



General Certificate of Education

Human Biology 2406

**HBI6X Externally Marked Practical
Assignment (EMPA)**

Report on the Examination

2010 examination - June series

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General comments

This was the first examination of this component for the new specification. Candidates would have completed the AS version of either an ISA or EMPA and it was anticipated that a good appreciation of How Science Works would be in place. In part this was true but weaknesses from AS were still evident with some aspects of the investigation and questions that arose. This was also the first opportunity to test understanding of the use of statistical methods. A general observation was that while the majority used the Students' Statistics Sheet appropriately, when it came to a question within the written test where an interpretation was required, explanation was less convincing. In short, while many had been prepared for the statistical analysis of data, there was a weakness with understanding how a test statistic or probability value should be interpreted.

Assessment Advisers reported that few centres had difficulties with the investigation. There was a typographical error with the concentration of urea required in Task 2, but this did not affect the investigation and consequently was only reported where a centre questioned the concentration. Centres are reminded that candidates are required to collect their own data. If there is a problem on the day, candidates should be provided with another opportunity to collect their own data. A candidate has restricted access to marks associated with the table if data are supplied. This is because it is expected that a candidate's investigation will reveal a particular trend. Centres should ensure that sufficient trials have been carried out to make collection of adequate data possible. However, this was an issue for only a small minority.

The mark scheme made allowance for interpretations to questions that could also be valid. However, the commentary that follows focuses on the key ideas that were expected and whether candidates met the expectations. What is revealed, as a generality, is that too few candidates spend enough time understanding what the investigation is about. Without such comprehension, it is little wonder that some of the answers or responses seen made little sense in this context.

TASK 1

Question 1

Most candidates made a good start and were able to complete the table successfully. A minority did not provide appropriate units and a few suggested relative volumes that would not produce the required concentration. This was usually a result of wanting to keep the volume of urease constant in making all concentrations.

Question 2

Seemingly a simple question testing knowledge to meet an AO1 requirement, the length of the list of suggested names for the type of reaction was alarming. Some, such as decarbonisation, bore no relationship to study for this specification and left the examiners to wonder where such a suggestion came from. Teachers will also wonder how their A2 candidates could offer anything other than hydrolysis, but so many did.

Question 3

The need for equilibration was described in various ways, many worthy of credit, but it was rare to see use of the term. Few were able to explain clearly whether a water bath was necessary or not. Many candidates appreciated that temperature would become a variable if not controlled, or that air temperature fluctuates more than water temperature and a water bath would overcome this. However, it would have been equally valid to explain that the speed of the reaction meant that any temperature change would be insignificant and hence a water bath would not be required in such circumstances, but very few considered this as a possible answer. In (c), simply adding a thermometer to the water bath does not monitor the temperature, readings must be taken at intervals. This is a basic HSW idea yet a significant number failed fully to describe how it should be done, even when now at A2.

Question 4

There were better explanations of the purpose of the control. This could be expressed either as showing that there would be no colour change without the enzyme, or that any colour change would be due to the enzyme. Reference to the enzyme was required, so just “to make it a fair test” lacked the necessary explanation related to this investigation.

Question 5

The choice of concentration was expected to vary according to the results of each candidate. Those that related their choice to allowing adequate time for measurements to be made, or allowing time for replicates to be fitted in within the session, appreciated what the question was expecting.

Question 6

Many focused on the effect of pH, producing a rehearsed answer, and did not consider the context of the investigation. Better candidates, those that appreciated the science within the investigation, or to put it more simply, those that had understood what they were doing, realised that a buffer would prevent a pH change and yet, the investigation depended on a pH change to produce the end point. Thus, it would not be appropriate to use a buffer in this case.

TASK 2**Question 7 – presenting data (the table)**

Table skills are also assessed at AS so it was to be expected that candidates would be well prepared. This proved to be the case. IOB conventions were invariably followed but a weakness was to not give a full description of the dependent variable in the column heading. Centres are reminded that, although not a specific requirement, a title can sometimes provide further detail for an otherwise incomplete column heading. It is therefore suggested that it is a good practice to provide a title for the table. The accuracy of data was shown when the lowest used temperature did not equate to the optimum temperature for the investigation. Candidates who had been supplied data could not achieve this mark. Centres are reminded that they should ensure that they have conducted adequate trials of the investigation.

Question 8 – Statistical Analysis

With the Students' Statistics Sheet in front of them, it was anticipated that much credit could be achieved with this part of the investigation. This did not always prove to be the case and few candidates achieved full credit. Many had difficulty with stating a null hypothesis and this suggests more practice is required. Weaker candidates tried to make a connection between time taken and temperature as opposed to a change in temperature having no effect on enzyme activity.

