



Guide to Assessment in the Sciences

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Preface

1 Preface

This guide is intended primarily for new teachers and Faculty Heads. It is an additional resource to be used in conjunction with SQA Arrangements documents and National Assessment Bank materials.

2.1 Standard Grade Biology

2 Biology

2.1 Standard Grade Biology

Information about this Course

Standard Grade Biology is described in terms of a number of topics, as shown below.

Topics

1. The Biosphere
2. The World of Plants
3. Animal Survival
4. Investigating Cells
5. The Body in Action
6. Inheritance
7. Biotechnology

Recommended entry

Entry is at the discretion of the centre.

Course assessment

The assessment of pupil performance in the three Elements Knowledge and Understanding, Problem Solving and Practical Abilities is carried out with reference to the Extended Grade Related Criteria defined for each of these Elements within the Arrangements document, which is available to download from SQA's website: www.sqa.org.uk.

Knowledge and Understanding and Problem Solving are assessed externally by a written examination.

Practical Abilities are internally assessed, and are subject to external verification.

External assessment

Two external papers are offered: General, assessing grades 3 and 4, and Credit, assessing grades 1 and 2. The examination is 1 hour 30 minutes in duration.

Both papers contain multiple choice items, short-answer questions, extended-answer questions and interpretation questions. Grade 5 is awarded to candidates who narrowly fail to meet the criteria for General level.

Marks are allocated to each question and a total mark obtained for the appropriate Element. The two grades associated with each level are distinguished by setting two cut-off scores. The lower score (in the region of 40–50%) reflects a satisfactory overall standard of performance, the upper score (in the region of 70–80%) reflects a high overall standard of performance.

Assessment for certification

Certification

A grade for attainment in each Element is recorded on the certificate, together with an overall grade awarded for the Course derived from the mean of the Element grades with a weighting of 2:2:1 in favour of the externally assessed Elements.

For Biology, grades are awarded on the scale 5 to 1, with grade 1 denoting the highest performance. Grade 6 is not available for an Element, but may be gained in the overall aggregate award. Grade 7 is available.

Internal assessment and estimates

For SQA's purposes, centres are required to provide:

- ◆ an estimate of performance for each of Knowledge and Understanding and Problem Solving; and
- ◆ a grade for Practical Abilities

Estimates for Knowledge and Understanding and for Problem Solving

Centres must submit an estimate grade for each candidate for each of Knowledge and Understanding and Problem Solving to SQA. For information on key dates, refer to the Operational Help Centre which is available on SQA's website.

The teacher should determine the estimate grades on the basis of each candidate's actual work. Estimates may be used by SQA for its internal procedures, including such cases as absence from external examinations, adverse circumstances and appeals. Evidence in support of these estimates should be retained by centres for submission to SQA if required.

Internal assessment of Practical Abilities

The assessment of Practical Abilities focuses on two categories:

- ◆ Carrying out Techniques
- ◆ Designing and Carrying out Investigations

Carrying out Techniques

Techniques fall naturally into two groups, those which relate to fieldwork and those which relate to laboratory work.

The candidate's grade with regard to this ability is determined by the degree of success achieved in undertaking a total of 10 Techniques at varying points throughout the two years of the Course. The required Techniques for both fieldwork and laboratory work are as follows.

1. Using sampling techniques applicable to ecosystems
2. Measuring one abiotic factor
3. Measuring a different abiotic factor
4. Using a simple biological key for living/preserved specimens
5. Using a compound microscope with a low power objective lens
6. Preparing a microscope slide as a wet mount
7. Making a simple line drawing from a biological specimen
8. Carrying out a test for starch
9. Carrying out a test for reducing sugar
10. Setting up a choice chamber

One mark should be awarded for successful demonstration of each Technique and a record, which subsequently can be scrutinised if necessary for verification purposes, should be retained by the centre in respect of each candidate. In addition, it may be necessary to observe candidates carrying out certain Techniques. **It is anticipated that, where possible, assessment will occur during on-going class work.** It is open to teachers to re-assess candidates who have not previously mastered particular Techniques.

Designing and Carrying out Investigations

Investigatory experimental work is a fundamental aspect of the Course and opportunities to undertake Investigations occur in all topics.

Candidates are required to design methods for carrying out a number of Investigations. In normal class activities, it is desirable that candidates collaborate in preparing designs for particular Investigations. However, for assessment purposes, candidates must carry out a minimum of two Investigations independently.

This category is assessed in terms of the extent to which Investigative Skills Objectives are achieved by a candidate in the course of carrying out each of his/her two best Investigations. During the Course, candidates should be given opportunities to undertake a number of Investigations, each of which involves demonstration of the 13 specified Investigative Skills Objectives.

A list of possible topics is provided in Appendix I of the Arrangements document.

The Investigative Skills Objectives to be assessed are grouped under four headings as follows:

1. Generative Skills (G)
2. Experimentation Skills (E)
3. Evaluation Skills (EV)
4. Recording and Reporting Skills (RR)

Two Investigations, each covering all of the Investigative Skills Objectives, should be submitted for the purpose of assessment for certification. At least one of the Investigations must involve a continuous variable.

Structure of Investigation

Investigations carried out for certification purposes should provide opportunities for candidates to demonstrate all 13 of the Investigative Skills Objectives. They should be of a suitable standard and should not be repeats of Investigations which have already been attempted either during practice or previous assessment.

It is important that a candidate's 'report' of an Investigation, ie the candidate's written response to an Investigation, is structured in a way which allows the teacher and an External Verifier to readily identify in the evidence generated those parts which relate to the individual objectives. It is equally important that the degree of structuring provided in an Investigation booklet is not so great that the candidate receives an excessive amount of support. The Investigation Booklet (Appendix II) issued by SQA must be used for all Investigations conducted for the purposes of assessment for certification.

Conduct of Investigations

It is expected that, at the outset of an Investigation, teachers will stimulate class or group discussion. Candidates should be introduced to the broad area for Investigation by way of a general statement and/or leading questions, perhaps provided on an Investigation starter sheet (see Appendix I in the Arrangements document). Discussion should then take place within small groups of candidates. Individual candidates who suggest a relevant investigable aspect which cannot be investigated within the constraints of the school situation should be directed to other alternatives without penalty. During the generative phase, teachers should advise candidates of any specific problems — eg timing, availability/suitability of apparatus — which may occur with particular Investigations.

Subsequent to the discussion, if the candidate is unable to meet the criterion for G1, the teacher should give assistance to enable the candidate to proceed but will not award the mark allocated to this Objective. Should a candidate fail to meet a criterion associated with Objective G2, G3 or G4, it is permissible for the teacher to intervene and give sufficient support to enable the candidate to proceed, but the mark allocated to the relevant criterion will not be awarded. Where intervention has taken place, a statement to this effect should be made by the teacher at the appropriate point in the candidate's report on the Investigation.

After the generative phase (Objectives G1, G2, G3 and G4), candidates must be left to pursue the Investigation independently. Teacher intervention in the post-generative phase is permitted only when the candidate fails to adopt standard, safe laboratory practice. In such a case, the mark allocated to the relevant criterion for Objective E1 is forfeited.

Investigations for certification purposes must be carried out and written up by the candidate in class time, with all materials being retained by the teacher between classes.

Candidates should not have access to their own notes or to textbooks when carrying out an Investigation for the purposes of formal assessment. It should be noted that an Investigation booklet is the only support material which may be available.

Assessment scheme for Investigation

Assessment of achievement of Investigative Skills Objectives is undertaken by applying the following assessment scheme to a candidate's write-up of an Investigation. The scheme identifies the criteria which must be satisfied for the purposes of assessment for certification. For each of the criteria, the mark to be awarded where the requirements of the criterion are satisfied is indicated in the table on the following pages. Where a criterion is not satisfied, zero marks are awarded. The total mark allocation for each Investigation is 24. For certification purposes, the final mark should be the sum of the scores for the candidate's two best Investigations to give a score out of 48.

Investigative Skills Objectives and assessment criteria

TAPS Investigative Skills Objective		Assessment criteria and available marks	Marks total
The candidate should be able to:			
G1	Demonstrate understanding of the problem posed	Following group discussion, the candidate individually identifies and records an investigable aspect of the problem (1,0)	1
G2	State the aim of the Investigation	Clearly identifies the aim of the Investigation in terms of the two relevant variables (1,0)	1
G3	Articulate a testable hypothesis	Articulates a testable hypothesis in terms of the two relevant variables; this should be directional if a continuous variable is chosen (1,0)	1
G4	Suggest a broad strategy to adopt	The strategy gives sufficient detail by description and/or diagram to indicate: <ol style="list-style-type: none"> how the chosen independent variable will be altered (1,0) that the candidate has considered what will have to be measured (1,0) 	2
E1	Adopt appropriate and safe procedures	Adopts appropriate and safe procedures (1,0)	1
E2	Identify the independent variable to be used and alter it over a suitable range	<ol style="list-style-type: none"> Provides a working definition of the independent variable (1,0) Alters the independent variable over an appropriate range taking account of a suitable number of types or values (1,0) 	2
E3	Control all relevant variables as necessary	<ol style="list-style-type: none"> Makes a written statement of the variables which need to be actively controlled by the candidate (1,0) Controls these variables in practice (1,0) 	2
E4	Make valid, reliable measurement of the dependent variable	<ol style="list-style-type: none"> Uses a valid method of measuring the dependent variable (1,0) Evidence is provided of a form of repeat/replicate testing which improves the reliability of the results or a valid written justification is given for not repeating/replicating measurements (1,0) 	2
RR1	Tabulate results with appropriate headings and units of measurement	<ol style="list-style-type: none"> Values (or types) with appropriate headings for independent, dependent (and any derived) variable are entered in the table (1,0) Appropriate units or their correct abbreviations are entered in the table (1,0) 	2

(continued)

TAPS Investigative Skills Objective		Assessment criteria and available marks	Marks total
The candidate should be able to:			
RR2	Present the results on a graph or chart	<ul style="list-style-type: none"> a. A graph or chart of a suitable size and scale is produced (1,0) b. Both axes have appropriate labels and units (1,0) c. Plots all the points/bars accurately (1,0) d. Draws line/curve of best fit or joins up the points as appropriate when the independent variable is continuous or draws a bar chart when independent variable is not continuous (1,0) 	4
Ev1	Draw a valid conclusion inter-relating the appropriate variables	Draws a conclusion which inter-relates the appropriate variables or states that no firm conclusion can be drawn (1,0)	1
Ev2	Use results to evaluate the original hypothesis	Confirms hypothesis if appropriate, or refutes hypothesis and replaces it with appropriate substitute or states that no conclusion can be drawn (1,0)	1
RR3	Describe how the Investigation was carried out	<p>The description includes:</p> <ul style="list-style-type: none"> a. a labelled diagram and/or statement of the apparatus used (1,0) b. an account of the procedure adopted to measure the dependent variable (1,0) c. an account of how the independent variable was altered (1,0) d. an indication of how variables which were the investigators' responsibility to control were kept constant (1,0) 	4

Recording of assessment of Practical Abilities

For each candidate, a summary record should be kept of the outcome of the assessment of the two categories of Practical Abilities, Carrying out Techniques and Designing and Carrying out Investigations.

For Carrying out Techniques, a record should be kept of the mark (1 or 0) achieved for each of the 10 Techniques and, thereafter, the total of these marks.

For Designing and Carrying out Investigations, the total mark obtained for each Investigation should be recorded, together with the sum of these two marks. Form Ex5 (Flyleaf) will be issued annually to centres for use in connection with the submission of materials at the verification stage. The reverse side should be used to record the above details of a candidate's performance in Practical Abilities. SQA will also provide details of the arrangements for the submission of internal assessments of Practical Abilities for all candidates on an annual basis.

Evidence of attainment of Practical Abilities

Evidence of a candidate's attainment of Practical Abilities should comprise a summary report on the Ex5 (Flyleaf), as described in the paragraph above, together with the reports on the two best Investigations.

Where a centre elects to assess Carrying out Techniques by using the exemplar materials prepared by the Central Support Group for Biology and issued by the Scottish Consultative Council on the Curriculum in 1988, the exemplar materials should not be submitted as evidence to support internal grades awarded. Where a centre decides to modify the CSG exemplar materials for all or any of the 10 required Techniques, or where alternative approaches are used, one complete set of all teacher and pupil assessment materials should be retained for possible submission to SQA along with the evidence in support of the internal grades awarded.

For Designing and Carrying out Investigations, the evidence should be in the form of an Investigation booklet for each of the two Investigations. Each of these Investigation booklets must give a clear indication of the mark awarded for each of the Investigative Skills Objectives, and also of the total mark awarded.

Grade for Practical Abilities

For each candidate, a total score for Practical Abilities should be determined by multiplying the mark awarded for Techniques by two and adding it to the mark awarded for Investigations. The overall grade for the Element should then be determined by reference to the following table.

Marks range	Grade
58–68	1
49–57	2
39–48	3
29–38	4
19–28	5

Candidates for whom there is evidence in support of at least one Technique or Investigation and who achieve an overall total score of less than 19 marks should be awarded a grade 7 for Practical Abilities.

Verification of internal assessments

To ensure the uniform application of the Extended Grade Related Criteria for Practical Abilities, each year a sample of centres will be required to submit evidence to SQA in support of internal assessments of Practical Abilities for a sample of candidates. Where a centre's internal assessments cannot be confirmed, the centre will be required to carry out re-assessment as necessary.

2.2 Access 3 Biology

2.2 Access 3 Biology

Information about this Course

Access 3 Biology is made up of the following three mandatory Units:

D023 09	Health and Technology (Acc 3)	1 credit (40 hours)
D024 09	Biotechnological Industries (Acc 3)	1 credit (40 hours)
D025 09	Growing Plants (Acc 3)	1 credit (40 hours)

These three Units are based on Units available at Intermediate 1 level, with the Outcomes modified to meet the needs of candidates who may be achieving at Access 3. The titles at Access 3 level have been kept the same as the corresponding Intermediate 1 Units.

Appropriate groups of candidates can be taught at Intermediate 1 level using the content and suggested activities provided in the Intermediate 1 Course Arrangements document. Candidates can then be assessed to provide evidence of their actual level of achievement, ie to determine whether this is at Intermediate 1 or Access 3. Appropriate assessment material is provided through the National Assessment Bank.

Recommended entry

Entry is at the discretion of the centre.

Internal assessment

Outcome 1

Assessment Type	End of Unit test
Duration	30 minutes
Total Marks	15
Threshold of Attainment	9

Appropriate assessment material is provided through the National Assessment Bank. Contact the SQA Co-ordinator for access to this material.

Outcome 2

Assessment Type: Checklist of Techniques

Unit	Title	Techniques
D023 09	Health and Technology	Pulse Rate Measurement Body Temperature Measurement
D024 09	Biotechnological Industries	Resazurin Test Yeast Immobilisation Biological Enzyme Test
D025 09	Growing Plants	Sowing Seeds Growing Plants Pricking Out Potting On Taking Cuttings

2.3 Intermediate 1 Biology

2.3 Intermediate 1 Biology

Information about this Course

The Intermediate 1 Biology Course is made up of the following three mandatory Units:

D023 10	Health and Technology (Int 1)	1 credit (40 hours)
D024 10	Biotechnological Industries (Int 1)	1 credit (40 hours)
D025 10	Growing Plants (Int 1)	1 credit (40 hours)

Recommended entry

Whilst entry for the Course is at the discretion of the centre and no previous Biology experience is required, the Course would also be suitable for those with an award in Standard Grade Biology, Chemistry, Physics or Science, at grades 4–7.

Course assessment

To gain the Course award the candidate must achieve each component Unit of the Course as well as the external instrument. Each Unit is internally assessed by the centre and is subject to external verification.

External assessment provides the basis for grading attainment in the Course award.

External assessment

The external assessment instrument is an exam of 1 hour and 30 minutes' duration, with a total allocation of 75 marks.

The examination consists of two sections:

Section A	Multiple choice questions	25 marks
Section B	Structured questions	50 marks

Section A is made up of 25 multiple choice questions (9–11 of these test Problem Solving and/or Practical Abilities, the remainder tests Knowledge and Understanding).

Section B contains structured questions with an allocation of 50 marks. Between 25 and 30 marks test Problem Solving and Practical Abilities.

Internal assessment

Outcome 1

Assessment Type	End of Unit test
Duration	30 minutes
Total Marks	15
Threshold of Attainment	10

Appropriate assessment material is provided through the National Assessment Bank. Contact the SQA Co-ordinator for access to this material.

Outcome 2

Assessment Type: Checklist of Techniques

Unit Code	Unit	Techniques
D023 10	Health and Technology	Pulse Rate Measurement Body Temperature Measurement
D024 10	Biotechnological Industries	Resazurin Test Yeast Immobilisation Biological Enzyme Assay
D025 10	Growing Plants	Sowing Seeds Growing Plants Pricking Out Potting On Taking Cuttings

Outcome 3

A report of one Investigation is required covering all the Performance Criteria set out in the Unit Specifications.

Candidates are only required to produce one report for Outcome 3 which relates to the contents and notes specified for Intermediate 1 Biology. This report can be used as evidence for Outcome 3 for all Units of the Course.

Assessment scheme for Outcome 3

At Intermediate 1 level, it is appropriate to support the candidate in meeting the requirements for Outcome 3 throughout the activity. The ‘Outcome 3 — Candidate Guidelines’, available in the NAB, should be completed by the candidate and discussed with the teacher/lecturer at appropriate stages during the activity. It is not expected that candidates write any more than indicated by the spaces provided. Once completed this serves as the report required for evidence for Outcome 3.

The ‘Outcome 3: Teacher/lecturer guide’ given on the following page is provided to indicate what must be addressed to achieve a specific Performance Criterion. The relevance of the items will vary according to the Investigation being undertaken. The professional judgement of the teacher/lecturer will be important in deciding if a Performance Criterion has been met for a particular Investigation.

Outcome 3: Teacher/lecturer guide

All the Performance Criteria given in the left-hand column must be achieved in order to attain the Outcome. The right-hand column gives suggestions which might aid the professional judgement of the assessor.

Performance Criteria	Suggestions to aid professional judgement
(a) The aims of the Investigation are clearly stated	Main features to be investigated are identified.
(b) Appropriate data is identified and collected	<p>The plan should include:</p> <ul style="list-style-type: none"> ◆ what is to be measured/collected ◆ what (variable) is to be altered ◆ what (variable) is to be kept constant ◆ how many readings/measurements/observations/subjects/equipment/resources required ◆ how data will be recorded <p>Collected data must be recorded in a clear table with correct headings, appropriate units and results/readings entered correctly.</p>
(c) The collected data is analysed and presented in an appropriate format	<p>Data should be analysed and presented in tabular or graphical format as appropriate:</p> <ul style="list-style-type: none"> ◆ for a tabular presentation this may be an extension of the table used for PC (b) above, and must include: suitable headings and units showing averages or other appropriate computations ◆ for a graphical presentation this must include: data presented as a histogram, bar chart, connected points, line of best fit as appropriate, with suitable scales and axes labelled with quantity and units and with data correctly plotted
(d) Conclusions drawn are valid	<p>Conclusions should make use of the presented evidence and could:</p> <ul style="list-style-type: none"> ◆ consider the implications for health of the presented evidence and suggest possible courses of action ◆ identify strengths and weaknesses of the Investigation based on the evidence

2.4 Intermediate 2 Biology

2.4 Intermediate 2 Biology

Information about this Course

The Intermediate 2 Biology Course is made up of the following three mandatory Units:

D026 11	Living Cells (Int 2)	1 credit (40 hours)
D027 11	Environmental Biology and Genetics (Int 2)	1 credit (40 hours)
D028 11	Animal Physiology (Int 2)	1 credit (40 hours)

Recommended entry

Entry for the Course is at the discretion of the centre, however candidates would normally be expected to have attained one of the following:

- ◆ Standard Grade Biology with Knowledge and Understanding and Problem Solving at grades 3 or 4
- ◆ Intermediate 1 Biology or its component Units

Course assessment

To gain the award of the Course the candidate must achieve each component Unit of the Course as well as the external instrument. Each Unit is internally assessed by the centre and is subject to external verification.

External assessment provides the basis for grading attainment in the Course award.

External assessment

The external assessment instrument is an exam of two hours' duration, with a total allocation of 100 marks.

The examination is split into the following three sections:

Section A	Multiple choice questions	25 marks
Section B	Structured questions	65 marks
Section C	Extended-response questions	10 marks

Section A is made up of 25 multiple choice questions (9–11 of these test Problem Solving and/or Practical Abilities, the remainder tests Knowledge and Understanding).

Section B contains structured questions with an allocation of 65 marks. Between 15 and 20 marks test Problem Solving and/or Practical Abilities, the remainder tests Knowledge and Understanding.

Section C consists of four extended-response questions to test the candidates' ability to select, organise and present relevant knowledge. Candidates are expected to answer two of the four questions. There are 10 marks allocated (five marks to each extended-response question).

Internal assessment

Outcomes 1 and 2

Assessment Type	End of Unit test
Duration	45 minutes
Total Marks	40
Threshold of Attainment	26

Appropriate assessment material is provided through the National Assessment Bank. Contact the SQA Co-ordinator for access to this material.

Outcome 3

A report of one Investigation is required covering all the Performance Criteria set out in the Unit Specifications.

Candidates are only required to produce one report for Outcome 3, which relates to the contents and notes specified for Intermediate 2 Biology. This report can be used as evidence for Outcome 3 for all Units of the Course.

Assessment scheme for Outcome 3

The Evidence Requirements for Outcome 3 require the teacher/lecturer to attest that the report is the individual work of the candidate derived from the active participation in an experiment involving the candidate in:

- ◆ planning the experiment
- ◆ deciding how it is to be managed
- ◆ identifying and obtaining the necessary resources, some of which must be unfamiliar
- ◆ carrying out the experiment
- ◆ evaluating all stages of the experiment, including the initial analysis of the situation and planning and organising experimental procedures

This means that there are two main pieces of evidence for Outcome 3, namely (i) the teacher/lecturer's judgement that the above has taken place which is indicated when PC (a) is signed off and (ii) the candidate's report, ie not all the evidence is present in the report.

The 'Outcome 3: Teacher/lecturer guide' given on the following pages is provided to indicate what must be addressed to achieve a specific Performance Criterion. The relevance of the items will vary according to the experiment being undertaken. The professional judgement of the teacher/lecturer will be important in deciding if a Performance Criterion has been met for a particular experiment.

Outcome 3: Teacher/lecturer guide

All the Performance Criteria given in the left-hand column must be achieved in order to attain the Outcome. The right-hand column gives suggestions which might aid the professional judgement of the assessor.

Performance Criteria	Suggestions to aid professional judgement
(a) The information is collected by active participation in the experiment	The candidate has taken active part in the collection of the information.
(b) The experimental procedures are described accurately	<p>A clear statement of the aim of the experiment is made and a few brief concise sentences, including as appropriate:</p> <ul style="list-style-type: none"> ◆ a labelled diagram or brief description of apparatus or instruments used ◆ how the independent variable was altered ◆ control measure used ◆ how measurements were taken or observations made <p>There is no need for a detailed description. The use of the impersonal passive voice is to be encouraged as an example of good practice but this is not mandatory for meeting the Performance Criteria.</p>
(c) Relevant measurements and observations are recorded in an appropriate format	Readings or observations (raw data) must be recorded in a clear table with correct headings, appropriate units and results/readings entered correctly.
(d) Recorded experimental information is analysed and presented in an appropriate format	<p>Data should be analysed and presented in tabular, graphical format or as a scatter diagram or equivalent, as appropriate:</p> <ul style="list-style-type: none"> ◆ for a tabular presentation this may be an extension of the table used for PC (c) above, and must include: suitable headings and units showing averages or other appropriate computations ◆ for a graphical presentation this must include: data presented as a histogram, bar chart, connected points or line of best fit as appropriate, with suitable scales and axes labelled with quantity and units and with data correctly plotted

(continued)

Performance Criteria	Suggestions to aid professional judgement
(e) Conclusions drawn are valid	<p>Conclusions should use evidence from the experiment and relate back to the aim of the experiment. At least one of the following should be included:</p> <ul style="list-style-type: none"> ◆ overall pattern to readings or observations (raw data) ◆ trends in analysed information or results ◆ connection between variables and controls
(f) The experimental procedures are evaluated with supporting argument	<p>The evaluation could cover all stages of the activity including preparing for the activity, analysis of the activity and the results of the activity. The evaluation must include supporting argument in at least one of the following:</p> <ul style="list-style-type: none"> ◆ effectiveness of procedures ◆ control of variables ◆ limitations of equipment ◆ possible sources of error ◆ possible improvements

2.5 Higher Biology

2.5 Higher Biology

Information about this Course

The Higher Biology Course is made up of the following three mandatory Units:

D029 12	Cell Biology (H)	1 credit (40 hours)
D030 12	Genetics and Adaptation (H)	1 credit (40 hours)
D031 12	Control and Regulation (H)	1 credit (40 hours)

Recommended entry

Entry for the Course is at the discretion of the centre, however candidates would normally be expected to have attained one of the following:

- ◆ Standard Grade Biology with Knowledge and Understanding and Problem Solving at grades 1 or 2
- ◆ Intermediate 2 Biology

Course assessment

To gain the award of the Course the candidate must achieve each component Unit of the Course as well as the external instrument. Each Unit is internally assessed by the centre and is subject to external verification.

External assessment provides the basis for grading attainment in the Course award.

External assessment

The external assessment instrument is an exam of two hours 30 minutes' duration, with a total allocation of 130 marks.

The examination is split into the following three sections:

Section A	Multiple choice questions	30 marks
Section B	Structured questions and data handling	80 marks
Section C	Extended-response questions	20 marks

Section A contains 30 multiple choice questions of which 9–11 questions test Problem Solving and/or Practical Abilities, the remainder tests Knowledge and Understanding.

Section B contains structured questions and data handling questions with an allocation of 80 marks. Between 25 and 30 marks test Problem Solving and/or Practical Abilities, the remainder tests Knowledge and Understanding.

Section C consists of four extended-response questions to test the candidates' ability to select, organise and present relevant knowledge. This section has an allocation of 20 marks and includes:

- ◆ two structured extended-response questions for 10 marks. Candidates are expected to answer **one** of these questions. Marking schemes for these questions are similar to current practice for essay questions.
- ◆ two open extended-response questions for 10 marks (1 mark for relevance, 1 mark for coherence and 8 marks for Knowledge and Understanding). Candidates are expected to answer **one** of these questions.

Internal assessment

Outcomes 1 and 2

Assessment Type	End of Unit test
Duration	45 minutes
Total Marks	40
Threshold of Attainment	26

Appropriate assessment material is provided through the National Assessment Bank. Contact the SQA Co-ordinator for access to this material.

