Sixth Form Transition Pack

A-LEVEL CHEMISTRY

COURSE INTRODUCTION

Welcome to AQA A Level Chemistry! This course is designed to build on the fundamental concepts you've learned at GCSE and take your understanding of the subject to a deeper and more advanced level.

Over the next two years, you'll explore the core principles of physical, inorganic, and organic Chemistry, developing not only your theoretical knowledge but also your practical skills through a range of hands-on experiments.

From atomic structure and bonding to reaction mechanisms and analytical techniques, A Level Chemistry will challenge your thinking, sharpen your problem-solving skills, and prepare you for a wide range of future pathways, including medicine, engineering, and beyond. Whether you're passionate about discovering how the world works or aiming for a science-based career, this course offers a fascinating and rewarding journey into the heart of matter.

To succeed in A Level Chemistry, you'll need to bring a strong work ethic, curiosity, and a willingness to engage with challenging concepts. Key skills include analytical thinking, mathematical ability (particularly with formulae, equations, and data analysis), and a logical approach to problem-solving.

You'll also need to develop precision and attention to detail, especially in practical work and when interpreting experimental results. Time management and independent study are essential, as the step up from GCSE requires regular revision and consistent effort outside of lessons. Most importantly, an open mind and a positive attitude toward learning will help you overcome challenges and achieve your full potential in the subject.

"Chemistry is not just about mixing substances in a lab – it's about understanding the invisible world that governs everything we see. From the air we breathe to the medicines we take, chemistry explains how things work, why they change, and how we can use that knowledge to solve real-world problems"

I

WHAT WILL I STUDY

Over the two-year AQA A Level Chemistry course, you will explore the key areas of **Physical, Inorganic, and Organic Chemistry**, building both your theoretical understanding and practical skills.

Year 1 Topics:

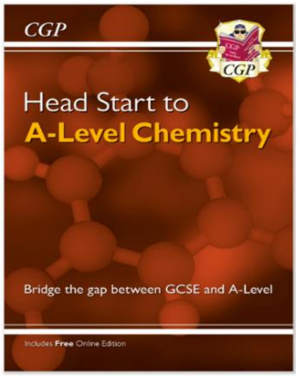
- **Atomic Structure and Bonding** – Learn about the fundamental structure of atoms, electron configuration, and different types of chemical bonding.
- **Amount of Substance** – Master calculations involving moles, concentrations, and reacting masses.
- **Energetics** – Study energy changes in reactions, including enthalpy changes and Hess's Law.
- **Kinetics** – Understand what affects the rate of chemical reactions.
- **Chemical Equilibria** – Dynamic equilibrium, Le Chatelier's Principle and Kc calculations
- **Redox and Group Chemistry** – Focus on redox reactions, the Periodic Table, and properties of Group 2 and Group 7 elements.
- **Introduction to Organic Chemistry** – Investigate the basics of carbon-based compounds, including alkanes, alkenes, halogenoalkanes, and alcohols.
- **Analytical Techniques** – Begin using infrared spectroscopy and mass spectrometry to identify substances.

Year 2 Topics:

- **Further Physical Chemistry** – Dive deeper into topics like thermodynamics, rate equations, and electrochemical cells.
- **Transition Metals and Further Inorganic Chemistry** – Study the properties, reactions, and uses of transition metals and Period 3 elements.
- **Advanced Organic Chemistry** – Explore more complex organic molecules such as aldehydes, ketones, carboxylic acids, esters, amines, and aromatic compounds.
- **Biological Molecules and Polymers** – Look at the chemistry of amino acids, proteins, DNA, and synthetic polymers.
- **Further Analytical Techniques** – Expand your skills in chromatography and NMR spectroscopy.

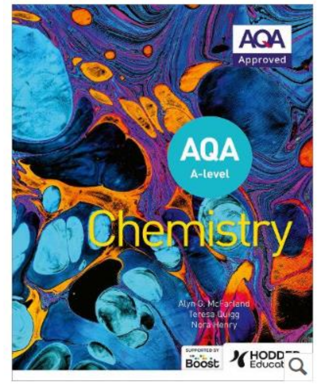
Throughout the course, you'll also complete **required practicals**, which develop your experimental skills and count toward your **Practical Endorsement**—a key part of the A Level qualification.

