Chemistry Department

Y11 to Y12 Bridging Work

Helping you to leap the gap between GCSE and A level

Summer 2022

Welcome

Welcome to A-Level Chemistry! At Weald of Kent Grammar School we study the OCR Advanced Level Chemistry course. It requires a good understanding of all aspects of the GCSE Chemistry course and a great deal of dedication and perseverance. You will need to spend as much time studying out of the classroom as spent studying in it. The concepts you have met in GCSE are developed further and the depth of your explanations needs to improve. You will use many of the calculations you have already met at GCSE with further mathematical manipulations to solve increasingly complex multi-stage problems. It will help if you are studying A-Level Mathematics, but it is not essential. If you are naturally inquisitive, like understanding why things happen and love the challenge of problem solving then Chemistry is the subject for you.

I appreciate with the school closure and the cancellation of the GCSE examinations your traditional preparation for studying A-Levels will be different than previous years. I suggest you complete at least one set of past papers to identify any gaps that are in your GCSE knowledge, so that you can address them. The material in the bridging work will focus on the key skills that you will need to bring with you and help test whether you have the mathematical skills necessary to enjoy Advanced Level Chemistry. The work is not everything you will need but will give you some pointers towards what the Chemistry Department at Weald thinks are important and it is a requirement that this is completed and handed in when we return to school. There will be a test at the end of the first week. If you have done this work, it should not be a problem but if you have concerns about your suitability for the course you need to discuss these with a member of staff as soon as possible. Support will be available during the course and two years does allow the time for students to develop their skills but only if they have the desire and work ethic to do so.

In addition to the bridging work I have included a suggested (you are not expected to do all of this); reading list so that you can begin to read around the subject; films and documentaries to watch; and links to Massive Open Online Courses (MOOC) if you wish to best prepare for the start of your A-Level. You do not need to purchase any course materials, as you will be provided them at the beginning of the course.

Best of luck and if you have any questions do not hesitate in emailing me.

Mr Walsh
Head of Science

Contents

3. The Periodic Table of Elements

1	2											3	4	5	6	7	0
							1 **H** hydrogen 1										4 **He** helium 2
7 **Li** lithium 3	9 **Be** beryllium 4											11 **B** boron 5	12 **C** carbon 6	14 **N** nitrogen 7	16 **O** oxygen 8	19 **F** fluorine 9	20 **Ne** neon 10
23 **Na** sodium 11	24 **Mg** magnesium 12											27 **Al** aluminium 13	28 **Si** silicon 14	31 **P** phosphorus 15	32 **S** sulfur 16	35.5 **Cl** chlorine 17	40 **Ar** argon 18
39 **K** potassium 19	40 **Ca** calcium 20	45 **Sc** scandium 21	48 **Ti** titanium 22	51 **V** vanadium 23	52 **Cr** chromium 24	55 **Mn** manganese 25	56 **Fe** iron 26	59 **Co** cobalt 27	59 **Ni** nickel 28	63.5 **Cu** copper 29	65 **Zn** zinc 30	70 **Ga** gallium 31	73 **Ge** germanium 32	75 **As** arsenic 33	79 **Se** selenium 34	80 **Br** bromine 35	84 **Kr** krypton 36
85 **Rb** rubidium 37	88 **Sr** strontium 38	89 **Y** yttrium 39	91 **Zr** zirconium 40	93 **Nb** niobium 41	96 **Mo** molybdenum 42	[98] **Tc** technetium 43	101 **Ru** ruthenium 44	103 **Rh** rhodium 45	106 **Pd** palladium 46	108 **Ag** silver 47	112 **Cd** cadmium 48	115 **In** indium 49	119 **Sn** tin 50	122 **Sb** antimony 51	128 **Te** tellurium 52	127 **I** iodine 53	131 **Xe** xenon 54
133 **Cs** caesium 55	137 **Ba** barium 56	139 **La*** lanthanum 57	178 **Hf** hafnium 72	181 **Ta** tantalum 73	184 **W** tungsten 74	186 **Re** rhenium 75	190 **Os** osmium 76	192 **Ir** iridium 77	195 **Pt** platinum 78	197 **Au** gold 79	201 **Hg** mercury 80	204 **Tl** thallium 81	207 **Pb** lead 82	209 **Bi** bismuth 83	[209] **Po** polonium 84	[210] **At** astatine 85	[222] **Rn** radon 86
[223] **Fr** francium 87	[226] **Ra** radium 88	[227] **Ac*** actinium 89	[261] **Rf** rutherfordium 104	[262] **Db** dubnium 105	[266] **Sg** seaborgium 106	[264] **Bh** bohrium 107	[277] **Hs** hassium 108	[268] **Mt** meitnerium 109	[271] **Ds** darmstadtium 110	[272] **Rg** roentgenium 111	Elements with atomic numbers 112 – 116 have been reported but not fully authenticated						

