Subject and unit	Year	Term
Chemistry Unit 1 Physical Chemistry	**12**	**Autumn 1**

Big Picture	This unit covers chemical properties of elements in relation to their atomic structure. The arrangement of electrons in their orbitals will be used to explain how the periodic table is organized. This unit also introduces the mass spectrometer and how it is used to measure atomic masses.

No/Place in Sequence	Required/desired prior knowledge and skills.	Tasks and independent work.	Assessment opportunities	Further learning opportunities	Link to SPEC And Core Practicals
Lesson number. *How does the task relate to big picture?* *E.G By the end of this we can …*	*What does the student need to know and know how to…before s/he arrives?* *What would be desirable prior knowledge/skill?*	*What activities will each student do in the lesson?* *What wider study skill is actively developed?*	*How will you check learning in the lesson and over time?* *How does AfL build toward AOL?*	*Bridging lessons (closing knowledge GAP)* *Home learning, extension, projects etc.*	*Are on the right track for the final assessment?* *AOs.*
Lesson 1: Atomic Structure **Evaluate** how and why atomic structure model developed over time. **Describe** the structure of atoms in terms of protons, neutrons and electrons. **Define** the terms, relative mass and relative charge of protons, neutrons and electrons.	**BRICK: Basics: Reflective** The structure of the atom and its constituents will be reviewed.	• Drawing and labeling structure of an atom. • Write electronic arrangement for different elements. • Evaluate how atomic structure developed over time.	**Mini-plenary:** Multiple choice mini-quizzes . Exam practice question. www: EBI:	**STRETCH: How can we tell what is inside an atom if we can't see it?** Assessed homework:	RSC timeline: http://www.rsc.org/chemsoc/timeline RSC: Chemists in a social & historical context: http://www.rsc.org/learn-chemistry/resource/res00001332/the-atom-detectives?cmpid=CMP00002843 RI Christmas Lecture – section on atomic structure http://www.rsc.org/learn-chemistry/resource/res00001119/ri-christmas-lectures-2012-atomic-

					structure
Lesson 2: Isotopes **Explain** the existence of isotopes. **Determine** the number of fundamental particles in atoms and ions. **Define** the term isotope.	**BRICK: Basics: Reflective** Atomic structure and isotopes (GCSE).	• Students identify atoms and ions from numbers of protons, neutrons and electrons, and vice versa. • Calculate number of neutrons using mass number and atomic number.	**Mini-plenary:** Answer the question on mini-white board. Exam practice question. www: EBI: Assessed homework:	**STRETCH: How can we tell what is inside an atom if we can't see it?**	
Lesson 3: Mass Spectrum **Calculate** relative atomic mass of elements using isotope abundance data. **Interpret** simple mass spectra of elements **Describe** how mass spectrometry is used to identify elements and determine relative molecular mass.	**BRICK: Knowledge** Atomic structure and isotopes (GCSE).	• Students determine the relative atomic mass of elements using isotope abundance data (this could include data for elements found in meteorites to show some difference). • Students look at the mass spectra of compounds to determine the relative formula mass.	**Mini-plenary:** Quick on the draw exam question. Assessed homework:	**STRETCH: Students investigate the use of mass spectroscopy in drug testing athletes.**	RSC: Build an atom simulation: http://www.rsc.org/learn-chemistry/resource/res00001433/build-an-atom-simulation-rsc-funded RSC Spectral School: http://www.rsc.org/learn-chemistry/collections/spectroscopy Isotope data: http://www.chem.ualberta.ca/~massspec/atomic_mass_abund.pdf Data on isotopes in meteorites: 'The Elements: Their Origin, Abundance, and Distribution' by P. A. Cox

Lesson 4: Ionisation Energy **Explain** first and successive ionisation energies in period 3 and group 2. **Describe** the structure of atoms and ions in terms of shells and sub shells. **Define** ionisation energy and write equations for the first and second ionisation energies.	**BRICK: Knowledge** Learning about first ionization energies and linking them to atomic structure and subatomic particles in each atom.	• Students write the electron structure of atoms and ions with Z=1-36 • Students research values of first ionisation energies for elements Z=1-36 and plot them on a graph and then explain trends.	**Mini-plenary:** Questions on the board. Peer assessment. Self assessment in task review. Assessed homework:	**STRETCH:**	Orbitron (shows shapes of orbitals): http://winter.group.shef.ac.uk/orbitron/ Ionisation energy data (1st and successive) http://en.wikipedia.org/wiki/Molar_ionization_energies_of_the_elements
Lesson 5: Period 3 Elements **Analyse** data about melting points of period 3 elements and explain these in relation to their structure and bonding **Explain** the trends in atomic radius and first ionisation across period 3. **Describe** the trends in atomic radius and first ionisation across period3.	**BRICK: Knowledge** Ionisation energy and the periodic table.	• Students plot data on graphs for atomic radius, first ionisation energy and melting point and explain those trends	**Do Now:** Mini-quiz based on previous lessons (mastery style questions) **Mini-plenary:** Questions on the board. Self assessment. Self assessment in task review. Assessed homework:	**STRETCH:**	