Outcome 3

A report of one Investigation is required covering all the Performance Criteria set out in the Unit Specifications.

Candidates are only required to produce one report for Outcome 3 which relates to the contents and notes specified for Higher Biology. This report can be used as evidence for Outcome 3 for all Units of the Course.

Assessment scheme for Outcome 3

The Evidence Requirements for Outcome 3 require the teacher/lecturer to attest that the report is the individual work of the candidate derived from the active participation in an experiment involving the candidate in:

- ◆ planning the experiment
- ◆ deciding how it is to be managed
- ◆ identifying and obtaining the necessary resources, some of which must be unfamiliar
- ◆ carrying out the experiment
- ◆ evaluating all stages of the experiment, including the initial analysis of the situation and planning and organising experimental procedures

This means that there are two main pieces of evidence for Outcome 3, namely (i) the teacher/lecturer's judgement that the above has taken place which is indicated when PC (a) is signed off and (ii) the candidate's report, ie not all the evidence is present in the report.

The 'Outcome 3: Teacher/lecturer guide', given on the following pages, is provided to indicate what must be addressed to achieve a specific Performance Criterion. The relevance of the items will vary according to the experiment being undertaken. The professional judgement of the teacher/lecturer will be important in deciding if a Performance Criterion has been met for a particular experiment.

Outcome 3: Teacher/lecturer guide

All the Performance Criteria given in the left-hand column must be achieved in order to attain the Outcome. The right-hand column gives suggestions which might aid the professional judgement of the assessor.

Performance Criteria	Suggestions to aid professional judgement
(a) The information is collected by active participation in the experiment	The candidate has taken active part in the collection of information.
(b) The experimental procedures are described accurately	<p>A clear statement of the aim of the experiment is made and a few brief concise sentences including, as appropriate:</p> <ul style="list-style-type: none"> ◆ a labelled diagram or brief description of apparatus or instruments used ◆ how the independent variable was altered ◆ control measure used ◆ how measurements were taken or observations made <p>There is no need for a detailed description. The use of the impersonal passive voice is to be encouraged as an example of good practice but this is not mandatory for meeting the Performance Criteria.</p>
(c) Relevant measurements and observations are recorded in an appropriate format	Readings or observations (raw data) must be recorded in a clear table with correct headings, appropriate units and results/readings entered correctly.
(d) Recorded experimental information is analysed and presented in an appropriate format	<p>Data should be analysed and presented in tabular, graphical format or as a scatter diagram or equivalent, as appropriate:</p> <ul style="list-style-type: none"> ◆ for a tabular presentation this may be an extension of the table used for PC (c) above, and must include: suitable headings and units showing averages or other appropriate computations ◆ for a graphical presentation this must include: data presented as a histogram, bar chart, connected points or line of best fit as appropriate, with suitable scales and axes labelled with quantity and units and with data correctly plotted

(continued)

Performance Criteria	Suggestions to aid professional judgement
(e) Conclusions drawn are valid	<p>Conclusions should use evidence from the experiment and relate back to the aim of the experiment. At least one of the following should be included:</p> <ul style="list-style-type: none"> ◆ overall pattern to readings or observations (raw data) ◆ trends in analysed information or results ◆ connection between variables and controls
(f) The experimental procedures are evaluated with supporting argument	<p>The evaluation could cover all stages of the activity including preparing for the activity, analysis of the activity and the results of the activity. The evaluation must include supporting argument in at least one of the following:</p> <ul style="list-style-type: none"> ◆ effectiveness of procedures ◆ control of variables ◆ limitations of equipment ◆ possible sources of error ◆ possible improvements

2.6 Advanced Higher Biology

2.6 Advanced Higher Biology

Information about this Course

The Advanced Higher Biology Course is made up of three mandatory Units and one optional Unit from a choice of three as follows:

Mandatory Units

D032 13	Cell and Molecular Biology (AH)	1 credit (40 hours)
D033 13	Environmental Biology (AH)	1 credit (40 hours)
D034 13	Biology Investigation (AH)	0.5 credit (20 hours)

Optional Units

D035 13	Biotechnology (AH)	0.5 credit (20 hours)
D036 13	Animal Behaviour (AH)	0.5 credit (20 hours)
D037 13	Physiology, Health and Exercise (AH)	0.5 credit (20 hours)

Recommended entry

Entry for the Course is at the discretion of the centre, however candidates are normally expected to have attained an award in Higher Biology or Higher Human Biology.

Course assessment

To gain the award of the Course the candidate must achieve each component Unit of the Course as well as the external instrument. Each Unit is internally assessed by the centre and is subject to external verification.

External assessment provides the basis for grading attainment in the Course award.

External assessment

The external assessment instruments are an exam of two hours 30 minutes' duration, with a total allocation of 100 marks, and an Investigation Report, with an allocation of 25 marks.

The examination consists of the following three sections:

Section A	Multiple choice questions	25 marks
Section B	Structured/data handling and extended-response questions	55 marks
Section C	As in section B but examines optional Units	20 marks

Section A contains 25 multiple choice questions based on the two mandatory Units. Of these, 8–10 questions test Problem Solving and/or Practical Abilities, the remainder tests Knowledge and Understanding.

Section B contains structured questions, data handling questions and extended-response questions based on the two mandatory Units with an allocation of 55 marks. Between 13 and 16 marks test Problem Solving and/or Practical Abilities, the remainder tests Knowledge and Understanding.

Section C contains structured questions, data handling questions and extended-response questions based on each of the optional Units with an allocation of 20 marks. Candidates will be expected to answer questions on one of the optional Units. For each Unit 4–6 marks will test Problem Solving and/or Practical Abilities, the remainder will test Knowledge and Understanding.

Investigation Report

The Investigation Report is based on work carried out in the mandatory Investigation Unit. The report should be around 2000–2500 words in length excluding contents page, tables, graphs etc.

The report is externally assessed using the following assessment categories:

- a. Introduction (4 marks)
- b. Procedures (6 marks)
- c. Results (5 marks)
- d. Discussion (7 marks)
- e. Presentation (3 marks)

An Investigation Guidance document is available to download from SQA's website.

Internal assessment

Outcomes 1 and 2

Mandatory Units

Assessment Type	End of Unit test
Duration	45 minutes
Total Marks	40
Threshold of Attainment	26

Optional Units

Assessment Type	End of Unit test
Duration	30 minutes
Total Marks	20
Threshold of Attainment	13

Appropriate assessment material is provided through the National Assessment Bank. Contact the SQA Co-ordinator for access to this material.

Outcome 3

A report of one experimental activity is required covering all the Performance Criteria set out in the Unit Specifications.

Candidates are only required to produce one report for Outcome 3 which relates to the contents and notes specified for Advanced Higher Biology. This report can be used as evidence for Outcome 3 in all other Units of the Course, excluding the Biology Investigation Unit.

Outcomes 1 and 2 — D034 13 Biology Investigation

Assessment Type: Record of Work (commonly known as ‘the daybook’)

Outcome 1

Candidates are required to develop a plan for an Investigation.

Performance Criteria

- a. A record is maintained in a regular manner.
- b. The aims of the Investigation are clearly stated.
- c. Hypothesis or questions relevant to the aims of the Investigation are formulated.
- d. Experimental, observational and sampling procedures, techniques and apparatus devised are appropriate for the Investigation.
- e. The need for controls and replicate treatments or survey samples is considered.
- f. Relevant problems associated with the use of living materials or natural habitats are considered.

Evidence Requirements

A record giving brief summaries to indicate the planning stage. Ideas rejected and important contributions made by the teacher/lecturer or other individuals should be included.

Outcome 2

Collect and analyse information obtained from the Investigation.

Performance Criteria

- a. The collection of the experimental information is carried out with due accuracy.
- b. Relevant measurements and observations are recorded in an appropriate format.
- c. Recorded experimental information is analysed and presented in an appropriate format.

Evidence Requirements

A record of the collection and analysis of the information, both of which must be the individual work of the candidate.

Assessment scheme for Outcome 3

The ‘Outcome 3: Teacher/lecturer guide’ given on the following pages is provided to indicate what must be addressed to achieve a specific Performance Criterion. The relevance of the items will vary according to the experiment being undertaken. The professional judgement of the teacher/lecturer will be important in deciding if a Performance Criterion has been met for a particular experiment.

Outcome 3: Teacher/lecturer guide

All the Performance Criteria given in the left-hand column must be achieved in order to attain the Outcome. The right-hand column gives suggestions which might aid the professional judgement of the assessor.

Performance Criteria	Suggestions to aid professional judgement
(a) The information collected by active participation in the experiment	The candidate has taken active part in the collection of the information.
(b) The experimental procedures are described accurately	<p>A clear statement of the aim of the experiment is made and a few brief concise sentences, including as appropriate:</p> <ul style="list-style-type: none"> ◆ a labelled diagram or brief description of apparatus or instruments used ◆ how the independent variable was altered ◆ control measure used ◆ how measurements were taken or observations made
	<p>There is no need for a detailed description. The use of the impersonal passive voice is to be encouraged as an example of good practice but this is not mandatory for meeting the Performance Criteria.</p>
(c) Relevant measurements and observations are recorded in an appropriate format	<p>Readings or observations (raw data) must be recorded in a clear table with correct headings, appropriate units and results/readings entered correctly.</p>
(d) Recorded experimental information is analysed and presented in an appropriate format	<p>Data should be analysed and presented in tabular, graphical format or as a scatter diagram or equivalent, as appropriate:</p> <ul style="list-style-type: none"> ◆ for a tabular presentation this may be an extension of the table used for PC (c) above, and must include: suitable headings and units showing averages or other appropriate computations ◆ for a graphical presentation this must include: data presented as a histogram, bar chart, connected points or line of best fit as appropriate, with suitable scales and axes labelled with quantity and units and with data correctly plotted

(continued)

Performance Criteria	Suggestion to aid professional judgement
(e) Conclusions drawn are valid	<p>Conclusions should use evidence from the experiment and relate back to the aim of the experiment. At least one of the following should be included:</p> <ul style="list-style-type: none"> ◆ overall pattern to readings or observation (raw data) ◆ trends in analysed information or results ◆ connection between variables and/or controls
(f) The experimental procedures are evaluated with supporting argument	<p>The evaluation could cover all stages of the activity including preparing for the activity, analysis of the activity and the results of the activity. The evaluation must include supporting argument in at least one of the following:</p> <ul style="list-style-type: none"> ◆ effectiveness of procedures ◆ control of variables ◆ limitations of equipment ◆ possible sources of error ◆ possible improvements

2.7 NAB Threshold of Attainment: Biology

2.7 NAB Threshold of Attainment: Biology

Level	Unit	Code	NAB Versions	Threshold of Attainment
Access 3	Health and Technology	D023 09	NAB001, NAB002, NAB003	9 out of 15
	Biotechnological Industries	D024 09	NAB001, NAB002, NAB003	9 out of 15
	Growing Plants	D025 09	NAB001, NAB002, NAB003	9 out of 15
Intermediate 1	Health and Technology	D023 10	NAB001, NAB002, NAB003, NAB004, NAB005	10 out of 15
	Biotechnological Industries	D024 10	NAB001, NAB002, NAB003, NAB004, NAB005	10 out of 15
	Growing Plants	D025 10	NAB001, NAB002, NAB003, NAB004, NAB005	10 out of 15
Intermediate 2	Living Cells	D026 11	NAB001, NAB002, NAB003, NAB004, NAB005	26 out of 40
	Environmental Biology and Genetics	D027 11	NAB001, NAB002, NAB003, NAB004, NAB005	26 out of 40
	Animal Physiology	D028 11	NAB001, NAB002, NAB003, NAB004, NAB005	26 out of 40

NAB Threshold of Attainment: Biology

(continued)

Level	Unit	Code	NAB Versions	Threshold of Attainment	Notes
Higher	Cell Biology	D029 12	NAB001, NAB002, NAB003, NAB004, NAB005	26 out of 40	—
	Genetics and Adaptation	D030 12	NAB001, NAB002, NAB003, NAB004, NAB005	26 out of 40	—
	Control and Regulation	D031 12	NAB001, NAB002, NAB003, NAB004, NAB005	26 out of 40	—
Advanced Higher	Cell and Molecular Biology	D032 13	NAB001, NAB002, NAB003	26 out of 40	—
	Environmental Biology	D033 13	NAB001, NAB002, NAB003	26 out of 40	—
	Biotechnology	D035 13	NAB001, NAB002, NAB003	13 out of 20	Optional Unit
	Animal Behaviour	D036 13	NAB001, NAB002, NAB003	13 out of 20	Optional Unit
	Health and Technology	D037 13	NAB001, NAB002, NAB003	13 out of 20	Optional Unit

2.8 Transfer of Evidence

Outcome 3: Biology

2.8 Transfer of Evidence Outcome 3: Biology

Level	Credit transfer permitted
Intermediate 1	<p>An Outcome 3 report on the Investigation in any of the Units:</p> <ul style="list-style-type: none"> ◆ D023 10 Health and Technology or ◆ D024 10 Biotechnological Industries or ◆ D025 10 Growing Plants <p>may be used as evidence of achievement of Outcome 3 of all three Units.</p> <p>Candidates who are repeating a Course may carry forward evidence of an appropriate standard generated in a previous year.</p>
Intermediate 2	<p>An Outcome 3 report of practical work in any of the Units:</p> <ul style="list-style-type: none"> ◆ D026 11 Living Cells ◆ D027 11 Environmental Biology and Genetics ◆ D028 11 Animal Physiology <p>may be used as evidence of achievement of Outcome 3 of all of the Units.</p> <p>Candidates may transfer evidence for Outcome 3 from one level to the one below provided the experiment is in the context of the Course concerned.</p> <p>Candidates who are repeating a Course may carry forward evidence of an appropriate standard, generated in a previous year.</p>

Transfer of Evidence Outcome 3: Biology

(continued)

Level	Credit permitted	Credit not permitted
Higher	<p>An Outcome 3 report of one experimental activity in any of the Units:</p> <ul style="list-style-type: none"> ◆ D029 12 Cell Biology ◆ D030 12 Genetics and Adaptation ◆ D031 12 Control and Regulation <p>can be used as evidence for Outcome 3 for all of the Units of the Course.</p> <p>Candidates may transfer evidence for Outcome 3 from one level to the one below provided the experiment is in the context of the Course concerned, eg in Unit D029 12 Cell Biology, a report on measuring water concentration in cell sap could be transferred to Intermediate 2 since it is in the context of osmosis.</p> <p>Candidates who are repeating a Course may carry forward evidence of an appropriate standard, generated in a previous year.</p>	<p>A report on chromatography of photosynthesis pigments could not be transferred to Intermediate 2 since there is no equivalent context at this level.</p>
Advanced Higher	<p>An Outcome 3 report of one experimental activity in any of the Units:</p> <ul style="list-style-type: none"> ◆ D032 13 Cell and Molecular Biology ◆ D033 13 Environmental Biology ◆ D035 13 Biotechnology ◆ D036 13 Animal Behaviour ◆ D037 13 Physiology, Health and Exercise <p>can be used as evidence for Outcome 3 in all of the Units of the Course.</p> <p>Candidates who are repeating a Course may carry forward evidence of an appropriate standard, generated in a previous year.</p>	<p>Candidate records generated as evidence for the assessment of the Unit D034 13 Biology Investigation may not be used as evidence of achievement of Outcome 3 of any Advanced Higher Biology Unit.</p> <p>Outcome 3 reports of practical work in Advanced Higher Biology Units may not be used as evidence of achievement of the Biology Investigation Unit.</p>

Transfer of Evidence Outcome 3: Biology

3.1 Intermediate 2 Biotechnology

3 Biotechnology

3.1 Intermediate 2 Biotechnology

Information about this Course

The Intermediate 2 Biotechnology Course is made up of the following three mandatory Units:

DF5F 11	The Biology of Micro-organisms (Int 2)	1 credit (40 hours)
D039 11	Working with Micro-organisms (Int 2)	1 credit (40 hours)
DF5G 11	Biotechnology Processes (Int 2)	1 credit (40 hours)

Recommended entry

Entry is at the discretion of the centre, however candidates will normally be expected to have attained one of the following:

- ◆ Standard Grade Biology
- ◆ Intermediate 1 Biology

Previous Biology experience is not an absolute requirement and the Course is therefore also suitable for those wishing to study Biotechnology with a background in other sciences. The Course would also be suitable for studying in tandem with Intermediate 2 Biology or Higher Biology or Higher Human Biology.

Course assessment

To gain the Course award the candidate must achieve each component Unit of the Course as well as the external instrument. Each Unit is internally assessed by the centre and is subject to external verification.

External assessment will provide the basis for grading attainment in the Course award.

External assessment

The external assessment instrument is an examination of 2 hours' duration with a total allocation of 100 marks.

The examination consists of three sections:

Section A	Multiple choice questions	25 marks
Section B	Structured questions	65 marks
Section C	Extended-response questions	10 marks

Section A contains 25 multiple choice questions. Of these, between 9 and 11 test Problem Solving and/or Practical Abilities, the remainder tests Knowledge and Understanding.

Section B contains structured questions with an allocation of 65 marks. Between 15 and 20 marks test Problem Solving and/or Practical Abilities, the remainder tests Knowledge and Understanding.

Section C consists of four extended-response questions to test the candidates' ability to select, organise and present relevant knowledge. Candidates are expected to answer two of the four questions. Section C has an allocation of 10 marks (5 to each extended response question).

The content of the Units will be sampled using a weighting of 2:1:2 in the Course examination which will include familiar contexts as well as contexts which are less familiar and more complex than in the Unit assessments.

Internal assessment

Unit: DFSF 11 The Biology of Micro-organisms

Outcomes 1 and 2

Assessment Type	End of Unit test
Duration	45 minutes
Total Marks	40
Threshold of Attainment	26

Appropriate assessment material is provided through the National Assessment Bank. Contact the SQA Co-ordinator for access to this material.

Outcome 3

A report of one Problem Solving activity related to Intermediate 2 Biotechnology is required covering all the Performance Criteria set out in the Unit Specification.

This report can be used as evidence for Outcome 2 in ‘Biotechnology Processes’ and for Outcome 3 in ‘The Biology of Micro-organisms’.

Unit: D039 11 Working with Micro-organisms

Outcome 1

Assessment Type	End of Unit test
Duration	30 minutes
Total Marks	10
Threshold of Attainment	6

Outcome 2

Assessment Type: Checklist of Techniques

Candidates are required to carry out the following Techniques:

- ◆ plate pairing
- ◆ sub-culturing
- ◆ separating a mixed culture
- ◆ staining and microscopy

Unit: DF5G 11 Biotechnology Processes

Outcome 1

Assessment Type	End of Unit test
Duration	30 minutes
Total Marks	20
Threshold of Attainment	13

Outcome 2

A report of one Problem Solving activity related to Intermediate 2 Biotechnology is required covering all the Performance Criteria set out in the Unit specification.

This report can be used as evidence for Outcome 2 in ‘Biotechnology Processes’ and for Outcome 3 in ‘Biology of Micro-organisms’.

Assessment scheme for Outcome 2/ Outcome 3

The ‘Outcome 2/Outcome 3: Teacher/lecturer guide’ on the following pages is provided to indicate what might be addressed to achieve a specific Performance Criterion. The relevance of the items will vary according to the Problem Solving activity being undertaken, eg bullet points which refer to variables would not apply in a case study type Problem Solving activity. The professional judgement of the teacher/lecturer will be important in deciding if a Performance Criterion has been met for a particular activity.

Outcome 2/Outcome 3: Teacher/lecturer guide

All the Performance Criteria given in the left-hand column must be achieved in order to attain the Outcome. The right-hand column gives suggestions which might aid the professional judgement of the assessor.

Performance Criteria	Suggestions to aid professional judgement
(a) The problem to be solved is identified	Main features of the problem are identified.
(b) Resources required to solve the problem are identified and obtained	<p>Resources might include:</p> <ul style="list-style-type: none"> ◆ sources of information ◆ set procedures ◆ people ◆ equipment/physical resources ◆ materials
(c) Procedures appropriate to solving the problem are planned and designed	<p>The plan might include</p> <ul style="list-style-type: none"> ◆ what is to be measured/collected ◆ variable altered ◆ variable kept constant ◆ how many readings/measurements/observations/subjects ◆ equipment/resources required ◆ how data will be recorded, analysed and presented
(d) The planned procedures are carried out	<p>This would include a record of the data collected, analysis and presentation of data.</p> <p>Data should be analysed and presented in tabular, graphical format or as a scatter diagram or equivalent as appropriate:</p> <ul style="list-style-type: none"> ◆ for tabular presentation this might include: suitable headings and units showing averages or other appropriate computations ◆ for graphical presentation this might include: data presented as a histogram, bar chart, connected points, line of best fit as appropriate, with suitable scales and axes labelled with quantities and units and with data correctly plotted

(continued)

Performance Criteria	Suggestions to aid professional judgement
(e) The Problem Solving procedure is evaluated	<p>The evaluation might include:</p> <ul style="list-style-type: none">◆ an assessment of the effectiveness of the procedure including: planning and organising and the Outcome of the activity◆ drawing valid conclusions, which make use of the presented evidence◆ suggestions for alternative or modified strategies, further work, predictions or generalisations◆ an assessment/explanation of the relevance of the results

3.2 Higher Biotechnology

3.2 Higher Biotechnology

Information about this Course

The Higher Biotechnology Course is made up of the following three mandatory Units:

DF5H	12	Microbiology (H)	1 credit (40 hours)
D042	12	Microbiological Techniques (H)	1 credit (40 hours)
DF5J	12	Biotechnology (H)	1 credit (40 hours)

Recommended entry

Entry is at the discretion of the centre, however candidates will normally be expected to have attained one of the following:

- ◆ Intermediate 2 Biotechnology
- ◆ Standard Grade Biology at Credit level
- ◆ Intermediate 2 Biology

Course assessment

To gain the Course award the candidate must achieve each component Unit of the Course as well as the external instrument. Each Unit is internally assessed by the centre and is subject to external verification.

External assessment will provide the basis for grading attainment in the Course award.

External assessment

The external assessment instrument is an examination of 2 hours 30 minutes' duration with a total allocation of 130 marks.

The examination consists of three sections:

Section A	Multiple choice questions	30 marks
Section B	Structured and data handling questions	80 marks
Section C	Extended-response questions	20 marks

Section A contains 30 multiple choice questions. Of these, between 9 and 11 questions test Problem Solving and/or Practical Abilities, the remainder tests Knowledge and Understanding.

Section B contains structured questions and data handling questions with an allocation of 80 marks. Between 25 and 30 marks test Problem Solving and/or Practical Abilities, the remainder tests Knowledge and Understanding.

Section C consists of four extended-response questions to test the candidates' ability to select, organise and present relevant knowledge. Candidates will be expected to answer two of the four questions. Section C has an allocation of 20 marks and includes:

- ◆ two structured extended-response questions each with an allocation of 10 marks. Candidates are expected to answer **one** of these questions. Marking schemes for these questions will be similar to current practice for essay questions.
- ◆ two open extended-response questions for 10 marks (1 mark for relevance, 1 mark for coherence and 8 marks for Knowledge and Understanding). Candidates are expected to answer **one** of these questions.

The content of the Units is sampled using a weighting of 2:1:2 in the Course examination which will include familiar contexts as well as contexts which are less familiar and more complex than in the Unit assessments.

Internal assessment

Unit: DF5H 12 Microbiology

Outcomes 1 and 2

Assessment Type	End of Unit test
Duration	45 minutes
Total Marks	40
Threshold of Attainment	26

Appropriate assessment material is provided through the National Assessment Bank. Contact the SQA Co-ordinator for access to this material.

Outcome 3

A report of one Problem Solving activity related to Higher Biotechnology is required covering all the Performance Criteria set out in the Unit specification.

This report can be used as evidence for Outcome 3 in ‘Microbiology’ and for Outcome 2 in ‘Biotechnology’.

Unit: D042 12 Microbiological Techniques

Outcome 1

Assessment Type	End of Unit test
Duration	30 minutes
Total Marks	10
Threshold of Attainment	6

Outcome 2

Assessment Type: Checklist of Techniques

Candidates are required to carry out the following Techniques:

- ◆ growth limitation and sterilisation
- ◆ culturing micro-organisms
- ◆ identifying micro-organisms

Unit: DF5J 12 Biotechnology

Outcome 1

Assessment Type	End of Unit test
Duration	30 minutes
Total Marks	20
Threshold of Attainment	13

Outcome 2

A report of one Problem Solving activity related to Higher Biotechnology is required covering all the Performance Criteria set out in the Unit specification.

This report can be used as evidence for Outcome 2 in ‘Biotechnology’ and for Outcome 3 in ‘Microbiology’.

Assessment scheme for Outcome 2/ Outcome 3

The ‘Outcome 2/Outcome 3: Teacher/lecturer guide’ on the following pages is provided to indicate what might be addressed to achieve a specific Performance Criterion. The relevance of the items will vary according to the Problem Solving activity being undertaken, eg bullet points which refer to variables would not apply in a case study type Problem Solving activity. The professional judgement of the teacher/lecturer will be important in deciding if a Performance Criterion has been met for a particular activity.

Outcome 2/Outcome 3: Teacher/lecturer guide

All the Performance Criteria given in the left-hand column must be achieved in order to attain the Outcome. The right-hand column gives suggestions which might aid the professional judgement of the assessor.