Key

relative atomic mass
atomic symbol
name
atomic (proton) number

* The Lanthanides (atomic numbers 58 – 71) and the Actinides (atomic numbers 90 – 103) have been omitted.

Cu and **Cl** have not been rounded to the nearest whole number.

Bonding

Draw dot-cross diagrams (outside shell only) for the following substances:

1. Chlorine, Cl_2

2. Water, H_2O

3. Carbon dioxide, CO_2

4. Ammonia, NH_3

5. Nitrogen, N_2

6. Ethene, C_2H_4

7. Sodium chloride, NaCl

8. Lithium fluoride, LiF

9. Magnesium oxide, MgO

10. Magnesium chloride, $MgCl_2$

11. Sodium oxide, Na_2O

Formulae

Write the formulae of the following compounds:

1. hydrogen sulfide

2. propane

3. ethene

4. ethanol

5. silicon hydride

6. nitrogen fluoride

7. sodium sulfate

8. barium carbonate

9. aluminium nitrate

10. aluminium sulfate

11. iron(III) sulfide

Structure

1. Use the data in the table to identify the types of structure:

Substance	Melting point (°C)	Boiling Point (°C)	Electrical conductivity as solid	Electrical conductivity as liquid	Electrical conductivity as a solution	Type of Structure (simple or giant) & Bonding (covalent, ionic or metallic)
A	54	120	poor	poor	poor	
B	403	567	good	good	not soluble	
C	-210	-196	poor	poor	poor	
D	1610	2230	poor	poor	not soluble	
E	615	876	poor	good	good	
F	3727	4827	good	-	not soluble	
G	56	342	good	good	good	
H	934	1568	poor	good	insoluble	
I	-105	-45	poor	poor	good	

2. Explain each of the following about melting and boiling points:

a) Simple molecular substances have low melting and boiling points.

b) Giant covalent substances have very high melting and boiling points.

b) Ionic substances have high melting and boiling points.

c) Metals have very high boiling points.

3. Explain each of the following about electrical conductivity:

a) Simple molecular substances do not conduct electricity.

b) Giant covalent substances do not conduct, apart from graphite and graphene.

c) Ionic substances do not conduct when solid but do conduct when melted or in solution.

d) Metals conduct as solids and when molten.

Acids, Bases and Salts

1. ***Complete the four general equations for the reactions of acids:***

   a) ***Acid + alkali →***

   b) ***Acid + base →***

   c) ***Acid + carbonate →***

   d) ***Acid + metal →***

2. ***Complete the word equations and then write balanced formula equations underneath:***

   1. ***magnesium + oxygen →***

   2. ***hydrogen + oxygen →***

   3. ***magnesium + hydrochloric acid →***

   4. ***magnesium oxide + sulphuric acid →***

   5. ***magnesium hydroxide + nitric acid →***

   6. ***magnesium carbonate + hydrochloric acid →***

   7. ***copper(II) oxide + sulphuric acid →***

   8. ***copper + hydrochloric acid →***

   complete combustion:

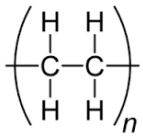
   9. ***ethane + oxygen →***

   incomplete combustion producing only gaseous products

   10. ***decane + oxygen →***

Reaction Types

Classify the following reactions:

1. burning wood
2. a copper coin slowly tarnishing over time
3. a farmer putting calcium carbonate on his fields
4. ethanol + oxygen
5. copper forming on the negative electrode during copper purification
6. copper being produced from a solution of copper sulphate when scrap iron is added
7. calcium carbonate being heated to for lime
8. cracking long-chain alkanes to form smaller hydrocarbons
9. $Al^{3+} + 3e^- \rightarrow Al$
10. $2Cl^- \rightarrow Cl_2 + 2e^-$
11. $2NH_3 + H_2SO_4 \rightarrow (NH_4)_2SO_4$
12. $Ca(HCO_3)_2 \rightarrow CaCO_3 + CO_2 + H_2O$
13. $Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$
14. $C_{20}H_{42} \rightarrow C_{18}H_{38} + C_2H_4$
15. $C_2H_4 + H_2O \rightarrow C_2H_5OH$
16. $C_2H_5OH \rightarrow C_2H_4 + H_2O$
17. $C_{10}H_{20} + H_2 \rightarrow C_{10}H_{22}$
18. ethanol in a glass of wine turning vinegary overnight
19. n $C_2H_4 \rightarrow$ 
20. $C_2H_4 + Br_2 \rightarrow C_2H_4Br_2$

Balancing Equations

1. $Ca + O_2 \rightarrow CaO$
2. $Cl_2 + KI \rightarrow KCl + I_2$
3. $Al + O_2 \rightarrow Al_2O_3$
4. $K + Cl_2 \rightarrow KCl$
5. $CaCO_3 \rightarrow CaO + CO_2$
6. $Na + O_2 \rightarrow Na_2O$
7. $C_3H_8 + O_2 \rightarrow CO_2 + H_2O$
8. $C_3H_8 + O_2 \rightarrow C + H_2O$
9. $Ca(OH)_2 + HNO_3 \rightarrow Ca(NO_3)_2 + H_2O$
10. $AlCl_3 + NaOH \rightarrow Al(OH)_3 + NaCl$
11. $HCl + Mg(OH)_2 \rightarrow MgCl_2 + H_2O$

Calculations

Show clear working for each calculation

1. **Calculate the M_r of:**
   (a) $Ca(OH)_2$ (b) Na_2CO_3 (c) $CuSO_4.5H_2O$

2. **Calculate the % composition by mass of oxygen in:**
   (a) $CaCO_3$ (b) K_2O (c) $CuSO_4.5H_2O$

3. A compound contains:
   76.0% lead (Pb) 13.0% chlorine (Cl) 2.2% carbon (C) 8.8% oxygen (O)
   Calculate the empirical formula of this compound:

4. Titanium chloride is heated with sodium to form titanium metal. This reaction takes place in an atmosphere of a noble gas, such as argon.

   $4Na(s) + TiCl4(l) \rightarrow Ti(s) + 4NaCl(s)$

   Calculate the mass of titanium that can be extracted from 570 kg of titanium chloride:

5. Iron is extracted in a blast furnace from iron oxide using carbon monoxide.

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

   Calculate the amount of iron that can be extracted from 2000 tonnes of iron oxide:

Rearranging Equations:

GCSE Chemistry uses a range of equations including: **n= m/Mr**, **n = cV** and **q = mcΔT** where Δ means "big change".

A Level Chemistry uses far more equations and rearranging them is a particular skill that needs to be mastered. For the equations below, rearrange them for the given subject:

Equation	
$n = m/M_r$	**m =**
$n = m/M_r$	M_r =
n = cV	**c =**
pV = nRT	**n =**
q = mcΔT	**c =**
$K_c = \frac{[H_2]\,[I_2]}{[HI]^2}$	$[H_2]$ =
$K_c = \frac{[H_2]^3\,[N_2]}{[NH_3]^2}$	$[N_2]$ =
$K_a = \frac{[H^+]\,[CH_3COO^-]}{[CH_3COOH]}$	$[H^+]$ =
$K_a = \frac{[H^+]^2}{[CH_3COOH]}$	$[H^+]$ =
ΔG = ΔH - TΔS	**T =**

Standard Form and Significant Figures

1. ***Complete the calculations giving the answer <u>to an</u> <u>appropriate number of significant figures</u>:***

   (a) A copper can containing 75cm^3 of water is heated by an ethanol (C_2H_5OH) burner. Its starting temperature is 20.0^{o}C and it rises to a maximum temperature of 34.5^{o}C.

