Chemistry
at
Penistone Grammar School

A LEVEL CHEMISTRY TRANSITION UNIT

Name: _____

Secondary School (if not PGS) _____

Contents

Introduction

Welcome to A-Level Chemistry at Penistone Grammar School

Congratulations! All being well with GCSE results, you will be embarking on a rewarding and exciting A-level Chemistry course in September.

The transition to A Level is always a challenging one. To help make this transition smoother and give you the best possible start, we have prepared this booklet for you. It is important that you read through this booklet and then complete all the questions. The tasks cover GCSE topics which you should have already covered. You will need a secure knowledge of these topics before you start the course in September.

At the beginning of the course you will be given a base line test to check how well you have understood the topics. If you do not pass this test we will put in additional support classes to help bring your knowledge and understanding up to the standard required for you to succeed. To help you complete the tasks, the following resources may be useful:

- http://www.bbc.co.uk/schools/gcsebitesize/
- http://www.s-cool.co.uk/gcse
- Any GCSE Additional Science/Chemistry revision guide
- Your own old GCSE Science/Chemistry exercise books
- Head Start to AS Chemistry Published by CGP

Tasks

You must complete Tasks 1, 3-5, 7-8 and 11 for the start of Year 12. The other tasks are advised and will help with the transition from GCSE to A Level.

Course Outline

The Chemistry course you are studying is **AQA Chemistry**, which has the examination code **7404/5**

If you want to, you can access course information directly from AQA at

http://www.aqa.org.uk/subjects/science/as-and-a-level/chemistry-7404-7405

Course Assessment

AS Level			
Unit:	**Title:**	**Assessment:**	
1	Paper 1- Inorganic and Physical Chemistry	90 minute exam	50%
2	Paper2- Organic and Physical Chemistry	90 minute exam	50%
A Level			
1	Paper 1- Inorganic and Physical Chemistry	120 minute exam	33%
2	Paper2- Organic and Physical Chemistry	120 minute exam	33%
3	Paper 3- Practical Assessment, Synoptic questions and multiple choice	120 minute exam	34%

AS level is sat at the end of Year 12 and is a separate qualification to the A Level.

A level is independent of the AS level and will assess both Year 12 and year 13 content during the summer of 2017.

Structure of lessons

You will receive **10 hours** of Chemistry teaching a fortnight, delivered by **two** of our five Chemistry teachers, **Mr Pike, Mrs Taylor, Mrs Rostern, Mrs Clegg and Miss Hambleton**.

Here are our email addresses in case you need to contact us:

spike@penistone-gs.uk drostern@penistone-gs.uk htaylor2@penistone-gs.uk

sclegg@penistone-gs.uk shambleton@penistone-gs.uk

What we expect of you

By taking this course at Penistone Grammar School, we will expect you to:

- **Attend all lessons** unless you have a genuine medical or personal reason for absence (and give advance notice of any unavoidable planned absence).
- **Copy up** any missing work/establish assignments and deadlines if you have been absent.
- Be **punctual** to all lessons and remain for the full hour.
- Be **ready to learn** at the start of every lesson.
- Display a **positive attitude** and participate fully in lessons.
- **Meet all deadlines** by handing in all work on time - You will be given homework on a regular basis.
- **Actively seek assistance** from your teachers as soon as you are aware that you have problems with set work or any other aspect of the course.
- Be aware of and **utilise fully all of the resources** that are available in the department and the school to help you to succeed in the course.
- **Spend a *minimum* of one hour Chemistry study time outside of class for every hour that you spend in class (i.e. a minimum of 10 hours a fortnight).**
- Regularly **read through and supplement your notes** by using both the textbook and other general reading such as *NewScientist* magazine or 'popular science' books.

These guidelines have been drawn up based on our previous experience and based on what previous students have told us. By following these we hope to develop and maintain a highly motivated learning environment from which you will experience the best of what Chemistry has to offer you at Penistone Grammar School.