Recommended textbooks

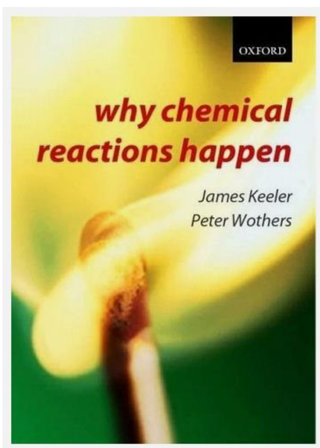


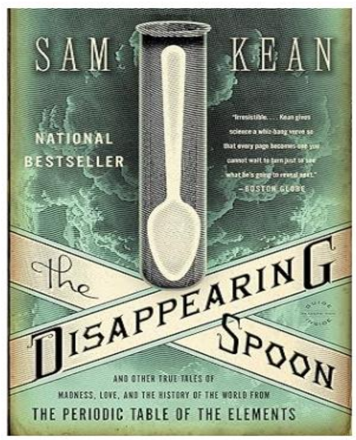
Short book designed to help students transition from GCSE to A Level. Highly recommended to ensure you feel confident with the basics.

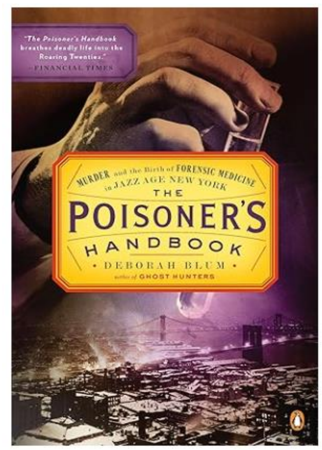
We study for AQA exam board, and the Hodder A level textbook is excellent in line with the specification which can be found on the link: https://www.aqa.org.uk/subjects/chemistry/a-level/chemistry-7405/specification/specification-at-a-glance



Summer reading







Additional online resources

- Chemguide: https://www.chemguide.co.uk/
- Royal society of Chemistry: https://www.rsc.org/
- Science daily: https://www.sciencedaily.com/

TRANSITION WORK

The following tasks will help you prepare for the course. It involves skills that are essential for Chemistry and are designed to consolidate your GCSE learning and ensure you have the basics to start the course with confidence.

Task	Score
1. Balancing equations	/10
2. Constructing ionic formula	/10
3. Writing balanced equations	/10
4. Rearranging equations	/10
5. Unit determination	/10
6. Standard form	/10
7. Significant figures and rounding	/10
8. Unit conversions	/10
9. Moles and mass	/10
10. Moles and concentration	/10
11. Laboratory equipment	/10
12. Graphical skills	/10
TOTAL SCORE	/120

Task 1: Balancing equations

1. ____C + O_2 → ____CO
2. Ba + ____ H_2O → $Ba(OH)_2$ + H_2
3. C_2H_6 + ____O_2 → CO_2 + ____H_2O
4. ____HCl + $Mg(OH)_2$ → $MgCl_2$ + H_2O
5. N_2 + O_2 → ____NO
6. ____Fe_2O_3 + ____C → ___Fe + ____CO_2
7. CH_3CH_2OH+____[O] → CH_3COOH + H_2O
8. ____HNO_3 + CuO → $Cu(NO_3)_2$ + H_2O
9. Al^{3+} + …..e^- → ____Al
10. ___$Fe(H_2O)_6]^{3+}$ + ____CO_3^{2-} → ____$Fe(OH)_3(H_2O)_3$ + ____CO_2 + ____H_2O

10 marks

Task 2: Constructing ionic formula

1. Construct the formula of the salts below.

(5 marks)

a. Magnesium oxide
b. Sodium sulfate
c. Calcium hydroxide
d. Aluminium oxide
e. Copper(I) oxide

2. When an acid is added to water it dissociates to form H^+ ions and an anion (negative ion).
Deduce the charge on the anions in the following acids. The acidic H atoms, H^+, have been underlined for you.

(5 marks)

a. $\underline{H_2}SO_3$
b. $\underline{H}NO_3$
c. $\underline{H_3}PO_4$
d. $HCOO\underline{H}$
e. $\underline{H_2}CO_3$

Task 3: Writing balanced equations from text

For each one, write a balanced symbol equation for the process. For some reactions, products are missing. You are expected to know these so include their formulas.

