

Sample Teaching Plan  
Unit G621: Analysis at Work

**Suggested teaching time**

Plan is based on 12 weeks at 5 hours per week (4 hours contact time + 1 hour directed study)

The learning activities are suggestions only. Teachers may wish to develop alternative strategies. The plan should be read alongside the G621 Specification and, in particular, the Assessment Evidence Grid (attached for your reference).

Week number	Specification Unit Reference and Assessment Objectives	Suggested Learning Activities	Resources
1	<p><b>3.2.1: Qualitative Chemical Analysis - A03</b></p> <ul style="list-style-type: none"> <li>Carry out chemical tests (including flame tests) to identify the cations: <math>\text{Fe}^{2+}</math>, <math>\text{Fe}^{3+}</math>, <math>\text{Cu}^{2+}</math>, <math>\text{Al}^{3+}</math>, <math>\text{Na}^+</math>, <math>\text{K}^+</math>, <math>\text{Ca}^{2+}</math>, <math>\text{Zn}^{2+}</math> and <math>\text{NH}_4^+</math>.</li> <li>Carry out chemical tests to identify the following anions: <math>\text{Cl}^-</math>, <math>\text{Br}^-</math>, <math>\text{I}^-</math>, <math>\text{SO}_4^{2-}</math>, <math>\text{NO}_3^-</math> and <math>\text{CO}_3^{2-}</math>.</li> <li>Describe chemical reactions involved.</li> <li>Identify uses of chemical tests in qualitative analysis and their limitations.</li> </ul>	<p>Teacher introduction to the chemical reactions involved in the tests for cations and anions and practical work on compounds containing known cations and anions.</p> <p>Practical work on the identification of unknown compounds by means of tests for cations and anions.</p> <p><b>Assessment:</b> Practical work and a detailed report of a qualitative chemical analysis linked to a vocational context in which risk assessments have been used.</p> <p><i>This could form the basis of one of the three analyses.</i></p> <p>Candidates to devise suitable questions to link to assignment brief.</p>	<p>Teacher handout notes and/or resource-based introduction notes.</p> <p>Detailed worksheets showing tests for anions and cations.</p> <p>Appropriate small apparatus for this test tube scale work.</p> <p>Known and unknown materials and reagents.</p> <p><i>Sample Assignment D:</i> A Preservative for Mummies.</p>

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2	<p><b>3.2.1: Qualitative Chemical Analysis - A03</b></p> <ul style="list-style-type: none"> <li>• Carry out chemical tests to identify the organic functional groups: <math>&gt;C=C&lt;</math>, <math>-CH_2OH</math>, <math>-CHO</math>, <math>&gt;C=O</math> and <math>-COOH</math>.</li> <li>• Use infrared spectroscopy to identify the presence of <math>-CH_2OH</math>, <math>-CHO</math> and <math>-COOH</math> groups in organic compounds.</li> <li>• Describe chemical reactions involved.</li> <li>• Identify uses of chemical tests in qualitative analysis and their limitations.</li> </ul>	<p>Teacher introduction to the chemistry behind the tests for these organic functional groups.</p> <p>Practical work to identify these groups in known and unknown materials.</p> <p>The use of infrared spectroscopy (either paper based or with the use of an infrared spectrophotometer) to identify the presence of <math>-CH_2OH</math>, <math>-CHO</math> and <math>-COOH</math> and the differences between these spectra.</p> <p><b>Assessment:</b> Practical work and a detailed report of a qualitative chemical analysis linked to a vocational context in which risk assessments have been used.</p> <p><i>This could form the basis of one of the three analyses.</i></p>	<p>Teacher handout notes and/or resource based introduction notes.</p> <p>Detailed worksheets showing tests for the required functional groups.</p> <p>Appropriate small apparatus for this test tube scale work.</p> <p>Known and unknown materials and reagents.</p> <p>Use of an infrared spectrophotometer or provided spectra.</p> <p>An assignment identifying organic unknowns could be used here.</p>

