

Accreditation of degree programmes



About us

The Royal Society of Chemistry is an international organisation connecting chemical scientists with each other, with other scientists,

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Part one: what is accreditation?

Why is accreditation important?

Accreditation of degree programmes by professional and statutory bodies is a mark of assurance that particular standards are met. Accredited programmes address the needs of employers and students, and provide marketing advantages for universities.

Our accreditation is a peer review process founded on the judgement of professional chemists. This ultimately provides a credible and independently verifiable method for employers and students to differentiate between degree programmes.

Our accreditation service can be summarised in terms of its features, advantages and benefits for the HEI:

Feature of service	Advantage	Benefit
Externally validated mark of excellence by a leading professional body	Allows differentiation of the institution, thereby enhancing its profile and credibility as a provider of quality chemistry education	<ul style="list-style-type: none"> • Enhanced prospects for student recruitment • Enhanced prospects for government funding • Increased engagement and networking with other leading universities • Enhanced mobility and employability for graduate students
An independent benchmark against respected quality standards	Provides a peer review mechanism to assess, evaluate and enhance chemistry degree programmes. Our assessors are experts from leading universities worldwide which leads to continuous improvement and sharing of best practice	<ul style="list-style-type: none"> • University able to stay at the forefront of education standards • Improved prospects for student recruitment and funding by government or corporates

Pathways to accreditation

This document explains accreditation for Bachelor's level degrees as well as integrated Master's (MChem, MSci) and discrete Master's (MSc) levels.

We can assess any chemistry-based programme, and make a judgement based on output standards against our accreditation key requirements.

How accreditation works

Our accreditation operates as a single, global, summative assessment process for all degree programmes based on the discipline of chemistry. It is a peer-reviewed process managed by our Committee for Accreditation and Validation (CAV), which is responsible for assessing applications, applying the published criteria and making judgements. Royal Society of Chemistry Trustees appoint CAV committee members from our membership. This ensures that reviewers have contemporary experience of university-level education and an understanding of the demands of employers and academia. We also employ professionally qualified staff whose role is to help and advise you and to manage the accreditation process. Together CAV members and our staff ensure the high quality of our accreditation.

Accreditation lasts for a period of five years, after which you are invited to submit your programmes for re-accreditation. Continued accreditation throughout the five year period is dependent on you telling us of any subsequent changes in the structure or content of your programmes. For major changes, we carry out a formal review of a programme's accreditation status.

Importantly, accreditation is more than a single mark of quality. It provides you with opportunities for wider engagement with us through our extensive range of activities for promoting and developing science. Because we share a common purpose: advancing excellence in the chemical sciences.

Reference points

Bachelor's accreditation

Bachelor's accredited programmes are expected to provide students with:

- a broad and balanced appreciation of key chemical concepts.
- a range of practical skills so that they can understand and assess risks and work safely in the laboratory.
- the ability to apply standard methodology to the solution of problems in chemistry.
- the knowledge and skills base which leads to graduate employment or to further study.

In terms of professional qualification, an accredited Bachelor's degree provides access to professional categories of Royal Society of Chemistry membership and partially meets the academic requirements for our Chartered Chemist (CChem) award.

Master's accreditation

Master's accredited programmes are expected to provide students with:

- an in-depth understanding of specialised areas of chemical science.
- the ability to plan and carry out experiments independently and assess the significance of outcomes.
- the ability to adapt and apply methodology to the solution of unfamiliar types of problems.
- a critical awareness of advances at the forefront of the chemical science discipline.
- effective preparation for professional employment or doctoral studies in the chemical sciences.

In terms of professional qualification, Master's accreditation provides access to professional categories of Royal Society of Chemistry membership and fully satisfies the academic requirements for our Chartered Chemist (CChem) award.

There are generally two types of Master's degree programmes: discrete and integrated.

a) Discrete Master's programmes

These programmes normally follow on from the award of a Bachelor's level qualification. This is the study pattern followed in most parts of the world. The chemical science qualification conferred is usually either MSc (Master of Science) or simply referred to as a Master's degree.

b) Integrated Master's programmes

These programmes take students from university entry to master's level, combining learning outcomes at Bachelor's and Master's levels. The qualification conferred is usually MChem (Master in Chemistry) or MSci (Master in Science). Normally there is no intermediate award of a Bachelor's qualification.