Lesson 6: Group 2 Elements **Analyse** data about the melting point of group 2 elements and explain this in relation to bonding. **Explain** the trends in atomic radius and first ionisation. **Describe** the trends in atomic radius, first ionisation energy and melting point of group 2 elements (Mg-Ba)	**BRICK: Knowledge**	• Students plot data on graphs for atomic radius, first ionisation energy and melting point and explain those trends.	**Do Now:** Answer the questions review-self assessment. **Mini-plenary:** Exam practice- Self assessment. Assessed homework:	**STRETCH:**	RSC AfL exercise on Group 2: http://www.rsc.org/learn-chemistry/resource/res00000118/afl-group-2 Royal College of Radiologists leaflet on barium meals: https://www.rcr.ac.uk/docs/patients/worddocs/CRPLG_meal.doc
Lesson 7: Reaction of group 2 with water. **Explain** how magnesium is used in the extraction of titanium from $TiCl_4$. **Carryout** experiment of reaction of Mg-Ba with water and Mg with steam and record results. **Describe** the reaction of Mg-Ba with water.	**BRICK: Knowledge** Knowledge of periodic table and general properties of group 2 elements (GCSE)	• Practical Opportunity: Students test the reactions of Mg–Ba with water and Mg with steam and record their results.	Assess practical skills: Following safety procedure. Carefully handle solids and liquids, including corrosive, irritant, flammable and toxic substances.	**STRETCH:**	RSC AfL exercise on Group 2: http://www.rsc.org/learn-chemistry/resource/res00000118/afl-group-2 Royal College of Radiologists leaflet on barium meals: https://www.rcr.ac.uk/docs/patients/worddocs/CRPLG_meal.doc

Lesson 8: Solubility of group 2 hydroxides and sulphates in water. **Discuss** the use of CaO/CaO_3 to remove SO_2 from the gases and $Mg(OH)_2$ in medicine. **Explain** why $BaCl_2$ solution is used to test for sulphates ions and why it is acidified. **Describe** the relative solubilities of group 2 hydroxides and sulphates (Mg-Ba) in water.	**BRICK: Knowledge** Knowledge of definitions: Soluble Insoluble Precipitate.	• Practical Opportunity: Students test the solubility of Group 2 hydroxides by mixing solutions of soluble Group 2 salts with sodium hydroxide and record their results.	Assess practical skills: Following safety procedure. Carefully handle solids and liquids, including corrosive, irritant, flammable and toxic substances.	**STRETCH:**	
Lesson 9: **Mid-term Assessment** **Calculate** the relative atomic mass of elements from abundance data. Describe and **explain** ionisation energies of period 3 elements. **Describe** atomic structure, its subatomic constituents, shells and orbitals.	**BRICK: Reflective** Knowledge of all topic covered in lessons1-8. • Atomic structure • Isotopes • Mass spectrum • Period 3 • Group 2 elements.	Students complete end of topic test.	Assessment based on content covered in lessons 1-8.		
Lesson 10: **Assessment Review** Reflect on the test and set revision targets. Correct answers (Self assessment) Review exam questions. www/EBI	**BRICK: Reflective**	Students review their assessments and correct them.	Self assessment		

