# CHEMISTRY Transition Work

Name

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## ‘Starting Year 12 Chemistry on the Front Foot’

So you have expressed an interest in Chemistry… what a great choice!

To help you prepare for year 12 and to start the A-level course on the front foot, the Chemistry department have put together some excellent resources.

- **To watch and listen…** Chemistry is a fascinating and evolving subject. There are some books and resources you might like to look at in this document.

- **To practice**… This focuses on questions of key concepts in Chemistry, keeping your skills honed and Chemistry brain sharp for the start of year 12.

  The purpose of these tasks is to reinforce fundamental concepts that are covered at GCSE and are extended at A level Chemistry.

  It is important to identify **NOW** whether these concepts are clearly understood, whether there are any misconceptions, or topics where understanding is missing. Once identified, these misunderstandings can be addressed and as a result a solid foundation can be provided for A level learning.

  Complete each section in this task and indicate on the scale how you confident you feel in your understanding/answers.

Any issues, please contact Mr. Cartledge or Mr. Woodhouse at mcartledge@st-peters.surrey.sch.uk or dwoodhouse@st-peters.surrey.sch.uk

**Linking GCSE Chemistry to A-Level Chemistry Specification**

note the key concepts are those covered in year 12

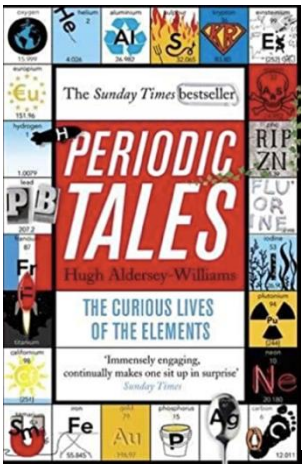
| | | R | A | G | Link to A-level Chemistry |
|---|---|---|---|---|---|
| **1: Atomic Structure and the Periodic Table** | 1.1. Model of the atom, symbols, relative atomic mass, electronic charge and isotopes, development of model of the atom | | | | Year 12: Atomic Structure |
| | 1.2 The periodic table (~~including development of the modern Periodic Table,~~ Group 1, Group 0 and Group 7) | | | | Year 12: Atomic Structure<br>Year 12: Group 7 |
| | 1.3 Transition metals | | | | Year 13: Transition Metals |
| **2: Bonding, Structures and properties of matter** | 2.1 Chemical bonds, ionic, covalent and metallic | | | | Year 12: Bonding |
| | 2.2 How bonding relates to properties (ionic compounds, small molecules, polymers, giant covalent structures, metals and alloys) | | | | |
| | 2.3 Structure and bonding of carbon | | | | |
| | ~~2.4 Bulk and Surface properties of matter including nanoparticles~~ | | | | |
| **3: Quantitative Chemistry** | 3.1 Relative Mass and equations | | | | Year 12: Amount of Substance |
| | 3.2 Moles (calculating moles reacting mass and moles, limiting reactants, concentration g/dm$^3$) | | | | |
| | 3.3 Yield and atom economy of chemical reactions | | | | |
| | 3.4 Using concentration in mol/dm$^3$ | | | | |
| | 3.5 Use of amount of substance in relation to the volume of gas | | | | |
| **4: Chemical changes** | 4.1 Reactivity of metals | | | | Year 12: Group 2 |
| | 4.2 Reactivity of Acids | | | | Year 13: Acids and Base |
| | 4.3 Electrolysis | | | | Year 13: Electrode Potentials and Electrochemical Cells |
| **5: Energy changes** | 5.1 Exothermic and endothermic reactions | | | | Year 12: Energetics |
| | 5.2 Chemical and Fuel Cells | | | | Year 13: Electrode Potentials and Electrochemical Cells |
| **6: The rate and extent of chemical change** | 6.1 Rate of reaction | | | | Year 12: Kinetics |
| | 6.2 Reversible reactions and dynamic equilibrium | | | | Year 12: Chemical Equilibria |
| **7: Organic Chemistry** | 7.1 Carbon compounds as fuels and feedstock | | | | Year 12: Organic intro, alkanes |
| | 7.2 Reactions of alkenes and alcohols | | | | Year 12: Alkenes and alcohols |

