Chemistry A Level Preparation

Name: _____
GCSE Target: _____
GCSE Grade: _____
Did you attend the Taster Day in June? _____

In this pack are a few useful documents to let you know more about the A Level course you will start next term and some questions to keep your brain ticking over until September! If you have any problems please e-mail Miss Jones at jonesme@wallingfordschool.com or Mrs Choi at choifa@wallingfordschool.com

Many of the topics you will cover in Year 12 should feel familiar as they build on the ideas you have covered at GCSE. The work you will complete in preparation for the start of your A Level course is designed to consolidate your understanding of GCSE work. Use revision guides and online resources like BBC Bitesize to review the content and then complete the practise examples. It is important to note that we will cover all of these calculations again from September onwards.

Useful websites: Quantitative Chemistry - https://www.bbc.co.uk/bitesize/topics/z87mw6f, Bonding and structure - https://www.bbc.co.uk/bitesize/topics/zq6h2nb. I have also inserted links to useful websites throughout.

Task	Topic covered	Completed ✓	Percentage achieved
1	Atoms and ions		
2	Equations and balancing		
3	Ionic bonding and ionic formulae		
4	Drawing molecules		
5	Bonding and structure		
6	Relative formulae mass and percentage by mass		
7	Moles and molar ratios		
8	Reacting masses		
9	Limiting reagents		
10	Concentration		
11	Calculations mixture		
12	Bond energy calculations		

How to succeed in Chemistry…

When asked this question most students say “work hard”. As you have chosen to study Chemistry that is a given! Remember – you have now chosen to do Chemistry because you enjoy it , the minimum expectation is that you will complete all work set. Here are some other tips.

1. **Stay organised –** Organisation is a huge problem for some students and a reason why many struggle. The key tip is start off well and keep it up. Bring your folder to **every lesson** and keep your notes complete, well presented and in order. File dividers will be provided to help.

2. **Read ahead** – Get into the routine of reading ahead in the text book before a lesson and making notes on what you’ve read. This way you are coming to lessons with an idea of the content being studied and the context of when and why it is studied.

3. **Play an active part in lessons –** Learning is very much an active process. Take a leading role in group activities and practical experiments. Participating in discussions and asking lots of questions will also help. Simply turning up to lessons will not help you progress.

4. **Be proactive –** never be content if you do not fully understand something you have covered in lessons or in your homework. There are lots of things you can do - read your notes and text book again, ask other members of your class to explain it to you, ask the teacher to explain it again in a different way etc. You will be given a Chemistry textbook and a set of flashcards. The textbook you will receive is:
   - A Level Chemistry for OCR A Student Book (OCR A Level Sciences) Paperback – 23 July 2015 by Rob Ritchie and Dave Gent (978-0198351979)

   Other useful resources you may want to get to supplement this may include:
   - A-Level Chemistry: OCR A Year 1 & 2 Complete Revision & Practice - 23 Aug. 2018 by CGP Books (978-1789080384)
   - A-Level Chemistry: OCR A Year 1 & 2 Exam Practice Workbook – 23 Aug. 2018 by CGP Books (978-1782949220)

5. **Don’t leave gaps –** Related to number 3, if you don’t get a question don’t leave it. You will still not understand it in the exam! Ask for help preferably before the work is due to be handed in.

6. **Ask for help –** The Chemistry department has an open door policy. You can come and get help any lunch time or after school. If you are stuck on a question at home also feel free to e-mail for help.

7. **If you have no work to do ask for more or find some!** There are always things you can do to help you progress in Chemistry. Look through your PLC (personalised learning checklist) and identify topics you found more difficult and look over these again. Read through the next few topics to prepare you for future lessons, get some more practice of common types of calculations, compile a glossary of key terms and their definitions. E-mail your teacher and ask for some extension work!

8. **Read and listen around.** Universities are looking for more than good grades. It is important that you show an interest in the subject and can talk intelligently about Chemistry above and beyond the topics you cover in lessons. Reading around the subjects in books and journals, listening to podcasts and watching relevant TV programmes can all help you to put the work you have covered in class into context.

We study the OCR A specification. If you would like to read more about this course please look at the OCR website: http://www.ocr.org.uk/qualifications/as-a-level-gce-chemistry-a-h032-h432-from-2015/

Content Overview	Assessment Overview	
Content is split into six teaching modules: • Module 1 – Development of practical skills in chemistry • Module 2 – Foundations in chemistry • Module 3 – Periodic table and energy • Module 4 – Core organic chemistry • Module 5 – Physical chemistry and transition elements • Module 6 – Organic chemistry and analysis Component 01 assesses content from modules 1, 2, 3 and 5. Component 02 assesses content from modules 1, 2, 4 and 6. Component 03 assesses content from all modules (1 to 6).	Periodic table, elements and physical chemistry (01) 100 marks 2 hours 15 minutes written paper	**37%** of total A level
	Synthesis and analytical techniques (02) 100 marks 2 hours 15 minutes written paper	**37%** of total A level
	Unified chemistry (03) 70 marks 1 hour 30 minutes written paper	**26%** of total A level
	Practical endorsement in chemistry (04)* (non exam assessment)	Reported separately (see Section 5)

In Year 12 we will cover Modules 2, 3 and 4. Module 1 relates to skills and these will be covered across the two years, as and when, we do practical work. In Year 13 we cover Modules 5 and 6. There is no longer any coursework but over the 2 years you will take part in a number of practical experiments and if these are completed satisfactorily you will also gain a pass in the practical assessment (this is separate to the A-level grade). At the end of Year 13 you will sit 3 exams as outlined above. Practical skills and knowledge will now be assessed in the 3 written exams.