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<p style="text-align: center;"><b>3</b></p> <p>This could be optional</p> <p>Needed for G628</p> <p>Can be taught in G620/ may be needed for G627</p>	<p><b>3.2.1: Qualitative Analysis - AO3</b></p> <ul style="list-style-type: none"> <li>• Explain the basic principles of chromatographic separation, its uses and limitations.</li> <li>• Use chromatography to separate mixtures and identify their components.</li> <li>• Carry out chromatographic separations using thin layer chromatography and paper chromatography.</li> <li>• Interpret chromatograms.</li> </ul>	<p>Theory of separation using chromatography.</p> <p>Advantages and disadvantages of thin layer and paper chromatography and the limitations of each method.</p> <p>Simple separations using the two methods.</p> <p>Further practical work on TLC and paper chromatography, including component identification.</p> <p>Use of provided chromatograms to interpret components present.</p> <p>Theory and research based work on the application of GLC and HPLC in industry. (optional re:G628)</p> <p><b>Assessment:</b> Practical work and a detailed report of a qualitative chemical analysis linked to a vocational context in which risk assessments have been used.</p> <p><i>This could form the basis of one of the three analyses.</i></p>	<p>Teacher-produced worksheets or candidate resourced materials outlining the theory of chromatography and the interpretation of its results.</p> <p>Materials and equipment appropriate to simple separations using paper and thin layer chromatography.</p> <p><b>Be Aware:</b> If used as an assignment – ensure complex work is included not just simple paper chromatography.</p>
<p style="text-align: center;"><b>4</b></p>	<p><b>3.2.2: Quantitative Chemical Analysis - AO3</b></p> <ul style="list-style-type: none"> <li>• Prepare standard solutions.</li> <li>• Carry out a normal titration.</li> <li>• Carry out the necessary calculations.</li> </ul>	<p>Basic theory and ideas behind volumetric work including simple work on equations and moles.</p> <p>The preparation of a standard solution and the use of this solution in an acid-base titration.</p>	<p>Teacher-produced handout notes and/or resource based introductory material.</p> <p>Apparatus appropriate for acid-base titration exercises.</p>

Week number	Specification Unit Reference and Assessment Objectives	Suggested Learning Activities	Resources
5	<p><b>3.2.2: Quantitative Chemical Analysis - AO3</b></p> <ul style="list-style-type: none"> <li>• Carry out further titrations (acid-base, redox and complexometric).</li> <li>• Carry out the necessary calculations.</li> <li>• Interpret the results of simple volumetric analyses.</li> <li>• Find the limits of detection of a volumetric analysis.</li> <li>• Carry out and report on a quantitative chemical analysis linked to a vocational context.</li> </ul>	<p>Continuation of practical work involving titrations of acid-base, redox and complexometric type linked to a vocational context.</p> <p>Calculations involving stoichiometry and moles.</p> <p>Appreciate the range of concentrations used in volumetric work.</p> <p><b>Assessment:</b> Practical work and a detailed report of a quantitative chemical analysis linked to a vocational context in which risk assessments have been used.</p> <p><i>This could form the basis of one of the three analyses in AO3.</i></p>	<p>Apparatus for titrimetric analysis including reagents and materials for more complex work.</p> <p><i>Sample Assignment E:</i> Power Station Emissions or assignment based on iron tablets / <math>\text{KMnO}_4</math>.</p>
6	<p><b>3.2.2: Quantitative Analysis - AO3</b></p> <ul style="list-style-type: none"> <li>• Describe the principles of colorimetric analysis.</li> <li>• Use colorimetric analysis to find the percentage of a particular components in a sample.</li> </ul>	<p>Discuss the theory behind colorimetric analysis.</p> <p>Research the uses of colorimetric analysis in industry.</p> <p>Practical colorimetric analysis using a two metal alloy.</p> <p><b>Assessment:</b> Practical work and a detailed report linked to a researched vocational context in which risk assessments have been used.</p> <p><i>This could form the basis of one of the three analyses in AO3.</i></p>	<p>Teacher or candidate produced materials outlining the principles of colorimetry and its application in industry.</p> <p>Apparatus and materials appropriate to a simple colorimetric determination.</p> <p><i>Sample Assignment C:</i> Finding the Percentage of Copper in a Brass Alloy.</p> <p>Candidate produced resources outlining the vocational context of this exercise.</p>

