

# Technical Report Questionnaire

By completing the required sections of the Technical Report Questionnaire (TRQ), IChemE can determine whether you have the technical skills, knowledge and learning at a level equivalent to an accredited chemical engineering degree programme. You should focus your responses on the technical principles you followed and quantitative methods you used. Describe the work you yourself completed, rather than the management of others to carry out tasks. Where you worked as part of a team, specify what your contribution was to the overall activity, and avoid lengthy descriptions of manufacturing processes, equipment etc.

**Write your responses in the first person eg "I designed...", "I calculated...", I was responsible for..." etc.**

Please provide details in the relevant sections of this form, drawing from your qualifications and/or experience to show how you meet the criteria listed for each question. Make sure to only complete the numbered sections mentioned in the letter you received after submitting your Technical Biography:

- if you believe that one (or more) modules in your academic qualifications meets the requirement
  1. List the title of the module(s) and, if possible, the university's module code.
  2. Where possible, give the university's description of the module's aims (those relevant to the section), otherwise give details of what you learnt from the module.
  
- if you believe that you meet the requirement through professional experience:
  1. Indicate the context in which you gained the experience (eg a particular project).
  2. Show what you have learned relevant to the specific requirement.
  3. Where possible, indicate how you have applied, or would apply, this learning to other situations relevant to the requirement.

The word counts in each section are indicative. While your particular circumstances may occasionally require a longer response, please bear in mind that your ability to express yourself succinctly is a key professional skill. **Do not exceed the word count** - any TRQ that is 10% or more over the total word count for the total sections required will be returned for revision by the candidate.

**Further guidance on how to complete this questionnaire and example TRQ answers can be found at [www.icheme.org/trq-guidance](http://www.icheme.org/trq-guidance) and [www.icheme.org/trq-example-answers](http://www.icheme.org/trq-example-answers)**

ICP Number (office use only):

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## Part O. Underpinning chemical and bio sciences

### Understanding of science

Your knowledge and understanding of molecular science (chemistry, biology) should be of appropriate depth and breadth to appreciate the scientific and engineering context of chemical engineering, and to support your understanding of future developments.

Assessment criteria	Applicant self-assessment
Evidence of knowledge and understanding of: <ul style="list-style-type: none"> <li>■ relevant aspects of chemistry and bioscience, to enable the understanding of chemical engineering principles.</li> </ul> <b>Use 150–250 words</b>	<b>In the box below, provide details such as module descriptors (with learning outcomes and level) for qualifications and/or experiential understanding gained through work roles or projects.</b>

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## Part A. Fundamentals of chemical engineering

### 1. Core chemical engineering

In the following sections you should demonstrate your understanding of chemical engineering principles to fluids and solids formation and processing, and their application to:

- problems involving fluid flow, heat transfer, mass transfer and reaction engineering, and
- the analysis of complex systems within a structured approach to safety, health and sustainability.

Demonstrate an understanding of the broad range of applications of the principles and your ability to analyse, model quantitatively, and synthesise at the appropriate scale. You should include evidence of:

- different types of process, including continuous and batch, chemical processes, and bioprocesses
- different time scales: short and long periods; steady and unsteady state
- different physical scales: from molecular level to large scale continuous.

You should demonstrate the knowledge and ability to handle broader implications of work as a chemical engineer. These include:

- sustainability aspects
- process safety, health, environmental and other professional issues including ethics, risk, commercial and economic considerations etc.

### 1.1 Core chemical engineering – fundamentals

Assessment criteria	Applicant self-assessment
<p><b>1.1.1</b></p> <p>Evidence of ability to apply:</p> <ul style="list-style-type: none"> <li>■ the principles of material and energy balances.</li> </ul> <p><b>Use 150–250 words</b></p>	<p><b>In the box below, provide details such as module descriptors (with learning outcomes and level) for qualifications and/or experiential understanding gained through work roles or projects. If necessary, IChemE may request further details.</b></p>

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Assessment criteria	Applicant self-assessment <b>In the relevant box(es) below, provide details such as module descriptors (with learning outcomes and level) for qualifications and/or experiential understanding gained through work roles or projects.</b>
<p><b>1.1.2</b> Evidence of understanding of:</p> <ul style="list-style-type: none"> <li>■ the principles of momentum, heat and mass transfer and application to problems involving flowing fluids and multiple phases.</li> </ul> <p><b>Use 150–250 words</b></p>	
<p><b>1.1.3</b> Evidence of understanding of:</p> <ul style="list-style-type: none"> <li>■ the principles of equilibrium and chemical thermodynamics, and application to phase behaviour, to systems with chemical reaction and to processes with heat and work transfer.</li> </ul> <p><b>Use 150–250 words</b></p>	
<p><b>1.1.4</b> Evidence of understanding of:</p> <ul style="list-style-type: none"> <li>■ the principles of chemical and/or biochemical reaction and reactor engineering.</li> </ul> <p><b>Use 150–250 words</b></p>	

