Applied General Assignment Brief

(Unit 2 Chemistry)

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| **Qualification title** | Level 3 certificate and extended certificate in applied science |
| **Unit code** | L/507/6498 |
| **Unit title** | Unit 2 Applied experimental techniques (Chemistry) |

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| **Learner name** |  | | |
| **Tutor/Assessor name** |  | | |
| **Assignment Title** | Analysis of river water | | |
| **Date assignment issued** |  | **Submission Date** |  |

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| **Performance Criteria** | | | |
|  | **Pass** | **Merit** | **Distinction** |
| **Performance Outcome** | P4 | M4 |  |
| P5 | M5 | D3 |
| P6 | M6 | D4 |
|  | P10 |  |  |

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| **Tasks** | **Performance criteria covered** |
| Task 1 (Approximately 5 hrs) | P4, M4 |
| Task 2 (Approximately 8 hrs) | P5, M5, D3 and P 10 |
| Task 3 (Approximately 7 hrs) | P6, M6, D4 and P10 |

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| **Submission Checklist (please insert the items the learner should hand in)** | **Confirm submission** |
| Evidence of a report outlining and explaining the basic scientific principles covering (P4 and M4) |  |
| Evidence of a report for volumetric analysis including:   * standard procedure followed * tabulated results (P5) * carrying out the calculations (M5) |  |
| Evidence of a report exploring the volumetric technique used in industry (D3) |  |
| Evidence of a report for colorimetric analysis including:   * standard procedure followed * tabulated results(P6) * carrying out the calculations * explaining the choice of wavelength/filter * identifying anomalies and referring to the Beer-Lambert Law(M6) |  |
| Evidence of a report evaluating the experimental outcome of colorimetric analysis (D4) |  |
| Evidence of two risk assessments, one for each technique, of which one must be carried out by you (P10) |  |
| Witness confirmation form completed for these techniques by the tutor |  |
| **Learner - please confirm that you have proofread your submission** |  |

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| **Learner Authentication**  I confirm that the work and/or the evidence I have submitted for this assignment is my own. I have referenced any sources in my evidence (such as websites, text books). I understand that if I don’t do this, it will be considered as a deliberate deception and action will be taken. |
| **Learner Signature Date** |
| **Tutor declaration**  I confirm the learner’s work was conducted independently and under the conditions laid out by the specification. I have authenticated the learner’s work and am satisfied that the work produced is solely that of the learner. |
| **Tutor/Assessor Signature\* Date** |
| *\*Please record any assistance given to the learner beyond the group as a whole even if within the parameters of the specification* |

**For marking purposes only**

**Marking grid**

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| **Performance Criteria (PC) Achieved** | | | | | | | | | **1stsub\*** | **Resub\*** |
| **Pass** | **1st sub\***  **✓ / X\*\*** | **Resub\***  **✓ / X\*\*** | **Merit\*\*\*** | **1st sub\***  **✓ / X\*\*** | **Resub\***  **✓ / X\*\*** | **Distinction\*\*\*** | **1st sub\***  **✓ / X\*\*** | **Resub\***  **✓ / X\*\*** | **Number of PCs achieved** | **Number**  **of PCs achieved** |
| P4 |  |  | M4 |  |  |  |  |  |  |  |
| P5 |  |  | M5 |  |  | D3 |  |  |  |  |
| P6 |  |  | M6 |  |  | D4 |  |  |  |  |
| P10 |  | **P10 to be graded only once on the unit submission form** | | | | | | |  |  |
| **Total PCs achieved:** | | | | | | | | |  |  |

***\* Sub= submission and Re-sub=Re-submission (Re-submission column to be completed only if the learner has re-submitted the assignment.***

***\*\* Achieved (✓ ) Not achieved (X). Please tick or cross for each performance criteria (PC)***

***\*\*\* Distinction and Merit criteria can be achieved only where the associated Merit and Pass criteria have been achieved first.***

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| **Tutor summative feedback for learner**  (*Note to tutors: this section should focus on what the learner has done well. Where a learner has not achieved a specific performance criterion or is likely to want to improve on a response to a performance criterion, then you may identify the issues related to the criterion, but should not provide explicit instructions on how the learner can improve their work to achieve the outstanding criteria.)\** |
| Feedback  Tutor name(print) and date |
| Resubmission Feedback  Tutor name(print) and date |

\* All tutor notes should be deleted before the template is used.

**Scenario**

**Analysis of river water**

Rivers throughout the UK are constantly monitored by the environment and water standards agencies whose responsibility it is to ensure that water quality is maintained. To ensure this, samples are regularly collected and analysed by these agencies.

JEM Water is analysing the quality of its local rivers and streams and has recently found that one of its rivers is showing high levels of acid present, thought to be hydrochloric acid released from an industrial site upstream, and investigates this further using volumetric analysis.

It has also found a local stream contaminated with a coloured pollutant (identified as a copper (II) compound) that the agency thinks is caused by an industrial plant further upstream in the next town. JEM Water has been tasked to investigate the contamination and they will carry out the investigation using colorimetric analysis. As a laboratory technician working for JEM, you have been asked to carry out the investigations.



**Task overview**

Consideration should be given to understanding the basic principles of volumetric and colorimetric analysis.

When carrying out laboratory investigations, standard procedures should be followed and results recorded. The Witness Confirmation sheet should confirm that you have carried out both titration and colorimetry experiments. Records should include a full account of the standard procedure, results obtained, relevant tabulated results with calculations, and graphs as appropriate.