Either of the *t*-test or standard error and 95% confidence limits would have been an appropriate test to use, since the investigation was comparing two means, or two sets of measurements. Examiners saw all possible tests suggested, including standard deviation, not in itself a statistical test and not part of the flow chart on the Students' Statistics Sheet. An inappropriate test could not achieve credit for reasons for the choice, but where candidates had chosen an appropriate test, most were able to use the Sheet to select appropriate wording to support their choice. The majority of candidates produced an accurate calculation of the test statistic. The ability to demonstrate this skill was allowed even where the wrong test had been chosen. Similarly, an appropriate interpretation of the candidate's calculated test statistic was also allowed. However, there was a general failure to refer to both probability and chance during the interpretation and more direction will be provided in future. There was no necessity to compare any more than two temperatures, but a few candidates attempted to do more than was required for no possible benefit. Some centres are to be congratulated for how well their candidates were prepared for this aspect of the EMPA.

EMPA Written Test**Section A****Question 9**

To answer this type of question, it would be advisable for centres to give more attention to how an end-point is determined. Where an end-point is subjective, it helps to have a standard to compare against. This then allows all tubes to be measured to the same colour (pink/red in this case). Many identified use of their first result to compare all others against. This was equally valid. Another strategy, which few recorded, is to allow a run past the perceived and timed end-point, for confirmation that it has been reached.

Question 10

This question anticipated that candidates would articulate the subjective nature of the end-point. Inevitably there are differences with how people recognise colour change and this would affect the reliability of combined data. With different water baths used, it would also be a problem maintaining all at exactly the same temperatures. Given all candidates carried out the same investigation though, concentrations of materials used would not vary but the source material for making them might, another reason for questioning the reliability of combined data.

Question 11

All that was expected in this question was a justification of the temperatures chosen based on a reference to the data collected and not to what a candidate thought might be shown by the

temperatures. Candidates had been told that the optimum temperature for bacterial urease was not the same as for human enzymes in Task 2, so it was inappropriate to make assumptions, or base suggestions on what was known of human enzymes. It was acceptable, for example, to propose using temperatures where the data showed little variation, or choosing the two temperatures where the data seemed to show a large difference.

Question 12

Many candidates did not appreciate that the question provided a probability (p) value and that this would have been determined from the critical value obtained during analysis. Thus, many attempted to describe how the critical value should be determined and how it should then be interpreted. Candidates who had performed well during the statistical analysis of their data were often found wanting in this question. But there were also candidates who showed a sophisticated understanding of statistical values beyond just being able to use prepared sheets. For these candidates, it was clear that the difference in results was not due to chance, and that the null hypothesis would be rejected because the probability of the difference being due to chance was less than 0.05.

In part (b), it was surprising that so few drew attention to the overlapping standard deviation bars and what this showed, or the need for a wider range of temperatures to test the conclusion. Many were keen to agree with the conclusion but had difficulty finding ways to support their decision.

Question 13

It was disappointing that the majority failed to use the information from, and understanding of, the investigation to answer this question. As was apparent elsewhere, the question was only answered on face value. The few who did show understanding identified the inability to produce urease or ammonia as reasons for the non survival of bacteria in gastric juice, but most did get some credit for knowledge of enzyme denaturation as a reason.

Question 14

Given that the researcher investigated pH, it was hardly appropriate to control pH but this did not deter a significant number of candidates from suggesting it should be. However, many did finish this section identifying two appropriate factors to keep constant.

Section B

Question 15

Most candidates were successful with the early parts of this question but were less so with the last part. This was mainly due to a failure to express the problem that the test would detect *H.pylori* as well as *P. mirabilis*, since both would cause a colour change. Few recognised that this could be overcome if a time comparison (for colour change) was available.

Question 16

What was thought to be a straightforward question troubled a great many candidates. Even though just two substances needed to be identified, some gave three. There was a multitude of suggestions as to what these substances might be, including urease itself. A few could not differentiate the use of this reagent strip from earlier knowledge and proposed that glucose would be present, showing no understanding of what was happening.

Question 17

The lack of comprehension was again evident in part (a) despite the provision of information. It was anticipated that most would identify that the carbon dioxide in the breath, from the breakdown of urea, would be radioactive, thus allowing detection. The specification tests limited chemical knowledge but many believed that the carbon isotope would be in the ammonia. This suggests that some candidates believe that ammonia contains carbon and is a normal component of breath.

Most candidates only answered some of part of (b). There was little reference to what a programme of treatment, such as an antibiotic appropriate for use with *H.pylori*, might be.

Question 18

Most were successful with the calculation, and many appreciated that data presented as percentages did not reveal the number of patients in a category. Only better candidates recognised the limitation of a single study or the absence of information about sample size.

Question 19

Performance in the final question varied and discriminated across the ability range. Better answers identified the urease test strip as the most appropriate to use but some credit was possible for other suggestions where a valid explanation of the choice was given. Good answers made reference to its non-invasive nature, the speed with which a result was obtained, the lack of requirement for specialist facilities, and the ability of patients to carry out the test for themselves. For many though, this sort of thought process was not evident and the relative merits of each test were considered instead.