Name: .....

Date: .....

St John's CATHOLIC COMPREHENSIVE SCHOOL

Chemistry

A-level

Bridging Work

Appendix 1—Atomic Structure Timeline— Add diagrams of the atomic models proposed by the scientists below.

Democritus	**John Dalton**	**J.J. Thomson**	**Ernest Rutherford**
			
Everything is made up of tiny particles called atoms. The atom is indivisible.	Atoms cannot be created or destroyed. Elements are made up of only one type of atom. Atoms join together in chemical reactions.	Atoms contain tiny negatively charged particles called electrons. The rest of the atom is positive to balance out the charge, and the electrons are embedded in this like pieces of fruit in a pudding.	The positive charge and mass of the atom is concentrated in a tiny nucleus in the centre of the atom. The electrons exist randomly in the space around the nucleus.

Niels Bohr	**James Chadwick**	**Louis de Broglie**
		
Electrons are not randomly arranged around the atom. They exist in specific shells – like the orbits of the planets.	Some of the mass of the atom is accounted for by an uncharged particle, called a neutron. The neutron does not affect chemical properties of an element.	Just as waves can sometimes behave like particles, very small particles – like electrons – can behave like waves.

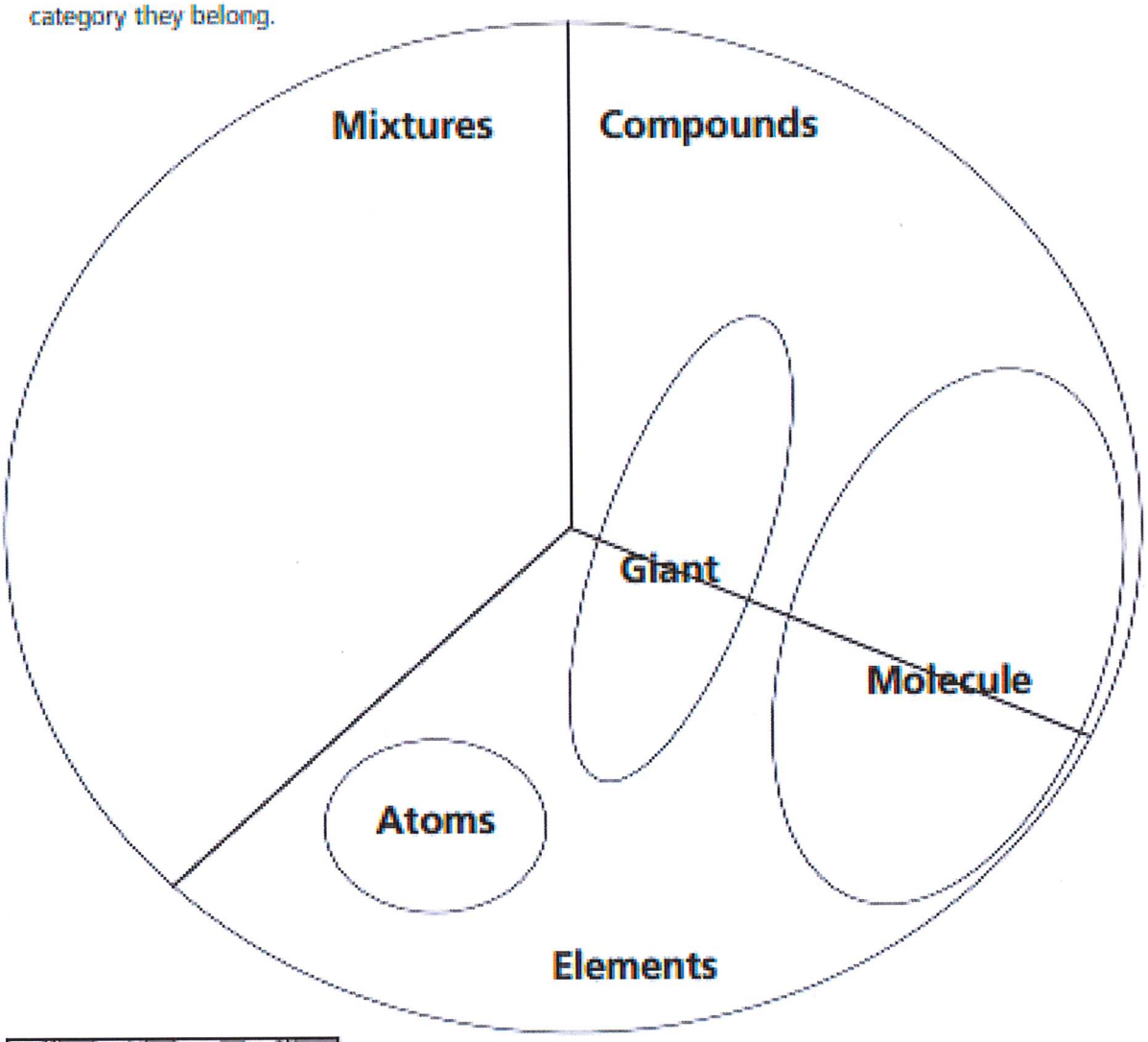
Appendix 2—Using Models to Explain Phenomena

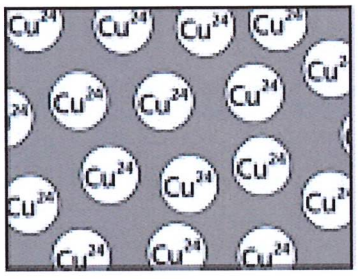
Read through the statements and decide upon the simplest model of the atom that is still sufficiently detailed to explain the observation. For example, the production of a beam of charged particles from the heating of a metal can be explained simply by the fact that atoms contain electrons, but periodic properties can only be explained if the Bohr model of the atom is used.

