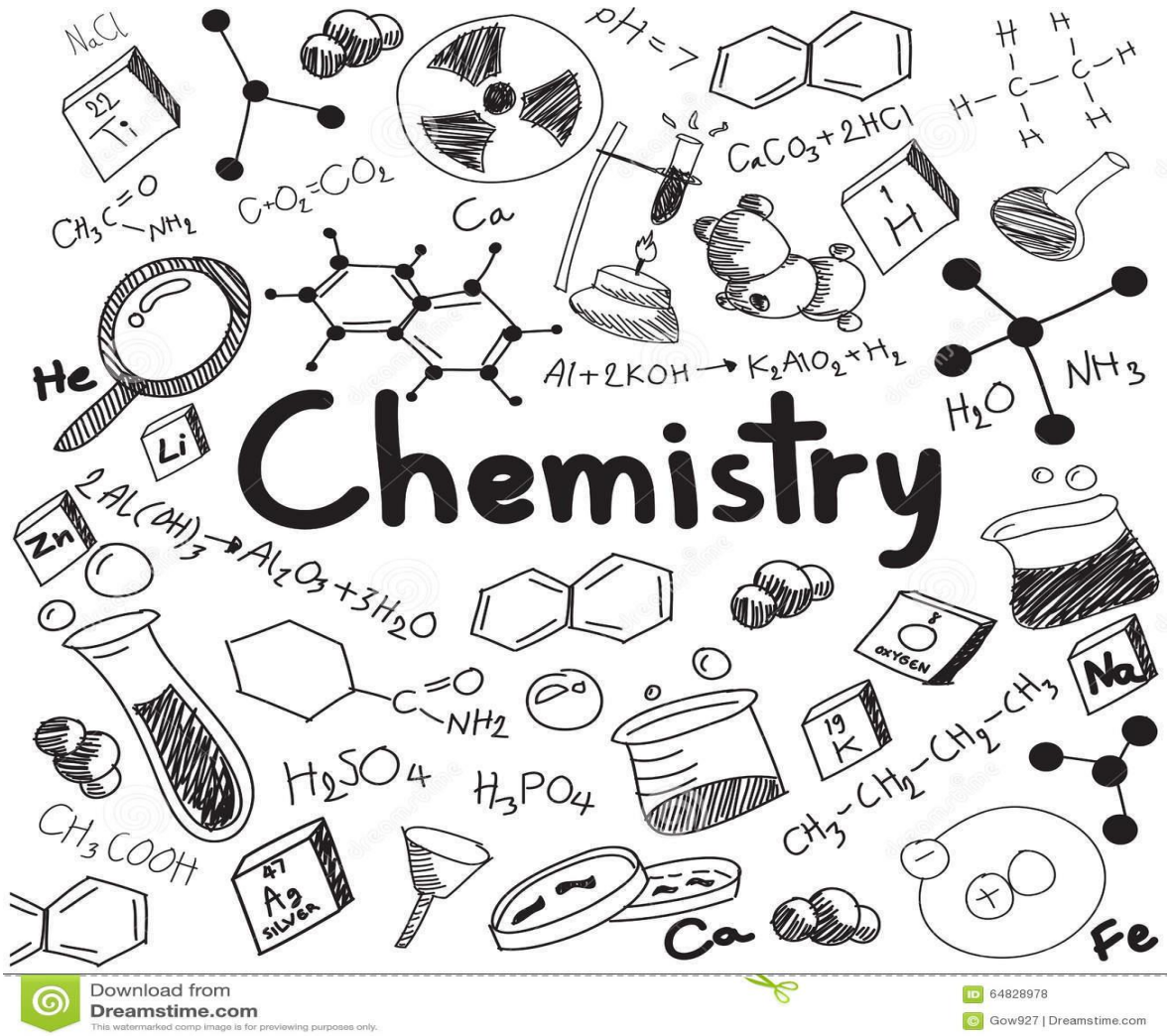
# NEWSTEAD WOOD SCHOOL
# SIXTH FORM
# SEPTEMBER 2022

# Chemistry Handbook




*'The lab is a place for the young: returning there you feel again, with the same longing for adventure, discovery, and the unexpected that you have at seventeen.' - Primo Levi*

## Contents



## Title and specification code

AQA Advanced Level GCE in Chemistry 7405

## Web site

www.aqa.org.uk

## Who's who in the Department

Alphabetical order

| | |
|---|---|
| Mr A Begbey | Head of Chemistry |
| Mrs C Britton | Chemistry Technician |
| Mrs R Choudhury | Chemistry Teacher |
| Mr S Patel | Chemistry Teacher |
| Mr J Sheehan | Chemistry Teacher |
| Miss P Sitambuli | Chemistry Teacher |

# Welcome to Chemistry

At Newstead Wood we study the AQA syllabus which is an exciting practical based course, incorporating physical, inorganic and organic Chemistry. The course builds on knowledge gained at GCSE but there is a greater emphasis on application and analysis. You will have some of your current ideas challenged and improved. There are required practicals throughout the two years which will give you the opportunity to use and understand a variety of new equipment, and chemicals to enthral, and make your learning truly engaging.