The Periodic Table of the Elements

(1)	(2)											(3)	(4)	(5)	(6)	(7)	(0)
1																	**18**
1 **H** hydrogen 1.0	**2**											**13**	**14**	**15**	**16**	**17**	2 **He** helium 4.0
3 **Li** lithium 6.9	4 **Be** beryllium 9.0											5 **B** boron 10.8	6 **C** carbon 12.0	7 **N** nitrogen 14.0	8 **O** oxygen 16.0	9 **F** fluorine 19.0	10 **Ne** neon 20.2
11 **Na** sodium 23.0	12 **Mg** magnesium 24.3	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	13 **Al** aluminium 27.0	14 **Si** silicon 28.1	15 **P** phosphorus 31.0	16 **S** sulfur 32.1	17 **Cl** chlorine 35.5	18 **Ar** argon 39.9
19 **K** potassium 39.1	20 **Ca** calcium 40.1	21 **Sc** scandium 45.0	22 **Ti** titanium 47.9	23 **V** vanadium 50.9	24 **Cr** chromium 52.0	25 **Mn** manganese 54.9	26 **Fe** iron 55.8	27 **Co** cobalt 58.9	28 **Ni** nickel 58.7	29 **Cu** copper 63.5	30 **Zn** zinc 65.4	31 **Ga** gallium 69.7	32 **Ge** germanium 72.6	33 **As** arsenic 74.9	34 **Se** selenium 79.0	35 **Br** bromine 79.9	36 **Kr** krypton 83.8
37 **Rb** rubidium 85.5	38 **Sr** strontium 87.6	39 **Y** yttrium 88.9	40 **Zr** zirconium 91.2	41 **Nb** niobium 92.9	42 **Mo** molybdenum 95.9	43 **Tc** technetium	44 **Ru** ruthenium 101.1	45 **Rh** rhodium 102.9	46 **Pd** palladium 106.4	47 **Ag** silver 107.9	48 **Cd** cadmium 112.4	49 **In** indium 114.8	50 **Sn** tin 118.7	51 **Sb** antimony 121.8	52 **Te** tellurium 127.6	53 **I** iodine 126.9	54 **Xe** xenon 131.3
55 **Cs** caesium 132.9	56 **Ba** barium 137.3	● 57–71 lanthanoids	72 **Hf** hafnium 178.5	73 **Ta** tantalum 180.9	74 **W** tungsten 183.8	75 **Re** rhenium 186.2	76 **Os** osmium 190.2	77 **Ir** iridium 192.2	78 **Pt** platinum 195.1	79 **Au** gold 197.0	80 **Hg** mercury 200.6	81 **Tl** thallium 204.4	82 **Pb** lead 207.2	83 **Bi** bismuth 209.0	84 **Po** polonium	85 **At** astatine	86 **Rn** radon
87 **Fr** francium	88 **Ra** radium	● 89–103 actinoids	104 **Rf** rutherfordium	105 **Db** dubnium	106 **Sg** seaborgium	107 **Bh** bohrium	108 **Hs** hassium	109 **Mt** meitnerium	110 **Ds** darmstadtium	111 **Rg** roentgenium	112 **Cn** copernicium		114 **Fl** flerovium		116 **Lv** livermorium		

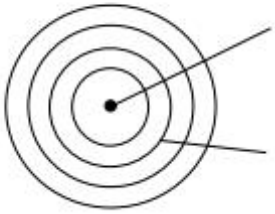
Key
atomic number
Symbol
name
relative atomic mass

●	57 **La** lanthanum 138.9	58 **Ce** cerium 140.1	59 **Pr** praseodymium 140.9	60 **Nd** neodymium 144.2	61 **Pm** promethium 144.9	62 **Sm** samarium 150.4	63 **Eu** europium 152.0	64 **Gd** gadolinium 157.2	65 **Tb** terbium 158.9	66 **Dy** dysprosium 162.5	67 **Ho** holmium 164.9	68 **Er** erbium 167.3	69 **Tm** thulium 168.9	70 **Yb** ytterbium 173.0	71 **Lu** lutetium 175.0
●	89 **Ac** actinium	90 **Th** thorium 232.0	91 **Pa** protactinium	92 **U** uranium 238.1	93 **Np** neptunium	94 **Pu** plutonium	95 **Am** americium	96 **Cm** curium	97 **Bk** berkelium	98 **Cf** californium	99 **Es** einsteinium	100 **Fm** fermium	101 **Md** mendelevium	102 **No** nobelium	103 **Lr** lawrencium

1 https://www.bbc.co.uk/bitesize/guides/z3sg2nb/revision/1 ATOMIC STRUCTURE

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 .....). Atoms have no electric charge because they contain the same number of protons and ..... .

sub-atomic particle	relative mass	relative charge
proton		
neutron		
electron		



Atomic number = number of .....

Mass number = number of ..... + number of .....

The number of protons, neutrons and electrons in an atom can be worked out using the atomic number and mass number.

Number of protons = ...

Number of neutrons = ...

Number of electrons = ...

Atoms can be represented as follows:

$^{\text{mass number}}_{\text{atomic number}}\textbf{Symbol}$ e.g. $^{19}_{9}F$ protons = ... neutrons = ... electrons = ...

Atoms of the same element have the same number of ..... In fact, it is the number of ..... that determines what type of atom it is (e.g. all atoms with 6 protons are carbon atoms). Atoms of different elements have different numbers of ..... .

Isotopes are atoms with the same number of ..... but a different number of ..... . This means they are atoms of the same ..... with the same ..... number but a different ..... number.