In addition to the above:

* the resulting evidence should be analysed textually, visually (diagrams/photographs), mathematically and graphically as appropriate
* procedures should be evaluated in terms of the data recorded and the calculated outcomes with reference to the expected values
* consider the choice of wavelength and any inconsistencies recorded in the data and how the calibration graph relates to the Beer-Lambert Law.

You should practise the techniques beforehand to help you understand accuracy and precision.

**Activities**

**Task 1**

**PO2 Demonstrate applied experimental techniques in chemistry**

Firstly you need to become familiar with the **two** techniques that you will use for analysing the samples. You need to research and report on the basic principles and uses of volumetric analysis of various types as applied in industrial settings, including reference to the reactions, molar rations, end points and indicators.

For colorimetry, you need to research and report on the basic principles including the visible spectrum, absorption of visible light, the construction and mode of working of a colorimeter, and the uses in industrial contexts (**P4**).

In addition, for **M4**, you should explain and report in depth the scientific principles of volumetric analysis and colorimetry with particular reference to: standard solutions, choice of indicators, and a consideration of the Beer-Lambert Law.

**Task 2**

**PO2 (a) Volumetric analysis**

###### **PO4 Understand safety procedure and risk assessment when undertaking scientific practical**

###### **work**

###### Before any practical work is started, you should complete a risk assessment. This will make you

###### aware of any risks or hazards that are associated with the practical work you are about to do **(P10)**.

###### In order to obtain accurate and reproducible results, your procedure should include:

* making a standard solution
* safely and correctly setting up and using the apparatus
* safely using the chemicals
* obtaining burette readings recorded to the nearest 0.05 cm3
* finding and recognising the end-point of the reaction with a suitable choice of indicator
* repeating the work until you get reproducible results (titres within +/- 0.10 cm3)
* safely putting apparatus and chemicals away
* correctly recording and presenting data in a suitable format, with reference to precision, reliability and correct units (P5).

###### 

**You should include the standard procedure followed in your report for this technique.**

###### On completion of the practical work, you should carry out the calculations to support your analysis,

###### demonstrating (**M5**):

* correct identification of the standard used and its Mr
* correct equation for the reaction and molar ratio (stoichiometry)
* calculation of the moles of solid used and the concentration of the standard solution
* calculation of the mean titre and its use in calculating the unknown concentration
* correct units
* correct precision evident for the data used, the molarity of the standard solution and the final unknown molarity of the acid pollutant.

**You are expected to show evidence of independent work for calculations.**

In addition, for **D3**,you need to explore how volumetric analysis is used in industry, making reference to accuracy, precision and use of primary standards. (Reference any literature used)

**Task 3**

**PO2 (b) Colorimetric analysis**

###### **PO4 Understand safety procedure and risk assessment when undertaking scientific practical**

###### **work**

###### Before any practical work is started, you should complete a risk assessment. This will make you aware of any risks or hazards that are associated with the practical work you are about to do **(P10)**.

**Safety sheets**

[science.cleapss.org.uk/Resource-Info/Student-Safety-Sheets-ALL.aspx](file:///H:\Development\Science\Support%20Material\SABs\FINAL%20SABs\science.cleapss.org.uk\Resource-Info\Student-Safety-Sheets-ALL.aspx)

Again for the colorimetric technique, the results for the analysis of the pollutant need to be accurate and reproducible and you should practise the technique beforehand to help you understand accuracy and precision.

###### In order to obtain accurate and reproducible results, your procedure should include:

* making a standard solution and preparing a range of solutions of different concentrations using serial dilutions
* safely and correctly setting up the equipment
* safely using the chemicals
* calculating the molarity of the standard solution and the concentrations produced by the serial dilutions
* measuring the absorbance of the standard solution at different wavelengths of visible light or for a range of different filters
* producing a graph of absorbance v wavelength or filter
* identifying the wavelength or filter to use in the experiment
* reading and noting results accurately
* safely putting away apparatus and chemicals
* producing a calibration graph of absorbance v concentration
* determining an unknown concentration
* correctly recording and presenting data in a suitable format with correct units and precision **(P6)**.

###### **You should include the standard procedure followed in your report for this technique.**

###### On completion of the practical work, you should use your graph of abs v wavelength or filter to justify the choice of wavelength made. For your graph of abs v concentration, you should give reasons for any any inconsistencies or anomalies and relate the line of best fit obtained to the Beer-Lambert Law.(**M6**).

To achieve **(D4)**, the experimental outcomes should be evaluated, with a consideration of:

* accuracy of measurements (compared against literature or expected value)
* quantitative (%) errors associated with the measurements made
* the precision of recording and reliability of measurements recorded
* a qualitative assessment of the practical methodology.

**Technical notes**

**Risk assessment (CLEAPPS) for volumetric analysis**

**Standard solution**

* weighing bottle/boat
* spatula
* chemical (depending on chosen titration eg anhydrous sodium carbonate for titration against hydrochloric acid)
* accurate balance
* distilled water
* beaker
* stirring rod
* volumetric flask
* funnel

**Titration**

* pipette
* pipette filler
* volumetric flask
* burette
* conical flask
* funnel
* white tile
* Solution of acid polluted water (depends on the titration selected, but say approx. 0.1M HCl or similar)
* appropriate indicator

**Risk assessment (CLEAPPS) for colorimetric analysis**

* colorimeter
* cuvettes
* filters (if no wavelength control on colorimeter)
* balance, weighing boat, spatula, beaker, glass rod
* Volumetric flask, funnel
* sample of solid metal salt for the standard (depends on the standard procedure and scenario selected but, for example, CuSO4.5H2O)
* pipettes
* pipette filler
* range of volumetric flasks (e.g. 6 x 100ml)
* test tubes
* distilled water
* river water (as unknown) made up to give a reading within range made up for the colorimeter