Version 1.0

General Certificate of Education (A-level)
June 2012

Human Biology HBI3X

(Specification 2405)

Unit 3X: Externally Marked Practical Assignment

Report on the Examination

Further copies of this Report on the Examination are available from: aqa.org.uk

Set and published by the Assessment and Qualifications Alliance.

The Assessment and Qualifications Alliance (AQA) is a company limited by guarantee registered in England and Wales (company number 3644723) and a registered charity (registered charity number 1073334).
Registered address: AQA, Devas Street, Manchester M15 6EX.

General comments

The task set within an EMPA is based on the specification. This may relate directly to a practical investigation identified in the units, or require use of the investigative and practical skills in a new context but still based on the specification. Students are expected to have carried out the identified practical investigations but there is a concern that investigations involving chromatography may not have received appropriate attention in some centres.

Performance with Task 1 was a little disappointing but graph skills were generally good. Some weaknesses still exist with table construction and the degree of detail expected for identification of the independent and dependent variables. There was a modest improvement in performance with Section B of the Written Test.

Few centres reported any difficulties with the investigation. The examiners greatly appreciated the use of treasury tags to hold the components together. Most centres included a signed Centre Declaration Sheet, as required, but not all teachers remembered to tick the practical skills verification and sign the front of the Written Test paper.

The mark scheme made allowance for potential but valid different interpretations of questions. The commentary that follows focuses on the key ideas that were expected and whether students expressed those ideas and met expectations.

Task 1

Question 1

A large proportion of students took full advantage of what was anticipated to be a simple opening question but there were several common errors. While the use of mixed units was not penalised where they were alternatives in common use, such as cm^3 and ml, it was not uncommon to see cm^2 or ml^3 suggested. Quite a few apparently used solutions other than water to make their dilutions and in many cases the volumes used did not add up to 1.0 cm^3 as required.

Question 2

A suitable way of determining when a solution turns clear had evidently been considered in the majority of centres. It was not helpful when students proposed to recognise the end point – a clear solution – when they saw that the solution went clear. A less subjective practice was required, such as the ability to visualise letters or words through the solution when it was clear, or a standard such as tube of water, or the result of a pilot trial to compare against. Quite a few failed to identify that they would follow the same procedure for both trials.

Question 3

Repeat investigations allow not just the calculation of a mean, but of a mean that is reliable. This idea was often expressed poorly with many giving the advantage as producing 'reliable results'. Alternatively, the ability to recognise anomalies was widely appreciated; although the spelling of this term remains a challenge for many.

Question 4

Surprisingly, most students could not give two appropriate ways to improve the method used in the investigation. Given the involvement of an enzyme, it was expected that more than just the few seen would suggest controlling pH by the inclusion of a buffer. The beaker and thermometer did constitute a water bath but many wanted to use a 'proper' water bath. Those who proposed using some form of electric or thermostatically controlled version gained credit but 'proper' did not. The use of a colorimeter to provide quantitative data was

not widely appreciated. Only a minority recognised that tube **B** (the enzyme solution) should also be incubated before mixing and, similarly, only a few identified that 37 °C would be the optimum temperature for enzyme activity.

Question 5

Time taken for the solution to go clear was being measured providing numeric and quantitative data. Many students thought that the data would be qualitative because the dependent variable was their judgement of when the solution had gone clear as opposed to how long it took for the change to occur. A minority confused the two terms.

Question 6

Quite a few students produced what appeared to be rehearsed but not usually productive answers about accuracy (and precision). Students who had given due consideration to their own method generally provided appropriate suggestions. Although a more precise value could be read on the timer, it would not improve accuracy because the end point was subjective, a judgement of when the solution became clear. Also, the time it would take to stop (or start) the timer would be more than the additional precision provided by the timer.

Task 2

Question 7 – the table

The table has been a feature common to all previous EMPAs (and ISAs). Centres have had time to appreciate the requirements and expectations. Accordingly, it was often the case that students achieved full credit. There were few errors, but students who made them were at a clear disadvantage, given the performance of most. Errors included the failure to identify the independent variable as trypsin concentration; headings such as 'Tube A' were insufficient. The dependent variable heading was sometimes incomplete, given as just 'Time'. The method required the recording of time in seconds. Some chose to record in minutes and seconds (a failure to follow the method) and this lead to the inclusion of mixed units, also an error. Only a few made the mistake of including units within the body of the table.

Question 8 – processing of data

The outline method advised students of the potential time required for a solution to go clear. This was to assist planning and enable more than one set of results to be collected. For processing, it was expected that means of the data would be calculated and that these would be used accurately with the given units to use. For the majority of students, this proved to be true.

Question 9 – the graph

As with the table, requirements and expectations are now well known and were met, in most cases, by students. Students were told the unit to use for the relative rate of reaction. There was some confusion where students chose to disregard this and do otherwise. The major weakness was with the choice of scale for the independent variable. Even some of the better students, as shown by their overall performance, failed to recognise that the concentrations of trypsin were not equally spaced (0.1%, 2.5%, 5.0% etc.) and, consequently, they produced a scale for the x-axis that was not linear. With only a few exceptions, a line graph was drawn appropriately. Students should be discouraged from extrapolating data beyond the plotted points and advised that joining points, dot-to-dot, is often a better representation of the data than a curve of best fit, especially where there is limited number of plotted points.

