T-LEVELS | Institute for Apprenticeships & Technical Education

T Level Technical Qualification in Science

Occupational specialism assessment (OSA)

Laboratory Sciences

All assignments

Provider guide

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Contents

Introduction

This occupational specialism is assessed by a synoptic assessment consisting of a package of 3 assignments. The assignments require the student to independently apply an appropriate selection of knowledge, understanding, skills and techniques developed throughout the full course of study, in response to briefs or tasks. This will allow the student to demonstrate that they have met a level of threshold competence in the performance outcomes of the occupational specialism.

The synoptic assessment for this occupational specialism is graded by pass, merit or distinction, and the final grade will contribute 50% of the overall technical qualification grade. Therefore, it is important that students have the opportunity to produce work of the highest standard they can. The assignments within this synoptic assessment are designed to allow the student to do this in a way that is as occupationally realistic as possible.

What is threshold competence?

Threshold competence is defined as a level of competence that:

- signifies that a student is well-placed to develop full occupational competence with further support and development, once in employment
- is as close to full occupational competence as can be reasonably expected of a student studying the technical qualification in a provider-based setting with a substantial placement
- signifies that a student has achieved the level for a pass in relation to the relevant occupational specialism component

This level is reflected in the grading descriptors of the occupational specialism and successful completion of the assignments will ensure that students are well-placed to develop full occupational competence once in employment. Grading descriptors can be found in the technical qualification specification document.

What is synoptic assessment?

Synoptic assessment is a form of assessment in which students are required to demonstrate that they can identify and use, in an integrated way, an appropriate selection of skills, techniques, concepts, theories and knowledge from across the technical area, relevant to the tasks.

Synoptic assessment is integral to high-quality technical qualifications to allow students to demonstrate a holistic understanding of the sector, making effective connections between different aspects of the subject content.

The assignments and tasks in this assessment are designed to be synoptic in a way that is as occupationally realistic as possible.

How will students be assessed?

Students will be assessed against the following set of performance outcomes (POs) that describe what the student should be able to do.

Laboratory Sciences POs	
PO1	Perform a range of appropriate scientific techniques to collect experimental data in a laboratory setting, complying with regulations and requirements
PO2	Plan, review, implement and suggest improvements to scientific tasks relevant to a laboratory setting
PO3	Identify and resolve issues with scientific equipment or data errors

The synoptic assessment consists of 3 assignments:

Assignment 1

Perform a literature review surrounding a given problem that is relevant to an occupational setting. Carry out a literature search to determine suitable methods, and how to interpret results.

Students will be provided with an online information package of literature sources. They should search only these sources to find relevant material and to carry out the review.

Students should write a literature review which demonstrates how they have evaluated which literature to select for the task, including justifications for the literature selected.

Use this knowledge to design a scientific standard operating procedure (SOP) and related risk assessment (RA) that could be used to determine whether the new technique would offer an improvement over current process.

Select key information that will be needed to write the SOP and to interpret the results, for example:

- information that would help to inform the methods, techniques and equipment used
- how results are determined
- the results expected
- safety considerations

Comment on the quality and reliability of the information used.

Reference any sources of information.

Assignment 2

Perform 2 experimental techniques relevant to an occupational setting that will be assessed in terms of the student's ability to competently, accurately and safely perform the technical task to acquire the necessary data.

Assignment 3

Review a given set of experimental data/records to identify potential errors in either samples/equipment or usage of equipment by an operator. Identify the factors that could be contributing to any errors and suggest process improvements to rectify and prevent any errors identified.

Assignments are broken down into tasks where necessary. The assignments, tasks and associated guidance for students and tutors show how the assignments are expected to be delivered.

Evidence produced by students for the assignments will be sent to NCFE for marking. Assessment judgements, including overall judgement of the performance required at each of the grade boundaries, will be made by NCFE and results released to the provider at the appropriate time.

Assignment coverage

See the table at the end of this provider guide document which shows how the PO content is covered by the assignments and tasks.

