Chemistry and Physics
Advice for teachers

The importance of instrument-specific criteria and standards:
Moving on from "marks"

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The Chemistry (2007) and Physics (2007) syllabuses require that each assessment task be accompanied by an instrument-specific criteria sheet that is derived from, and consistent with, the standards associated with exit criteria, as defined in the syllabus (pp. 28–29 for Chemistry, pp. 30–31 for Physics). Instrument-specific criteria sheets are usually presented as a matrix that sets out the requirements of the task in terms of the syllabus exit criteria and also defines five standards in each aspect of the criteria to be assessed. The extent to which the syllabus standards are reflected in an instrument-specific criteria sheet will vary according to the general objectives associated with the task and according to the stage in the course. Instrument-specific criteria sheets must be provided to students before they undertake an assessment task. These instrument-specific criteria sheets:

- clearly specify each of the five standards (A–E)
- inform teaching and learning practice
- are annotated to indicate student achievement
- provide the basis for teacher judgment about student achievement
- provide students with the opportunity to develop self-evaluative expertise.

An analysis of the standards associated with exit criteria quickly reveals that the discrimination between each standard is on the basis of quality, not quantity (see following page). For example, the difference between the B and C standards in the first element of Knowledge and conceptual understanding (KCU) is in interpretation (as opposed to simply reproduction) of concepts, theories and principles of greater complexity or challenge. This means that B-standard evidence is different to (not just more than) C-standard evidence. The excerpt from the syllabus on the following page highlights the aspects of the standards that discriminate at the various levels of achievement.

Instrument-specific criteria sheets support teacher judgments on the quality of student work, rather than the quantity. The syllabus standards discriminate on the basis of quality. For example, numerous correct responses to “recall” and “describe” type questions may yield many numerical marks (high quantity), but may still only provide evidence of a C-standard when matched to the syllabus descriptors (a qualitative decision).

Instrument-specific criteria sheets provide students with powerful feedback and feed-forward devices. They preserve the relationship between syllabus standards and teacher judgment. Students can be taught to interrogate instrument-specific criteria sheets in order to make informed judgments about their areas of weakness with respect to the syllabus criteria. Teaching students this skill allows the formative potential of criteria-based assessment to be more fully realised. The syllabus requires that criteria sheets be annotated to support teacher decisions about the quality of the student work. The more specific and extensive this annotation is, the more useful it is to students. Attempting to encode syllabus standards in numerical grading systems, by definition, separates the criteria and standards from which the marks were derived. Not only is such practice inconsistent with syllabus intent, but it may also disadvantage students because they may not be well informed about the specific areas of their strengths and weaknesses.

Instrument-specific criteria sheets have greater capacity than numerical marks to preserve the strengths and weaknesses of students’ responses with respect to the syllabus criteria and standards. A student’s folio of work (be it for any interim semester, monitoring, verification or exit) is a collection of individual instruments, and is to be judged as a whole, rather than as the sum of its parts. Although the total folio must demonstrate a student’s achievements in all three general objectives (KCU, IP, EC), the emphasis on each criterion may vary from instrument to instrument. Judgments on a student’s achievement in a particular criterion must be based on the extent to which the pattern of evidence, from a suite of assessment tasks, matches with the syllabus standards for that criterion. An on-balance judgment can then be made in each criterion. It is not an appropriate practice to ‘‘add-up” or aggregate grades to arrive at an overall judgment about a student’s level of achievement within each criterion. The aggregation of marks and application of pre-specified, arbitrary numerical cut-offs for level of achievement decisions tends to disguise the strengths and weaknesses of a student’s work.