What you can expect of us

We will:

- Provide a **friendly and supportive atmosphere** for study;
- Set **regular assignments** which will be marked and returned promptly;
- Give you enough **time** to complete assignments so that you can discuss any difficulties before the deadline;
- Give you **feedback** on your progress via written comments, conversations, tests and reviews;
- Ensure that a member of the Chemistry staff is **available outside of lessons** at specific times;
- Provide a **range of resources** to aid your learning and advise you on the best ways to use them;
- Handle all **administration** involved in submitting you for examinations etc.

Resources available to you

- A course **textbook**, AQA AS Chemistry (year 1) and AQA A2 Chemistry (year 2), will be loaned to you for the duration of your course. It is your responsibility to return this at the end of the AS or A2 course, in good condition, or to accept responsibility for the purchase of a replacement book.
- **Other textbooks** are available for reference in the Chemistry department and for use in some lessons.
- FROG has a wide range of resources to help with topics such as PPQs on topics and other revision materials.

Helping you to stay on track

There are various systems that we will ask you to follow in order to stay on top of things. These include, but are not limited to:

- You will need to keep an A4 file to keep your notes in. They will be subjected to regular **file checks**, focusing on basic organisational things – like having your (complete!) notes in sections. *The reason for this is that organising your written notes actually helps to straighten out and link the concepts within your mind, too. Bizarre, but seemingly true...*

- "**Chemistry Clinic**", a weekly hour-long afterschool drop in session (usually a Wednesday or Thursday) for both Year 12 **and Year 13** Chemistry students. This is very informal and whilst we can't make you come, some of you will definitely benefit from doing so!

You, the GCSE graduate

When students talk about the challenge of the transition to A-level from GCSEs, they are *not* talking about the difficulty of the subject. They are talking about the rapid need to develop some extra skills to face that challenge.

As already mentioned, AS Chemistry is a greater *challenge* than Chemistry at GCSE level, but not greatly *harder*. The challenge is in adapting to a new way of working that requires you to be more pro-active than GCSE demanded and to constantly want to find out more in order to build and develop your own skills and knowledge. If you are accustomed to achieving A's and A*'s at GCSE there can also be a danger of coasting when it comes to AS and this is something to be very wary of!

GCSE did not require you (in any great way) to be "independent learners". A-level, on the other hand, is most definitely easier if you aim to develop the skills described below, from day one.

You, the independent learner

One key to success at A Level is to be a successful independent learner.

Successful independent learners are those that, just weeks after GCSEs, develop a set of new skills that enables *them* to take ownership of the learning, managing their time effectively and developing an inquisitive approach to learning without necessarily waiting to be guided by the teacher.

The key to developing these skills is your *motivation* for choosing to study. Why have you chosen Chemistry and not something else? Keep reminding yourself of the reason.

The most successful students have all of the following qualities:

- They **want to learn** – and, moreover, to **understand** – what they are studying. Learning is either a **joy** or a **welcome** route to a recognised next step, never an unwelcome chore that is forced upon them. The goal is *not* "to pass exams" or to reproduce rote-learned statements, but to genuinely achieve ***understanding***. Passing exams is just a happy consequence.

- They **value their education** for its own sake and for the opportunities it affords them. They are willing to invest their time and to **prioritise their learning**. Their learning is not something that they are doing to put off entering the world of employed work.

- They recognise very early on the benefits of becoming **organised** – they arrive on time, have the right equipment, meet deadlines, keep notes organised in their files. They attempt their assignments early enough that they have time to seek help if they get stuck. They proactively catch-up missed work.

- They **try their hardest**, utilising the resources available to them, and when that isn't enough they recognise that they need to **seek help** from their peers and/or teachers when they can't resolve things for themselves. When there is a serious problem, they tell their teachers earlier, rather than after a prolonged period with their head in the sand.

While these skills will make A-level Chemistry easier to master, they are an absolute pre-requisite for successful entry to university courses and, increasingly, the admissions process is beginning to reflect this. This is just one extra reason to want to develop the approach to study described above.

The following tasks have been designed to help smooth the transition between GCSE and A-Level in terms of knowledge. You will be assessed on this material in September so don't just rush it to get it finished – make sure you understand it!