Controls

There is a requirement for work completed under supervised conditions to be collected and securely stored, for controls in place to ensure that providers do not release materials to their students until the appropriate time (and that when they do release materials, they are retrieved as appropriate), and for tasks designed in ways that minimise any advantage students might gain by having prior knowledge of what they entail.

Where the occupational specialism assessments allow for research requiring the use of the internet, students must reference the sources in their work.

Marks available

Marks available for each assignment are detailed below.

Assignment		**Raw marks**	**% weighting**
1	Perform a literature review and develop a new SOP and RA to investigate a possible process improvement	102 marks	47.9%
2	Perform an experimental task relevant to an occupational setting	70 marks	32.9%
3	Assess a given set of scientific data to identify potential sources of error in the data and suggest improvements to rectify these errors	41 marks	19.2%
	Total	**213 marks**	**100%**

Assignment timings

Assignment 1 consists of 3 tasks which will take place within the provider setting. The time allocation for this assignment is 7 hours in total, divided as:

- task 1 involves a literature review in which students will be assessed on their ability to extract relevant information from literature within a searchable database given to providers - task 1 is allocated 3 hours
- the literature review will then be used by the student to support their development of task 2, designing a scientific task in an unfamiliar context and selecting appropriate equipment to complete a theoretical scientific practical - task 2 is allocated 3 hours
- task 3 will involve developing a risk assessment that would be followed alongside the student's scientific practical - task 3 is allocated 1 hour

A submission deadline for the evidence for assignment 2 will be set for each academic year to allow NCFE to carry out moderation and awarding before the release of results in the August of that year.

Assignment 2 consists of 2 practical tasks in which students will be assessed on their ability to safely and effectively carry out a given technique. Assignment 2 is allocated 6 hours in total, split across a part A and part B, 3 hours for each. It will be assessed by direct observation and through the student's written record from the practical activity. Assessors will be required to observe each student while completing their practical task.

This assignment will be released on a particular date each year for delivery over a set window. These dates will be set to allow providers time to plan the delivery of the assignments. Evidence for assignment 2 must be returned to NCFE for marking after completion.

For assignment 3, providers and students will be provided with a dataset and scenario in which the student is expected to identify potential sources of error in the dataset and suggest the origins of any errors, as well as suggesting methods for rectifying and preventing these errors in the future. Assignment 3 is allocated 3 hours.

Assignment 3 will be assessed via the student's written records and will be released on a particular date each year for delivery across a defined assessment window, for example, 1 week. These dates will be set to allow providers time to plan the delivery of the assignments.

All evidence created, generated and recorded for these assignments is subject to data protection rules, and information should be anonymised to protect the rights of individuals, where relevant.

Assignment specific guidance

Required material

The provided material (including a searchable database of literature) will be sent to providers ahead of the assessment window. Providers must issue the provided material to their students upon commencement of task 1.

Students are not allowed to bring outside research or any other unauthorised materials into the supervised environment.

Assignment 1: perform a literature review and develop a new SOP and RA to investigate a possible process improvement

This assignment is to be completed under supervised conditions over a period of 7 hours, split into 3 tasks, of duration 3 hours, 3 hours, and 1 hour respectively. The assignment will be completed during a week-long assessment window. The 1 week assessment window will be specified by NCFE.

Providers must ensure that their entire cohort of students complete the tasks at the same time.

Providers may schedule supervised rest breaks. Any rest breaks must be supervised, and students must not have access to any resources during this time. In addition, assessment materials must be kept securely between assessment sessions and must not be removed from the supervised environment by students.

Providers must ensure that during the supervised assessment, students have access to the provided searchable database of literature, as well as pro-forma sheets provided for developing their SOP and RA.

Students must not have access to the internet and must not bring anything into the supervised environment.

