T Level Technical Qualification in Science

Occupational specialism assessment (OSA)

Laboratory Sciences

Assignment 2 - Part B

Mark scheme

v1.1: Specimen assessment materials
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Contents

Task 1(a)

Task 1(a): assessor observation checklist

Criteria	Assessor check	Marks awarded	Essential criteria (All essential criteria must be awarded to pass)
Safe handling of chemical agents during task		1	Yes
Safe storage and disposal of chemical agents		1	Yes
Well organised workstation to facilitate the completion of the task		1	Yes
Safe handling of equipment during task		1	Yes
Use of appropriate PPE in preparation and completion of the task		1	Yes
Performed scientific techniques effectively: • measuring • observing • use equipment correctly		1 for completing technique effectively **and** 1 for completing techniques accurately **(maximum 6 marks)** **Guidance** Assessor must check accuracy of recorded measurements and observations on at least 2 occasions during the task	Yes
Total awarded*		11 marks	

Task 1(a): following the standard operating procedure (SOP)

Band	Mark	Descriptor
4	10–12	The student has demonstrated autonomy and judgement in following the multi-step standard operating procedure (SOP), carrying out all instructions in full, and carrying out the task logically and in a time efficient manner to produce accurate results.
3	7–9	The student has followed the multi-step SOP, carrying out most instructions in full, with only occasional minor omissions or errors (for example, stoppers not replaced immediately; instructions on air bubbles, mixing or wait time not accurately followed) and carried out the task in the correct order of steps to produce accurate results.
2	4–6	The student has followed the multi-step SOP to produce results, but in some areas attention to detail is lacking. Carried out all major steps in the correct order, although there may be some errors or omissions within some of the steps (for example, mistakes in volumes or equipment used, parts of steps carried out in the wrong order, indicator added at start of titration).
1	1–3	The student has followed parts of the multi-step SOP correctly to produce results, carrying out most of the major steps, but may omit a key step and complete some of the steps in the wrong order, compromising the validity of results.
0	0	No creditworthy material as described in bands 4 to 1.

Indicative content

Following the SOP correctly would include, for example:

1) labelling and organising all tubes for dilution for correct volumes for glucose concentrations
2) using suitable PPE for use of Benedict's and use of Bunsen burner for water bath
3) accurately judging changes in colour change in the boiling tubes and removing from heat
4) centrifuging and balancing out tubes correctly
5) using blanks and correct filter on colorimeter

Highly effective application of practical scientific and mathematics skills would include (but is not limited to):

- measuring, for example, confident measurement of volumes of reagents demonstrating good practice to enable accurate measurements
- correct use of pipette and measuring cylinder, for example, read at eye level, base of meniscus used
- manual dexterity, for example, accurate and efficient transfer of liquids (when pouring or avoiding bubbles in boiling tubes and test tubes) or skilful and safe handling of glassware – note that other titration skills are covered below
- observing, for example, suitable approach to end point determination of colour change in Benedict's solution

- careful use of blank between readings for transmission of light
- cleaning cuvette and rinsing cuvette between each sample reading
- analysing
  - calculates concentration of glucose by dilution of stock solution
  - uses information provided to read transmission from colorimeter
  - correct and complete use of units

Effective techniques and skills for carrying out dilution includes (but is not limited to):

- labelled test tubes with correct dilutions
- pipette of correct size with no air bubbles with the stock solution/water is used
- use of clean syringe, used to avoid contamination between dilutions
- reading taken from base of syringe and accurate measurements taken, no solution left in the syringe barrel
- effective techniques and skills for carrying out Benedict's includes (but is not limited to)
  - pipette of correct size with no air bubbles when the stock solution/water is used
  - reading taken from base of syringe and accurate measurements taken; no solution left in the syringe barrel
  - water bath heated to correct temperature using temperature monitored several times
  - boiling tubes added at same time using tongs for health and safety
  - careful observation of colour change and safety through reduced gas power to avoid water spitting
  - boiling tubes left to cool down in safe clean area on bench in a rack