Good luck! ☺

Task 1: The structure of atoms

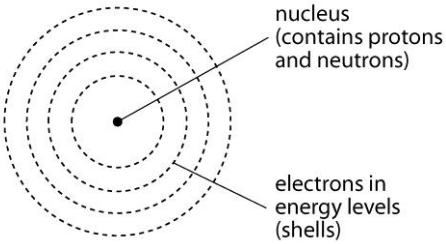
1. Complete the gaps to create a set of notes about the structure of atoms:

Atoms consist of a central _____ containing protons and _____. The nucleus is _____ compared to the size of the whole atom. The nucleus is surrounded by _____ in energy levels (also called shells). Atoms have no electric charge because they contain the same number of _____ and electrons.

2 Complete the table

–1	0	+1	1	1	very small

Particle	**Mass**	**Charge**
Proton		
Neutron		
Electron		



Atomic number = number of _____.

Mass number = number of _____ + number of _____.

mass number **19**

Symbol e.g. **F**

atomic number **9**

protons = _____

neutrons = _____

electrons = _____

Atoms of the same element have the same number of _____. It is the number of protons that determines what type of atom it is. For example, all atoms with six protons are carbon atoms. Atoms of different elements have different numbers of _____. Isotopes are atoms of the same element. They contain the same number of protons but a different number of _____. In other words, they have the same _____ number but a different _____ number.

3 Complete the table about some atoms.

Atom	**Atomic number**	**Mass number**	**Number of protons**	**Number of neutrons**	**Number of electrons**
$^{23}_{11}$Na					
Li	3	7			
Ar		40	18		
K			19	20	
Al				14	13

Task 2: Atoms and ions

You will need to look at the Periodic Table to help you answer the following questions.

1 Complete the table to show the electronic structure of the following ions.

Ion	F^-	Na^+	Al^{3+}	K^+	S^{-2}	H^+	O^{-2}	Ca^{2+}	Li^+	Mg^{2+}	Cl^-	Be^{2+}
Electronic structure												

Predict the charge that the following ions would have using the Periodic Table and your table.
strontium ions _____ iodide ions _____ rubidium ions _____

2 Calcium atoms react with chlorine atoms to form the ionic compound calcium chloride. Calcium atoms each lose two electrons to form calcium ions. Chlorine atoms each gain one electron to form chloride ions. This means that calcium atoms react with chlorine atoms in the ratio of one calcium atom for every two chlorine atoms. Draw a diagram opposite to show the electronic structure of the calcium and chlorine atoms and the calcium and chloride ions.

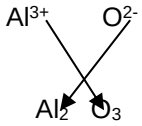
3 Complete the following table about some atoms and ions. The first row has been done for you.

Particle	Atom or ion	Atomic no.	Mass no.	Protons	Neutrons	Electrons	Electronic structure
$^{16}O^{2-}$	ion	8	16	8	8	8	$[2,8]^{2-}$
^{31}P							
		13	27			13	
		13	27			10	
	atom	2	4				
		16	32				$[2,8,8]^{2-}$
				12	12		$[2,8]^{2+}$

Task 3: Writing formulae

Use the table of ions to write the formula of the following ionic compounds. Use the general rule of cross-the signs and then simplify where possible.

Eg: Aluminium oxide:



Positive ions				**Negative ions**			
Aluminium	Al^{3+}	Lead Pb^{2+}		Bromide Br^-		Oxide O^{2-}	
Ammonium NH_4^+		Lithium Li^+		Carbonate CO_3^{2-}		Sulphate SO_4^{2-}	
Barium Ba^{2+}		Magnesium Mg^{2+}		Chloride Cl^-		Sulphide	S^{2-}
Calcium Ca^{2+}		Potassium	K^+	Fluoride	F^-		
Copper (II) Cu^{2+}		Silver Ag^+		Hydrogencarbonate HCO_3^-			
Hydrogen	H^+	Sodium Na^+		Hydroxide OH^-			
Iron (II) Fe^{2+}		Zinc Zn^{2+}		Iodide	I^-		
Iron (III) Fe^{3+}				Nitrate NO_3^-			