Students are required to sign declarations of authenticity to confirm that all of the work they complete during the supervised assessment is their own. Students must be made aware of the importance of this declaration and the impact this could have on their overall grade if malpractice was to be identified. Providers must also ensure that the students' work is authenticated by the tutor before it is submitted to NCFE for marking. The declaration forms are available on the NCFE website.

The assignment is a formal external assessment and must be conducted with reference to the instructions on the front of the assignment booklet, as well as the regulations for the conduct of external assessment and qualification specific instructions for delivery (QSID) documents, which should be accessed from www.qualhub.co.uk to ensure they are the most up-to-date versions.

Providers are not allowed to give any support or guidance to students during the supervised time.

Students must ensure that all materials can be identified as their own work.

Assignment 2: experimental practical assessments, part A and part B

Each part of this assignment must be completed under supervised conditions during an assessment window specified by NCFE. Providers will be given preliminary materials and details of the assignment ahead of the assessment window. The tasks will be something that will be achievable using standard laboratory equipment that should be available to providers as part of their delivery of the qualification.

Providers must ensure that their entire cohort of students complete the 3 hours for each part of this assignment in the same sessions. Task A is 3 hours and Task B is 3 hours; totalling 6 hours altogether.

Providers may schedule supervised rest breaks during the 3 hours. Any rest breaks must be supervised, and students must not have access to any resources during this time. In addition, assessment materials must be kept securely and must not be removed from the supervised environment.

Providers must ensure that during the supervised assessment, students have access to the required personal protective equipment, laboratory equipment and reagents necessary to complete the tasks.

Students must not have access to the internet and must not bring anything into the supervised environment.

Students are required to sign declarations of authenticity to confirm that all the work they complete during the supervised assessment is their own. Students must be made aware of the importance of this declaration and the impact this could have on their overall grade if malpractice was to be identified. Providers must also ensure that the students' work is authenticated by the tutor before it is submitted to NCFE for marking. The declaration forms are available on the NCFE website.

The assignment is a formal external assessment and must be conducted with reference to the instructions on the front of the assignment booklet, as well as the regulations for the conduct of external assessment and qualification specific instructions for delivery (QSID) documents, which should be accessed from www.qualhub.co.uk to ensure they are the most up-to-date versions.

Providers are not allowed to give any support or guidance to students during the supervised time, unless the students are operating in a manner which may endanger themselves or others. If this is required, this aspect of performance will be reflected in the mark scheme.

Students must ensure that all materials can be identified as their own work.

Space the students out evenly at a distance where it is not feasible for them to see other students' work in detail. Exam conditions should be followed during the assignment, and students should turn over their paper when leaving the workstation. Each individual student will have created their own SOP, and these need to be kept personal to them and not copied from or by other students.

Task 1 (a)

Each student will need one standard bench space area in order to carry out the experiment. The students will need to be distributed around the lab without any issues. One consideration is that the addition of the concentrated sulfuric (VI) acid must be carried out in a fume hood, which will likely mean a queue of students will form around this timepoint. However, this step will only take a minimal amount of time, so it is unlikely to cause too much of a delay to students.

Around 15 students will be able to be assessed at one time. The observation checklist provided will aid the assessor in assigning marks, with many of the observations being able to be performed at any point or continuously across the room. The exception to this would be the 'performed scientific techniques accurately', which would be observed during one of the stages in which a reagent is added to the mixture, and during the titration. However, an assessment of the student's ability to perform the technique correctly will be able to be observed by the assessor, and students will not be required to be observed throughout the whole procedure.

Additionally, there are multiple repeated steps, such as pipetting reagents into the mixture, that the protocol requires repeating in the same manner with different reagents, so only one of these would need to be observed by the assessor to be confident that the whole procedure has been performed correctly.

