



# T Level Technical Qualification in Science

Occupational specialism assessment (OSA)

## Laboratory Sciences

Assignment 1

Mark scheme

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# Task 1

## Task 1 - literature review

Band	Mark	Descriptor
4	13–16	<p>The student has justified their selection of relevant literature based on a thorough evaluation of:</p> <ul style="list-style-type: none"> <li>the literature content, balancing the strengths and weaknesses, for example, ‘source A has good methods, but it would be very expensive and time consuming so overall the methods in source C would be better’</li> <li>the source (primary or secondary) of the literature, for example, whether it is from a reliable peer-reviewed journal</li> <li>the author, for example, whether it is written as an academic article by a scientist or a newspaper article written by a journalist</li> <li>commercial implications, for example, whether any competing interests are declared relating to the authors work for specific companies</li> <li>the science within it, for example, an assessment of sample sizes, potential biases or flaws in the methodology of the source, relating this and how it could impact the conclusions drawn and how this may need to be considered for the proposed task</li> <li>the quality and reliability of each piece of literature</li> <li>linking the analysis clearly to the purpose of the task</li> </ul> <p>The literature review overall is well-structured, laid out in a clear and professional manner and is accessible to a scientific audience.</p>
3	9–12	<p>The student has explained their selection of relevant literature based on:</p> <ul style="list-style-type: none"> <li>the literature content, referencing strengths and weaknesses</li> <li>the source (primary or secondary) of the literature</li> <li>the author</li> <li>commercial implications</li> <li>the science within it, relating this and how it could impact the conclusions drawn and how this may need to be considered for the proposed task</li> <li>the quality and reliability of each piece of literature</li> <li>linking the explanation to the purpose of the task</li> </ul> <p>The literature review overall explains their selection of relevant literature, but justification may sometimes be weak.</p>
2	5–8	<p>The student has described their selection of literature based on most of the following:</p> <ul style="list-style-type: none"> <li>the literature content, to include some strengths and weaknesses</li> <li>the source (primary or secondary) of the literature</li> <li>the author</li> <li>the science within it, with some considerations of how this might impact the task</li> <li>the quality and reliability of each piece of literature</li> <li>linking the description to the purpose of the task, although some elements may have limited detail</li> </ul> <p>The description may lack some detail of the advantages or disadvantages of the literature that</p>

Band	Mark	Descriptor
		was selected or rejected.
1	1–4	<p>The student has listed their selection of literature based on:</p> <ul style="list-style-type: none"> <li>the literature content, to include limited strengths and weaknesses</li> <li>some mention of the science with reference to how this might impact the task</li> <li>some reference to the quality and reliability of each piece of literature</li> </ul> <p>The list may be supported by assertions or general reasons, for example, “I chose source A because they have been used before”, rather than occupational knowledge in context.</p>
0	0	No creditworthy material or describes any performance that would automatically warrant 0 marks.

### Task 1 - creation of a SOP

Band	Mark	Descriptor
4	10–12	<p>The student has selected all the key information needed to write the SOP at an evaluative level, taking into account:</p> <ul style="list-style-type: none"> <li>the strengths and weaknesses of techniques and methods for a thorough assessment of the bacteriological quality of raw milk, including cost and practicability</li> <li>methods that are highly likely to provide an accurate and reliable analysis of results that are informative</li> <li>alterations that might be needed to address the task, for example, if sampling techniques would be different, such as if in the literature surfaces were swabbed</li> </ul> <p>All relevant safety considerations have been considered.</p>
3	7–9	<p>The student has selected most of the key information needed to write the SOP at an explanatory level, to include:</p> <ul style="list-style-type: none"> <li>the strengths and weaknesses of techniques and methods for a relevant assessment of the bacteriological quality of raw milk, including cost and practicability</li> <li>methods that are likely to provide an accurate and reliable analysis of results that are useful</li> </ul> <p>All relevant safety considerations have been considered.</p>
2	4–6	<p>The student has selected some key information needed to write the SOP at a descriptive level, to include:</p> <ul style="list-style-type: none"> <li>potential methods and techniques that are relevant to the assessment of the bacteriological quality of raw milk</li> <li>methods of results analysis that are likely to provide some useful results but could be better developed - for example, if they state they would count the colonies but did not also reference that a control plate would be required to identify any improvements within the process/contamination</li> </ul> <p>All relevant safety considerations have been considered.</p>

Band	Mark	Descriptor
1	1–3	The student has selected some key information needed to write the SOP based on a list of potential methods and techniques that show some relevance to the task but may not yield sufficient or relevant results to inform the identified problem, for example, if they state they would measure the quantity of bacteria which grew on a plate but offered no details about how they would be expected to count colonies and compare between groups.
0	0	No creditworthy material or describes any performance that would automatically warrant 0 marks.

