Applied Science **Chemistry** (AAQ) BTEC work to be submitted in the first lesson in September with Mr Boddaert

Hi all
This work needs to be completed and handed in the first lessons in September.
If you attended paper the taster lessons you would have received a paper copy.

Use the PDF attached on the school website to access the links for videos to watch before each section, to remind yourself of the topic before completing the each section of this booklet.

Many thanks in advance and I look forward to teaching you in September

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The Periodic Table of Elements

1	2											3	4	5	6	7	0 (8) (18)
							1.0 H hydrogen 1										4.0 He helium 2
(1)	(2)		Key									(13)	(14)	(15)	(16)	(17)	
6.9 Li lithium 3	9.0 Be beryllium 4		relative atomic mass atomic symbol name atomic (proton) number									10.8 B boron 5	12.0 C carbon 6	14.0 N nitrogen 7	16.0 O oxygen 8	19.0 F fluorine 9	20.2 Ne neon 10
23.0 Na sodium 11	24.3 Mg magnesium 12	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	27.0 Al aluminium 13	28.1 Si silicon 14	31.0 P phosphorus 15	32.1 S sulfur 16	35.5 Cl chlorine 17	39.9 Ar argon 18
39.1 K potassium 19	40.1 Ca calcium 20	45.0 Sc scandium 21	47.9 Ti titanium 22	50.9 V vanadium 23	52.0 Cr chromium 24	54.9 Mn manganese 25	55.8 Fe iron 26	58.9 Co cobalt 27	58.7 Ni nickel 28	63.5 Cu copper 29	65.4 Zn zinc 30	69.7 Ga gallium 31	72.6 Ge germanium 32	74.9 As arsenic 33	79.0 Se selenium 34	79.9 Br bromine 35	83.8 Kr krypton 36
85.5 Rb rubidium 37	87.6 Sr strontium 38	88.9 Y yttrium 39	91.2 Zr zirconium 40	92.9 Nb niobium 41	95.9 Mo molybdenum 42	[98] Tc technetium 43	101.1 Ru ruthenium 44	102.9 Rh rhodium 45	106.4 Pd palladium 46	107.9 Ag silver 47	112.4 Cd cadmium 48	114.8 In indium 49	118.7 Sn tin 50	121.8 Sb antimony 51	127.6 Te tellurium 52	126.9 I iodine 53	131.3 Xe xenon 54
132.9 Cs caesium 55	137.3 Ba barium 56	138.9 La* lanthanum 57	178.5 Hf hafnium 72	180.9 Ta tantalum 73	183.8 W tungsten 74	186.2 Re rhenium 75	190.2 Os osmium 76	192.2 Ir iridium 77	195.1 Pt platinum 78	197.0 Au gold 79	200.6 Hg mercury 80	204.4 Tl thallium 81	207.2 Pb lead 82	209.0 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

140 Ce cerium 58	141 Pr praseodymium 59	144 Nd neodymium 60	[147] Pm promethium 61	150 Sm samarium 62	152 Eu europium 63	157 Gd gadolinium 64	159 Tb terbium 65	163 Dy dysprosium 66	165 Ho holmium 67	167 Er erbium 68	169 Tm thulium 69	173 Yb ytterbium 70	175 Lu lutetium 71
232 Th thorium 90	[231] Pa protactinium 91	238 U uranium 92	[237] Np neptunium 93	[242] Pu plutonium 94	[243] Am americium 95	[247] Cm curium 96	[245] Bk berkelium 97	[251] Cf californium 98	[254] Es einsteinium 99	[253] Fm fermium 100	[256] Md mendelevium 101	[254] No nobelium 102	[257] Lr lawrencium 103

* Lanthanide series

* Actinide series

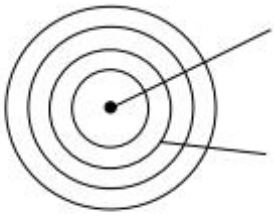
1 ATOMIC STRUCTURE

https://www.bbc.co.uk/bitesize/guides/z2sg2nb/revision/3

Atomic number and mass number - Atomic structure - AQA - GCSE Chemistry (Single Science) Revision - AQA - BBC Bitesize

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).