	$^{35}_{17}Cl$	$^{37}_{17}Cl$
protons		
neutrons		
electrons		

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
$^{235}_{92}U$					
$^{238}_{92}U$					

1 https://www.bbc.co.uk/bitesize/guides/zyydng8/revision/1

IONS

Atoms are neutral because they contain the same number of positive protons as negative electrons. For example, the atom $^{23}_{11}Na$ is neutral because it contains 11 protons (11+ charges) and 11 electrons (11– charges).

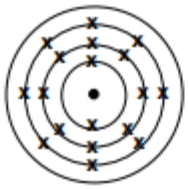
Ions are particles that contain a different number of protons and electrons. For example, an ion with 11 protons (11+ charges) and 10 electrons (10– charges) has an overall charge of 1+.

The noble gas elements (Group 0 elements) have very stable electron arrangements. Ions also have the electron structure of the noble gases (group 0 elements), except H^+ which has no electrons at all.

1) Complete the table below to show whether particles are atoms or ions, and for ions their charge.

Number and overall charge of protons	11+	11+	16+	4+	13+	18+	17+	15+	21+	1+	32+	35+
Number and overall charge of electrons	11–	10–	18–	2–	10–	18–	18–	18–	18–	0–	32–	36–
Atom or ion?	atom	ion	ion									
Overall charge		1+	2–									

2) Complete the table below to show the electronic structure of some common ions. The first one has been done for you. You will need to use the Periodic Table to help.

Ion	**Cl^-**	**Li^+**	**F^-**	**Mg^{2+}**
Protons	17			
Electrons	18			
Electron structure				
Electron structure	2,8,8			

Ion	**K^+**	**S^{2-}**	**H^+**	**P^{3-}**
Protons				
Electrons				
Electron structure				
Electron structure				

1 ATOMS & IONS 1

Species	Atom / ion	Atomic number	Mass number	Number of protons	Number of neutrons	Number of electrons
$^{14}_{7}N$	atom					
$^{31}_{15}P$	atom					
	atom	3	7			
	atom	10			10	
	atom		40	20		
	atom		40		22	
	atom			4	5	
	atom	82			126	
	atom	35			44	
	atom	35			46	
$^{23}_{11}Na^{+}$						
$^{16}_{8}O$						
$^{16}_{8}O^{2-}$						
		17	35			18
		19			20	19
		19			20	18
				20	20	18
		1			0	0
		53			74	54
			14		7	10

ATOMIC STRUCTURE (C)

1 Complete the table about these atoms and ions.

atom / ion	protons	neutrons	electrons	electron structure
$^{27}_{13}Al$				
$^{27}_{13}Al^{3+}$				
$^{17}_{8}O$				
$^{17}_{8}O^{2-}$				

2 The electron structure of some atoms are given. Which group of the Periodic Table does each of these atoms belong to?

electron structure	2,8,7	2,8,8,1	2,8,18,3	2,8,18,18,6	2,8
group					

3 There are two isotopes of boron, which are shown in the table.

Isotope	$^{10}_{5}B$	$^{11}_{5}B$
Abundance	19.9%	80.1%

a Explain why they are both atoms of boron. .....

.....

b The radius of a boron atom is 180 pm. Write this in metres in standard form.

.....

c Calculate the relative atomic mass of boron to 3 significant figures. .....

.....

.....

.....

.....

.....

2 NAMING SUBSTANCES 2

https://www.ducksters.com/science/chemistry/naming_chemical_compounds.php

Name the following substances.

Formula	Name
O_2	
CuO	
Cu	
$CuSO_4$	
CuS	
$CuCO_3$	
$FeSO_4$	
$Fe(NO_3)_2$	
N_2	
H_2SO_4	
CO	
CO_2	
NO_2	
HCl	
$KHCO_3$	
K_2CO_3	
Mg	
AgF	
$Ca(OH)_2$	
$CaCO_3$	

Formula	Name
Al_2O_3	
Na	
$Al_2(SO_4)_3$	
HNO_3	
I_2	
Ni	
Al	
Na_2O	
NaOH	
NaBr	
Na_2CO_3	
He	
CH_4	
NH_3	
NH_4Br	
H_2Te	
$SnCl_4$	
WO_3	
HgO	
TiC	

2 WORD EQUATIONS 1

Convert the following equations into word equations. Here is an example

$Na_2CO_3 + 2\,HCl \rightarrow 2\,NaCl + CO_2 + H_2O$

sodium carbonate + hydrochloric acid → sodium chloride + water + carbon dioxide

1) $2\,Mg + O_2 \rightarrow 2\,MgO$

.....

2) $2\,K + Br_2 \rightarrow 2\,KBr$

.....

3) $Cu + S \rightarrow CuS$

.....

4) $CuCO_3 \rightarrow CuO + CO_2$

.....

5) $PbI_2 \rightarrow Pb + I_2$

.....

6) $CuBr_2 \rightarrow Cu + Br_2$

.....

7) $Zn + H_2SO_4 \rightarrow ZnSO_4 + H_2$

.....

8) $Na_2CO_3 + H_2SO_4 \rightarrow Na_2SO_4 + CO_2 + H_2O$

.....

9) $KBr + AgNO_3 \rightarrow AgBr + KNO_3$

.....

10) $MgSO_4 + Ba(NO_3)_2 \rightarrow BaSO_4 + Mg(NO_3)_2$

.....

2 BALANCING EQUATIONS 1

https://www.youtube.com/watch?v=vxCyzR6uETs

- An equation is balanced when there are the same number of atoms of each type on both sides of the equation.
- An equation can only be balanced by putting numbers in front of formulas – you cannot change the formula itself.
- Equations can be written with state symbols: (s) = solid, (l) = liquid, (g) = gas, (aq) = aqueous (dissolved in water).