Equipment for task 1 (a)	Quantity	Special considerations
250 ml biochemical oxygen demand stoppered bottle	1 clean and dry bottle per sample	Ensure the bottles are 250 ml as the protocol instructs students to add 250 ml of sample. A bigger bottle will introduce oxygen if only 250 ml of sample is added and make the experiment invalid
1 cm^3 transfer pipette	2 per sample	N/A
2 cm^3 transfer pipette	2 per sample	N/A
Burette and burette stand	1 of each	N/A
Personal protective equipment		To be used and disposed of correctly

Task 1 (b)

Each student will need one standard bench space area in order to carry out the experiment. As such, the students will be distributed around the lab without any issues. However, it is likely that only a limited number of colorimeters will be available, which means that it is possible that a queue of students will form around this timepoint. This step may take up to 5 minutes to complete as each student will need to be able to record readings for all their samples, therefore time needs to be factored in to allow the students waiting to be able to complete their measurements.

Around 15 students will be able to be assessed at one time. The observation checklist provided will aid the assessor in assigning marks, with the majority of the observations being able to be performed at any point or continuously across the room. The exception to this would be the ‘performed scientific techniques accurately’, which would be observed during one of the stages in which Benedict's solution is added to one of the samples. However, an assessment of the student's ability to perform the technique correctly will be able to be observed by the assessor, and the students will not be required to be observed throughout the whole procedure. Additionally, there are multiple repeated steps, such as pipetting reagents into the mixture, that the protocol requires repeating in the same manner with different reagents, so only one of these would need to be observed by the assessor to be confident that the whole procedure has been performed correctly. The use of the colorimeter would also need to be monitored to ensure students are correctly inserting the cuvettes and taking readings correctly.

Equipment for task 1 (b)	Quantity	Special considerations
Test tubes	Minimum of 6 test tubes for calibration samples and 1 test tube for the unknown sample	A minimum of 6 known solutions should be used to create the calibration curve, but more than 6 is also acceptable

Test tube rack	1	Must be able to hold at least 7 samples and be able to be inserted into the water bath
1 cm^3 transfer pipette or syringe	2 per concentration (one for sample and one for Benedict's solution)	N/A
70 °C heated water bath	1	Multiple students will be able to share a single water bath
Cuvettes	1 clean and dry cuvette per sample	N/A
Colorimeter	1	Multiple students will be able to share a single colorimeter
Personal protective equipment		To be used and disposed of correctly

Assignment 3: assess a given set of scientific data to identify potential sources of error in the data and suggest improvements to rectify these errors

This assignment must be completed under supervised conditions over a period of 3 hours during a week-long assessment window. The 1 week assessment window will be specified by NCFE. Providers will be given the necessary datasets ahead of the assessment window.

Providers must ensure that their entire cohort of students complete the 3 hours for this assignment in the same session.

Providers may schedule supervised rest breaks during the 3 hours. Any rest breaks must be supervised, and students must not have access to any resources during this time. In addition, assessment materials must be kept securely and must not be removed from the supervised environment.

Students must not have access to the internet and must not bring anything into the supervised environment.

Students are required to sign declarations of authenticity to confirm that all the work they complete during the supervised assessment is their own. Students must be made aware of the importance of this declaration and the impact this could have on their overall grade if malpractice was to be identified. Providers must also ensure that the students' work is authenticated by the tutor before it is submitted to NCFE for marking. The declaration forms are available on the NCFE website.

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Providers are not allowed to give any support or guidance to students during the supervised time.

Students must ensure that all materials can be identified as their own work.

Assignment coverage

Assignment 1: perform a literature review and develop a new SOP and RA to investigate a possible process improvement

K2.1: How the following considerations inform the planning of laboratory procedures:

- developing a specific hypothesis, where appropriate for a scientific task
- translating the client objectives into the hypothesis
- identifying the most appropriate techniques for scientific task

K2.2: How to undertake literature searches and use scientific papers to plan scientific tasks

K1.1: How health, safety and environmental practices are applied when performing scientific techniques

K1.48: The factors to consider when choosing between a range of techniques

K1.52: When it is appropriate to use the following laboratory techniques:

- tissue culture to grow cells or tissues on a culture medium
- microbiology techniques
- aseptic culturing to analyse biological environments to confirm the presence of microorganisms
- cell counting methods to count/quantify number of cells present in a sample, including manual counting methods, such as using a haemocytometer or colony-forming unit (CFU) counting, or automated cell counting such as coulter counters or flow cytometry

K1.62: The importance of using appropriate reagents and raw materials to complete practical scientific tasks

K1.67: The purpose and importance of SOPs within the laboratory environment

K2.1 How considerations inform the planning of laboratory task

K2.3: The principles of laboratory method validation when planning scientific tasks

K2.4: The principles of laboratory equipment validation when planning scientific tasks

K2.5: The difference between concrete and abstract modelling techniques:

- concrete: a trial task prior to planning
- abstract: planning on paper or using computer simulations

K2.7: How to establish the validity of the results against standards and controls

K2.8: The purpose of the following data processing and analysis to support improvements in laboratory techniques:

- laboratory trend charts: to determine that laboratory equipment is working within specification, for example, colony-forming unit (CFU) data
- laboratory method validation results: revalidating methods if results are outside of specification

S2.15: Design a scientific task in an unfamiliar context, taking into consideration a range of factors

S2.16: Perform a literature review to extract relevant information to support planning

S2.17: Apply knowledge of scientific techniques to an unfamiliar context when planning a scientific task

S1.70: Complete a risk assessment to minimise potential hazards and risks when performing a scientific technique

Assignment 2: experimental practical assessment

K1.1: How health, safety and environmental practices apply to laboratory settings:

- safely performing the procedure
- completing the procedure

K1.49: The purpose of:

- analysing substances and chemical environments to confirm composition and/or quantity of materials

K1.50: Why the following techniques are used:

- titration, for example, purity analysis
- purity analysis and determining concentration

K1.53: The purpose of the following environmental laboratory techniques:

- biochemical oxygen demand (BOD) to determine the amount of dissolved oxygen needed by microorganisms in a water sample

K1.67: The purpose and importance of SOPs within the laboratory environment

K1.13: How to perform calculations for acid-base titrations based on mean titres, using n = cV and mass = n/Mr

K1.22: The oxidation and reduction process

K1.47: When scientific and mathematical skills may be applied when completing scientific tasks:

- measuring:
  - volume using a burette
- manual dexterity:
  - when using a pipette
- observing:
  - colour changes at titration end point
- analysing:
  - calculations

K1.63: The principles of producing reliable and verifiable results:

- recording in a clear and unambiguous way, such as the use of tables, indelible ink, not using sticky notes or loose papers and ensuring writing is legible
- using appropriate units, notation, and correct number of significant figures

K2.6: How the following considerations inform data processing and subsequent analysis of the results in a laboratory environment:

- regulatory requirements (for example, validation, conformity to known analytical standards)
- relevant calculations (for example, magnification and Rf values)
- conversion of units (for example, consistent use of units across different data sets)

- appropriate statistical techniques to determine the validity or significance of the results (for example, standard deviation, p-value, uncertainty values)
- customer requirements for the presentation of data (for example, graphs)
- using laboratory control charts and trend charts (for example, to confirm equipment and/or protocols are within tolerance)

K2.7: How to establish the validity of results against standards and controls:

- using certified reference material (CRMs)

S1.68: Work safely in a laboratory when performing specific scientific techniques

S1.69: Comply with relevant health and safety legislation and regulations, including COSHH and biosafety containment levels, when handling and disposing of solids, liquids and gases relevant for the scientific technique being performed

S1.71: Use appropriate PPE when performing scientific tasks, for example, suitable eye protection and gloves

S1.77: Use the following practical scientific techniques to analyse substances:

- acid-base and redox titration
- preparation of serial dilutions
- colorimetry
- selecting the appropriate filter
- zeroing the colorimeter using a cuvette containing the solvent only
- measuring the absorbance of a cuvette with test solution

S1.75: Apply a range of science and mathematical skills when performing practical scientific techniques