Week number	Specification Unit Reference and Assessment Objectives	Suggested Learning Activities	Resources
7	<p><b>3.2.3:</b> Energy</p> <ul style="list-style-type: none"> <li>• Use ideas of transfer of energy during breaking and making chemical bonds between particles to explain why some reactions are exothermic and some are endothermic.</li> <li>• Investigate enthalpy of combustion of different fuels.</li> </ul>	<p>General discussion work on the bullet points listed in 3.2.3.</p> <p>This should include work on energy changes during the combustion of simple alkane hydrocarbons.</p> <p><b>Assessment:</b> Practical work on enthalpy of combustion of alcohols methanol / ethanol / propanol linked to a researched vocational context in which risk assessments have been used.</p> <p><i>This could form the basis of one of the three analyses in AO3.</i></p>	<p>A-level chemistry worksheets on enthalpy of combustion.</p> <p>To include definition/importance of state symbols and simple calculations from experiments.</p>
8 – 10	<p><b>3.2.3:</b> Energy and <b>3.2.4:</b> Efficiency <b>- AO1</b></p> <ul style="list-style-type: none"> <li>• Investigate energy policies and energy saving practices of non-domestic consumers of electricity.</li> <li>• Explain what is meant by efficiency.</li> <li>• Explain why actual efficiency will always be less than the theoretical maximum.</li> <li>• Investigate steps that could be taken by a non-domestic consumer to maximise efficiency of energy use.</li> </ul>	<p><b>Assessment:</b> A detailed description of the energy policy of a non-domestic consumer of energy, with ways in which they limit their energy consumption.</p> <p>Note that the chosen organisation should be a consumer rather than a producer of electricity.</p> <p>The environmental impacts considered should focus on the effects of the energy usage of the company NOT other aspects such as their waste products.</p>	<p><i>Sample Assignment A:</i> Report on an organisation's energy policy and usage.</p>

Week number	Specification Unit Reference and Assessment Objectives	Suggested Learning Activities	Resources
11 – 12	<p>3.2.3: Energy</p> <ul style="list-style-type: none"> <li>• Discuss forms of energy transfer.</li>   <li>• Comparison of relative benefits and problems of large-scale and small-scale electrical generation.</li>   <li>• Research data on energy values and fuel costs.</li> <li>• Do calculations from data researched.</li> </ul>	<p>Draw block diagrams showing the forms of energy and transfer processes stage by stage as energy is converted from its 'raw' form such as coal or solar energy into electrical energy.</p> <p>Students should choose two types of energy source and compare large and small scale electrical production for each. For example a candidate might choose to compare:</p> <p>(i) a large-scale oil-fired power station with a small diesel generator such as those used to power electrical tools where no mains supply is available.</p> <p>(ii) a large-scale off-shore wind farm with a small wind-powered generator used to supply electricity to an individual dwelling.</p> <p>Research data on the energy values of fuels per Kg, per L, per m<sup>3</sup> or per kWh as appropriate. Calculate the cost per joule for each fuel researched. Compare the relative cost per joule of different fuels.</p> <p><b>Assessment:</b> a study of large-scale and small-scale generation, to include energy transfer involved; to include data and calculations to show a comparison of fuel/energy costs, including calculations.</p>	<p><i>Sample Assignment B:</i> Generation of electricity - Some the material in this assignment could be cross-linked to required material in Unit G620, assignment objective AO1.</p> <p>Current fuel costs can be found from local suppliers such as petrol stations and coal merchants. Many petrol stations supply coal and bottled gas as well as petrol &amp; diesel. Some also supply LPG. Mains gas and electricity costs can be obtained from domestic bills if available, or from suppliers' websites.</p> <p>Energy values (also called calorific values) are given on the Kaye and Laby website: <a href="http://www.kayelaby.npl.co.uk/chemistry/3_11/3_11_4.html">www.kayelaby.npl.co.uk/chemistry/3_11/3_11_4.html</a></p> <p>The Nottingham Energy Partnership website also includes a useful table of energy value and cost data: <a href="http://www.nottenergy.com/energy_cost_comparison/">www.nottenergy.com/energy_cost_comparison/</a></p> <p>The BWEA website gives data on wind energy costs.</p> <p>Websites such as <a href="http://eltec solar.co.uk/">eltec solar.co.uk/</a> give some useful information about solar energy costs.</p>