How to balance an equation:

a) Calculate how many atoms of each type are on each side of the equation.

b) If the numbers are the same then the equation is balanced.

c) If the numbers are not the same, then numbers are put in front of the formulas (this adds more of that substance). You cannot change the formulas (this would make a different substance). Hint – start with unbalanced elements that only appear in one substance on each side of the equation.

d) Keep doing this until the equation is balanced.

e.g. $CH_4 + O_2 \rightarrow CO_2 + H_2O$

Questions

Put your final answers here although you may wish to do your working on a separate sheet of paper or on the back.

1) $Ca + O_2 \rightarrow CaO$

2) $Na_2O + H_2O \rightarrow NaOH$

3) $Al + O_2 \rightarrow Al_2O_3$

4) $Na + Cl_2 \rightarrow NaCl$

5) $Na_2CO_3 \rightarrow Na_2O + CO_2$

6) $K + O_2 \rightarrow K_2O$

7) $C_4H_8 + O_2 \rightarrow CO_2 + H_2O$

8) $Fe_2O_3 + HCl \rightarrow FeCl_3 + H_2O$

9) $F_2 + KBr \rightarrow KF + Br_2$

10) $C_5H_{12} + O_2 \rightarrow CO_2 + H_2O$

11) $NH_3 + O_2 \rightarrow NO + H_2O$

12) $HNO_3 \rightarrow NO_2 + H_2O + O_2$

3 IONIC COMPOUNDS 2

https://www.bbc.co.uk/bitesize/guides/zyydng8/revision/1

1) Fill in the missing words in the passage below.

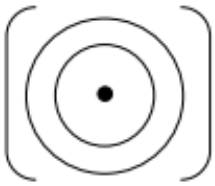
Ions are particles that have a different number of protons and ..... Ions are electrically charged . Ions can be formed when a metal reacts with a non-metal. Metal atoms ..... electrons to form ..... ions. Non metals ..... electrons to form ..... ions.

2) Which of the following compounds have ionic structures? Indicate with ✓/×.

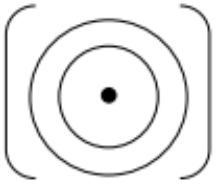
ethane, C_2H_6 ..... hydrogen sulfide, H_2S ..... copper oxide, CuO ..... zinc bromide, $ZnBr_2$ ..... Ammonia, NH_3 .....

3) Magnesium oxide (MgO) contains magnesium ions (Mg^{2+}) and oxide ions (O^{2-}).

a) Draw the electronic structure of these ions on the diagram.



magnesium ion (Mg^{2+})



oxide ion (O^{2-})

b) Explain what the formula MgO means. .....

.....

4) a) Explain why ionic compounds have high melting and boiling points. .....

.....

.....

b) Explain why ionic compounds conduct electricity when melted or dissolved in water. .....

.....

.....

c) Explain why ionic compounds do not conduct electricity as solids. .....

.....

5) Which of the following substances are ionic? .....

Substance	Melting point (°C)	Boiling point (°C)	Electrical conductivity as		
			solid	liquid	solution (aq)
A	650	1107	conducts	conducts	insoluble
B	114	184	does not conduct	does not conduct	does not conduct
C	801	1467	does not conduct	conducts	conducts
D	2040	2980	does not conduct	conducts	insoluble
E	119	445	does not conduct	does not conduct	insoluble
F	1610	2230	does not conduct	does not conduct	insoluble

3 https://www.youtube.com/watch?v=tV8Cv2x0SD0

IONIC FORMULAE 1

1

a) sodium iodide .....
b) potassium oxide .....
c) aluminium chloride .....
d) magnesium bromide .....
e) aluminium oxide .....
f) iron(II) oxide .....
g) iron(III) oxide .....
h) magnesium sulfide .....
i) copper(II) fluoride .....
j) lithium iodide .....
k) barium bromide .....
l) zinc(II) sulfide .....
m) lead(II) iodide .....
n) iron(III) sulfide .....
o) magnesium oxide .....
p) rubidium bromide .....
q) strontium chloride .....
r) caesium selenide .....
s) calcium astatide .....
t) radium polonide .....
u) gallium fluoride .....
v) scandium(III) bromide .....
w) chromium(III) oxide .....
x) strontium iodide .....
y) lithium arsenide .....

2

a) sodium sulfate .....
b) calcium sulfate .....
c) magnesium hydroxide .....
d) zinc(II) nitrate .....
e) copper(II) carbonate .....
f) sodium hydroxide .....
g) potassium carbonate .....
h) iron(III) hydroxide .....
i) ammonium nitrate .....
j) ammonium hydroxide .....
k) iron(III) sulfate .....
l) aluminium nitrate .....
m) silver(I) nitrate .....
n) calcium carbonate .....
o) magnesium nitrate .....
p) ammonium astatide .....
q) caesium nitrate .....
r) strontium hydroxide .....
s) platinum(II) nitrate .....
t) cobalt(II) carbonate .....
u) copper(I) oxide .....
v) copper(II) oxide .....
w) francium telluride .....
x) gold(I) fluoride .....
y) rubidium sulfate .....

4 DRAWING MOLECULES 1

https://www.youtube.com/watch?v=lenvZEcMc60

When non-metals combine with other non-metals, the atoms share electrons to form a molecule. The atoms are held together by these shared electrons which are known as covalent bonds.

Molecule = a particle made up of atoms joined by covalent bonds

Covalent bond = 2 shared electrons

How many covalent bonds?

