OCR
RECOGNISING ACHIEVEMENT

Support Material

GCE Chemistry B (Salters)

OCR Advanced Subsidiary GCE in Chemistry B (Salters): H035

Unit: F331 Chemistry for Life

This Support Material booklet is designed to accompany the OCR Advanced Subsidiary GCE specification in Chemistry B (Salters) for teaching from September 2008.

Contents

Introduction

Background

A new structure of assessment for A Level has been introduced, for first teaching from September 2008. Some of the changes include:

- The introduction of stretch and challenge at A2 (including the new A* grade at A2) – to ensure that every young person has the opportunity to reach their full potential;
- The reduction or removal of coursework components for many qualifications – to lessen the volume of marking for teachers;
- A reduction in the number of units for many qualifications – to lessen the amount of assessment for learners;
- Amendments to the content of specifications – to ensure that content is up-to-date and relevant.

OCR has produced an overview document, which summarises the changes to Chemistry. This can be found at **www.ocr.org.uk**, along with the new specification.

In order to help you plan effectively for the implementation of the new specification we have produced this Scheme of Work for Chemistry B (Salters). These Support Materials are designed for guidance only and play a secondary role to the Specification.

Our Ethos

All our Support Materials were produced 'by teachers for teachers' in order to capture real life current teaching practices and they are based around OCR's revised specifications. The aim is for the support materials to inspire teachers and facilitate different ideas and teaching practices.

Each Scheme of Work is provided in:

- PDF format – for immediate use;
- Word format – so that you can use it as a foundation to build upon and amend the content to suit your teaching style and students' needs.

The Scheme of Work provides examples of how to teach this unit and the teaching hours are suggestions only. Some or all of it may be applicable to your teaching.

The Specification is the document on which assessment is based and specifies what content and skills need to be covered in delivering the course. At all times, therefore, this Support Material booklet should be read in conjunction with the Specification. If clarification on a particular point is sought then that clarification should be found in the Specification itself.

Introduction to Salters Advanced Chemistry Course Materials Available from Heinemann

The Salters Advanced Chemistry course for AS and A2 is made up of 13 teaching modules. *Chemical Storylines AS* forms the backbone of the five AS teaching modules. There is a separate book of *Chemical Ideas*, and a *Support Pack* containing activities to accompany the AS teaching modules.

Each teaching module is driven by the storyline. You work through each storyline, making 'excursions' to activities and chemical ideas at appropriate points.

The storylines are broken down into numbered sections. You will find that there are **assignments** at intervals. These are designed to help you through each storyline and check your understanding, and they are best done as you go along.

From AS Chemical Storylines (ISBN: 9780435631475)

How this scheme fits into the academic year

This scheme of work should be read in conjunction with three other documents:

- OCR Chemistry B (Salters) Support Material F332 Chemistry of Natural Resources;
- Practical Skills Handbook: available via OCR Interchange https://interchange.ocr.org.uk and at www.ocr.org.uk;
- The Specification, OCR Advanced Subsidiary GCE in Chemistry B (Salters): H035: available via www.ocr.org.uk

The number of teaching hours contained within this scheme **should not** be taken as the absolute number required for delivering this course. The times indicated below are given for guidance only, to allow teachers to plan how this course will fit into the educational year for their school. It must be noted that the two schemes of work to support the Chemistry B (Salters) Specification **do not** contain time for review of homework, assignments or end of module tests, all of which are essential for effective teaching and learning.

The teaching hours suggested by the schemes of work are as follows:

F331 Chemistry for Life: Total 50 suggested teaching hours

- Elements of Life 24
- Developing Fuels 26

F332 Chemistry of Natural Resources: Total 75 suggested teaching hours

- Elements from the Sea 36
- The Atmosphere 25
- Polymer Revolution 14

F333 Chemistry in Practice: Total 10 suggested teaching hours

- Skill I for this unit can be assessed during lesson activities within this scheme of work
- Skills II to V must be assessed using OCR supplied Tasks and Mark Schemes under supervised conditions as specified in the Practical Skills Handbook for the course (the Tasks are only available from OCR's secure extranet, Interchange – see the Specification and Handbook for more details). Whilst only one mark (the best) needs to be submitted for each Skill area, some candidates may need to attempt more than one Task (a total of three Tasks are offered by OCR in each skill area, Skills II to V). Tasks must **not** be returned to candidates. Tasks remain confidential question paper items for the lifetime of the specification.

As with all Advanced Subsidiary GCE qualifications, the Guided Learning Hours for this Specification are 180. This should include lesson time and directed study. The schemes of work provided in the Support Material for this Specification do not identify how this directed time should be spent. Individual teachers must account for this in their planning and ensure that students receive the full Guided Learning Hours for this Specification.

Delivery of F333 – Chemistry in Practice

To enable students to achieve their maximum potential in this unit it is recommended that teachers fully familiarise themselves with the Practical Skills Handbook (available from www.ocr.org.uk). At the start of each academic year, centres should review the current Tasks from Interchange (a Getting Started file is supplied on Interchange summarising the Tasks available for the current assessment period and, from 2009, what areas of the specification should have been taught before attempting the Task with candidates. Tasks are posted on 1 June each year and are valid for assessment use from 1 June until 14 May of the following year. From 2009, Mark Schemes are available from 1 September each year). This will allow teachers to plan the point in their teaching where they should break to carry out an appropriate Task. Teachers should aim to assess Skills II to V immediately after the appropriate theory has been taught. All Tasks should be trialled by teachers before they are carried out by candidates, check the Practical Skills Handbook for further details, and Interchange should be checked to ensure no updates for Tasks have been posted. OCR offer a free e-mail updates service to notify centres if changes are made to information on Interchange and it is recommended that all centres register for this service, details are given in the Practical Skills Handbook and on Interchange.