1 a potassium iodide

b sodium oxide

c aluminium bromide

d magnesium chloride

e silver oxide

f iron (II) oxide

g iron (III) oxide

h calcium sulfide

i copper (II) chloride

j lithium fluoride

k barium chloride

l lead sulphide

2a potassium sulfate

b magnesium sulfate

c magnesium hydroxide

d copper (II) nitrate

e zinc carbonate

f potassium hydroxide

g sodium carbonate

h aluminium hydroxide

i ammonium hydroxide

j ammonium chloride

k aluminium sulfate

l iron (III) nitrate

Task 4: Relative masses

Element	**A_r**	**Element**	**A_r**	**Element**	**A_r**
Aluminium	27	Hydrogen	1	Phosphorus	31
Bromine	80	Iodine	127	Potassium	39
Calcium	40	Iron	56	Silver	108
Carbon	12	Magnesium	24	Sodium	23
Chlorine	35.5	Nitrogen	14	Sulphur	32
Copper	63.5	Oxygen	16	zinc	65
Fluorine	19				

1.Use the table above to calculate the relative formula masses of the following substances:.
(HINT: if there is a formulae in brackets, everything in the brackets needs to be multiplied by the number outside).

$MgCO_3$ $Mg(OH)_2$ Na_2O Al_2O_3

2. The dot means to add. So for $CuSO_4.5H_2O$ add $CuSO_4$ to 5 lots of H_2O).

a $Mg(OH)_2$

b $Al(NO_3)_3$

c $Fe_2(SO_4)_3$

d $Ca(HCO_3)_2$

e $(NH_4)2SO_4$

f $CuSO_4.5H_2O$

g $Na_2CO_3.10H_2O$

h $Fe(NH_4)_2(SO_4)_2.6H_2O$

3 Calculate the percentage by mass of the element shown in each of the following substances.

a O in $Mg(OH)_2$

b O in $Al(NO_3)_3$

c O in $Fe_2(SO_4)_3$

d H in $Ca(HCO_3)_2$

e N in $(NH_4)_2SO_4$

f O in $CuSO_4.5H_2O$

g Na in $Na_2CO_3.10H_2O$

h Fe in $Fe(NH_4)_2(SO4)_2.6H_2O$

Task 5: Balancing equations

Balance the following equations.

a N_2 + _____ H_2 → _____ NH_3
b _____Ca + O_2 → _____ CaO
c Br_2 + _____ KI → _____ KBr + I_2
d _____ Fe + _____H_2O → Fe_3O_4 + _____ H_2
e C_3H_8 + _____ O_2 → _____CO_2 + _____ H_2O
f _____ NH_3 + _____ O_2 → _____ NO + _____ H_2O

Task 6: Writing symbol equations from words

Write symbol equations for the following reactions taking place. You will first need to convert the names of the materials into formulae and then balance the equation.

1. Zinc metal reacts with copper sulphate solution to produce solid copper metal and zinc sulphate solution.

2. Solid calcium hydroxide reacts with solid ammonium chloride on heating to produce solid calcium chloride, steam and ammonia gas.

3. When lead (II) nitrate is heated in a dry test tube lead (II) oxide, nitrogen dioxide gas and oxygen are produced.

4. Silicon tetrachloride reacts with water to produce solid silicon dioxide and hydrogen chloride gas.

5. When octane (C_8H_{18}) vapour is burned with excess air in a car engine carbon dioxide and water vapour are produced.

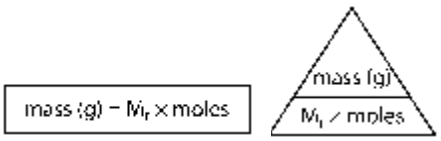
6. When rubidium reacts with water a solution of the hydroxide of the metal is produced as well as hydrogen gas.

