T-LEVELS | Institute for Apprenticeships & Technical Education

T Level Technical Qualification in Science

Occupational specialism assessment (OSA)

Laboratory Sciences

Assignment 3

Mark scheme

v1.1: Additional sample material
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NCFE CACHE

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Contents

Task 1

Task 1: accuracy of data

Band	Mark	Descriptor
4	7–8	The student has made a **clear and reasoned judgement** on the accuracy of the data which is **justified** by a balanced evaluation and which reflects on the relative strengths and weaknesses of the data and data sources. A balanced evaluation considers the evidence for and against inaccuracy in data, the uncertainty in data and evidence from both overall patterns and repeated measurements. Calculation of the proportional rates of MRSA per year is calculated as a percentage accurately throughout the document and used to support their conclusions.
3	5–6	The student has made a **judgement** on the accuracy of the data which is supported by a relevant explanation of some of the strengths and weaknesses of the data and data sources. Students attempt to calculate the rate of MRSA but this may include minor errors (for example, not converting to a % by multiplying by 100), but this does not affect the validity of the conclusion.
2	3–4	The student has **described their opinion** on the accuracy of the data which includes some valid references to the data. Student makes some attempt to determine the rate of MRSA but this may be done inaccurately
1	1–2	The student has **identified an assertion** about the accuracy of the data supported by general or common-sense statements or reasons (rather than occupational knowledge in context). Little attempt is made to determine the actual rates of MRSA infection.
0	0	No creditworthy material as described in bands 4 to 1.

Indicative content

Judgement:

- where a coherent and logical statement is made about the accuracy of the data (for example, correctly identifying errors in the local data where there are more MRSA infections than total infections whereas there are no such errors in the national data)
- effective communication skills are demonstrated

Using information to evaluate:

- a balanced evaluation might consider the evidence for and against inaccuracy in data, the uncertainty in data and evidence from both overall patterns

Uncertainty:

- whether there is enough of a clear trend in data to be certain of whether the rates are increasing. Students will identify that the overall trend seems to be increasing, with an increase from ~20% of total cases being MRSA up to 2017, with this increasing to ~60% in 2021
- examples of evaluative points based on the data obtained:
    - slight variance in data may reflect natural variation in infections
- examples of evaluative points based on results of different measurements:
    - measurements from the different months generally show good agreement, which may suggest the data is accurate

Rate calculations should be performed (what % of total cases each year are caused by MRSA infection – number of MRSA cases divided by total Staph cases multiplied by 100).

Content mapping

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
- inadequate training, for example, use of the equipment or procedure
- equipment not set up properly or used incorrectly
- method not followed, for example, standard operating procedure not followed
- transcription errors

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

Task 2

Task 2: identification of errors

Band	Mark	Descriptor
3	5–6	The student has identified different types of errors and explained whether they are **random** or **systematic**. Commented on all errors, and explanations are evidence-based.
2	3–4	The student has identified different types of errors and explained whether they are **random** or **systematic**. Commented on some errors with some reference to relevant evidence.
1	1–2	The student has identified some errors and explained whether they are **random** or **systematic**, with no reference to evidence.
0	0	No creditworthy material as described in bands 3 to 1.

Indicative content

Identifying types of error:

- identifies the likely main source of error as systematic error for Jul-16 to Sep-16 local data as the number of MRSA infections is consistently 2 cases higher
- identifies the likely main source of error as random error for Oct-20 as no other data around that date is incorrect
- identifies the difference between random and systematic errors, for example, random are unpredictable errors that vary from one result to another while systematic show a similar value or proportion of error with every result

Using data to explain errors:

- identifies likely transcription errors in the data, with some months having more cases of MRSA than total SA infections

Content mapping

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
- inadequate training, for example, use of the equipment or procedure
- equipment not set up properly or used incorrectly
- method not followed, for example, standard operating procedure not followed
- transcription errors

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 accepted tolerance
- remove or minimise the sources of error
- record the source of error and the action taken

Task 3

Task 3: representing data in graphical form

Band	Mark	Descriptor
4	7–8	Appropriate calculations have been carried out. A trend has been identified. Identifies at least two factors and their effect on the trend. Data points are referenced to historical data sheet. An appropriate graph of data is produced. Axes are labelled, and a trend line is added as a single smooth line. The graph is titled.
3	5–6	Appropriate calculations have been carried out although there may be some numerical errors. A trend has been established. Identifies at least two factors and their effect on the trend. Data points are referenced to the historical data sheet. An appropriate graph has been plotted. The graph has a trend line added which although trending in the correct manner has been drawn with a degree of imprecision such as double lines, and a lack of smoothness at one point.
2	3–4	Made a simple comparison of the data sets making observations about the similarities in data. Establish a trend in data from the historical data sheet. Identify a factor affecting the trend. Plotted a graph although this may be inappropriate for the data provided. A trend line is added although it is drawn with inaccuracies such as double lines, trend line outside of data range at more than one point, and line lacks smoothness at two points.
1	1–2	A comparison is made but this is weak and poorly supported. Identify a factor affecting the trend. A graph is attempted although it may be inappropriate for the data provided. A trend is established, and a trend line is added but it is not wholly representative of the trend displaying a lack of smoothness at multiple points, multiple ‘tram lines’.
0	0	There is no valid response.