1. The reaction between silicon and nitrogen to form silicon nitride Si_3N_4.
2. The neutralisation of sulfuric acid with sodium hydroxide.
3. The preparation of boron trichloride from its elements.
4. The reaction of nitrogen and oxygen to form nitrogen monoxide.
5. The combustion of ethanol (C_2H_5OH) to form carbon dioxide and water only.
6. The formation of silicon tetrachloride ($SiCl_4$) from SiO_2 using chlorine gas and carbon.
7. The extraction of iron from iron(III) oxide (Fe_2O_3) using carbon monoxide.
8. The complete combustion of methane.
9. The formation of one molecule of ClF_3 from chlorine and fluorine molecules.
10. The reaction of nitrogen dioxide with water and oxygen to form nitric acid.

(10 marks)

Task 4: Rearranging equations

1. The amount of substance in moles (n) in a solution can be calculated when the concentration given in mol/dm^3 (c) and volume (v) in cm^3 are known by using the equation:

$$n = \frac{cv}{1000}$$

a. Rearrange this equation making c the subject of the equation. (1 mark)

b. Rearrange this equation making v the subject of the equation. (1 mark)

2. The density of a substance can be calculated from its mass (m) and volume (v) using the equation:

$$d = \frac{m}{v}$$

a. Rearrange this equation so that the mass of a substance can be calculated given its density and volume.

(1 mark)

b. Write an expression for the calculation of density in the SI unit of kg/m^3 when the mass (m) of the substance is given in g and the volume (v) of the substance is given in cm^3.

(2 marks)

3. The de Broglie relationship relates the wavelength of a moving particle (λ) with its momentum (p) through Planck's constant (h):

$$\lambda = \frac{h}{p}$$

a. Rearrange this equation to make momentum (p) the subject of the formula.

(1 mark)

Momentum can be calculated from mass and velocity using the following equation.

$$p = mv$$

b. Using this equation and the de Broglie relationship, deduce the equation for the velocity of the particle.

(2 marks)

4. The kinetic energy (KE) of a particle in a time of flight mass spectrometer can be calculated using the following equation.

$$KE = \frac{1}{2}mv^2$$

Rearrange this equation to make v the subject of the equation.

(2 marks)

Task 5: Unit determination

1. Determine the units of density given that

$$density = \frac{mass(g)}{volume\ (cm^3)}$$

(1 mark)

2. Determine the units of concentration given that

$$concentration = \frac{number\ of\ moles\ (mol)}{volume\ (dm^3)}$$

(1 mark)

3. Pharmacists often calculate the concentration of substances for dosages. In this case the volumes are smaller, measured in cm^3, and the amount is given as a mass in grams. Determine the units of concentration when

$$concentration = \frac{mass\ (g)}{volume\ (cm^3)}$$

(1 mark)

4. Rate of reaction is defined as the *'change in concentration per unit time'*. Determine the units for rate when concentration is measured in mol dm^{-3} and time in seconds.

(1 mark)

5. Pressure is commonly quoted in pascals (Pa) and can be calculated using the formula below. The SI unit of force is newtons (N) and area is m^2.

$$pressure = \frac{force}{area}$$

Use this formula to determine the SI unit of pressure that is equivalent to the Pascal.

(1 mark)

6. Determine the units for each of the following constants (K) by substituting the units for each part of the formula into the expression and cancelling when appropriate. For this exercise you will need the following units [ ] = mol dm^{-3}, rate = mol dm^{-3} s^{-1}, p = kPa.

a. $K_c = \frac{[A][B]^2}{[C]}$

b. $K = \frac{rate}{[A][B]}$

c. $K_p \frac{(pA)^{0.5}}{(pB)}$

d. $K_w = [H^+][OH^-]$

e. $K_a = \frac{[H^+]\,[X^-]}{[HX]}$

(5 marks)

Task 6: Standard form

In standard form a number is expressed as;

$$\boldsymbol{a \times 10^n}$$

where ***a*** is a number between 1 and 10 and ***n*** is an integer.

Eg, 160 000 would be expressed as 1.6×10^5

Sometimes scientists want to express numbers using the same power of ten. This is especially useful when putting results onto a graph axis. This isn't true standard form as the number could be smaller than 1 or larger than 10. This is more correctly called **scientific form**.
Eg, 0.9×10^{-2}, 2.6×10^{-2}, 25.1×10^{-2} and 101.6×10^{-2} are all in the same scientific form.