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1.2 Core chemical engineering – mathematical modelling and quantitative methods	
Assessment criteria	Applicant self-assessment
<p><b>1.2.1</b></p> <p>Evidence of:</p> <ul style="list-style-type: none"> <li>■ ability to apply, a range of appropriate tools such as dimensional analysis and mathematical modelling.</li> </ul> <p><b>Use 150–250 words</b></p>	<p>In the relevant box(es) below, provide details such as module descriptors (with learning outcomes and level) for qualifications and/or experiential understanding gained through work roles or projects.</p>
<p><b>1.2.2</b></p> <p>Evidence of:</p> <ul style="list-style-type: none"> <li>■ knowledge of the role of empirical correlation and other approximate methods and ability to apply these to engineering problems.</li> </ul> <p><b>Use 150–250 words</b></p>	
<p><b>1.2.3</b></p> <p>Evidence of:</p> <ul style="list-style-type: none"> <li>■ competency in the use of numerical and computer methods, including commercial software, for solving chemical engineering problems (detailed knowledge of computer coding is not required).</li> </ul> <p><b>Use 150–250 words</b></p>	

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1.3 Core chemical engineering – process and product technology	
This is a broad heading that includes: the 'unit operations' of separation and mixing; particle technology; equipment sizing and performance.	
Assessment criteria	Applicant self-assessment
In the relevant box(es) below, provide details such as module descriptors (with learning outcomes and level) for qualifications and/or experiential understanding gained through work roles or projects.	
<p><b>1.3.1</b></p> <p>Evidence of:</p> <ul style="list-style-type: none"> <li>■ ability to use basic chemical engineering principles to model the characteristics and performance of a range of typical mixing, separation, and similar processing steps for fluids, particulates and multi-phases.</li> </ul> <p><b>Use 150–250 words</b></p>	
<p><b>1.3.2</b></p> <p>Evidence of:</p> <ul style="list-style-type: none"> <li>■ ability to use the principles on which processing equipment operates to determine equipment size and performance of common items such as reactors, exchangers and columns.</li> </ul> <p><b>Use 150–250 words</b></p>	
<p><b>1.3.3</b></p> <p>Evidence of:</p> <ul style="list-style-type: none"> <li>■ ability to quantify the effect of processing steps on the state of the material being processed, and its transformation to the end product in terms of its composition, morphology and functionality.</li> </ul> <p><b>Use 150–250 words</b></p>	

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1.4 Core chemical engineering – systems	
Assessment criteria	Applicant self-assessment
<p><b>1.4.1</b></p> <p>Evidence of understanding of:</p> <ul style="list-style-type: none"> <li>■ the principles of batch and continuous operation and criteria for process selection.</li> </ul> <p><b>Use 150–250 words</b></p>	
<p><b>1.4.2</b></p> <p>Evidence of understanding of:</p> <ul style="list-style-type: none"> <li>■ the interdependence of elements of a complex system and ability to synthesise a conceptual process by combining steps into a sequence and applying analysis techniques such as balances (mass, energy) and pinch.</li> </ul> <p><b>Use 150–250 words</b></p>	
<p><b>1.4.3</b></p> <p>Evidence of ability to:</p> <ul style="list-style-type: none"> <li>■ determine the dynamic response to changes in a process, and ability to design measurement and control functions and determine their performance.</li> </ul> <p><b>Use 150–250 words</b></p>	

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1.5 Core chemical engineering – process safety	
Assessment criteria	Applicant self-assessment
<p><b>1.5.1</b> Evidence of:</p> <ul style="list-style-type: none"> <li>■ ability to identify the principal hazard sources in chemical and related processes (including biological hazards)</li> <li>■ knowledge of the principles of safety and loss prevention and their application for inherently safe design</li> <li>■ knowledge of the principles of risk assessment and of safety management, and ability to apply techniques for the assessment and abatement of process and product hazards</li> <li>■ ability to apply systematic methods for identifying process hazards (eg HAZOP) and for assessing the range of consequences (eg impact on people, environment, reputation, financial).</li> </ul> <p><b>Note: the total word limit for section 1.5.1 is 150–250 words</b></p>	<p>In the box below, provide details such as module descriptors (with learning outcomes and level) for qualifications and/or experiential understanding gained through work roles or projects.</p>