A Guided Tour through the Scheme of Work

= Innovative Teaching Idea

All the teaching idea contained in the SOW are innovative, but the icon is used to highlight exceptionally innovative ideas.

= Stretch & Challenge Activity

This icon is added at the end of text when there is an explicit opportunity to offer Stretch and Challenge.

= ICT Opportunity

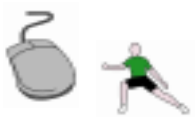
This icon is used to illustrate when an activity could be taught using ICT facilities.

= Skill I Assessment Opportunity

This icon is used to illustrate when an activity could be used to assess Skill I from unit F333.

GCE Chemistry B (Salters): H035. F331 Chemistry for Life

Suggested teaching time	9 hours	**Topic**	Story EL 1 Where do the chemical elements come from?

Lesson	Suggested teaching and homework activities	Non-Salters resources	Specification Statements & Points to note
1 + 2 and (3)	• **ACT EL1.1** 'How do we know about atoms?' Develop this into accepted view of atom from GCSE and mass and charge contributions of protons neutrons and electrons  **If students are to gain maximum benefit from this first activity, ideally one lesson should be allowed for research and one lesson for the presentations before moving on to the theory below** • Discuss **STORY EL1** p3-5 and **IDEAS 2.2** p19-20 'Nuclear reactions'. Students draw a flow diagram to illustrate the formation of elements in space • **IDEAS 2.1** 'A simple model of the atom' to cover: structure of the atom and introduce isotopes	• http://www.fordhamprep.org/gcurran/sho/sho/lessons/lesson32.htm • http://chemistry.jcu.edu/nicholsweb/ch221f01/Fall_2003_hw/ch141f98/atomtheor1.htm • http://www.learnnc.org/lessons/annachilds1142004055 gives a good lesson plan • http://dbhs.wvusd.k12.ca.us/webdocs/AtomicStructure/AtomicStructure.html provides many links • http://www.freezeray.com/flashFiles/atomicStructure.htm • http://education.jlab.org/elementmath/index.html is useful revision from GCSE • http://www.quia.com/quiz/253521.html quiz opportunity • http://imagine.gsfc.nasa.gov/docs/teachers/lessons/xray_spectra/activity-fusion.html	Candidates should be able to: • Understand that knowledge of the structure of the atom developed in terms of a succession of gradually more sophisticated models; given information, interpret these and other examples of such developing models • Use nuclear symbols to write equations for nuclear processes, both fusion and radioactive decay • Recall that, in fusion reactions, lighter atoms join to give heavier atoms (under conditions of high temperature and pressure) and understand that this is how certain elements are formed • Describe protons, neutrons and electrons in terms of their mass and relative charge • Describe the structure of an atom in terms of electrons and a central nucleus containing protons and neutrons • Explain and use the terms: atomic number, mass number, isotope

Lesson	Suggested teaching and homework activities	Non-Salters resources	Specification Statements & Points to note
4 + 5	• **STORY EL1** p5-6. Discuss stars as cores of iron. • Demonstrate use of pipettes and burettes. • **ACT EL1.2** 'How much iron is in a sample of an iron compound?' 		Candidates should be able to: • Carry out a titration
6 + (7)	**The extra lesson will be required if time is allowed to develop the presentation effectively** • **STORY EL1** p6-8 'How do we know so much about outer space?' • Review fusion reactions and the stars. Discuss **IDEAS 2.3** 'Electronic structure: shells' which is mostly revision of GCSE work plus a small introduction to ionisation energy. Attempt end of section Qs • **ACT EL1.3** 'Investigating visible emission spectra' 	• http://www.teachnet.ie/pjackson/emmisionspectrum.ppt#257 ,1,Emission Spectrum Animation • http://jersey.uoregon.edu/vlab/elements/Elements.html	Candidates should be able to: • Describe the electron structure of atoms in terms of main energy levels (electron shells), up to Z=36 • Recall that the position of an element in the Periodic Table is related to its electron structure (main energy levels or electron shells) and *vice versa* • Carry out an experiment involving ICT
8	• **ACT EL1.3** Discuss and get students to deduce ideas about emission and absorption spectra • **IDEAS 6.1** 'Light and electrons'. The end of section Qs are thought provoking. As part of the discussion, students should be encouraged to investigate units and dimensions as well as the link between frequency, wavelength and energy • Relate understanding of emission/absorption spectra to **STORY EL1**. Do **ASS 2** (**STORY** p7)	• http://www.chemguide.co.uk/atoms/properties/hspectrum.html • http://www.york.ac.uk/org/seg/salters/chemistry/DIY/ppoint/CI6.1.ppt This is a resource produced by Lesley Johnston, King James's School, Knaresborough specifically for the Salters course	Candidates should be able to: • Explain the occurrence of absorption and emission atomic spectra in terms of changes in electronic energy levels; compare and contrast the features of these spectra: (i) similarities: both line spectra; lines in the same position for a given element; lines become closer at higher frequencies; sets of lines representing transitions to or from a particular level, (ii) differences: bright/coloured lines on a black background or black lines on a coloured/bright background; understand the relationship between the energy emitted or absorbed and the frequency of the line produced in the spectra; $\Delta E = h\nu$

