

# T Level Technical Qualification in Science

Occupational specialism assessment (OSA)

## Metrology Sciences

Assignment 1

Mark scheme

v1.3: Specimen assessment materials  
21 November 2023  
603/6989/9

Internal reference: SCI-0011-02

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# Metrology Sciences

## Mark scheme

Assignment 1

## Contents

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# Task 1

## Assessor observation checklist

### PO1, PO2 and PO4

Criteria	Essential criteria (all essential criteria must be awarded to pass)	Assessor check	Marks awarded
Selected 2 suitable pieces of equipment from each department. Guidance: suitable means suitable for the task.	Yes		1 mark for selecting 6 pieces 1 mark for 2 suitable pieces from each department <b>(maximum 2 marks)</b>
Inspected each piece of equipment in respect of overall condition. Results recorded for later reporting.	Yes		1 mark for 2 items inspected and result of overall condition recorded <b>(maximum 3 marks)</b>
Inspected each piece of equipment in respect of units. Results recorded for later reporting.	No		1 mark for 2 items inspected and results recorded <b>(maximum 3 marks)</b>
Inspected each piece of equipment in respect of markings and calibration marks. Results recorded for later reporting.	No		1 mark for 2 items inspected and results recorded <b>(maximum 3 marks)</b>
Applied safe handling requirements for equipment, including the use of personal protective equipment if required.	Yes		1 mark
Maintained health and safety of the workstation throughout, for example, maintained organisation of all equipment being used, safe use of any chemicals or electrical equipment, appropriate handling of all equipment and tools.	Yes		1 mark

Criteria	Essential criteria (all essential criteria must be awarded to pass)	Assessor check	Marks awarded
Completed all required preparation tasks on the equipment, such as cleaning, fixturing, or clamping.	No		1 mark for preparation of equipment 1 mark for cleaning equipment 1 mark for clamping/securing equipment <b>(maximum 3 marks)</b>
Cleaned up the workstation and appropriate surfaces following the completion of the inspection, returned all equipment to storage location, disposed of any waste product appropriately.	No		1 mark for cleaning workstation and surfaces 1 mark for return/storage of equipment used and/or any disposal of waste <b>(maximum 2 marks)</b>
Total marks			18 marks

## PO1 and PO2

Band	Mark	Descriptor
		The student has:
3	7–9	Produced a risk assessment that evaluates the risk of all major hazards relevant to the setting and their potential impact. Explained and justified suitable and realistic recommendations to overcome, or limit, the impact of the identified risks. Used and applied correct terminology throughout the risk assessment, including classification of all equipment.
2	4–6	Produced a risk assessment that explains the risk of most major hazards relevant to the setting and their potential impact. Described realistic and suitable recommendations to overcome or limit the impact of the identified risks. Attempted to apply correct terminology throughout the risk assessment, including classification of equipment, with minimal error.

Band	Mark	Descriptor
		The student has:
1	1–3	<p>Produced a risk assessment that identifies the risk of some major hazards relevant to the setting and their potential impact.</p> <p>Described some recommendations to overcome or limit the impact of the identified risks. Recommendations may be limited in relevance or practicability.</p> <p>Attempted to apply correct terminology throughout the risk assessment, including classification of equipment, with some patterns of error.</p>
0	0	No creditworthy material as described in bands 3 to 1.

### Indicative content:

- has taken into account that teams from different departments do not use the same equipment
- correct terminology is used throughout the risk assessment and inspection
- 2 pieces of measurement equipment from each department (6 in total)
- any surface damage to the equipment is correctly identified
- any misshaping of the equipment is correctly identified
- any other damage that could affect results is correctly identified
- identify any measurement bias which could affect results
- risk assessment contains risks for employee, company, and customer, including, but not limited to, physical harm, damage to reputation from faulty installations, harm to customer from poorly fitted appliances
- physical inspection is used, not just visual
- equipment is inspected following the correct use of the equipment

### Content mapping:

K1.1: The concept of measurement

K1.2: How metrology is defined

K1.3: The importance of metrology to society and everyday life

K1.6: How the accuracy of measurements is related to tolerance and cost

K1.15: How an unbroken chain of comparisons, directly related to SI units, ensures confidence in results

K1.17: Techniques for gaining confidence in measurement

K1.25: The difference between validation and verification of scientific measurement equipment

K1.26: The correct terminology for measurement in metrology

K1.27: The impact of using incorrect terminology when communicating about measurement

K1.33: Why different sample preparation methods are required when preparing an item for measurement

K1.34: The most relevant sources to use to extract measurement requirements

K1.42: How to mitigate risk using control measures

K1.43: The hierarchy of written standards and their application in a metrology environment

K2.5: Use the escalation route if the calibration status is not identifiable, or if the instrument is clearly out of calibration

