

Structures and Bonding

Simple Covalent Molecules

Worksheet

Combined Science - Chemistry - Key Stage 4

Mr Robbins



Periodic Table of Elements

Key:

relative atomic mass	1	Atomic symbol
Name	hydrogen	Atomic (proton number)

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	[97] 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	[267] Rf rutherfordium 104	[270] Db dubnium 105	[269] Sg seaborgium 106	[270] Bh bohrium 107	[270] Hs hassium 108	[278] Mt meitnerium 109	[281] Ds darmstadtium 110	[281] Rg roentgenium 111	[285] Cn copernicium 112	[286] Nh nihonium 113	[289] Fl flerovium 114	[289] Mc moscovium 115	[293] Lv livermorium 116	[293] Ts tennessine 117	[294] Og oganesson 118				

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

Relative atomic masses for **Cu** and **Cl** have not been rounded to the nearest whole number.



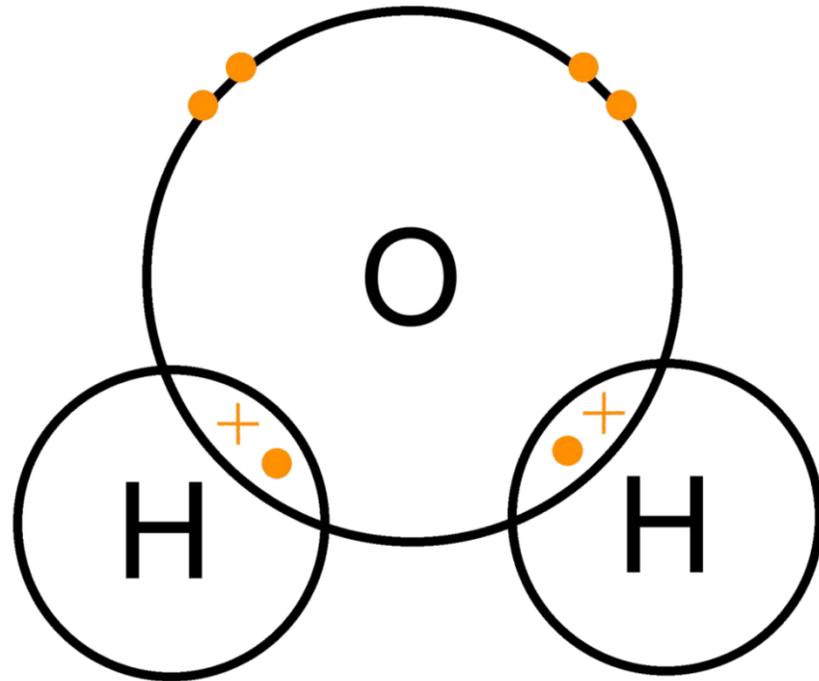
1. Draw a dot and cross diagram of water
2. Explain why it is difficult to separate the hydrogen atoms from the oxygen atoms in a molecule of water.
3. Water is a simple molecular substance. What would you expect its properties to be?
4. Our atmosphere is a mixture of **elements** and **compounds**, which are mainly made up of single **atoms** or small **molecules**. In the molecules, the atoms are held together by **covalent bonds**.

Write a sentence to explain or describe each of the terms in bold in the above passage.



Answers

1.



2.

They are held together by strong covalent bonds

3.

Low melting and boiling point.

Does not conduct electricity

4.

Elements: Substances made of 1 type of atom

Compounds: Substances made from two or more different elements/atoms bonded

Atoms: Smallest unit of matter

Molecules: Two or more atoms bonded

Covalent bond: A bond formed by a shared pair of electrons between two non-metals



Independent task

Chlorine (Cl_2) is a typical non-metal.

It is a green gas at room temperature and does not conduct electricity.

Use your knowledge of structures and bonding to explain these properties

[3 marks]

Hints:

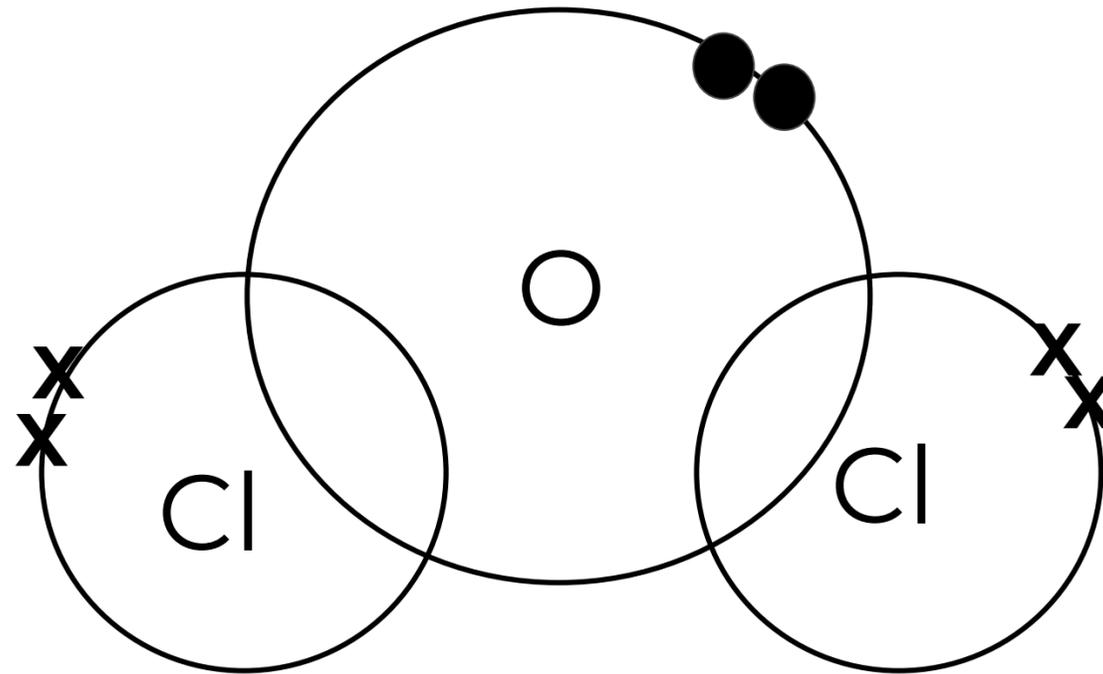
- State the type of bonding
- Discuss the strength of the bonds between molecules
- Link charges to conductivity



Exam style question

- a) One oxygen atom shares one pair of electrons with each chlorine atom in oxygen dichloride (OCl_2). Complete the dot and cross diagram of oxygen dichloride below. You should show only the electrons in the outer shells.

(2)



Exam style question

- b) Oxygen dichloride (OCl_2) has a melting point of $-224\text{ }^\circ\text{C}$ and a boiling point of $-145\text{ }^\circ\text{C}$.

What is the state of oxygen dichloride at room temperature?

Explain your answer in terms of structure and bonding.

(4)