*Don't be afraid of hard work. Nothing worthwhile comes easily. Don't let others discourage you or tell you that you can't do it. In my day I was told women didn't go into Chemistry. I saw no reason why we couldn't.*
*Gertrude B. Elion*

# Aims of the course

- develop your interest in and enthusiasm for Chemistry, including developing an interest in further study and careers associated with Chemistry
- develop essential knowledge and understanding of different areas of Chemistry and how they relate to each other
- develop and demonstrate a deep appreciation of the skills, knowledge and understanding of scientific methods
- develop competence and confidence in a variety of practical, mathematical and problem solving skills
- use knowledge and understanding to pose scientific questions, define scientific problems, present scientific arguments and scientific ideas
- carry out experimental and investigative activities, including appropriate risk management, in a range of contexts

# Attributes for your success in Chemistry

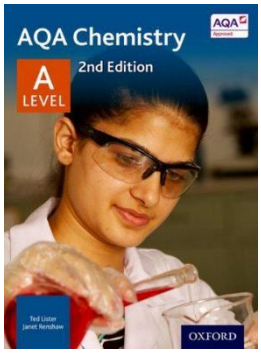
- **Be organised**
  Be aware of the topic you are studying, plan when you are going to do your homework.

- **Be proactive**
  Ask questions in class and participate in lessons; we like students to ask questions!

- **Be dedicated**
  On average you will spend approximately 2 hours per week on work outside of lessons per teacher. One hour for homework, one hour preparing, reviewing or reading around the subject; see recommended reading on the next page.

- **Use your text book**
  You *must* have a copy of the course text book AQA Chemistry A Level Student Book, Second edition, Ted Lister (author), Janet Renshaw (author) ISBN 9780198351825

  You may choose to buy the year 1 and year 2 book separately.




- **Wear a lab coat**
  You *should* have a white thick cotton lab coat. If you choose to take part in a practical without a lab coat, then you are responsible for any damage to your clothes.

- **Maintain high attendance**
  If attendance falls below 80%, without valid and substantiated reasons (e.g. medical concerns with certification), we will consider withdrawing your entry into the public examinations.

# Recommended reading list

(this has been compiled from the Oxbridge 1st year undergraduate degree course)

**General texts:**

1. Keeler J. and Wothers P. Why chemical reactions happen, Oxford, 2003.
2. Keeler J. and Wothers P. Chemical structure and reactivity: an integrated approach, Oxford, 2008.

**Physical Chemistry:**

3. Atkins P.W. The Elements of Physical Chemistry, any edition, OUP.
4. Atkins P.W. Physical Chemistry, OUP, (any edition).

**Organic Chemistry:**

5. Clayden J., Greeves N., Warren S. and Wothers P. Organic Chemistry, OUP, 2001.
6. Solomons T.W.G. Organic Chemistry, Wiley, 10th Edn, 2010.
7. Carey F.A. Organic Chemistry, McGraw Hill, 7th Edn, 2007.
8. Sykes P. Guidebook to Mechanism in Organic Chemistry, Longman, 6th Edn, 1986
9. Warren S. Chemistry of the Carbonyl Group, Wiley 1974.

**Inorganic Chemistry:**

10. Wulfsberg, G. Inorganic Chemistry, University Science Books.
11. Mingos, E.M.P. Essentials of Inorganic Chemistry, OUP, 1995.

**For reference:**

12. Greenwood N.N. and Earnshaw A. Chemistry of the Elements, Pergamon, 1984.
13. Henderson E. Main Group Chemistry, Royal Society of Chemistry 2000

**Spectroscopy:**

14. Williams D.H. and Fleming I. Spectroscopic Methods in Organic Chemistry, McGraw Hill, 6th Edn, 2007. (earlier editions are perfectly acceptable)

**Kinetics:**

15. Cox B.G. Modern Liquid Phase Kinetics, (Oxford Chemistry Primers 21), OUP, 1994.
16. Pilling M.J. and Seakins P.W. Reaction Kinetics, (Oxford Science Publications), OUP, 1995.