K4.1: How to recognise when measuring equipment is operating incorrectly

S1.51: Use the correct terminology for measurement in metrology

S1.55: Plan any specific preparation tasks needed on the item to be measured

S1.61: Complete a risk assessment appropriate to the measurement task

S4.4: Use problem solving techniques to identify issues relating to measuring equipment

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## Task 2

### Assessor observation checklist

#### PO1, PO2 and PO3

Criteria	Essential criteria (all essential criteria must be awarded to pass)	Assessor check	Marks awarded
Applies safe handling requirements for equipment, including the use of personal protective equipment if required.	Yes		1 mark
Maintained health and safety of the workstation throughout, for example, maintained organisation of all equipment being used, safe use of any chemicals or electrical equipment, appropriate handling of all equipment and tools.	Yes		1 mark
Completed all required preparation tasks on the equipment, such as cleaning, fixturing, or clamping.	No		1 mark for preparation of equipment 1 mark for cleaning equipment 1 mark for clamping/securing equipment <b>(maximum 3 marks)</b>
Selected a suitable standard to check the selected piece of equipment.	Yes		1 mark
Taken measurement of the equipment under test from a minimum of 2 points, including minimum or maximum, and one other.	Yes		1 mark for measurement from minimum or maximum <b>and</b> from one other point <b>(maximum 1 mark)</b>
Suitable piece of equipment has been selected to measure the template.	Yes		1 mark

Criteria	Essential criteria (all essential criteria must be awarded to pass)	Assessor check	Marks awarded
Taken measurements of equipment following the correct standard procedure consistently and accurately, with no errors for calibration and measurement.	No		1 mark for following standard procedure consistently and accurately 1 mark for no calibration errors 1 mark for no measurement errors <b>(maximum 3 marks)</b>
Taken measurement of template following the correct standard procedure consistently and accurately, with no errors for calibration and measurement.	No		1 mark for following standard procedure consistently and accurately 1 mark for no calibration errors 1 mark for no measurement errors <b>(maximum 3 marks)</b>
Cleaned up the workstation and appropriate surfaces following the completion of the inspection, returned all equipment to storage location, disposed of any waste product appropriately.	No		1 mark for cleaning workstation and surfaces 1 mark for return/storage of equipment used and/or any disposal of waste <b>(maximum 2 marks)</b>
Total marks			16 marks

## Content mapping:

K1.1: The concept of measurement

K1.2: How metrology is defined

K1.3: The importance of metrology to society and everyday life

K1.4: The definition of measurement standards

K1.5: The use of measurement standards in calibration

K1.6: How the accuracy of measurements is related to tolerances, cost and timescales

K1.7: The concept and purpose of measurement uncertainty

K1.8: How most sources of uncertainty can be categorised

K1.9: The difference between repeatability and reproducibility of measurement results

K1.11: The concept of random and systematic effects

K1.12: How to mitigate for random and systematic effects



- K1.13: The role of measurement uncertainty in conformity assessment
- K1.14: The concept of confidence levels using  $k = 1$  ( $\approx 68\%$ ),  $k = 2$  ( $\approx 95\%$ ) and  $k = 3$  ( $\approx 99.7\%$ )
- K1.21: The purpose of an uncertainty budget
- K1.22: The components of an uncertainty budget, used to calculate measurement uncertainty
- K1.29: The International System of Units (SI)
- K1.30: The tools and equipment (and software programs where applicable) used within the operating principles
- K1.31: The considerations when deciding on the most appropriate equipment and tools to be used
- K1.32: The advantages and limitations of different commercially available equipment and instrumentation used within the operating principles
- K1.41: The considerations to make when interpreting customer requirements
- K1.43: The hierarchy of written standards and their application in a metrology environment
- K2.1: The purpose of validation or verification techniques for measuring equipment
- K2.2: The purpose of calibrating and testing metrology equipment
- K2.3: How to check the current calibration status
- K2.4: Why it is important to follow the correct escalation route if an instrument's calibration status is not identifiable, or if the instrument is clearly out of calibration
- K2.5: The escalation route if the calibration status is not identifiable, or if the instrument is clearly out of calibration
- K3.1: The stages of processing raw data
- K3.2: The purpose of the following techniques to remove spurious results from metrology data
- S1.50: Read a simple uncertainty budget for a measurement task and use it
- S2.6: Prepare the work environment in order to perform measurement tasks
- S2.7: Set up the equipment and the item to be measured
- S2.8: Read and follow a calibration procedure
- S2.9: Determine the current calibration status of a system to ensure the equipment is at the required level of accuracy
- S2.10: Select/prepare the correct reference material/standard for the measurement task
- S2.11: Perform a measurement task using a developed plan
- S3.10: Contribute to the production of reports and other measurement
- S3.11: Present data/results in the most appropriate format to meet customer requirements (for example, production of reports and other measurement documentation)