| | | | | | |
|---|---|---|---|---|---|
| | 7.3 Synthetic and naturally occurring polymers | | | | Year 12: Alkenes<br>Year 13: Polymers |
| **8. Chemical analysis** | 8.1 Purity, formulations and chromatography | | | | Year 13: Chromatography |
| | 8.2 Identification of common gases | | | | Year 12: Group 2 and Group 7 |
| | 8.3 Identification of ions by chemical and spectroscopic means | | | | Year 12: Group 2 and Group 7 |
| **~~9. Chemistry of the atmosphere~~** | ~~9.1 The composition and evolution of the Earth's atmosphere~~ | | | | |
| | ~~9.2 Carbon dioxide and methane as greenhouse gases~~ | | | | |
| | ~~9.3 Common atmospheric pollutants and their sources~~ | | | | |
| **10. Using resources** | ~~10.1 Using Earth's resources and obtaining potable water~~ | | | | |
| | ~~10.2 Life cycle assessment and recycling~~ | | | | |
| | ~~10.3 Using materials (corrosion and prevention, alloys, ceramics)~~ | | | | |
| | 10.4 The Haber process ~~and the use of NPK fertilisers~~ | | | | Year 12: Chemical Equilibria |

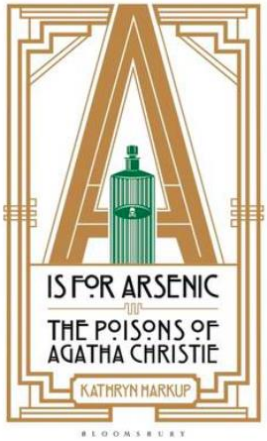
# Reading and More List

Below are some popular science books, magazines and podcasts that the Chemistry Department have enjoyed. This might be something that you might like to engage with over the long Summer break.

## Books




**Periodic Tales'** is a fascinating books about the elements on the Periodic Table. Each chapter focuses on a different element and delves into it's discovery, history and cultural relevance. Why is gold so valuable? Which element was discovered through urine? Why did Napoleon show off to his guests by providing them

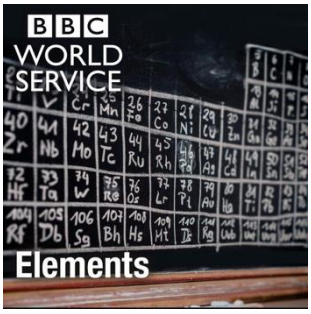



**'A is for Arsenic**' delves into the dark, mysterious side of Agatha Christie. Agatha is one of Britain's most famous author's, the writer of the classic murder mystery involving Hercule Poirot and Miss Marple. You have probably seen one or two of her books adapted to BBC dramas – a Christmas classic. Less known, is that Agatha was a pharmacy assistant during the second world war and had an excellent understanding of poisons. Each chapter explores one of the poisons used in a murder

## Magazine

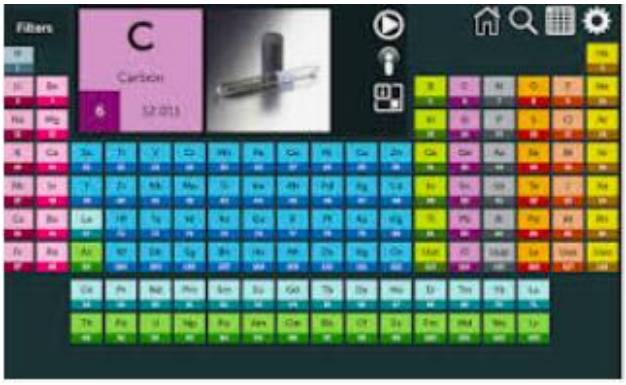

'Chemistry Review' by Hodder. This is aimed at A-level students, giving exam tips and a examples of current research.
https://www.hoddereducation.co.uk/subjects/science/products/16-18/chemistry-review-magazine-volume-31,-2021-22

## Podcasts




**'Elements'** by the world service is a podcast which does exactly what it says on the tin (or title). Each episode explores the geopolitical and economic importance of the element and gives fascinating and unusual examples of how they are used. Brilliant podcast.

