



LEVEL 3 EXTENDED CERTIFICATE **APPLIED SCIENCE**

ASC6a: Microbiology
Report on the Examination

1777
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General

The entries were all well marked by college assessors who showed a good level of understanding of the standards expected at Pass and Merit levels. On this occasion, Distinction level portfolios were scarce, but this may have been due to time pressures and some submissions where PO4 was significantly less well completed than other aspects of the course. Issues with PO4 were similarly reported for the last series, and with six marks available from this performance outcome, it is an important point for colleges to consider for any future submissions.

Compared to summer 2018 submissions, there was an improved approach to the practical work in terms of the ways in which it fitted in logically with the assessment criteria and the requirements of the unit content. It remains important that, for all practical work:

- an observation statement is completed to support student achievement and to provide the evidence that they have completed the experiment, followed the standard procedure, applied the risk assessment, used aseptic technique, recorded results correctly, etc
- if the student has not provided, for instance, photographic evidence to support results (eg images of plates), then the observation record should do that, again supporting student achievement and the award of college marks
- the Unit Submission form signatures of both the student and the teacher are present to confirm that the work submitted is that student's own independent work.

P01: Identify the main groups of microorganisms in terms of their structure

P1, M1

The requirements are clearly described in the unit content and also the performance descriptor. All three types of microorganism should be covered with the same degree of detail. Whilst akaryotes could theoretically be covered by using red blood cells as an example, the delivery guidance (specification p101) does clearly indicate 'viruses'.

P1 and M1 were covered well by many students. Good portfolios had the following content for all three types, all research based and with source material adapted well by the students in most cases:

- characteristic structures and features
- labelled diagrams
- functions of the key features.

There was clear evidence of un-reworded 'cut and paste' in some instances. This negated the mark(s) awarded, immediately putting relevant students at the tolerance limits

P2, M2, D1

P2 should describe methods used to identify microorganisms to include:

- Gram staining
- light microscopy
- electron microscopy
- colony characteristics.

Annotated diagrams and images from research will add to the descriptions.
All techniques are expected to be covered.

M2 continues from **P2** and explains how the techniques used and structures of microorganisms are linked. Again, to achieve M2, all the techniques covered in P1 should be considered.

- How differences in structure for different types of bacteria enable them to be identified by Gram staining?
- How colony characteristics (morphology) enable microorganisms to be identified?
- How light microscopy and electron microscopy are used and how their usefulness is related to resolution and magnification and the structural features of the microorganism?

D1 expands the information established in M2 and compares the use of the techniques in biotechnological industries.

Whilst there is much information that can be researched, students struggled to identify suitable industries in the first place and this then impacted on their ability to compare techniques across the different applications. Food and beverage, pharmaceuticals, water, environmental, and forensics are just some areas that could be researched, but there are new applications emerging all the time.

P3 is a practically based criterion and it would be sensible to integrate this with the relevant content in P2 and M2. The evidence that allows this to be awarded consists of the following:

- standard procedure and risk assessment followed (both issued by college)
- Observation Record
- individual student results (eg photographic images)

P02: Use aseptic techniques to safely cultivate microorganisms

P02 leads directly on to aspects of study assessed in PO3 and which feature later in portfolios. It would be good practice, when students are reviewing portfolios, to include links on the relevant pages, or, for instance, an indication that ‘this technique, pour plates, is later used for the investigation of the effects of temperature on bacterial growth on page...’.

The portfolios seen this January had a more complete and logical approach to all the criteria in PO2 and PO3 than previously seen.

P4, M3

P4: Risk Assessments are prepared by each student for the safe cultivation of microorganisms and include:

- preparation of sterile growth media
- names (and types) of microorganisms used
- cultivation of microorganisms
- aseptic techniques
- safe disposal.

Colleges should note that, without specific identification of the microorganisms used and full risk assessments associated with them, the risk assessment will be considered to have significant omissions and should not be awarded credit.

M3: Explanations of control measures taken can be incorporated into the risk assessment table, or considered separately. This should include explanations of how aseptic techniques are applied and how they contribute to the control measures. Details of aseptic techniques should be included.

M3 cannot be considered for credit if P4 is not awarded.

P5, M4, D2

The choice of which three cultivation techniques to carry out is a matter for the college, but there must be at least two different types of microorganism used as indicated in the delivery guidance (specification p101).