   Calculate the heat transferred given that the specific heat capacity of water, c, is 4.18Jmol^{-1}K^{-1} and the heat transferred q = m c ΔT.

   The ethanol burner was weighed at the start of the experiment and at the end. Its starting mass was 210.67g and its final mass was 209.83g.

   Calculate the energy change per mole.

2. 25.00 cm^3 of the hydrochloric acid were titrated against 0.40 mol/dm^3 sodium hydroxide solution. The average volume of hydroxide used was 24.05 cm^3.

   Calculate the concentration of the hydrochloric acid solution in mol/dm^3.

   The relative formula mass of HCl is 35.5, calculate the concentration of the solution in g/dm^3.

3. Nanoparticles have very large surface area to volume ratios and unexpected properties compared with bulk samples. Nanoparticles have a diameter of less than 100nm. Give their maximum diameter in standard form and metres.

4. Avogadro's Constant, the number of atoms in one mole of carbon-12 is 6.02 x 10^{23}

   Calculate the number of formula units in each of the following samples, giving your answer in standard form to an appropriate number of significant figures:

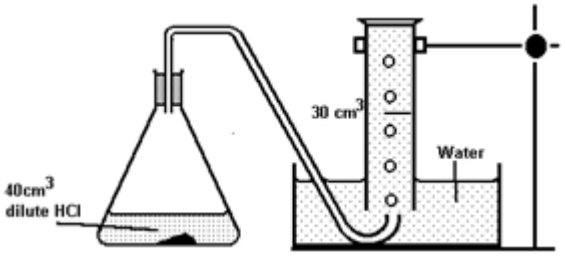
   1. 0.01g of Mg (b) 5kg of $CaCO_3$ (c) 5 tonnes of NH_3

Graphs

Drawing and analysing graphs are key skills throughout science:

The effect of concentration on rate of reaction can be assessed by reacting a marble chip with different concentrations of hydrochloric acid and collecting $10cm^3$ of carbon dioxide in an inverted measuring cylinder.