Lesson	Suggested teaching and homework activities	Non-Salters resources	Specification Statements & Points to note
9	This lesson can be kept very simple or used to extend the most able: • Recap nuclear equations from lesson 1 using **ASS 1** (**STORY** p6) • Revision of material from Core GCSE. Including types and properties of radiations and their uses.  • **STORY EL1** p8 'Our solar system' and **IDEAS 2.2** p20-23 'Nuclear reactions'. Attempt end of section Qs • **ACT EL1.4** 'Simulating radioactive decay' allows further practise at working out radioactive half lives  • **STORY EL1** p9-10 'Archaeological uses of carbon-14 dating'	• http://www.bbc.co.uk/schools/gcsebitesize/science/aqa/radiation/radiocativerev1.shtml • http://www.bbc.co.uk/apps/ifl/schools/gcsebitesize/science/quizengine?quiz=radioactivetest&templateStyle=science The bite size web site and test is a quick and useful way of checking prior knowledge  • http://www.bustertests.co.uk/take_test/42	Candidates should be able to: • Recall that the nuclei of some atoms are unstable and that these atoms are radioactive • Recall and explain the different properties of α-, β- and γ- radiations • Recall that the term *half-life* refers to the time taken for half the radioactive nuclei in a sample to decay and that the half-life is fixed for any given isotope • Carry out half-life calculations • Understand how radioactive isotopes can be used as 'tracers' in the body and (given information) for other uses • Explain that the half-life of 'tracers' must be of an appropriate length to allow detection but not cause undue damage • Understand the use of radioisotopes in the dating of archaeological and geological material

Suggested teaching time	4 hours	Topic	Story EL 2 The molecules of life

Lesson	Suggested teaching and homework activities	Non-Salters resources	Specification Statements & Points to note
10	• **STORY EL2** p10-13 'The molecules of life' • Work through **IDEAS 3.1** p36-41 'Chemical bonding' omit the sections titled 'Why are bonds like bears' and 'Electronegativity'. Attempt end of section Qs 1-5, 8 and 12 • **ACT EL2.3** 'What type of properties do different structures have?' • A plenary activity here could be **ACT EL2.1** 'Why do atoms form ions'	• 'A short history of nearly everything' by Bill Bryson has a very readable section as background for this bit • Video Education Australasia resources: http://www.vea.com.au/Default.aspx Title 'The chemical bonding series' • RSC Spot the bonding from 'Chemical misconceptions – prevention, diagnosis and cure' • RSC Ionic Bonding True and false worksheets from 'Chemical misconceptions – prevention, diagnosis and cure' • RSC Predicting the melting temperature of carbon from 'Chemical misconceptions – prevention, diagnosis and cure'	Candidates should be able to: • Draw and interpret simple electron 'dot and cross' diagrams to show how atoms bond through ionic, covalent and dative covalent bonds and be able to describe a simple model of metallic bonding • Describe some of the limitations of these models • Recall the typical physical properties (melting point, solubility in water, ability to conduct electricity) characteristic of giant lattice (metallic, ionic, covalent network) and simple molecular structure types
11 + (12)	• Work through **IDEAS 3.2** 'The shapes of molecules' and attempt end of section Qs • **ACT EL 2.2** 'Shapes of molecules', both parts. The balloon modelling in particular is a good way to show why molecules take up the shape they do. 	• Students can make molecular ball and stick models to show how molecules form and then translate these into dot and cross diagrams • Then students can model molecules with double and triple bonds 	Candidates should be able to: • Use the electron pair repulsion principle to predict and explain the shapes of simple molecules (such as CH_4, NH_3, H_2O and SF_6) and ions (such as NH_4^+) with up to six outer pairs of electrons (any combination of bonding pairs and lone pairs) (no treatment of hybridisation or molecular orbitals is expected)
13	• Complete and review work for this topic. • Students should use **ACT EL2.4** 'Check your knowledge and understanding (part 1)' to review and amend notes. They should have the opportunity to resolve problems now if they have not done so before.		

Suggested teaching time	5 hours	Topic	Story EL 3 What are we made of?

Lesson	Suggested teaching and homework activities	Non-Salters resources	Specification Statements & Points to note
14	• **STORY EL3** p13-14 'What are we made of?' • Introduce simple mole calculations using **IDEAS 1.1** 'Amount of substance' The Qs from the end of this section should be set as preparation for next lesson. • **ACT EL3** 'Making and analysing Epsom salts'. This practical is an excellent opportunity to discuss the different methods of weighing substances (by tare or by difference)	• For students whose GCSE study of moles was brief (foundation tier etc.) it will be extremely useful for them to work through the book 'Moles: A survivors guide for GCSE chemistry' by Keith Brown	Candidates should be able to: • Use the concept of amount of substance to perform calculations involving: masses of substances, empirical and molecular formulae, percentage composition
15	• Review **ACT EL3** • Give notes to include correct worked examples of calculations from **IDEAS 1.1** • Review Qs from **IDEAS 1.1.** Set aside time in lesson 16 if necessary to revisit this topic	• **Ideas 12.1** Qs 2-4 provide further example questions • Determination of the empirical formula of copper(II) oxide by reduction • Precipitation titration (ILPAC 'Advanced Practical Chemistry) • http://www.docbrown.info/page04/4_73calcs/MAMmcTEST.htm	Candidates should be able to: • Explain and use the terms: Avogadro constant, relative atomic mass, relative formula mass, relative molecular mass • Use the concept of amount of substance to perform calculations involving: masses of substances, empirical and molecular formulae, percentage composition