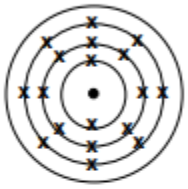
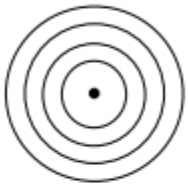
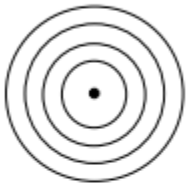
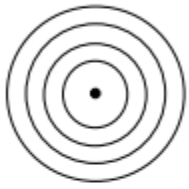
Ions are particles that contain a different number of protons and electrons. For example, an ion with 11 protons (11+ charges) and 10 electrons (10– charges) has an overall charge of 1+.

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				

Ionic bonding

1. Watch each of these short videos on ionic bonding:
   - Formation of ions. https://youtu.be/900dXBWgx3Y
   - Ionic bonding https://youtu.be/zpaHPXVR8WU
   - Giant ionic compounds and their melting and boiling points https://youtu.be/PNKsbnH1vw8 properties of ionic compounds. https://youtu.be/TxHi5FtMYKk

2. Make key notes on the following using KS4 Bitesize https://www.bbc.co.uk/bitesize/guides/z6k6pbk/revision/1

What an ionic bond is

Example of how a metal and non-metal bond ionically

Properties of ionic compounds, with an explanation of each.

3. **Answer the following exam questions on ionic bonding and use the mark scheme attached to the online resources to mark them.**

Exam questions in Ionic Bonding

Q1.

This question is about calcium.

(b) Ionic compounds, such as calcium oxide, have high melting points.

Complete the sentences. Use words from the box.

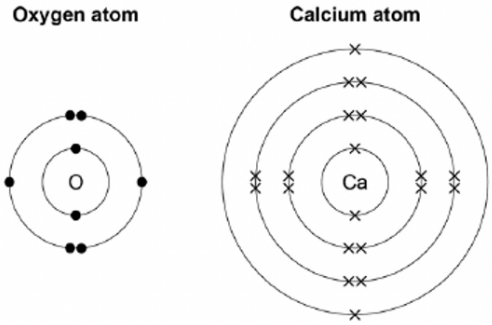
bonds	forces	ions	layers

Calcium oxide has a giant ionic lattice in which there are strong electrostatic

_____ of attraction in all directions.

(1)

(c) The figure below shows the electronic structure of an oxygen atom and a calcium atom.



Describe how the calcium atom and the oxygen atom forms calcium oxide.

You should give the charge on each ion formed.

_____

_____

_____

_____

_____

_____

_____

_____

(4)

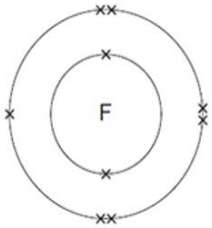
(Total 6 marks)

Q2.

This question is about fluorine.

(a) **Figure 1** shows the arrangement of electrons in a fluorine atom.

Figure 1



(i) In which group of the periodic table is fluorine?

Group _____

(1)

(ii) Complete the table below to show the particles in an atom and their relative masses.

Name of particle	Relative mass
Proton	
Neutron	1
	Very small

(2)

(iii) Use the correct answer from the box to complete the sentence.

alkalis	alloys	isotopes

Atoms of fluorine with different numbers of neutrons are

called _____ .

(1)

(b) Sodium reacts with fluorine to produce sodium fluoride.

(i) Complete the word equation for this reaction.

sodium + _____ → _____

(1)

(iv) **Figure 2** shows what happens to the electrons in the outer shells when a sodium atom reacts with a fluorine atom.

The dots (•) and crosses (×) represent electrons.