To award **P5**, the following are required:

- standard procedure(s) (issued by college) for the preparation of the growth media
- standard procedures (issued by college) for all three techniques including incubation
- observations (eg photographic evidence, suitably annotated)
- observation record supporting the completion of all three techniques including evidence of following aseptic technique.

M4 requires:

- an explanation of the principles behind the use of growth media
- an explanation of each of the three techniques
- (separate) clear accounts for each cultivation technique and associated evidence
- clear evidence that the three techniques were all completed successfully.

Although reported as not a strong area for many students in summer 2018, there was a more organised approach evident this January. With all the material / evidence correctly provided for M4, it is then easier for students to move forward and evaluate the effectiveness of the techniques for **D2**.

P03: Use practical techniques to investigate the factors that affect the growth of microorganisms

P6, M5, D3

The specification lists 10 different factors which promote or inhibit growth of microorganisms, and **P6** requires a selected range to be described. There can be a tendency for lower scoring portfolios not to describe sufficient factors or provide little detail of those considered.

M5 requires practical work investigating three factors that affect growth. The expected approaches to this work include the following (see, also, delivery guidance - specification p101):

- Use of a range of cultivation techniques, typically following on from those used for P5.
- Use at least two types of microorganism if carrying on from P5.
- Use a range of counting or measuring techniques to include measuring clear zones and viable counts.
- Use serial dilutions in one of the practical techniques* (so meeting P8). Alternatively, serial dilutions can be used in a separate, unrelated activity, for instance with a haemocytometer based investigation as suggested in the delivery guidance (specification p102).
- Standard procedures, risk assessments (college issued).
- Observation records, evidence for completion of all three practicals including aseptic technique.
- Recorded results, images, photographic evidence.

Portfolio evidence was variable across a range of colleges and some was particularly weak:

- Some results were poorly presented, others were entirely absent or incomplete
- Only 2 temperatures were investigated by some students: the specification (p102) suggests more
- Graphs were produced based on minimal evidence (eg only 2 temperatures).
- Some did not report all three investigations but were incorrectly awarded credit.
- Some results were identical across all students indicating group work, but there was no indication of individual contribution. The Observation Record should record any use of group or pair work and the individual's contribution.

D3 follows directly on from M5 and draws conclusions concerning the effects on growth of microorganisms by the three factors investigated.

P7, M6, D4

P7 requires the use of one suitable technique to count/measure microorganisms. This was most commonly a haemocytometer, but success rates varied with the student's levels of understanding. Many could not follow the explanations and calculations through to a successful conclusion.

That said, there were some excellent explanations of the use of haemocytometers in some colleges, with well explained subsequent calculations. Viable counts were also a popular choice of technique and worked well for a number of colleges.

In addition to, and in combination with, serial dilutions, the following techniques may be used:

- viable counts on plates
- haemocytometer (direct counts)
- colorimetry (to measure turbidity and so an indirect count)
- measurement of clear zones
- viral plaque assay.

Colleges generally avoided turbidity and preferred their students to achieve a more directly quantitative approach. Also, for turbidity, the complete determination via standard samples of known bacterial counts is probably beyond the scope of most, and some basic colorimeters may give questionable results.

M6: Explanations of the technique used were often not sufficiently detailed, and were based on incomplete understanding of the processes involved as indicated above. It would be appropriate to record all 'raw' data, rather than just state the number of live cells. The specification (p102) indicates that the total count should include viable and non viable cells.

D4 (evaluation of measuring and counting techniques and suggestions for improvement) was often left by students until all the required elements of PO3 had been completed, and this included serial dilutions (P8) and calculations relating to the original sample (M7): this is entirely acceptable.

P04: Identify the use of microorganisms in biotechnological industries

P04 requires independent student research, suitably referenced, and (very importantly) targeting the relevant sections of the unit content and the PO grid. This was often a tough area for students, and some promising earlier sections (for PO1, 2, 3) were not reinforced well by their work in P04.

Whether a weaker final performance outcome was the result of time constraints, insufficient research, or simply a lack of understanding of the specific requirements of each of the six relevant criteria, was not clear from the submissions seen.

It is important that the research and portfolio content target:

- biotechnological industries (and not, for instance, the Haber process or other inorganic industrial reactions) for **P9**
- named microorganisms and specific biotech industries for **D5**
- named microorganisms again in **P10** and **M9** (which may be different from those stated in D5)
- relevant processes or techniques in two different biotech industries for P10 and M9
- genetic engineering of microorganisms in one biotech industry for **D6** (which may be a different industry again).

Further details relating to previous submissions can be found in the report for summer 2018.

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](#)