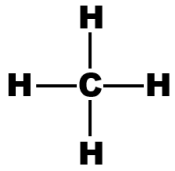
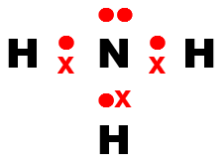
Atoms	Number of electrons in outer shell	Number of extra electrons needed to fill the outer shell	Number of covalent bonds formed
Group 7 (e.g. F, Cl, Br, I)	7	1	1
Group 6 (e.g. O, S)	6	2	2
Group 5 (e.g. N, P)	5	3	3
Group 4 (e.g. C, Si)	4	4	4
H	1	1	1

Drawing stick diagrams & dot-cross diagrams

Stick diagrams – these show each covalent bond as a stick.

Dot-cross diagrams – these show the outer shell electrons only

1. Draw a stick diagram
2. Re-draw the stick diagram without the sticks
3. Replace the stick with a **X●** which represents the two electrons in the bond (**X** represents electrons from one atom, and ● represents the electron from the other atom).
4. Add in any other outer shell electrons from each atom (electrons are always in pairs)
5. CHECK that there are 8 electrons around each atom (except H where there should be 2 electrons)

Stick diagram	Molecule	Dot-cross diagram
	CH_4	
	NH_3	
	O_2	

	HCl	
	Br_2	
	PH_3	
	CO_2	
	SiH_4	
	H_2O	
	N_2	
	C_2H_4	
	C_2H_2	
	C_6H_6	

5

https://www.bbc.co.uk/bitesize/topics/zq6h2nb

PROPERTIES OF STRUCTURE TYPES

Complete the table to show the properties of the five different types of substances. The answers to choose from are in the last column.

Property	**Monatomic**	**Ionic**	**Simple molecular**	**Giant covalent**	**Metallic**	
Melting and boiling points						Very high High High Low Very low
Conductivity as solid						conducts some conduct, some don't does not conduct does not conduct does not conduct
Conductivity when melted						conducts conducts does not conduct does not conduct does not conduct
Solubility in water						soluble (usually) insoluble (usually) insoluble insoluble insoluble
Conductivity of solution						conducts insoluble (usually) insoluble insoluble insoluble

5 STRUCTURE TYPES 1

https://www.bbc.co.uk/bitesize/topics/zq6h2nb

1) Which type of structure do the following substances have?

	K_2O	K	O_2	CH_2O	Ar	S_8	Br_2	Cr	FeI_3	$MgSO_4$	N_2H_4
ionic											
simple molecular											
metallic											
monatomic											
giant covalent											

2) Look at the properties of the following substances.

Substance	Melting point (°C)	Boiling point (°C)	Electrical conductivity as	
			solid	liquid
A	587	843	does not conduct	conducts
B	28	201	does not conduct	does not conduct
C	-39	357	conducts	conducts
D	-189	-101	does not conduct	does not conduct
E	2157	2895	does not conduct	does not conduct
F	1024	1598	does not conduct	conducts

a) Which of these compounds could have an ionic structure? .....

b) Which of these compounds could have a simple molecular structure? .....

c) Which of these compounds could have a metallic structure? .....

d) Which of these compounds could have a giant covalent structure? .....

3) Write the formula of the following ionic compounds.

a) potassium oxide .....

b) magnesium nitrate .....

c) aluminium hydroxide .....

d) copper carbonate .....

e) ammonium hydroxide .....

f) iron (III) oxide .....

4) a) Aluminium oxide is an ionic substance with formula Al_2O_3. Explain what this formula means. .....

.....

.....

b) Explain why aluminium oxide has a high melting point. .....

.....

c) Explain why aluminium oxide does not conduct electricity as a solid but does when melted. .....

.....

.....

5) a) Aluminium is a metal. Explain why it has a high melting point. .....

.....

b) Explain why aluminium conducts electricity. .....

.....

6) a) Ammonia is a simple molecular substance with formula NH_3. Explain what this formula means. .....

.....

.....

b) Explain why ammonia has a low melting point. .....

.....

c) Explain why ammonia does not conduct electricity in any state. .....

.....

.....

7) a) Explain why diamond is hard but graphite is soft. .....

.....

.....

b) Explain why graphite conducts electricity but diamond does not. .....

.....

.....

6 RELATIVE FORMULA MASS

https://www.youtube.com/watch?v=q49NwIrjaFw

Calculate the relative formula mass of the following substances.

1 F_2 .....

2 Fe .....

3 H_2SO_4 .....

4 Al_2O_3 .....

5 $Mg(OH)_2$ .....

6 $Al(NO_3)_3$ .....

7 $(NH_4)_2SO_4$ .....

8 $CuCO_3$ .....

9 $AgNO_3$ .....

10 NH_4NO_3 .....

11 $CuSO_4.5H_2O$ .....

12 magnesium .....

13 oxygen .....

14 sodium bromide .....

15 calcium fluoride .....

16 potassium sulfate .....

17 chlorine .....

18 chromium(III) oxide .....

19 sodium .....

20 iron(III) sulfate .....

6 PERCENTAGE MASS

You can find the percentage by mass of an element in a compound.

e.g. % by mass of Fe in Fe_2O_3 = $100 \, x \, \frac{2(56)}{160}$ = 70%

1 % by mass of O in H_2O .....

.....

2 % by mass of O in SO_3 .....

.....

3 % by mass of Na in Na_2CO_3 .....

.....

4 % by mass of N in $Ca(NO_3)_2$ .....

.....

5 % by mass of O in $Ca(NO_3)_2$ .....

.....

6 % by mass of Cl in $FeCl_3$ .....

.....

7 % by mass of N in NH_4NO_3 .....

.....

8 % by mass of S in $Al_2(SO_4)_3$ .....

.....

9 % by mass of Li in lithium oxide .....

.....

