General Comments

The paper produced a relatively good spread of marks, with all students able to access the paper. Less able students had the opportunity to write about what they knew but the better students were able to express their greater understanding and gain very high marks. Students were generally well prepared for this examination this year.

Task 1

Question 1

(a) Nearly all students gave the correct answer 'oxygen' here. Very occasionally, incorrect answers of 'carbon dioxide' or 'nitrogen' were seen.

(b) Most students achieved the first mark point with the idea that the faster the rate of bubbling, the faster the rate of photosynthesis; rather than using the words proportional to, or correlates with. Some failed to obtain this mark by stating that the rate of bubbling was equal to the rate of photosynthesis, or just that it could be used to calculate it. Only the best answers went on to state how the oxygen was produced and gained the second mark.

(c) The vast majority of students gained credit for the idea that respiration uses oxygen gas, or produces carbon dioxide gas, and many went on to gain the second mark for how that would affect their results.

Question 2

Most students had the idea of using the beaker of water to reduce temperature changes. A few answers were seen that related to refraction of light, so that it would be the same as the plant was used to. These answers were not given credit.

Question 3

Better responses showed appreciation that the rate of photosynthesis would become constant. Many gave answers relating to the plant ‘getting used to/acclimatising to the new conditions’, this was insufficient.

Question 4

(a) Precise descriptions were required here of additional measures that needed to be taken to control variables, beyond the apparatus shown in the diagram.

- Temperature: many students just described the water bath, as shown in the diagram, but this was insufficient to gain credit here. Too many students wrote that they would use a thermometer to keep the temperature constant and failed to obtain the mark.
- Piece of plant: too many vague answers were seen relating to using the same plant and not being specific about the piece/length/mass of plant, or the reason for using the same piece of plant (same surface area/chlorophyll concentration).
- Carbon dioxide: same ‘amount’ of sodium hydrogen carbonate was insufficient. Volume was needed, unless the student clearly demonstrated an understanding of the fact that the sodium hydrogen carbonate in solution provides a continuous excess of carbon dioxide.
• Light: again a little more was required to gain this mark than many students gave. Just keeping the background light the same was insufficient, unless linked to maintaining the intensity/wavelength of the light.

(b) Better answers expressed the importance of only the independent variable affecting the results. Many gave vague answers relating to other variables not influencing the results and did not gain credit.

Task 2

Question 5

(a) The vast majority of students gave a reasonable null hypothesis. Some incorrectly stated that the rate of photosynthesis would be the same as the wavelength of light.

(b) and (c) Nearly everyone correctly selected standard error and 95% confidence limits.

(d) Most calculations were accurate and complete. When calculating standard deviation, some students used Σ(n-1) and some Σn; either was given credit but it should be noted that in these circumstances Σ(n-1) is more correct. Common errors in the calculation included not multiplying the standard error by 2 and calculating the range around the standard deviation rather than the mean. Some students did not complete the calculation to show the range around the mean and could not gain credit unless this idea was shown somewhere (either within the calculations or on the graph paper).

(e) Many students gained both marks here and answers seem to be improving on previous years. The most common error was failing to mention more than or less than a 5% probability level.

Written Test: Section A

Question 6

A variety of answers was seen here but most students gained credit for the idea that different pieces of plant would photosynthesise at different rates.

Question 7

There was a variety of answers that gained credit. Some students gave vague answers relating to running out of time and, without referring to repeats, this was not enough.

Question 8

Many students wrote about identifying anomalies and eliminating or ignoring them; this was not credited. Vague answers relating to results being more reliable or allowing a mean to be calculated were insufficient. The list rule was applied here; so students who gave three reasons, where two were correct and one related to eliminating anomalies, only scored one mark.

Question 9

This was generally answered well. A few students used the wrong numbers from the table and one or two were confused by the standard deviation and tried to incorporate this into their calculation.
Question 10

More sophisticated answers were required to gain credit here. Those students who wrote ‘food source’ rarely went on to state ‘food source for the plant-eating fish’. Similarly, those who wrote ‘shelter’ rarely went on to describe why this would be important for reducing stress or avoiding predators. Some gave acceptable alternative answers relating to plants providing a place for fish to lay eggs.

Question 11

(a) Students had to relate the high percentage of red light to the rate of photosynthesis. Credit was not given if this was only related to the rate of bubble production. Some seemed confused by the data for white light and described how this lamp had the most even distribution of colours and was, therefore, ‘most similar’ to white light. This did not gain credit.

(b) Most students gained this mark.

Question 12

Many students seemed confused by this apparatus and described the syringe as a gas syringe. Others related it to a type of potometer, where they were moving the bubble to the start of the scale to take the next reading (presumably thinking the measurement was of the bubble movement rather than the size of the bubble produced).

Question 13

This question was generally answered well.

Written Test: Section B

Question 14

This was answered well by many students, although some failed to identify the peaks accurately.

Question 15

This was answered well, with many scoring three marks. Only better answers noted that at all wavelengths less light energy was passing through, for mark point 1. Very few went on to point out that photosynthesis would not exceed respiration (mark point 5). Some students stated that none of the pigments could absorb the wavelengths that pass through, rather than specifying chlorophyll.

Question 16

Many students gained one mark here but few achieved both. Many identified that light or temperature would not be limiting but did not go on to describe how this would affect the biochemistry of photosynthesis. Some mentioned the use of carbon dioxide in the light-independent reaction but did not link this to the high use of carbon dioxide, to gain both mark points 5 and 6. Several answers were seen with a clear misunderstanding that a higher concentration of oxygen causes a lower concentration of carbon dioxide.
Question 17

This was generally answered well. Some references to error bars without mention of representing standard deviation were seen, and these answers were not given credit for mark point 2.

Question 18

This was generally answered well. There were some inappropriate uses of grids and coordinates and some trees shaken or beaten to remove leaves; neither method was credited.

Question 19

The vast majority of students pointed out that there was no overlap of standard deviations (or \(2 \times\) the standard deviation) for mark point 3 but did not go any further to gain the second mark. Although the range was calculated correctly by many for mark point 4, very few correctly identified that it was not possible to draw a conclusion without a statistical test result. Many students referred to standard error without appreciating that this had not been given and could not be worked out without knowing the sample size.

Question 20

This question provided an opportunity for students to shine and express their understanding correctly in the context of the information provided. Many answers were seen, however, relating to sun leaves being warmer and therefore having more enzyme activity to produce chlorophyll. These were in the wrong context and did not gain the marks.

Question 21

Most students identified that chlorophyll b could absorb some of the light that passes through leaves. Many then failed to identify accurately the cross-over ranges of light available and light absorbed to gain the second mark.

Question 22

(a) A very poorly answered question, because the vast majority of students incorrectly chose hypothesis 1 for which there was little or no evidence. The few who fully understood the data, the implications of the hypotheses and who chose hypothesis 2 usually scored 2 marks.

(b) Few students were able to offer suitable additional evidence. Many gave answers relating to absorption by pigments at different wavelengths, information that they had been provided with already. There were, though, some very well thought out answers, marks most often being given in relation to finding out the effect of bright light on chlorophyll (mark point 3).
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.

UMSconversioncalculator