Indicative content

An appropriate method of comparing data and establishing trend is used

- a graph is constructed from both sets of data that is labelled, units given and titled
- an appropriate trend line is plotted
- a discussion of the difference between the percentage at the beginning of the study and the percentage of MRSA infections at the end is offered:
    - the percentage of MRSA is increasing in the hospital as a proportion of total cases due to more MRSA infections
- potential factors that could influence this trend are identified, such as but not limited to:
    - MRSA is resistant to methicillin and therefore is harder to treat, meaning it is more likely to spread which would lead to increased infections and therefore an increased percentage
    - identification of MRSA may have improved over time which could lead to a higher percentage of MRSA infections due to a higher number of MRSA infections identified
    - testing for MRSA could have increased over time which could lead to a higher percentage of MRSA infections due to a higher number of MRSA infections identified

Content mapping

K1.47 When scientific and mathematical skills are applied when performing a range of scientific techniques:

- analysing:
    - trend charts
    - calculations
    - statistical analysis
- evaluating:
    - evaluating the success of the scientific method

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

- determine trends
- assess statistical validity
- support technical arguments
- draw conclusions
- communicate effectively to a range of stakeholders

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, considering 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

Task 4

Task 4: calculation method

Criteria	Marks awarded
Comments on comparison between local and national means	1 mark for comparison of when means when similar in value (2015, 2017, 2018). 1 mark for comparison of when means when local percentage is much higher (2016, 2019, 2020 and 2021). 1 mark for correctly comparing the trend of means (**maximum 2 marks**).
Standard deviations correctly calculated	1 mark for correct calculation method. 1 mark for each correct standard deviation value (**maximum 2 marks**). 1 mark for presenting values to a suitable number of decimal places, maximum of 2 d.p.
Carrying out the relevant T tests	1 mark for correctly calculating the P value using a T test for 2015 and 2021 (**maximum 2 marks**)
Comparison of the P value	1 mark for P value in 2015 of 0.5621 suggests no significant differences between local and national rates of infection 1 mark for P value in 2021 of <0.0001 suggests significant differences between local and national rates of infection (**maximum 2 marks**)
Total	11 marks

Indicative content

Calculated percentages and calculated mean % of MRSA infections:

2015

Local hospitals –	mean rate	14.16% (to 2 d.p)
National hospitals -	mean rate	16.27%

P = 0.5621

2021

Local hospitals –	mean rate	55.27% (to 2 d.p)
National hospitals -	mean rate	14.56%

P = 0.00003 (<0.0001)

- P value of 0.5621 in 2015 shows differences likely due to chance, as such no significant difference between local and national levels of MRSA infection
- P value of <0.0001 in 2021 shows differences unlikely due to chance, as such there is a significant difference between local and national levels of MRSA infection in 2021

Content mapping

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

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

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

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

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

Task 5

Task 5: MRSA rates in your hospital, justifying a conclusion

Band	Mark	Descriptor
4	7–8	The student has made a clear determination of whether the rates of MRSA in the hospital are comparable to the national rates: • used trends and data to support the conclusion • there are cited examples from the data sets as well as from literature sources that are used in a manner that support their conclusion A wide range of options for improving the hospital's rate of MRSA infections are offered.
3	5–6	The student has made a clear declaration as to whether the rates of MRSA in the hospital are comparable to the national rates: • used available data and trends to support their conclusion • there are references to literature and articles which are used in a manner to support findings A range of options for improving the hospital's rate of MRSA infections are offered.
2	3–4	The student has: • used trends to support data • there are limited references to literature, these are not well-used and may cause some confusion • the consideration of factors may be biased towards one outcome based on sources used Multiple options for improving the hospital's rate of MRSA infections are offered, though there may be several important possibilities omitted.
1	1–2	The student has used trends to support the conclusion and the conclusion may be uncertain containing ambiguity. The student has made very few valid references to literature sources, these may be factually incorrect or biased. Only one factor is considered in the justification of their conclusions. A limited range of options for improving the hospital's rate of MRSA infections are offered.
0	0	No creditworthy material as described in bands 4 to 1.

Indicative content

- comments on the differences between rates in the hospital and national rates; identify that while the local rates of MRSA as a proportion of cases are increasing, the national rates are remaining stable at around 20%-30%, suggesting that the local hospital has a particular issue with MRSA
- knowledge of how infections can be treated and prevented
- know that the rate of infection depends on multiple factors and be able to recognise bias in reports

Options for improving the hospital's rate of MRSA infections are offered:

- improvements in hygiene
- increased screening and isolation
- correct usage of antibiotics
- human factors (for example, doubt, fear)
- reporting procedures.
- trustworthiness of article/report source
- multiple factor approach – all variables should be accounted for
- further valid and reasonable factors

Content mapping

S2.26 Source expert help, when required, in relation to laboratory data processing and analysis by:

- accurately describing the issue
- summing up key points
- expressing opinions and supporting these with relevant and persuasive arguments
- asking and responding to questions for clarification

Performance objective (PO) grid

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

Document information

The T Level Technical Qualification is a qualification managed and approved 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	Additional sample material		01 September 2023
v1.1	Sample added as watermark	November 2023	20 November 2023