Lesson	Suggested teaching and homework activities	Non-Salters resources	Specification Statements & Points to note
16 + (17)	**The extra lesson will be required if time is allowed to develop moles in solution effectively** • Review Qs from **IDEAS 1.1** and address any issues • Students discuss what they understand by the terms 'concentrated' and 'dilute' and try to define the term concentration. • Explain the meaning of 'concentration' in terms of amount of substance (moles) in a given volume and that the units are mol/dm^3 or mol dm^{-3}. Do a few simple calculations e.g. **IDEAS 1.5** 'Concentrations of solutions' Qs 1-5 • Students perform a simple neutralisation **titration** e.g. ***NaOH*** and ***HCl*** of equal concentrations to prepare a salt. Using c = n/v they can determine the reacting ratio and hence the balanced equation	• Group work using RSC resource sheets: Concentrated and Dilute Acids from 'Chemical Misconceptions'  • http://www.docbrown.info/page04/4_73calcs/MScmcTEST.htm • http://www.docbrown.info/page04/4_73calcs/MScsaTEST.htm	Candidates should be able to: NOTE: the treatment of moles in solution is not addressed until the 'Elements from the sea' topic but that may prove too late for practical assessment purposes, hence the inclusion of this material here. • Carry out a titration
18	• Practical: ***NaOH / H_2SO_4*** titration involving stock solution preparation • **IDEAS 1.5** 'Concentrations of solutions' Qs 6-8	• ILPAC video: preparing a standard solution • Determination of concentration of limewater • Weaker students may benefit from extra Qs from 'Moles: A survivors guide for GCSE chemistry' by Keith Brown	Candidates should be able to: NOTE: the treatment of moles in solution is not addressed until the 'Elements from the sea' topic but that may prove too late for practical assessment purposes, hence the inclusion of this material here. • Carry out a titration

Suggested teaching time	6 hours	Topic	Story EL 4 Looking for patterns in elements

Lesson	Suggested teaching and homework activities	Non-Salters resources	Specification Statements & Points to note
19 + 20	• **STORY EL4** p15-16 'Looking for patterns in elements' first two paragraphs • Quick review of how to write balanced equations using **IDEAS 1.2.** • Students to predict/explain trend in reactivity of Group 2 in terms of ability to lose electrons  • **ACT EL4.1** 'Investigating the chemistry of Group 2 elements'  • Use **IDEAS 11.2** 'The s block: Groups 1 and 2' to gain the information needed for completion of **ACT EL4.1.** • Students to develop their communication skills by making their own notes from **IDEAS 11.2** 'The s block: Groups 1 and 2'. Answer end of section Qs.	• The rate of decomposition of Group 2 carbonates can be studied by measuring time taken for limewater to go cloudy (ILPAC 'Advanced Practical Chemistry') • RSC Classic chemistry experiments: Neutralisation of indigestion tablets • Study the reaction of heat on $CaCO_3$ to form *CaO* and the subsequent action of water to produced slaked lime • Students could plan an experiment studying the ease of decomposition of the Group 2 carbonates	Candidates should be able to: • Write and interpret balanced chemical equations including state symbols • Use given information to describe trends in a group of the Periodic Table and to make predictions concerning the properties of an element in this group; describe periodic trends in the properties of elements, in terms of melting and boiling point • Describe and compare the following properties of the elements and compounds of Mg, Ca, Sr and Ba in Group 2: reactions of the elements with water, acid-base character of the oxides and hydroxides, thermal stability of the carbonates, solubilities of hydroxides and carbonates • Carry out qualitative experiments using test-tubes
21	• Discuss **STORY EL4** p15-16 'Looking for patterns in elements'. Most schools have a suitable video of periodic trends. An alternative is given in the adjacent column • **ACT EL 4.3** 'Patterns in the physical properties of elements'. This activity can be extended to look at other trends across periods and trends within Groups.  • Extended ICT work following the study of **IDEAS 11.1** 'Periodicity', using the end of section Qs as prompts	• http://www.freezeray.com/flashFiles/discoveryDates.htm • http://www.freezeray.com/flashFiles/periodicHistory.htm • http://media.rsc.org/videoclips/TV/ferociouselements.mpg This is a video which covers trends in the periodic table. It needs downloading prior to use due to its size.	Candidates should be able to: • Recall that the Periodic Table lists elements in order of atomic (proton) number and groups elements together according to their common properties • Understand how Mendeleev developed the Periodic Table by leaving gaps and rearranging some elements from their atomic mass order and how subsequent research validated this knowledge; given relevant information, discuss other examples of how scientific research can be used to assess the validity of a discovery.

Lesson	Suggested teaching and homework activities	Non-Salters resources	Specification Statements & Points to note
22	• Revisit **IDEAS 2.1** 'A simple model of the atom' to cover: structure of the atom and isotopes. • **IDEAS 6.5** p139-142 'Mass spectrometry' to include Qs 1-2 Provide an outline diagram for students to annotate and answer Qs. • Worked examples for A_r calculations (see **IDEAS 2.1** and **ACT EL4.2** for a range of questions of varying complexity)	• http://www.rmjordan.com/Resources/Tutorial.pdf a good resource for teachers to familiarise themselves with this newer spectroscopy technique • www.chm.bris.ac.uk/ms/theory/tof-massspec.html this article also contains information on time of flight spectroscopy • http://www.knockhardy.org.uk/assets/MS2.PDF good for its interpretation section but the equipment section deals with the older type of mass spectrometry no longer assessed • http://www.docbrown.info/page04/4_73calcs01ram.htm	Candidates should be able to: • Use data from a mass spectrometer to: (ii) calculate relative atomic mass and the relative abundance of isotopes (iii) work out the relative molecular mass of molecules and understand that other peaks are caused by fragments of molecules (no detail required at this stage) • Explain and use the terms: relative isotopic mass, relative atomic mass • Explain and use the terms: atomic number, mass number, isotope • Describe and explain the main stages in the operation of a time-of-flight mass spectrometer
23	• Complete and review work for this topic. • Students should use **ACT EL5** 'Check your knowledge and understanding (part 2)' to review and amend notes. They should have the opportunity to resolve problems now if they have not done so before.		
24	• End of module test		

Suggested teaching time	8 hours	Topic	Story DF 1 The vehicle of the future? Story DF 2 Getting energy from fuels