7. When strontium reacts with water a solution of the hydroxide of the metal is produced as well as hydrogen gas.

8. Sodium chloride reacts with concentrated sulfuric acid to produce sodium hydrogen sulphate and hydrogen chloride.

Task 7: Using moles

Element	**A_r**	**Element**	**A_r**	**Element**	**A_r**
Aluminium	27	Hydrogen	1	Phosphorus	31
Bromine	80	Iodine	127	Potassium	39
Calcium	40	Iron	56	Silver	108
Carbon	12	Magnesium	24	Sodium	23
Chlorine	35.5	Nitrogen	14	Sulphur	32
Copper	63.5	Oxygen	16	zinc	65
Fluorine	19				



1. Complete the blank parts of the following table.

Substance	**Formula**	**M_r**	**Mass**	**Moles**
Carbon monoxide	CO		560g	
Propane	C_3H_8			0.2
Unknown solid	unknown		0.104g	0.0005
Methane	CH_4		6kg	
Sodium carbonate	Na_2CO_3			2.5
Unknown gas	Unknown		0.1g	0.0025

2 How many moles are there in each of the following?
a 72 g of Mg

b 39 g of $Al(OH)_3$

c 1 tonne of NaCl

d 20 mg of $Cu(NO_3)_2$

3 What is the mass of each of the following?
a 5 moles of Cl_2

b 0.2 moles of Al_2O_3

c 0.002 moles of $(NH_4)2SO_4$

d 0.3 moles of $Na_2CO_3.10H_2O$

4 An experiment was carried out to find the Mr of vitamin C (ascorbic acid). It was found that 1 g contains 0.00568 moles of vitamin C molecules. Calculate the Mr of vitamin C.

Task 8: Reacting mass calculations

Use Ar values given in task 7 for this exercise. Answer in the space provided. Show your working.

1 What mass of hydrogen is needed to react with 40 g of copper oxide?

$CuO + H_2 \rightarrow Cu + H_2O$

2 What mass of sulfur trioxide is formed from 96 g of sulfur dioxide?

$2\ SO_2 + O_2 \rightarrow 2\ SO_3$

3 What mass of carbon monoxide is needed to react with 480 g of iron oxide?

$Fe_2O_3 + 3\ CO \rightarrow 2\ Fe + 3\ CO_2$

4 What mass of oxygen is needed to react with 8.5 g of hydrogen sulfide (H2S)?

$2\ H_2S + 3\ O_2 \rightarrow 2\ SO_2 + 2\ H_2O$

5 What mass of oxygen is required to oxidise 34 g of ammonia (NH3) to nitrogen monoxide (NO)?

$4\ NH_3 + 5\ O_2 \rightarrow 4\ NO + 6\ H_2O$

6 5.00 g of hydrated sodium sulfate crystals ($Na_2SO_4.nH_2O$) gave 2.20 g of anhydrous sodium sulfate on heating to constant mass. Work out the relative formula mass (Mr) of the hydrated sodium sulfate and the value of *n*.

$Na_2SO_4.nH_2O \rightarrow Na_2SO_4 + n\ H_2O$

Task 9: Yields and atom economy

$$\%\ \text{yield} = \frac{\text{actual yield}}{\text{theoretical yield}} \times 100\%$$

Calculation of Atom Economy

$$\text{atom economy} = \frac{\text{mass of atoms in desired product}}{\text{mass of atoms in reactant}} \times 100\%$$

1 Quicklime (calcium oxide, CaO) can be made by thermal decomposition of limestone (calcium carbonate, CaCO3).

$$CaCO_3 \rightarrow CaO + CO_2$$

a Calculate the maximum theoretical mass of quicklime that can be made by heating 50 g oflimestone (relative atomic masses: C = 12, O = 16, Ca = 40).

b In the reaction, only 26 g of quicklime was produced. Calculate the percentage yield.

2 Aluminium is made by the electrolysis of aluminium oxide. Calculate the atom economy for the production of aluminium in this reaction. (relative atomic masses: O = 16, Al = 27)

$$2\ Al_2O_3 \rightarrow 4\ Al + 3\ O_2$$

3 Hydrazine (N_2H_4) was used as the rocket fuel for the Apollo missions to the moon. It is made by the reaction of ammonia (NH_3) with sodium chlorate (NaOCl) (relative atomic masses: H = 1, N = 14, O = 16, Na = 23, Cl = 35.5).

ammonia + sodium chlorate → hydrazine + sodium chloride + water

$2\ NH_3 + NaOCl \rightarrow N_2H_4 + NaCl + H_2O$

a Calculate the maximum theoretical mass of hydrazine that can be made by reacting 340 g of ammonia with an excess of sodium chlorate.

b In the reaction, only 280 g of hydrazine was produced. Calculate the percentage yield.

c Give **three** reasons why less than the maximum theoretical yield was produced.

d Calculate the atom economy for this way of making hydrazine

Task 10: Different types of structures

Complete the table about substances with each of the types of structures shown.

