General comments

The paper produced a good range of marks and correct responses were seen in all parts of all questions.

Students frequently scored poorly where they were asked for explanations, or to use information, or data provided in questions. There were several parts of questions where students commonly failed to read the question stems carefully. In questions with a perceived How Science Works component, some students ignored the context and produced stock phrases and expressions. However, it was pleasing to note that this appeared to occur less frequently than in previous exams.

Question 1

(a)+(b) These questions involved factual recall in a frequently tested topic area. Despite this, part (a) discriminated quite highly, with students who scored highly on the paper as a whole tending to get the highest marks. About half obtained both marks but 20% failed to score. Most students obtained one mark for noting that the blood in the coronary arteries is oxygenated, or supplies oxygen. They were much less secure about where the blood was going, with many thinking these arteries supplied the rest of the body. Part (b) was better answered by most students.

(c) For this part, many obtained 1 mark for noting that the aorta is the nearest artery to the heart. Relatively few noted that the aorta has a lot of elastic tissue that stretches and recoils, allowing large changes in pressure. Some incorrectly wrote about elastic tissue contracting.

Question 2

(a) About a third obtained both marks and half one mark. The commonest correct observation was that female lizards are longer. Fewer students noted that there is a greater range of lengths amongst females. Many students had trouble expressing themselves clearly. Some said that most females were 90 mm long and most males 80 mm. This is not correct, these are modal values. Others stated that males were mainly shorter than females below 100 mm.

(b)(i) 75% obtained both marks for the calculation.

(b)(ii) The problem for many students in (b)(ii) was that they wrote about factors affecting the number of lizards, not the number of species as required in the stem of the question. This meant that large numbers wrote about less food in the plantation, rather than fewer food sources, and failed to gain credit. The question required students to think about fewer food sources for both lizards and the insects they feed on. Only just over a tenth of students noted that there would be a lower diversity of insects in the plantation. This, together with fewer species of plants, would limit the range of food sources available and thus the number of species of lizard that could live there. It was pleasing to see that many students obtained a mark for stating there were fewer habitats or niches in the plantation.
Question 3

(a) This part discriminated more than was, perhaps, intended. In both (i) and (ii), many students did not read the question carefully enough and included comparisons of properties or function, rather than structure. For example, many wrote about starch and cellulose being insoluble but this is not a similarity of structure. About 40% obtained both marks in (i) and 60% in (ii).

(b) This required students to use the figure and apply some basic concepts. As in (a), some students did not read the stem of the question carefully enough and couched their answers in terms of structures I and J.

(b)(i) Many students described (in various ways) the large open space in the sieve cell and some went on to suggest that this would lead to a (relatively) unrestricted flow; about 30% obtained 2 marks and 40% 1 mark.

(b)(ii) This was where more students failed to score because of answers based around plasmodesmata (J), which are precluded by the stem of the question. Over 40% obtained 2 marks by linking energy from mitochondria to active transport. Some students missed one mark because the examiners rejected references to mitochondria creating or making energy.

Question 4

(a)(i) Only a quarter of students obtained the mark. DNA polymerase catalyses the reactions that make the polymer, DNA. It does this by catalysing the formation of bonds between nucleotides that have already undergone complementary base-pairing to an exposed template strand. Many students described DNA polymerase as making nucleotides base-pair and this was not given credit.

(a)(ii) Many students appeared to ignore ‘DNA’ in the question and included various differences between prokaryotic and eukaryotic cells, including differences in how they divide. As a result, only a quarter obtained 2 marks.

(b)(i) About 40% of students obtained 2 marks in (b)(i). This was usually for references to different sequences of bases resulting in different proteins being made. Some failed to obtain one of these marks because they referred to different sequences on DNA making or producing different amino acids. Few students noted that different species have different genes, reflected in different base sequences.

(b)(ii) About half of students failed to score in (b)(ii). The question did discriminate, in that students who did well on the whole paper tended to do well on this question. Most commonly, correct responses referred to the differences in percentages of C and G and A and T and then went on to suggest there was no base-pairing. A few students correctly suggested the DNA was single-stranded. Weaker responses simply restated the numbers from the table.
Question 5

(a) There were many good answers to part (a) and nearly half of students obtained all 3 marks.

(b) This part also produced many correct responses, with most referring in some way to using a real or intact male in an experiment and recording female responses. Those who failed to score often tried to find alternative ways to use the recorded songs described in the question but without success.

(c) Very few students obtained all 4 marks in (c). This was rarely due to errors but rather to writing at length about only one or two points on the mark scheme. Many noted that courtship occurred when no song was played, or there were no chirps, or no ticks. Others went into a lot of detail about why ticks seemed to be less important than chirps. Many obtained one mark for one or more of these ideas being evidence for some other factor being involved.

Question 6

(a) The examiners noted that many students approached (a) as 'describe mitosis' and proceeded to do so in various degrees of correct detail. The question asked for an explanation of how events in mitosis lead to the production of genetically identical cells. Some students focused on DNA replication but ignored chromatid movements and others only discussed chromatids. Many obtained 1 or 2 marks for references to DNA replication and/or chromatids moving to the poles (of the spindle).

Some students clearly got confused between sister chromatids and homologous pairs of chromosomes.

The examiners were looking for replication of DNA, involving complementary base-pairing, in order to produce exact copies of genetic information. Then, how this is linked to sister chromatids and how their separation during mitosis leads to genetically identical cells.