Criterion	A	B	C	D	E
Knowledge and conceptual understanding	The student work has the following characteristics: • **reproduction and interpretation** of **complex *and* challenging** concepts, theories and principles • **comparison and explanation** of **complex** concepts, processes and phenomena • **linking and application** of algorithms, concepts, principles, theories and schema to **find solutions** in **complex and challenging situations**.	The student work has the following characteristics: • **reproduction and interpretation** of **complex *or* challenging** concepts, theories and principles • **comparison and explanation** of concepts processes and phenomena • **linking and application** of algorithms, concepts, principles, theories and schema to **find solutions** in **complex or challenging situations**.	The student work has the following characteristics: • **reproduction** of concepts, theories and principles • **explanation** of **simple** processes and phenomena • **application** of algorithms, principles, theories and schema to **find solutions** in **simple situations**.	The student work has the following characteristics: • **reproduction** of **simple** ideas and concepts • **description** of **simple** processes and phenomena • **application** of algorithms, principles, theories and schema.	The student work has the following characteristics: • **reproduction** of **isolated facts** • **recognition** of **isolated simple** phenomena • **application** of **simple given** algorithms.
Investigative processes	The student work has the following characteristics: • **formulation of justified significant** questions/hypotheses which inform **effective and efficient design, refinement and management** of investigations • **assessment** of risk, safe selection and **adaptation** of equipment, and appropriate application of technology to **gather, record and process valid** data • **systematic analysis** of primary and secondary data to **identify relationships between** patterns, trends, errors and anomalies.	The student work has the following characteristics: • **formulation of justified** questions/hypotheses which inform **design and managemen**t of investigations • **assessment** of risk, safe **selection** of equipment, and appropriate application of technology to **gather, record and process** data • **analysis** of primary and secondary data to **identify** patterns, trends, errors and anomalies.	The student work has the following characteristics: • **formulation** of questions and hypotheses to **select and manage** investigations • **assessment** of risk, safe **selection** of equipment, and appropriate application of technology to **gather and record** data • **analysis** of primary and secondary data to **identify obvious** patterns, trends, errors and anomalies.	The student work has the following characteristics: • **implementation** of **given** investigations • **safe use of** equipment and technology to **gather and record** data • **identification** of obvious patterns and errors.	The student work has the following characteristics: • **guided use of given** procedures • **safe directed use** of equipment to **gather** data • **recording** of data.

Criterion	A	B	C	D	E
Evaluating and concluding	The student work has the following characteristics: • **analysis and evaluation of complex** scientific interrelationships • **exploration** of scenarios and possible outcomes with **justification** of conclusions/ recommendations • **discriminating selection, use and presentation** of scientific data and ideas to make meaning accessible to **intended audiences** through **innovative use of range** of formats.	The student work has the following characteristics: • **analysis** of **complex** scientific interrelationships • **explanation** of scenarios and possible outcomes with **discussion** of conclusions/ recommendations • **selection, use and presentation** of scientific data and ideas to make meaning accessible to **intended audiences** in **range of** formats.	The student work has the following characteristics: • **description** of scientific interrelationships • **description** of scenarios and possible outcomes with **statements** of conclusion/ recommendation • **selection, use and presentation** of scientific data and ideas to make meaning accessible in **range of** formats.	The student work has the following characteristics: • **identification** of **simple** scientific interrelationships • **identification** of scenarios or possible outcomes • **presentation** of scientific data or ideas in **range of** formats.	The student work has the following characteristics: • **identification** of **obvious** scientific interrelationships • **statements** about outcomes • **presentation** of scientific data or ideas.

Instrument-specific criteria sheets support the school's ability to uphold the principles of assessment, in particular:

- Balance. The syllabus requires "a suitable balance … across the criteria" (p. 17 in Chemistry; p. 18 in Physics), among other aspects. Importantly, balance is required *over the course of study* and not necessarily within a semester or between semesters, and certainly not in an individual assessment instrument. It is only by mapping assessment opportunities against the elements of the exit criteria that such balance becomes apparent. The principle of balance is more complex than simply an equal aggregation of marks across the criteria.
- Fullest and latest. The syllabus requires (p.18 in Chemistry, p.19 in Physics) that "judgments about student achievement made at exit from a school course of study must be based on the fullest and latest information available", where "fullest" refers to information about student achievement gathered across the range of general objectives and "latest" refers to information about student achievement gathered from the most recent period in which the general objectives are assessed. In this context, consideration must be given to the breadth and depth of treatment of the exit criteria in any individual assessment task. This may be disguised by the use of marks since the attribution of more marks to later assessment tasks does not necessarily appropriately value the "fullest" or "latest" information, nor does the aggregation of marks recognise the developmental nature of a course.

Decisions about levels of achievement need to be made in the context of a folio of evidence and the extent to which that evidence matches with the syllabus standards at a certain level. The syllabus requires each assessment instrument to be accompanied by a task-specific criteria sheet that is derived from, and is consistent with, the syllabus exit criteria and standards. Attempts to encode these standards in numerical marks are not consistent with the syllabus intent. Moreover, the use of instrument-specific criteria and standards offers many important advantages outlined above and further discussed in *The Place of Numerical Marks in Criteria-based Assessment*[1] (p.6)*:*

> An analysis of the underlying assumptions shows that numerical marking systems enjoy a status that is higher than they strictly deserve. The use of marks in criteria-based assessment is inappropriate for two sets of reasons. Firstly, the assumptions are not generally satisfied in any form of school-based assessment, and secondly, the use of marks as currency in grade-exchange transactions diverts attention away from criteria, standards, and the processes of qualitative appraisals, and to that extent is educationally counterproductive.

[1] Paper 21 of the ROSBA discussion papers, available from the QSA website: <www.qsa.qld.edu.au > then select Publications > Reports and papers > QBSSSS>.