T Level Technical Qualification in Science

Occupational specialism assessment (OSA)

Laboratory Sciences

Assignment 1

Mark scheme

V1.0 P001945
Summer 2023
603/6989/9

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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(for example, 'X has good descriptions of measurements of radioactivity, the radiation levels and the isotopes found, but the article is produced by an environmental action group so has the potential for bias. Y on the other hand contains reports of changes in radioactive contamination and changes over time…' • the source (primary or secondary) of the literature, for example, whether it is from a reliable peer-reviewed journal • the author, for example, whether it is written as an academic article by a scientist or a newspaper article written by a journalist • commercial implications, for example, whether any competing interests are declared relating to the authors work for specific companies • the science within the literature (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 quality and reliability of each piece of literature The analysis of the literature is clearly linked to the purpose of the task. An appropriate referencing system is used. The literature review overall is well-structured, laid out in a clear and professional manner and is 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 the literature, relating this and how it could impact the conclusions drawn, and how this may need to be considered for the proposed task • the quality and reliability of each piece of literature The explanation of the literature is linked to the purpose of the task. An appropriate referencing system is used. Overall, the literature review explains their selection of relevant literature, but justification may sometimes be weak.

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 • the science within it, with some considerations of how this might impact the task • the quality and reliability of each piece of literature The description of the literature is linked 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 that was selected or rejected.
1	1–4	The student has listed their selection of literature based on: • the literature content, including 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 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 a thorough assessment of the contaminated samples of spinach, which includes practicability and potential cost escalations • 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 bench top Geiger counter for a computer data logging system 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 contaminated spinach samples including cost and 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 contaminated spinach samples • methods of results analysis that are likely to provide some useful results but could be better developed All relevant safety considerations have been considered.
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 radiation but offer no details about how they might eliminate error due to background radiation.
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 an appropriate referencing system. For example, any sources that are irrelevant 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.

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 the planning of 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 that includes a logical and well-justified explanation of how to test the radioactive count rate of spinach leaves collected from the Fukushima Daiichi prefecture, including effective use of literature sources.
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 technique for determining radioactive count rate of spinach leaves, depending upon the type of Geiger-Müller tube and associated counter, will draw a valid conclusion that would meet the demands of the client. For example, drawing samples from around the laboratory, discounting those readings that may be unusually high due to specific emitters such as smoke detectors.

Students have explained the controls that are required to determine an accurate background radiation value and how this impacts the result determined for the radioactive count rate in spinach leaves.

Students know about alpha, beta and gamma emissions from radioactive sources.

Students know about the inverse square rule for radioactive emissions and how distance must be controlled

Task 2: list of equipment

Band	Mark	Descriptor
3	7–9	The student has produced a clear and complete list of equipment, including any calibration and set up requirements and the power source required, 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 and the power source required but some minor elements may be missing that would need to be added in for successful completion of the task as per their standard operating procedure (SOP) in the lab, for example, a high voltage power pack allowing power potential differences of 200 to 600V.
1	1–3	The student has produced a list of the equipment and the power source required 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, power leads.
0	0	No creditworthy material or describes any performance that would automatically warrant 0 marks.

Indicative content

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

- a high voltage power pack/scalar
- a counter
- a Geiger-Müller tube
- timer (digital)
- a data logging system
- samples of spinach including control sample

The apparatus and counting very much depends on the type of equipment selected.

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.
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 selected all the key information needed to write the SOP at an evaluative level, taking into account: • the strengths and weaknesses of techniques and methods for a thorough assessment of the background radiation in the laboratory and the radioactive count rate of spinach leaves • effective use of literature, for example consideration of 'dead time' within the apparatus • 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, if different apparatus was used or different sampling techniques to overcome variance within background radiations, such as if there were multiple americium smoke detectors All relevant safety considerations have been considered.
3	9–12	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 background radiation and the radioactive count rate of spinach leaves in a laboratory, including practicability

		• methods that are likely to provide an accurate and reliable analysis of results that are useful • inclusion of suggestions as to why readings may be significantly different to other readings, for example, readings that may have been caused by fixtures or fittings that are themselves low level radioactive emitter All relevant safety considerations have been considered.
2	5–8	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 background radiation and the radioactive count rate of spinach leaves in a laboratory • methods of results analysis that are likely to provide some useful results but could be better developed, for example, omission of suggestions as to why readings may be significantly different to other readings All relevant safety considerations have been considered.
1	1–4	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.
0	0	No creditworthy material or describes any performance that would automatically warrant 0 marks.

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 how mean and standard deviation are calculated, has allowed for dead time based on the literature review and has subtracted mean background radiation • analysed how these results can then be used to determine whether the samples are significantly contaminated
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 how mean and standard deviation are calculated, and has subtracted mean background radiation • explained how these results can then be used to determine whether the samples are significantly contaminated

1	1–4	The student has: • identified a method for analysing and interpreting the results, though there may be some elements of this that 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 • provided a limited description of how mean and standard deviation are calculated, and has subtracted mean background radiation • identified how these results can then be used to determine whether the samples are significantly contaminated
0	0	No creditworthy material.

Indicative content

For the method selected, the number of tests carried out on each sample is sufficiently large to allow the result to be considered valid.

The student evaluates how the equipment available in their laboratory is capable of producing results that are valid.

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

K1.67: 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

S2.15: Design a scientific task to address a particular hypothesis, taking into consideration a range of factors

S2.16: Perform a literature review to extract relevaspelnt 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 personal protective equipment (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 (hierarchy of risk).
0	0	No creditworthy material.

Indicative content

The student has considered:

- health and safety in the workplace
- health and safety standards for working with ionising radiation
- how to construct a risk assessment and consequences in accordance with 2019 Radiation Emergency Preparedness and Public Information Regulation

They have fully and correctly assessed all identified risks, comprehensively explaining the risk and the likelihood of the risk arising, 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, those who are pregnant, and the potential impact on environment if inappropriate disposal is undertaken).

The risk assessment includes 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 radioactive hazards. The risk assessment would also give details on the hazard factors, such as how sources of ionising radiation can cause harm to the body system. For example:

- radiation
- knowledge of alpha, beta, and gamma radiation
- knowledge of background radiation

- understanding of penetrative power of each type of ionising radiation
- knowledge of the potential effects of ionising radiation on the body
- knowledge of units of radiation to include Becquerels and Sieverts

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 and biosafety containment levels, when handling and disposing of solids, liquids and gases relevant for the scientific technique being performed including:

- radioactive materials

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 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	10%	90%	0%	100%

Document information

Owner: Head of Assessment Design