A-Level Chemistry

Name: _____

If you have any further questions about the tasks below, please email: apau@williamperkin.org.uk

Essential Study

1. You need to purchase and complete the 'Head Start to A-Level Chemistry' book
   - Publisher: Coordination Group Publications Ltd (CGP) (2nd Mar. 2015)
   - ISBN 978 1 78294 280 1
   - http://bit.ly/headstartbook - link to Amazon - £4.95

   The questions at the bottom of each page must be fully answered with clear and structured workings **in this booklet**. This needs to be self-marked with corrections as necessary and handed in to your first Chemistry lesson, where you will have an induction test. The test is straightforward and will be based solely on the GCSE level content **within the Head Start book**. As a result, you should expect to achieve a very high result in the test. **You must memorise all of the common ions on p7 of the book.**

2. Ensure that you are able to apply the key chemistry skills in the **Chemist's toolbox** (page 16) by answering the questions on **pages 17 onwards of the A level chemistry booklet**.

3. Review key areas of GCSE

   You will build on everything you have done at GCSE over the two year course and discover that many areas of chemistry aren't quite how we have taught them up until now! The following specification points are the key concepts at GCSE and A-Level and essential for the first term, so you must make sure that you are confident about this content to make the best possible start to the course. You may also want to purchase 'Essential Maths Skills for A-Level Chemistry' published by CGP, as this will ensure that you are well prepared to use the key mathematical skills which are essential in this course.

   You should make revision notes in whichever style you choose and ensure you practise questions on these topics by visiting physics and maths tutor: https://www.physicsandmathstutor.com/past-papers/gcse-chemistry/

Ionic bonding

Spec Point	Students should	RAG
1.21	Explain how ionic bonds are formed by the transfer of electrons between atoms to produce cations and anions, including the use of dot and cross diagrams	
1.22	Recall that an ion is an atom or group of atoms with a positive or negative charge	
1.23	Calculate the numbers of protons, neutrons and electrons in simple ions given the atomic number and mass number	
1.24	Explain the formation of ions in ionic compounds from their atoms, limited to compounds of elements in groups 1, 2, 6 and 7	
1.25	Explain the use of the endings –ide and –ate in the names of compounds	
1.26	Deduce the formulae of ionic compounds (including oxides, hydroxides, halides, nitrates, carbonates and sulfates) given the formulae of the constituent ions	
1.27	Explain the structure of an ionic compound as a lattice structure a consisting of a regular arrangement of ions b held together by strong electrostatic forces (ionic bonds) between oppositely-charged ions	

Covalent bonding

Spec Point	Students should	RAG
1.28	Explain how a covalent bond is formed when a pair of electrons is shared between two atoms	
1.29	Recall that covalent bonding results in the formation of molecules	
1.30	Recall the typical size (order of magnitude) of atoms and small molecules	
1.31	Explain the formation of simple molecular, covalent substances, using dot and cross diagrams, including: a hydrogen b hydrogen chloride c water d methane e oxygen f carbon dioxide	

Types of substance

Spec Point	Students should	RAG
1.32	Explain why elements and compounds can be classified as: a ionic b simple molecular (covalent) c giant covalent d metallic and how the structure and bonding of these types of substances results in different physical properties, including relative melting point and boiling point, relative solubility in water and ability to conduct electricity (as solids and in solution)	
1.33	Explain the properties of ionic compounds limited to: a high melting points and boiling points, in terms of forces between ions b whether or not they conduct electricity as solids, when molten and in aqueous solution	
1.34	Explain the properties of typical covalent, simple molecular compounds limited to: a low melting points and boiling points, in terms of forces between molecules (intermolecular forces) b poor conduction of electricity	
1.35	Recall that graphite and diamond are different forms of carbon and that they are examples of giant covalent substances	
1.36	Describe the structures of graphite and diamond	
1.37	Explain, in terms of structure and bonding, why graphite is used to make electrodes and as a lubricant, whereas diamond is used in cutting tools	
1.40	Explain the properties of metals, including malleability and the ability to conduct electricity	
1.42	Describe most metals as shiny solids which have high melting points, high density and are good conductors of electricity whereas most non-metals have low boiling points and are poor conductors of electricity	