(b)(i) About 60% of students correctly suggested that the sections had to be thin to allow light to pass through but few went beyond that. The examiners were looking for the idea that thin sections would allow individual cells, or layers of cells, to be seen (and the chromosomes within them, if present). Only about 20% obtained a second mark.

(b)(ii) Many students wrote about the size of the mitotic index in (b)(ii), simply describing the graph and not explaining growth. The examiners were looking for answers relating the rate of mitosis at the tip of the root to growth. A third of students did this and obtained both marks.

Question 7

(a) It was pleasing to see that most students obtained the marks in (a).

(b)(i) There were many good answers to (b)(i) and a third of students obtained 3 marks. Many identified the context as one involving a genetic bottleneck and wrote about lower genetic diversity in the surviving population. Some failed to score the latter point because they wrote about fewer alleles, rather than variety of alleles. Quite a few seemed to imply the idea of the surviving individuals breeding within a small group but failed to express
themselves clearly enough. In a similar fashion, many wrote about an increased chance of inheriting the condition but referred to chances of inheriting the gene, rather than the allele (of the gene) for colour blindness.

(b)(ii) As seen in other exams, many students had a great deal of trouble calculating a ratio and only 50% scored both marks. Many did not appreciate that a ratio should be expressed as something : 1. Other students did not realize that it was important to put the number representing people in the USA on the left of the ratio, given the way the question was framed.

Question 8

(a) There were many good answers to (a), with 25% of students obtaining all 6 marks. For the rest, it was a matter of how much of the story they gave. As in an earlier question, some students failed to gain one of the marks because the examiners rejected references to changes in base sequences leading to different amino acids being produced or made. The most commonly missed point related to changes in bonding within the structure, due to a different primary structure. The examiners were also looking for changes in tertiary structure of the protein, rather than just changes in shape.

(b) In this part, many obtained one mark for noting the difference in response of SR and non-SR above 10 µg cm⁻³. Fewer, about a third, noted the greater effect on the non-SR up to 10 µg cm⁻³ and obtained a second mark.

(c) The logic in (c) defeated many students and nearly half failed to score. In the main stem, it says that the scientists stopped cell division before exposing the bacteria to the antibiotic. Despite stopping cell division in both SR and non-SR, the SR bacteria remained more resistant. This suggests something other than stopping cell division is involved. There were some very good answers (13%) that did follow the logic and obtained 2 marks. Some obtained 1 mark, usually for noting that cell division had been stopped.

(d) Many students obtained 1 mark for suggesting the development/use of either a competitive or non-competitive inhibitor of an enzyme involved in the stringent response. Surprisingly few were able to explain successfully how either of these would stop an enzyme working and thus obtain a second mark. A minority of students obtained a mark for just suggesting the use of an inhibitor (type unspecified) to block the enzyme pathway.

In part (d), students illustrated something that is frequently seen in answers to exam questions. Information is provided in the question, students are instructed to use this information, but then go off on a different tangent. Students who did use the information often produced very good and very clear answers along the following lines. The SR bacteria contain fewer harmful free radicals. They also contain more of the enzyme catalase. (Perhaps) the catalase breaks down the free radicals (before they cause harm). Other students did not make comparisons between SR and non-SR but often tried explanations based around comparisons between free radicals and catalase within strains but with no sensible explanation of how this would help the bacteria. Some invented hypothetical effects of free radicals, or catalase, or both on antibiotics, or on bacterial cells.
Question 9

(a) This part was most notable for the very large number of students who misread the stem of the question. The stem states that the _substrate_ of aromatase was injected into mice. The majority of students wrote about injecting aromatase, the enzyme. This made it unlikely that they could score 2 marks. About 50% did obtain one mark, almost always for noting that removing the ovaries removed a major source of oestrogen. The 20% who obtained a second mark usually did so by noting that this allowed the scientists to control oestrogen (concentration by injecting the substrate).

(b) About 25% scored both marks. These students recognized that one drug reduces oestrogen production and the other stops any remaining oestrogen binding to its receptors. Obviously, this makes the drugs more effective together. Weaker answers just re-stated information about what each drug does from the stem. Others marred their answers by writing about competition by fulvestrant for ‘active sites’, rather than binding sites or receptors.

(c) This required students to explain their answer. Weaker answers were often just observations without explanations. For example, noting that there are only a few mice in each group but not going on to explain that this means the results may not be very representative/reliable. A large number of students incorrectly wrote about standard deviations, when it clearly states that Figure 10 includes ranges. For those who did attempt explanations, it was a case of how many valid points they made; there were 10 on the mark scheme. Only 5% scored all 5 marks but the question did discriminate well, in the sense that students who did well on the whole paper tended to do well on this question.

(d) Many students (about 60%) obtained 1 mark in (d) for suggesting a more reliable measurement of tumour size. Only a quarter noted that tumour area gives no idea of depth of the tumour and went on to get a second mark.

(e) Part (e) produced quite a large number of generic ‘How Science Works’ attempts at answers and these did not score any marks. Many good answers were seen, where students noted that the extra time allowed tumours to develop and thus the chance to see how effective the drugs are on already-developed tumours.

(f) Nearly half of students failed to score any marks in (f). Perhaps most worrying were the students who wanted to give human cancer patients no treatment, or inactive forms of the drugs. The other students often obtained 1 mark for referring to it being unethical not to treat people with cancer. About half of these then went on to suggest the use of existing treatments for cancer; often suggesting chemotherapy or radiotherapy.
Mark Ranges and Award of Grades

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

Converting Marks into UMS marks

Convert raw marks into Uniform Mark Scale (UMS) marks by using the link below.

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