Type of structure	**Simple molecular**	**Ionic**	**Giant covalent**	**Metallic**
Description of structure				
Type of bonding				
Melting points and boiling points (with reason)				
Electrical conductivity (with reason)			Exception = graphite	
Examples of substances with this structure				

Task 11: Alkanes and formulae

1 Hydrocarbons are the main compounds in crude oil.
a What are hydrocarbons? *(1 mark)*

b Name the type of chemical bond present between the atoms in a hydrocarbon molecule.*(1 mark)*

c What are alkanes? *(1 mark)*

d Explain why alkanes are *saturated* hydrocarbons. *(1 mark)*

2 The molecular formula for propane is C_3H_8.
a Explain what information this formula shows. *(2 marks)*

b State one feature of a propane molecule that is not shown in the molecular formula. *(1 mark)*

3 The alkanes form a homologous series of compounds.
a Apart from the same general formula, state one feature that is common to members of a homologous series. *(1 mark)*

b Give the general formula for the alkanes. *(1 mark)*

c Predict the molecular formula for octane, which has eight carbon atoms. *(1 mark)*

4 Methane, ethane and propane are alkanes with 1, 2 and 3 carbons respectively.
a Give their molecular formulae. *(3 marks)*

b Draw their displayed formulae. *(3 marks)*

Task 12: Products from fuels

Burning fossil fuels

1 a Name the product from the complete combustion of carbon.*(1 mark)*

b Name the product from the complete combustion of hydrogen. *(1 mark)*

2 Coal is mostly carbon. Name the main product from the complete combustion of coal. *(1 mark)*

3 a Paraffin wax is a hydrocarbon. Name the two products made during the complete combustion of paraffin wax. *(2 marks)*

b Which gas, found in air, is needed for combustion to happen? *(1 mark)*

d Use your answers to parts **b** and **c** to write a word equation for the complete combustion of paraffin wax. *(2 marks)*

Other products of combustion

4 Incomplete combustion happens when the supply of air is not plentiful.

a Name the solid product released during the incomplete combustion of hydrocarbon fuels. *(1mark)*

b Name the gaseous product released during the incomplete combustion of hydrocarbon fuels.*(1 mark)*

5 a Fossil fuels often contain sulfur. Name the gaseous product formed when sulfur is burned. *(1 mark)*

b The product named in part **a** is a cause of acid rain. NOx form at high temperatures and are also a cause of acid rain. Which gas reacts with oxygen to form NOx? *(1 mark)*

Balanced equations

6 Correctly balance these equations.

a C_3H_8 + ___ O_2 → ___ CO_2 + ___ H_2O *(1 mark)*

b C_3H_8 + ___ O_2 → ___ CO + ___ H_2O *(1 mark)*

c __ N_2 + O_2 → NO_2 *(1 mark)*

Task 13: Fractional distillation and cracking

1. Use the words from the box to complete the sentences

Boiling	distillation	fractions	fuel	gas	oil	vapour

The different fractions in crude _____ can be separated by fractional _____. The different fractions have different _____ points. The crude oil is heated and turned into a _____. It travels up a fractionating column where different fractions cool down, and the _____ turns back into a liquid. Different _____ have different boiling points and different uses. For example petrol is used as a _____ for cars.

2. The table below shows how many barrels of different fractions of crude oil are produced in a day at an oil refinery.

Fraction	**LPG**	**Petrol**	**Naphtha**	**Paraffin**	**Diesel**
Number of barrels you produce	100	500	300	700	800
Number of barrels you can sell	100	700	300	500	800

a Which fraction can you more of than you produce each day? (*I mark)*

b Some barrels are ;eft over and not sold each say. Which fraction is this? (*I mark)*

c Write a paragraph to explain what you do with the leftover barrels. Use the following words in your answer: cracked, alkanes, alkenes, fuels, plastics (*7 marks).*