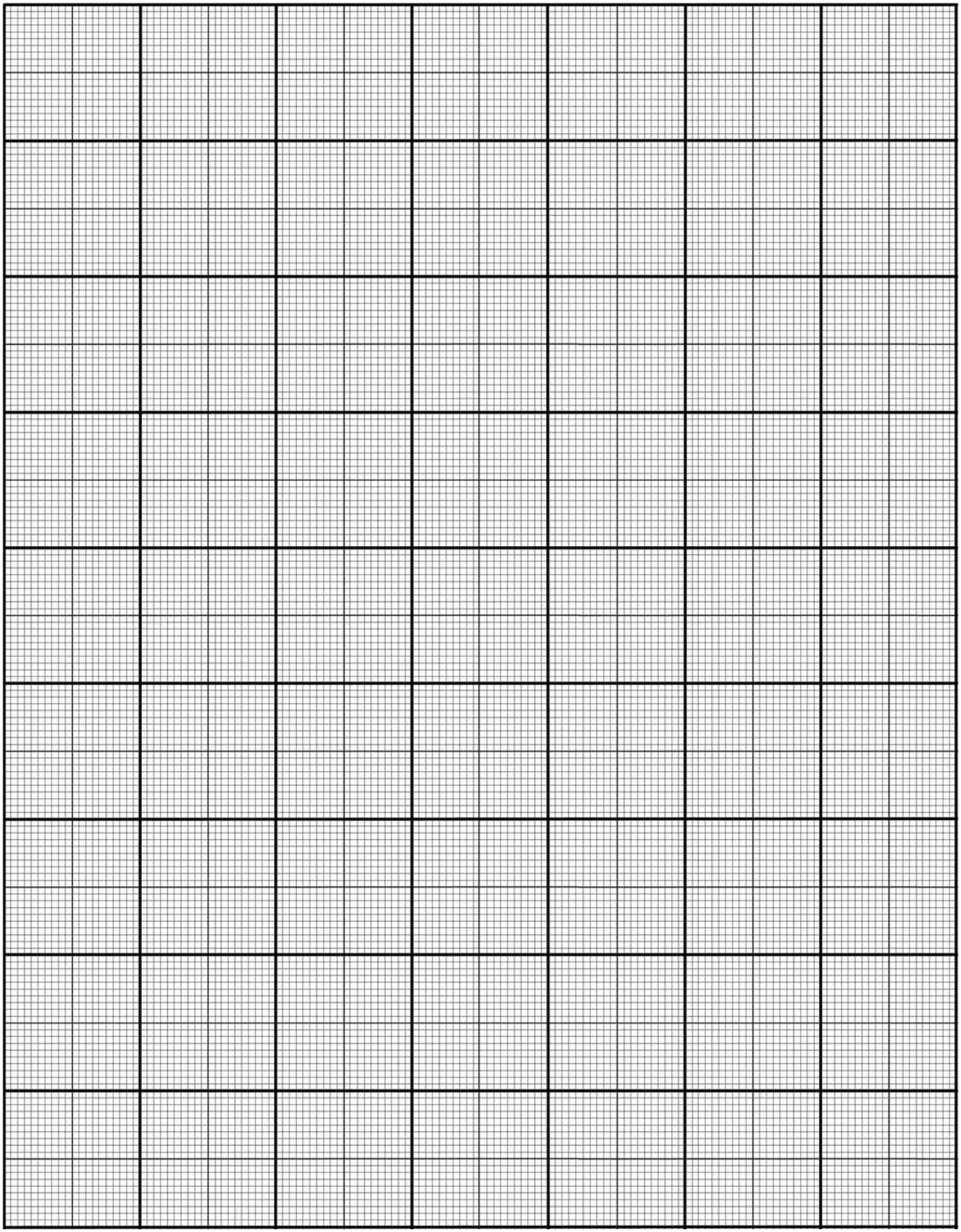
The different concentrations of acid were created by mixing different volumes of $1.0moldm^{-3}$ HCl and distilled water.