Performance Criteria	Suggestions to aid professional judgement
(a) The problem to be solved is identified	Main features of the problem are identified.
(b) Resources required to solve the problem are identified and obtained	<p>Resources might include:</p> <ul style="list-style-type: none"> ◆ sources of information ◆ set procedures ◆ people ◆ equipment/physical resources ◆ materials
(c) Procedures appropriate to solving the problem are planned and designed	<p>The plan might include:</p> <ul style="list-style-type: none"> ◆ what is to be measured/collected ◆ variable altered ◆ variable kept constant ◆ how many readings/measurements/observations/subjects ◆ equipment/resources required ◆ how data will be recorded, analysed and presented
(d) The planned procedures are carried out	<p>This would include a record of the data collected, analysis and presentation of data.</p> <p>Data should be analysed and presented in tabular, graphical format or as a scatter diagram or equivalent as appropriate:</p> <ul style="list-style-type: none"> ◆ for tabular presentation this must include: suitable headings and units showing averages or other appropriate computations ◆ for graphical presentation this must include: data presented as a histogram, bar chart, connected points, line of best fit as appropriate, with suitable scales and axes labelled with quantities and units and with data correctly plotted

(continued)

Performance Criteria	Suggestions to aid professional judgement
(e) The Problem Solving procedure is evaluated	<p>The evaluation might include:</p> <ul style="list-style-type: none"> ◆ an assessment of the effectiveness of the procedure including: planning and organising and the outcome of the activity ◆ drawing valid conclusions, which make use of the presented evidence ◆ suggestions for alternative or modified strategies, further work, predictions or generalisations ◆ an assessment/explanation of the relevance of the results

3.3 NAB Threshold of Attainment: Biotechnology

3.3 NAB Threshold of Attainment: Biotechnology

Level	Unit	Code	NAB Versions	Threshold of Attainment
Intermediate 2	The Biology of Micro-organisms	DF5F 11	NAB001, NAB002, NAB003	26 out of 40
	Working with Micro-organisms	D039 11	NAB001, NAB002, NAB003	6 out of 10
	Biotechnology Processes	DF5G 11	NAB001, NAB002, NAB003	13 out of 20
Higher	Microbiology	DF5H 12	NAB001, NAB002, NAB003	26 out of 40
	Microbiological Techniques	D042 12	NAB001, NAB002, NAB003	6 out of 10
	Biotechnology	DF5J 12	NAB001, NAB002, NAB003	13 out of 20

3.4 Transfer of Evidence

Outcome 2/Outcome 3:

Biotechnology

3.4 Transfer of Evidence Outcome 2/Outcome 3: Biotechnology

Level	Credit permitted
Intermediate 2	<p>Candidates are only required to produce one report of a Problem Solving activity related to Intermediate 2 Biotechnology. This report can be used as evidence for Outcome 3 in Unit DF5F 11 ‘The Biology of Micro-organisms’ and for Outcome 2 in the Unit DF5G 11 ‘Biotechnology Processes’.</p> <p>Candidates who are repeating a Course may carry forward evidence of an appropriate standard, generated in a previous year.</p>
Higher	<p>Candidates are only required to produce one report of a Problem Solving activity related to Higher Biotechnology. This report can be used as evidence for Outcome 3 in Unit DF5H 12 ‘Microbiology’ and for Outcome 2 in the Unit DF5J 12 ‘Biotechnology’.</p> <p>Candidates may transfer evidence for Outcome 3 from one level to the one below provided the experiments are in the context of the Course concerned.</p> <p>Candidates who are repeating a Course may carry forward evidence of an appropriate standard, generated in a previous year.</p>

4.1 Higher Human Biology

4 Human Biology

4.1 Higher Human Biology

Information about this Course

The Human Biology Higher Course is made up of the following three mandatory Units:

D043 12	Cell Function and Inheritance (H)	1 credit (40 hours)
D044 12	The Continuation of Life (H)	1 credit (40 hours)
D045 12	Behaviour, Populations and the Environment (H)	1 credit (40 hours)

Recommended entry

Entry is at the discretion of the centre however, candidates will normally be expected to have attained one of the following:

- ◆ Standard Grade Biology at Credit level
- ◆ Intermediate 2 Biology

Course assessment

To gain the Course award the candidate must achieve each component Unit of the Course as well as the external instrument. Each Unit is internally assessed by the centre and is subject to external verification.

External assessment will provide the basis for grading attainment in the Course award.

External assessment

The external assessment instrument is an examination of 2 hours 30 minutes' duration with a total allocation of 130 marks.

The examination consists of three sections:

Section A	Multiple choice questions	30 marks
Section B	Structured and data handling questions	80 marks
Section C	Extended response questions	20 marks

Section A contains 30 multiple choice questions. Between 9 and 11 of these test Problem Solving and Practical Abilities, the remainder tests Knowledge and Understanding.

Section B contains structured questions and data handling questions with an allocation of 80 marks. Between 25 and 30 marks test Problem Solving and Practical Abilities, the remainder tests Knowledge and Understanding.

Section C consists of four extended response questions to test the candidates' ability to select, organise and present relevant knowledge. This section has an allocation of 20 marks and includes:

- ◆ two structured extended response questions each with an allocation of 10 marks. Candidates are expected to answer **one** of these questions. Marking schemes for these questions will be similar to current practice for essay questions.
- ◆ two open ended response questions for 10 marks (1 mark for relevance, 1 mark for coherence and 8 marks for Knowledge and Understanding). Candidates are expected to answer one of these questions.

Internal assessment

Outcomes 1 and 2

Assessment Type	End of Unit Test
Duration	45 minutes
Total Marks	40
Threshold of Attainment	26

Appropriate assessment material is provided through the National Assessment Bank. Contact your SQA Co-ordinator for access to this material.

Outcome 3

A report of one Investigation is required, covering all the Performance Criteria set out in the Unit Specifications.

Candidates are only required to produce one report for Outcome 3 which relates to the content and notes specified for Higher Human Biology. This report can be used as evidence for Outcome 3 for all Units of the Course.

The evaluation should cover all stages of the experiment, including the initial analysis of the situation and planning and organising the experimental procedure.

Assessment scheme for Outcome 3

The Evidence Requirements for Outcome 3 require the teacher/lecturer to attest that the report is the individual work of the candidate derived from the active participation in an experiment involving the candidate in:

- ◆ planning the experiment
- ◆ deciding how it is to be managed
- ◆ identifying and obtaining the necessary resources, some of which must be unfamiliar
- ◆ carrying out the experiment
- ◆ evaluating all stages of the experiment, including the initial analysis of the situation and planning and organising experimental procedures

This means that there are two main pieces of evidence for Outcome 3, namely (i) the teacher/lecturer's judgement that the above has taken place which is indicated when Performance Criterion (a) is signed off and (ii) the candidate's report, ie not all the evidence is present in the report.

The 'Outcome 3: Teacher/lecturer guide' given on the following pages is provided to indicate what must be addressed to achieve a specific Performance Criterion. The relevance of the items will vary according to the experiment being undertaken. The professional judgement of the teacher/lecturer will be important in deciding if a Performance Criterion has been met for a particular experiment.

Outcome 3: Teacher/lecturer guide

All the Performance Criteria given in the left-hand column must be achieved in order to attain the Outcome. The right-hand column gives suggestions which might aid the professional judgement of the assessor.

Performance Criteria	Suggestions to aid professional judgement
(a) The information is collected by active participation in the experiment	The candidate has taken an active part in the collection of the information.
(b) The experimental procedures are described accurately	<p>A clear statement of the aim of the experiment is made and a few brief concise sentences, including as appropriate:</p> <ul style="list-style-type: none"> ◆ a labelled diagram or brief description of apparatus or instruments used ◆ how the independent variable was altered ◆ control measure used ◆ how measurements were taken or observations made <p>There is no need for a detailed description. The use of the impersonal passive voice is to be encouraged as an example of good practice but this is not mandatory for meeting the Performance Criteria.</p>
(c) Relevant measurements and observations are recorded in an appropriate format	Readings or observations (raw data) must be recorded in a clear table with correct headings, appropriate units and results/readings entered correctly.
(d) Recorded experimental information is analysed and presented in an appropriate format	<p>Data should be analysed and presented in tabular, graphical format or as a scatter diagram or equivalent, as appropriate:</p> <ul style="list-style-type: none"> ◆ for a tabular presentation this may be an extension of the table used for PC (c) above, and must include: suitable headings and units showing averages or other appropriate computations ◆ for a graphical presentation this must include: data presented as a histogram, bar chart, connected points or line of best fit as appropriate, with suitable scales and axes labelled with variable and units and with data correctly plotted

(continued)

Performance Criteria	Suggestions to aid professional judgement
(e) Conclusions drawn are valid	<p>Conclusions should use evidence from the experiment and relate back to the aim of the experiment. At least one of the following should be included:</p> <ul style="list-style-type: none"> ◆ overall pattern to readings or observations (raw data) ◆ trends in analysed information or results ◆ connection between variables and/or controls
(f) The experimental procedures are evaluated with supporting argument	<p>The evaluation could cover all stages of the activity including preparing for the activity, analysis of the activity and the results of the activity. The evaluation must include supporting argument in at least one of the following:</p> <ul style="list-style-type: none"> ◆ effectiveness of procedures ◆ control of variables ◆ limitations of equipment ◆ possible sources of error ◆ possible improvements

4.2 NAB Threshold of Attainment: Human Biology

4.2 NAB Threshold of Attainment: Human Biology

Level	Unit	Code	NAB Versions	Threshold of Attainment
Higher	Cell Function and Inheritance	D043 12	NAB001, NAB002, NAB003, NAB004, NAB005	26 out of 40
	The Continuation of Life	D044 12	NAB001, NAB002, NAB003, NAB004, NAB005	26 out of 40
	Behaviour, Populations and the Environment	D045 12	NAB001, NAB002, NAB003, NAB004, NAB005	26 out of 40

4.3 Transfer of Evidence

Outcome 3: Human Biology

4.3 Transfer of Evidence Outcome 3: Human Biology

Level	Credit transfer permitted
Higher	<p>An Outcome 3 report of one Problem Solving activity in any of the Units:</p> <ul style="list-style-type: none">◆ D043 12 Cell Function and Inheritance◆ D044 12 The Continuation of Life◆ D045 12 Behaviour, Populations and the Environment <p>can be used as evidence for Outcome 3 in all of the Units of the Course.</p> <p>Candidates who are repeating a Course may carry forward evidence of an appropriate standard generated in a previous year.</p>

5.1 Standard Grade Chemistry

5 Chemistry

5.1 Standard Grade Chemistry

Information about this Course

Standard Grade Chemistry is described in terms of a number of topics, as shown below.

Topics

1. Chemical Reactions
2. Speed of Reactions
3. Atoms and the Periodic table
4. How Atoms Combine
5. Fuels
6. Structures and Reactions of Hydrocarbons
7. Properties of Substance
8. Acids and Alkalies
9. Reactions of Acids
10. Making Electricity
11. Metals
12. Corrosion
13. Plastics and Synthetic Fibres
14. Fertilisers
15. Carbohydrates and Related Substances

Recommended entry

Entry is at the discretion of the centre.

Course assessment

The assessment of pupil performance in the three Elements Knowledge and Understanding, Problem Solving and Practical Abilities is carried out with reference to the Extended Grade Related Criteria defined for each of these Elements.

Knowledge and Understanding and Problem Solving are assessed externally by a written examination.

Practical Abilities are internally assessed and are subject to external verification.

External assessment

Two external papers are offered: General, assessing grades 3 and 4, and Credit, assessing grades 1 and 2. Each examination is 1 hour 30 minutes in duration.

Both papers may contain multiple choice items, grid questions, short-answer questions and extended-answer questions. Grade 5 will be awarded to candidates who narrowly fail to meet the criteria for General level.

Marks will be allocated to each question and a total mark obtained for the appropriate Element. The two grades associated with each level will be distinguished by setting two cut off scores. The lower score (in the region of 40–50%) will reflect a satisfactory overall standard of performance, the upper score (in the region of 70–80%) will reflect a high overall standard of performance.

Assessment for certification

Certification

A grade for attainment in each Element is recorded on the Certificate, together with an overall grade awarded for the Course derived from the mean of the Element grades with a weighting of 2:2:1 in favour of the externally assessed Elements.

For Chemistry, grades are awarded on the scale 5 to 1, with grade 1 denoting the highest performance. Grade 6 is not available for an Element, but may be gained in the overall aggregate award. Grade 7 is available (see Arrangements document for further information).

Internal assessment and estimates

For SQA's purposes, centres are required to provide:

- ◆ an estimate of performance for each of Knowledge and Understanding and Problem Solving; and
- ◆ a grade for Practical Abilities

Estimates for Knowledge and Understanding and for Problem Solving

Centres must submit an estimate grade for each candidate for each of Knowledge and Understanding and Problem Solving to SQA. For information on key dates, refer to the Operational Help Centre which is available on SQA's website.

The teacher should determine the estimate grades on the basis of each candidate's actual work. Estimates may be used by SQA for its internal procedures, including such cases as absence from external examinations, adverse circumstances and appeals. Evidence in support of these estimates should be retained by centres for submission to SQA if required.

It is for each centre to decide which testing procedure or combination of procedures should be used to provide the estimates of performance in the two Elements.

Internal assessment of Practical Abilities

Within Standard Grade Chemistry, there are two categories of Practical Ability, namely:

- ◆ Techniques
- ◆ Investigations

Techniques

For assessment purposes, 10 Techniques, considered to be the most appropriate vehicles for the assessment of the key abilities, are grouped as shown in the table below.

Group A	Group B	Group C	Group D	Group E
1.Bubbling gases into solutions and observing changes 2.Electrolysing solutions 3.Heating solids and observing changes	1.Filtration 2.Collecting a sample of gas over water, when the gas has been produced by chemical reaction	1.Mixing substances and observing changes 2.Carrying out solubility tests	1.Titrations	1.Preparing compounds by neutralisation and evaporation 2.Distillation

It should be noted that SQA will not accept the substitution of Techniques as alternatives to those listed. However, chemicals different from those indicated in the support package distributed by the Scottish Consultative Council on the Curriculum may be used.

While opportunities should be given throughout the Course to experience Techniques, for certification purposes only, one Technique from each of Groups A–E should be undertaken by candidates. Assessment of individual Techniques can take place at any appropriate time during the Course.

The relationships of the 10 specified Techniques to the key abilities are shown in the table below.

Abilities		Techniques									
1	Following instructions	A1	A2	A3	B1	B2	C1	C2	D1	E1	E2
2	Selecting all the required items of apparatus	A1	A2	A3	B1	B2	C1	C2	D1	E1	E2
3	Setting up all the apparatus safely	A1	A2	A3	B1	B2	C1	C2	D1	E1	E2
4	Carrying out any necessary calibrations and zeroings								D1		
5	Manipulating apparatus correctly and safely	A1	A2	A3	B1	B2	C1	C2	D1	E1	E2
6	Making observations and measurements	A1	A2	A3			C1	C2	D1		
7a	Recording observations and measurements in an appropriate format — writing	A1	A2	A3						E1	
7b	Recording observations and measurements in an appropriate format — constructing tables of data						C1	C2	D1		

(continued)

Abilities		Techniques								
7c	Recording observations in an appropriate format — drawing labelled diagrams	A1	A2	A3	B1	B2				E2
8	Supplying and using common units of measurement							D1		
9	Measuring with precision appropriate to the technique							D1		
10	Completing calculations							D1		

Guidance on the assessment of Techniques

The following general points relating to the undertaking of Techniques should be noted:

- ◆ Candidates should be encouraged to draw clear sectional, labelled diagrams. The quality of drawing can be assessed in conjunction with the question — ‘Would the experiment work as drawn?’. Rulers and/or stencils must be used. Cut-out diagrams are not acceptable.
- ◆ Tables of results must have appropriate headings.
- ◆ Experiments should be written up in class.
- ◆ All colour changes should include original and final colours.
- ◆ While undertaking Techniques for assessment purposes, candidates must not have access to teachers’ checklists.
- ◆ Candidates must wear eye protection when carrying out Techniques.

Specific points

The following notes of specific guidance relate to each of the 10 Techniques.

A1 Bubbling gases into solutions and observing changes

There is no need to identify the gas(es). One gas passed into two test solutions or two gases passed into a test solution would be acceptable.

A2 Electrolysing solutions

The diagram (key ability 7c) should be labelled to show positive and negative electrodes. The products, which need not be named, should be described either by noting on the diagram or in the written account.

A3 Heating solids and observing changes

Two changes must be observed, eg heating copper carbonate and noting the colour change of the solid and the effect of the gas produced on lime water. Alternatively, heating two compounds (eg copper carbonate and cobalt chloride) and noting the colour in each solid.

B1 Filtration

The diagram (key ability 7c), as a minimum, should be labelled to show residue, filtrate, funnel and paper. The residue and filtrate need not be named.

B2 Collecting a sample of gas over water, when the gas has been produced by chemical reaction

The diagram (key ability 7c) should show the reaction vessel, the method of delivery and the method of collecting the gas. The reactant(s) should be named.

C1 Mixing substances and observing changes

Three distinct experiments should be conducted. Chemicals which react at room temperature may be used.

C2 Carrying out solubility tests

The candidates should test three chemicals. Careful choice of chemicals is necessary.

The results should be recorded as ‘soluble’ or ‘insoluble’ rather than as a rank order of solubility.

D1 Titrations

Candidates should be provided with standardised solutions. It is advisable to use a strong base/strong acid reaction.

The table of results should show the rough titre and titration necessary to achieve concordancy (within $\pm 0.2 \text{ cm}^3$ of the actual value).

Rogue results should be discarded.

Key ability 10 — ‘Completing calculations’ — is satisfied by the subtraction of the initial and final volumes and averaging. Appropriate units should be used.

Two titrations of accuracy to $\pm 0.2 \text{ cm}^3$ of each other should be obtained.

In order to ensure this level of accuracy, it may be helpful to have adequate volumes of standardised solutions stored in small bottles.

E1 Preparing compounds by neutralisation and evaporation

Candidates should provide a written report to include the neutralisation, filtration and evaporation stages.

The candidate should name the reagents used and their products and describe any crystals produced. The description should include colour and shape.

E2 Distillation

It is recommended that distillation should be carried out on a solution of a food dye. This will make it easier to assess the effectiveness of the distillation. Candidates should build the apparatus required from a kit.

Marking

For each of the Techniques in Groups A, B and C a maximum of six marks can be awarded. For each Technique in Groups D and E a maximum of nine marks can be awarded. Thus, a total of 36 marks is available for assessment of Techniques.

In each of the Techniques, safety should count for 1 mark and should cover the wearing of goggles and clearing up any spills without having to be so instructed. The remaining marks available for the different Techniques should be awarded on the following basis.

For Techniques in Groups A, B and C, three marks are allotted to the manipulative aspects such as collecting, setting up and manipulating the apparatus and two marks are available for the write-up.

For Techniques in Groups D and E, 5 marks are allotted to the manipulative aspects and three marks are available for the write-up.

Single marks should be deducted for each error or omission. It should be noted that there is no barrier to the Techniques being repeated if desired.

Evidence to substantiate the marks awarded should include candidate material which identifies the Techniques assessed and the key abilities demonstrated within each. Supporting materials in the form of records and results for each candidate should also be retained. Candidate-generated reports should be dated and initialled by the teacher. It should be noted that teachers' checklists alone will not constitute adequate evidence. Evidence should be retained for possible submission to SQA in connection with verification procedures.

Evidence submitted by a centre may be based on the same Techniques for all candidates. Some centres may have good organisational reasons for restricting the range of Techniques used for formal assessment purposes, whereas other centres will have arrangements which allow assessment of individual candidates on different Techniques.

Investigations

The Investigative Skills Objectives are grouped under four headings, as follows:

1. Generative Skills (G)
2. Experimentation Skills (E)
3. Evaluation Skills (Ev)
4. Recording and Reporting Skills (RR)

Two Investigations, each covering all of the Investigative Skills Objectives, should be submitted for the purpose of assessment for certification. At least one of the Investigations must involve a continuous variable.

The Investigative Skills Objectives, together with the related assessment criteria and mark allocations for Standard Grade Chemistry, are set out in the table which follows.

Investigative Skills Objectives and assessment criteria

TAPS Investigative Skills Objective		Assessment criteria and available marks	Marks Total
The candidate should be able to:			
G1	Demonstrate understanding of the problem posed	Following group discussion, the candidate individually identifies and records an investigable aspect of the problem (1,0)	1
G2	State the aim of the Investigation	Clearly identifies the aim of the Investigation in terms of the two relevant variables (1,0)	1
G3	Articulate a testable hypothesis	Articulates a testable hypothesis in terms of the two relevant variables; this should be directional if a continuous variable is chosen (1,0)	1
G4	Suggest a broad strategy to adopt	<p>The strategy gives sufficient detail by description and/or diagram to indicate:</p> <ul style="list-style-type: none"> a. how the chosen independent variable will be altered (1,0) b. that the candidate has considered what will have to be measured (1,0) 	2
E1	Adopt appropriate and safe procedures	Adopts appropriate and safe procedures (1,0)	1
E2	Identify the independent variable to be used and alter it over a suitable range	<ul style="list-style-type: none"> a. Provides a working definition of the independent variable (1,0) b. Alters the independent variable over an appropriate range taking account of a suitable number of types or values (1,0) 	2
E3	Control all relevant variables as necessary	<ul style="list-style-type: none"> a. Makes a written statement of the variables which need to be actively controlled by the candidate (1,0) b. Controls these variables in practice (1,0) 	2
E4	Make valid, reliable measurement of the dependent variable	<ul style="list-style-type: none"> a. Uses a valid method of measuring the dependent variable (1,0) b. Evidence is provided of a form of repeat/replicate testing which improves the reliability of the results or a valid written justification is given for not repeating/replicating measurements (1,0) 	2
RR1	Tabulate results with appropriate headings and units of measurement	<ul style="list-style-type: none"> a. Values (or types) with appropriate headings for independent, dependent (and any derived) variable are entered in the table (1,0) b. Appropriate units or their correct abbreviations are entered in the table (1,0) 	2

(continued)

TAPS Investigative Skills Objective		Assessment criteria and available marks	Marks total
The candidate should be able to:			
RR2	Present the results on a graph or chart	<ul style="list-style-type: none"> a. A graph or chart of a suitable size and scale is produced (1,0) b. Both axes have appropriate labels and units (1,0) c. Plots all the points/bars accurately (1,0) d. Draws line/curve of best fit or joins up the points as appropriate when the independent variable is continuous or draws a bar chart when the independent variable is not continuous (1,0) 	4
Ev1	Draw a valid conclusion inter-relating the appropriate variables	Draws a conclusion which inter-relates the appropriate variables or states that no firm conclusion can be drawn (1,0)	1
Ev2	Use results to evaluate the original hypothesis	Confirms hypothesis if appropriate or refutes hypothesis and replaces it with appropriate substitute or states that no conclusion can be drawn (1,0)	1
RR3	Describe how the Investigation was carried out	<p>The description includes:</p> <ul style="list-style-type: none"> a. a labelled diagram and/or statement of the apparatus used (1,0) b. an account of the procedure adopted to measure the dependent variable (1,0) c. an account of how the independent variable was altered (1,0) d. an indication of how variables which were the investigators' responsibility to control were kept constant (1,0) 	4

Structure of Investigations

During the Course, candidates should be given opportunities to undertake a number of Investigations, each of which involves demonstration of the 13 specified Skills Objectives. Investigations for certification purposes should be carried out and written up in class time. The progress and achievement in Investigations should be recorded in the Investigation booklet issued by SQA (Appendix II).

That booklet must be used for all Investigations conducted for the purposes of assessment for certification.

Conduct of Investigations

It is expected that at the outset of the Investigation teachers will stimulate class or group discussion. Subsequent to the discussion, if the candidate is unable to meet the criterion for G1, the teacher should give assistance to enable the pupil to proceed but will not award the mark allocated to this Objective. In the case of a candidate who identifies a relevant investigable aspect which cannot be investigated within the constraints of the school situation, the candidate should be directed to other alternatives without penalty. Should a candidate fail to meet a criterion associated with Objective G2, G3 or G4, it is permissible for the teacher to intervene and give sufficient support to enable the candidate to proceed, but the mark allocated to the relevant criterion will not be awarded.

After the generative phase (Objectives G1, G2, G3 and G4), candidates must be left to pursue the Investigation independently. Teacher intervention in the post-generative phase is permitted only when the candidate fails to adopt standard, safe laboratory practice. In such a case, the mark allocated to the criterion for Objective E1 is forfeited.

Investigations undertaken by candidates should be assessed on the basis of the above mark scheme. In awarding marks for each Objective, only those marks indicated in the mark scheme may be given. For certification purposes, the final mark should be the sum of the scores for the candidate's two best Investigations to give a score out of 48.

Grade for Practical Abilities

For each candidate, a total score for Practical Abilities should be determined by multiplying the mark awarded for Techniques by two and adding it to the mark awarded for Investigations. The overall grade for the Element should then be determined by reference to the following table.

Marks range	Grade
106–120	1
91–105	2
78–90	3
66–77	4
53–65	5

Candidates for whom there is evidence in support of at least one Technique or Investigation and who achieve an overall total of less than 53 marks should be awarded a grade 7 for Practical Abilities.

Annually, SQA will provide centres with details of the arrangements for the submission of internal assessments of Practical Abilities for all candidates.

Verification of internal assessments

To ensure the uniform application of the Extended Grade Related Criteria for Practical Abilities, each year a sample of centres will be required to submit to SQA evidence in support of internal assessments for a sample of candidates. Where a centre's internal assessments cannot be confirmed, the centre will be required to carry out assessment as necessary.

5.2 Access 3 Chemistry

5.2 Access 3 Chemistry

Information about this Course

The Access 3 Chemistry Course is made up of the following three mandatory Units:

D063 09	Chemistry in Action (Acc 3)	1 credit (40 hours)
D064 09	Everyday Chemistry (Acc 3)	1 credit (40 hours)
D065 09	Chemistry and Life (Acc 3)	1 credit (40 hours)

These three Units are based on Units available at the Intermediate 1 level, with the Outcomes modified to meet the needs of candidates who may be achieving at Access 3. The titles of the Units at the Access 3 level have been kept the same as the corresponding Intermediate 1 Units.

Appropriate groups of candidates can be taught at the Intermediate 1 level using the content, contexts, applications, illustrations and activities provided in the Intermediate 1 Course specification. Candidates can then be assessed to provide evidence of their actual level of achievement, ie to determine whether this is at Intermediate 1 or Access 3.

Recommended entry

Entry is at the discretion of the centre.

Prescribed Practical Activities

All candidates are expected to carry out the Prescribed Practical Activities listed below.

Activity	Unit
The Effect of Temperature Changes on Dissolving Speed	1
The Effect of Concentration Changes on Reaction Speed	1
Testing the pH of Solutions	1
Electrical Conductivity	2
Reaction of Metals with Dilute Acid	2
Factors which Affect Lathering	2
Solubility	3
Burning Carbohydrates	3
Testing for Starch	3

A Prescribed Practical Activities pack produced by Learning and Teaching Scotland for Intermediate 1, Intermediate 2 and Higher Chemistry provides further guidance on the assessment of Outcome 3 for each Unit by way of lists of:

- ◆ experiments
- ◆ candidates' instruction sheets
- ◆ recording pro formas
- ◆ technician's guide
- ◆ advice related to marking

Packs are available to download from: www.ltscotland.org.uk.

Internal assessment

Outcomes 1 and 2

Assessment Type	End of Unit test made up of three sub-sections
Duration of each sub-section	20 minutes
Total Marks	30
Threshold of Attainment	18

Appropriate assessment material is provided through the National Assessment Bank. Contact the SQA Co-ordinator for access to this material.

Outcome 3

Candidates are required to produce one report on an experiment covering all of the Performance Criteria and related to Access 3/Intermediate 1 Chemistry.