Calculations involving masses

Spec Point	Students should	RAG
1.43	Calculate relative formula mass given relative atomic masses	
1.44	Calculate the formulae of simple compounds from reacting masses or percentage composition and understand that these are empirical formulae	
1.45	Deduce: **a)** the empirical formula of a compound from the formula of its molecule; **b)** the molecular formula of a compound from its empirical formula and its relative molecular mass	
1.46	Describe an experiment to determine the empirical formula of a simple compound such as magnesium oxide	
1.47	Explain the law of conservation of mass applied to: **a)** a closed system including a precipitation reaction in a closed flask; **b)** a non-enclosed system including a reaction in an open flask that takes in or gives out a gas	
1.48	Calculate masses of reactants and products from balanced equations, given the mass of one substance	
1.49	Calculate the concentration of solutions in g dm^{-3}	
1.50	**Recall that one mole of particles of a substance is defined as: a) the Avogadro constant number of particles (6.02 × 1023 atoms, molecules, formulae or ions) of that substance; b) a mass of 'relative particle mass' g**	
1.51	**Calculate the number of: a) moles of particles of a substance in a given mass of that substance and vice versa; b) particles of a substance in a given number of moles of that substance and vice versa; c) particles of a substance in a given mass of that substance and vice versa**	
1.52	**Explain why, in a reaction, the mass of product formed is controlled by the mass of the reactant which is not in excess**	
1.53	**Deduce the stoichiometry of a reaction from the masses of the reactants and products**	

How will this help me in Y12?

The step up to A-level Chemistry is a significant one, and your success in this subject will largely depend on your ability to build upon your knowledge from GCSE and revise throughout this year. The CGP book will help you with this transition, as well as introducing you to some key concepts that you will meet next year. It also gives you a chance to develop the layout of your workings and answers. The additional tasks, and the exceptional one, will develop your wider understanding of why you have chosen chemistry and the exciting opportunities for the future in this field.

How will I be assessed?

You will complete an assessment based on the content and skills within this book in the first Chemistry lesson of the year. The assessment in the first lesson will be given a percentage, and this will then be given a grade, based on scaling from the current A-Level assessments. The assessment will be self-marked, checked by your teacher and returned to you, and you will spend time reviewing and improving upon your areas of misunderstanding. Failure to achieve a good result in the test will make us question your commitment to the summer task and therefore, the course itself.

Your CGP answers will be submitted on the first lesson to review the layout and structure of your answers.

Exceptional activity

If you are considering Chemistry or a related subject at university, you should complete one or more of the following:

1. Read one of the following books and write a one page summary of what you have learned:
    - Periodic Tales (Hugh Aldersey-Williams)
    - The Periodic Table (Primo Levi)
2. Complete a mini university module on a range of free topics – www.futurelearn.com. Suggested courses:
    - Food Fraud (4 weeks of 2 hours a week) – University of East Anglia
    - Exploring Everyday Chemistry (4 weeks of 5 hours per week) – University of York
    - Introduction to Translational Research – Connecting medicine and science (6 weeks of 2 hours per week)
    - Discovering Science: Chemical Products (2 weeks of 5 hours per week)
    - Chemical Engineering: Shaping a Sustainable Future (2 weeks of 2 hours per week) University of Leeds

There are also modules in study skills and more general medicine, dentistry and chemical engineering topics.

Use the space here to complete and self-mark (in green pen) the Head Start to A-Level Chemistry summer tasks.

Section 1 – Structure of the Atom	
Atomic Structure	
1	
2	
3	
Atomic Number, Mass Number and Isotopes	
1	
2	
3	
Relative Atomic Mass	
1	
2	
3	
4	
5	
Electronic Structure	
1	
2	

3		
The Periodic Table		
1	s-block	p-block
2		
Section 2 – Formation of Ions		
Ionisation Energy		
1		
2		
3		
Formation of Ions		
1		
2		
3		
Oxidation Numbers		
1		
2		
3		
Section 3 – Intermolecular Bonding		
Intermolecular Bonding		
1		
2		