**Calculations:**

17. Calculations in AS/A Level Chemistry by Jim Clark

## Links to useful websites

http://www.chemguide.co.uk/
www.docbrown.info
http://www.physicsandmathstutor.com/Chemistry-revision/a-level-aqa/
https://chemrevise.org/revision-guides/
www.s-cool.co.uk/a-level/Chemistry
https://www.youtube.com/user/MrERintoul
https://www.youtube.com/allerychemistry

# KS5 Chemistry Sharepoint

https://newsteadwood.sharepoint.com/sites/KS5ChemistryStudents

## What to do when stuck

*'We all make mistakes, but only the wise learn from their mistakes'*
*Winston Churchill*

**Class teacher**

Your two subject specialists will be your first port of call. However there are 5 members of the team that you may also approach.

**Classmates**

By all means ask your peers for help but do not disrupt their learning.

**Drop ins**

You can come and see any teacher anytime during the school day if you have any queries or concerns. For longer discussions make an appointment. There is usually a weekly Chemistry support session at lunchtimes in lab C6.

# Assessment

You will take three exams papers at the end of the A-level, in which content from both years will be assessed. There is still no coursework as such, but there will be questions about practical Chemistry in the exam, and you will have to show you are a competent practical chemist, by completing a number of required practicals.

| **Paper 1**<br>Physical and inorganic | **Paper 2**<br>Physical and organic | **Paper 3**<br>Any content, any practical |
|---|---|---|
| • 2 hour exam<br>• 105 marks<br>• 35% of the A-level<br>• Short and long answer questions | • 2 hour exam<br>• 105 marks<br>• 35% of the A-level<br>• Short and long answer questions | • 2 hour exam<br>• 90 marks<br>• 30% of the A-level<br>• 40 marks of questions on practical techniques and data analysis.<br>• 20 marks of questions testing across the specification<br>• 30 marks multiple choice questions. |

Students who have studied Chemistry in recent years have gone on to Chemical engineering, Medicine, and Pharmacy at

- Cambridge
- Kings College London
- Oxford
- Queen Mary and Westfield
- St Andrew's
- UCL

**Some quotes from Y12 and Y13 students**

"I'm glad I used my frees for studying"
"The staff are so helpful."
"Revising properly for topic tests made the end of year exams easier"
"Going over topic tests, and making improvement actually helped me get better"

# Laboratory Rules for Sixth Form Students

When you are in a science lesson, you are expected to take reasonable care for the health and safety of yourself and any other person who might be affected by your acts or omissions.

- You may enter a laboratory when there is no member of staff present provided you are sure that a science teacher is within call in an adjacent laboratory or prep room. However, practical work can only be carried out if there is a science teacher present.
- Outdoor coats/jackets and large bags should not be brought into laboratories.
- You must not touch any materials or equipment unless told to do so by a teacher or have previously clear instructions that you may do so. If you are not sure what to do, ask the teacher or the technician before you start using apparatus or materials.
- Class practicals have been risk assessed and your teacher will warn you of any potential hazards. Chemical hazards are found on Student Safety Sheets which are found in the laboratories.
- When planning any sort of individual investigation you must carry out a **Risk Assessment**, write down any hazards that might be involved and discuss them with your teacher **before** starting the practical work.
- You must wear eye protection whenever there is a risk to your eyes. You must not rub your eyes without washing your hands first.
- When using a Bunsen burner make sure that you tie back your hair and keep any loose clothing away from the flame. You should be standing, when using a Bunsen.
- You must not taste anything or put anything in your mouth when in a science laboratory.
- If chemicals get on your hands or other parts of your body, wash them off and check with the teacher that this is sufficient. Wash your hands after all experimental work.
- Do not put waste solids down the sink. Do not pick up broken glass except with a dustpan and brush. Broken glass is put in the special 'broken glass bins'.
- Keep your workbench clean and tidy and put any folders or textbooks in a safe place.
- Report any accident to the teacher immediately. If you suffer a heat or chemical burn, put the injury under a **gentle** stream of cold water from a tap.
- In the event of an emergency **stop** any practical work, **turn off** any apparatus, **stand quietly** and wait for instructions.