Accreditation values

Accredited degree programmes stimulate students in the subject of chemistry and allow them to develop an appreciation of its application in different contexts. We don't want to inhibit creative curriculum development designed to meet evolving needs and regional demand, so we don't specify required content in detail. However, to become accredited, a degree programme must satisfy a range of criteria based on knowledge and understanding, intellectual abilities, and both practical and professional skills.

In general terms, an accredited degree programme provides:

- knowledge of chemical science that builds upon secondary education (study prior to university) and incorporates a critical understanding of theories and principles.
- essential skills for applying chemical knowledge and solving complex scientific problems with a strong emphasis on laboratory skills in synthesis and analysis.
- development of professional skills which allow transferability within the chemical sciences and across employment sectors.
- competence in dealing with challenging activities or projects while taking on responsibility for decision-making in variable contexts.
- an awareness of the role played by the chemical sciences in meeting sustainability goals.
- equal opportunities for all students to achieve their full potential.

Part two: output standards for Royal Society of Chemistry accredited programmes

Key requirements (KR) for accreditation		Bachelor's	Integrated Master's	Discrete Master's
Professional skills	KR9: Programmes must develop a broad range of transferable key skills.	✓	✓	
	KR10: Programmes must develop professional skills for those intending to practice chemical science as a profession.		✓	✓
Placement	KR11: External placements must be subject to assessment against explicit and demanding criteria, with departments sharing control and supervision of their students while continuing to provide both academic and wellbeing support.	✓	✓	✓
Assessment	KR12: Assessment should be varied, appropriate and rigorous, and require students to apply their knowledge and solve problems. All assessment methods should be inclusive and accessible.	✓	✓	✓
Quality assurance	KR13: Robust quality assurance mechanisms must be in place and adhered to for all aspects of the programmes.	✓	✓	✓
Title	KR14: The title of a programme should be indicative of its content and address the assumptions an employer will make about the graduates' abilities based on the title.	✓	✓	✓
Inclusion, diversity and wellbeing	KR15: Resources devoted to a programme should provide all students with a suitably supportive environment, so enabling them to be successful in achieving the stated learning outcomes.	✓	✓	✓
	KR16: The department should have robust inclusion, diversity and wellbeing support mechanisms to ensure all students have equal opportunities to meet the stated learning outcomes.	✓	✓	✓

Further guidance on each of the key requirements can be found in the following pages.

Guidance notes on key requirements

Section One - subject knowledge

KRI: Evidence of study of the main branches of chemistry is provided and developed at appropriate times during the course.

Applicable to:
i) Bachelor's
ii) Integrated Master's

- The chemical sciences represent a broad field of study and stakeholders expect that core chemical concepts form a fundamental part of Royal Society of Chemistry accreditation. While we do not set a syllabus, it is essential that those studying an accredited programme demonstrate knowledge of such core chemical concepts as those contained within a broad qualifications framework, for example the UK **QAA Subject Benchmark Statement** for chemistry. These studies should lead on from secondary/high school education and are likely to feature at an introductory stage of the programme. As a minimum, students must develop an ability to evaluate and interpret core chemical concepts.
 - Programmes titled 'Chemistry' will provide a balanced programme across the discipline. Although specialism is allowed, if significant weighting is given to the specialism this must be reflected in the title.
 - Typically, programmes titled 'Chemistry and [xxx]' should have an even split in the studies, whereas 'Chemistry with [xxx]' should devote ca. 25% of the course to the specialism. The contribution of the minor subject to the final degree classification must not be greater than 25%. Suitably titled interdisciplinary chemical science degrees such as 'Pharmaceutical
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KR2: Programme outcomes should include a breadth of understanding of chemistry with the ability to solve problems at the threshold level of competence for Bachelor's or Master's outcomes as defined by the

