Qualification Requirement for BTEC Higher Nationals in Applied Chemistry

This Qualification Requirement should be read in conjunction with overarching guidance from Edexcel.

Rationale

BTEC Higher Nationals using the title Applied Chemistry should be developed to provide:

- the education and training of chemistry technologists who are employed in a variety of types of technical work, such as in: quality control, organic preparations, laboratory analysis, materials testing, pilot scale, research and development, education etc
- a standard national vocationally specific qualification at Level 4 linked to the National Occupational Standards and the professional body requirement.
- a nationally recognised vocationally specific qualification that will provide confidence to employers recruiting applied chemistry technologists that holders of the qualification possess the requisite knowledge, understanding and skills
- a qualification that will be assessed to a national standards and thus provide confidence to those recruiting to more advanced higher education vocational qualifications such as a full-time degree in Applied Chemistry or related area
- a programme of learning that ensures full understanding of the role of the applied chemistry technologist. This includes an understanding of the role at departmental/section level as well as an appreciation of how the role and that of the department/section fits within the overall structure of their organisation and within the scientific and local community.

Aims of the Qualification

Qualifications in Applied Chemistry meet the needs of the above rationale by:

- equipping individuals with knowledge, understanding and skills for success in employment in the applied chemically-based industry
- enabling progression to an undergraduate degree or further professional qualification in applied chemistry or related area
- providing specialist studies relevant to individual vocations and professions in which students are working or intend to seek employment in the chemical sciences and their related industries
- developing the learners ability in the chemical sciences environment through effective use and combination of the knowledge and skills gained
- developing a range of skills and techniques, personal qualities and attributes essential for successful performance in working life and thereby enable learners to make an immediate contribution to employment
- providing flexibility, knowledge, skills and motivation as a basis for future studies and career development - an educational foundation for a range of careers in chemical sciences and their related industries

- providing opportunities for learners to focus on the development of the higher level skills in a science and technological context
- providing opportunities for learners to develop a range of skills and techniques and attributes essential for successful performance in working life.

Mandatory Curriculum

Chemical Analytical Techniques: use high level technical skills in order to carry out quantitative and qualitative laboratory analytical techniques in physical, organic and inorganic chemistry; interpret the results; including use of spectroscopic techniques IR, atomic, visible, UV, mass spec., nmr, separation techniques GLC, HPLC, TLC etc.

Chemical Preparative Techniques: use of discrete and integrated complex laboratory preparative techniques in physical, organic and inorganic chemistry. Comparison of the factors involved in small to large scale preparations.

Laboratory Management and Organisation: resource management; in-house and out-sourced services; laboratory management information systems; supervisory management; the management of individuals and teams, Health and Safety Management.

Applied Chemistry: understand and apply theoretical principles of applied inorganic, physical and organic chemistry including quantum mechanics; electronic structure; inter- and intra-molecular attractive forces; properties and applications of elements and compounds; organic reaction mechanisms; isomerism; structure and bonding; functional group reactions; ionic conductance; nernst equation; rates and feasibility of reactions.

ICT and Management of Information: use sector specific chemistry software packages for the management of information; collection; analysis and use of data; ICT skills used to obtain information from electronic sources and synthesise information.

Instrumental Techniques: use modern instrumentation techniques to monitor chemical reactions; data logging; interpret and analyse data to assess the purity of products.

Scientific Project Management: use of project management; implement a project plan including evaluation and review; importance of communications and presentation in project management.

Analysis of Scientific Information and Data: use of numerical and statistical techniques to solve scientific problems; the types of errors and tolerances; evaluation of data obtained; including random, systematic and gross errors; accuracy and precision; linear and non-linear equations; constrained optimisation; differentiation and integration; differential equations.

Optional Curriculum

Assignment in the Workplace: apply with a degree of autonomy and responsibility for own learning the knowledge, understanding and technical skills to a practical work-based assignment. This is for students employed within the chemical or related industry

Further Inorganic Chemistry: develops and applies the knowledge and understanding of more complex principles of inorganic chemistry including homogeneous and heterogeneous catalysis; transitional metal co-ordination complexes; theoretical models of co-ordination complexes; redox behaviour of transitional metal co-ordination complexes.

Further Organic Chemistry: develops and applies the knowledge and understanding of more complex principles of organic chemistry including mechanisms; physical and electronic structures of aromatic compounds; carbonyl compounds; structures and reactions of optically active molecules and their industrial applications.

Further Physical Chemistry: develops and applies the knowledge and understanding of more complex principles of physical chemistry including conductivity; electrochemistry; molecular spectroscopy; surface chemistry and colloids and their industrial applications.