# A LEVEL CHEMISTRY - SOME DEFINITIONS TO LEARN

| | |
|---|---|
| **ISOTOPE** | Atoms with ... the same atomic number but different mass number or<br>the same number of protons but different numbers of neutrons |
| **ATOMIC NUMBER** | The number of protons in the nucleus of an atom |
| **MASS NUMBER** | The sum of the protons and neutrons in the nucleus of an atom |
| **RELATIVE ATOMIC MASS** | The mass of an atom relative to that of the carbon 12 isotope having a value of 12.000 |
| **EMPIRICAL FORMULA** | The simplest, whole number, ratio of elements in a compound |
| **MOLECULAR FORMULA** | The exact number of atoms of each element in the formula of a compound |
| **IONIC BOND** | Oppositely charged ions held together in a crystal lattice by electrostatic attraction |
| **COVALENT BOND** | A shared pair of electrons, one electron being supplied by each atom either side of the bond |
| **DATIVE COVALENT (CO-ORDINATE) BOND** | A shared pair of electrons, both electrons being supplied by one atom in the bond |
| **ELECTRONEGATIVITY** | The ability of an atom to attract the pair of electrons in a covalent bond to itself |
| **MACRO (GIANT) MOLECULE** | Many atoms joined together in a regular array by a large number of covalent bonds |
| **POLAR BOND** | A covalent bond where the shared pair of electrons is displaced to one end |
| **FAJAN'S RULES** | A compound is more likely to be covalent if the ... cation has a small size and a high charge<br>anion has a large size and a high charge |
| **FIRST IONISATION ENERGY** | The energy required to remove one mole of electrons (to infinity) from one mole of gaseous atoms to form one mole of gaseous positive ions. |
| **ELECTRON AFFINITY** | The enthalpy change when one mole of gaseous atoms acquires one mole of electrons (from infinity) to form one mole of gaseous negative ions. |
| **STANDARD ENTHALPY OF FORMATION** | The enthalpy change when one mole of a compound is formed in its standard state from its elements in their standard states |
| **STANDARD ENTHALPY OF COMBUSTION** | The enthalpy change when one mole of a substance undergoes complete combustion in its standard state |
| **BOND (DISSOCIATION) ENTHALPY** | The energy required to break one mole of gaseous bonds to form gaseous atoms |
| **STANDARD ENTHALPY OF ATOMISATION** | The enthalpy change when ONE MOLE of gaseous atoms is formed from an element in its standard state |
| **ENTHALPY OF FORMATION** | The enthalpy change when one mole of a compound is formed in its standard state from its elements in their standard states |
| **LATTICE DISSOCIATION ENTHALPY** | The enthalpy change when ONE MOLE of an ionic lattice dissociates into isolated gaseous ions |
| **LATTICE FORMATION ENTHALPY** | The enthalpy change when ONE MOLE of an ionic lattice dissociates is formed from its isolated gaseous ions |
| **ENTHALPY OF HYDRATION** | The enthalpy change when ONE MOLE of gaseous ions dissolves in (an excess of) water |
| **ENTHALPY OF HYDROGENATION** | The enthalpy change when ONE MOLE of double bonds is reduced to single bonds by reacting with gaseous hydrogen. |
| **HESS'S LAW** | The enthalpy change of a reaction is independent of the path taken |

# Bridging Unit task 1 of 3
## Due 1st lesson of Year 12.

Multiple choice

You **must** show your working

1.
Sodium hydroxide neutralises hydrochloric acid as shown in the equation:

$NaOH(aq) + HCl(aq) \rightarrow NaCl(aq) + H_2O(l)$

A student found that 27.20 cm3 of 0.100 moles per $dm^3$ sodium hydroxide neutralised 5.00 $cm^3$ of hydrochloric acid.
Calculate the concentration of the hydrochloric acid in moles per $dm^3$.
Give your answer to three significant figures.

**A** 0.544
**B** 0.500
**C** 544
**D** 54.4

2.
'Iron tablets' usually contain iron sulphate ($FeSO_4$).
This salt can be made by reacting iron with sulphuric acid.
$Fe + H_2SO_4 \rightarrow FeSO_4 + H_2$
Calculate the mass of iron sulphate that could be obtained from 4.00 g of iron. Give your answer to 3 significant figures.
(Relative atomic masses: Fe = 56, H = 1, O = 16, S = 32)

**A** 170.24
**B** 170
**C** 10.857
**D** 10.9

3.
In a different reaction Iron makes another iron sulphate compound.
Which is the balanced symbol equation?

**A** $3Fe + 2H_2SO_4 \rightarrow 3Fe_2(SO_4)_3 + 2H_2$
**B** $2\ Fe + 3H_2SO_4 \rightarrow Fe_2(SO_4)_3 + 3H_2$
**C** $6\ Fe + 3\ H_2SO_4 \rightarrow 3Fe_2(SO_4)_3 + 6H_2$
**D** $2\ Fe + 12\ H_2SO_4 \rightarrow 2\ Fe_2(SO_4)_3 + 3H_2$

No working needs to be shown for **THIS** question.