Figure 2

Use **Figure 2** to help you answer this question.

Describe, as fully as you can, what happens when sodium reacts with fluorine to produce sodium fluoride.

_____

_____

_____

_____

_____

_____

_____

_____

(4)

(v) Sodium fluoride is an ionic substance.

What are **two** properties of ionic substances?

Tick (✓) **two** boxes.

- Dissolve in water ☐
- Gas at room temperature ☐
- High melting point ☐
- Low boiling point ☐

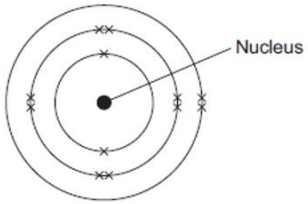
(2)

(Total 13 marks)

Q3.

This question is about magnesium.

(a) (i) The electronic structure of a magnesium atom is shown below.



Use the correct answer from the box to complete each sentence.

electrons	neutrons	protons	shells

The nucleus contains protons and _____ .

The particles with the smallest relative mass that move around the nucleus are called _____ .

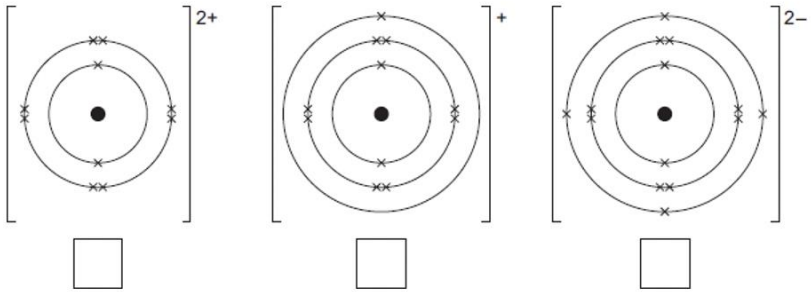
Atoms of magnesium are neutral because they contain the same number of electrons and _____ .

(3)

(ii) A magnesium atom reacts to produce a magnesium ion.

Which diagram shows a magnesium ion?

Tick (✓) **one** box.



☐ ☐ ☐

(1)

Covalent bonding

1. Watch each of these short videos on covalent bonding:

- Covalent bonding Covalent bonding - Structure and bonding: Video playlist - BBC Bitesize
- Properties of covalent compounds: https://youtu.be/h24UmH38_LI
- Covalent bonding of hydrogen, oxygen and nitrogen https://youtu.be/0HfN3CvXP2M
- Covalent bonding in methane, water and ammonia https://youtu.be/oy1CiebbTzU

2. Make key notes on the following using KS4 Bitesize. Open up the revision notes and click through the BBC Bitesize pages

Covalent bonds - Small molecules - AQA -GCSE Chemistry (Single Science) Revision - AQA - BBC Bitesize
Dot and cross models - Bonding - GCSE Chemistry (Single Science) Revision - WJEC - BBC Bitesize

What a covalent bond is

Properties of **simple covalent** compounds, including an explanation of these properties

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
H-Cl	HCl	
	CO_2	
	N_2	
	H_2O	

Q1.

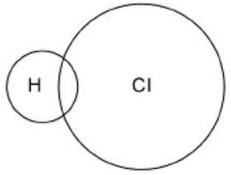
This question is about hydrogen chloride.

(a) A hydrogen atom contains 1 electron and a chlorine atom contains 17 electrons.

Complete **Figure 1** to show a dot and cross diagram for a hydrogen chloride molecule.

Show the outer electrons only.

Figure 1



(2)

Hydrogen gas (H_2) reacts with chlorine gas to produce hydrogen chloride.

(b) Complete the balanced chemical equation for the reaction between hydrogen and chlorine.

$$H_2 + \_\_\_\_\_ \rightarrow \_\_\_\_\_$$

(2)

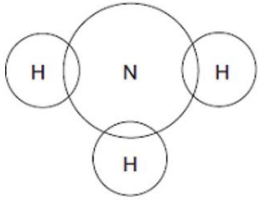
Q2.