The report must be based on one of the Unit 1 Prescribed Practical Activities.

5.3 Intermediate 1 Chemistry

5.3 Intermediate 1 Chemistry

Information about this Course

The Intermediate 1 Chemistry Course is made up of the following three mandatory Units:

D063 10	Chemistry in Action (Int 1)	1 credit (40 hours)
D064 10	Everyday Chemistry (Int 1)	1 credit (40 hours)
D065 10	Chemistry and Life (Int 1)	1 credit (40 hours)

Recommended entry

Entry for the Course is at the discretion of the centre, however candidates are normally expected to have attained one of the following awards or its equivalent:

- ◆ Standard Grade Biology, Physics or Science with Knowledge and Understanding and Problem Solving at Grades 4 to 7
- ◆ Standard Grade Chemistry with Knowledge and Understanding and Problem Solving at Grades 5 and 7
- ◆ appropriate Units at Access level

Course assessment

To gain the Course award the candidate must achieve each component Unit of the Course as well as the external instrument. Each Unit is internally assessed by the centre and is subject to external verification.

External assessment provides the basis for grading attainment in the Course award.

External assessment

The external assessment instrument is an examination of 1 hour 30 minutes' duration with a total allocation of 60 marks.

The examination consists of two sections:

Section A	Multiple choice questions	20 marks
Section B	Extended-answer questions	40 marks

Section A is made up of 20 multiple choice questions.

Section B has an allocation of 40 marks and 4 marks are allocated to questions which draw on the candidates' experience of the Prescribed Practical Activities.

Of the 60 marks in the paper between 34 and 37 marks are allocated to the assessment of Knowledge and Understanding and between 23 and 26 marks are allocated to the assessment of Problem Solving.

Prescribed Practical Activities

All candidates are expected to carry out the Prescribed Practical Activities listed below.

Activity	Unit
The Effect of Temperature Changes on Dissolving Speed	1
The Effect of Concentration Changes on Reaction Speed	1
Testing the pH of Solutions	1
Electrical Conductivity	2
Reaction of Metals with Dilute Acid	2
Factors which Affect Lathering	2
Solubility	3
Burning Carbohydrates	3
Testing for Sugars and Starch	3

A Prescribed Practical Activities pack produced by Learning and Teaching Scotland for Intermediate 1, Intermediate 2 and Higher Chemistry provides further guidance on the assessment of Outcome 3 for each Unit by way of lists of:

- ◆ experiments
- ◆ candidates' instruction sheets
- ◆ recording pro formas
- ◆ technician's guide
- ◆ advice related to marking

Packs are available to download from: www.ltscotland.org.uk.

Internal assessment

Outcomes 1 and 2

Assessment Type	End of Unit test
Duration	45 minutes
Total Marks	30
Threshold of Attainment	18

Appropriate assessment material is provided through the National Assessment Bank. Contact the SQA Co-ordinator for access to this material.

Outcome 3

Candidates are required to produce one report on an experiment covering all of the Performance Criteria and related to Intermediate 1 Chemistry.

The report must be based on one of the Unit 1 Prescribed Practical Activities.

Assessment scheme for Outcome 3

The ‘Outcome 3: Teacher/lecturer guide’ on the following pages is provided to indicate what should be demonstrated by the candidate to achieve each specified Performance Criterion. The relevance of the items suggested will vary according to the experiment being undertaken. These items are pointers to aid the professional judgement of the teacher/lecturer and will assist in deciding if a Performance Criterion has been met for a particular experiment.

Guidance on approaches to assessment of Outcome 3 is provided in the Support Notes in the Unit Specification included in the Arrangements document.

Further guidance is included in the separate Prescribed Practical Activities pack.

Assessment of the Performance Criteria for Outcome 3

The Evidence Requirements for Outcome 3 require the teacher/lecturer to attest that the report is the individual work of the candidate derived from the active participation in an experiment involving the candidate in:

- ◆ planning the experiment
- ◆ deciding how it is to be managed
- ◆ identifying and obtaining the necessary resources, some of which must be unfamiliar
- ◆ carrying out the experiment
- ◆ evaluating all stages of the experiment, including the initial analysis of the situation and planning and organising experimental procedures

This means that there are two main pieces of evidence for Outcome 3, namely (i) the teacher/lecturer’s judgement that the above has taken place which is indicated when Performance Criterion (a) is signed off and (ii) the candidate’s report, ie not all the evidence is present in the report.

Outcome 3: Teacher/lecturer guide

All the Performance Criteria given in the left-hand column must be achieved in order to attain the Outcome. The right-hand column gives suggested items which might aid the professional judgement of the assessor.

Performance Criteria	Suggested items to aid professional judgement
(a) The information is collected by active participation in the experiment	The candidate should be involved in planning, organising and completing the experiment.
(b) The experimental procedures are described accurately	<p>A clear statement of the aim or objective of the experiment.</p> <p>A few brief concise sentences as appropriate:</p> <ul style="list-style-type: none"> ◆ a labelled diagram or brief description of apparatus, instruments used ◆ how the measurements were taken or observations made ◆ comments on safety <p>There is no need for a detailed description. The use of the impersonal passive voice is to be encouraged as an example of good practice but this is not mandatory for meeting the Performance Criteria.</p>
(c) Relevant measurements and observations are recorded in an appropriate format	<p>Readings or observations recorded using the following as appropriate:</p> <ul style="list-style-type: none"> ◆ a table with correct headings and appropriate units ◆ a table with readings/observations entered correctly ◆ a statement of results

(continued)

Performance Criteria	Suggested items to aid professional judgement
(d) Conclusions drawn are valid	<p>Conclusions should use evidence from the experiment and relate back to the aim of the experiment. At least one of the following should be included:</p> <ul style="list-style-type: none"> ◆ overall pattern to readings ◆ trends in analysed information or results ◆ connection between variables ◆ an analysis of the observations <p>Conclusions should also include evaluation of the experimental procedures and could make reference to one of the following:</p> <ul style="list-style-type: none"> ◆ effectiveness of procedures ◆ control of variables ◆ limitations of equipment ◆ possible improvements ◆ possible sources of error

5.4 Intermediate 2 Chemistry

5.4 Intermediate 2 Chemistry

Information about this Course

The Intermediate 2 Chemistry Course is made up of the following three mandatory Units:

D066 11	Building Blocks (Int 2)	1 credit (40 hours)
D067 11	Carbon Compounds (Int 2)	1 credit (40 hours)
D068 11	Acids, Bases and Metals (Int 2)	1 credit (40 hours)

Recommended entry

Entry for the Course is at the discretion of the centre, however candidates are normally expected to have attained one of the following awards or its equivalent:

- ◆ Standard Grade Chemistry with Knowledge and Understanding and Problem Solving at grades 3 and 4
 - ◆ Standard Grade Biology, Physics or Science with Knowledge and Understanding and Problem Solving at grades 1 to 3
 - ◆ The Intermediate 1 Chemistry Course or its component Units
 - ◆ The Intermediate 2 Biology or Physics Course
- together with**
- ◆ Standard Grade Mathematics with Knowledge and Understanding and Reasoning at grades 3 and 4 or Intermediate 1 Mathematics

Course assessment

To gain the Course award the candidate must achieve each component Unit of the Course as well as the external instrument. Each Unit is internally assessed by the centre and is subject to external verification.

External assessment provides the basis for grading attainment in the Course award.

External assessment

The external assessment instrument is an examination of two hours' duration with a total allocation of 80 marks.

The examination consists of two sections:

Section A	Multiple choice questions	30 marks
Section B	Extended-answer questions	50 marks

Section A will be made up of 30 multiple choice questions.

Section B has an allocation of 50 marks and approximately 5 marks will be allocated to questions which will draw on the candidates' experience of the Prescribed Practical Activities.

Of the 80 marks in the paper between 46 and 50 marks will be allocated to the assessment of Knowledge and Understanding and between 30 and 34 marks will be allocated to the assessment of Problem Solving.

Prescribed Practical Activities

All candidates are expected to carry out the Prescribed Practical Activities listed below.

Activity	Unit
The Effect of Concentration Changes on Reaction Rate	1
The Effect of Temperature Changes on Reaction Rate	1
Electrolysis	1
Testing for Unsaturation	2
Cracking	2
Hydrolysis of Starch	2
Preparation of a Salt	3
Factors which Affect Voltage	3
Reaction of Metals with Oxygen	3

A Prescribed Practical Activities pack produced by Learning and Teaching Scotland for Intermediate 1, Intermediate 2 and Higher Chemistry provides further guidance on the assessment of Outcome 3 for each Unit by way of lists of:

- ◆ experiments
- ◆ candidates' instruction sheets
- ◆ recording pro formas
- ◆ technician's guide
- ◆ advice related to marking

Packs are available to download from: www.ltscotland.org.uk.

Internal assessment

Outcomes 1 and 2

Assessment Type	End of Unit test
Duration	45 minutes
Total Marks	30
Threshold of Attainment	18

Appropriate assessment material is provided through the National Assessment Bank. Contact the SQA Co-ordinator for access to this material.

Outcome 3

Candidates are required to produce one report on an experiment covering all of the Performance Criteria and related to Intermediate 2 Chemistry.

The report must be based on one of the Unit 1 Prescribed Practical Activities.

Assessment scheme for Outcome 3

The ‘Outcome 3: Teacher/lecturer guide’ on the following pages is provided to indicate what should be demonstrated by the candidate to achieve each specification Performance Criterion. The relevance of the items suggested will vary according to the experiment being undertaken. These items are pointers to aid the professional judgement of the teacher/lecturer and will assist in deciding if a Performance Criterion has been met for a particular experiment.

Guidance on approaches to assessment of Outcome 3 is provided in the Support Notes in the Unit Specification included in the Arrangements document.

Further guidance is included in the separate Prescribed Practical Activities pack.

Assessment of the Performance Criteria for Outcome 3

The Evidence Requirements for Outcome 3 require the teacher/lecturer to attest that the report is the individual work of the candidate derived from the active participation in an experiment involving the candidate in:

- ◆ planning the experiment
- ◆ deciding how it is to be managed
- ◆ identifying and obtaining the necessary resources, some of which must be unfamiliar
- ◆ carrying out the experiment
- ◆ evaluating all stages of the experiment, including the initial analysis of the situation and planning and organising experimental procedures

This means that there are two main pieces of evidence for Outcome 3, namely (i) the teacher/lecturer’s judgement that the above has taken place which is indicated when Performance Criterion (a) is signed off and (ii) the candidate’s report, ie not all the evidence is present in the report.

Outcome 3: Teacher/lecturer guide

All the Performance Criteria given in the left-hand column must be achieved in order to attain the Outcome. The right-hand column gives suggested items which might aid the professional judgement of the assessor.

Performance Criteria	Suggested items to aid professional judgement
(a) The information is collected by active participation in the experiment	The candidate should be involved in planning, organising and completing the experiment.
(b) The experimental procedures are described accurately	<p>A clear statement of the aim or objective of the experiment.</p> <p>A few brief concise sentences as appropriate:</p> <ul style="list-style-type: none"> ◆ a labelled diagram or brief description of apparatus, instruments used ◆ how the measurements were taken or observations made ◆ comments on safety <p>There is no need for a detailed description. The use of the impersonal passive voice is to be encouraged as an example of good practice but this is not mandatory for meeting the Performance Criteria.</p>
(c) Relevant measurements and observations are recorded in an appropriate format	<p>Readings or observations recorded using the following as appropriate:</p> <ul style="list-style-type: none"> ◆ a table with correct headings and appropriate units ◆ a table with readings/observations entered correctly ◆ a statement of results

(continued)

Performance Criteria	Suggested items to aid professional judgement
(d) Conclusions drawn are valid	<p>Conclusions should use evidence from the experiment and relate back to the aim of the experiment. At least one of the following should be included:</p> <ul style="list-style-type: none"> ◆ overall pattern to readings ◆ trends in analysed information or results ◆ connection between variables ◆ an analysis of the observations <p>Conclusions should also include evaluation of the experimental procedures and could make reference to one of the following:</p> <ul style="list-style-type: none"> ◆ effectiveness of procedures ◆ control of variables ◆ limitations of equipment ◆ possible improvements ◆ possible sources of error

5.5 Higher Chemistry

5.5 Higher Chemistry

Information about this Course

The Higher Chemistry Course is made up of the following three mandatory Units:

D069 12	Energy Matters (H)	1 credit (40 hours)
D070 12	The World of Carbon (H)	1 credit (40 hours)
D071 12	Chemical Reactions (H)	1 credit (40 hours)

Recommended entry

Entry for the Course is at the discretion of the centre, however candidates are normally expected to have attained one of the following awards or its equivalent:

- ◆ Standard Grade Chemistry with Knowledge and Understanding and Problem Solving grades 1 and 2
- ◆ The Intermediate 2 Chemistry Course or its component Units

Course assessment

To gain the Course award the candidate must achieve each component Unit of the Course as well as the external instrument. Each Unit is internally assessed by the centre and is subject to external verification.

External assessment will provide the basis for grading attainment in the Course award.

External assessment

The external assessment instrument is an examination of 2 hours 30 minutes' duration with a total allocation of 100 marks.

The examination consists of two sections:

Section A	Multiple choice questions	40 marks
Section B	Extended-answer questions	60 marks

Section A is made up of 40 multiple choice questions.

In section B approximately six marks are allocated to questions that draw on the candidates' experience of the Prescribed Practical Activities.

Of the 100 marks in the paper between 57 and 62 marks are allocated to the assessment of Knowledge and Understanding and between 38 and 43 marks are allocated to the assessment of Problem Solving.

Up to 10 marks of the paper are allocated to questions based on content which is common to Standard Grade and Intermediate 2, with assessment at a level appropriate to Higher.

Prescribed Practical Activities

All candidates are expected to carry out the Prescribed Practical Activities listed below.

Activity	Unit
The Effect of Concentration Changes on Reaction Rate	1
The Effect of Temperature Changes on Reaction Rate	1
Enthalpy of Combustion	1
Oxidation	2
Making Esters	2
Factors Affecting Enzyme Activity	2
Hess's Law	3
Quantative Electrolysis	3
A Redox Titration	3

A Prescribed Practical Activities pack produced by Learning and Teaching Scotland for Intermediate 1, Intermediate 2 and Higher Chemistry provides further guidance on the assessment of Outcome 3 for each Unit by way of lists of:

- ◆ experiments
- ◆ candidates' instruction sheets
- ◆ recording pro formas
- ◆ technician's guide
- ◆ advice related to marking

Packs are available to download from: www.ltscotland.org.uk.

Internal assessment

Outcomes 1 and 2

Assessment Type	End of Unit test
Duration	45 minutes
Total Marks	30
Threshold of Attainment	18

Appropriate assessment material is provided through the National Assessment Bank. Contact the SQA Co-ordinator for access to this material.

Outcome 3

Candidates are required to produce one report on an experiment covering all of the Performance Criteria and related to Higher Chemistry.

The report must be based on one of the Unit 1 Prescribed Practical Activities.

Assessment scheme for Outcome 3

The ‘Outcome 3: Teacher/lecturer guide’ on the following pages is provided to indicate what should be demonstrated by the candidate to achieve each specification Performance Criterion. The relevance of the items suggested will vary according to the experiment being undertaken. These items are pointers to aid the professional judgement of the teacher/lecturer and will assist in deciding if a Performance Criterion has been met for a particular experiment.

Guidance on approaches to assessment of Outcome 3 is provided in the Support Notes in the Unit Specification included in the Arrangements document.

Further guidance is included in the separate Prescribed Practical Activities pack.

Assessment of the Performance Criteria for Outcome 3

The Evidence Requirements for Outcome 3 require the teacher/lecturer to attest that the report is the individual work of the candidate derived from the active participation in an experiment involving the candidate in:

- ◆ planning the experiment
- ◆ deciding how it is to be managed
- ◆ identifying and obtaining the necessary resources, some of which must be unfamiliar
- ◆ carrying out the experiment
- ◆ evaluating all stages of the experiment, including the initial analysis of the situation and planning and organising experimental procedures

This means that there are two main pieces of evidence for Outcome 3, namely (i) the teacher/lecturer’s judgement that the above has taken place which is indicated when Performance Criterion (a) is signed off and (ii) the candidate’s report, ie not all the evidence is present in the report.

Outcome 3: Teacher/lecturer guide

All the Performance Criteria given in the left-hand column must be achieved in order to attain the Outcome. The right-hand column gives suggested items which might aid the professional judgement of the assessor.

Performance Criteria	Suggested items to aid professional judgement
(a) The information is collected by active participation in the experiment	The candidate should be involved in planning, organising and completing the experiment.
(b) The experimental procedures are described accurately	<p>A clear statement of the aim or objective.</p> <p>A few brief concise sentences as appropriate:</p> <ul style="list-style-type: none"> ◆ a labelled diagram or brief description of apparatus, instruments used ◆ how the measurements were taken or observations made ◆ comments on safety <p>There is no need for a detailed description. The use of the impersonal passive voice is to be encouraged as an example of good practice but this is not mandatory for meeting the Performance Criteria.</p>
(c) Relevant measurements and observations are recorded in an appropriate format	<p>Readings or observations (raw data) should be recorded using the following, as appropriate:</p> <ul style="list-style-type: none"> ◆ a table with correct headings and appropriate units ◆ a table with readings/observations entered correctly. ◆ a statement of results

(continued)

Performance Criteria	Suggested items to aid professional judgement
<p>(d) Recorded experimental information is analysed and presented in an appropriate format</p> <p>Unit D069 12 Energy Matters and Unit D071 12 Chemical Reactions only</p>	<p>Readings or observations (raw data) should be analysed/presented using the following, as appropriate:</p> <ul style="list-style-type: none"> ◆ a table with suitable headings and units ◆ a table with ascending or descending independent variable ◆ a table showing appropriate computations ◆ a correct calculation ◆ a graph with independent and dependent variables plotted on appropriate axes ◆ a graph with suitable scales and axes labelled with quantities and units ◆ a graph with data correctly plotted with a line or curve of best fit <p>For a tabular presentation this may be an extension of the table used for Performance Criteria (c).</p>
<p>(e) Conclusions drawn are valid</p>	<p>Conclusions should use evidence from the experiment and relate back to the aim of the experiment. At least one of the following should be included:</p> <ul style="list-style-type: none"> ◆ the overall pattern to readings ◆ the trends in analysed information or results ◆ the connection between variables ◆ an analysis of the observations ◆ the findings from completed calculations <p>Conclusions should also include evaluation of the experimental procedures and could make reference to one of the following:</p> <ul style="list-style-type: none"> ◆ effectiveness of procedures ◆ control of variables ◆ limitations of equipment ◆ possible improvements ◆ possible sources of error

5.6 Advanced Higher Chemistry

5.6 Advanced Higher Chemistry

Information about this Course

The Advanced Higher Chemistry Course is made up of the following four mandatory Units:

D072 13	Electronic Structure and the Periodic Table (AH)	0.5 credit (20 hours)
D073 13	Principles of Chemical Reactions (AH)	1 credit (40 hours)
D074 13	Organic Chemistry (AH)	1 credit (40 hours)
D075 13	Chemical Investigation (AH)	0.5 credit (20 hours)

Recommended entry

Entry for the Course is at the discretion of the centre, however candidates are normally expected to have attained one of the following awards or its equivalent:

- ◆ Higher Chemistry or its component Units

Course assessment

To gain the Course award the candidate must achieve each component Unit of the Course as well as the external instrument. Each Unit is internally assessed by the centre and is subject to external verification.

External assessment will provide the basis for grading attainment in the Course award.

External assessment

The external assessment instruments are an exam of two hours 30 minutes' duration with a total allocation of 100 marks, and an Investigation Report with an allocation of 25 marks.

The examination is split into the following sections:

Section A	Multiple choice questions	40 marks
Section B	Extended-answer questions	60 marks

Section A is made up of 40 multiple choice questions.

In section B approximately six marks are allocated to questions which draw on the candidates' experience of the Prescribed Practical Activities.

Of the 100 marks in the written paper, between 50 and 55 marks are allocated to the assessment of Knowledge and Understanding and between 45 and 50 marks are allocated to the assessment of Problem Solving.

Up to 10 marks of the paper are allocated to questions based on the content of Higher Chemistry, with assessment at a level appropriate to Advanced Higher.

Investigation Report

The Investigation Report is based on the work carried out in the component Unit, Chemical Investigation (AH). The report should be around 2000–2500 words in length excluding contents pages, indexes, tables, graphs, etc.

The report is externally assessed using the following assessment categories:

- a. Introduction (4 marks)
- b. Procedures (6 marks)
- c. Results (5 marks)
- d. Discussion (7 marks)
- e. Presentation (3 marks)

An Investigation Guidance document is available to download from SQA's website.

Prescribed Practical Activities

All candidates will be expected to carry out the Prescribed Practical Activities listed below.

Activity	Unit
Preparation of Potassium Trioxalatoferate (III)	1
Colorimetric Determination of Manganese in Steel	1
Complexometric Determination of Nickel using EDTA	2
Gravimetric Determination of Water in Hydrated Barium Chloride	2
Determination of a Partition Coefficient	2
Verification of a Thermodynamic Prediction	2
Kinetics of the Acid-Catalysed Propanone/Iodine Reaction	2
Preparation of Cyclohexene	3
Identification by Derivative Formation	3
Preparation of Benzoic Acid by Hydrolysis of Ethyl Benzoate	3
Preparation of Aspirin	3
Aspirin Determination	3

A Prescribed Practical Activities pack produced by Learning and Teaching Scotland for Advanced Higher Chemistry provides further guidance on the assessment of Outcome 3 for each Unit by way of lists of:

- ◆ experiments
- ◆ student guides
- ◆ student instruction sheets
- ◆ teacher/lecturer/technician guides

Packs are available to purchase from Learning and Teaching Scotland.

Internal assessment

Outcomes 1 and 2

Unit: D072 13	Electronic Structures and the Periodic Table
Assessment Type	End of Unit test
Duration	30 minutes
Total Marks	20
Threshold of Attainment	10
Units: D073 13 D074 13	Principles of Chemical Reactions Organic Chemistry
Assessment Type	End of Unit test
Duration	45 minutes
Total Marks	30
Threshold of Attainment	15

Appropriate assessment material is provided through the National Assessment Bank. Contact the SQA Co-ordinator for access to this material.

Outcome 3

Candidates are required to produce one report on an experiment covering all of the Performance Criteria and related to Advanced Higher Chemistry, ie the report must be based on any one of the Prescribed Practical Activities.

Outcomes 1 and 2: D075 13 Chemical Investigation

Assessment Type: Record of Work (commonly known as ‘the daybook’)

Outcome 1

Candidates are required to develop a plan for an Investigation.

Performance Criteria

- a. A record is maintained in a regular manner
- b. The aims of the Investigation are clearly stated
- c. Experimental procedures and apparatus are appropriate for the Investigation

Evidence Requirements

A completed record giving brief summaries to indicate the planning stage. Ideas rejected and important contributions made by the teacher/lecturer or other individuals should be included.

Outcome 2

Collect and analyse information obtained from the Investigation

Performance Criteria

- a. The collection of the experimental information is carried out with due accuracy
- b. Relevant measurements and observations are recorded in an appropriate format
- c. Recorded experimental information is analysed and presented in an appropriate format

Evidence Requirements

A record of the collection and analysis of the information, both of which must be the individual work of the candidate.

For further guidance refer to pages 81 and 82 of the Arrangements document, and NAB material.

Assessment scheme for Outcome 3

Guidance on approaches to assessment of Outcome 3 is provided in the Support Notes in the Unit Specification included in the Arrangements document.

The ‘Outcome 3: Teacher/lecturer guide’ given on the following pages is provided to indicate what should be demonstrated by the candidate to achieve each specification Performance Criterion. The relevance of the items suggested will vary according to the experiment being undertaken. These items are pointers to aid the professional judgement of the teacher/lecturer and will assist in deciding if a Performance Criterion has been met for a particular experiment.

Teachers/lecturers should indicate on each candidate’s report that Performance Criteria (a) to (f) have been met. In signing off Performance Criteria (a) teachers/lecturers are attesting that the candidate has been actively involved in the collection of the experimental information.

Outcome 3: Teacher/lecturer guide

All the Performance Criteria given in the left-hand column must be achieved in order to attain the Outcome. The right-hand column gives suggested items which might aid the professional judgement of the assessor.

