T-LEVELS | Institute for Apprenticeships & Technical Education

T Level Technical Qualification in Science

Occupational specialism assessment (OSA)

Laboratory Sciences

Assignment 1

Mark scheme

v1.1: Additional sample material
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Contents

Task 1

Task 1: literature review

Band	Mark	Descriptor
4	13–16	The student has justified their selection of relevant literature based on a thorough evaluation of: • the literature content, balancing the strengths and weaknesses • the source (primary or secondary) of the literature • the author and their expertise • commercial implications • the science within the source • the quality and reliability of each piece of literature • linking the analysis clearly to the purpose of the task An appropriate referencing system (such as Harvard referencing) is used. The literature review overall is well-structured, laid out in a clear and professional manner and accessible to a scientific audience.
3	9–12	The student has explained their selection of relevant literature based on: • the literature content, referencing strengths and weaknesses • the source (primary or secondary) of the literature • the author • commercial implications • the science within it • the quality and reliability of each piece of literature • linking the explanation to the purpose of the task An appropriate referencing system is used. The literature review overall explains their selection of relevant literature, but justification may sometimes be weak.

Band	Mark	Descriptor
2	5–8	The student has described their selection of literature based on most of the following: • the literature content, to include some strengths and weaknesses • the source (primary or secondary) of the literature • the author and their area of expertise • commercial implications • the science within it • the quality and reliability of each piece of literature • linking the description to the purpose of the task, although some elements may have limited detail An appropriate referencing system is used, however with inconsistencies in accuracy. The description may lack some detail of the advantages or disadvantages of the literature selected or rejected.
1	1–4	The student has listed their selection of literature based on: • the literature content, to include limited strengths and weaknesses • some mention of the science with reference to how this might impact the task • some reference to the quality and reliability of each piece of literature An appropriate referencing system is used; however it is not completed correctly. 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.
0	0	No creditworthy material or describes any performance that would automatically warrant 0 marks.

Task 1: selection of literature resources in creation of a standard operating procedure (SOP)

Band	Mark	Descriptor
4	10–12	The student has selected all the key information needed to write the SOP at an evaluative level, taking into account: • the strength and weakness of the technique chosen for assessment of the Gram status of bacterial samples through the Gram staining procedure which includes practicability • methods that are highly likely to provide an accurate and reliable analysis of results that are informative • alterations that might be needed to address the task, for example, substitution of component pieces of apparatus, such as a Bunsen burner rather than a heated stage to fix the samples All relevant safety considerations have been considered.
3	7–9	The student has selected most of the key information needed to write the SOP at an explanatory level, to include: • the strengths and weaknesses of techniques and methods for a relevant assessment of the Gram status of bacterial samples through the Gram staining procedure including practicability • methods that are likely to provide an accurate and reliable analysis of results that are useful All relevant safety considerations have been considered.
2	4–6	The student has selected some key information needed to write the SOP at a descriptive level, to include: • potential methods and techniques that are relevant to the assessment of the Gram status of bacterial samples through the Gram staining procedure • methods of results analysis that are likely to provide some useful results but could be better developed, for example, if they state they would examine the stained bacteria but make no reference to how the stain should be interpreted All relevant safety considerations have been considered.

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 stated they would examine the bacteria but do not fully explain how the staining would be done.
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 availability of resources and practicality
- the literature content, balancing the strengths and weaknesses, for example, 'source A provides a good protocol instructing how to perform Gram stains and assess the staining to identify different types of bacteria, whereas source C describes what Gram stains are used for in general'
- the source (primary or secondary) of the literature, for example, whether it is from a reliable peer-reviewed journal
- commercial implications, for example, whether any competing interests are declared relating to the author's work for specific companies
- 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
- the student has considered the background and context of the sources for example, whether it is written as an academic article by a scientist, or a newspaper article written by a journalist
- the student has extracted the correct information from the sources and used an appropriate referencing system, for example, any irrelevant sources would have not been included, or an explanation given that the information contained is not relevant or would provide inaccurate results
- the student 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

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 determine the Gram status of bacteria present in a sample.
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

Students have explained how the selected Gram staining technique for the sample of bacteria will determine the Gram status of bacteria present in a sample and will draw a conclusion for the clinician requesting the analysis.

Task 2: list of equipment

Band	Mark	Descriptor
3	7–9	The student has: Produced a clear and complete list of equipment and requirements, which is sufficient to allow for the successful completion of their defined task without the need for any further additions or alterations.
2	4–6	The student has: Produced a list of the equipment 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: alcohol for ensuring the slides are clean prior to the addition of the sample.
1	1–3	The student has: Produced a list of the equipment 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, a Bunsen burner for fixing the stain.
0	0	No creditworthy material or describes any performance that would automatically warrant 0 marks.