(b) Hydrogen is used to make ammonia (NH_3).

Complete the diagram to show the bonding in ammonia.

Use dots (•) and crosses (x) to show electrons.

Show only outer shell electrons.



(2)

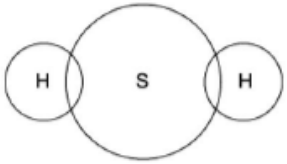
Q3.

(b) A problem with lead compounds is that they slowly react with hydrogen sulfide in the air. This produces lead sulfide which is black.

(i) Hydrogen sulfide has the formula H_2S. The bonding in a molecule of hydrogen sulfide can be represented as:

H–S–H

Complete the diagram below to show the arrangement of the outer electrons of the hydrogen and sulfur atoms in hydrogen sulfide.
Use dots (•) and crosses (x) to represent the electrons.
You need only show the outer shell electrons.
(Atomic numbers: H = 1; S = 16.)



(1)

(ii) Hydrogen sulfide has a low boiling point.

Explain why.

_____

_____

_____

_____

(2)

(iii) Lead white is also used in paint. The white colour slowly darkens when lead sulfide is produced.

The painting can be restored with hydrogen peroxide. This converts the black lead sulfide into white lead sulfate.

Balance the equation for the reaction between lead sulfide and hydrogen peroxide (H_2O_2).

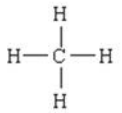
$$PbS(s) + \_\_\_\_\_H_2O_2(aq) \rightarrow PbSO_4(s) + 4H_2O(l)$$

(1)

(2)

Covalent bonding exam questions

Q5. (b) The diagram shows the structure of a molecule of methane.



Write down everything that this diagram tells you about a methane molecule.

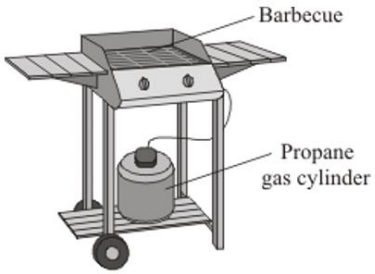
To gain full marks in this question you should write your ideas in good English. Put them into a sensible order and use the correct scientific words.

_____

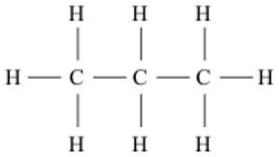
_____

Q6.

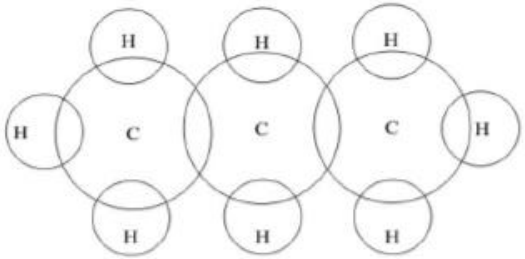
This barbecue burns propane gas.



The structure of propane is shown below.



(a) Complete the diagram to show how the outer energy level (shell) electrons of hydrogen and carbon are arranged in a molecule of propane.



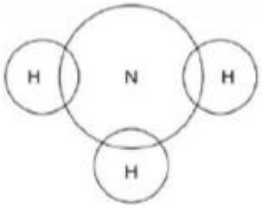
(1)

Q7.

This question is about ammonia (NH_3).

(a) Complete the diagram to show the bonding electrons in ammonia.

Show the outer electrons only.

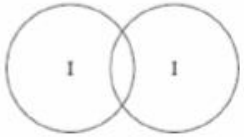


(2)

Q8. (d) The bonding in iodine is similar to the bonding in chlorine.

(i) Complete the diagram below to show the bonding in iodine.

Show the outer electrons only.



(2)

(ii) Explain why iodine has a low melting point.

_____

_____

_____

_____

_____

_____

(3)