Performance Criteria	Suggested items to aid professional judgement
(a) The information is collected by active participation in the experiment	The candidate should be involved in planning, organising and completing the experiment.
(b) The experimental procedures are described accurately	<p>A clear statement of the aim or objective.</p> <p>A brief description of the background theory of the experiment.</p> <p>A few brief concise sentences as appropriate:</p> <ul style="list-style-type: none"> ◆ a labelled diagram or brief description of apparatus, instruments used ◆ how the measurements were taken or observations made ◆ comments on safety <p>There is no need for a detailed description. The use of the impersonal passive voice is to be encouraged as an example of good practice but this is not mandatory for meeting the Performance Criteria.</p>
(c) Relevant measurements and observations are recorded in an appropriate format	<p>Readings or observations (raw data) should be recorded using the following, as appropriate:</p> <ul style="list-style-type: none"> ◆ a table with correct headings and appropriate units ◆ a table with readings/observations entered correctly ◆ a statement of results

(continued)

Performance Criteria	Suggested items to aid professional judgement
(d) Recorded experimental information is analysed and presented in an appropriate format	<p>Readings or observations (raw data) should be analysed/presented using the following, as appropriate:</p> <ul style="list-style-type: none"> ◆ a table with suitable headings and units ◆ a table with ascending or descending independent variable ◆ a table showing appropriate computations ◆ a correct calculation ◆ a graph with independent and dependent variables plotted on appropriate axes ◆ a graph with suitable scales and axes labelled with quantities and units ◆ a graph with data correctly plotted with a line or curve of best fit <p>For a tabular presentation this may be an extension of the table used for Performance Criteria (c).</p>
(e) Conclusions drawn are valid	<p>Conclusions should use evidence from the experiment and relate back to the aim of the experiment. At least one of the following should be included:</p> <ul style="list-style-type: none"> ◆ the overall pattern to readings ◆ the trends in analysed information or results ◆ the connection between variables ◆ an analysis of the observations ◆ the findings from completed calculations
(f) The experimental procedures are evaluated with supporting argument	<p>Evaluation of the experimental procedures should make reference to one of the following:</p> <ul style="list-style-type: none"> ◆ effectiveness of procedures ◆ control of variables ◆ limitations of equipment ◆ possible improvements ◆ possible sources of error

5.7 NAB Threshold of Attainment: Chemistry

5.7 NAB Threshold of Attainment: Chemistry

Level	Unit	Code	NAB Versions	Threshold of Attainment
Access 3	Chemistry in Action	D063 09	NAB001, NAB002, NAB003	18 out of 30
	Everyday Chemistry	D06409	NAB001, NAB002, NAB003	18 out of 30
	Chemistry and Life	D065 09	NAB001, NAB002, NAB003	18 out of 30
Intermediate 1	Chemistry in Action	D063 10	NAB001, NAB002, NAB003, NAB004, NAB005	18 out of 30
	Everyday Chemistry	D064 10	NAB001, NAB002, NAB003, NAB004, NAB005	18 out of 30
	Chemistry and Life	D065 10	NAB001, NAB002, NAB003, NAB004, NAB005	18 out of 30
Intermediate 2	Building Blocks	D066 11	NAB001, NAB002, NAB003, NAB004, NAB005	18 out of 30
	Carbon Compounds	D067 11	NAB001, NAB002, NAB003 NAB004 NAB005	18 out of 30
	Acids, Bases and Metals	D068 11	NAB001, NAB002, NAB003, NAB004, NAB005	18 out of 30

NAB Threshold of Attainment: Chemistry

(continued)

Level	Unit	Code	NAB Versions	Threshold of Attainment
Higher	Energy Matters	D069 12	NAB001, NAB002, NAB003, NAB004, NAB005	18 out of 30
	The World of Carbon	D070 12	NAB001, NAB002, NAB003, NAB004, NAB005	18 out of 30
	Chemical Reactions	D071 12	NAB001, NAB002, NAB003, NAB004, NAB005	18 out of 30
Advanced Higher	Electronic Structures and the Periodic Table	D072 13	NAB001, NAB002, NAB003	10 out of 20
	Principles of Chemical Reactions	D073 13	NAB001, NAB002, NAB003	15 out of 30
	Organic Chemistry	D074 13	NAB001, NAB002, NAB003	15 out of 30

5.8 Transfer of Evidence Outcome 3: Chemistry

5.8 Transfer of Evidence Outcome 3: Chemistry

Level	Credit permitted	Credit not permitted
Access 3	<p>An Outcome 3 report on an experiment covering all of the Performance Criteria and which is based on one of the Unit 1 Prescribed Practical Activities listed below may be used as evidence of achievement of Outcome 3 requirements for all three Units:</p> <ul style="list-style-type: none"> ◆ The Effect of Temperature Changes on Dissolving Speed ◆ The Effect of Concentration Changes on Reaction Speed ◆ Testing the pH of Solutions <p>A report on an Intermediate 1 Unit 1 D063 10 Chemistry in Action Prescribed Practical Activity may be used as evidence to meet the Outcome 3 requirements of all three Units.</p> <p>Candidates who are repeating a year may use evidence of an appropriate standard generated in a previous year.</p>	<p>An Outcome 3 report on an experiment which is based on one of the Unit 2 or Unit 3 Prescribed Practical Activities may not be used as evidence of achievement of Outcome 3 requirements for any Access 3 Chemistry Unit.</p> <p>A report on an Intermediate 1 Unit 2 D064 10 Everyday Chemistry or Unit 3 D065 10 Chemistry and Life Prescribed Practical Activity may not be used as evidence to meet the Outcome 3 requirements of any Access 3 Chemistry Unit, unless they are being taken as stand-alone Units.</p>

Transfer of Evidence Outcome 3: Chemistry

(continued)

Level	Credit permitted	Credit not permitted
Intermediate 1	<p>An Outcome 3 report on an experiment covering all of the Performance Criteria and which is based on one of the Unit 1 Prescribed Practical Activities listed below may be used as evidence of achievement of Outcome 3 requirements for any Intermediate 1 Chemistry Unit:</p> <ul style="list-style-type: none"> ◆ The Effect of Temperature Changes on Dissolving Speed ◆ The Effect of Concentration Changes on Reaction Speed ◆ Testing the pH of Solutions <p>Candidates may transfer evidence of Outcome 3 from Unit 1 D066 11 Building Blocks of Intermediate 2 in respect of the Prescribed Practical Activity The Effect of Temperature Changes on Reaction Rates.</p> <p>Candidates, who are repeating a year, may use evidence of an appropriate standard generated in a previous year.</p>	<p>An Outcome 3 report of one experimental activity related to one of the following experiments may not be used as evidence of achievement of Outcome 3 of any Intermediate 1 Chemistry Unit, unless they are being taken as stand-alone Units.</p> <ul style="list-style-type: none"> ◆ Electrical Conductivity ◆ Reaction of Metals with Dilute Acid ◆ Factors which affect Lathering ◆ Solubility ◆ Burning Carbohydrates ◆ Testing for Sugars and Starch <p>The Prescribed Practical Activity Electrolysis (Intermediate 2) cannot be transferred to Intermediate 1.</p>

Transfer of Evidence Outcome 3: Chemistry

Level	Credit permitted	Credit not permitted
Intermediate 2	<p>An Outcome 3 report on an experiment covering all of the Performance Criteria and which is based on one of the Unit 1 Prescribed Practical Activities listed below may be used as evidence of achievement of Intermediate 2 Chemistry Unit:</p> <ul style="list-style-type: none"> ◆ The Effect of Concentration Changes on Reaction Rate ◆ The Effect of Temperature Changes on Reaction Rate ◆ Electrolysis <p>Candidates may transfer evidence of Outcome 3 from Unit 1 D069 12 Energy Matters of Higher to Unit 1 D066 11 Building Blocks of Intermediate 2 in respect of the Prescribed Practical Activities The Effect of Concentration Changes on Reaction Rate and The Effect of Temperature Changes on Reaction Rate.</p> <p>Candidates may transfer evidence of Outcome 3 from Unit 1 D066 11 Building Blocks of Intermediate 2 to Unit 1 D063 10 Chemistry in Action of Intermediate 1 in respect of the Prescribed Practical Activities The Effect of Concentration Changes on Reaction Rate and The Effect of Temperature Changes on Reaction Rate.</p> <p>Candidates who are repeating a year, may use evidence of an appropriate standard generated in a previous year.</p>	<p>An Outcome 3 report of one experimental activity related to one of the following experiments may not be used as evidence of achievement of Outcome 3 of any Intermediate 2 Chemistry Unit, unless they are being taken as stand-alone Units.</p> <ul style="list-style-type: none"> ◆ Electrolysis ◆ Testing for Unsaturation ◆ Cracking ◆ Hydrolysis of Starch ◆ Preparation of a Salt ◆ Factors which affect Voltage ◆ Reaction of Metals with Oxygen <p>The Prescribed Practical Activity Enthalpy of Combustion (Higher) cannot be transferred since it is not in the context of any Unit of Intermediate 2.</p> <p>The Prescribed Practical Activity Electrolysis (Intermediate 2) cannot be transferred to Unit 1 of Intermediate 1.</p>

Transfer of Evidence Outcome 3: Chemistry

(continued)

Level	Credit permitted	Credit not permitted
Higher	<p>An Outcome 3 report on an experiment covering all of the Performance Criteria and which is based on one of the Unit 1 Prescribed Practical Activities listed below may be used as evidence of achievement of Outcome 3 requirements for any Higher Chemistry Unit:</p> <ul style="list-style-type: none"> ◆ The Effect of Concentration Changes on Reaction Rate ◆ The Effect of Temperature Changes on Reaction Rate ◆ Enthalpy of Combustion <p>Candidates may transfer evidence of Outcome 3 from Unit 1 D069 12 Energy Matters of Higher to Unit 1 D066 11 Building Blocks of Intermediate 2 in respect of the Prescribed Practical Activities The Effect of Concentration Changes on Reaction Rate and The Effect of Temperature Changes on Reaction Rate.</p> <p>Candidates who are repeating a year may use evidence of an appropriate standard generated in a previous year.</p>	<p>An Outcome 3 report of one experimental activity related to one of the following experiments may not be used as evidence of achievement of Outcome 3 of any Higher Chemistry Units, unless they are being taken as stand-alone Units.</p> <ul style="list-style-type: none"> ◆ Oxidation ◆ Making Esters ◆ Factors Affecting Enzyme Activity ◆ Hess's Law ◆ Quantitative Electrolysis ◆ A Redox Titration <p>The Prescribed Practical Activity Enthalpy of Combustion (Higher) cannot be transferred since it is not in the context of any Unit of Intermediate 2.</p>

Level	Credit permitted	Credit not permitted																										
Advanced Higher	<p>An Outcome 3 report on an experiment covering all of the Performance Criteria and which is based on any one of the Prescribed Practical Activities listed below may be used as evidence of achievement of Outcome 3 requirements for any Advanced Higher Chemistry Unit.</p> <table border="1" data-bbox="517 631 1002 1686"> <thead> <tr> <th data-bbox="517 631 949 676">Activity</th><th data-bbox="949 631 1002 676">Unit</th></tr> </thead> <tbody> <tr> <td data-bbox="517 676 949 743">Preparation of Potassium Trioxalatoferate(III)</td><td data-bbox="949 676 1002 743">1</td></tr> <tr> <td data-bbox="517 743 949 866">Colorimetric Determination of Manganese in Steel</td><td data-bbox="949 743 1002 866">1</td></tr> <tr> <td data-bbox="517 866 949 979">Complexometric Determination of Nickel using EDTA</td><td data-bbox="949 866 1002 979">2</td></tr> <tr> <td data-bbox="517 979 949 1091">Gravimetric Determination of Water in Hydrated Barium Chloride</td><td data-bbox="949 979 1002 1091">2</td></tr> <tr> <td data-bbox="517 1091 949 1158">Determination of a Partition Coefficient</td><td data-bbox="949 1091 1002 1158">2</td></tr> <tr> <td data-bbox="517 1158 949 1226">Verification of a Thermodynamic Prediction</td><td data-bbox="949 1158 1002 1226">2</td></tr> <tr> <td data-bbox="517 1226 949 1338">Kinetics of the Acid-Catalysed Propanone/Iodine Reaction</td><td data-bbox="949 1226 1002 1338">2</td></tr> <tr> <td data-bbox="517 1338 949 1405">Preparation of Cyclohexene</td><td data-bbox="949 1338 1002 1405">3</td></tr> <tr> <td data-bbox="517 1405 949 1473">Identification by Derivative Formation</td><td data-bbox="949 1405 1002 1473">3</td></tr> <tr> <td data-bbox="517 1473 949 1585">Preparation of Benzoic Acid by Hydrolysis of Ethyl Benzoate</td><td data-bbox="949 1473 1002 1585">3</td></tr> <tr> <td data-bbox="517 1585 949 1630">Preparation of Aspirin</td><td data-bbox="949 1585 1002 1630">3</td></tr> <tr> <td data-bbox="517 1630 949 1686">Aspirin Determination</td><td data-bbox="949 1630 1002 1686">3</td></tr> </tbody> </table> <p>Candidates who are repeating a year may use evidence of an appropriate standard generated in a previous year.</p>	Activity	Unit	Preparation of Potassium Trioxalatoferate(III)	1	Colorimetric Determination of Manganese in Steel	1	Complexometric Determination of Nickel using EDTA	2	Gravimetric Determination of Water in Hydrated Barium Chloride	2	Determination of a Partition Coefficient	2	Verification of a Thermodynamic Prediction	2	Kinetics of the Acid-Catalysed Propanone/Iodine Reaction	2	Preparation of Cyclohexene	3	Identification by Derivative Formation	3	Preparation of Benzoic Acid by Hydrolysis of Ethyl Benzoate	3	Preparation of Aspirin	3	Aspirin Determination	3	<p>Candidate records generated as evidence for the assessment of the Unit D075 13 Chemical Investigation may not be used as evidence of achievement of Outcome 3 of any Advanced Higher Chemistry Unit.</p> <p>Outcome 3 reports of practical work in Advanced Higher Chemistry Units may not be used as evidence of achievement of the Chemical Investigation Unit.</p>
Activity	Unit																											
Preparation of Potassium Trioxalatoferate(III)	1																											
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Aspirin Determination	3																											

6.1 Standard Grade Physics

6 Physics

6.1 Standard Grade Physics

Information about this Course

Standard Grade Physics is described in terms of a number of topics, as shown below.

Topics

1. Telecommunications
2. Using Electricity
3. Health Physics
4. Electronics
5. Transport
6. Energy Matters
7. Space Physics

Recommended entry

Entry is at the discretion of the centre.

Course assessment

The assessment of pupil performance in the three Elements Knowledge and Understanding, Problem Solving and Practical Abilities are carried out with reference to the Extended Grade Related Criteria defined for each of these Elements.

Knowledge and Understanding and Problem Solving are assessed externally by a written examination.

Practical Abilities are internally assessed and are subject to external verification.

External assessment

Two external papers are offered: General, assessing grades 3 and 4, and Credit, assessing grades 1 and 2. The examination for General is 1 hour 30 minutes in duration and 1 hour 45 minutes for Credit level.

Both papers may contain multiple choice items, numerical direct answer and short-answer questions and extended-answer questions, but there may be a greater proportion of questions requiring extended-answers in the Credit level paper.

Grade 5 may be awarded to candidates who narrowly fail to meet the criteria for General level.

Units of physical quantities are written out in full in the General level paper. The solidus notation is used for describing the units of physical quantities in questions in the Credit level paper.

There is no choice of questions in either paper and the division and distribution of questions assessing each Element in both papers is 50% Knowledge and Understanding and 50% Problem Solving.

Marks are allocated to each question and a total mark obtained. The two grades associated with each Element at each level are distinguished by setting two cut-off scores. The lower score (in the region of 40–50%) reflects a satisfactory overall standard of performance, the upper score (in the region of 70–80%) reflects a high overall standard of performance.

Presentations for external papers

All candidates are required to be presented at both levels, but it is emphasised that they are not obliged to attempt both papers. They should, however, be made aware that, other than as the result of an appeal, candidates taking the General paper alone have only grades 3, 4, 5 and 7 open to them in KU and PS. For candidates taking only the Credit paper, the grades available in these Elements are 1, 2 and 7.

Candidates who attempt both papers are given the better of the two grades achieved for each of KU and PS. Performance at one level is not taken into account in grading at the other level.

Assessment for certification

Introduction

Assessment has an important contribution to make to the teaching and learning process. Assessment is also used for the purposes of certification and this is the concern of this section.

Assessment scheme

The assessment of pupil performance in the three Elements Knowledge and Understanding, Problem Solving and Practical Abilities is carried out with reference to the Extended Grade Related Criteria defined for each of these Elements (see Arrangements document).

A grade for attainment in each Element is recorded on the Certificate together with an overall grade for the Course derived from the mean of the Element grades with a weighting of 2:2:1 in favour of the externally assessed Elements. For Physics, Element grades are awarded on the scale 5 to 1, grade 1 denoting the highest performance. Grade 6 is not available for an Element, but may be gained as an overall award. Grade 7 is available (see below).

Centres must submit an estimate grade for each candidate for each of Knowledge and Understanding and Problem Solving to SQA. For information on key dates, refer to the Operational Help Centre which is available on SQA's website.

The teacher should determine the estimate grades on the basis of the candidate's work. Estimates may be used by the SQA for its internal procedures, including such cases as absence from external examinations, adverse circumstances and appeals. In these cases, evidence in support of these estimates should be retained by centres for submission to SQA.

The assessment scheme in summary is as follows.

Element	Type of Assessment
Knowledge and Understanding	External
Problem Solving	External
Practical Abilities	Internal with external verification

Internal Assessment of Practical Abilities

The abilities which comprise the Element Practical Abilities are:

- ◆ Carrying out Practical Techniques
- ◆ Planning and Carrying out Investigations

Assessment of Practical Abilities may take place at any time during the Course after candidates have had the opportunity to develop the abilities in which performance is being assessed: suggested activities and Practical Investigations offer opportunities for the assessment of the Practical Abilities Element.

Carrying out Practical Techniques

This ability is assessed by monitoring the candidate's success in carrying out eight prescribed Techniques. These Techniques, the conditions under which each should be demonstrated (the specification), and the criteria which must be satisfied for certification purposes are set out in the table on the following pages.

Planning and Carrying out Investigations

This ability is assessed in terms of the extent to which the Investigative Skills Objectives are achieved by the candidate in the course of planning and carrying out a practical Investigation. The Investigative Skills Objectives are grouped under the four headings:

1. Generative Skills (G)
2. Experimental Skills (E)
3. Evaluation Skills (Ev)
4. Recording and Reporting Skills (RR)

Two Investigations, each covering all of the Investigative Skills Objectives, should be submitted for the purpose of assessment for certification. At least one of the Investigations must involve a continuous variable.

The Investigation Booklet (Appendix II) issued by SQA must be used for all Investigations conducted for the purposes of assessment for certification. Investigations for certification purposes must be carried out and written up by the candidate in class time.

Practical Techniques

Technique	Specification	Criteria for assessment
<p>The candidate is able to:</p> <ol style="list-style-type: none"> 1. measure the speed of a moving object 	<p>The candidate uses a light-gate to measure the instantaneous speed of an object as it moves down a slope. A length of card is fixed to the object. The length of the card is measured by the candidate. The object is released from a reference line on the slope so that it passes through the light-gate which is positioned at a second reference point on the slope. The time for the card to pass through the light-gate is measured electronically. The instantaneous speed of the object at the second reference point is calculated by the candidate.</p>	<p>The candidate produces written results and arrives at a value of the instantaneous speed within + or – 10% of the teacher's measurement.</p>
<ol style="list-style-type: none"> 2. measure the approximate focal length in order to select a particular convex lens from a box containing five different lenses 	<p>The candidate is presented with a box containing five unmarked converging lenses covering a range of focal lengths from 50 mm to 500 mm. The candidate is asked to identify by measurement a lens of specified focal length.</p>	<p>The candidate correctly measures the focal length and selects a lens of specified focal length.</p>
<ol style="list-style-type: none"> 3. measure the angle of incidence and the angle of refraction of a ray of light going from plastic or glass into air 	<p>The candidate is provided with a ray-box, a protractor and a plastic or glass semi-circular block. The candidate sets up a ray-box on a sheet of paper and directs a non-divergent ray of light at the curved surface of the semi-circular block and emerges from the plane surface. The direction of the incident ray and the position of the glass block are previously drawn on the sheet of paper by the teacher. The candidate draws the normal and the direction of the refracted ray on the sheet of paper. The angle of incidence and the angle of refraction are then measured from the sheet of paper using the protractor.</p>	<p>The candidate draws the normal, measures the angle of incidence and the angle of refraction and records values which are within + or – 2 degrees of the teacher's measurements.</p>

(continued)

Technique	Specification	Criteria for Assessment
The candidate is able to: 4. detect an open or a short circuit in an electric circuit	The candidate is supplied with three circuit boards each with three similar lamps in lampholders and connected in series. Each circuit board has a different fault. One has an open-circuited lead, another has an open-circuited lamp, and the other a short-circuited lampholder.	The candidate correctly identifies the fault on each board and its location.
5. measure current in and voltage across an electrical component	The candidate is presented with an assembled series circuit comprising a d.c. supply, resistor and a lamp. The circuit components are on mounts with terminals. The candidate is given a suitable d.c. ammeter and voltmeter (or multimeter).	The candidate measures the current in the circuit, and the voltage across either the resistor or the lamp and arrives at values within $+/- 5\%$ of those measured by the teacher.

(continued)

Technique	Specification	Criteria for Assessment
<p>The candidate is able to:</p> <p>6. connect an oscilloscope to an a.c. supply and measure the peak voltage</p>	<p>The candidate is given the following apparatus: signal generator, oscilloscope, calculator, connecting leads.</p> <p>The oscilloscope is set by the teacher as follows:</p> <ul style="list-style-type: none"> a) brightness and focus correctly adjusted; b) X-shift and Y-shift centred; c) X-gain minimum, Y-gain minimum amplification; stability adjusted for 1 kHz; d) input; e) Sync — internal, Trig-auto; f) time-base on lowest setting. <p>The signal generator is set as follows:</p> <ul style="list-style-type: none"> a) frequency at 1 kHz; b) voltage such as to give a waveform that is just discernible when the oscilloscope is set as described above. <p>The oscilloscope and signal generator have been switched on previously, but are not connected to each other.</p> <p>The candidate must not adjust the signal generator, but will require to adjust the time-base and the Y-gain controls, and use the Y-gain calibration scale to calculate the voltage.</p> <p>Different candidates are asked to measure different voltages.</p>	<p>The candidate must adjust the time-base and Y-gain controls, measure the peak voltage and arrive at a value within +/- 5% of that measured by the teacher.</p>

(continued)

Technique	Specification	Criteria for Assessment
The candidate is able to: 7. set up and adjust a voltage divider circuit to produce a specified voltage	The candidate is given a low voltage supply eg cell, battery; a suitable linear potentiometer and a suitable d.c. voltmeter or multimeter. The components are supplied on mounts with terminals. No connections are made between any of the components. The candidate is not provided with a circuit diagram.	The circuit must be correctly assembled as a voltage divider circuit and the voltmeter must read 1.0 V +/- 0.1 V.
8. wire up correctly a mixed series and parallel circuit, given the circuit diagram	The candidate is supplied with 2 cells, 2 lamps, a resistor, a suitable d.c. ammeter or multimeter, a switch, connecting leads and a circuit diagram. The components are presented with no connections made between them. The components are on mounts with 4 mm sockets. The circuit diagram shows the two cells, the switch, the resistor, all in series, and in series with these components is a parallel arrangement of the two lamps. The value of the resistor is such that the lamps will light.	The circuit must be set up as shown in the diagram presented to the candidate and, when switched on, allow the current to be measured.

Each candidate should be assessed on all of the eight Techniques listed above, the assessment being carried out during on-going class work or in specific practical tests. Candidates who on a particular occasion are unable to carry out a Technique should be assessed again on another day until the teacher is satisfied that the candidate can carry out the Technique or is unlikely to benefit from further opportunities. A score of two marks should be awarded by the teacher for each Technique successfully demonstrated by the candidate. Where the candidate is unsuccessful in demonstrating a Technique, zero marks should be awarded for that Technique. A total of 16 marks are available for Carrying out Practical Techniques.

Investigations

Planning and Carrying out Investigations

This ability is assessed in terms of the extent to which Investigative Skills Objectives are achieved by the course of planning and carrying out a practical Investigation. The Investigative Skills Objectives are grouped under four headings, as follows:

1. Generative Skills (G)
2. Experimental Skills (E)
3. Evaluation Skills (Ev)
4. Recording and Reporting Skills (RR)

Two Investigations, each covering all of the Investigative Skills Objectives, should be submitted for the purpose of assessment for certification. At least one of the Investigations must involve a continuous variable.

The Investigative Skills Objectives, together with the related assessment criteria and mark allocations for Standard Grade Physics, are set out in the paragraph headed ‘Assessment Scheme for Planning and Carrying out Investigations’.

Structure of Investigations

It is important that Investigations carried out for certification purposes provide opportunities for candidates to demonstrate all of the 13 identified Skills Objectives and are structured in a way which allows the teacher and an External Verifier to readily identify in the evidence generated those parts which relate to the individual objectives. It is equally important that the degree of structuring of the Investigation is not so great that the candidate receives an excessive amount of support. The Investigation Booklet (Appendix 2) issued by SQA must be used for all Investigations conducted for the purposes of assessment for certification.

Conduct of Investigations

The following comments give guidance on the permissible limits of support which may be offered by teachers during an Investigation which is being assessed for certification purposes.

It is expected that, at the outset of the Investigation, teachers will stimulate class or group discussion. Subsequent to the discussion, candidates must work individually throughout the remainder of the Investigation. However, if the candidate is unable to meet the criterion for G1, the teacher should give assistance to enable the candidate to proceed but will not award the mark allocated to this Objective. In the case of a candidate who identifies a relevant investigable aspect which cannot be investigated within the constraints of the school situation, the candidate should be directed to other alternatives without

penalty. Should a candidate fail to meet a criterion associated with Objective G2, G3 or G4, it is permissible for the teacher to intervene and give sufficient support to enable the candidate to proceed, but the mark allocated to the relevant criterion will not be awarded.

After the generative phase (Objectives G1, G2, G3 and G4) candidates must be left to pursue the Investigation independently. Teacher intervention in the post-generative phase is permitted only when the candidate fails to adopt standard, safe laboratory practice. In such a case, the mark allocated to the criterion for Objective E1 is forfeited.

Investigations for certification purposes must be carried out and written up by the candidate in class time.

Assessment Scheme for Planning and Carrying out Investigations

Assessment of achievement of Investigative Skills Objectives is undertaken by applying the following assessment scheme to evidence generated by the candidate in conducting practical Investigations. The scheme identifies the criteria which must be satisfied for the purposes of assessment for certification. For each of the criteria, one mark should be awarded where the requirements of the criterion are satisfied. If the criterion is not satisfied, zero marks should be awarded. The mark allocation for an Investigation is 24. A total of 48 marks is therefore available for Planning and Carrying out Investigations.

Assessment Scheme for Planning and Carrying out Investigations

Investigative Skills Objective		Assessment criteria and available marks	Marks Total
The candidate should be able to:			
G1	Demonstrate understanding of the problem posed	Following group discussion, the candidate individually identifies and records and investigable aspect of the problem (1,0)	1
G2	State the aim of the Investigation	Clearly identifies the aim of the Investigation in terms of the two relevant variables (1,0)	1
G3	Articulate a testable hypothesis	Articulates a testable hypothesis in terms of the two relevant variables; this should be directional if a continuous variable is chosen (1,0)	1
G4	Suggest a broad strategy to adopt	The strategy gives sufficient detail by description and/or diagram to indicate: <ul style="list-style-type: none"> a. how the chosen independent variable will be altered (1, 0) b. that the candidate has considered what will have to be measured (1,0) 	2
E1	Adopt appropriate and safe procedures	<ul style="list-style-type: none"> a. Adopts appropriate and safe procedures (1,0) 	1
E2	Identify the independent variable to be used and alter it over a suitable range	<ul style="list-style-type: none"> a. Provides a working definition of the independent variable (1, 0) b. Alters the independent variable over an appropriate range taking account of a suitable number of types or values (1,0) 	2
E3	Control all relevant variables as necessary	<ul style="list-style-type: none"> a. Makes a written statement of the variables which need to be actively controlled by the candidate (1, 0) b. Controls these variables in practice (1,0) 	2
E4	Make valid, reliable measurement of the dependent variable	<ul style="list-style-type: none"> a. Uses a valid method of measuring the dependent variable (1, 0) b. Evidence is provided of a form of repeat/replicate testing which improves the reliability of the results or a valid written justification is given for not repeating/replicating measurements (1, 0) 	2

(continued)

Investigative Skills Objective	Assessment criteria and available marks	Marks total
The candidate should be able to:		
RR1 Tabulate results with appropriate headings and units of measurement	<ul style="list-style-type: none"> a. Values (or types) with appropriate headings for independent, dependent (and any derived) variable are entered in the table (1,0) b. Appropriate units or their correct abbreviations are entered in the table (1,0) 	2
RR2 Present the results on a graph or chart	<ul style="list-style-type: none"> a. a graph or chart of a suitable size and scale is produced (1, 0) b. Both axes have appropriate labels and units (1,0) c. Plots all the points/bars accurately (1, 0) d. Draws line/curve of best fit or joins up the points as appropriate when the independent variable is continuous or draws a bar chart when the independent variable is not continuous (1, 0) 	4
Ev1 Draw a valid conclusion inter-relating the appropriate variables	Draws a conclusion which interrelates the appropriate variables or states that no firm conclusion can be drawn (1,0)	1
Ev2 Use results to evaluate the original hypothesis	Confirms hypothesis if appropriate or refutes hypothesis and replaces it with appropriate substitute or states that no conclusion can be drawn (1,0)	1
RR3 Describe how the Investigation was carried out	<p>The description includes:</p> <ul style="list-style-type: none"> a. a labelled diagram and/or statement of the apparatus used (1,0) b. an account of the procedure adopted to measure the dependent variable (1,0) c. an account of how the independent variable was altered (1,0) d. an indication of how variables which were the investigator's responsibility to control were kept constant (1,0) 	4

Recording Assessment of Practical Abilities

An Assessment Record should be used to record the outcome of the assessment of Practical Abilities. The Assessment Record should provide a summary of the candidate's attempts at the eight prescribed Techniques and the mark out of 16 attained. The Record should also give the candidate's total mark out of 48 for Planning and Carrying out Investigations and the breakdown of the marks attained for each of the Investigative Skills Objectives. In addition, the total mark and the overall grade for Practical Abilities should be included. An exemplar of an Assessment Record is given in Appendix II of the Arrangements document.