Lesson	Suggested teaching and homework activities	Non-Salters resources	Specification Statements & Points to note
	These sections are aimed at studying the chemistry behind combustion and looking at where the energy comes from when a fuel burns. Bond enthalpy calculations follow more naturally from GCSE so it makes more sense to do this first and then tackle Hess Cycles (the opposite of the order suggested in Storylines). Students must be encouraged to make correct careful notes for this topic- these notes should include correct worked examples of ALL calculations.		
1 + 2	**The first two lessons in this section are largely revision from core and additional GCSE, some or all of it may be omitted depending on the ability of the students** • Discuss **STORY DF1** p21-22. Use this as an opportunity for students to recall and reflect upon their knowledge from GCSE • Review the basics of energy- difference between energy/enthalpy, energy level diagrams, exothermic and endothermic, ΔH, units and signs for ΔH, system, surroundings, standard conditions, measuring enthalpy changes. All of this is revision from core GCSE and will therefore have been met previously by all students. See **IDEAS 4.1** p56-58 (top half) 'Energy out, energy in' • If not already covered in **EL14** it would be useful to review **IDEAS 1.2** 'Balanced equations' • **IDEAS 1.3** 'Using equations to work out reacting masses' including end of section Qs. To do the activity which follows, students need a basic understanding of moles = mass / M_r. Equations in calculations will be needed later in the unit so it would appear sensible to review it all here	• http://www.creative-chemistry.org.uk/gcse/revision/equations/index.htm is useful for revising balanced equations • Some of the example reactions listed for the next lesson may be used here to remind students of the definitions of exo and endothermic	Candidates should be able to: • Use the concept of amount of substance to perform calculations involving: balanced chemical equations • Explain and use the terms: exothermic, endothermic, standard state

Lesson	Suggested teaching and homework activities	Non-Salters resources	Specification Statements & Points to note
3 + 4	• **ACT DF2.1** 'Measuring the enthalpy change of combustion of different fuels'. This activity could be extended to look at a homologous series of fuels with students putting forwards their reasons for the trends  • **ACT DF2.2** 'Determining an enthalpy change of reaction'  For both of these activities, emphasise the method used, safe handling of chemicals, accurate measurement technique and analysis of errors.	• Students can perform a series of experiments looking at **endothermic** and **exothermic** reactions and measure the associated temperature changes. Students could use dataloggers to monitor temperature and plot graphs to determine 'instantaneous' temperature change.  • Example reactions include: $NaOH(aq)$/ $HCl(aq)$; $Zn(s)$/ $CuSO_4(aq)$; $HCl(aq)$/ $Na_2CO_3(s)$ • Using the observed temperature changes calculate $\Delta H = mc\Delta T$ for each experiment. This can be used to calculate ΔH_{molar}. Students can then construct enthalpy profile diagrams for the associated reactions • Different equipment can be used to allow students to evaluate (e.g. beakers/polystyrene cups/ thermos flasks, different thermometers) and varied particle size 	Candidates should be able to: • Calculate enthalpy changes from experimental results, recalling the formula: heat transferred = mass × specific heat capacity × temperature change; describe the approximations in density and specific heat capacity of solutions made in these calculations • Use the concept of amount of substance to perform calculations involving: balanced chemical equations, enthalpy changes • Describe and design simple experiments to measure the energy transferred when reactions occur in solution or when flammable liquids burn; explain the limitations of such practical procedures and the uncertainties of measurement involved • Carry out quantitative experiments accurately and make and record reliable and valid measurements with appropriate accuracy and precision • Apply chemical knowledge and processes to unfamiliar situations, to analyse and evaluate their own quantitative experiments • Make thermochemical measurements
5	• Discuss **IDEAS 4.2** 'Where does the energy come from?' This is largely revision from GCSE but particular attention should be paid to p65 'Bonds and enthalpy cycles' as this can be a useful introduction to Hess Cycles • Students attempt end of section Qs. It is vital that understanding is established here before progression to lesson 4	• Students set up a spreadsheet to calculate successive enthalpies of combustion of a homologous series and comment on their findings. (NB This is an activity from the Heinemann Support Pack 2nd Edition)  • Using molecular models students can investigate the concept of bond making and breaking as being exothermic and endothermic respectively	Candidates should be able to: • Explain and use the term (*average*) *bond enthalpy* and relate bond enthalpy to the length and strength of a bond; recall that bond-breaking is an endothermic process and bond-making is exothermic and use these ideas to explain the overall enthalpy change for a reaction

Lesson	Suggested teaching and homework activities	Non-Salters resources	Specification Statements & Points to note
6 + 7	• Discuss the need to be able to measure some enthalpy changes indirectly using enthalpy cycles. Introduce the remainder of **IDEAS 4.1** p58 (bottom half)-61 'Energy out, energy in' • Ensure students have correct worked examples of Hess Cycles using both combustion enthalpies and formation enthalpies as the given quantities • Use **ACT DF2.3** 'Calculating an enthalpy change of a reaction using Hess' law' as a discussion point to assess understanding of calculation • Students attempt end of section Qs. It is advisable not to set these Qs as homework as many students find this concept challenging at the start of the course.	• Students can carry out an experiment to calculate the enthalpy change for a reaction using a Hess cycle. Example reactions include: $CuSO_4$ → $CuSO_4 \cdot 5H_2O$ (hydration of anhydrous and hydrated salt) (ILPAC); reaction of Ca and CaO with HCl ; CaO and $CaCO_3$ with HCl ; $2KHCO_3$ → $K_2CO_3 + H_2O + CO_2$ with HCl • In groups students could then design an experiment, (using a Hess' cycle), for an appropriate reaction where errors were minimised to see who could obtain the most accurate ΔH value • Using cards with arrows, formulae and coefficients students can solve Hess' cycle problems. This should be done for ΔH_r from ΔH_f and ΔH_r from ΔH_c and they can derive shortcuts for each cycle 	Candidates should be able to: • Explain and use the terms: *exothermic*, *endothermic*, *standard state*, (*standard*) *enthalpy change of combustion* (ΔH_c), (*standard*) *enthalpy change of reaction* (ΔH_r), (*standard*) *enthalpy change of formation* (ΔH_f) • Use Hess' law to explain how enthalpy cycles can be used to calculate enthalpy changes of reaction, including *via* enthalpy changes of formation, combustion and bond enthalpies; carry out these calculations
8	• Students to develop their communication skills by making their own notes from **STORY DF2** p22-24 'Getting energy from fuels'. • Discuss the concept of energy density as this is useful to consider later in the unit when looking at alternative fuels. Students attempt **ASS 2** (**STORY** p24) • Students should use **ACT DF2.4** 'Check your knowledge and understanding (part 1)' to review and amend notes. They should have the opportunity to resolve problems now if they have not done so before.	• http://www.york.ac.uk/org/seg/salters/chemistry/DIY/ppoint/DDDF2.ppt is from the York Salter's website. The reference refers to the old specification but the material is still relevant	