KR3: Breadth of understanding of chemistry through prior learning must be assured through admissions processes.Applicable to:
**Postgraduate taught
Master's only**

- There is an expectation that those embarking on discrete Master's programmes have already developed a level of subject knowledge, abilities and skills in chemical science that enable them to pursue studies at the Master's level and successfully achieve the prescribed learning outcomes.
- The accreditation process will seek to ensure that university admissions processes are robust and applied effectively.
- Typically, those applying for discrete Master's programmes will have an undergraduate or equivalent qualification in chemistry or one which contained largely chemistry. It must be established before admission that any prior qualifications have enabled the student to develop subject knowledge and understanding at Bachelor's level, together with the appropriate abilities and skills, including practical, as described in the chemistry Subject Benchmark Statement and the practical skills list. This can be established through scrutiny of degree transcripts, interviews and/or any other means the university chooses.
- Admissions processes can also be applied to those with an undergraduate or equivalent qualification in a related interdisciplinary area, and/or those with suitable supplementary learning. In admitting such students, universities may wish to provide a programme of supplementary studies in order to strengthen areas of weakness.
- A discrete Master's degree which admits students from outside the chemical sciences can be accredited. However, only those students with prior learning in the chemical sciences will fully meet the academic requirements for CChem.

KR4: Programmes should build on the knowledge base to allow students to appreciate developments at the forefront of some areas of chemical sciences.

Applicable to:
Bachelor's only

- Programmes must provide significant enhancement beyond the required level for breadth of study (defined by KR1 and KR2).
 - Students should gain detailed knowledge and critical understanding in one or more chemical science specialisms, some of which are informed by or at the forefront of the subject.
 - Specialisation should provide students with a knowledge base from which they can proceed to graduate employment or to further studies in the chemical sciences.
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KR5: Programmes should ensure a depth of knowledge in specialist areas of chemical science, demonstrated by an ability to solve problems at the Master's level.

Applicable to:
Integrated and postgraduate taught Master's programmes

- In all cases, intellectual rigour demonstrated by depth of study will be necessary.
 - A postgraduate taught Master's degree will contain an appropriate amount of taught material which should normally equate to 33–66% of overall content. There is an expectation that at least 83% of learning outcomes will be at Master's level, as outlined in the QAA MSc characteristics statement.
 - Depth of study cross-references to Master's level in the chemistry Subject Benchmark Statement, and is exemplified by the provision of a number of problems of an advanced nature.
 - Material at the level of QAA Master's outcomes would normally be included in the latter stages of a full-time integrated Master's programme.
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Section 2 - Skills

KR6: Students must be competent in a range of practical skills.

Applicable to:
**BSc and integrated
Master's only**

- Health and safety training must be provided prior to commencing each practical, and health and safety must be fully embedded across all work. Students should be able to describe, document and enact safe working practices, in terms of managing chemical toxicity, chemical stability, chemical reactivity and chemical disposal through knowledge-based risk assessments and practical activities.
- For all programmes, students must attend and complete a minimum of 300 timetabled laboratory hours (exclusive of project or independent investigative work).
- The practical component should be laboratory based and designed so that students are exposed to a variety of synthetic, measurement and computational techniques. While supporting the subject theory, laboratory work should be stimulating and challenging in its own right. Laboratory work should provide the essential chemistry-related practical skills described in the chemistry Subject Benchmark Statement, and ensure all aspects of the practical skills list in appendix 1 are delivered.
- Case studies and short investigative tasks can contribute to the total timetabled hours, along with preparatory tasks which form part of the marked report, for example preparation of a COSHH assessment or any preparatory tasks which are conducted in the laboratory under the supervision of a demonstrator or academic. Similarly, any post-experimental data manipulation carried out in the laboratory or computer suite while under supervision may also be counted.
- For students who do not attend laboratories due to university approved mitigations, there should be a mechanism for those students to undertake the missing laboratory component(s). This could include attending catch-up laboratories, undertaking an appropriate replacement laboratory, or writing up pre-collected data.
- During the earlier years of a programme, students on an integrated Master's course must be suitably prepared for carrying out a major project in their final year.
- Allowances are permitted for fully integrated credit-bearing industrial placements in a laboratory setting. The Royal Society of Chemistry will consider a lower value for programmes which incorporate a period of study in industry or for part-time modes of study. In such cases a condition may be imposed on the accreditation status of the programme and applicants may be required to provide evidence of developing appropriate practical skills within a workplace context.
- Any postgraduate student demonstrators should be provided with suitable technological and safety training to adequately equip them to impart the necessary practical skills to students.
- Practical work must be rigorously and appropriately assessed and contribute towards the final mark of the degree programme.
- Programmes with specialisms are expected to meet the requisite practical hours. However, the nature of the practical content may reflect the nature of the specialism.
- Practical work must be accessible to all. An institution should make anticipatory reasonable adjustments to ensure that disabled students can participate on an equal basis, such as height-adjustable work benches. Adjustments for specific students, for example laboratory helpers, help with fine manipulations, or directing laboratory work remotely should be considered. Accreditation is reflective of the overall programme rather than individual situations.