Written Test: Section A

Question 10

Many students offered a guess at how long would be suitable. Those giving more considered answers identified timing how long it took to reach the required temperature, or the same temperature as the water bath, and then applying this to all tubes.

Question 11

Students often failed to provide sufficient detail when asked to "Describe what the contents…" would be. The enzyme should be replaced by an equal volume of water or boiled enzyme. Weaker responses gave no consideration to maintaining the same overall volume as the experimental tube, for which there was some credit, or even including milk in the control experiment. Surprisingly, many wanted to retain the active enzyme in the control tube. In such cases an imaginary relative rate of reaction figure was proposed instead of a rate of zero that one would expect given that no enzyme would be present. Some tried an unspecified 'low' value, revealing a lack of understanding of what the control should contain.

Question 12

This question proved to be a good discriminator of ability. A detailed description was required in part (a) but few included both variables. "It goes down from A to B and goes down further from B to C" did not recognise the overall trend that as concentration increases (independent variable), time taken decreases (dependent variable). Most did differentiate between the need to describe in (a) and provide an explanation in (b), although the explanations revealed a lack of basic knowledge in some cases. Good answers demonstrated understanding that enzyme concentration was the limiting factor between A and C and understanding that increasing the concentration would increase the number of available active sites. Between E and G, however, this would no longer be the case; substrate concentration would now be the limiting factor, which explained why the rate remained constant beyond a certain concentration of enzymes. Relatively few students demonstrated the knowledge and understanding required to explain the constant rate of reaction. Some centres should be congratulated on how well their students had been prepared. Complete responses were infrequent but, where a full understanding was shown, a sound appreciation of scientific principles was evident.

Question 13

The splitting of a bond using water was all that was required. Some complicated this by identifying inappropriate bonds; it is never a good idea to offer more information than necessary and, in this case, for just one mark. Others managed to confuse hydrolysis with condensation. Even though the question stated that the milk protein had been fully hydrolysed, some accounted for the colour change by proposing the continued presence of some milk protein or imagined that amino acids had quickly recombined. Good answers identified enzymes as proteins that would remain, unaffected, to react with Biuret reagent.

Written Test: Section B

Question 14

Some students were a little confused about which substance was the enzyme, what the substrate for the enzyme was and whether an active site is a feature of an enzyme or a substrate. It was acceptable to suggest that the alpha-1-antitrypsin attached to the active site or attached to some other part of trypsin. Either way, a change in the shape of the enzyme would result, with a consequent inability of trypsin to form enzyme-substrate complexes with proteins (in lung tissue).

Question 15

Some students only provided a general definition of 'healthy people' and did not relate their definition to the specific investigation. It was sufficient to identify that in the investigation in question, healthy people would be free of lung disease.

Question 16

The majority of students were comfortable with explaining the meaning of range and median but were less confident with explaining standard deviation. In some cases, the choice of language was not given sufficient consideration. Having already provided a definition for range in part (a), it did not help to describe standard deviation as "…the range of values…", or "…the average distance from the mean…".

Question 17

Few students looked for an overview or took a starting point that the results showed that there was a correlation, or simply a link, between the concentration of alpha-1-antitrypsin and lung disease and then considered how the data supported that assertion. Many did still achieve full credit by recognising that the mean values for both lung diseases were higher than for the control group of healthy people. There was some reference to ranges but it was inappropriate to assert that the lung disease ranges were greater. Few picked out that the bottom values of the ranges were higher as were the top values of the ranges for both lung diseases. There was nothing to be gained by considering people with asthma in this question but that did not prevent some students from doing so.

Question 18

Without justification, some took the view that asthma was not a lung disease. This made it a little more difficult for students to achieve full marks in this question. 'Evaluate' usually requires that reasons for supporting or doubting a conclusion are given. In support, it could be seen that both the mean and the median were higher for all three types of lung disease (than for healthy people). Students were generally better at identifying reasons to doubt the conclusion such as the inequality of group sizes, the overall sample size, the overlap of the ranges for both healthy people and those with lung disease and the concern that the conclusion may not be true for other types of lung disease.

Question 19

As a part of Unit 1, students are expected to have carried out practical investigations involving chromatography and the calculation of Rf values. For some, this did not appear to be the case. There were clear differences between centres in how this task was approached and the level of detail that was provided. There were many examples of excellent detail and consistent full marks for students of some centres, but there were also situations where it would seem that due consideration had not been given to the specification requirement. In such cases, students were at a disadvantage. Weaknesses in some accounts related to applying a stain to the mixture on the origin line, not keeping the origin line above the level of the solvent, or not removing the paper before the solvent reached the top.

Mark Ranges and Award of Grades

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