (probably) mean large amounts of the enzyme. It should be noted that quite a large number of students wrote about mRNA breaking down glycogen (as an enzyme), or being broken down into glucose. Many students did write about the role of the enzyme in kidney and intestinal cells in producing glucose. However, many of these did not compare this with what happens in the normal mice referred to in the question. Some weak
answers simple involved attempts to use rote-learned material about control of blood glucose concentration with no reference to the information in the question.

(c) This again had students writing about the results/data being significant, rather than the difference in the amounts of mRNA, as given in the stem. Quite a few ignored the ‘less than’ symbol, or read it as ‘more than’. Others ignored the 0.01 and wrote entirely about less than 5%, which did not gain credit.

Question 9

(a) Over half of students managed to communicate the idea that the same restriction enzymes cut at the same place/recognition sequence on DNA. Only just over 10 percent considered the context of the question and went on to say that this would give fragments containing the same gene (R).

(b) About half of students obtained both marks in (b) and over 40 percent obtained 1. Most managed to convey the idea that there was binding between complementary base sequences on a primer and DNA from an allele. The better answers conveyed the idea of a specific base sequence for each primer.

(c) Some very good and clear answers were seen to (c) and a third of students obtained 3 marks. These students identified the genotypes of L, M and N and explained how they identified them on the basis of the sizes of primer attached to each and how far the bands moved. Quite a large number went on at length about the offspring as represented by M but failed to identify L and N. A few thought that there were two types of offspring because there were two bands for M; they clearly did not understand the simple genetics of the cross.

(d) This proved far more challenging than expected. The examiners were looking for the idea that chromosomes would be visible (as separate structures) and thus the scientists could see to which chromosome the probe was attached. Fewer than 10 percent got both marks.

(e)(i) There were quite a large number of attempts at generic ‘How Science Works’ answers to 9(e)(i). 50 percent of students obtained 1 mark, usually for suggesting that the control was to see the effect of the insecticide or that it was for comparison with resistant flies. However, only around 10 percent gave both of these.

(e)(ii) Most students focused on one aspect of the results and scored 2 marks. They frequently spotted that if the enzyme was the only factor in resistance, then the results for the controls and the resistant flies with the inhibitor would be the same. Others focused on evidence for the statement by comparing the resistant flies with resistant flies with the inhibitor added.

Question 10

The essay titles were not equally popular, with far more attempts at (a). The examiners’ opinion was that many of the better essays were produced in response to title (b).

Many students wrote about relevant topics but failed to relate the content to the theme of a title. The vast majority of students appeared to understand that this is a synoptic exercise, where they have to draw on a wide range of examples to obtain a high mark. Examiners reported that
substantive attempts at extension material were uncommon. GCSE-level content was common; as in previous years, the use of examples that any member of the public might use did not gain any extra credit. Extension material has to be at least of A-level standard and accurately described using appropriate scientific terminology.

Appropriate terminology was often poorly used or absent. For example, many students wrote about ‘signals’ and ‘messages’ rather than impulses/action potentials. The use of ‘levels’ and ‘amounts’ for concentration was also very common. The essay is supposed to be written using appropriate terminology, at a level to be expected after two years of A-level study.

The marking annotation of the essay this year was the same as last year. Where an AS or A2 topic was included, a vertical line should appear in the right margin. If a paragraph (or substantial piece of text) was irrelevant, a vertical line should appear in the left margin. Any notable errors should be underlined. The vertical lines do not give any information about the quality of the content. That was assessed by the examiner as they read the essay.

This report will mainly consider the topics identified on the mark scheme as relevant to the title and which were frequently used by students.

(a) The importance of responses to changes in the internal and external environment of an organism.

Most wrote about thermoregulation and the control of blood glucose concentration. Many accounts of thermoregulation were at GCSE level, or below, and did not include details of receptors, their location, the coordinator or the effectors. There were unfortunate references to blood vessels migrating to and from the surface of the skin and capillaries dilating or contracting. There were also many signals and messages. Most did identify the importance of thermoregulation in terms of enzyme activity.

Control of blood glucose concentration was somewhat better done. There were some very good accounts that included the mechanisms of action of insulin, glucagon and adrenaline. These also got credit for the role of hormones in responses to changes. Weaker students wrote about levels a great deal, confused insulin with glucagon, alpha cells with beta cells and glucagon with glycogen.