KR7: Programmes must incorporate some student-led independent investigative methodology.

Applicable to:
Bachelor's only

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KR9: Programmes must develop a broad range of transferable key skills.

Applicable to:
i) Bachelor's
ii) Integrated Master's

- Transferable skills development is an essential feature of all degree programmes.
- Requisite transferable skills cross-reference to generic skills outlined in the QAA chemistry Subject Benchmark Statement. At Bachelor's level these should incorporate:
 - communication skills
 - scientific writing, data presentation, referencing literature
 - problem solving skills relating to qualitative and quantitative information
 - numeracy and mathematical skills
 - ethical responsibilities
 - sourcing of information
 - digital skills
 - teamworking
 - time management and organisational skills
 - personal development awareness, interview techniques and CV writing

Section 3 – Assessment and Quality Assurance

KR12: Assessment should be varied, appropriate and rigorous, and require students to apply their knowledge and solve problems. All assessment methods should be inclusive and accessible.

Applicable to:
All programmes

- Universities are encouraged to use a wide range of appropriate summative and formative assessment methods. These could include, but are not limited to, a mixture of online assessments, coursework, practicals, oral assessments and invigilated exams.
- For key concepts in particular, assessment methods should also be able to demonstrate that the work submitted is genuinely that of each student. This can be demonstrated through assessment design or the way in which the assessments are deployed. Innovation in assessment is strongly encouraged, but it is recognised that the most effective way of achieving this requirement may be through formal, written examinations conducted under controlled conditions.
- Assessment should be matched to particular aspects of the programme, and should be carefully designed and applied to ensure validity and reliability as discriminators, with the option of applying mitigating circumstances as appropriate.
- The final degree classification regulations should be clear, transparent and fair, leading to grading that accurately reflects a student's performance across the programme.
- Departments must have processes in place to ensure that assessment outcomes are authentic, are not the result of collusion, and protect academic integrity. Quality assurance for all assessment must be robust.
- The choice of assessment method should be a reasoned, appropriate choice made by subject experts within the discipline and tested with external examiners.
- Progression to subsequent stages of a programme should only be possible when a minimum competence has been demonstrated in prerequisite areas. Practical and project work cannot be compensated or condoned.
- All assessments should be explicitly aligned to the intended learning outcomes of the relevant material in terms of nature, subject and context. This may include:
 - various forms of in-course assessment with particular, but not exclusive, evaluation of practical competence.
 - assessments that allow students to apply their knowledge and understanding, demonstrate their problem-solving abilities, and critically analyse information, construct synopses and devise solutions.
 - assessments that contain original, unseen questions and problems, especially when in a timed examination format.
 - assessments that allow students to demonstrate their ability for research, initiative and innovation.
- Departments must demonstrate that assessment of project work is rigorous and conducted against clear criteria. The project supervisor must not be the main marker, with the contribution to the final mark from the supervisor being less than 40% of the final mark.
- Students should be made aware of, and given opportunities to prepare for and practice, any