SQA provides centres annually with details of the arrangements for the submission of internal assessments of Practical Abilities for all candidates.

Evidence of attainment of Practical Abilities

Evidence of a candidate's attainment of Practical Abilities should comprise a summary, as described below, of the candidate's attempts to demonstrate the ability to carry out practical Techniques. In addition, the evidence should include the candidate's written work from two practical Investigations, each of which covers the 13 Investigative Skills Objectives listed in the previous table.

The two best practical Investigations should be used as evidence for certification purposes. At least one of the two Investigations must involve a continuous variable. The conditions for the structure and conduct of Investigations specified must be met and the Investigations must be assessed in accordance with the assessment scheme. The candidate's written work for the two practical Investigations should be marked and totalled, and must give a clear indication of the mark awarded for each of the Investigative Skills Objectives.

For each candidate, the evidence from the two best practical Investigations should be retained by the centre for possible submission to SQA for the purposes of verification of the centre's internal assessments.

Grade for Practical Abilities

The grade awarded for Practical Abilities is determined by totalling the candidate's mark for Carrying out Practical Techniques and the marks for the two best Investigations. The total mark is then compared with the marks ranges in the table below and the corresponding grade awarded.

Marks range	Grade
64–55	1
54–46	2
45–39	3
38–30	4
29–19	5

Candidates for whom there is evidence in support of at least one of the two abilities (ie Carry out Practical Techniques and Plan and Carry out Practical Investigations) and who achieve fewer than 19 marks should be awarded a Grade 7 for Practical Abilities.

Verification of internal assessments

To ensure the uniform application of the Extended Grade Related Criteria for Practical Abilities, each year a sample of centres will be required to submit to SQA evidence in support of internal assessments for a sample of candidates. Where a centre's internal assessments cannot be confirmed, the centre will be required to carry out assessment as necessary.

6.2 Access 3 Physics

6.2 Access 3 Physics

Information about this Course

The Access 3 Physics Course is made up of the following six mandatory Units:

D373 09	Telecommunications (Acc 3)	0.5 credit (20 hours)
D374 09	Practical Electricity (Acc 3)	0.5 credit (20 hours)
D375 09	Radiations (Acc 3)	0.5 credit (20 hours)
D376 09	Sound and Music (Acc 3)	0.5 credit (20 hours)
D377 09	Movement (Acc 3)	0.5 credit (20 hours)
D378 09	Electronics (Acc 3)	0.5 credit (20 hours)

These six Units are based on Units available at Intermediate 1 level, with the Outcomes modified to meet the needs of candidates who may be achieving at Access 3. The titles of the Units at the Access 3 level have been kept the same as the corresponding Intermediate 1 Units.

Appropriate groups of candidates can be taught at Intermediate 1 level using the content, contexts, applications, illustrations and activities provided in the Intermediate 1 Course Specification. Candidates can then be assessed to provide evidence of their actual level of achievement ie, to determine whether this is at Intermediate 1 or Access 3.

Recommended entry

Entry is at the discretion of the centre.

Internal assessment

Outcome 1

Assessment Type	End of Unit test
Duration	25 minutes
Total Marks	15
Threshold of Attainment	9

Appropriate assessment material is provided through the National Assessment Bank. Contact the SQA Co-ordinator for access to this material.

Outcome 2

Candidates are required to produce a report on one practical application of Access 3 Physics as outlined in the Arrangements document. The report must be the individual work of the candidate.

Assessment scheme for Outcome 2

Guidance on approaches to assessment of Outcome 2 is provided in the Support Notes in the Unit Specification included in the Arrangements document.

The ‘Outcome 2: Teacher/lecturer guide’ given on the following pages is provided to indicate what should be demonstrated by the candidate to achieve each specific Performance Criterion. These items are pointers to aid the professional judgement of the teacher/lecturer and will assist in deciding if a Performance Criterion has been met for a particular topic.

Outcome 2: Teacher/lecturer guide

Unit: D373 09 Telecommunications

All the Performance Criteria given in the left-hand column must be achieved in order to attain the Outcome. The right-hand column gives suggestions which might aid the professional judgement of the assessor.

Performance Criteria	Suggested items to aid professional judgement
(a) The sources of information are used appropriately	The candidate should play an active part in the collection of the information.
(b) The practical application is described clearly	<ul style="list-style-type: none"> ◆ a statement of the name of the telecommunications system ◆ a few concise sentences describing the practical application
(c) Conclusions drawn are valid	Conclusions should contain, as appropriate, a statement relating to: <ul style="list-style-type: none"> ◆ one advantage and one disadvantage of the application ◆ benefits of the application ◆ comment on effects of the application on individuals and/or society

Unit: D375 09 Radiations

Performance Criteria	Suggested items to aid professional judgement
(a) The sources of information are used appropriately	The candidate should play an active part in the collection of the information.
(b) The practical application is described clearly	<ul style="list-style-type: none"> ◆ a statement of the name of the radiation ◆ a few concise sentences describing the practical application
(c) Conclusions drawn are valid	Conclusions should contain, as appropriate, a statement relating to: <ul style="list-style-type: none"> ◆ one advantage and one disadvantage of the application ◆ benefits of the application ◆ comment on effects of the application on individuals and/or society

Unit: D376 09	Sound and Music
D374 09	Practical Electricity
D377 09	Movement

Performance Criteria	Suggested items to aid professional judgement
(a) The information is collected by active participation in the experiment	The candidate should take an active part in the collection of the information
(b) The experimental procedures are described accurately	<p>A clear statement of the aim or objective of the experiment.</p> <p>A few concise sentences as appropriate:</p> <ul style="list-style-type: none"> ◆ a labelled diagram or brief description of apparatus, instruments used ◆ how the independent variable was altered ◆ how measurements were taken or observations made <p>There is no need for a detailed description. The use of the impersonal passive voice is to be encouraged as an example of good practice but this is not mandatory for meeting the Performance Criterion.</p>
(c) Relevant measurements and observations are recorded in an appropriate format	<p>Readings or observations recorded in a clear table which must include:</p> <ul style="list-style-type: none"> ◆ correct headings ◆ appropriate units ◆ readings/observations entered in the correct positions

(continued)

Performance Criteria	Suggested items to aid professional judgement
(d) Recorded information is analysed and presented in an appropriate format	<p>Readings should be analysed and presented in tabular or graphical form as appropriate.</p> <p>For a tabular presentation this may be an extension of the table used for PC (c), eg the calculation of product or quotient, and must include:</p> <ul style="list-style-type: none"> ◆ a table with suitable headings and units ◆ a table showing appropriate computations <p>For a graphical presentation this must include:</p> <ul style="list-style-type: none"> ◆ a graph with independent and dependent variables plotted on appropriate axes ◆ a graph with suitable scales and axes labelled with quantities and units ◆ a graph with data correctly plotted with a line or a curve of best fit ◆ a bar chart
(e) Conclusions drawn are valid	<p>Conclusions should contain, as appropriate, a statement of:</p> <ul style="list-style-type: none"> ◆ overall pattern to readings or observations ◆ trends in analysed information or results ◆ measurement of a physical quantity

Unit: D378 09 Electronics

Performance Criteria	Suggested items to aid professional judgement
(a) Selected subsystems are appropriate for a specific function	<p>Clear statements of the names of the</p> <ul style="list-style-type: none"> ◆ input device ◆ output device ◆ processor <p>A block diagram of the system is required.</p>
(b) Justification for the choice of each subsystem is correctly made	<p>Sentences stating why the</p> <ul style="list-style-type: none"> ◆ input device ◆ output device ◆ processor <p>were chosen.</p>
(c) Subsystems are correctly assembled	<p>Correct connection of input, processor and output devices should be confirmed by direct observation.</p>
(d) System provides a solution to the problem	<p>A few concise sentences describing how the system functions in terms of the three component parts.</p>

The candidate should receive a pro forma report sheet containing appropriate headings to complete. Notes made by the candidate can be available during completion of the report. The report should be in the candidate's own words.

6.3 Intermediate 1 Physics

6.3 Intermediate 1 Physics

Information about this Course

The Intermediate 1 Physics Course is made up of the following six mandatory Units:

D373 10	Telecommunications (Int 1)	0.5 credit (20 hours)
D374 10	Practical Electricity (Int 1)	0.5 credit (20 hours)
D375 10	Radiations (Int 1)	0.5 credit (20 hours)
D376 10	Sound and Music (Int 1)	0.5 credit (20 hours)
D377 10	Movement (Int 1)	0.5 credit (20 hours)
D378 10	Electronics (Int 1)	0.5 credit (20 hours)

Recommended entry

Entry for the Course is at the discretion of the centre, however candidates are normally expected to have attained one of the following awards or its equivalent:

- ◆ Standard Grade Physics at grade 5, 6 or 7
- ◆ Standard Grade Biology, Chemistry or Science with Knowledge and Understanding and Problem Solving at grades 4, 5, 6 or 7
- ◆ Appropriate Units at Access level

Course assessment

To gain the Course award the candidate must achieve each component Unit of the Course as well as the external instrument. Each Unit is internally assessed by the centre and is subject to external verification.

External assessment will provide the basis for grading attainment in the Course award.

External assessment

The external assessment instrument is an examination of 1 hour 30 minutes' duration with a total allocation of 80 marks.

The question paper samples the Content Statements of all six component Units. The question paper consists of two sections:

Section A	Multiple choice questions	20 marks
Section B	Extended-answer questions	60 marks

Section A is made up of 20 multiple choice questions.

A summary of the breakdown of the marks allocation across the Outcomes and component Units is as follows:

Mark allocation for:	Outcome 1	Outcomes 2 and 3	Total
Whole paper	40 ± 4	40 ± 4	80
Each component Unit (20 hours)	7 ± 3	7 ± 3	14 ± 4

Internal assessment

Outcomes 1 and 2

Assessment Type	End of Unit test
Duration	25 minutes
Total Marks	20
Threshold of Attainment	12

Appropriate assessment material is provided through the National Assessment Bank. Contact the SQA Co-ordinator for access to this material.

Outcome 3

Candidates are required to produce three reports on experiments covering all of the Performance Criteria and related to Intermediate 1 Physics as outlined in the Arrangements document:

- ◆ Telecommunications/Radiations
- ◆ Practical Electricity/Sound and Music/Movement
- ◆ Electronics

Assessment scheme for Outcome 3

The ‘Outcome 3: Teacher/lecturer guide’ on the following pages is provided to indicate what should be demonstrated by the candidate to achieve each specification Performance Criterion. The relevance of the items suggested will vary according to the experiment being undertaken. These items are pointers to aid the professional judgement of the teacher/lecturer and will assist in deciding if a Performance Criterion has been met for a particular experiment.

Guidance on approaches to assessment of Outcome 3 is provided in the Support Notes in the Unit Specification included in the Arrangements document.

Outcome 3: Teacher/lecturer guide

All the Performance Criteria given in the left-hand column must be achieved in order to attain the Outcome. The right-hand column gives suggested items which might aid the professional judgement of the assessor.

Unit: D373 10 Telecommunications

Performance Criteria	Suggested items to aid professional judgement
(a) The sources of information are used appropriately	The candidate should play an active part in the collection of the information.
(b) The practical application is described clearly	<ul style="list-style-type: none"> ◆ a statement of the name of the telecommunications system ◆ a few concise sentences describing the practical application
(c) Conclusions drawn are valid	Conclusions should contain, as appropriate, a statement relating to: <ul style="list-style-type: none"> ◆ one advantage and one disadvantage of the application ◆ benefits of the application ◆ comment on effects of the application on individuals and/or society

Unit: D375 10 Radiations

Performance Criteria	Suggested items to aid professional judgement
(a) The sources of information are used appropriately	The candidate should play an active part in the collection of the information
(b) The practical application is described clearly	<ul style="list-style-type: none"> ◆ a statement of the name of the radiation ◆ a few concise sentences describing the practical application
(c) Conclusions drawn are valid	Conclusions should contain, as appropriate, a statement relating to: <ul style="list-style-type: none"> ◆ one advantage and one disadvantage of the application ◆ benefits of the application ◆ comment on effects of the application on individuals and/or society

Intermediate 1 Physics

Unit: D374 10 Practical Electricity
 D376 10 Sound and Music
 D377 10 Movement

Performance Criteria	Suggested items to aid professional judgement
(a) The information is collected by active participation in the experiment	The candidate should play an active part in the collection of the information
(b) The experimental procedures are described correctly	<p>A clear statement of the aim or objective of the experiment.</p> <p>A few brief concise sentences as appropriate:</p> <ul style="list-style-type: none"> ◆ a labelled diagram or brief description of apparatus, instruments used ◆ how the independent variable was altered ◆ how measurements were taken or observations made <p>There is no need for a detailed description. The use of the impersonal passive voice is to be encouraged as an example of good practice but this is not mandatory for meeting the Performance Criteria.</p>
(c) Relevant measurements and observations are recorded in appropriate format	<p>Readings or observations recorded in a clear table which must include:</p> <ul style="list-style-type: none"> ◆ correct headings ◆ appropriate units ◆ readings/observations entered in the correct positions

(continued)

Performance Criteria	Suggested items to aid professional judgement
(d) Recorded information is analysed and presented in an appropriate format	<p>Readings should be analysed and presented in tabular or graphical form as appropriate.</p> <p>For a tabular presentation this may be an extension of the table used for Performance Criterion (c), eg the calculation of a product or quotient, and must include:</p> <ul style="list-style-type: none"> ◆ a table with suitable headings and units ◆ a table showing appropriate computations <p>For a graphical presentation this must include:</p> <ul style="list-style-type: none"> ◆ a graph with independent and dependent variables plotted on appropriate axes ◆ a graph with suitable scales and axes labelled with quantities and units ◆ a graph with data correctly plotted with a line or a curve of best fit ◆ a bar chart (D376 10 Sound and Music and D377 10 Movement only)
(e) Conclusions drawn are valid	<p>Conclusions should contain, as appropriate, a statement of:</p> <ul style="list-style-type: none"> ◆ overall pattern to readings or observations ◆ trends in analysed information or results ◆ measurement of a physical quantity

Intermediate 1 Physics

Unit: D378 10 Electronics

Performance Criteria	Suggested items to aid professional judgement
(a) Selected sub-systems are appropriate for a specific function	Clear statements of the names of the: <ul style="list-style-type: none">◆ input device◆ output device◆ processor A block diagram of the system is required.
(b) Justification for the choice of each sub-system is correctly made	Sentences stating why the: <ul style="list-style-type: none">◆ input device◆ output device◆ processor were chosen
(c) Sub-systems are correctly assembled	Correct connection of input, processor and output devices should be confirmed by direct observation.
(d) System provides a solution to the problem	A few concise sentences describing how the system functions in terms of the three component parts.

The candidate should receive a pro forma report sheet containing appropriate headings to complete. Notes made by the candidate can be available during completion of the report. The report should be in the candidate's own words.

6.4 Intermediate 2 Physics

6.4 Intermediate 2 Physics

Information about this Course

The Intermediate 2 Physics Course is made up of the following four mandatory Units:

D379 11	Mechanics and Heat (Int 2)	1 credit (40 hours)
D380 11	Electricity and Electronics (Int 2)	1 credit (40 hours)
D381 11	Waves and Optics (Int 2)	0.5 credit (20 hours)
D382 11	Radioactivity (Int 2)	0.5 credit (20 hours)

Recommended entry

Entry for the Course is at the discretion of the centre, however candidates are normally expected to have attained one of the following awards or its equivalent:

- ◆ Standard Grade Physics with Knowledge and Understanding and Problem Solving at grade 3 or 4

or

- ◆ Standard Grade Biology, Chemistry or Science with Knowledge and Understanding and Problem Solving at grade 1, 2 or 3

or

- ◆ Intermediate 1 Physics

and

- ◆ Standard Grade Mathematics at grade 3 or 4 or Intermediate 1 Mathematics

Course assessment

To gain the Course award the candidate must achieve each component Unit of the Course as well as the external instrument. Each Unit is internally assessed by the centre and is subject to external verification.

External assessment provides the basis for grading attainment in the Course award.

External assessment

The external assessment instrument is an examination of two hours' duration with a total allocation of 100 marks.

The question paper samples the Content Statements of all six component Units. The question paper consists of two sections:

Section A	Multiple choice questions	20 marks
Section B	Extended-answer questions	80 marks

Section A is made up of 20 multiple choice questions.

A summary of the breakdown of the marks allocation across the Outcomes and component Units is as follows:

Mark allocation for:	Outcome 1	Outcomes 2 and 3	Total
Whole paper	50 ± 4	50 ± 4	100
Each component Unit (40 hours)	17 ± 4	17 ± 4	34 ± 4
Each component Unit (20 hours)	8 ± 3	8 ± 3	16 ± 4

Internal assessment

Outcomes 1 and 2

Units:	D379 11	Mechanics and Heat
	D380 11	Electricity and Electronics

Assessment Type	End of Unit test
Duration	45 minutes
Total Marks	40
Threshold of Attainment	24

Units:	D381 11	Waves and Optics
	D382 11	Radioactivity

Assessment Type	End of Unit test
Duration	25 minutes
Total Marks	20
Threshold of Attainment	12

Appropriate assessment material is provided through the National Assessment Bank. Contact the SQA Co-ordinator for access to this material.

Outcome 3

Candidates are required to produce a report on an experiment covering all of the Performance Criteria and related to Intermediate 2 Physics as outlined in the Arrangements document.

Assessment scheme for Outcome 3

Guidance on approaches to assessment of Outcome 3 is provided in the Support Notes in the Unit Specification included in the Arrangements document.

The ‘Outcome 3: Teacher/lecturer guide’ on the following pages is provided to indicate what should be demonstrated by the candidate to achieve each specification Performance Criterion. The relevance of the items suggested will vary according to the experiment being undertaken. These items are pointers to aid the professional judgement of the teacher/lecturer and will assist in deciding if a Performance Criterion has been met for a particular experiment.

Outcome 3: Teacher/lecturer guide

All the Performance Criteria given in the left-hand column must be achieved in order to attain the Outcome. The right-hand column gives suggested items which might aid the professional judgement of the assessor.

Units:	D379 11	Mechanics and Heat
	D380 11	Electricity and Electronics
	D381 11	Waves and Optics

Performance Criteria	Suggested items to aid professional judgement
(a) The information is collected by active participation in the experiment	The candidate should take an active part in the collection of the information.
(b) The experimental procedures are described accurately	<p>A clear statement of the aim or objective of the experiment.</p> <p>A few brief concise sentences as appropriate:</p> <ul style="list-style-type: none"> ◆ a labelled diagram or brief description of apparatus, instruments used ◆ how the independent variable was altered ◆ how measurements were taken or observations made <p>There is no need for a detailed description. The use of the impersonal passive voice is to be encouraged as an example of good practice but this is not mandatory for meeting the Performance Criteria.</p>
(c) Relevant measurements and observations are recorded in appropriate format	<p>Readings or observations recorded in a clear table which must include:</p> <ul style="list-style-type: none"> ◆ correct headings ◆ appropriate units ◆ readings/observations entered in the correct positions

(continued)

Performance Criteria	Suggested items to aid professional judgement
(d) Recorded information is analysed and presented in an appropriate format	<p>Readings should be analysed and presented in tabular or graphical form as appropriate.</p> <p>For a tabular presentation this may be an extension of the table used for PC (c) eg the calculation of a product or quotient, and must include:</p> <ul style="list-style-type: none"> ◆ a table with suitable headings and units ◆ a table showing appropriate computations <p>For a graphical presentation this must include:</p> <ul style="list-style-type: none"> ◆ a graph with independent and dependent variables plotted on appropriate axes ◆ a graph with suitable scales and axes labelled with quantities and units ◆ a graph with data correctly plotted with a line or a curve of best fit
(e) Conclusions drawn are valid	<p>Conclusions should contain, as appropriate, a statement of:</p> <ul style="list-style-type: none"> ◆ overall pattern to readings or observations ◆ trends in analysed information or results ◆ measurement of a physical quantity
(f) The experimental procedures are evaluated with supporting argument	<p>The evaluation is likely to contain, as appropriate, a few sentences commenting on:</p> <ul style="list-style-type: none"> ◆ effectiveness of procedures ◆ control of variables ◆ limitations of equipment ◆ possible improvements ◆ possible sources of error

Unit: D382 11 Radioactivity

Performance Criteria	Suggested items to aid professional judgement
(a) The information is collected by active participation in the experiment	<p>The candidate should take an active part in the collection of the information.</p> <p>As an alternative to participating in an actual experiment, the candidate could collect information by:</p> <ul style="list-style-type: none"> ◆ participating in a simulation ◆ watching a video of an experiment <p>Where a video or simulation is used, this must be a video or simulation of a radioactivity experiment.</p>
(b) The experimental procedures are described accurately	<p>A clear statement of the aim or objective of the experiment.</p> <p>A few brief concise sentences as appropriate:</p> <ul style="list-style-type: none"> ◆ a labelled diagram or brief description of apparatus, instruments used ◆ how the independent variable was altered ◆ how measurements were taken or observations made <p>There is no need for a detailed description. The use of the impersonal passive voice is to be encouraged as an example of good practice but this is not mandatory for meeting the Performance Criteria.</p>
(c) Relevant measurements and observations are recorded in an appropriate format	<p>Readings or observations recorded in a clear table which must include:</p> <ul style="list-style-type: none"> ◆ correct headings ◆ appropriate units ◆ readings/observations entered in the correct positions

(continued)

Performance Criteria	Suggested items to aid professional judgement
(d) Recorded information is analysed and presented in an appropriate format	<p>Readings should be analysed and presented in tabular or graphical form as appropriate.</p> <p>For a tabular presentation this may be an extension of the table used for Performance Criterion (c), eg the calculation of a product or quotient, and must include:</p> <ul style="list-style-type: none"> ◆ a table with suitable headings and units ◆ a table with ascending or descending independent variable ◆ a table showing appropriate computations <p>For a graphical presentation this must include:</p> <ul style="list-style-type: none"> ◆ a graph with independent and dependent variables plotted on appropriate axes ◆ a graph with suitable scales and axes labelled with quantities and units ◆ a graph with data correctly plotted with a line or a curve of best fit
(e) Conclusions drawn are valid	<p>Conclusions should contain, as appropriate, a statement of:</p> <ul style="list-style-type: none"> ◆ overall pattern to readings or observations ◆ trends in analysed information or results ◆ measurement of a physical quantity
(f) The experimental procedures are evaluated with supporting argument	<p>The evaluation is likely to contain, as appropriate, a few sentences commenting on:</p> <ul style="list-style-type: none"> ◆ effectiveness of procedures ◆ control of variables ◆ limitations of equipment ◆ possible improvements ◆ possible sources of error

6.5 Higher Physics

6.5 Higher Physics

Information about this Course

The Higher Physics Course is made up of the following three mandatory Units:

D383 12	Mechanics and Properties of Matter (H)	1 credit (40 hours)
D380 12	Electricity and Electronics (H)	1 credit (40 hours)
D384 12	Radiation and Matter (H)	1 credit (40 hours)

Recommended entry

Entry is at the discretion of the centre, however candidates are normally expected to have attained one of the following awards or equivalent:

- ◆ Standard Grade Physics with Knowledge and Understanding and Problem Solving at grade 1 or 2
- or**
- ◆ Intermediate 2 Physics
- and**
- ◆ Standard Grade Mathematics at grade 1 or 2 **or** Intermediate 2 Mathematics

Course assessment

To gain the Course award the candidate must achieve each component Unit of the Course as well as the external instrument. Each Unit is internally assessed by the centre and is subject to external verification.

External assessment provides the basis for grading attainment in the Course award.

External assessment

The external assessment instrument is an examination of 2 hours 30 minutes' duration with a total allocation of 90 marks.

The question paper samples the Content Statements of all three component Units. The question paper consists of two sections:

Section A	Multiple choice questions	20 marks
Section B	Extended-answer questions	70 marks

Section A is made up of 20 multiple choice questions.

A summary of the breakdown of the marks allocation across the Outcomes and component Units is as follows:

Mark allocation for:	Outcome 1	Outcomes 2 and 3	Total
Whole paper	36 ± 4	54 ± 4	90
Each component Unit (40 hours)	12 ± 3	18 ± 4	30 ± 4

Internal assessment

Outcomes 1 and 2

Assessment Type	End of Unit test
Duration	45 minutes
Total Marks	30
Threshold of Attainment	18

Appropriate assessment material is provided through the National Assessment Bank. Contact the SQA Co-ordinator for access to this material.

Outcome 3

Candidates are required to produce a report on an experiment covering all of the Performance Criteria and related to Higher Physics as outlined in the Arrangements document.

Assessment scheme for Outcome 3

Guidance on approaches to assessment of Outcome 3 is provided in the Support Notes in the Unit Specification included in the Arrangements document.