Polarity	
1	a) b) c)
2	
Section 4 – Bonding and Properties	
Ionic Bonding	
1	
2	
Ionic Compounds	
1	
2	

Covalent Bonding	
1	a) b) c) d)
Small Covalent Molecules	
1	
2	
Giant Covalent Structures	
1	
2	

Metallic Bonding	
1	
2	
3	
Trends in Properties Across the Periodic Table	
1	
2	
3	a) b)
Section 5 – Chemical Equations	
Writing and Balancing Equations	
1	

2	a) b)
3	
Section 6 – Inorganic Chemistry	
Group 2	
1	
2	
Group 7	
1	a) b) c) d)
2	
Acids and Bases	
1	
2	a) b) c)

Section 7 – Organic Chemistry	
Organic Molecules	
1	
2	
Alkanes	
1	
2	a) b)
3	
Alkenes	
1	
2	
3	
Polymerisation	
1	
2	a) b)
Alcohols	
1	

2	
3	
Section 8 – Chemical Reactions	
Reaction Types	
1	a) b) c) d)
Section 9 – Rates of Reactions	
Reaction Rates	
1	a) b) c)
Collision Theory	
1	
2	
3	
Reaction Rates and Catalysts	
1	
2	

3	
4	
Section 10 – Equilibria	
Reversible Reactions	
1	a) b)
2	
Le Chatelier's Principle	
1	
2	a) b)
Equilibrium and Yield	
1	
2	
Section 11 – Calculations	
The Mole	
1	
2	
3	
Determination of Formulae from Experiments	
1	a)

	b)
2	
Calculation of Molecular Formulae	
1	
2	
3	a) b) c)
Atom Economy	
1	a) b)
Section 12 – Enthalpy	
Endothermic and Exothermic Reactions	
1	a) b) c) d)

2	a) b)
Bond Energy	
1	a) b) c) d)

Section 13 – Investigating and Interpreting	
Planning Experiments	
1	a) b)
Presenting and Interpreting Data	
1	
Conclusions and Error	
1	a) b) c)

Fundamental Chemistry Skills

Reactions and Equations	Atoms and Ions	Amounts of Substance
Understand:	Understand:	Understand:
• The state symbols: ○ (g) gas ○ (l) liquid (s) solid ○ (aq) aqueous (dissolved in water)	• An element contains only one type of atom • Compounds are more than one element chemically bonded • Molecules represent the smallest fundamental unit of a chemical compound. • The number of protons determines the element • The number of protons = number of electrons • The electrons determine how an element behaves. • The key atomic and molecular ions. • The molecular formula of key substances (H_2O CO_2 H_2 N_2 F_2 O_2 I_2 Cl_2 Br_2 HCl H_2SO_4 HNO_3 H_3PO_4) • The state of matter of key substances (water, oxygen, carbon dioxide, metals, group 7)	• There are different ways of quantifying how much there is: ○ g/ml/cm^3 ○ moles/no. atoms/g dm^{-3}/mol dm^{-3} • The relative molecular mass of a molecule is the sum of the relative atomic masses of the constituent elements
Apply:	Apply:	Apply:
• Write word equations from a description of the reaction • Write a symbol equation from a word equation • Balance a symbol equation • Use a symbol equation to write an ionic equation	• Identify the 'type' of element by relating it to the periodic table • Deduce the elements in a substance from its name • Draw and write the electron configuration of an atom or ion • Deduce the charge of an ion from the electron configuration of its atom. • Use the name of a compound to determine the formula of compound. • Identify the type of bonding by the 'type' of elements in the name. • Determine the cations and anions present from an (ionic) compound's name.	• Relate number of moles to number of particles using Avogadro's number • Calculate the number of moles from the mass of a substance • Calculate moles from the concentration of a substance • Interconvert units g ↔ mol & dm^3 ↔ cm^3

Test Your Understanding

State what is mean by an element.

State what is mean by a compound.

State what is mean by a molecule.

Give the unit with which the mass of a substance is quantified.

Give the unit with which the volume of a substance is quantified.