Effective techniques and skills for carrying out calibration curve including colorimeter and centrifuge (but is not limited to):

- careful pipetting into centrifuge tube from supernatant so equal volumes in all tubes – no air bubbles in pipette and all liquid pushed out of tip
- tubes balanced carefully in centrifuge so even spinning
- colorimeter set to correct red filter at each reading and use clean cuvette with distilled water to 0 colorimeter between readings
- careful pipetting into centrifuge tube from centrifuge tubes to cuvette – no air bubbles in pipette and all liquid pushed out of tip
- 3 readings taken for each concentration of glucose for mean to 3dp

Content mapping

K1.1: How health, safety and environmental practices apply to laboratory settings:

- safely performing a scientific technique
- completing a scientific technique

K1.13: How to perform calculations for acid-base titrations based on mean titres, using n = cV and mass = n/Mr

K1.22: The oxidation and reduction process

K1.47: When scientific and mathematical skills may be applied when completing scientific tasks:

- measuring
  - volume using a burette
- manual dexterity
  - when using a pipette
- observing
  - colour changes at titration end point
- analysing
  - calculations

K1.49: The purpose of:

- analysing substances and chemical environments to confirm composition and/or quantity of materials

K1.50: Why the following techniques are used:

- titration, (for example, purity analysis)
  - purity analysis and determining concentration

K1.53: The purpose of the following environmental laboratory techniques:

- biochemical oxygen demand (BOD) to determine the amount of dissolved oxygen needed by microorganisms in a water sample

K1.63 The principles of producing reliable and verifiable results:

- recording in a clear and unambiguous way, (for example, use of tables, indelible ink, not using sticky notes or loose papers, ensuring writing is legible)
- using appropriate units, notation, and correct number of significant figures

K1.67: The purpose and importance of SOPs within the laboratory environment

S1.68: Work safely in a laboratory when performing specific scientific techniques

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

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

S1.77: Use the following practical scientific techniques to analyse substances

- acid base and redox titration
- preparation of serial dilutions
- colorimetry
  - selecting the appropriate filter
  - zeroing the colorimeter using a cuvette containing the solvent only
  - measuring the absorbance of a cuvette with test solution

Task 1(b)

Task 1(b): calculating results

Band	Mark	Descriptor
4	10–12	The student has used relevant and appropriate methods to calculate mean read for light transmission for each glucose concentration, presenting a complete, identifiable, and relevant set of results in an entirely suitable format which is fit for purpose, including the following elements: • clearly labelled axis on graph with glucose concentration on horizontal axis and transmission on vertical axis • to appropriate significant figures • mean reading taken for each concentration and reading – written in appropriate format • with appropriate units and notation • suitable number of repeats for all samples • plot points within +/- 1 on graph • sharp curve with no faint points or gaps • clear indication/plot of unknowns on graph which are consistent • correct scale and size used on graph paper with clear title
3	7–9	The student has used appropriate methods to calculate mean read for light transmission for each glucose concentration, presenting an identifiable set of results in a valid format, including the following elements: • clearly labelled axis on graph with glucose concentration on horizontal axis and transmission on vertical axis • to appropriate significant figures • mean reading taken for each concentration and reading – written in appropriate format • appropriate units and notation with minimal error • suitable number of repeats for most samples • plot points within +/- 1 on graph for most data points • sharp curve with no faint points or gaps • clear indication/plot of most of the unknowns on graph which are consistent • correct scale and size used on graph paper with clear title