The ‘Outcome 3: Teacher/lecturer guide’ on the following pages is provided to indicate what should be demonstrated by the candidate to achieve each specification Performance Criterion. The relevance of the items suggested will vary according to the experiment being undertaken. These items are pointers to aid the professional judgement of the teacher/lecturer and will assist in deciding if a Performance Criterion has been met for a particular experiment.

Outcome 3: Teacher/lecturer guide

Performance Criteria	Suggested items to aid professional judgement
a) The information is collected by active participation in the experiment	The candidate should take an active part in the collection of the information.
b) The experimental procedures are described accurately	<p>A clear statement of the aim or objective of the experiment.</p> <p>A few brief concise sentences as appropriate:</p> <ul style="list-style-type: none"> ◆ a labelled diagram or brief description of apparatus, instruments used ◆ how the independent variable was altered ◆ how measurements were taken or observations made <p>There is no need for a detailed description. The use of the impersonal passive voice is to be encouraged as an example of good practice but this is not mandatory for meeting the Performance Criteria.</p>
c) Relevant measurements and observations are recorded in an appropriate format	<p>Readings or observations recorded in a clear table which must include:</p> <ul style="list-style-type: none"> ◆ correct headings ◆ appropriate units ◆ readings/observations entered in the correct positions
d) Recorded information is analysed and presented in an appropriate format	<p>Readings should be analysed and presented in tabular or graphical form as appropriate.</p> <p>For a tabular presentation this may be an extension of the table used for Performance Criterion (c), eg the calculation of the inverse or square of a variable, and must include:</p> <ul style="list-style-type: none"> ◆ a table with ascending or descending independent variable ◆ a table showing appropriate computations <p>For a graphical presentation this must include:</p> <ul style="list-style-type: none"> ◆ a graph with independent and dependent variables plotted on appropriate axes ◆ a graph with suitable scales and axes labelled with quantities and units ◆ a graph with data correctly plotted with a line or a curve of best fit

(continued)

Performance Criteria	Suggested items to aid professional judgement
e) Uncertainties are treated appropriately	<p>Depending on the activity the following should be included as appropriate:</p> <ul style="list-style-type: none"> ◆ uncertainties in individual readings ◆ mean value and approximate random uncertainty in the mean ◆ uncertainties expressed in absolute or percentage form
f) Conclusions drawn are valid	<p>Conclusions should contain, as appropriate, a statement of:</p> <ul style="list-style-type: none"> ◆ overall pattern to readings or observations ◆ trends in analysed information or results ◆ connection between variables ◆ measurement of a physical quantity
g) The experimental procedures are evaluated with supporting argument	<p>The evaluation is likely to contain, as appropriate, a few sentences commenting on:</p> <ul style="list-style-type: none"> ◆ effectiveness of procedures ◆ control of variables ◆ limitations of equipment ◆ possible improvements ◆ possible sources of error

6.6 Advanced Higher Physics

6.6 Advanced Higher Physics

Information about this Course

The Advanced Higher Physics Course is made up of the following four mandatory Units:

D385 13	Mechanics (AH)	1 credit (40 hours)
D386 13	Electrical Phenomena (AH)	1 credit (40 hours)
D387 13	Wave Phenomena (AH)	0.5 credit (20 hours)
D388 13	Physics Investigation (AH)	0.5 credit (20 hours)

Recommended entry

Entry is at the discretion of the centre, however candidates will normally be expected to have attained the following:

- ◆ Higher Physics
- ◆ Higher Mathematics

Course assessment

To gain the Course award the candidate must achieve each component Unit of the Course as well as the external instrument. Each Unit is internally assessed by the centre and is subject to external verification.

External assessment provides the basis for grading attainment in the Course award.

External assessment

The external assessment instruments are an exam of two hours 30 minutes' duration with a total allocation of 100 marks, and an Investigation Report, with an allocation of 25 marks.

The question paper samples the Content Statements of all three component Units. The question paper consists of:

Extended-answer questions 100 marks

A summary of the breakdown of the marks allocation across the Outcomes and component Units is as follows:

Mark allocation for:	Outcome 1	Outcomes 2 and 3	Total
Whole paper	40 ± 4	60 ± 4	100
Each component Unit (40 hours)	16 ± 3	24 ± 4	40 ± 4
Each component Unit (20 hours)	8 ± 2	12 ± 3	20 ± 3

The Investigation Report is based on the work carried out in the component Unit, Physics Investigation (AH). The report should be around 2000–2500 words in length excluding contents pages, tables, graphs, etc.

The report is externally assessed using the following assessment categories:

- a. Introduction (4 marks)
- b. Procedures (6 marks)
- c. Results (6 marks)
- d. Discussion (6 marks)
- e. Presentation (3 marks)

Internal assessment

Outcomes 1 and 2

Units:	D385 13	Mechanics
	D386 13	Electrical Phenomena

Assessment Type	End of Unit test
Duration	45 minutes
Total Marks	30
Threshold of Attainment	18

Unit:	D387 13	Wave Phenomena
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Assessment Type	End of Unit test
Duration	30 minutes
Total Marks	20
Threshold of Attainment	12

Appropriate assessment material is provided through the National Assessment Bank. Contact the SQA Co-ordinator for access to this material.

Outcome 3

Candidates are required to produce a report on an experiment covering all of the Performance Criteria and related to Advanced Higher Physics as outlined in the Arrangements document.

Outcomes 1 and 2 — Unit: D388 13 Physics Investigation

Assessment Type: Record of Work (commonly known as ‘the daybook’)

Outcome 1

Develop a plan for a Physics Investigation at the level of Advanced Higher.

Performance Criteria

- a. A record is maintained in a regular manner.
- b. Experimental procedures and apparatus are appropriate for the Investigation.

Evidence Requirements

A completed record giving brief summaries to indicate the planning stage. Ideas rejected and important contributions made by the teacher/lecturer or other individuals should be included. The topic chosen must be at a standard commensurate with the demands of Advanced Higher Physics.

Outcome 2

Collect and analyse information obtained from the Investigation.

Performance Criteria

- a. The collection of the experimental information is carried out with due accuracy.
- b. Relevant measurements and observations are recorded in an appropriate format.
- c. Recorded experimental information is analysed and presented in an appropriate format.
- d. Uncertainties are treated appropriately.

Evidence Requirements

A record of the collection and analysis of the information, both of which must be the individual work of the candidate is required. The record must provide evidence in respect of a sample of the Content Statements for uncertainties (see Physics (Advanced Higher), Course Content).

For further guidance refer to pages 42 and 43 of the Arrangements document, and NAB material.

Assessment scheme for Outcome 3

Guidance on approaches to assessment of Outcome 3 is provided in the Support Notes in the Unit Specification included in the Arrangements document

The ‘Outcome 3: Teacher/lecturer guide’ on the following pages is provided to indicate what should be demonstrated by the candidate to achieve each specification Performance Criterion. The relevance of the items suggested will vary according to the experiment being undertaken. These items are pointers to aid the professional judgement of the teacher/lecturer and will assist in deciding if a Performance Criterion has been met for a particular experiment.

Outcome 3: Teacher/lecturer guide

Performance Criteria	Suggested items to aid professional judgement
a) The information is collected by active participation in the experiment	The candidate should take an active part in the collection of the information.
b) The experimental procedures are described accurately	<p>A clear statement of the aim or objective of the experiment.</p> <p>A few brief concise sentences as appropriate:</p> <ul style="list-style-type: none"> ◆ a labelled diagram or brief description of apparatus, instruments used ◆ how the independent variable was altered ◆ how measurements were taken or observations made <p>There is no need for a detailed description. The use of the impersonal passive voice is to be encouraged as an example of good practice but this is not mandatory for meeting the Performance Criteria.</p>
c) Relevant measurements and observations are recorded in an appropriate format	<p>Readings or observations recorded in a clear table which must include:</p> <ul style="list-style-type: none"> ◆ correct headings ◆ appropriate units ◆ readings/observations entered in the correct positions
d) Recorded information is analysed and presented in an appropriate format	<p>Readings should be analysed and presented in tabular or graphical form as appropriate.</p> <p>For a tabular presentation this may be an extension of the table used for Performance Criterion (c), eg the calculation of the inverse or square of a variable, and must include:</p> <ul style="list-style-type: none"> ◆ a table with suitable headings and units ◆ a table with ascending or descending independent variable ◆ a table showing appropriate computations <p>For a graphical presentation this must include:</p> <ul style="list-style-type: none"> ◆ a graph with independent and dependent variables plotted on appropriate axes ◆ a graph with suitable scales and axes labelled with quantities and units ◆ a graph with data correctly plotted with a line or a curve of best fit

(continued)

Performance Criteria	Suggested items to aid professional judgement
e) Uncertainties are treated appropriately	<p>Depending on the activity the following should be included as appropriate:</p> <p>Unit: D385 13 Mechanics only</p> <ul style="list-style-type: none"> ◆ calibration uncertainties, reading uncertainties and random uncertainties ◆ a combination of individual uncertainties ◆ an uncertainty in the numerical value of a measured quantity ◆ uncertainties estimated from a straight line graph <p>Unit: D386 13 Electrical Phenomena and Unit: D387 13 Wave Phenomena only</p> <ul style="list-style-type: none"> ◆ uncertainties in individual readings ◆ mean value and approximate random uncertainty in the mean ◆ uncertainties expressed in absolute or percentage form
f) Conclusions drawn are valid	<p>Conclusions should contain, as appropriate, a statement of:</p> <ul style="list-style-type: none"> ◆ overall pattern to readings or observations ◆ trends in analysed information or results ◆ connection between variables ◆ measurement of a physical quantity
g) The experimental procedures are evaluated with supporting argument	<p>The evaluation is likely to contain, as appropriate, a few sentences commenting on:</p> <ul style="list-style-type: none"> ◆ effectiveness of procedures ◆ control of variables ◆ limitations of equipment ◆ possible improvements ◆ possible sources of error

6.7 NAB Threshold of Attainment: Physics

6.7 NAB Threshold of Attainment: Physics

Level	Unit	Code	NAB Versions	Threshold of Attainment
Access 3	Telecommunications	D373 09	NAB001, NAB002, NAB003	9 out of 15 (8 ½)
	Practical Electricity	D373 09	NAB001, NAB002, NAB003	9 out of 15 (8 ½)
	Radiations	D375 09	NAB001, NAB002	9 out of 15 (8 ½)
	Sound and Music	D376 09	NAB001, NAB002, NAB003	9 out of 15 (8 ½)
	Movement	D377 09	NAB001, NAB002, NAB003	9 out of 15 (8 ½)
	Electronics	D378 09	NAB001, NAB002, NAB003	9 out of 15 (8 ½)

NAB Threshold of Attainment: Physics

(continued)

Level	Unit	Code	NAB Versions	Threshold of attainment	Notes
Intermediate 1	Telecommunications	D373 10	NAB001, NAB002, NAB003, NAB004, NAB005	12 out of 20 (11 ½)	9 out of 20 (8½) TOA for Access 3
	Practical Electricity	D374 10	NAB001, NAB002, NAB003, NAB004, NAB005	12 out of 20 (11 ½)	9 out of 20 (8½) TOA for Access 3
	Radiations	D375 10	NAB001, NAB002, NAB003, NAB004, NAB005	12 out of 20 (11 ½)	9 out of 20 (8½) TOA for Access 3
	Sound and Music	D376 10	NAB001, NAB002, NAB003, NAB004, NAB005	12 out of 20 (11 ½)	9 out of 20 (8½) TOA for Access 3
	Movement	D377 10	NAB001, NAB002, NAB003	12 out of 20 (11 ½)	9 out of 20 (8½) TOA for Access 3
	Electronics	D378 10	NAB001, NAB002, NAB003	12 out of 20 (11 ½)	9 out of 20 (8½) TOA for Access 3

(continued)

Level	Unit	Code	NAB Versions	Notes
Intermediate 2	Mechanics and Heat	D379 11	NAB001, NAB002, NAB003, NAB004, NAB005	24 out of 40 (23 ½)
	Electricity and Electronics	D380 11	NAB001, NAB002, NAB003	24 out of 40 (23 ½)
	Waves and Optics	D381 11	NAB001, NAB002, NAB003, NAB004, NAB005	12 out of 20 (11 ½)
	Radioactivity	D382 11	NAB001, NAB002, NAB003, NAB004, NAB005	12 out of 20 (11 ½)
Higher	Mechanics and Properties of Matter	D383 12	NAB001, NAB002, NAB003, NAB004, NAB005	18 out of 30 (17 ½)
	Electricity and Electronics	D380 12	NAB001, NAB002, NAB003, NAB004, NAB005	18 out of 30 (17 ½)
	Radiation and Matter	D384 12	NAB001, NAB002, NAB003, NAB004, NAB005	18 out of 30 (17 ½)
Advanced Higher	Mechanics	D385 13	NAB001, NAB002, NAB003	18 out of 30 (17 ½)
	Electrical Phenomena	D386 13	NAB001, NAB002, NAB003	18 out of 30 (17 ½)
	Wave Phenomena	D387 13	NAB001, NAB002, NAB003	12 out of 20 (11 ½)

6.8 Transfer of Evidence Outcome 3: Physics

6.8 Transfer of Evidence Outcome 3: Physics

Level	Credit permitted	Credit not permitted
Access 3	<p>An Outcome 2 report of practical work in either of the Units:</p> <ul style="list-style-type: none"> ◆ D373 09 Telecommunications or ◆ D375 09 Radiations may be used as evidence of achievement of Outcome 2 of the other Unit. <p>An Outcome 2 report of practical work in any of the Units:</p> <ul style="list-style-type: none"> ◆ D374 09 Practical Electricity or ◆ D376 09 Sound and Music or ◆ D377 09 Movement may be used as evidence of achievement of Outcome 2 of all three of these Units. 	<p>An Outcome 2 report of practical work in Telecommunications or Radiations may not be used as evidence of achievement of Outcome 2 of Practical Electricity or Sound and Music or Movement or Electronics.</p> <p>An Outcome 2 report of practical work in Practical Electricity or Sound and Music or Movement may not be used as evidence of achievement of Outcome 2 of Telecommunications, Radiations or Electronics.</p> <p>An Outcome 2 report of practical work in the Unit D378 09 Electronics may not be used as evidence of achievement of Outcome 2 of any other Access 3 Physics Unit.</p>

Transfer of Evidence Outcome 3: Physics

(continued)

Level	Credit permitted	Credit not permitted
Intermediate 1	<p>An Outcome 3 report of practical work in either of the Units:</p> <ul style="list-style-type: none"> ◆ D373 10 Telecommunications or ◆ D375 10 Radiations may be used as evidence of achievement of Outcome 3 of the other Unit. <p>An Outcome 3 report of practical work in any of the Units:</p> <ul style="list-style-type: none"> ◆ D374 10 Practical Electricity or ◆ D376 10 Sound and Music or ◆ D377 10 Movement may be used as evidence of achievement of Outcome 3 of all of these Units. 	<p>An Outcome 3 report of practical work in Telecommunications or Radiations may not be used as evidence of achievement of Outcome 3 of Practical Electricity, Sound and Music, Movement, or Electronics.</p> <p>An Outcome 3 report of practical work in Practical Electricity or Sound and Music or Movement may not be used as evidence of achievement of Outcome 3 of Telecommunications, Radiations, or Electronics.</p> <p>An Outcome 3 report of practical work in the Unit D378 10 Electronics may not be used as evidence of achievement of Outcome 3 of any other Intermediate 1 Physics Unit.</p>
Intermediate 2	<p>An Outcome 3 report of practical work in any of the Units:</p> <ul style="list-style-type: none"> ◆ D379 11 Mechanics and Heat or ◆ D380 11 Electricity and Electronics or ◆ D381 11 Waves and Optics may be used as evidence of achievement of Outcome 3 of all three of these Units. <p>An Outcome 3 report of practical work in any of the above three Units may be used as evidence of achievement of Outcome 3 of Unit D381 11 Radioactivity.</p>	<p>As simulation is permitted in the assessment of Outcome 3 of Unit D382 11 Radioactivity, an Outcome 3 report for this Unit may not be used as evidence of achievement of Outcome 3 of any other Intermediate 2 Physics Unit.</p>

Transfer of Evidence Outcome 3: Physics

(continued)

Level	Credit permitted	Credit not permitted
Higher	<p>An Outcome 3 report of practical work in any of the Units:</p> <ul style="list-style-type: none"> ◆ D383 12 Mechanics and Properties of Matter or ◆ D380 12 Electricity and Electronics or ◆ D384 12 Radiation and Matter <p>May be used as evidence of achievement of Outcome 3 of all three of these Units.</p>	N/A
Advanced Higher	<p>An Outcome 3 report of practical work in any of the Units:</p> <ul style="list-style-type: none"> ◆ D385 13 Mechanics or ◆ D386 13 Electrical Phenomena or ◆ D387 13 Wave Phenomena <p>May be used as evidence of achievement of Outcome 3 of all three of these Units.</p>	<p>Candidate records generated as evidence for the assessment of the Unit D388 13 Physics</p> <p>Investigation may not be used as evidence of achievement of Outcome 3 of any other Advanced Higher Physics Unit.</p> <p>Outcome 3 reports of practical work in Advanced Higher Physics Units may not be used as evidence of achievement of the Physics Investigation Unit.</p>

7.1 Standard Grade Science

7 Science

7.1 Standard Grade Science

Information about this Course

Standard Grade Science consists of four mandatory topics, as shown below.

Topics

1. Healthy and Safe Living
2. An Introduction to Materials
3. Energy and its uses
4. A Study of Environments

The Course also consists of one or two additional topics selected by the centre. For further guidance refer to the Arrangements document, available to download from www.sqa.org.uk.

Course assessment

The assessment of candidate performance in the three Elements Knowledge and Understanding, Problem Solving and Practical Abilities are carried out with reference to the Extended Grade Related Criteria defined for each of these Elements within the Arrangements document.

Knowledge and Understanding and Problem Solving are assessed externally by a written examination.

Practical Abilities are internally assessed and are subject to external verification.

External assessment

Three external examination papers will be offered: Foundation, assessing grades 5 and 6, with an examination of 1 hour's duration, General, assessing grades 3 and 4 with an examination of 1 ¼ hours' duration, and Credit, assessing grades 1 and 2, with an examination of 1 ½ hours' duration.

The questions in each paper relate to the compulsory topics as illustrated by the Content Statements for the Course. A variety of question types may be used and candidates are expected to attempt all questions.

Marks will be allocated to each question and a total mark obtained for each Element. The two grades associated with each level will be distinguished by setting two cut-off scores. The lower score (in the region of 40–50%) will reflect a satisfactory overall standard of performance, the upper score (in the region of 70–80%) will reflect a high overall standard of performance.

Candidates who attempt papers at two levels will be given the better of the two grades achieved on these papers. Performance at one level will not be taken into account in grading at the other level.

Internal assessment and estimates

For SQA's purposes, centres will be required to provide:

- ◆ an estimate of performance for each of Knowledge and Understanding and Problem Solving; and
- ◆ a grade for Practical Abilities

Estimates for Knowledge and Understanding and Problem Solving

Centres must submit an estimate grade for each candidate for each of Knowledge and Understanding and Problem Solving to SQA. For information on key dates, refer to the Operational Help Centre which is available on SQA's website.

In the light of their overall performance in an Element, candidates should be assigned in the first instance to one of the three levels, Foundation, General or Credit, and then to the upper or lower of the grades within the level.

Assessment for certification

Candidates are assessed by a system common to all levels.

The Certificate records an overall award on a 7-point scale of grades, grade 1 being the highest. The Certificate also records attainment in each assessable Element. The overall award is derived from the mean of the Element grades with a weighting of 2:2:1 in favour of the externally assessed Elements.

In general terms, Standard Grade certification is a portrayal of the attainment level reached at the end of the Course. Internal assessments submitted to SQA should accordingly indicate the position reached at the time of submission. It will nevertheless be desirable to have periodic internal assessments at intermediate stages during the Course in order to provide a sound basis for final judgement and, where appropriate, to record achievement in areas where content coverage (eg end-of-topic tests in Knowledge and Understanding) or skill development is not to be taken any further as well as illustrating the candidate's achievement in Science.

Centres should retain suitable evidence in support of estimates submitted. This should not be submitted to SQA, but should be available for use in connection with SQA's internal procedures, including such cases as absence from the external examinations, adverse circumstances and appeal. The evidence must be sufficient to support the estimates submitted and should therefore represent an adequate sample of the Extended Grade Related Criteria for these Elements.

The internal estimates should relate to performance in both the compulsory and the additional topic(s).

Teachers may choose to encourage pupils to collect work in a folio for reasons such as increasing motivation and developing a sense of achievement and of progression through the Course. In such cases, there is no need to submit the complete folio if evidence is required by SQA; the evidence submitted should be drawn from both the compulsory and the additional topic(s) and might for example include tests on different topics and a sample or samples of written work.

In any event, it is important that some of the evidence is drawn from a case study or investigative work in the laboratory.

Internal assessment of Practical Abilities

Assessment of Practical Abilities is the responsibility of the teacher concerned. Candidates will be awarded a grade on the 7-point scale based on performance in relation to the assessment scheme set out below and the Grade Related Criteria.

Within Standard Grade Science, there are two categories of Practical Ability, namely:

- ◆ Techniques
- ◆ Investigations

Guidance on the assessment of Techniques

The specified Techniques and the related criteria for assessment, together with a note of opportunities within the Course to practise each Technique, are set out as follows.

Technique	Criteria for assessment	Opportunities to practise Technique
1. Measuring the pH soil or water samples	<p>To achieve success in this Technique the candidate must:</p> <ol style="list-style-type: none"> 1. demonstrate the correct use of pH paper or liquid or pH meter, including moistening of paper/sample if necessary 2. correctly measure pH to +/- two pH units for at least three samples <p>The measurements should be made in context. Preferably the Technique should be carried out on samples the candidates have collected. If not, then candidates should be provided with samples suitably labelled as, ‘river water’, ‘polluted water’, ‘forest soil’, ‘peaty soil’, etc.</p>	A Study of Environments Interdependence and Populations Pollution Energy and its Uses Non-renewable Sources of Energy (acid rain)
2. Wiring a plug	<ol style="list-style-type: none"> 1. given a length of cable with part of the sheath removed, cut each of the three wires to the required length 2. connect all 3 wires to the correct terminal so that the plug would work safely (ie no damage to wires, no possibility of shorting and fuse correctly fitted) 3. ensure that the cable is in the cord grip 4. tighten all screws so that the wires cannot be pulled loose 	Energy and its Uses Electrical Safety in the Home.
3. Testing for electrical conductivity	<ol style="list-style-type: none"> 1. set up a simple circuit consisting of a battery (or power pack), bulb (or meter) and connecting wires, by reference to a simple circuit diagram. The diagram may be in pictorial form rather than in circuit notation 2. test a minimum of five solids and correctly classify each one as either a conductor or insulator 	An Introduction to Materials Classification, Uses and Properties of Materials

(continued)

Technique	Criteria for Assessment	Opportunities to Practise Technique
4. Measuring temperature changes	<ol style="list-style-type: none"> 1. demonstrate the correct use of the thermometer (eg bulb immersed, left to come to a steady temperature, not removed to read) 2. make two correct readings to an accuracy of +/- 1°C and subtract to find the temperature change 	Any point in the Course where temperature differences are measured eg: Healthy and Safe Living Fit for life An Introduction to Materials Classification, Uses and Properties of Materials Energy and its Uses Energy in the Home
5. Measuring light intensity using a meter in three different locations	<ol style="list-style-type: none"> 1. use the apparatus correctly 2. read the correct scale 3. take the correct readings in three different locations 	A Study of Environments Energy from the Sun for Living Things
6. Using a microscope	<ol style="list-style-type: none"> 1. adjust the microscope so that there is enough light 2. adjust the microscope so that the specimen/prepared slide is in focus 	Healthy and Safe Living Healthy lungs Heart and blood An Introduction to Materials Classification, Uses and Properties of Materials
7. Measuring pulse rate	<ol style="list-style-type: none"> 1. demonstrate how to measure pulse rate 2. listen to an audio-tape of heart beats 3. count the number of heart beats on the tape in a given time interval 4. calculate the equivalent pulse rate 	Healthy and Safe Living Heart and Blood

(continued)

Technique	Criteria for Assessment	Opportunities to practise Technique
8. Making estimates of weight, time, volume and length	<p>To achieve success in this Technique the candidate must achieve success in any three of the following:</p> <ol style="list-style-type: none"> 1. given four objects differing in mass by approximately 250g, identify the one which is approximately 1 kilogram 2. estimate a short time interval of 30 seconds to an accuracy of +/- 5 seconds 3. given four commonly used containers differing in capacity by approximately 250 ml, identify the one which has a capacity of approximately 1 litre 4. estimate a length of 1 metre, eg by marking or cutting material, to an accuracy of +/- 10% 	Any point in the Course where weight, time, volume or length is measured

Each candidate should be assessed on all of the eight Techniques listed above, the assessment being carried out during on-going class work or in specific practical tests. Candidates who on a particular occasion are unable to carry out a Technique successfully may be given further opportunities to practise the Technique and then be assessed again on another occasion.

A score of one mark should be awarded by the teacher for each Technique successfully demonstrated by the candidate. Where the candidate is unsuccessful in demonstrating a Technique, zero marks should be awarded.

Investigations

This component is assessed in terms of the extent to which Investigative Skills Objectives are achieved by a candidate in the course of carrying out each of his/her best two Investigations. During the Course, candidates should be given opportunities to undertake a number of Investigations, each of which involves demonstration of the 13 specified Investigative Skills Objectives.

The objectives are grouped under four headings, as follows:

- a. Generative Skills (G)
- b. Experimentation Skills (E)
- c. Evaluation Skills (Ev)
- d. Recording and Reporting Skills (RR)

Two Investigations, each covering all of the Investigative Skills Objectives, should be submitted for the purpose of assessment for certification. At least one of the Investigations must involve a continuous independent variable.

Structure of Investigations

Investigations carried out for certification purposes should provide opportunities for candidates to demonstrate all 13 of the Investigative Skills Objectives. They should be of a suitable standard and should not be repeats of class work experiments or Investigations which have already been attempted either during practice or previous assessment. It is important that a candidate's 'report' of an Investigation (ie the candidate's written response to an Investigation) is structured in a way which allows the teacher and an External Verifier to readily identify in the evidence generated those parts which relate to the individual objectives. It is equally important that the degree of structuring of the Investigation is not so great that the candidate receives an excessive amount of support. The Investigation booklet issued by SQA must be used for all Investigations conducted for the purpose of assessment for certification.

Conduct of Investigations

The following comments give guidance of the permissible limits of support which may be offered by teachers during an Investigation which is being assessed for certification purposes.