For the elements below, identify whether they are a metal or a non-metal:

- Sodium
- Manganese
- Silicon
- Chorine
- Tungsten
- Iodine
- Ag
- Pb
- Xe
- H
- Hg

From the following description, write a word equation that describes the reaction:

> A piece of magnesium is added to a solution of copper sulphate and a displacement reaction took place.

_____ + _____ → _____ + _____

For the compounds below, deduce the substances that make up that compound.

E.g. Calcium Carbonate – Calcium, carbon, oxygen.

- Sodium chloride
- Carbon dioxide
- Tungsten carbide
- Sodium sulfate
- Aluminium phosphate

State the name of the element with the number of protons given below:

- 2
- 7
- 13
- 26
- 73

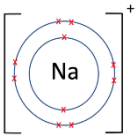
For each of the following elements, draw the electron configuration:

- Be

- Si

- Ca

For each of the following ions, draw the electron configuration and explain its charge in terms of electrons gained or lost.

e.g. – Na^+ 

sodium has lost 1 electron, therefore has a 1+ charge.

- Ca^{2+}

- O^{2-}

- N^{3-}

Give the formula of the following ions:

Hydrogen	Chloride
Sodium	Bromide
Silver	Fluoride
Potassium	Iodide
Lithium	Hydroxide
Ammonium	Nitrate
Barium	Oxide
Calcium	Sulfide
Copper(II)	Sulfate
Magnesium	Carbonate
Zinc	
Lead	
Iron(II)	
Iron(III)	
Aluminium	

Deduce the chemical formula of the following ionic compounds:

- Lithium chloride
- Calcium fluoride
- Potassium nitride
- Sodium sulfide
- Sodium sulfate
- Iron (II) oxide
- Iron (III) oxide
- Ammonium nitrate
- Lead hydroxide

Use the following word equation to write a balanced symbol equation with appropriate state symbols:

Silver nitrate + aluminium chloride → silver chloride + aluminium nitrate

Give the molecular formula of the following substance and give the state of matter at room temperature:

- Water
- Carbon dioxide
- Hydrogen
- Nitrogen
- Fluorine
- Oxygen
- Iodine
- Chlorine
- Bromine

Give the molecular formula of the following acids:

- Hydrochloric acid
- Sulfuric acid
- Nitric acid
- Phosphoric acid

For each of the following substances, identify whether the constituent elements are metal or a non-metal and hence deduce whether the bonding in the substance is ionic, covalent or metallic.

E.g. Sodium chloride – Sodium = metal, chloride is a non-metal. Therefore it is ionic

- Nitrogen dioxide
- Barium
- Silver iodide
- Lead chloride
- PCl_3
- CuI_2

For each of the following ionic compounds, give the cation and anion that it is comprised of.

E.g. Sodium chloride – Na^+ and Cl^-

- $MgBr_2$
- Al_2O_3
- NH_4F
- MnO_2

Give the unit with which the amount of a substance is quantified.

Give the unit with which the concentration of a substance is quantified.

Calculate the molar mass of the following substances:

- N_2
- S_8
- TiO_2
- $Na_2S_2O_4$
- $CuSO_4.5H_2O$
- $CH_3CH_2CH_2COOH$

Calculate the number of particles present from in following number of moles:

- 1 mol
- 0.5 mol
- 2.5 mol
- 3.22×10^{-3} mol
- 7.11×10^{4} mol

Calculate the number of moles from the following masses:

- 7 g of Li
- 8 g of S_8
- 12.5 g of NaCl
- 3.26 g of NH_4NO_3
- 1.036 g of $Al_2(SO_4)_3.18H_2O$

Convert the following volumes from cm^3 to dm^3, or from dm^3 to cm^3:

- 500 cm^3
- 20 cm^3
- 0.1 dm^3
- 9.0 cm^3
- 12 dm^3
- 0.001 dm^3

Calculate the number of moles of each substance from the following concentrations and volumes:

- 100 cm^3 of 1 mol dm^{-3} HCl
- 25 cm^3 of 0.5 mol dm^{-3} NaOH
- 8.0 cm^3 of 2 mol dm^{-3} HNO_3

Write an ionic equation for the following reaction:

$$AgNO_3\,(aq) + NaCl\,(aq) \rightarrow AgCl\,(s) + NaNO_3\,(aq)$$