1. Express the following numbers using standard form.

a. 1 060 000

b. 0.001 06

c. 222.2

(3 marks)

2. The following numbers were obtained in rate experiments and the students would like to express them all on the same graph axes. Adjust the numbers to a suitable scientific form.

0.1000	0.0943	0.03984	0.00163

(3 marks)

3. Calculate the following without using a calculator. Express all values in standard form.

a. $\dfrac{10^9}{10^5}$

b. $\dfrac{10^7}{10^{-7}}$

c. $\dfrac{1.2 \times 10^6}{2.4 \times 10^{17}}$

d. $(2.0 \times 10^7) \times (1.2 \times 10^{-5})$

(4 marks)

Task 7: Significant figures and rounding

For each of the numbers in questions 1–6, state the number of significant figures and the number of decimal places.

		Significant figures	Decimal places
1	3.131 88		
2	1000		
3	0.000 65		
4	1006		
5	560.0		
6	0.000 480		

(6 marks)

Round the following numbers to (i) 3 significant figures and (ii) 2 decimal places.

a. 0.075 84

b. 231.456

(4 marks)

Task 8: Unit conversions

The SI unit for volume is **metre cubed, m^3**. However as volumes in chemistry are often smaller than 1 m^3, fractions of this unit are used as an alternative.

centimetre cubed, cm^3	**decimetre cubed, dm^3**
centi- *prefix* one hundredth	**deci-** *prefix* one tenth
1 cm = $\frac{1}{100}$ m so,	1 dm = $\frac{1}{10}$ m so,
1 cm^3 = $\left(\frac{1}{100}\right)^3$ m^3 = $\left(\frac{1}{1\,000\,000}\right)$ m^3	1 dm^3 = $\left(\frac{1}{10}\right)^3$ m^3 = $\left(\frac{1}{1\,000}\right)$ m^3

1. Complete the table by choosing the approximate volume from the options in bold for each of the everyday items

(1 mark)

1 cm^3 **1 dm^3** **1 m^3**

	drinks bottle	sugar cube	washing machine
Approx. volume			

2. Complete the following sentences;

(1 mark)

To convert a volume in **cm^3** into a volume in **dm^3**, divide by...........

To convert a volume in **cm^3** into a volume in **m^3**, divide by.............

3.

a) A balloon of helium has a volume of 1600 cm^3. What is its volume in units of dm^3?

b) The technician has prepared 550 cm^3 of HCl(aq). What is its volume in units of m^3?

c) An experimental method requires 1.35 dm^3 of NaOH(aq). What volume is this in cm^3?

d) A swimming pool has a volume of 375 m^3. What volume is this in cm^3?

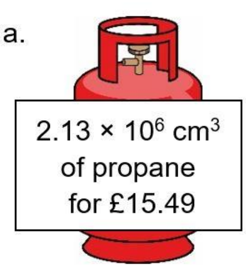
e) A 12 g cylinder of CO_2 contains 6.54 dm^3 of gas. What volume of gas is this in units of m^3?

(5 marks)

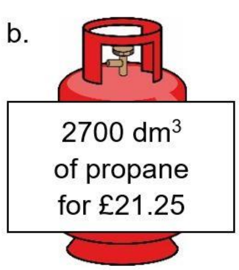
4. Which cylinder of propane gas is the best value for money?

(3 marks)

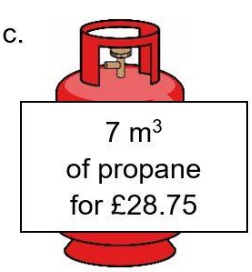
a.



b.



c.



Task 9: Moles and mass

One mole of a substance is equal to **6.02×10^{23} atoms**, **ions** or **particles** of that substance. This number is called the **Avogadro constant**.
We can use the equation below when calculating an amount in moles:

$$n\text{ (moles)} = \frac{m\text{ (mass)}}{M\text{ (molar mass)}}$$

Use the equation above to help you answer the following questions.