4.
A “drink-driving” offence is committed if the blood alcohol level of a driver is over 80 mg of
ethanol per 100 cm3 of blood.
What is the concentration (in mol dm3) of ethanol if there are 80 mg of ethanol per 100 cm3 of blood?
1g = 1000mg Mr of ethanol is 46 $1dm^3 = 1000cm^3$

**A** 0.0017
**B** 0.017
**C** 0.080
**D** 0.80

5.
Salicylic acid can be made in to Aspirin $C_9H_8O_4$ The equation for the reaction is shown below.

$C_7H_6O_3 + C_4H_6O_3 \rightarrow C_9H_8O_4 + CH_3COOH$
Salicylic acid Aspirin

Calculate the maximum mass of aspirin that could be made from 2.00 g of salicylic acid.
The relative formula mass (*M*r) of salicylic acid, $C_7H_6O_3$, is 138
The relative formula mass (*M*r) of aspirin, $C_9H_8O_4$, is 180

**A** 1.53
**B** 12420
**C** 2.60
**D** 2.61

6.
$31cm^3$ of NaOH was neutralised by $25cm^3$ of sulphuric acid. The concentration of the sulphuric acid was 1.5 moles per $dm^3$.
The equation for the reaction is:
$2NaOH + H_2SO_4 \rightarrow Na_2SO_4 + 2H_2O$
Calculate the concentration of the sodium hydroxide.
Give your answer to three significant figures.

**A** 2.42
**B** 1.209
**C** 1.20
**D** 1.21

7.
Which one of the following compounds contains the smallest percentage, by mass, of oxygen?

**A** $CH_3OCH_2CH_3$
**B** $CH_3OCH_2NH_2$
**C** COS
**D** $C_4H_9Al(OH)_2$

**8.**
Magnesium reacts with hydrochloric acid according to the following equation.

$$Mg + 2HCl \longrightarrow MgCl_2 + H_2$$

A student calculated the minimum volume of 2.56 mol $dm^{-3}$ hydrochloric acid required to react with an excess of magnesium to form 5.46 g of magnesium chloride ($M_r$ = 95.3).

Which of the following uses the correct standard form and the appropriate number of significant figures to give the correct result of the calculation?

**A** $4.476 \times 10^{-2}$ $dm^3$
**B** $4.48 \times 10^{-2}$ $dm^3$
**C** $4.50 \times 10^{-2}$ $dm^3$
**D** $44.8 \times 10^{-3}$ $dm^3$

**9.**
The removal of silicon dioxide with limestone in the Blast Furnace can be represented by the
following equation.
$CaCO_3(s) + SiO_2(s) \rightarrow CaSiO_3(l) + CO_2(g)$
The minimum mass of calcium carbonate needed to remove 1.00 tonne (1000 kg) of silicon
dioxide is

**A** 0.46 tonne
**B** 0.60 tonne
**C** 1.67 tonne
**D** 2.18 tonne

**10.**
A particular sample of iron ore contains 85% by mass of $Fe_2O_3$ (*M*r= 159.6) and no other iron compound. The maximum mass of iron that could be extracted from 1.0 tonne of this ore is

**A** 0.59 tonne
**B** 0.66 tonne
**C** 0.75 tonne
**D** 0.85 tonne

**11.**
In a reaction which gave a 27.0% yield, 5.00 g of methylbenzene (Mr = 92.1) were converted into the explosive 2,4,6-trinitromethylbenzene (TNT) (*M*r = 227.0). For every one mole of Methylbenzene one mole of TNT can be made. The mass of TNT formed was

**A** 1.35 g
**B** 12.34 g
**C** 3.65 g
**D** 3.33 g

**12.**
Analysis of a compound shows that it contains:

76.0% lead (Pb)
13.0% chlorine (Cl)
2.2% carbon (C)
8.8% oxygen (O)

Which is the empirical formula of this compound.

Relative atomic masses:

Pb = 207; Cl = 35.5; C = 12 ; O = 16

**A** $Pb_3Cl_3CO_5$
**B** $Pb_2Cl_2CO_3$
**C** $Pb_{35}Cl_6CO_4$
**D** $Pb_{17}Cl_3CO$