10 % by mass of Cr in chromium(III) oxide .....

.....

11 % by mass of O in calcium hydroxide .....

.....

12 % by mass of N in ammonium iodide .....

.....

13 % by mass of O in $CuSO_4.5H_2O$ .....

.....

7 https://www.bbc.co.uk/bitesize/guides/z3kg2nb/revision/1

MOLES

1) Calculate the number of moles of each of the following substances. Give your answers to 3 sig figs.

a) 90.0 g of H_2O .....

.....

b) 20.0 g of C_4H_{10} .....

.....

c) 685 g of NH_3 .....

.....

d) 102 tons of O_2 .....

.....

e) 2.00 kg of Al_2O_3 .....

.....

f) 20.6 mg of Au .....

.....

2) Calculate the mass of each of the following substances. Give your answers to 3 sig figs.

a) 4.00 moles of N_2 .....

.....

b) 0.100 moles of HNO_3 .....

.....

c) 0.0200 moles of K_2O .....

.....

d) 2.50 moles of PH_3 .....

.....

e) 0.400 moles of C_2H_5OH .....

.....

f) 10.0 moles of $Ca(OH)_2$ .....

.....

3) 0.0200 moles of a compound is found to have a mass of 1.64 g. Find the formula mass of the compound. Give your answers to 3 sig figs. .....

.....

7 MOLAR RATIOS

https://www.youtube.com/watch?v=3zmeVamEsWI

A balanced equation shows us how many moles of each substance are used or produced in a chemical reaction. Complete the questions in a similar way to the example which has been done for you.

EXAMPLE	C_3H_8	+	$5O_2$	→	$3CO_2$	+	$4H_2O$
what it means	1 mol of C_3H_8		5 mol of O_2		3 mol of CO_2		4 mol of H_2O
a)	2 mol		10 mol		6 mol		8 mol
b)	10 mol		50 mol		30 mol		40 mol
c)	0.5 mol		2.5 mol		1.5 mol		2.0 mol

1	**2Ca**	+	**O_2**	→	**2CaO**
what it means					
a)	4 mol				
b)			5 mol		
c)	0.10 mol				

2	**2Fe**	+	**$3Cl_2$**	→	**$2FeCl_3$**
what it means					
a)	10 mol				
b)			9 mol		
c)			0.60 mol		

3	**$TiCl_4$**	+	**4Na**	→	**Ti**	+	**4NaCl**
what it means							
a)	3 mol						
b)			10 mol				
c)	0.020 mol						

4	**$2Al_2O_3$**	→	**4Al**	+	**$3O_2$**
what it means					
a)	5 mol				
b)			0.100 mol		
c)					60 mol

5	**C_2H_5OH**	+	**$3O_2$**	→	**$2CO_2$**	+	**$3H_2O$**
what it means							
a)			12 mol				
b)	0.25 mol						
c)					0.10 mol		

8 REACTING MASS CALCULATIONS

https://www.youtube.com/watch?v=TV6n5MFH6IU

Step 1 Write ✓ for the substance whose mass is given and ? for the substance whose mass is to calculated on the balanced equation

Step 2 Find the moles of the ✓ substance (using $\boldsymbol{moles} = \frac{\boldsymbol{mass}}{\boldsymbol{M_r}}$)

Step 3 Use the balanced equation and your answer from step 2 to find the moles of the ? substance

Step 4 Find the mass of the ? substance (using $\boldsymbol{mass} = \boldsymbol{M_r\ x\ moles}$)

1) What mass of oxygen reacts with 12 g of magnesium? $2Mg + O_2 \rightarrow 2MgO$

.....

.....

.....

.....

.....

2) What mass of calcium hydroxide is made from 14 kg of calcium oxide? $CaO + H_2O \rightarrow Ca(OH)_2$

.....

.....

.....

.....

3) What mass of aluminium is needed to react with 640 g of iron oxide? $Fe_2O_3 + 2Al \rightarrow 2Fe + Al_2O_3$

.....

.....

.....

.....

.....

4) What mass of titanium chloride reacts with 460 g of sodium? $TiCl_4 + 4Na \rightarrow Ti + 4NaCl$

.....

.....

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.....

.....

8 REACTING MASS CALCULATIONS 3

1) Calculate the mass of calcium that can react with 40 g of oxygen.

$2Ca + O_2 \rightarrow 2CaO$

2) Calculate the mass of fluorine that reacts with 3.9 g of potassium.

$2K + F_2 \rightarrow 2KF$

3) Calculate the mass of nitrogen that reacts with 30 g of hydrogen.

$N_2 + 3H_2 \rightarrow 2NH_3$

4) What mass of carbon dioxide is made when 7.2 g of pentane (C_5H_{12}) burns in oxygen?

$C_5H_{12} + 8O_2 \rightarrow 5CO_2 + 6H_2O$

5) What mass of potassium can react with 4.0 g of oxygen?

$4K + O_2 \rightarrow 2K_2O$

6) What mass of chlorine reacts with 8.1 g of aluminium? $2Al + 3Cl_2 \rightarrow 2AlCl_3$

7) What mass of iron can be made from 20 kg of iron(III) oxide? $Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$

8) What mass of hydrogen is needed to react with 31.8 mg of copper(II) oxide? $CuO + H_2 \rightarrow Cu + H_2O$

9) 5.95 g of hydrated cobalt(II) chloride decompose to form 3.25 g of anhydrous cobalt(II) chloride on heating. Calculate the formula mass of hydrated cobalt(II) chloride and the value of *n*. $CoCl_2.nH_2O \rightarrow CoCl_2 + nH_2O$

9

https://www.youtube.com/watch?v=MuzOmFhiE8o

LIMITING REAGENTS 1

In each example one of the reactants is in excess. Work out how many moles of the products are formed in each case.