1. Calculate the amount of substance, in moles, in:

(3 marks)

a. 32 g of methane, CH_4 (molar mass, 16.0 g mol^{-1})

b. 175 g of calcium carbonate, $CaCO_3$

c. 200 mg of aspirin, $C_9H_8O_4$

2. Calculate the mass in grams of:

(3 marks)

a. 20 moles of glucose molecules (molar mass, 180 g mol^{-1})

b. 5.00×10^{-3} moles of copper ions, Cu^{2+}

c. 42.0 moles of hydrated copper sulfate, $CuSO_4 \cdot 5H_2O$

3. 3.09 g of a transition metal carbonate was known to contain 0.0250 mol.

i. Determine the molar mass of the transition metal carbonate.

(1 mark)

ii. Choose the most likely identity for the transition metal carbonate from the list below:

$CoCO_3$ **$CuCO_3$** **$ZnCO_3$** (1 mark)

4.26 g of a sample of chromium carbonate was known to contain 0.015 mol.

Which of the following is the correct formula for the chromium carbonate? (2 marks)

$CrCO_3$ **$Cr_2(CO_3)_3$** **$Cr(CO_3)_3$**

Task 10: Moles and concentration

To calculate the concentration of a solution we use the equation:

$$amount(mol) = concentration(mol/dm^3) \times volume(dm^3)$$

Use the equation to help you complete each of the statements in the questions below.

a) 1.5 mol of NaCl dissolved in 0.25 dm^3 of water produces a solution with a concentration of mol dm^{-3}.

b) 250 cm^3 of a solution of HCl(aq) with a concentration of 0.0150 mol dm^{-3} contains moles.

c) A solution with a concentration of 0.85 mol dm^{-3} that contains 0.125 mol has a volume of dm^3.

(3 marks)

In this question you will need to convert between an amount in moles and a mass as well as using the equation above.

Space for working is given beneath each question.

a. 5.0 g of $NaHCO_3$ dissolved in 100 cm^3 of water produces a solution with a concentration of mol dm^{-3}.

(2 marks)

b. 25.0 cm^3 of a solution of NaOH(aq) with a concentration of 3.8 mol dm^{-3} contains g of NaOH.

(2 marks)

c. The volume of a solution of cobalt(II) chloride, $CoCl_2$, with a concentration of 1.3 mol dm^{-3} that contains 2.5 g of $CoCl_2$ is cm^3.

(3 marks)

Task 11: Laboratory equipment

Practical work is a key aspect in the work of a chemist.
To help you plan effective practical work it is important that you are familiar with the common laboratory equipment available to you.

For each of the pieces of glassware shown in the images below, state their name and give a possible volume(s).

a. 

Name: ....

Possible volume(s): ....

b. 

Name: ....

Possible volume(s): ....

c. 

Name: ....

Possible volume(s): ....

d. 

Name: ....

Possible volume(s): ....

e. 

Name: ....

Possible volume(s): ....

f. 

Name: ....

Possible volume(s): ....

(6 marks)

Name the common laboratory equipment in the images below. (4 marks)

a. 

....

b. 

....

c. 

....

d. 

Task 12: Graphical skills

When you want to find a correlation between two variables it is helpful to draw a scatter graph.

Key points to remember when drawing scatter graphs include:

- The **independent variable** (the variable that is changed) goes on the *x*-axis and the **dependent variable** (the variable you measured) goes on the *y*-axis.
- The plotted points must cover more than half the graph paper.
- The axes scales don't need to start at zero.
- A straight **line** or smooth **curve of best fit** is drawn through the points to show any correlation.

Karina is investigating the relationship between the volume of a gas and its temperature.

She injects 0.2 cm^3 of liquid pentane (b.p. 36.1 °C) into a gas syringe submerged in a water bath at 40 °C. After 5 minutes she measures the volume of gas in the syringe. She repeats the experiment three times with the water bath at 40 °C.
She then repeats the experiment for temperatures of 50, 60, 70 and 80 °C.

Her results are shown in the table below:

Temperature / °C	**Volume of gas / cm^3**			
	Run 1	**Run 2**	**Run 3**	**Mean**
40	40.8	43.1	42.7	**42.2**
50	46.1	46.2	46.9	**46.4**
60	54.7	48.1	48.3	**48.2**
70	49.1	49.6	49.5	**49.4**
80	51.0	47.3	51.0	**51.0**

1. Plot a scatter graph of the volume of the gas against the temperature on the graph paper provided on the next page. (6 marks)

2. Add error bars to show the range of readings used to calculate the mean volume of the gas at each temperature. (2 marks)

3. Draw in a line of best fit. (1 mark)

4. Describe the correlation observed. (1 mark)