## Apps




**'The Periodic Table App'** by The Royal Society of Chemistry brings together lots of different resources about each element. As well as the stats and figures there is information about rarity, cost, origin of discovery and name, as well as links to videos and podcasts about the element. A huge, encyclopaedia of information to explore at your fingertips. A great app to download free and waste away those boring hours waiting.

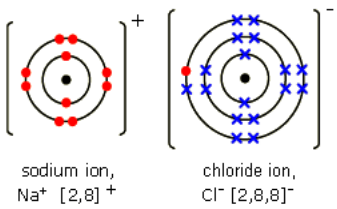
**Practice: Topic 1: Atomic Structure and Bonding**

**Task 1:** Draw the electronic structure of the element in the box:

| C | O | Ca | Ne |
|---|---|---|---|
| | | | |

**Bonding**: When bonding atoms transfer electrons (ionic) or share electrons (covalent) because atoms are more stable with complete electron shells (Rule = 2, 8, 8)

**Ionic Bonding**: Ions are atoms that have a charge:




Metals lose their outer electrons and form positive ions

Non-metals gain electrons and form negative ions

**Task 2:** Use a Periodic Table to complete the table below:

| Atom or Ion | Atomic Number | Mass number | Number of protons | Number of neutrons | Number of electrons | Electron Structure |
|---|---|---|---|---|---|---|
| $^{16}O^{2-}$ | 8 | 16 | 8 | 8 | 10 | $[2,8]^{2-}$ |
| $^{31}P$ | | | | | | |
| | 13 | 27 | | | 13 | |
| | 13 | 27 | | | 10 | |
| $^{32}S^{2-}$ | | | | | | |
| | | | 12 | 12 | | $[2,8]^{2+}$ |

**Covalent Bonding**: Non Metals share electrons:

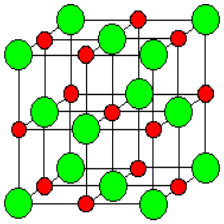
**Task 3**: Draw the following covalent compounds – just draw the outer shell (watch out for single and double bonds).

| $CH_4$ | $NH_3$ |
|---|---|
| $H_2O$ | $CO_2$ |

**Topic 2: Structures of chemicals**:

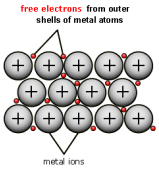
All Substances exist in one of the following structures:

**Giant Ionic** (metal + non-metal)



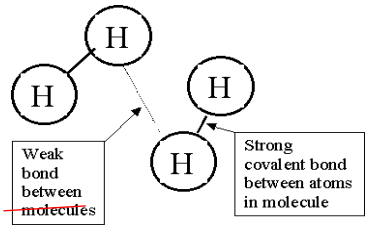

- Strong electrostatic attraction between charged ions
- Conducts electricity when molten or dissolved.

**Metallic**




- Delocalised electrons surround metal ions = conduct electricity
- Electrostatic attraction between positive ions and electrons
- Ions arranged in rows that are able to slide past each other

**Simple Molecular** (non-metals only, e.g. Hydrogen, water)

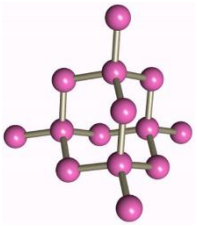



Weak forces between molecules

Strong covalent bonds within molecules

No charged particles

**Giant Covalent** (diamond, graphite, silicon dioxide)



Strong covalent bonds between atoms.

Giant structure of trillions of atoms

**Task 4**: Which structure are these substances: Giant Ionic, Metallic, Simple Molecular, Giant Covalent?

| Substance | Melting point (°C) | Boiling point (°C) | Electrical conductivity as | | | Type of structure |
|---|---|---|---|---|---|---|
| | | | solid | liquid | solution (aq) | |
| A | -106 | -34 | does not conduct | does not conduct | insoluble | |
| B | 649 | 1238 | does not conduct | conducts | conducts | |
| C | 367 | 984 | conducts | conducts | insoluble | |
| D | 2342 | 2482 | does not conduct | does not conduct | does not conduct | |
| E | 85 | 217 | does not conduct | does not conduct | does not conduct | |

**Topic 3: Formulae and Balancing equations**

At AS and A level students are expected to be able to form and use formula with ease. There are no marks available for formula themselves, but there are lots of marks for questions that involve using formula. It is a fundamental part of the course. And… you will not be given a list of charges like the one below or those given at AS level.