### Indicative content

The student has selected sources with academic or scientific backgrounds and has evaluated different factors of each method such as the expense, availability of resources and practicality.

Students have extracted the correct information from the sources and used the Harvard referencing system. For example, any sources which are irrelevant would have not been included, or an explanation given that the information contained is not relevant or would provide inaccurate results.

Students will indicate the validity of the resource based on its primary data or secondary data, the author/authors of the source material and the publishing information.

Perform a literature review to extract relevant information to support the planning of a scientific task by assessing the quality and reliability of the information accessed.

Identify when a random or systematic error has occurred in scientific tasks by gathering and interpreting data efficiently, and in an appropriate format, such as a chart or graph, and comparing results against previous data.

### Content mapping:

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 a scientific task

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

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

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

## Task 2

### Task 2 - producing a hypothesis

Band	Mark	Descriptor
3	7–9	The student has: Produced a hypothesis which includes a logical and well-justified explanation of how to test the growth of colony forming units using the 2 different storage techniques.
2	4–6	The student has: Produced a hypothesis that contains a description of what is to be tested, how it is to be tested and assessed; however, some areas may not be fully developed.
1	1–3	The student has: Produced a hypothesis that lists some general statements or assertions (rather than demonstrating occupational knowledge in context) about how testing can support it or not.
0	0	No creditworthy material or describe any performance that would automatically warrant 0 marks.

#### Indicative content

Explaining how the selected technique for assessing the quality of the milk, such as serial dilutions of samples plated out onto bacteriological agar plate, will draw a valid conclusion that would meet the demands of the client. For example, a comparison of the number of colonies between each plate at each dilution, with this information plotted out to compare the 2.

Explaining the controls that are required and the experimental sample, such as a negative control, including water, for example. The previous storage technique could be considered a positive control.

### Task 2 - list of equipment

Band	Mark	Descriptor
3	6–9	The student has: Produced a clear and complete list of equipment and reagents required, which is sufficient to allow for the successful completion of their defined task without the need for any further additions or alterations.

Band	Mark	Descriptor
2	4–6	The student has: Produced a list of the equipment and reagents required but some minor elements may be missing which would need to be added in for successful completion of the task as per their SOP in the lab. An example of this would be a Bunsen burner or similar equipment that is not necessary for completion of the task, but it would need to be included to perform the task fully and correctly.
1	1–3	The student has: Produced a list of the equipment and reagents but some elements are missing that would need to be added in for successful completion of the task as per their SOP in the lab, for example, some minor elements may be missing but the core key elements, such as samples, plates and an incubator are included.
0	0	No creditworthy material or describes any performance that would automatically warrant 0 marks.

### Indicative content

Depending on the exact technique selected this list would likely include the 2 samples to be assessed:

- bacteriological agar plates
- pipettes
- bacteriological spreaders
- an appropriate buffer/media for diluting the samples, for example, LB broth or PBS
- an incubator set at an appropriate temperature (37°C, though other temperatures could be used if justified)
- appropriate PPE
- Bunsen burner

### Task 2 - safe working practices

Band	Mark	Descriptor
4	10–12	The student has: Written the full range of safe working procedures, with no instructions that would be hazardous to the operator or those around them, and the instructions are entirely clear, accessible, prominent, and well-structured.
3	7–9	The student has: Written the full range of safe working procedures, with no instructions that would be hazardous to the operator or those around them, and the instructions are generally clear and accessible, although the reader may not find these instructions immediately prominent and the structure of procedures not entirely clear.

Band	Mark	Descriptor
2	4–6	The student has:  Written most of the relevant and critical safe working procedures with no instructions that would be hazardous to the operator or those around them, the content may lack some structure, and take the reader a while to navigate and understand.
1	1–3	The student has:  Written some of the relevant and critical safe working procedures with no instructions that would be hazardous to the operator or those around them, but the content lacks structure, may be difficult to find, and potentially ambiguous or challenging for the reader to understand.
0	0	No creditworthy material or more than one safe working procedure has been omitted.

### Task 2 - writing the SOP

Band	Mark	Descriptor
4	13–16	The student has:  Written a SOP which is entirely fit for the purpose in addressing the set task, including comprehensive details that allow a user with no prior knowledge of the techniques to carry out the protocol successfully.  Explained each required step as an individual step with the clear and relevant detail, set out in a logical manner to facilitate completion of the protocol.
3	9–12	The student has:  Written a SOP which is relevant for addressing the set task, including most details that would allow a user with no prior knowledge of the techniques to carry out the protocol successfully.  Described each required step to facilitate completion of the protocol, with sufficient detail though there may be some detail that could be developed, for example, if certain steps that should be differentiated into 2 steps are combined into one.
2	5–8	The student has:  Written a SOP which is relevant for addressing the set task, including some details that would allow only a user with prior knowledge and experience of the techniques to carry out those parts of the protocol.  Described most required steps to facilitate task completion, with sufficient detail for all potential users, although one or 2 steps are not sufficiently described for a non-experienced user, for example, how to plate out the sample may require additional simple information, such as details on both the volumes to use and how to spread onto the plate.