- Where online assessment is used, the duration should be carefully considered, recognising that shorter, timed assessments can reduce the opportunities for collusion and preserve academic integrity, but that students will need extra time to scan in and upload handwritten answers. Online, open-book types of examinations are generally appropriate for problem solving and testing the application of knowledge, but using this method for questions based on factual recall should be avoided.
- For Master's programmes, assessment of the project work is central to determining whether or not a programme has provided the subject knowledge, abilities and skills associated with Master's level learning outcomes and hence the basis for professional practice in the chemical sciences.
- The final grading of an award should be substantially weighted to student performance in the final stages of their programme, but should not rely exclusively on it.

KR13: Robust quality assurance mechanisms must be in place and adhered to for all aspects of the programmes.

KR14: The title of a programme should be indicative of its content and address the assumptions an employer will make about the graduates' abilities based on the title.

Applicable to:
All programmes

- The title of a programme should be indicative of the content, and it should follow that the subject knowledge, abilities and skills provided to successful students are directly relevant to the title.
- The Royal Society of Chemistry's general expectations are:
 - Programmes titled simply 'Chemistry' provide a balanced programme across the discipline. The substantial project can be on any chemistry topic.
 - Programmes with titles such as 'Chemistry with medicinal chemistry' or 'Chemistry with analytical chemistry' imply a balanced programme with a specialism in a particular area of chemical science.
 - » Bachelor's programmes should provide study in the specialism in the final year of study (see KR4).
 - » Master's programmes must contain taught material from the implied specialism at Master's level and must require students to conduct their substantial project in an area of chemical science related to specialism (see KR5 and KR8).
 - Programmes which combine studies in chemistry with those in another discipline such as 'Chemistry with French' and 'Chemistry with mathematics' denote a major/minor split.
 - » Generally, the minor subject would typically account for at least 25% of the programme. The contribution of the minor subject to the final degree classification must not be greater than 25%.
 - » For Master's programmes, chemistry studies should be taken to Master's level and form the substantial project.
- Broader chemical science degrees may be eligible for accreditation but must meet all key requirements. Stakeholders/employers expect a Royal Society of Chemistry accredited degree to retain a core breadth and depth of chemistry and practical aspects.

Section 4 - Inclusion, diversity and well-being

KR15: Resources devoted to a programme should provide all students with a suitably supportive environment, so enabling them to be successful in achieving the stated learning outcomes.

Applicable to:
All programmes

- Universities are expected to provide evidence that students on an accredited programme are adequately supported by appropriate learning resources and support such as computing and communication facilities (access to software, internet and email) and suitable library provision, including appropriate accessibility to key textbooks, major online chemical databases and the primary chemical literature, such as a range of peer-reviewed journals.
- All activities must be open to all students in an equitable manner with accessible lecture theatres, classrooms, laboratories, assessment and learning materials.
- Laboratories should adhere to strict safety guidelines and should house appropriate instrumentation, apparatus and fume cupboards for teaching and project work. They should be up to date, fit for purpose and properly maintained.
- An environment of health and safety should be employed throughout the programme. This should be championed by all staff involved in practical teaching and/or marking to set an example.
- Royal Society of Chemistry accredited degree programmes must be delivered by an appropriate level of fully qualified, full- and/or part-time staff (academic, administrative, and technical). Staff should be knowledgeable and suitably skilled in the areas they are teaching or supporting, and able to set assessments to an appropriate standard.
- Appropriate professional development opportunities should be available to all staff.
- Ultimately, adequate support is judged by whether or not the resources devoted to a programme provide all students with a suitably supportive environment, enabling them to be successful in achieving the stated learning outcomes.

KR16: The department should have robust inclusion, diversity and wellbeing support mechanisms to ensure all students have equal opportunities to meet the stated learning outcomes.