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1.6 Core chemical engineering – sustainability and economics	
Assessment criteria	Applicant self-assessment
<p><b>1.6.1</b></p> <p>Evidence of understanding of:</p> <ul style="list-style-type: none"> <li>■ the principles of sustainability (environmental, social and economic) and ability to apply techniques for analysing the interaction of process, product and plant with the environment and minimising adverse impacts.</li> </ul> <p><b>Use 150–250 words</b></p>	<p>In the relevant box(es) below, provide details such as module descriptors (with learning outcomes and level) for qualifications and/or experiential understanding gained through work roles or projects.</p>
<p><b>1.6.2</b></p> <p>Evidence of ability to:</p> <ul style="list-style-type: none"> <li>■ apply the principles of process, plant and project economics.</li> </ul> <p><b>Use 150–250 words</b></p>	

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## 2. Core chemical engineering practice

Chemical engineering practice is the practical application of chemical engineering skills, combining theory and experience, together with the use of other relevant knowledge and skills. You must understand the ways in which chemical engineering knowledge can be applied in practice, such as in: operations and management; projects; providing services or consultancy; developing new technology.

You should demonstrate high standards of appreciation and practice of Safety, Health and Environment (SH&E) in all aspects of your work.

Typical attainments include: possession of practical and laboratory skills relevant to chemical engineering; knowledge of the characteristics of particular equipment, processes or products; the ability to deal with technical uncertainty; appreciation of the sources and value of technical literature; awareness of the nature of intellectual property; facility in the use of appropriate codes of practice and industry standards.

Assessment criteria	Applicant self-assessment <b>In the relevant box(es) below, provide details such as module descriptors (with learning outcomes and level) for qualifications and/or experiential understanding gained through work roles or projects.</b>
<p><b>2.1</b></p> <p>Evidence of:</p> <ul style="list-style-type: none"> <li>■ knowledge and understanding of laboratory (or larger scale) practice, and ability to operate bench- (or larger) scale chemical engineering equipment.</li> </ul> <p><b>Use 150–250 words</b></p>	
<p><b>2.2</b></p> <p>Evidence of:</p> <ul style="list-style-type: none"> <li>■ ability to undertake well-planned experimental or plant work and to interpret, analyse and report on experimental or plant data.</li> </ul> <p><b>Use 150–250 words</b></p>	

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Assessment criteria	Applicant self-assessment <b>In the relevant box(es) below, provide details such as module descriptors (with learning outcomes and level) for qualifications and/or experiential understanding gained through work roles or projects.</b>
<p><b>2.3</b></p> <p>Evidence of:</p> <ul style="list-style-type: none"> <li>■ ability to find and apply, with judgement, information from technical literature and other sources.</li> </ul> <p><b>Use 150–250 words</b></p>	
<p><b>2.4</b></p> <p>Evidence of knowledge and understanding of:</p> <ul style="list-style-type: none"> <li>■ materials science and its application to the selection of materials of construction, corrosion protection etc.</li> </ul> <p><b>Use 150–250 words</b></p>	
<p><b>2.5</b></p> <p>Evidence of a basic understanding of:</p> <ul style="list-style-type: none"> <li>■ relevant elements from engineering disciplines commonly associated with chemical engineering, such as electrical power and motors; microelectronics; mechanics of pressure vessels; structural mechanics.</li> </ul> <p><b>Use 150–250 words</b></p>	

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### 3. Chemical engineering design & design practice

Chemical engineering design is the creation of a system, process, product or plant to meet an identified need. You must display competence in chemical engineering design, which requires bringing together technical and other skills, the ability to define a problem and identify constraints, the employment of creativity and innovation. You must understand the concept of 'fit for purpose' and the importance of delivery.

IChemE is keen to encourage innovation and diversity in design and to encourage a wide range of applications, which might include:

- process design – synthesis of unit operations into a manufacturing process to meet a specification
- process troubleshooting/debottlenecking – analysis of problems for an existing process for which the solutions require innovative process or equipment changes
- equipment design – the design of specific and complex equipment items to deliver a process or product objective, eg extruder, distillation column, etc
- product design
- product troubleshooting – analysis of problems for an existing product for which innovative solutions are required
- system design – where creativity, broad range thinking, and systems integration are needed to design a system to meet a specification, eg manufacturing supply chain, effluent handling system, transportation system, safety auditing system, recycling system, site utility system, product distribution system.