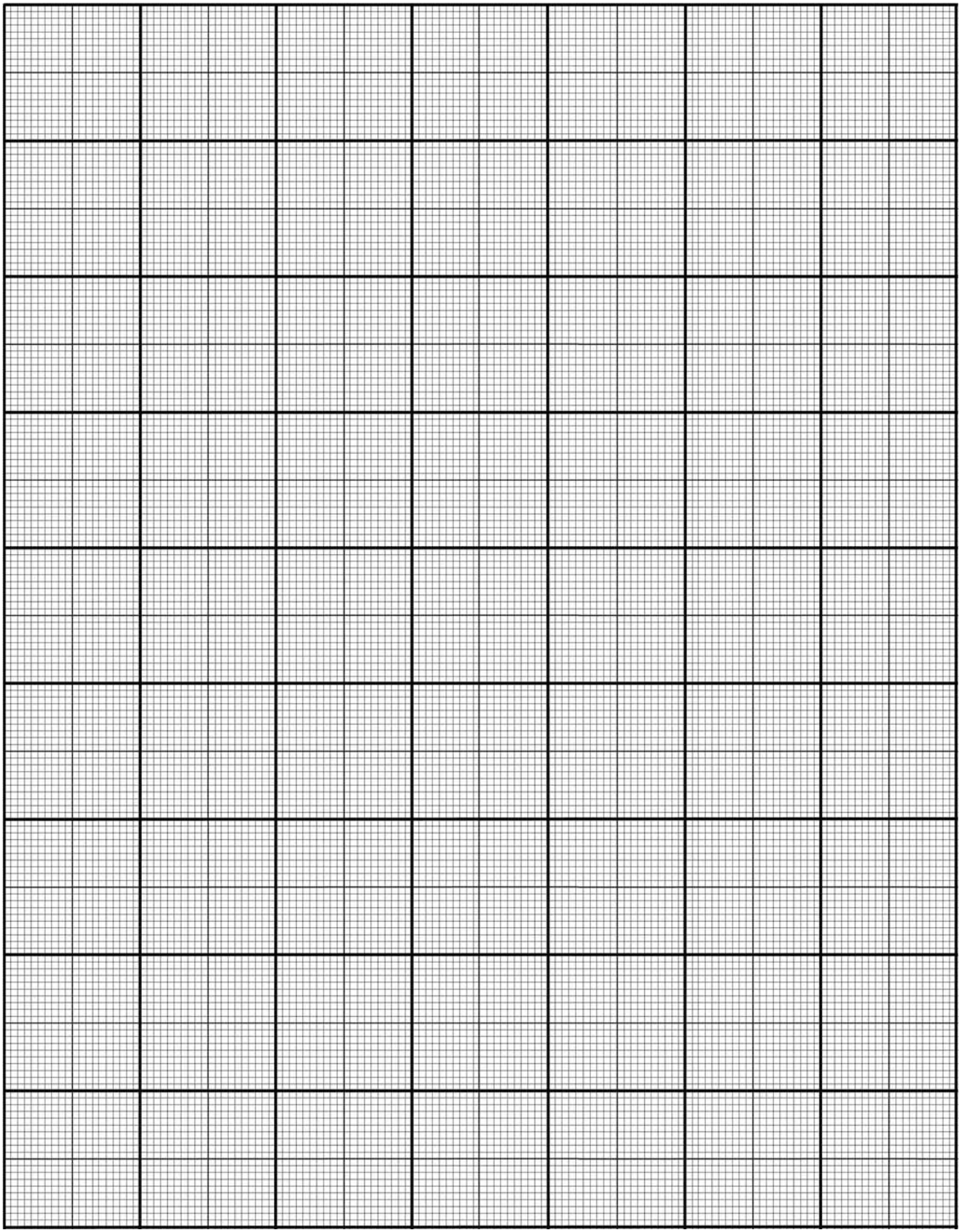


Complete this table:

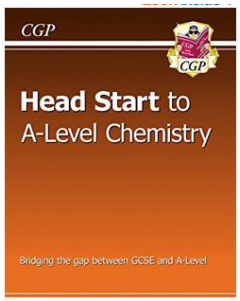
Solutions		**Concentration of acid ($moldm^{-3}$)**	Time taken to collect 10 cm^3 CO_2 (seconds)	'Rate' $\frac{10}{\text{time taken}}$ (cm^3 per second)
hydrochloric acid (cm^3)	distilled water (cm^3)			
10	30		177	
20	20		116	
30	10		48	
40	0		25	

1. Calculate the concentration of each solution in mol/dm^3
2. Draw a graph showing how concentration affects the time taken to collect $10cm^3$ of gas.
3. Describe what the graph shows.
4. Calculate the rate of reaction for each concentration.
5. Draw a second graph to show how concentration affects the rate of reaction.
6. Describe what the graph shows and explain any pattern observed.

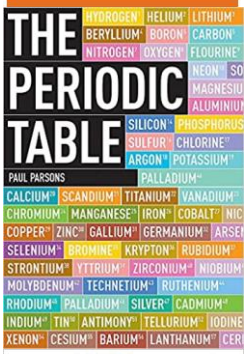




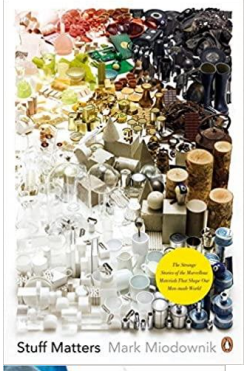
A-Level Chemistry reading list



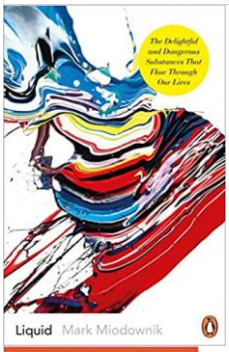
New Head Start to A-level Chemistry – Kindle version is free!
by CGP