Feedback and homeostasis were frequently mentioned by students in various contexts, including the two just discussed. However, very few went beyond a mention and moved into explanation. Some did use feedback control to justify the inclusion of the role of hormones in the oestrous cycle.

Control of heart rate was also popular, in terms of control of blood pressure and blood carbon dioxide concentration/pH. There were good answers that included the role of baro/pressure receptors and chemoreceptors in control of heart rate, the medulla, sympathetic and parasympathetic systems and the SAN. Weaker answers confused the medulla and hypothalamus and often missed out parts of the story. Only better answers included why the changes produced were important; for example, in terms of pH and enzyme activity. Those who considered blood carbon dioxide concentration sometimes included haemoglobin and the Bohr effect, together with its importance in supplying oxygen to rapidly respiring tissues.
Taxis and kinesis were frequently written about but often superficially, with incorrect examples and little regard to details of the importance of these responses. Tropism was also frequently written about but with problems similar to those with taxis and kinesis. In these three topics, many answers were given at GCSE level. Behaviour was also mentioned by many, usually when discussing thermoregulation in ectotherms. Other examples were rare, such as courtship behaviour and its importance.

Reflexes were discussed and some students showed understanding of the three neurones in a simple reflex arc and its importance in producing a rapid response, without involvement of the brain. However, many just wrote about fast responses and often included the brain. Receptors were also commonly written about, mainly rods, cones and Pacinian corpuscles. Levels of detail varied, as did attempts to explain their importance in responses.

Transpiration and control of gas exchange in plants were used as examples by many students. Some good accounts were seen that related changes in response to environmental stimuli. However, quite a few drifted into accounts of uptake by roots, without any link to the title. Some wrote that plants close their stomata at night, when they switch from photosynthesis to respiration.

Many students wrote about the responses of populations to changing environments. Some of these included excellent accounts of the processes involved, resulting changes in allele frequencies and, sometimes, speciation. Weaker students slipped into organisms ‘having to’, or ‘needing to’ evolve.

The immune response was also chosen by many. Those who knew the detail gave good accounts of the response and its importance in defending the body both now and in the future.

(b) The importance to humans of the control of growth, reproduction and development of organisms, including themselves.

Although infrequently attempted, this essay title produced a higher proportion of thoughtful essays and essays with suitable extension material.

Almost all students wrote about farming and how humans attempt to control growth, reproduction and development. The better students wrote about net productivity and the impact on this of various farming practices. They also often wrote about simplifying food webs and ways of removing competition for resources. In this context, fertilisers and pesticides were often mentioned. Some students went on to give good detail about how these affected productivity of producers and energy flows through food webs and chains. Selective breeding was also mentioned a great deal but rarely explained beyond ‘choosing the best animals to breed’. Weak answers wrote about all of the above but without any detail of biological concepts or appropriate terminology. There were some very good accounts of the control of succession to maintain certain habitats and thus conserve certain species.

Control of human populations was discussed by some. More usually, students wrote about controlling populations of other organisms. This resulted in many writing about control of pathogens. How well they fared depended on how much they knew about the topic. Better students frequently included accounts of vaccination programmes and resulting herd immunity as ways of controlling pathogen populations and their growth. Not surprisingly,
many who wrote about pathogens wrote about problems controlling populations of antibiotic-resistant bacteria.

Accounts of various aspects of regulation of gene expression featured in many good essays. This was also a topic area that produced quite a lot of extension material; including some references to epigenetics. Control of cell differentiation and division were often written about and often in relation to cancer. Some weaker students simply wrote about mitosis and/or meiosis but without relating what they wrote to the title. Students who wrote about control of gene expression often went on to write about gene therapy and attempts to control the development of inherited conditions. This was sometimes followed by accounts of genetic counselling, as a way of controlling reproduction to affect inheritance of such conditions.

There were some accounts of genetic engineering to affect the development of organisms and as a way of controlling pests in farming. These accounts were not as frequent as expected. There were few references to using genetic engineering to alter the development of organisms so that they produced substances useful to humans.
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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Convert raw marks into Uniform Mark Scale (UMS) marks by using the link below.

UMS conversion calculator www.aqa.org.uk/umsconversion