Suggested teaching time	2 hours	Topic	Story DF 3 Focus on petrol and diesel

Lesson	Suggested teaching and homework activities	Non-Salters resources	Specification Statements & Points to note
9	Fractional distillation is a topic from core GCSE science. • Students can revise this topic by producing a booklet/poster suitable for use by a GCSE student. It should include as a minimum, a labelled diagram of a fractionating tower, graphs and explanations about supply and demand and a brief description of the structures of alkanes, cycloalkanes, alkenes and arenes. (See **STORY** p24-26, **IDEAS** p265-266, 268, 272, 277)  • Use molymods and balloons etc to ensure a good understanding of the bond angles within these molecule types. Relate back to **EL8** if already covered.	• Students could make models of simple alkanes and write down the molecular formula of each. From this they can determine the empirical formula and **general formula** and identify the difference between successive members of the **homologous** series • They could then draw the displayed, structural and skeletal formulae of the first ten alkanes. Using models they can describe and explain the **shape** around each carbon • http://www.adventuresinenergy.org/Refining-Oil/index.html is a useful website with animations etc • http://www.footprints-science.co.uk/fractional.htm is a quick and fun revision tool • http://resources.schoolscience.co.uk/Exxonmobil/infobank/4/flash/distillation.htm	Candidates should be able to: • Recall that crude oil consists of a mixture of compounds, mainly hydrocarbons (compounds of hydrogen and carbon only) that can be separated by fractional distillation • Recognise members of the following homologous series: alkanes, cycloalkanes, alkenes, arenes • Explain and use the terms: *aliphatic*, *aromatic*, *saturated* and *unsaturated* • Use the concept of repulsion of areas of electron density to deduce the bond angles in organic molecules (including double bonds) (no treatment of small deviation of angle due to lone pair repulsion required) • Relate molecular shape to structural formulae and use wedges and dotted lines to represent 3D shape
10	• Introduce the concept of volatility and relate back to fractional distillation in previous lesson • **STORY** p26-27 'Summer and winter petrol' • Do **ACT DF3.1** 'Comparing winter and summer petrol blends • **STORY** p27-28 'The problem of knocking'. Explain what is meant by octane number • **ACT DF3.2** can be done as a class activity or a demo if time is short. It is worth finding the time to do as it is a very 'memorable' practical • Understanding can be assessed through **ASS 4** (**STORY** p28)	• http://www.chemistry-videos.org.uk/chem%20clips/DF%20Winter%20and%20summer%20fuels/winter%20and%20summer%20fuels.htm has a video of **ACT DF3.1** and other supporting material	Candidates should be able to: • Explain what is meant by the octane number of a petrol in terms of the tendency of petrol towards auto-ignition which causes 'knocking' in a car engine, describing the effect of chain length and chain branching on the octane number

Suggested teaching time	6 hours	Topic	Story DF 4 Making petrol- getting the octane number right

Lesson	Suggested teaching and homework activities	Non-Salters resources	Specification Statements & Points to note
11 + 12	• Use molymods and diagrams etc to ensure a good understanding of the different ways of representing structures. Ensure students have a list of the key naming rules e.g. find the longest chain, number to give side chains the lowest value etc. • Students complete **ACT DF4.1** 'Modelling and naming alkanes'. The activity includes the answers so that they can assess their own progress and get help. It introduces the concept of isomers but does not need further coverage in this lesson.	• http://www.docbrown.info/page06/DFalkanes/DFalkaneQmc.htm • http://www.docbrown.info/page06/DFalkanes/DFalkaneQsa.htm Both are useful as an in class extension activity or homework as well as revision just before the exam. The questions are randomised!  • Cards with name 'stems' and numbers can be used here e.g. 2-methylpropane 	Candidates should be able to: • Draw and interpret structural formulae (full, shortened and skeletal) • Use systematic nomenclature to name, and interpret the names of alkanes