Band	Mark	Descriptor
2	4–6	The student has used some relevant methods to calculate mean read for light transmission for each glucose concentration, presenting a set of results which includes some data in a suitable format, although is incomplete and sometimes unclear, or unnecessary data is used. Work may include the following elements: • graph with glucose concentration on horizontal axis and transmission on vertical axis • some appropriate significant figures • some mean reading taken for each concentration and reading • inconsistent use of appropriate units and notation • suitable number of repeats for some samples • plot points within +/- 1 on graph for some data points • sharp curve with no faint points or gaps • some indications/plots of most of the unknowns on graph which are consistent • correct scale and size used on graph paper with title • calculations are partially correct but may contain several minor errors or single major error
1	1–3	The student has calculated mean read for light transmission for each glucose concentration, presenting a set of results which includes some but limited data in a format that is not the most suitable for the purpose. Data is incomplete, and sometimes unclear or unnecessary data is used. Work may include the following elements: • inconsistent use of appropriate significant figures • inconsistent use of appropriate units and notation • repeats carried out for some samples but not based around identification of concordant results – repeats only carried out once or twice • calculations have some aspects that are correct but may follow an incorrect approach, be limited in extent, or contain major errors in data plotting • graph with incorrect scale, labelling or title • unknowns incorrectly plotted on graph, therefore concentrations are wrong • axis too small or too large to allow plotting of suitable curve • curve drawn inconsistently or with gaps or unclear points
0	0	No creditworthy material as described in bands 4 to 1.

Indicative content

Students may also suggest that glucose is a reducing sugar and describe its role in respiration. They may explain the colour changes for the concentration of glucose in the solution when reacted with Benedict's solution. For example, the more glucose (reducing sugar) present in the solution the greater the reaction with Cu2+ to produce a red colour. Students may also explain the differences between a qualitative test and quantitative test by comparing eye and colorimeter use.

Students may explain the serial dilution steps required from the stock solution for the suitable range of concentrations and how each dilution may be used to form a set of standards for a calibration curve.

This is covered in preparation of serial dilutions: amount of substance (for example, use of calculations to determine dilutions needed).

The use of blanks and water as a control in the colorimeter to reset and zero for each reading done so that anomalies are avoided. Students may also explain that misuse of a machine could lead to an error and a danger to the person carrying out the experiment.

Students may also include information concerning a bluer supernatant, which means more copper sulfate has reacted, therefore there is less glucose present, therefore more light is absorbed, and the percentage transmission rate is low.

Graph should be well drawn with sharp lines, suitable curves, labelled and units on axis, well plotted data point and full use of the page. The curve should follow a suitable shape. The student should also indicate the concentration of the unknown solution on the graph through a line or an X if needed.

In terms of health and safety, students may indicate the need for PPE and the need to follow health and safety in terms of protections of themselves and legislation such as COSHH and health and safety executive (HSE).

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.

Content mapping

K1.63: The principles of producing reliable and verifiable results:

- recording in a clear and unambiguous way (for example, use of tables, indelible ink, not using sticky notes or loose papers, ensuring writing is legible)
- using appropriate units, notation and correct number of significant figures
- critically reviewing data obtained (for example, identifying any anomalous results)
- repeating investigations and referencing why any action was taken, where appropriate

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

- regulatory requirements (for example, validation, conformity to known analytical standards)
- relevant calculations (for example, magnification and Rf values)
- conversion of units (for example, consistent use of units across different data sets)
- appropriate statistical techniques to determine the validity or significance of the results (for example, standard deviation, p value, uncertainty values)
- customer requirements for the presentation of data (for example, graphs)

- using laboratory control charts and trend charts (for example, to confirm equipment and/or protocols are within tolerance)

K2.7: How to establish the validity of results against standards and controls:

- using certified reference material (CRMs)

S1.87: Produce data from scientific techniques, which are reliable and verifiable, by:

- recording data and records in a clear and unambiguous way:

S2.19: Complete relevant calculations on data obtained in the laboratory environment

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

S2.23: Present data in an appropriate format

Performance outcome grid

Task	PO1	PO2	PO3	Total
1(a)	23	0	0	23
1(b)	12	0	0	12
Total marks	35	0	0	35
% Weighting	100%	0%	0%	100%

Document information

The T Level Technical Qualification is a qualification approved and managed by the Institute for Apprenticeships and Technical Education.

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	NCFE rebrand		September 2021