However the Periodic Table comes to the rescue, you do not need to learn all of these, just be able to use the patterns of the Periodic Table

| Positive Ions | | Negative Ions | |
|---|---|---|---|
| Group 1 Ions:<br>Lithium $Li^+$<br>Sodium $Na^+$ | Group 3 Ions:<br>Aluminium $Al^{3+}$ | Group 7 ions:<br>Fluoride $F^-$<br>Chloride $Cl^-$ | Other Common Ions:<br>Nitrate $NO_3^-$<br>Sulfate $SO_4^{2-}$ |
| Group 2 Ions<br>Magnesium $Mg^{2+}$<br>Calcium $Ca^{2+}$ | Other Common Ions<br>Silver $Ag^+$<br>Zinc $Zn^{2+}$<br>Hydrogen $H^+$<br>Ammonium $NH_4^+$ | Group 6 Ions<br>Oxide $O^{2-}$<br>Sulfide $S^{2-}$ | Carbonate $CO_3^{2-}$<br>Hydrogencarbonate $HCO_3^-$<br>Hydroxide $OH^-$ |

**How to write formulae** *(AgBr₃ is done as an example):*

1. Identify the ions present: ***$Al^{3+}$*** ***$Br^-$***
   a. Sometimes a roman numeral is written in brackets after the name, this shows the charge iron(II) = $Fe^{3+}$
2. Identify how many of each are required so that the overall charge = 0 **1 x $Al^{3+}$ = 3+** **3 x $Br^-$ = 3-**
3. Write the symbols together, remove the charges and put a subscript number to show how many ions are present – not needed if only 1 ion is present $AlBr_3$
4. The ratio within a formula is fixed. The subscript numbers cannot be altered when balancing equations.

**Task 6**: Write the formula below for these substances (you will need to use the table above and a Periodic Table)

1. Silver Bromide ……..
2. Sodium Carbonate ……..
3. Potassium Oxide ……..
4. Iron (III) Oxide ……..
5. Chromium (III) Chloride ……..
6. Calcium Hydroxide ……..
7. Lead (I) Oxide ……..
8. Rubidium Carbonate ……..
9. Zinc Hydrogencarbonate ……..
10. Ammonium Sulfate ……..
11. Gallium Hydroxide ……..
12. Strontium Selenide ……..

**Task 7**: Complete and Balance the following symbol equations where necessary

1. $Ca + H_2SO_4 \rightarrow$
2. $CO + O_2 \rightarrow CO_2$
3. $Li_2CO_3 + HCl \rightarrow$
4. $Fe_2O_3 + HCl \rightarrow FeCl_3 + H_2O$
5. $NH_3 + O_2 \rightarrow NO + H_2O$
6. $C_2H_6 + O_2 \rightarrow CO_2 + H_2O$

**General Equations:**

Metal + Acid → Salt + Hydrogen

Base + Acid → Salt + Water

Carbonate + Acid → Salt + Water + Carbon Dioxide

**Topic 4: Calculations**

In A level Chemistry the amount of marks available for calculations has increased with the new specification. So far in double award you have learnt about equation 1. Students taking triple award have also learnt about equation 2.

$$Moles = \frac{Mass}{Mr} \qquad Moles = \frac{Volume}{1000}\ x\ Concentration$$

You must be comfortable with the concept of 1 mole. 1 mole is just a number. You can have 1 moles of students, 1 mole of footballs, 1 mole of burgers. However 1 mole of a chemical is a very useful number:

- 1 mole of Hydrogen weighs 1g
- 1 mole of Helium weighs 2g
- 1 moles of Lithium weighs 3g

This is very useful because the mass of an individual atom is too small and makes Maths much, much easier. Become friendly with the idea of moles, you cannot do A level Chemistry without it.

**Task 8**: Calculate the relative molecule mass (Mr) of:

a. $H_2$ …….
b. Ne …….
c. $NH_3$ …….
d. $Ca(OH)_2$ …….
e. $K_2SO_4$ …….
f. $NH_4NO_3$ …….