Lesson	Suggested teaching and homework activities	Non-Salters resources	Specification Statements & Points to note
13 + (14)	• Work though **IDEAS 3.3** 'Structural isomerism'. End of section Qs could be linked to further work using molymod kits or could be completed using an ICT package as part of the next task.   • **ACT DF4.2** 'Drawing and displaying molecular structures using a computer'. Although this is not an essential activity (it cannot be used to assess Skill I) it is still very valuable, particularly for any student who wishes to take study of chemistry beyond A2. It is also a skill that many students ask to be taught during their A2 coursework. **The extra lesson will be required if time is allowed to develop use of the drawing package effectively**  • **STORY DF4** p29-30 'Making petrol- getting the right octane number'. Review how isomerisation is used as part of petrol production to raise octane rating. Students should summarise the reactions that occur and the conditions needed, in particular the catalyst used and the use of zeolites • Show models of zeolites and discuss uses • Understanding and consolidation of ideas could now take place through **ASS 3** (**STORY** p26) and **ASS 5** (**STORY** p29)	• There are many suitable molecular drawing packages for **ACT DF4.2**. 'ChemSketch', available as freeware from www.acdlabs.com is found in many schools and universities. • Encourage students to use molymods to make different structural isomers of butane and draw them out in all forms. Have a competition to see which group can find the most **isomers** of pentane and hexane. Students can discuss whether any are the same  • Cards with name 'stems' and numbers can also be used here e.g. 2-methylpropane  • http://www.adventuresinenergy.org/Refining-Oil/index.html is a useful website with animations etc • http://antoine.frostburg.edu/cgi-bin/senese/tutorials/isomer/index.cgi is a good way to review isomer structure	Candidates should be able to: • Describe the use of catalysts (including zeolites) in isomerisation, reforming and cracking processes and in the control of exhaust emissions • Explain and use the term *isomerism* and recognise and draw structural isomers • Explain what is meant by the octane number of a petrol in terms of the tendency of petrol towards auto-ignition which causes 'knocking' in a car engine, describing the effect of chain length and chain branching on the octane number • Describe what happens in isomerisation, reforming and cracking reactions of hydrocarbons; explain how these processes improve the performance of hydrocarbons as fuels

Lesson	Suggested teaching and homework activities	Non-Salters resources	Specification Statements & Points to note
15	• **STORY DF4** p30-32 'Reforming' and 'Cracking'. Brief explanation of the processes involved. Students should produce a set of notes for comparison against those for isomerisation from last lesson, including the reactions that occur and the conditions needed, in particular the catalysts used. See **IDEAS 12.1** p271 'Alkanes' for a summary • **ACT DF4.3** 'Planning to crack alkanes' is best used as a whole class discussion activity and is a good way of introducing the students to new A-level equipment and its correct use • **ACT DF4.4** 'Cracking alkanes' is ideally carried out as a small group activity but is also suitable for use as an assessment opportunity.  • **ASS 7-8** (**STORY** p32-33) are useful homework activities to assess understanding	• http://www.adventuresinenergy.org/Refining-Oil/index.html is a useful website with animations etc	Candidates should be able to: • Describe the use of catalysts (including zeolites) in isomerisation, reforming and cracking processes • Describe what happens in isomerisation, reforming and cracking reactions of hydrocarbons; explain how these processes improve the performance of hydrocarbons as fuels • Prepare an organic compound
16	• Extend the work on structures and naming by using **ACT DF4.5** 'A closer look at alcohols'  • Link to **STORY DF4** p33-34 'Adding oxygenates' • Work through **IDEAS 13.2** 'Alcohols and ethers' covering naming and physical properties only. This reviews and extends the earlier work in this lesson. Qs 1-6 from the end of section Qs would be useful here	• http://www.york.ac.uk/org/seg/salters/chemistry/DIY/ppoint/CI13.2alcohols%2BethersJHU.ppt is from the York Salter's web site. The specification reference is correct and the material it contains is only that required from this chapter of **IDEAS** at this stage	Candidates should be able to: • Recognise members of the following homologous series: alcohols, ethers • Use systematic nomenclature to name, and interpret the names of alcohols • Understand the work of chemists in improving fuels and in searching for and developing fuels for the future including use of *oxygenates*

Suggested teaching time	2 hours	Topic	Story DF 5 Making diesel fuel

Lesson	Suggested teaching and homework activities	Non-Salters resources	Specification Statements & Points to note
17	• Introduce lesson by discussing **STORY DF4** p34 'The perfect blend'. Link to the differences between petrol and diesel from **STORY DF5** p34 'Making diesel fuel'. • **ACT DF5.1** 'Why do hydrocarbons mix' is a quick and simple way to introduce the concept of entropy in terms of 'number of ways' • **IDEAS 4.3** 'Entropy and the direction of change' should be used here, including a discussion of the end of section Qs. It could then be linked to hydrogen bonding in alcohols from the previous lesson to get across the idea that mixing is the most likely consequence unless something prevents it	• http://www.tre.ngfl.gov.uk/server.php?request=cmVzb3VyY2UuZnVsbHZpZXc%3D&resourceId=14100 links to a practical based around the concept of entropy • http://forpd.ucf.edu/strategies/stratPoetry.html a poem about entropy! • http://media.rsc.org/Creative%20Problem%20Solving/CPS-29.pdf is a practically based extension task which could be used to stretch the more able 	Candidates should be able to: • Use the term *entropy* in a qualitative manner, interpreting it as a measure of the number of ways that molecules can be arranged • Describe the differences in magnitude of the entropy of a solid, a liquid, a solution and a gas
18	• A fun way of checking understanding of the concepts of naming and structure can be achieved through **ACT DF4**.6 'Organic dominoes'  • Students should use **ACT DF5.2** 'Check your knowledge and understanding (part 2)' to review and amend notes. They should have the opportunity to resolve problems now if they have not done so before.	• http://www.york.ac.uk/org/seg/salters/chemistry/DIY/ppoint/DDDF3.ppt is from the York Salter's website. The reference refers to the old specification but the material is still relevant	

Suggested teaching time	4 hours	Topic	Story DF 6 Trouble with emissions Story DF 7 Tackling the emissions problem