1		**CaO**	**+**	**H_2O**	**→**	**$Ca(OH)_2$**		
	a)	2 mol		3 mol				
	b)	10 mol		8 mol				
	c)	0.40 mol		0.50 mol				
2		**$2Ca$**	**+**	**O_2**	**→**	**$2CaO$**		
	a)	2 mol		2 mol				
	b)	10 mol		2 mol				
	c)	0.50 mol		0.20 mol				
3		**$2Fe$**	**+**	**$3Cl_2$**	**→**	**$2FeCl_3$**		
	a)	3 mol		3 mol				
	b)	12 mol		15 mol				
	c)	20 mol		40 mol				
4		**$TiCl_4$**	**+**	**$4Na$**	**→**	**Ti**	**+**	**$4NaCl$**
	a)	4 mol		4 mol				
	b)	2 mol		10 mol				
	c)	0.5 mol		1 mol				
5		**C_2H_5OH**	**+**	**$3O_2$**	**→**	**$2CO_2$**	**+**	**$3H_2O$**
	a)	15 mol		30 mol				
	b)	0.25 mol		1 mol				
	c)	3 mol		6 mol				
6		**N_2**	**+**	**$3H_2$**	**→**	**$2NH_3$**		
	a)	3 mol		6 mol				
	b)	0.5 mol		0.9 mol				
	c)	6 mol		20 mol				
7		**$4K$**	**+**	**O_2**	**→**	**$2K_2O$**		
	a)	10 mol		2 mol				
	b)	6 mol		4 mol				
	c)	0.50 mol		0.20 mol				

9 LIMITING REAGENTS 2

1 What mass of calcium hydroxide is formed when 10.0 g of calcium oxide reacts with 10.0 g of water?

$CaO + H_2O \rightarrow Ca(OH)_2$

2 What mass of magnesium bromide is formed when 1.00 g of magnesium reacts with 5.00 g of bromine?

$Mg + Br_2 \rightarrow MgBr_2$

3 What mass of copper is formed when 2.00 g of copper(II) oxide reacts with 1.00 g of hydrogen?

$CuO + H_2 \rightarrow Cu + H_2O$

10

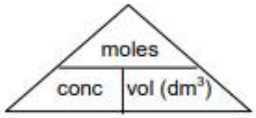
https://www.bbc.co.uk/bitesize/guides/z3kg2nb/revision/5

CONCENTRATION OF SOLUTIONS

The concentration of a solution is usually measured in moles per cubic decimetre (mol/dm^3). This is a measure of the number of moles in one cubic decimetre.

The volume must be in dm^3 (there are 1000 cm^3 in 1 dm^3). vol in dm^3 = $\frac{\text{vol in cm}^3}{1000}$

$$\text{concentration (mol/dm}^3\text{)} = \frac{\text{moles}}{\text{volume (dm}^3\text{)}}$$



1) Calculate the concentration of the following solutions in mol/dm^3.

a) 0.10 moles of NaCl in 200 cm^3 .....

.....

b) 0.20 moles of H_2SO_4 in 100 cm^3 .....

.....

c) 0.020 moles of NaOH in 25 cm^3 .....

.....

2) Calculate the number of moles in the following solutions.

a) 100 cm^3 of 0.20 mol/dm^3 HNO_3 .....

.....

b) 25 cm^3 of 1.50 mol/dm^3 KOH .....

.....

c) 50 cm^3 of 0.10 mol/dm^3 H_2SO_4 .....

.....

Concentration can also be measured in grams per cubic decimetre (g/dm^3). This is a measure of the number of grams in one cubic decimetre. [remember that *mass = M_r x moles*]

1 dm^3

2 moles of H_2SO_4

196 g of H_2SO_4

Concentration = 2 mol/dm^3

M_r of H_2SO_4 = 98

Concentration = 2 x 98 =196 g/dm^3

A simple conversion is: **conc (g/dm^3) = conc (mol/dm^3) x M_r**

3) Calculate the concentration of the following solutions in g/dm^3.

a) 0.100 mol/dm^3 NaOH .....

.....

b) 0.250 mol/dm^3 CH_3COOH .....

.....

c) 1.50 mol/dm^3 HNO_3 .....

.....

4) 0.20 moles of NaOH is dissolved in 250 cm^3 of water.

a) Calculate the concentration in mol/dm^3. .....

b) Calculate the concentration in g/dm^3. .....

.....

5) 5.0 g of KNO_3 is dissolved in 100 cm^3 of water.

a) Calculate the concentration in g/dm^3. .....

b) Calculate the concentration in mol/dm^3. .....

.....

11 CALCULATIONS MIXTURE 1

1) Sodium reacts with oxygen as shown: $4Na + O_2 \rightarrow 2Na_2O$

Find the M_r of the following substances involved in this reaction.

a) sodium .....

b) oxygen .....

c) sodium oxide .....

2) a) How many moles in the following:

i) 21.3 g of chlorine, Cl_2 .....

.....

ii) 5.34 kg of aluminium bromide, $AlBr_3$ .....

.....

b) What is the mass of 0.25 moles of sulfur dioxide, SO_2? .....

3) What mass of bromine reacts with 2.3 g of sodium to form sodium bromide? $2Na + Br_2 \rightarrow 2NaBr$

.....

.....

.....

.....

.....

4) What mass of oxygen reacts with 280 g of iron to form iron oxide? $2Fe + 3O_2 \rightarrow 2Fe_2O_3$

.....

.....

.....

.....

.....