**Note: This section requires a single response, whether you've been asked to answer one or more of the questions in this section, using 200–400 words. Please cross-reference your answer to the corresponding question number. In the case of practical learning, it is acceptable (and often beneficial) to refer to more than one project undertaken.**

Assessment criteria	Applicant self-assessment
<p>Evidence of:</p> <p><b>3.1</b> understanding of the importance of identifying the objectives and context of the design in terms of: business requirements; technical requirements; sustainable development; safety, health and environmental issues; appreciation of public perception and concerns.</p> <p><b>3.2</b> understanding of design as an open-ended process, lacking a pre-determined solution, which requires: synthesis, innovation and creativity; choices on the basis of incomplete and contradictory information; decision making; working with constraints and multiple objectives; justification of choices and decisions taken.</p> <p><b>3.3</b> ability to deploy chemical engineering knowledge, using rigorous calculation and results analysis, to develop a design and with appropriate checks on its feasibility and realisability.</p> <p><b>3.4</b> ability to take a systems approach to design appreciating: complexity; interaction; integration.</p>	

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## Part B. Advanced chemical engineering

In answering the following sections, you need to demonstrate attainment at an advanced level with evidence of:

- ability to handle uncertainty and complexity
- ability to familiarise yourself with the new and unknown
- ability to develop innovative approaches
- some understanding of the limits of available technology and of the potential of new and emerging technology
- a broad understanding of related subjects.

In the context of the above, you should also demonstrate your understanding and practice of:

- the principles of sustainability (environmental, social and economic)
- the need for high ethical and professional standards and how they are applied to issues facing engineers.

This attainment should be demonstrated through a combination of 'depth' and 'breadth' - see each sub section's definition.

### 4.1 Advanced chemical engineering depth

'Depth' is advanced knowledge and understanding (ie at a more challenging level) for a selection of subjects within core chemical engineering, often in a specialist area (such as a specialist MSc degree or PhD).

Assessment criteria	Applicant self-assessment
<p><b>4.1.1</b></p> <p>Provide evidence of attainment of advanced chemical engineering 'depth' according to the criteria listed above in at least one of the following:</p> <ul style="list-style-type: none"> <li>■ chemical engineering fundamentals (thermodynamics, fluid flow, chemical/biochemical reactors, etc)</li> <li>■ modelling and quantitative methods</li> <li>■ process and product technology (processes and process equipment design and performance)</li> <li>■ chemical engineering systems (batch/continuous, integration, control, dynamics etc)</li> <li>■ process safety</li> <li>■ sustainability and process economics.</li> </ul> <p><b>Use 150–250 words</b></p>	

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4.2 Advanced chemical engineering breadth	
Assessment criteria	Applicant self-assessment
<p>Chemical engineering is a broad, multi-faceted and expanding discipline. In distinction to 'depth', 'breadth' is advanced knowledge and understanding in an area of chemical engineering in its widest sense (possibly a focus on a novel application of chemical engineering principles or a specific industry sector outside the candidate's usual area of work).</p>	<p><b>In the relevant box(es) below, provide details such as module descriptors (with learning outcomes and level) for qualifications and/or experiential understanding gained through work roles or projects.</b></p>
<p><b>4.2.1</b></p> <p>You should provide evidence of attainment of advanced understanding of chemical engineering in its broadest sense according to the criteria given above.</p> <p><b>Use 150–250 words</b></p>	
4.3. Advanced chemical engineering practice	
<p><b>4.3.1</b></p> <p>Evidence of:</p> <ul style="list-style-type: none"> <li>■ awareness of research and developments in relevant technologies and their potential impact of current practice and its limitations</li> <li>■ having undertaken research and/or development project work that provides opportunities for: application of research methods; originality and experience in dealing with uncertainty and new concepts and/or applications</li> <li>■ having communicated the outcomes of the project work in a professional manner that may include: thesis; publication; poster; presentation.</li> </ul> <p><b>Use 150–250 words</b></p>	

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#### 4.4 Advanced chemical engineering design & design practice

**Note:** This section requires a single response, whether you've been asked to answer one or more of the questions in this section, using 200–400 words. Please cross-reference your answer to the corresponding question number. In the case of practical learning, it is acceptable (and often beneficial) to refer to more than one project undertaken.

Assessment criteria	Applicant self-assessment
<p><b>4.4.1</b> Evidence of:</p> <ul style="list-style-type: none"> <li>■ ability to work with information that may be incomplete or uncertain, quantify the effect of this on the design and, where appropriate, use theory or experimental research to mitigate deficiencies.</li> </ul> <p><b>4.4.2</b> Evidence of having achieved within a design project(s) some of the 'depth' and 'breadth' (see previous definition) outcomes of advanced chemical engineering described beneath 'Part B' heading on page 13. For example:</p> <ul style="list-style-type: none"> <li>■ detailed design of control systems based on process dynamics</li> <li>■ design and operation aspects of start-up and shut-down</li> <li>■ design of a process for a novel product for which data are unreliable or limited</li> <li>■ environmental impact and life cycle analysis</li> <li>■ evaluation of financial and other risks.</li> </ul> <p><b>4.4.3</b> Evidence of:</p> <ul style="list-style-type: none"> <li>■ ability to apply and adapt design processes and methodologies in unfamiliar situations.</li> </ul>	<p>In the box below, provide details such as module descriptors (with learning outcomes and level) for qualifications and/or experiential understanding gained through work roles or projects.</p>