## Unit G621 - Assessment Evidence Grid

Unit G621: Analysis at work				
What the candidate needs to do:				
<p><b>The candidate needs to produce</b> a portfolio related to information on organisations that use science to analyse processes [50 marks].</p> <p>This evidence needs to include:</p> <p><b>AO1:</b> relevant research, understanding and detail in a study of <b>one</b> organisation to produce a report for that organisation which considers their energy policy and energy usage; the report must include a consideration of their energy efficiency and environmental impact [19];</p> <p><b>AO2:</b> a study of large-scale and small-scale generation, to include energy transfer involved; to include data and calculations to show a comparison of fuel/energy costs [10];</p> <p><b>AO3:</b> evidence that the candidate has safely completed <b>three</b> practical analyses – to include a range of <b>both</b> qualitative and quantitative analysis– each needs to be appropriately recorded, processed and evaluated [21].</p>				
How the candidate will be assessed:				
Assessment Objective	Mark Band 1	Mark Band 2	Mark Band 3	Mark Awarded
AO1	Candidate will give a brief description of the energy policy of a non-domestic consumer of electricity;  <div style="text-align: right;">[0 1 2]</div>	candidate will give selected information obtained from a non-domestic consumer of energy to give a description about their energy policy;  <div style="text-align: right;">[3 4]</div>	candidate will give selected, relevant information obtained from a non-domestic consumer of energy, to give a detailed description of their energy policy and evaluate ways in which they limit their energy consumption.  <div style="text-align: right;">[5 6]</div>	
	Candidate will state what is meant by energy efficiency and state how the candidate's non-domestic consumer of energy has considered energy efficiency by <ul style="list-style-type: none"> <li>• carrying out processes or activities more efficiently</li> <li>• eliminating wasteful processes or activities</li> <li>• other means;</li> </ul> <div style="text-align: right;">[0 1 2]</div>	candidate will state what is meant by energy efficiency and describe how energy efficiency has been considered by the candidate's chosen non-domestic consumer of energy by <ul style="list-style-type: none"> <li>• carrying out processes or activities more efficiently (include a definition of energy efficiency)</li> <li>• eliminating wasteful processes or activities</li> <li>• other means</li> </ul> generally using accurate terminology and nomenclature;  <div style="text-align: right;">[3 4]</div>	candidate will state what is meant by energy efficiency and explain how energy efficiency has been considered by the candidate's chosen non-domestic consumer of energy and evaluate the reduction of energy consumption by <ul style="list-style-type: none"> <li>• carrying out processes or activities more efficiently (relate this to efficiency)</li> <li>• eliminating wasteful processes or activities</li> <li>• other means</li> </ul> using accurate terminology and nomenclature.  <div style="text-align: right;">[5 6]</div>	

<b>Unit G621: Analysis at work (continued)</b>				
<b>Assessment Objective</b>	<b>Mark Band 1</b>	<b>Mark Band 2</b>	<b>Mark Band 3</b>	<b>Mark Awarded</b>
<b>AO1</b>	<p>Candidate will state how their chosen organisation has considered the</p> <ul style="list-style-type: none"> <li>• environmental impacts</li> <li>• cost savings</li> </ul> <p>of reducing energy consumption, generally using correct, spelling, punctuation and grammar;</p> <p style="text-align: right;"><b>[0 1 2]</b></p>	<p>candidate will describe how their chosen organisation has considered the</p> <ul style="list-style-type: none"> <li>• environmental impacts</li> <li>• cost savings</li> </ul> <p>of reducing energy consumption, generally using correct terminology, spelling, punctuation and grammar;</p> <p style="text-align: right;"><b>[3 4 5]</b></p>	<p>candidate will describe in detail how their chosen organisation has considered the</p> <ul style="list-style-type: none"> <li>• environmental impacts</li> <li>• cost savings</li> </ul> <p>of reducing energy consumption and relate it to the energy policy of the organisation, using accurate terminology, correct spelling, punctuation and grammar.</p> <p style="text-align: right;"><b>[6 7]</b></p>	<b>/19</b>
<b>AO2</b>	<p>Candidate will show the forms of energy transfer involved in the generation of electricity; candidate will describe briefly large-scale and small-scale electrical generation from one chosen fuel or energy source;</p> <p style="text-align: right;"><b>[0 1]</b></p>	<p>candidate will describe and compare large-scale and small-scale electrical generation from two chosen fuel or energy sources; candidate will demonstrate good research skills and evidence of selection of material;</p> <p style="text-align: right;"><b>[2 3]</b></p>	<p>candidate will describe and compare the relative benefits and problems of large-scale and small-scale electrical generation from two chosen fuel or energy sources; candidate will demonstrate independent research skills and evidence of selection of relevant material.</p> <p style="text-align: right;"><b>[4 5]</b></p>	<b>/10</b>
	<p>Candidate will display information on energy values and fuel/energy costs to include</p> <ul style="list-style-type: none"> <li>• one non-renewable</li> <li>• one renewable</li> </ul> <p>fuel/energy source used in the generation of electricity;</p> <p>candidate will show a number of straightforward calculations using the candidate's data, generally obtaining the correct solutions;</p> <p style="text-align: right;"><b>[0 1]</b></p>	<p>candidate will research and display information on energy values and fuel/energy costs to include</p> <ul style="list-style-type: none"> <li>• one non-renewable</li> <li>• one renewable</li> </ul> <p>fuel/energy source used in the generation of electricity;</p> <p>candidate will show a number of complex and straightforward calculations using the data researched, generally obtaining the correct solutions;</p> <p style="text-align: right;"><b>[2 3]</b></p>	<p>candidate will research and display information on energy values and fuel/energy costs to include a range of</p> <ul style="list-style-type: none"> <li>• non-renewable</li> <li>• renewable</li> </ul> <p>fuel/energy sources used in the generation of electricity;</p> <p>candidate will show a number of complex and straightforward calculations using the data researched, obtaining the correct solutions to an appropriate degree of accuracy.</p> <p style="text-align: right;"><b>[4 5]</b></p>	