Lesson 11: Ionic Bonding **Explain** the properties of ionic compounds. **Describe** the formation of ionic compounds and their properties. **Predict** the charge on a simple ion using the position of elements in the periodic table.	**BRICK: Basics and reflective.** Knowledge of electron configuration, valence electrons for different elements and linking this to their groups. Ionic bonding from GCSE.	• Students explain the properties of ionic compounds. • Students write the formula of ionic compounds, including those with common compound ions.	**Do Now:** Answer the questions review-self assessment. **Mini-plenary:** Exam practice- Self assessment. Assessed homework:	**STRETCH:g**	Nuffield Science Data Book (free download): http://www.nationalstemcentre.org.uk/elibrary/resource/3402/nuffield-advanced-science-book-of-data-second-edition Chemistry Data Book (Starck, Wallace, McGlashan) ISBN: 9780719539510
Lesson 12: Covalent and Metallic Bonding **Explain** the properties of covalent properties. **Describe** the formation of covalent and metallic bonds and their properties. **Draw/represent** covalent bonds using lines.	**BRICK: Basics and reflective.** Knowledge of electron configuration, valence electrons for different elements and linking this to their groups. Covalent bonding from GCSE	• Students describe differences between ionic and covalent bonding. • Students describe similarities and differences between covalent and co-ordinate bonds. • Students draw diagrams of molecules showing covalent and co-ordinate bonds as lines/arrows respectively (“stick” diagrams).	**Mini-plenary:** Exam practice- Self assessment. Assessed homework:	**STRETCH:**	Animation showing covalent bonding http://www.chemit.co.uk/resource/Details/87

Lesson 13: **Compare** the different types of bonding and explain the differences between them. **Explain** metallic bonding and how it relates to its structure. **Describe** the properties of metallic bonds.	**BRICK: Basics and reflective.** Knowledge of electron configuration, valence electrons for different elements and linking this to their groups. Metallic bonding from GCSE	• Students describe differences between metallic, ionic and covalent bonding. • Students explain the properties of metals.	**Mini-plenary:** Exam practice- Self assessment. Assessed homework:	**STRETCH: Which metals have the highest and lowest melting points – sodium, potassium, magnesium – explain your reasoning?**	Nuffield Science Data Book (free download): http://www.nationalstemcentre.org.uk/elibrary/resource/3402/nuffield-advanced-science-book-of-data-second-edition Chemistry Data Book (Starck, Wallace, McGlashan) ISBN: 9780719539510
Lesson 14: Different crystal structures **Explain** the properties of the different structures/ crystals. **Draw** the structures of different types of crystals. **Describe** the structure of ionic, molecular, giant covalent and metallic substances.	**BRICK: Basics and reflective.** Knowledge of ionic, covalent and metallic bonding.	• Practical opportunity: investigate the melting point, solubility and conductivity of substances with different structure types. • Students create a summary table to describe and explain the structure and properties of ionic, molecular, giant covalent and metallic substances. • Students sketch the structures of diamond, graphite, ice, iodine, magnesium and sodium chloride as solids and label the diagrams to explain their melting/boiling	**Mini-plenary:** True or false Self assessment for task review. Assessed homework.	**STRETCH:**	Nuffield Science Data Book (free download): http://www.nationalstemcentre.org.uk/elibrary/resource/3402/nuffield-advanced-science-book-of-data-second-edition Chemistry Data Book (Starck, Wallace, McGlashan) ISBN: 9780719539510 *Chemistry Review* article: Graphene (Volume 19, edition 2) *Chemistry Review* article: The disguises of carbon (Volume 18, edition 1)

		points and conductivity. • Students determine which type of structure a substance has from its properties using data and/or experimentally			
Lesson 15: **Explain** the properties of the different structures/ crystals. **Draw** the structures of different types of crystals. **Describe** the structure of ionic, molecular, giant covalent and metallic substances.	**BRICK: Basics and reflective.** Knowledge of ionic, covalent and metallic bonding.	• Practical opportunity: investigate the melting point, solubility and conductivity of substances with different structure types. • Students create a summary table to describe and explain the structure and properties of ionic, molecular, giant covalent and metallic substances. • Students sketch the structures of diamond, graphite, ice, iodine, magnesium and sodium chloride as solids and label the diagrams to explain their melting/boiling points and conductivity.	**Do Now:** Mini-quiz (mastery style questions) peer assessment. **Mini-plenary:** True or false Self assessment for task review. Assessed homework.	**STRETCH:**	Nuffield Science Data Book (free download): http://www.nationalstemcentre.org.uk/elibrary/resource/3402/nuffield-advanced-science-book-of-data-second-edition Chemistry Data Book (Starck, Wallace, McGlashan) ISBN: 9780719539510 *Chemistry Review* article: Graphene (Volume 19, edition 2) *Chemistry Review* article: The disguises of carbon (Volume 18, edition 1)