Indicative content

Student correctly identifies how to perform a Gram stain, including the equipment required and necessary steps:

- light microscope fitted with a 40x air lens and a 100x oil immersion lens
- microscope slides
- cultures
- Bunsen burner
- alcohol for cleaning slides
- crystal violet
- Gram’s iodine solution
- acetone/ethanol (50:50 v/v)
- 0.1% basic fuchsin solution
- water

Task 2: safe working practices

Band	Mark	Descriptor
4	10–12	The student has: Written the full range of safe working procedures. There are **no** instructions that would be hazardous to the operator or those around them. The instructions are entirely **clear**, **accessible**, **prominent**, and **well-structured**.
3	7–9	The student has: Written the full range of safe working procedures. There are **almost no** instructions that would be hazardous to the operator or those around them, the instructions are **generally clear** and **accessible**, although the reader may not find these instructions immediately prominent. The structure of procedures is not entirely clear.
2	4–6	The student has: Written **most** of the relevant and critical safe working procedures with **very few** 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 **few** instructions that would be hazardous to the operator or those around them. The content **lacks** structure, **appropriate content** may be difficult to find. The content is 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 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.
1	1–4	The student has: 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. 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 a SOP that is difficult to follow in order to complete the protocol.
0	0	No creditworthy material or describes any performance that would automatically warrant 0 marks.

Indicative content

- explains how the Gram stain works by differential staining of the lipid bilayer in Gram-positive and Gram-negative bacteria
- explains how the technique differentiates between different species of bacteria, and how these could be used to direct treatment, identifying how different bacterial species will have distinct morphologies as well as staining patterns

Task 2: methods for analysis

Band	Mark	Descriptor
3	9–12	The student has: 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. Provided a detailed description of the morphology of different bacteria and their staining patterns. Analysed how these results can then be used to determine what the causative infection agent is.
2	5–8	The student has: Described a method for analysing and interpreting the results to enable the operator to draw a conclusion relevant to the stated hypothesis. Provided a clear description of the morphology of different bacteria and their staining patterns. Explained how these results can then be used to determine what the causative infection agent is.
1	1–4	The student has: 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 how different species of bacteria will be identified Provided a limited description of the morphology of different bacteria and their staining patterns Identified how these results can then be used to determine what the causative infection agent is
0	0	No creditworthy material.

Indicative content

- for the method selected, the differences in staining and morphology of different species of bacteria have been identified, allowing for the correct determination of species when examining the slides

- the student evaluates how the equipment available in their laboratory is capable of producing results that are valid; the use of control slides to ensure that the procedure has worked as required is considered

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:

- differential staining to identify microorganisms (for example, Gram staining to identify Gram negative or Gram positive)

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

S1.73 Apply scientific knowledge when undertaking scientific techniques by:

- choosing and justifying appropriate scientific techniques:
    - differential staining techniques: characteristics of microorganisms (for example cell wall components by Gram staining)

S1.78 Use the following practical scientific techniques to analyse environments and identify microorganisms within biological environments:

- differential staining techniques:
    - preparing the slide and introducing the smear, using aseptic technique
    - fixing the smear (for example, heat fix)
    - applying stains and rinses in the correct order
    - examining the smear using a light microscope and identifying if bacteria are Gram-positive (violet in colour) or Gram-negative (pink in colour)

S1.84 Select appropriate equipment to complete practical scientific techniques:

- light microscope
- heating apparatus

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

The student has considered:

- health and safety in the workplace
- health and safety standards for working with bacterial samples
- they have 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 the environment if inappropriate disposal is undertaken
- 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 biohazardous material

Content mapping:

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

K1.3 The principles of the 'Universal Ethical Code for Scientists 2007' and how it affects ethical practices in a laboratory setting

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

- differential staining (microorganisms)

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

step 1 – identifying the hazards, taking account of warning symbols and using model risk assessments:

  - chemical (for example, compressed gases, cleaning agents)
  - biological (for example, biological samples)
  - physical (for example, repetitive tasks, noise levels)

- step 2 – assessing the risks:
  - how likely is the scientific technique to go wrong?
  - who might be harmed?
  - what could be the consequences?
- step 3 – evaluating the risks and selecting control measures:
  - identifying alternate or safer methods than those proposed (for example, using a different concentration of chemicals)
  - identifying the appropriate PPE to use
- step 4 – recording findings, following the risk assessment, and amending the control measures as necessary:
  - in a clear and unambiguous way
  - using technical language correctly
  - organising the findings logically and coherently
  - using the appropriate vocabulary, spelling and grammar
- step 5 – reviewing risk assessment and modifying method where required

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

Performance outcome (PO) grid

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
Percentage weighting	9%	91%	0%	100%

Document information

Owner: Head of Assessment Design

Change History Record

Version	Description of change	Approval	Date of issue
v1.0	Additional sample material		01 September 2023
v1.1	Sample added as watermark	November 2023	20 November 2023