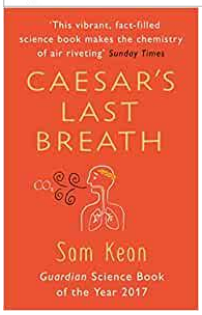
The Periodic Table: A Field Guide to the Elements
by Paul Parsons, Gail Dixon



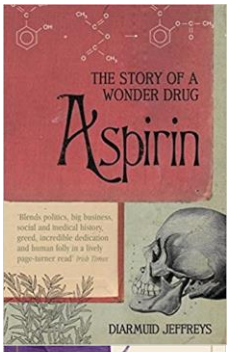
Stuff Matters: The Strange Stories of the Marvellous Materials that Shape Our Man-made World
by Mark Miodownik



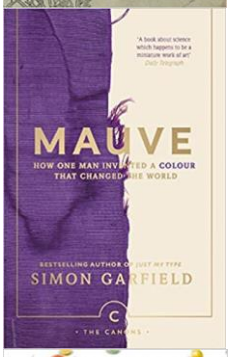
Liquid: The Delightful and Dangerous Substances That Flow Through Our Lives
by Mark Miodownik



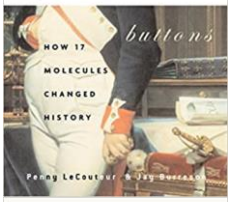
Caesar's Last Breath: The Epic Story of The Air Around Us
by Sam Kean



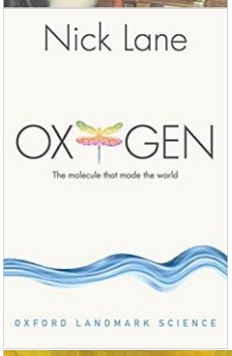
Aspirin: The Extraordinary Story of a Wonder Drug
by Diarmuid Jeffreys



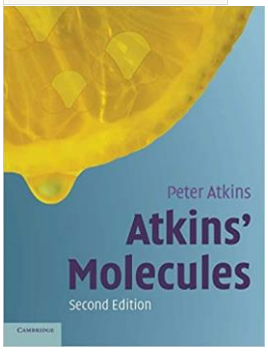
Mauve: How one man invented a colour that changed the world (Canons)
by Simon Garfield



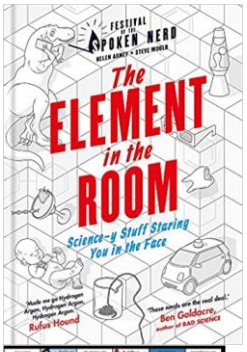
Napoleon's Buttons: How 17 Molecules Changed History
by Penny Le Couteur, Jay Burreson



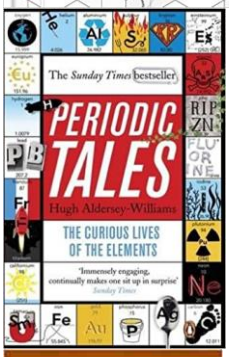
Oxygen: The molecule that made the world (Oxford Landmark Science)
by Nick Lane



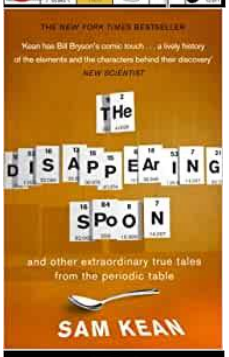
Atkins' Molecules
by Peter Atkins



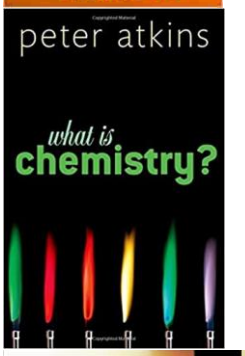
The Element in the Room: Science-y Stuff Staring You in the Face (Festival of the Spoken Nerd)
by Helen Arney, Steve Mould