It is expected that, at the outset of the Investigation, teachers will stimulate class or group discussion. Subsequent to the discussion, candidates must work individually throughout the remainder of the Investigation. However, if the candidate is unable to meet the criterion for G1, the teacher should give assistance to enable the candidate to proceed but will not award the mark allocated to this Objective. In the case of a candidate who identifies a relevant investigable aspect which cannot be investigated within the constraints of the school situation, the candidate should be directed to other alternatives without

penalty. Should a candidate fail to meet a criterion associated with Objective G2, G3 or G4, it is permissible for the teacher to intervene and give sufficient support to enable the candidate to proceed, but the mark allocated to the relevant criterion will not be awarded.

After the generative phase (Objectives G1, G2, G3 and G4) candidates must be left to pursue the Investigation independently. Teacher intervention in the post-generative phase is permitted only when the candidate fails to adopt standard, safe laboratory practice. In such a case, the mark allocated to the criterion for Objective E1 is forfeited.

Investigations for certification purposes must be carried out and written up by the candidate in class time.

Assessment scheme for Investigations

Assessment of achievement of Investigative Skills Objectives is undertaken by applying the following assessment scheme to a candidate's Investigation. The scheme identifies the criteria which must be satisfied for the purposes of assessment for certification. For each of the criteria, one mark should be awarded where the requirements of the criterion are satisfied. If a criterion is not satisfied, zero marks should be awarded. The total mark allocation for an Investigation is 24.

For certification purposes, the final mark should be the sum of the scores for the candidate's two best Investigations to give a score out of 48.

Investigative Skills Objectives and assessment criteria

TAPS Investigative Skills Objective		Assessment criteria and available marks	Marks total
The candidate should be able to:			
G1	Demonstrate understanding of the problem posed	Following group discussion, the candidate individually identifies and records and investigable aspect of the problem (1,0)	1
G2	State the aim of the Investigation	Clearly identifies the aim of the Investigation in terms of the two relevant variables (1,0)	1
G3	Articulate a testable hypothesis	Articulates a testable hypothesis in terms of the two relevant variables; this should be directional if a continuous variable is chosen (1,0)	1
G4	Suggest a broad strategy to adopt	The strategy gives sufficient detail by description and/or diagram to indicate: a. how the chosen independent variable will be altered (1, 0) b. that the candidate has considered what will have to be measured (1,0)	2
E1	Adopt appropriate and safe procedures	Adopts appropriate and safe procedures (1,0)	1
E2	Identify the independent variable to be used and alter it over a suitable range	a. Provides a working definition of the independent variable (1, 0) b. Alters the independent variable over an appropriate range taking account of a suitable number of types or values (1,0)	2
E3	Control all relevant variables as necessary	a. Makes a written statement of the variables which need to be actively controlled by the candidate (1, 0) b. Controls these variables in practice (1,0)	2
E4	Make valid, reliable measurement of the dependent variable	a. Uses a valid method of measuring the dependent variable (1, 0) b. Evidence is provided of a form of repeat/replicate testing which improves the reliability of the results or a valid written justification is given for not repeating/replicating measurements (1, 0)	2

(continued)

TAPS Investigative Skills Objective	Assessment criteria and available marks	Marks total	
The candidate should be able to:			
RR1	Tabulates results with appropriate headings and units of measurement	<p>a. Values (or types) with appropriate headings for independent, dependent (and any derived) variable are entered in the table (1,0)</p> <p>b. Appropriate units or their correct abbreviations are entered in the table (1,0)</p>	2
RR2	Present the results on a graph or chart	<p>a. A graph or chart of a suitable size and scale is produced (1, 0)</p> <p>b. Both axes have appropriate labels and units (1,0)</p> <p>c. Plots all the points/bars accurately (1, 0)</p> <p>Draws line/curve of best fit or joins up the points as appropriate when the independent variable is continuous or draws a bar chart when the independent variable is not continuous (1, 0)</p>	4
Ev1	Draw a valid conclusion inter-relating the appropriate variables	Draws a conclusion which inter-relates the appropriate variables or states that no firm conclusion can be drawn (1,0)	1
Ev2	Use results to evaluate the original hypothesis	Confirms hypothesis if appropriate or refutes hypothesis and replaces it with appropriate substitute or states that no conclusion can be drawn (1,0)	1
RR3	Describe how the Investigation was carried out	<p>The description includes:</p> <p>a. A labelled diagram and/or statement of the apparatus used (1,0)</p> <p>b. An account of the procedure adopted to measure the dependent variable (1,0)</p> <p>c. An account of how the independent variable was altered (1,0)</p> <p>d. An indication of how variables which were the investigators' responsibility to control were kept constant (1,0)</p>	4

Recording assessment of Practical Abilities

For each candidate, a summary record should be kept of the outcome of the assessment of the two components of Practical Abilities, Techniques and Investigations.

For Techniques a record should be kept of the mark (1 or 0) achieved for each of the eight Techniques and thereafter the total of these marks.

For Investigations, the record should state clearly whether assessment is based on:

- a) the total mark of two Investigations assessed using the 13 Investigative Skills Objectives
- b) the assessment of Inference Skills

In the first case, the total mark obtained for each of the Investigations should be recorded. In the second case, the mark (1 or 0) achieved for each of the four Inference Skills should be recorded, and thereafter the total of these marks.

Form Ex5 (Flyleaf) will be issued to centres annually for use in connection with the submission of materials at the verification stage. The reverse side should be used to record the above details of a candidate's performance in Practical Abilities. A sample of the reverse side of Form Ex5 (Flyleaf) is shown as Appendix I in the Arrangements document. Centres will also be provided on an annual basis with details of the arrangements for the submission of internal assessments of Practical Abilities for all candidates.

Evidence of attainment of Practical Abilities

Evidence of a candidate's attainment of Practical Abilities should comprise a summary record, as described above, and, as appropriate, evidence of the candidate's work in Inference Skills or in producing his/her best two Investigations. In the latter case the evidence should be in the form of an Investigation booklet for each of the two Investigations. Each of these Investigation booklets must give a clear indication of the mark awarded for each of the Investigative Skills Objectives and of the total mark awarded.

Grade for Practical Abilities

For each candidate, a total score for Practical Abilities should be determined by multiplying the mark awarded for Techniques by two and adding it to the mark awarded for Investigations. The grade for the Element should then be determined by reference to the following table.

Marks range	Grade
64–55	1
54–46	2
45–39	3
38–30	4
29–19	5
18–12	6

Candidates for whom there is evidence in support of at least one Technique or Investigation and who achieve an overall total score of less than 12 marks should be awarded a grade 7 for Practical Abilities.

Alternatively, if inference item sets were used to assess a candidate's skills of investigating, the grade should be determined by multiplying the mark awarded for Techniques by two, multiplying the mark awarded for Inference Skills by two and adding these two marks. The grade for the Element should then be determined by applying the cut-off scores for grades 5 and 6 given in the table above. The highest award possible by this method would be grade 5. For a grade 7, evidence would be required for at least one Technique or inference item set (see Appendix I in the Arrangements document),

Verification of internal assessments

To ensure the uniform application of the Extended Grade Related Criteria for Practical Abilities, each year a sample of centres will be required to submit to SQA evidence in support of internal assessments of Practical Abilities for a sample of candidates. Where a centre's internal assessments cannot be confirmed, the centre will be required to carry out re-assessment as necessary.

8.1 Appeals

8.2 Verification

8 General information

8.1 Appeals

Guidance on evidence requirements is contained within the document *Estimates, Absentees and Assessment Appeals*, available to download from SQA's website.

The guidance is for subject specialists in centres that are delivering National Courses. Details of the procedures SQA ask centres to follow are sent to centres at appropriate times during the year.

The guidance in the document covers those National Courses that are externally assessed by question papers, and the general advice also applies to Standard Grade Courses.

The information contained in the document is generic to all National Courses.

8.2 Verification

To maintain the credibility of SQA qualifications we rely on the effective collaboration between centres and SQA in ensuring national standards are maintained across all qualifications at all levels.

This is achieved through a range of Quality Assurance mechanisms, one of which is external verification.

Verification ensures that internal assessment of candidate achievement is valid, reliable and practicable, and is carried out in line with national standards.

For further information, please refer to the Verification section on SQA's website www.sqa.org.uk.

Appendices

Appendix 1: Assessment of Practical Abilities

Standard Grade Biology, Chemistry, Physics and Science

In August 1997 SQA issued revised arrangements for the assessment of Practical Abilities in all of the science subjects specified above. These revised arrangements were implemented for the first time in 1999.

Following central verification of the internal assessment of these subjects, SQA has decided that the following additional guidance should be provided to centres. This additional guidance does not change any requirements of the published Arrangements documents and should be read in conjunction with these documents.

General Comments

1. The assessment of candidate performance is carried out with reference to the Extended Grade Related Criteria (EGRC) that are included in Arrangements documents. Across the science subjects, the EGRC for Practical Abilities at Foundation, General and Credit levels detail requirements for both Techniques and Investigations. In addition, the Summary GRC for Practical Abilities confirm that both Techniques and Investigations are required at all levels.

To be awarded any grade other than 7 in Practical Abilities, candidate evidence must be consistent with the EGRC and so must cover both Techniques and Investigations. For example, to be awarded any grade between 1 and 6 for Practical Abilities in Standard Grade Science, in achieving the minimum mark specified in the Arrangements document, candidates must:

- ◆ carry out at least one practical Technique
and
- ◆ achieve at least one Investigative Skill Objective

All of the Arrangements documents for science Standard Grades include statements of the type:

‘Candidates for whom there is evidence in support of at least one Technique or Investigation and who achieve an overall total of less than X marks should be awarded a grade 7 for Practical Abilities.’

These statements apply only to the award of grade 7. A small number of schools have inferred, incorrectly, that these statements also apply to the award of grades other than 7. As indicated above, this inference is consistent neither with the EGRC nor the Summary GRC.

Appendix 1

A candidate who attempts neither Techniques nor Investigations will be deemed not to have completed the course in the Practical Abilities Element. Such a candidate will not receive a grade for this Element and hence will not receive an overall grade for the subject.

2. To comply with the EGRC, Investigations undertaken by candidates must be relevant to the subject, eg Investigation of:
 - ◆ the period of a pendulum is inappropriate for Chemistry or Biology candidates
 - ◆ lathering is inappropriate for Physics candidatesScience candidates may undertake an Investigation in any science subject. All candidates should have a clear understanding of the science content of their Investigations.
3. Investigations carried out for certification purposes must provide opportunities for candidates to demonstrate all of the 13 Skills Objectives. During the generative phase it is in order for the teacher to direct candidates away from trivial or other Investigations that will not permit candidates to demonstrate particular skills. For example, a candidate might want to investigate the rate of reaction of copper with dilute acids. This would result in a graph where all of the points would be on one of the axes. This Investigation is not appropriate for certification purposes as it would not permit the candidate to demonstrate skills in relation to criteria (a), (c) and (d) of Objective RR2. The candidate should be directed to alternatives without penalty.
4. The booklets supplied by SQA must be used. No change is permitted to the text of the booklets, or to the sequence. The following modifications are permitted:
 - ◆ addition of school or class details to the front page
 - ◆ reproduction in A4 or other format
 - ◆ alteration of font size
 - ◆ highlighting the boxes for marks awarded by direct observation
 - ◆ photocopying graph paper into the booklet
5. To facilitate assessment and verification, candidates should provide evidence in the appropriate places in the Investigation booklet. For example, evidence relevant to criterion G1 should normally be written in the space following instruction number 1. Where marks are awarded for evidence written elsewhere in the booklet, this must be clearly recorded by the assessor.
6. Candidates should be encouraged to avoid the use of the term ‘amount’ where other terms, eg mass, volume, weight, are more appropriate. Use of

‘amount’ usually results in loss of marks, as responses are misleading and/or ambiguous.

7. At least one Investigation must have a continuous independent variable to ensure that all candidates have the opportunity to draw a line graph.
8. To aid verification, the teacher should indicate briefly in the booklet why a candidate has not been awarded marks for one or more of the criteria G1, G2, G3 or G4. Similarly, the teacher should indicate briefly why marks dependent on direct observation (criteria E1, E3b and E4a) have not been awarded.

Planning and carrying out Investigations

Investigative Skills Objective	Criterion	Wording in Investigation Booklet	Additional Guidance
The candidate should be able to:			
G1	Demonstrate understanding of the problem posed	<p>Following group discussion, the candidate individually identifies and records an investigable aspect of the problem.</p> <p>1. Having thought about the problem and talked about it with others in your class, write down the factor which you are going to investigate.</p>	<p>Where the dependent variable is given, the candidate must give an independent variable that is to be investigated.</p> <p>Where neither variable is given, the candidate could give either an independent or a dependent variable eg:</p> <ul style="list-style-type: none"> ◆ concentration of acid or rate of reaction ◆ light intensity or number of seeds germinating ◆ length of pendulum or period <p>A list of variables is not required. Candidates who make a list must indicate the variable they have chosen to investigate.</p> <p>If the candidate is <i>unable to meet this criterion</i>, the teacher should give assistance to enable the candidate to proceed but should <i>not award the mark</i> allocated to this Objective.</p> <p>In the case of a candidate who identifies a relevant investigable aspect that <i>cannot be investigated within the constraints of the school situation</i> the candidate should be directed to alternatives without penalty.</p> <p>Note: The term ‘constraints of the school situation’ applies to any circumstance that would prevent the candidate from completing the Investigation, eg necessary equipment is not available, equipment that is available is insufficiently sensitive, length of school period is too short etc...</p>

(continued)

Investigative Skills Objective	Criterion	Wording in Investigation Booklet	Additional Guidance
The candidate should be able to:			
G2	State the aim of the Investigation	Clearly identifies the aim of the Investigation in terms of the two relevant variables.	2. What is the aim of your Investigation?
			<p>Both the independent and dependent variables must be mentioned, eg to find out how:</p> <ul style="list-style-type: none"> ◆ <i>light intensity</i> affects the <i>germination</i> of seeds ◆ the <i>length</i> of pendulum affects the <i>period</i> ◆ the <i>concentration</i> of an acid affects <i>rate of reaction</i>. <p>Candidates can use their own words — ie they do not have to use precise scientific terms to meet this criterion.</p>
G3	Articulate a testable hypothesis	Articulates a testable hypothesis in terms of the two relevant variables; this should be directional if a continuous variable is chosen.	<p>3. What is your hypothesis? (What do you expect to happen?)</p> <p>Where a discontinuous variable is used, candidates should not be penalised for using the word ‘change’, eg the following are acceptable:</p> <ul style="list-style-type: none"> ◆ I expect voltage to change when I use electrodes made of different metals. ◆ I expect height of rebound to change when I use different surfaces. <p>When a continuous variable is used the direction of change must be mentioned, eg I expect:</p> <ul style="list-style-type: none"> ◆ <i>more</i> seeds to germinate as temperature rises ◆ current to <i>increase</i> as voltage increases <p>If the candidate is <i>unable to meet this criterion</i>, the teacher should give assistance to enable the candidate to proceed but <i>should not award the mark</i> allocated to this Objective.</p>

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(continued)

Investigative Skills Objective	Criterion	Wording in Investigation Booklet	Additional Guidance
The candidate should be able to:			
G4	Suggest a broad strategy to adopt	<p>The strategy gives sufficient detail by description and/or diagram to indicate:</p> <p>a. how the chosen independent variable will be altered.</p>	<p>4. Describe briefly how you are going to carry out your Investigation.</p> <p>a. It is not sufficient for candidates to say what they are going to change; they must state how they are going to effect the change, eg I will change:</p> <ul style="list-style-type: none"> ◆ the voltage ...by adding more batteries/by turning the voltage control on the power supply. ('by using a power supply' on its own is insufficient as many common power supplies have a single output voltage) ◆ the temperature ... by heating with a Bunsen burner/water bath ◆ light intensity ... by putting one seed tray in a cupboard, one beside a window and one in a shaded part of the room <p>In each case the text after the ellipsis is essential. For Investigations where candidates are provided with prepared samples of the independent variable (eg acids of different concentrations), they should indicate that they are using a different sample for each test.</p>

(continued)

Investigative Skills Objective	Criterion	Wording in Investigation Booklet	Additional Guidance
The candidate should be able to:			
G4 cont		b. That the candidate has considered what will have to be measured.	<p>b. Candidates are not required to state how they intend to measure the dependent variable. It is sufficient for candidates to state that they intend to measure it, eg I will:</p> <ul style="list-style-type: none"> ◆ measure the volume of gas given off ◆ measure the current ◆ count the number of seeds that germinate <p>Where the independent variable requires to be measured, candidates should also state that they intend to measure this variable.</p>
E1	Adopt appropriate and safe procedures	<p><i>Adopts appropriate and safe procedures. (Mark awarded by teacher observation)</i></p>	<p>7. You should now carry out your Investigation in a safe way.</p> <p>Both appropriateness and safety are essential. Thus the mark allocated to this Objective should not be awarded if the procedures followed by candidates:</p> <ul style="list-style-type: none"> ◆ do not allow successful completion of the Investigation eg inappropriate method of measuring either variable ◆ put themselves or anyone else at risk

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Investigative Skills Objective	Criterion	Wording in Investigation Booklet	Additional Guidance								
The candidate should be able to:											
E2	Identify the independent variable to be used and alter it over a suitable range	<p>a. Provides a working definition of the independent variable.</p> <p>b. Alters the independent variable over an appropriate range taking account of a suitable number of types or values.</p>	<p>5. State clearly what variable you are going to change.</p> <p>8. Make a table of your results.</p> <p>The minimum number of types of values must be appropriate to the Investigation. While a minimum of three values will be appropriate in many Investigations, this number would be insufficient for others. For example, the three pairs of values below could be obtained by candidates investigating either the variation of range with angle of projection (smooth curve with maximum at 45°) or variation of current with voltage (straight line through the origin for ohmic circuit).</p> <table style="margin-left: 20px;"> <tr> <td><i>Variable 1</i></td> <td>10</td> <td>20</td> <td>30</td> </tr> <tr> <td><i>Variable 2</i></td> <td>3.2</td> <td>6.4</td> <td>8.8</td> </tr> </table> <p>b. These three points on their own are insufficient to establish the relationship between these variables.</p>	<i>Variable 1</i>	10	20	30	<i>Variable 2</i>	3.2	6.4	8.8
<i>Variable 1</i>	10	20	30								
<i>Variable 2</i>	3.2	6.4	8.8								

(continued)

Investigative Skills Objective	Criterion	Wording in Investigation Booklet	Additional Guidance
The candidate should be able to:			
E3	<p>Control all the relevant variables as necessary</p>	<p>a. Makes a written statement of the variables which need to be actively controlled by the candidate.</p> <p><i>b. Controls these variables in practice.</i></p>	<p>6. What variables are you going to keep the same?</p> <p>a. The statement should include all variables that must be controlled by the candidate to ensure that the results of the Investigation are valid. For example, if maintaining a constant temperature is crucial to the Investigation, temperature must be included in the statement. However, if small variations in laboratory temperature do not have a significant effect on the measurements made, the candidate need not include temperature in the list.</p> <p>A candidate who omits any variable that must be controlled should not be awarded this mark.</p> <p>b. Candidates must actively control all of the variables included in their lists.</p>

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(continued)

Investigative Skills Objective	Criterion	Wording in Investigation Booklet	Additional Guidance
The candidate should be able to:			
E4	Make valid, reliable measurement of the dependent variable	<p><i>a. Uses a valid method of measuring the dependent variable.</i></p> <p>b. Evidence is provided of a form of repeat/replicate testing which improves the reliability of the result or a valid written justification is given for not repeating/replicating measurements.</p>	<p>7. You should now carry out your Investigation in a safe way. Use the space below to note results or for rough notes.</p> <p>8. Make a table of your results.</p> <p>a. Candidates must use a valid method to measure the dependent variable. (The method used by the candidate to measure the independent variable is irrelevant to this criterion. However, a candidate using an invalid method for measuring the independent variable would not be awarded the mark allocated to objective E1).</p> <p>b. In addition to taking more than one reading of the same measurement, repetition/replication may involve:</p> <ul style="list-style-type: none"> ◆ simultaneous experiments eg planting many seeds at the same time ◆ measuring multiples eg the time for 10 swings of a pendulum. <p>Pooling of results is not permitted.</p> <p>The purpose of replication is to improve the reliability of the results. Thus a candidate who calculates an average incorrectly should not be awarded the mark allocated to this criterion. Normal constraints of the school situation, eg insufficient apparatus, cost, length of period etc. are not valid justifications for repeat/replicate testing not being carried out. Candidates should have been directed to other investigable aspects without penalty (see comments for Objective G1).</p>

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Investigative Skills Objective	Criterion	Wording in Investigation Booklet	Additional Guidance
The candidate should be able to:			
RR1	Tabulate results with appropriate headings and units of measurement	<p>a. Values (or types) with appropriate headings for independent, dependent (and any derived) variable are entered in the table.</p> <p>b. Appropriate units or their correct abbreviations are entered in the table.</p>	<p>8. Make a table of your results.</p> <p>a. Data must be presented in clearly discernible rows and columns. Headings should be clear and appropriate. Candidates should be encouraged to use a ruler when drawing tables. However, candidates should not be penalised for omitting table lines.</p> <p>Data errors, should be penalised, eg where it is apparent that the candidate has recorded incorrect readings for either variable.</p> <p>b. Units are required for both the independent and dependent variables. The units may appear in the table headings or in the body of the table. Where a table includes repeated measurements and an average value the units do not need to be repeated for each heading or entry eg:</p> <p><i>Reading 1 Reading 2 Reading 3 Average reading (units)</i></p> <p>would be acceptable for one variable.</p>

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(continued)

Investigative Skills Objective	Criterion	Wording in Investigation Booklet	Additional Guidance
The candidate should be able to:			
RR2 Present the results on a graph or chart	<p>a. A graph or chart of suitable size and scale is produced.</p> <p>b. Both axes have appropriate labels and units.</p> <p>c. Plots all the points/bars accurately.</p>	<p>9. On square ruled paper or graph paper draw a graph or a chart based on your results. Staple the square ruled paper or graph paper to your booklet.</p>	<p>During the generative phase it is in order for the teacher to direct candidates away from Investigations that will not permit the candidates to demonstrate these skills (see general comment 3 on page 210).</p> <p>a. The decision about <i>suitability</i> of size of a graph should relate to the quality of the communication, i.e. does the graph communicate findings clearly? A graph that is difficult to read or interpret does not meet this criterion.</p> <p>Numerical scales must rise in equal increments (e.g. 0, 2, 4, 6, 8 ... not 0, 2, 5, 11, 23 ...).</p> <p>b. Any error in labelling or units should be penalised <i>unless</i> the candidate has already been penalised for the error under criterion RR1a or RR1b.</p> <p>Line graph scales do not need to begin at zero. However, candidates using such scales will have to exercise great care when drawing conclusions. For bar charts, the y-axis should begin at zero.</p> <p>c. Plotting either average values or all replicates is acceptable. The points plotted should be consistent with the data in the table produced by the candidate.</p> <p>Incorrect data (penalised under criterion RR1a) plotted correctly should not be penalised again here.</p>

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Investigative Skills Objective	Criterion	Wording in Investigation Booklet	Additional Guidance
The candidate should be able to:			
RR2 cont	d. Draws line/curve of best fit or joins up the points as appropriate when the independent variable is continuous or draws a bar chart when independent variable is not continuous.		<p>d. A line/curve of best fit must be drawn where this is appropriate e.g. in physics Investigations. Joining of points with a series of straight lines should be accepted only if this is appropriate to the Investigation.</p> <p>Inappropriate extrapolation should be penalised e.g. straight line extended well beyond highest/lowest values without supporting data.</p> <p>Vertical solid lines (spikes) should be penalised in line graphs.</p> <p>In a bar chart adjacent bars may be separate or touching.</p> <p>Candidates should be encouraged to use bars of equal width and to avoid using spikes.</p>

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(continued)

Investigative Skills Objective	Criterion	Wording in Investigation Booklet	Additional Guidance
The candidate should be able to:			
Ev1	Draw a valid conclusion inter-relating the appropriate variables	Draws a conclusion which inter-relates the appropriate variables or states that no firm conclusion can be drawn.	<p>10. What conclusion can you draw from your results?</p> <p>The conclusion should relate to the aim of the Investigation (G2) and should reflect the findings. It should be more than a simple restatement of the results.</p> <ul style="list-style-type: none"> ◆ acceptable: ‘The higher the temperature the more seeds germinated.’ ◆ not acceptable: ‘Half the seeds germinated at 5°C and all the seeds germinated at 25°C.’ <p>Where a valid conclusion can be made that is directional, the direction of change must be included in the candidate’s conclusion.</p> <ul style="list-style-type: none"> ◆ acceptable: ‘The longer the pendulum string the greater the period.’ ◆ unacceptable: ‘The period of the pendulum changes as the string gets longer.’ <p>Candidates do not have to use precise scientific terms to meet this criterion i.e. candidates may answer in their own words.</p>

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Investigative Skills Objective	Criterion	Wording in Investigation Booklet	Additional Guidance
The candidate should be able to:			
Ev2	Use results to evaluate the original hypothesis	<p>Confirms the hypothesis if appropriate or refutes hypothesis and replaces it with appropriate substitute or states that no conclusion can be drawn.</p>	<p>11. What can you say about your hypothesis? (Circle A or B or C below. If you circle B complete the sentence).</p> <p>A. My hypothesis in part 3 is correct.</p> <p>B. My hypothesis in part 3 should be changed to ...</p> <p>C. My results do not allow me to choose A or B.</p>
RR3	Describe how the Investigation was carried out	<p>The description includes:</p> <p>a. a labelled diagram and/or statement of the apparatus used;</p> <p>b. an account of the procedure adopted to measure the dependent variable;</p>	<p>12. Describe clearly how you set up and carried out your Investigation.</p> <p>a. Key apparatus must appear in the text or in a labelled diagram. A list of apparatus is not required.</p> <p>b. This account should describe the procedure actually used by the candidate.</p>

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(continued)

Investigative Skills Objective	Criterion	Wording in Investigation Booklet	Additional Guidance
The candidate should be able to:			
RR3 cont	<p>c. an account of how the independent variable was altered;</p> <p>d. an indication of how variables which were the investigator's responsibility to control were kept constant.</p>		<p>c. This account should describe the procedure actually used by the candidate. The procedure used may be different from the procedure indicated for objective G4 e.g. a candidate may have planned to change temperature using a Bunsen burner but may actually have used an immersion heater.</p> <p>d. Candidates should indicate how they controlled all of the variables specified in their statement for criterion E3a.</p> <p>Some of the information required may be communicated by a clearly labelled diagram e.g. diagram could show that temperature was controlled by immersion of apparatus in crushed ice.</p>