## Task 3

### Assessor observation checklist

#### PO3

Criteria	Marks awarded
Suitable format chosen for data presentation, such as a table.	1 mark for suitable format 1 mark for chosen format clearly presented <b>(maximum 2 marks)</b>
Presented measurement data and information accurately and clearly from the inspection of all 6 pieces of equipment. (Data/information gained from task 1)	1 mark for suitable labelling of data 1 mark for accuracy against records <b>(maximum 2 marks)</b>
Presented measurement data accurately and clearly from the measurement in the provided template. (Data gained from task 2)	1 mark for suitable labelling of data 1 mark for accuracy against records <b>(maximum 2 marks)</b>
Errors clearly presented.	1 mark for suitable identification/labelling
Clear evidence of re-checked measurements.	1 mark for evidence of re-checked measurements indicated clearly 1 mark for accuracy against records <b>(maximum 2 marks)</b>
Total marks	9 marks

#### PO3 and PO4

Band	Mark	Descriptor
		The student has:
3	7–9	Produced clear and detailed reports on each piece of equipment that: <ul style="list-style-type: none"> <li>summarises the outcome of the inspection</li> <li>highlights all major risks and all measurements taken</li> <li>evaluates the impact of any issues identified within the process</li> </ul>

Band	Mark	Descriptor
		The student has:
2	4–6	Produced relevant reports on each piece of equipment that: <ul style="list-style-type: none"> <li>summarises the outcome of the inspection</li> <li>explains the impact of issues identified within the process</li> </ul>
1	1–3	Produced basic reports on some pieces of equipment that: <ul style="list-style-type: none"> <li>identifies the main findings of the inspection</li> <li>describes the issues identified within the process</li> </ul> The report may not refer to the impact of issues identified.
0	0	No creditworthy material as described in bands 3 to 1.

## PO3 and PO4

Band	Mark	Descriptor
		The student has:
3	5–6	Provided a well-balanced and detailed explanation of the recommendations regarding withdrawal or replacement of equipment in relation to the standard being used.  Suggested a realistic alternative if a piece of equipment is recommended for replacement, with well-reasoned and detailed justifications.  Included all relevant cases for all pieces of equipment, for example, minor damage that does not affect metrological integrity of the equipment.
2	3–4	Provided a credible description of recommendations regarding withdrawal or replacement of equipment in relation to the standard being used, using some relevant reasoning.  Included all relevant cases for all pieces of equipment, for example, minor damage that does not affect metrological integrity of the equipment.
1	1–2	Provided a basic list of recommendations regarding withdrawal or replacement of equipment in relation to the standard being used.  Included all relevant cases for most pieces of equipment, for example, minor damage that does not affect metrological integrity of the equipment.
0	0	No creditworthy material as described in bands 3 to 1.

### Indicative content:

- justified which items can and cannot be used any longer - for example, damage, unclear or inaccurate markings

- recommended that a piece of equipment in use, or equipment under test is either withdrawn or replaced due to unsuitability or no longer being accurate enough to produce viable results
- offer justification for a change to adjustable items
- links to risks in terms of user safety, impact on customer, impact on business - for example, loss of reputation, unsafe product for client, injury such as cuts to employee
- understanding the needs of measurement to accuracy standards and the actions required if products are found inaccurate and apply these to the scenario
- appropriate recommendations made to director to improve the measurement processes - for example, upgrade wooden rule to metal rule)
- offer recommendations for improvement - for example, use a higher classification of tool, different tools, increased range of tools per department
- demonstrated the understanding of measurement uncertainty, effect on final product, application of measurements to confirm continuing accuracy

## **Content mapping:**

K3.1: The stages of processing raw data

K3.2: The purpose of the following techniques to remove spurious results from metrology data

K4.1: How to recognise when measuring equipment is operating incorrectly

K4.2: The employees' responsibilities when an anomaly in the measurement process has been identified

K4.3: The considerations to make when measuring equipment needs repair

S3.10: Contribute to the production of reports and other measurement documentation

S4.4: Use problem solving techniques to identify issues relating to measuring equipment

S4.5: Discuss measurement results and issues with peers to determine when issues need to be escalated

## Performance outcome grid

Task	PO1	PO2	PO3	PO4	Total
1	12	13	0	2	27
2	6	5	5	0	16
3	0	0	17	7	24
Total marks	18	18	22	9	67
% weighting	26.87%	26.87%	32.84%	13.43%	100%

SAMPLE

## Document information

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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	Post approval amendments (Institute reference (ODSR_S_007 - ODSR_S_011)		March 2021
v1.2	NCFE rebrand.		September 2021
v1.3	Sample added as a watermark	November 2023	21 November 2023