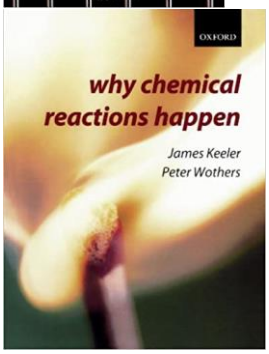
Periodic Tales: The Curious Lives of the Elements
by Hugh Aldersey-Williams



The Disappearing Spoon...and other true tales from the Periodic Table
by Sam Kean

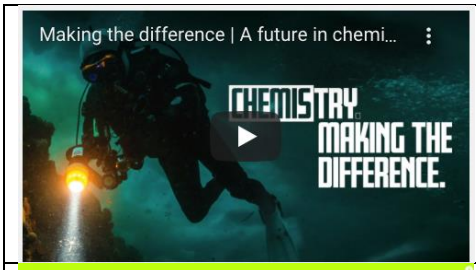
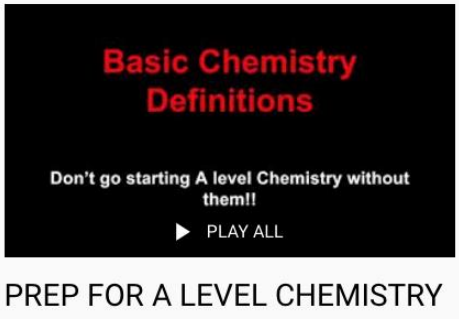


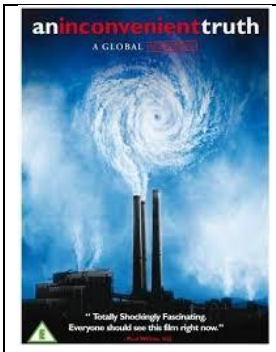
What is Chemistry?
by Peter Atkins



Why Chemical Reactions Happen
by James Keeler

Film and documentaries to watch

	**The Royal Society of Chemistry channel** Chemistry is everywhere. From what you're sitting on to what you're messaging on. From solving the world's crises to curing the world's diseases. Start your future in chemistry, end up changing the world.
	**The Royal Institution channel** Chemical elements are integral to our modern technology and even to the origins of life itself - but what would happen if we were to run out of them?
	**Preparation for A-Level Chemistry** By MaChem Guy (YouTube channel)
	**Starting A-level Chemistry** by ASFC Chemistry (YouTube channel)
	**Chemistry: A Volatile History (2010)** By BBC
	**Six Experiments That Changed the World: Marie Curie's Radium (2000)** By Channel 4
	**The Periodic Table of Videos (2010)** By University of Nottingham

	**An inconvenient truth (2006)** By Davis Guggenheim
	**Dark Waters (2019)** By Todd Haynes

Massive open online course (MOOC)

A Massive Open Online Course (MOOC) is an interactive step-by-step course aimed at reaching an unlimited number of participants worldwide to create a community of lifelong learners. As a MOOC Learner, you will build upon your knowledge of Chemistry beyond the specification of the A-Level. You will be able to draw upon this learning when writing the personal statement of your UCAS application. The best bit is they are all free. Below are a few suggestions, but explore the web and find something that interests you!

Future Learn	**Chemistry Courses** Chemistry is at the centre of many basic items, including clothes, food, and medicine. Discover how substances combine with these online chemistry courses.
The Open University	**Open Learn** This free course, *Discovering chemistry*, introduces you to some of these concepts, beginning with the idea that everything that you can see is made of building blocks called atoms. This leads on to a look at the chemical elements and how they are arranged in the Periodic Table, enabling chemists to rationalise patterns in their chemical and physical behaviour.
Duke University	**Advanced Chemistry** A chemistry course to cover selected topics covered in advanced high school chemistry courses, correlating to the standard topics as established by the American Chemical Society. Prerequisites: Students should have a background in basic chemistry including nomenclature, reactions, stoichiometry, molarity and thermochemistry.