S1.85: Demonstrate practical technical competence in the use of equipment:

- taking accurate measurements
- correctly manipulating the equipment
- using equipment safely and for intended purpose

S1.87: Produce data from scientific techniques, which are reliable and verifiable

S2.19: Complete relevant calculations on data obtained in the laboratory environment

S2.22: Use the results of calculations and statistical analysis to interpret and evaluate data from scientific tasks

S2.23: Present data in an appropriate format

Assignment 3: assess a given set of scientific data to identify potential sources of error in the data and suggest improvements to rectify these errors

K3.3: The factors that can contribute to data errors (random or systematic) in a laboratory:

- contamination of samples or equipment
- incorrect sample storage
- working outside acceptable tolerances
- incorrect laboratory equipment used, for example, using the wrong sized pipette
- equipment not set up properly or used incorrectly
- method not followed, for example, standard operating procedure not followed
- transcription errors

K2.6: How the following considerations inform data processing and analysis of the results in a laboratory setting:

- appropriate statistical techniques to determine the validity of the results
- mean
- standard deviation
- chi-square test
- t-test

K3.4: How to minimise errors in scientific tasks

S2.20: Select appropriate statistical techniques to analyse and interpret results from scientific tasks

S2.21: Process results, using statistical software

S2.22: Use the results of calculations and statistical analysis to interpret and evaluate data from scientific tasks to:

- assess statistical validity
- draw conclusions

S2.23: Present data in an appropriate format:

- using appropriate statistical techniques, including the use of data from laboratory information management systems (LIMS)
- in a clear and unambiguous way, taking into account the level and experience of the audience and the purpose
- using technical language correctly, and using graphics and other tools to aid understanding
- using digital technology competently and confidently to produce, design and create charts and graphs:
    - line graphs
    - pie charts
    - bar chart
    - results tables
    - histogram
- organising data logically and coherently

S2.24 Use relevant information from online databases to review scientific tasks

S2.28 Review and modify a scientific method to improve the task

S3.10 Recognise when equipment is likely to be damaged or cause injury due to malfunction

S3.13: Identify when a random or systematic error has occurred in scientific tasks:

- gathering and interpreting data efficiently and in an appropriate format, for example, chart or graph
- comparing results against previous data

S3.14: Address non-routine problems with samples and instrumentation in a scientific task:

- identify the error
- quantify the error to determine if this is within the accepted tolerance
- remove or minimise the sources of error
- record the source of error and the action taken

S3.15 Take steps to minimise errors in scientific tasks following continuous improvement techniques

Performance outcome grids

Assignment 1

Task	PO1	PO2	PO3	Total
1	0	28	0	28
2	10	48	0	58
3	0	16	0	16
Total marks	10	92	0	102
% weighting	10%	90%	0%	100%

Assignment 2

Task	PO1	PO2	PO3	Total
1 (a)	23	0	0	23
1 (b)	12	0	0	12
Total marks	35	0	0	35
% weighting	100%	0%	0%	100%

Assignment 3

Task	PO1	PO2	PO3	Total
1	0	0	8	8
2	0	0	6	6
3	0	0	8	8
4	0	0	8	8
5	0	0	11	11
Total marks	0	0	41	41
% weighting	0%	0%	100%	100%

Document information

The T Level Technical Qualification is a qualification approved and managed by the Institute for Apprenticeships and Technical Education. NCFE is currently authorised by the Institute to develop and deliver the T Level Technical Qualification in Science.

Owner: Head of Assessment Design

Change History Record

Version	Description of change	Approval	Date of Issue
v1.0	Post approval, updated for publication.		January 2021
v1.1	NCFE rebrand.		September 2021
v1.2	OS review Feb 23		February 2023
v2.0	Annual review 2023 Update to task wording for clarity. 'You have three hours to complete tasks 1(a) and 1(b).' p8	June 2023	19 June 2023
v2.1	Sample added as a watermark	November 2023	20 November 2023