Applicable to:
All programmes

- The department must have a proactive commitment to equality, inclusion and diversity. A clear and appropriate mechanism should be in place whereby institutional inclusion and diversity policies are enacted, with a focus on improving inclusive access and progression.
- Programmes should not preclude students on the grounds of any type of discrimination, such as gender/ gender identity, race and/or ethnic origins, socioeconomic background, sexual orientation, disability etc. The cultural environment of the programme may be taken into consideration.
- Programmes should offer suitable support and encourage a sense of belonging for all stages of the course, such as the transition to university, during the programme, and future careers.
- Suitable care for student wellbeing should be available to ensure the optimal student experience. There should be clear signposting for students to any necessary additional support, and there should be clear policies for both students and staff to report and be protected from discrimination, bullying, harassment or undue pressure.
- Programmes are expected to recognise and reflect the contribution of those working in the appropriate field, regardless of geographical or cultural boundaries and showcasing the rich diversity of the global chemical sciences community.

Review

Once you've collected all the information, submit your application. We distribute the documentation to members of the Committee for Accreditation and Validation (CAV) for detailed initial consideration against the key requirements. The feedback of this initial review will form the basis of the site visit (see below).

Department visit

The visit takes place across one day, the department visit is a key feature of the accreditation process and is designed to help the committee make its judgement. It provides a valuable opportunity for us to discuss the features of the programmes with your staff and with students and to check out the infrastructure and resources devoted to delivery.

We would expect senior staff from your department to be available to meet the assessors at some point. A meeting with some current students over lunch to discuss their learning experiences is an essential feature of the visit and we will also need to meet with QA representatives from your university.

The visit is across one day, and involves a team of trained peer assessors (2–3 committee members who are experts in the field of HE teaching) and a member of our professionally qualified staff.

Once we have received comments from the assessors we will contact you with a proposed agenda and any further documentation we would like to see during the visit. These will be sent approximately one week before the visit.

A typical one-day itinerary is shown overleaf. This is simply an example: the scale and duration of a visit will vary.

Any issues can be resolved and clarifications made. If anything has been left out of the documentation, this can be discussed in person. Ultimately having a department visit allows the accreditation committee to speed up its decision making processes.

Example of a department visit agenda

9.30 Arrival and greeting with head of department

This initial meeting allows introductions to be made and gives the department an opportunity to outline their overarching aims and objectives. This is also an opportunity for the head of department to illustrate how the recommendations from the previous accreditation have been met.

10.00 Private meeting of visiting team and review of additional materials

This meeting enables the Royal Society of Chemistry's visiting team to review the preliminary comments (identifying the specific areas for clarification or discussion) and to agree its primary objectives for the visit. Any material that has been requested prior to the campus visit should be made available to the team including the requested project reports.

10.30 Tour of facilities

The tour allows the visiting team to determine whether the learning resources available to support the programme are appropriate. The tour must include teaching laboratories and may include the library, IT facilities and any other specialist teaching areas or learning resources.

11.30 Meeting with QA department or departmental representatives responsible for this (international universities only)

This meeting focuses on the quality assurance the institution has in place and will involve discussions around how quality assurance is maintained in their programme.

12.30 Lunch meeting with students

This meeting allows the team to listen to the views of students and to gauge their experience of studying at the university. Ideally the meeting would include around 8-10 students from various year groups. If more than this number wish to attend, they are welcome to do so.

13.30 Meeting with programme team (head of department, head of teaching, heads of sections or programme leaders)

This meeting focuses on the specific areas for clarification or discussion. It involves a wide-ranging discussion on particular aspects of the programmes and is likely to drill down to more specific detail.

15.00 Private meeting of visiting team

This meeting enables the visiting team to review the day, to ensure that its objectives have been satisfied, and to prepare some provisional feedback.

15.30 Feedback meeting - outline of next steps

Some informal feedback is given on the department visit, and the remaining stages of the process, together with a timescale for an accreditation outcome, are outlined. However, no decision can be given on accreditation at this stage. Following the visit, the assessors will make a recommendation to the Committee for Accreditation, who will then take the decision.

16.00 Seminar from the visiting assessors (international universities only)

An opportunity for students and staff at the university to hear from the visiting assessors about their research, as well as to learn more about what the Royal Society of Chemistry has to offer.