**Task 9**: Attempt these questions – you will need to use the equations above and the ratio of moles in the chemical equations given.

1. What mass of Oxygen is needed to react with 8.5g of hydrogen sulphide?

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

2. What mass of potassium oxide is formed when 7.8g of potassium is burned in oxygen?

   $4K + O_2 \rightarrow 2K_2O$

3. Railway lines are welded together by the Thermite reaction which produces molten iron. What mass of iron is formed from 1kg of iron oxide?

$Fe_2O_3 + 2Al \rightarrow 2Fe + Al_2O_3$

4. What mass of oxygen is required to oxidise 10g of ammonia to NO?

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

**Challenge – Limiting Reagents and Reagents in Excess**

This is a difficult concept that you studied at GCSE, but one which you will need to secure next year at A-level. The key is to use the symbol equation for a reaction. The large numbers (called the stoichiometry of a reaction) tells you the ratio the reactants will react in. Therefore as the reactants are used up, their number/quantity will reduce in the ratio shown in the reaction equation.

- In the real world of chemistry, it is rare that we react the exact right amount of chemicals together. Usually, we have more than we need of one of the reactants and so it doesn't all react – it is in excess.
- Sometimes in calculations, we need to work out if one of the reactants is in excess. The reactant that is not in excess is sometimes called the limiting reagent.

*e.g.* $2\ SO_2 + O_2 \rightarrow 2\ SO_3$

| *Example 1* | $2\ SO_2$ | + | $O_2$ | → | $2\ SO_3$ |
|---|---|---|---|---|---|
| moles at the start | 4 mol | | 3 mol | | |
| change in moles | 4 mol react | | 2 mol react | | 4 mol made |
| moles at the end | 4 – 4 = 0 mol | | 3 – 2 = 1 mol | | 0 + 4 = 4 mol |
| | $SO_2$ limiting reagent | | $O_2$ in excess | | |

| *Example 2* | $2\ SO_2$ | + | $O_2$ | → | $2\ SO_3$ |
|---|---|---|---|---|---|
| moles at the start | 10 mol | | 3 mol | | |
| change in moles | 6 mol react | | 3 mol react | | 6 mol made |
| moles at the end | 10 – 6 = 4 mol | | 3 – 3 = 0 mol | | 0 + 6 = 6 mol |
| | $SO_2$ in excess | | $O_2$ limiting reagent | | |

**Task 10**

1) In each case work out the limiting reagent and moles of ammonia formed (assuming complete reaction).

$$N_2 + 3\,H_2 \rightarrow 2\,NH_3$$

a) 3.00 moles of $N_2$ + 3.00 moles of $H_2$

b) 3.00 moles of $N_2$ + 10.0 moles of $H_2$

c) 0.100 moles of $N_2$ + 0.200 moles of $H_2$

d) 0.50 moles of $N_2$ + 2.00 moles of $H_2$

e) 2.0 moles of $N_2$ + 10.0 moles of $H_2$

2) In each case work out the limiting reagent and moles of sulfur dioxide formed (assuming complete reaction).

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

a) 3.00 moles of $SO_2$ + 3.00 moles of $O_2$

b) 3.00 moles of $SO_2$ + 2.00 moles of $O_2$

c) 0.100 moles of $SO_2$ + 0.020 moles of $O_2$

d) 2.00 moles of $SO_2$ + 0.40 moles of $O_2$

e) 2.0 moles of $SO_2$ + 10.0 moles of $O_2$

3) 5.00 g of iron and 5.00 g of sulphur are heated together to form iron (II) sulphide. Which reactant is in excess and what is the maximum mass of iron (II) sulphide that can be formed?

$Fe + S \rightarrow FeS$

4) In the manufacture of the fertiliser ammonium sulphate, what is the maximum mass of ammonium sulphate that can be obtained from 2.00 kg of sulphuric acid and 1.00 kg of ammonia?

$H_2SO_4 + 2\,NH_3 \rightarrow (NH_4)_2SO_4$

## Confidence Scales

**Very tricky!** **Topic 1: Atomic Structure and Bonding** **EASY!**

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**Topic 2: Structures of Chemicals**

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**Topic 3: Formula and Balancing Equations**

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**Topic 4: Calculations**