		• Students determine which type of structure a substance has from its properties using data and/or experimentally			
Lesson 16: shapes of simple molecules **Explain** the shape of and bond angles in simple molecules and ions. **Describe** the shape of and bond angles in simple molecules and ions. **Define** the terms bond pairs and lone pairs.	**BRICK: Knowledge** Knowledge of electronic configuration and valence electrons for elements in different groups.	• Make models of molecular shapes • Use balloons to represent electron pairs to demonstrate shapes. • Deduce, sketch and name the shapes of given molecules and ions, including bond angles	**Mini-plenary:** Mini-quiz review Self assessment for task review. Assessed homework.	**STRETCH:**	Rotatable shapes https://people.ok.ubc.ca/wsmcneil/vsepr.htm Molymod molecular models RSC exercise on VSEPR theory: http://www.rsc.org/learn-chemistry/resource/res00000648/shapes-of-molecules-and-ions
Lesson 17: Bond polarity **Explain** how polar molecules originate and deduce whether a molecule has a permanent dipole. **Describe** how polar covalent bonds originate and deduce whether a bond is polar. **Define** the concept of electronegativity	**BRICK: Knowledge** Knowledge of electronic configuration.	• Predict and explain the trend in electronegativity down a group and across a period. • Predict whether covalent bonds are polar or not. • Predict whether molecules have permanent dipoles or not.	**Mini-plenary:** Mini-quiz review Self assessment for task review. Assessed homework.	**STRETCH:**	Rotatable shapes https://people.ok.ubc.ca/wsmcneil/vsepr.htm Molymod molecular models.

Lesson 18: Forces between Molecules **Explain** how the melting points are influenced by these intermolecular forces and the anomalous nature of ice. **Describe** how melting and boiling points of molecular substances depend on the relative strength of intermolecular forces. **State** the three types of intermolecular forces.	**BRICK: Knowledge** Knowledge of electronic configuration, bonding and polarity.	• Students produce a summary to compare the three types of intermolecular force. • Students explain trends in Group 4, 5, 6 and 7 hydrides. • Practical opportunity: Students could try to deflect jets of various liquids from burettes to investigate the presence of different types and relative size of intermolecular forces. • Students explain why ice floats on water by reference to hydrogen bonding.	**Mini-plenary:** Mini-quiz review Self assessment for task review. Assessed homework.	Nuffield Science Data Book (free download): http://www.nationalstemcentre.org.uk/elibrary/resource/3402/nuffield-advanced-science-book-of-data-second-edition Chemistry Data Book (Starck, Wallace, McGlashan) ISBN: 9780719539510 RSC AfL exercise on hydrogen bonding: http://www.rsc.org/learn-chemistry/resource/res00000129/afl-what-are-hydrogen-bonds-and-where-are-they-found *Chemistry Review* article: All things Ice (Volume 22, edition 3) RSC Kitchen Chemistry: The Structure of Ice and Water http://www.rsc.org/learn-chemistry/resource/res00000813/kitchen-chemistry-the-structure-of-ice-and-water *Chemistry Review* article: Gecko glue (Volume 21, edition 1)	

Lesson 19: Revision **Apply knowledge** by answering exam questions. **Practice exam** technique in order to ensure that key words are used appropriately to answer questions. **Revise** different topic covered this half term.	**BRICK: Reflective** Knowledge of all that has been covered since the start of term.		Mini-quiz and mini-quiz review. Exam question practice and review.		Revision websites; Chemguide.com S-cool.co.uk RSC.co.uk
Lesson 20: **End of half term Assessment** **Analyse** data and use it to answer exam questions. **Calculate** relative atomic mass using isotopes abundance data/mass spectra. **Apply knowledge** by answering exam questions.	Knowledge of all topic covered in lessons1-8. • Atomic structure • Isotopes • Mass spectrum • Period 3 • Group 2 elements. • Bonding • Molecule shapes • Bond polarity • Intermolecular forces.	Students complete end of topic test.	Assessment based on content covered in lessons 1-19.		
Lesson 21: **End of term Assessment Review** Reflect on the test and set revision targets. Correct answers (Self assessment) Review exam questions. www/EBI		Students review their assessments and correct them.			
Final assessment task, time required and date. **Assessment:** 2 X 1 hour 30 minutes written examination paper. The papers will consist of objective questions, short questions and					

long questions. Students may be required to apply their knowledge and understanding of physics to situations that they have not encountered before. The total number of marks available for this examination paper is 80. It contributes 20% to the Advanced GCE in Physics.