We prefer to keep the department visit relatively informal so that any aspects of the programme can be discussed openly. We don't publish visit reports, but use them to inform CAV.

Judgement

After the department visit has taken place, your submission is formally considered at the next available meeting of CAV. Meetings are usually in March, June and December of each year.

The committee's final decision is based on its review of the submitted documentation and the department visit report. If the committee are confident that you have satisfied all the key requirements, accreditation is granted.

After the meeting you will receive a letter outlining the terms of accreditation together with a feedback document. The feedback document may contain up to five general components.

1. Evident strengths

We value good practices in teaching and learning and are keen to make sure that people involved in such activities are acknowledged for their commitment to students' learning experiences. If appropriate we will promote and share good practice through our networks and published materials.

2. Prerequisites

These prerequisites are necessary before we grant accreditation. If you have followed all previous consultation during the submission process, it is unlikely any prerequisites will be on the feedback form.

3. Requirements

In some instances, we will specify a condition for accreditation. It would normally need a change to your programme. You must make this change to maintain your programme's accredited status. We normally give a timescale for these changes, which is typically 12 months.

4. Recommendations

These are continuous enhancement features which you should make during the accreditation period (five years). They may involve more significant changes and you may need to review your specifications, procedures and practices.

We expect that, when programmes are submitted for re-accreditation after five years, the committee will usually grant accreditation. It is unlikely that a programme will be refused accreditation. It is expected that, when programmes are submitted for re-accreditation after five years, the committee will usually grant accreditation. It is unlikely that a programme will be refused accreditation.

Appendices

Appendix 1: essential practical skills and guidance

General scientific skills and safety

- Apply a working knowledge of scientific regulation, health and safety and laboratory safe practice.
- This should include:**
- emergency procedures
 - principles of safe storage and safe use of equipment
 - use, disposal and containment of chemicals (e.g. use of fume-hoods)
 - use, disposal and containment of other hazards (e.g. electrical, magnetic fields, radiochemical, lasers, glass and sharps), including spillages and breakages
 - correct use of PPE
 - identification and labelling of materials
 - risk assessments'
- Prepare and use supporting documentation in compliance with local safety procedures and regulations (eg COSHH forms, risk assessments).
 - Plan, design and correctly rationalise experiments to test a scientific hypothesis in a timely manner which considers important measurement criteria such as accuracy and precision.
 - Competently and accurately observe and keep records of practical work, and effectively report the data in an appropriate scientific manner.
 - Behave in a proper, ethical and professional manner within the laboratory environment.

General laboratory techniques

- Use and care for balances and laboratory equipment (eg pH meters, glass/auto pipettes and burettes).
- Safely assemble and clean glassware (considering appropriateness for use and required precision where relevant).
- Correctly and safely use, prepare and handle solids, liquids, gases and solutions (including toxic and corrosive materials).
- Understand and use chemical terminology.
- Calculate quantities and concentrations of reagents.

Experimental methods

- Set up a wide range of reactions using a range of heating/cooling methods and appropriate atmospheres.
- Safely quench and work up reactions including aqueous work-up and using appropriate drying agents.
- Use common laboratory processes such as evaporation, measurements of melting points, measurement of pH and determination of equivalence points.
- Use a wide range of separation and purification techniques for solids, liquids and gases. These could include distillation, recrystallisation, sublimation, solvent extraction, filtration, thin layer chromatography and column chromatography (including gas chromatography, high performance liquid chromatography and flash chromatography).
- Design, construct and execute an experiment to determine quantitative, qualitative, kinetic or thermodynamic parameters and assess/evaluate the results.
- Prepare samples for and interpret spectra from a wide range of commonly used spectroscopic and spectrometric techniques. These could include infra-red, UV-visible, nuclear magnetic resonance, mass spectrometry, polarimetry, fluorescence, Raman, atomic absorption spectroscopy, X-ray diffraction and microscopy.

Data analysis

- Develop a wide range of numerical, data analysis and presentation skills such as calculating and accurately reporting measurement uncertainties by utilising appropriate statistical packages and databases.

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