Band	Mark	Descriptor
1	1–4	<p>The student has:</p> <p>Written a SOP which has some relevance for addressing the set task, including details that would allow only a user with prior knowledge and experience of the techniques to carry out the protocol.</p> <p>Attempted to lay out their SOP in a step-by-step manner, however, some steps may be unclear, incomplete, or not in the correct order, resulting in an SOP that is difficult to follow in order to complete the protocol.</p>
0	0	No creditworthy material

### Task 2 - methods for analysis

Band	Mark	Descriptor
3	9–12	<p>The student has:</p> <p>Explained clearly and sufficiently an efficient method for analysing and interpreting the results to enable an operator to draw clear conclusions in relation to the stated hypothesis.</p> <p>Provided a well-structured explanation of how the 2 storage methods will be compared, including detail of presenting the results, for example, in a table or plotting out the number of colonies on each dilution to produce a line graph, and any statistical tests that may be relevant.</p>
2	5–8	<p>The student has:</p> <p>Described a method for analysing and interpreting the results to enable the operator to draw a conclusion relevant to the stated hypothesis.</p> <p>Provided a relevant description of how the 2 storage methods will be compared, including some details for presenting the results.</p>
1	1–4	<p>The student has:</p> <p>Identified a method for analysing and interpreting the results, though there may be some elements of this which are unclear, for example, it not being immediately obvious which data point should be recorded where, or the student states to plot a graph but gives no information on the type of graph that would be best suited.</p>
0	0	No creditworthy material.

### Indicative content

Explaining how the selected technique for assessing the quality of the milk, such as, serial dilutions of samples plated out onto bacteriological agar plates will draw a valid conclusion that would meet the demands of the client; for example, a comparison of the number of colonies between each plate at each dilution, with this information plotted out to compare the 2.

Explaining the controls required and the experimental sample, such as a negative control, including water, for example. The previous storage technique could be considered a positive control.

The method selected will allow produce a large enough sample for the results to be valid. The student will evaluate the reliability of the method with the equipment available in a lab.

**Content mapping:**

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 scientific 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 a 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

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 of a scientific task

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

## Task 3

### Task 3 - completing the risk assessment

Band	Mark	Descriptor
4	13–16	The student has: Accurately evaluated all the relevant risks, demonstrating a clear understanding of priority (hierarchy of risk). They have suggested safe, feasible and realistic measures for controlling the risks to minimise their potential impact and provided a logical and valid reason why these control measures would help to minimise identified risks.
3	9–12	The student has: Explained all the relevant risks, demonstrating some awareness of the hierarchy of risk. They have described safe and feasible measures for controlling risks to minimise their potential impact, with some explanations of why control measures were chosen.
2	5–8	The student has: Described all the relevant risks and identified safe and feasible control measures for these, although some elements could be further developed, for example, if they suggest wearing appropriate PPE but do not specify which PPE would be appropriate for the procedure.
1	1–4	The student has: Identified most of the relevant risks and identified some feasible control measures, although measures may not always be practicable or realistic, and risks are treated the same, with little or no awareness demonstrated of more important and less important risks (risk hierarchy).
0	0	No creditworthy material.

#### Indicative content

Fully and correctly assessed all identified risks, comprehensively explaining the risk and the likelihood of the risk arising, such as, what the consequences would be were it to go wrong, as well as who would be likely to be harmed by any risk, for example, the operator, others in the vicinity, only those who are pregnant, and the potential impact on environment if inappropriate disposal is undertaken.

Analysed all the risks that could reasonably be expected to arise from the associated protocol, for example, working with biological materials, use of Bunsen burners, and potential release of pathogens into the environment.

The risk assessment would include all the relevant hazard labels and may include details about control of substances hazardous to health (COSHH) or health safety and the environment (HSE), and how to dispose of biological hazards. The risk assessment would also give details on the hazard factors, such as how biological pathogens can cause harm to respiratory system.

#### Content mapping:

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

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

## Performance outcome grid

<b>Task</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>TOTAL</b>
<b>1</b>	0	28	0	28
<b>2</b>	10	48	0	58
<b>3</b>	0	16	0	16
<b>Total marks:</b>	10	92	0	102
<b>Percentage weighting</b>	10%	90%	0%	100%

## Document information

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## 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