Lesson	Suggested teaching and homework activities	Non-Salters resources	Specification Statements & Points to note
19 + (20)	**The extra lesson will be required if time is allowed to develop the presentation effectively** • Begin with a consideration of **IDEAS 12.1** p270 'Chemical reactions of alkanes'. Use to introduce some revision of balancing equations, referring back to **IDEAS 1.2** 'Balanced equations' if necessary. • An introduction to the main theme of the lesson could be achieved using **ACT DF6.1** 'Some reactions of nitrogen dioxide and sulfur dioxide' or if facilities do not permit, the NOx animations indicated in the adjacent column could be used  • Work through **STORY DF6** 'Trouble with emissions' and **STORY DF7** 'Tackling the emissions problem' before using **ACT DF6.2** 'What are the origins and environmental implications of pollutants in car exhaust gases?' as an assessment and note-taking opportunity 	• http://www.esa.int/esaCP/SEM2AS1DU8E_index_1.html shows an animation of a daily map of nitrogen dioxide levels • http://www.sightline.org/maps/animated_maps/aboutnox another animated map for NO_x emissions, this one for the USA	Candidates should be able to: • Describe and write balanced equations for the combustion (oxidation) of alkanes • Describe and explain the origin of atmospheric pollutants including those from car exhausts and other sources: particulates, unburnt hydrocarbons, CO, CO_2, NO_x, SO_x; describe the environmental implications of these pollutants
21	• Finish **ACT DF6.2** and link in to tackling emissions via engine technology **STORY DF7** p39 • Briefly revisit **IDEAS 1.3** 'Using equations to work out reacting masses' before introducing **IDEAS 1.4** 'Calculations involving gases' • Complete the end of section Qs as well as **ASS 10** (**STORY** p39) and **ACT DF7** 'What is the volume of one mole of hydrogen gas?' if time allows	• http://www.airquality.co.uk/archive/index.php is an excellent website where you can access current graphs of air quality • http://media.rsc.org/nonRSC/GreenChemistryTeachersPack.pdf page 70-75 have some useful worksheets	Candidates should be able to: • Describe and explain the origin of atmospheric pollutants including those from car exhausts and other sources: particulates, unburnt hydrocarbons, CO, CO_2, NO_x, SO_x; describe the environmental implications of these pollutants; discuss methods of reducing these pollutants and the decisions society has to make in using such methods • Use the concept of amount of substance to perform calculations involving: volumes of gases, balanced chemical equations

Lesson	Suggested teaching and homework activities	Non-Salters resources	Specification Statements & Points to note
22	• Read through **STORY DF7** p40-41 'Using catalysts' and link to the pollutants discussed in lessons 15 and 16 • Complete **ASS 11** (**STORY** p40) after reminding students of the definitions of oxidation and reduction from GCSE • Work through **IDEAS 10.5** 'What is a catalyst?' paying particular attention to figure 1 p233. The end of section Qs link nicely to earlier topics within this unit	• http://www.corporate.basf.com/en/stories/wipo/katalysator/?id=V00-0Jd69DGB4bcp48e has an animated film about a 3-way catalytic converter and information about reducing diesel emissions • http://www.york.ac.uk/org/seg/salters/chemistry/DIY/ppoint/AUCI10.4.ppt is from the York Salter's web site. The specification reference refers to the old specification but the material is still relevant	Candidates should be able to: • Explain and use the terms: *catalyst* (a catalyst speeds up a chemical reaction but can be recovered chemically unchanged at the end of the reaction), *catalysis*, *catalyst poison*; *heterogeneous* • Describe a simple model to explain the function of a heterogeneous catalyst • Describe the use of catalysts in the control of exhaust emissions

Suggested teaching time	4 hours	Topic	Story DF 8 Using diesel fuel Story DF 9 Other fuels Story DF 10 Hydrogen- a fuel for the future?

Lesson	Suggested teaching and homework activities	Non-Salters resources	Specification Statements & Points to note
23 + 24	• Introduce the difficulty of the work of chemists developing fuels by discussing **ASS 13** (**STORY** p41) • Link back to previous lessons by getting students to balance some simple alkane and alcohol combustion equations before working out the enthalpies of combustion using bond enthalpies • Link to **ASS 14** (**STORY** p43). Instead of looking up the combustion enthalpies, they can be calculated from bond enthalpies • Complete **ACT DF10** 'Which fuel for the future?' This could be completed as written or developed into an activity where the students work collectively to produce information as part of a table. This could be enlarged as a poster for display 	• http://media.rsc.org/Learning%20about%20materials/Materials%20Biodiesel%20Part%202.pdf Students can make their own biodiesel. They could then compare its enthalpy of combustion with that of ethanol for example, as revision of lesson 2 • http://www.soton.ac.uk/chemistry/schoolsoutreach/A-level/resources.html this site has a link to a useful video about biodiesel	Candidates should be able to: • Explain and use the term (*average*) *bond enthalpy* and relate bond enthalpy to the length and strength of a bond; recall that bond-breaking is an endothermic process and bond-making is exothermic and use these ideas to explain the overall enthalpy change for a reaction • Describe and write balanced equations for the combustion (oxidation) of alkanes and alcohols • Understand the work of chemists in improving fuels and in searching for and developing fuels for the future including use of *oxygenates* and the hydrogen economy • Understand the benefits and risks associated with using fossil fuels and alternative fuels (biofuels, hydrogen, nuclear) and discuss the choices involved in making decisions about ensuring a sustainable energy supply
25	• Students should use **ACT DF11** 'Check your knowledge and understanding (part 3)' to review and amend notes. They should have the opportunity to resolve problems now if they have not done so before.		
26	• End of module test		

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Salters Advanced Chemistry Project

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The Salters Advanced Chemistry Project have also set up some online forums for teachers to discuss the course. Details of these can be found on their website.

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The OCR website has a dedicated Chemistry B (Salters) page at http://www.ocr.org.uk/qualifications/asa_levelgceforfirstteachingin2008/chemistry_b_salters/ This page hosts the latest version of the specification, the latest version of the Practical Skills Handbook, as well as forms and documentation associated with the course. There is an array of support available on this page. This includes past and specimen papers and mark schemes, candidate style answers, schemes of work, examiners reports and notices to centres as well as information on upcoming training courses.

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The assessment material for unit F333 is only available in Interchange. Access to Interchange will be required to access this material.

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