5) What is the percentage atom economy to make tungsten (W) from tungsten oxide in this reaction? $WO_3 + 3H_2 \rightarrow W + 3H_2O$

.....

.....

6) a) What is the maximum mass of calcium hydroxide that can be formed by reaction of 2.8 g of calcium oxide with water? $CaO + H_2O \rightarrow Ca(OH)_2$

b) In a reaction, 2.6 g of calcium hydroxide was formed from 2.8 g of calcium oxide. Calculate the percentage yield.

7) 1.95 g of potassium is reacted with 5.08 g of iodine. Work out which is the limiting reagent and then calculate the mass of potassium iodide formed. $2K + I_2 \rightarrow 2KI$

8) 1.20 g of hydrated tin chloride decompose to form 1.01 g of anhydrous tin chloride on heating. Calculate the value of *x*. $SnCl_2.xH_2O \rightarrow SnCl_2 + xH_2O$

12 BOND ENERGY CALCULATIONS 2

https://www.youtube.com/watch?v=it0HGXhxD-s

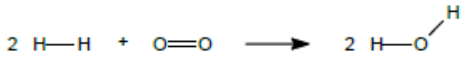
Bond	N-N	C-C	C-O	N-H	C-H	H-H
Bond energy (kJ/mol)	158	348	360	388	412	436

Bond	O-H	O=O	C=C	C=O	N≡N
Bond energy (kJ/mol)	463	498	612	743	944

For each of the following reactions, use the bond energy data to:

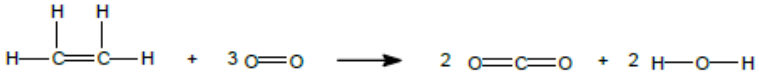
a) calculate the energy required to break the bonds in the reactants
b) calculate the energy released when the bonds in products are made
c) calculate the energy change for the reaction
d) state whether the reaction is exothermic or endothermic

1



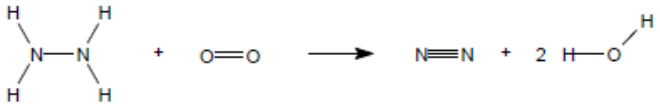
Break	Make	Energy change	Exo/endothermic (& reason)

2



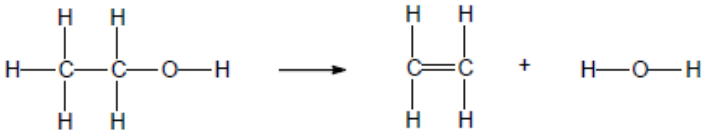
Break	Make	Energy change	Exo/endothermic (& reason)

3



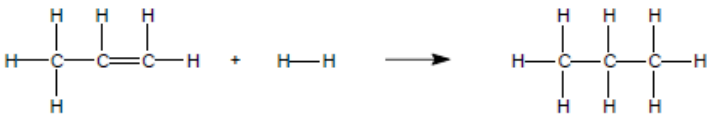
Break	Make	Energy change	Exo/endothermic (& reason)

4



Break	Make	Energy change	Exo/endothermic (& reason)

5



Break	Make	Energy change	Exo/endothermic (& reason)

BOND ENERGY CALCULATIONS 1

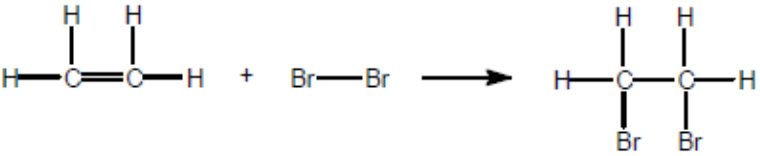
Bond	Br-Br	Cl-Cl	C-Br	C-C	C-O	C-H	H-Cl
Bond energy (kJ/mol)	193	242	276	348	360	412	431

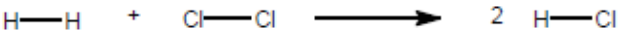
Bond	S=O	H-H	O-H	O=O	C=C	C=O	H-Br
Bond energy (kJ/mol)	435	436	463	498	612	743	366

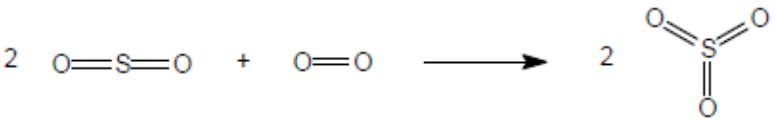
For each of the following reactions, use the bond energy data to:

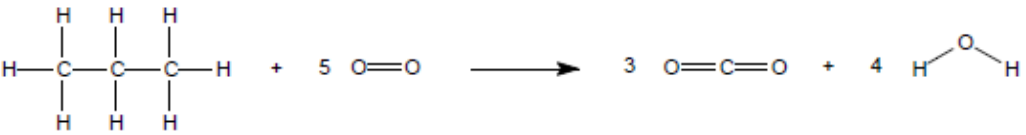
a) calculate the energy required to break the bonds in the reactants
b) calculate the energy released when the bonds in products are made
c) calculate the energy change for the reaction
d) state whether the reaction is exothermic or endothermic
e) explain why the reaction is exothermic or endothermic in terms of bond breaking and making

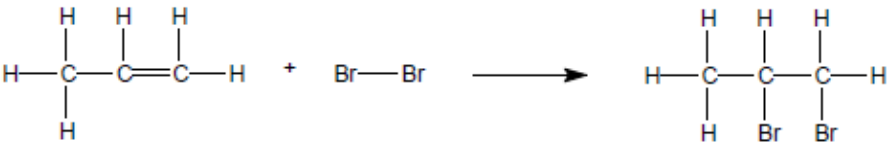
1 

2 

3 

4 

5 

6 

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