Environmental Chemistry: applies chemical principles in an environmental context; reviews a range of analytical techniques; quantitation in environmental chemistry; evaluate the usefulness of environmental modelling.

Industrial Applications of Chemistry: develops and applies the knowledge and understanding learnt in physical, organic and inorganic chemistry to factors that effect the complex process of scaling up from a laboratory environment to pilot to plant scale; physio-chemical aspects; plant design; location of plant; plant operating issues; health and safety and environmental issues.

Biochemistry: develops an understanding of the fundamental principles of biochemistry; including biological building block molecules; structure and function of biological macromolecules; major metabolic pathways and biochemical practical skills and cognate techniques.

Polymer Chemistry: applies the knowledge of chemistry and relevant practical skills to polymer chemistry. Investigates polymer mechanisms and techniques; relates the structure of polymers to their physical properties including creep and stress relaxation; crystal structure; molecular mass etc; evaluates service performance and environmental behaviour.

Medicinal Chemistry: develops an understanding and applies the aspects of chemistry relevant to medicinal and clinical chemistry. Drug-receptor interactions; physiochemical properties of drugs; pharmacokinetic and pharmodynamic behaviour of drugs; metabolism of drugs; abnormal response to chemicals; cellular metabolism; role of biological active molecules; clinical toxicity.

Physics: develops an understanding of the physics principles behind the operation of instruments used in the analysis of chemicals. Properties of particles and waves; electromagnetic radiation; wave-particle duality; spectra; harmonic motion and resonance; mass spectrometer.

Statistics and IT: application of statistical techniques to scientific data from primary and secondary sources; record, display and summarise scientific data; use of basic and more advanced statistical techniques to solve problem scientific problems; evaluate the results.

Biology for Chemists: application of chemistry principles to biology. Chemical principles related to the structure of biological molecules; review the role of inorganic ions in cells; physio-chemical aspects; examine the role of nuclear chemistry in biology.

Quality Assurance and Control: understand the principles and practices, costs and benefits of quality systems, TQM, performance indicators, applications of quality systems and how they are applied within a chemical industry environment

Environmental Analysis: develops and applies the knowledge, understanding and use of technical skills in bio-geochemical cycles, sewage, industrial waste, agricultural waste, use of fossil fuels, greenhouse effect, environmental sampling methods, concentration of analyates and maximum permitted levels.

Environmental Management and Conservation: develops and applies the knowledge, understanding and strategies for conservation, management of resources, recycling and preservation, causes, effects and control of pollution, land resources management, oceanic resources and management, atmospheric degradation, environmental planning and legislation, formulation of environmental policy.

Links to Professional Body

Students possessing an HNC/D in Applied Chemistry and a number of years (usually between 3 – 5 years) of post HNC/D experience in the chemical industry are able to apply for 'Associate Membership of the Royal Society of Chemistry'.

Learners on these programmes will be able to apply for Affiliate Membership of the Royal Society of Chemistry and gain the opportunity to access benefits of being an affiliate member.

Links to National Standards

There is the opportunity for the BTEC Higher National programmes in Applied Chemistry to provide some of the underpinning knowledge, understanding and skills for the Level 4 NVQ in Laboratory and Associated Technical Activities.

Higher Level Skills and Abilities

Learners will be expected to develop the following skills during the programme of study:

- the ability to work effectively as an individual and in teams
- the ability to be flexible and respond to the changing climate within the scientific community
- designing, planning, conducting and reporting on scientific investigations
- undertaking laboratory investigations in a responsible, safe and ethical manner
- recognising the moral and ethical issues of scientific enquiry and experimentation and appreciating the need for ethical standards and professional codes of conduct
- develop an appreciation of the interdisciplinary nature of science the capacity to give a clear and accurate account of a subject, marshal arguments in a mature way and engage in debate and dialogue both with specialists and non-specialists
- the ability to communicate effectively and appropriately
- the ability to use ICT and Management Information Systems in a chemical environment
- supervisory management responsibilities in an appropriate context
- personal qualities and attributes essential for successful performance in working life
- analysing, synthesising and summarising information critically
- the ability to read and use appropriate scientific literature with a full and critical understanding
- the ability and solve problems applying subject knowledge and understanding to address familiar and unfamiliar problems
- the ability to think laterally and be innovative and creative in relevant contexts
- the ability to work as an individual and in teams for successful performance in a chemically based industrial environment
- the ability to think independently, take responsibility for their own learning and recognise their own learning style

Qualification Requirement for the BTEC HNs in Applied Chemistry
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