Unit G621: Analysis at work (continued)				
Assessment Objective	Mark Band 1	Mark Band 2	Mark Band 3	Mark Awarded
AO3	<p>Candidate will produce a report of a qualitative analysis they have carried out, linked to a vocational context in which risk assessments have been used; relevant observations have been made and results suitably processed, with some interpretation;</p> <p style="text-align: right;"><b>[0 1 2 3]</b></p>	<p>candidate will produce a detailed report of a qualitative analysis they have carried out, linked to a vocational context in which risk assessments have been completed; relevant observations have been made and results accurately processed and interpreted; the information is presented clearly and logically;</p> <p style="text-align: right;"><b>[4 5]</b></p>	<p>candidate will produce a detailed report of a qualitative analysis they have carried out, linked to a vocational context in which risk assessments have been produced with evidence equipment has been used safely and to the appropriate degree of accuracy; relevant observations have been made and results accurately processed and interpreted; the information is presented clearly, logically and has been evaluated.</p> <p style="text-align: right;"><b>[6 7]</b></p>	
	<p>Candidate will produce a report of a quantitative analysis they have carried out, linked to a vocational context in which risk assessments have been used; relevant observations have been made and results suitably processed, with some interpretation;</p> <p style="text-align: right;"><b>[0 1 2 3]</b></p>	<p>candidate will produce a detailed report of a quantitative analysis they have carried out, linked to a vocational context in which risk assessments have been completed; relevant observations have been made and results processed and interpreted accurately; the information is presented clearly and logically;</p> <p style="text-align: right;"><b>[4 5]</b></p>	<p>candidate will produce a detailed report of a quantitative analysis they have carried out, linked to a vocational context in which risk assessments have been produced, with evidence that equipment has been used safely and to the appropriate degree of accuracy; relevant observations have been made and results processed and interpreted accurately; the information is presented clearly and logically and has been evaluated.</p> <p style="text-align: right;"><b>[6 7]</b></p>	
	<p>Candidate will produce a report of a <b>third</b> investigation they have carried out, linked to a vocational context in which risk assessments have been used; relevant observations or measurements have been made and results suitably processed, with some interpretation;</p> <p style="text-align: right;"><b>[0 1 2 3]</b></p>	<p>candidate will produce a detailed report of a <b>third</b> investigation they have carried out, linked to a vocational context in which risk assessments have been completed; relevant observations or measurements have been made and results accurately processed and interpreted; the candidate's information will be presented clearly and logically;</p> <p style="text-align: right;"><b>[4 5]</b></p>	<p>candidate will produce a detailed report of a <b>third</b> investigation they have carried out, linked to a vocational context in which risk assessments have been produced with evidence equipment has been used safely and to the appropriate degree of accuracy; relevant observations or measurements have been made with the appropriate precision and results accurately processed and interpreted; the candidate's information will be presented clearly, logically and has been evaluated.</p> <p style="text-align: right;"><b>[6 7]</b></p>	/21
<b>Total mark awarded:</b>				<b>/50</b>