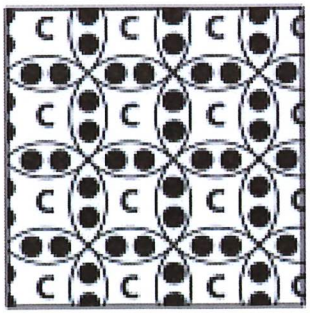
When liquids are heated they turn into a gas – when this gas is cooled again, it turns back into a liquid.	**Increasing the temperature increases the rate of a chemical reaction.**	**Particles of dust or smoke appear to move randomly through water or air, changing direction all the time (Brownian motion).**	**Many chemicals can be split up into separate substances, but there is a limit to this – eventually you will get a 'pure' substance.**
The first ionisation energy of sodium is much lower than the first ionisation energy of neon.	**When light of a specific frequency is shone on the surface of a metal, charged particles are given off (this is known as the photoelectric effect).**	**When positively charged alpha particles are fired at a thin piece of gold foil, most of them pass straight through but some are deflected straight back.**	**The second ionisation energy of magnesium is much lower than the second ionisation energy of sodium.**
The first ionisation energy of oxygen is slightly lower than the first ionisation energy of nitrogen.	**Atoms of the same element, with the same chemical properties, can have different masses.**	**The properties of elements show periodicity when the elements are placed in order of increasing atomic number.**	**Metal electrodes can give off tiny particles that are attracted to a positive plate.**
The total mass of substances at the end of a chemical reaction is the same as the total mass at the beginning.	**Two chemical reactions in separate containers can produce a potential difference (voltage) if connected by a wire.**	**The first ionisation energy of aluminium is slightly lower than the first ionisation energy of magnesium.**	**The absorption and emission spectra of hydrogen consist of discrete lines.**

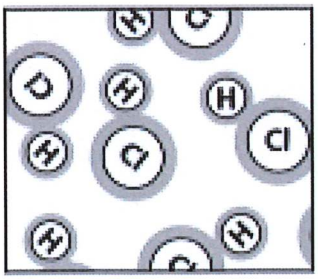
Appendix 3—Structure Terminology

5. A student drew a Venn diagram in a different style and incorporated a category for giant structures. Write in the names of all the substances at the bottom of the page into the region of the diagram where they belong. Draw arrows from the drawings in boxes to show to which category they belong.









Iron
Sand (SiO_2)
Diamond
Ethanol (C_2H_5OH)
Sodium chloride (NaCl)
Limestone ($CaCO_3$)
Bromine (Br_2)
Diesel
Vegetable Oil

Appendix 4 Bonding— Always or Usually True

Read each statement. Decide if it is always true, or usually true. Try to think of any exceptions to these rules. Be able to justify all statements.

A. The atoms of Group 2 elements have two electrons in their outer shell.

K. Bonding within compounds is either ionic or covalent.

C. Ionic substances have higher melting points than covalent substances.

M. Electrons that are closer to the nucleus experience less shielding and are more strongly attracted than electrons further away.

E. Delocalised electrons are more stable than electrons in fixed atomic orbitals.

O. Compounds are more stable than elements.

G. In an ionic compound, ions are combined in proportions which balance out the electrical charges.

Q. Ionic compounds are formed when metals react with non-metals.

I. Energy is required to form positive ions from atoms.

S. Hydrogen atoms form ions by losing one electron and becoming H^+.

B. Noble gases do not form any types of bonds because they have full outer shells.

L. Electrons shared between atoms (in molecular orbitals) are more stable than electrons in atomic orbitals.

D. Oppositely charged ions attract.

N. A covalent bond is formed from a shared pair of electrons; one electron comes from each atom within the bond.

F. Energy is released when ionic bonds form.

P. Elements always react to form ions with noble gas electron configurations.

H. Energy is needed to break covalent bonds.

R. Covalent compounds are formed when non-metals react with other non-metals.

J. Energy is released when negative ions are formed from atoms.

T. Within a covalent compound, all elements except hydrogen have eight electrons in their outer shells.

Appendix 5 Amount of Substance True or False

Decide if each statement is correct, justify your reasoning.

1. The total number and type of atoms present are the same at the start and end of a reaction.

2. The amount of substance, measured in moles, is the same at the start and end of a reaction.

3. The total mass of reactants is equal to the total mass of products for any reaction.

4. The total volume of gas is the same at the start and the end of a reaction.

5. The amount in moles is proportional to the number of particles for that substance.

6. One mole of methane molecules (CH_4) contains 1/5 mole of carbon atoms and 4/5 mole of hydrogen atoms.

7. One mole of methane molecules (CH_4) contains 1 mole of carbon atoms and 4 moles of hydrogen atoms.

8. 100 cm^3 of methane gas contains the same number of molecules as 100 cm^3 hydrogen gas at room temperature and pressure.

9. 100 cm^3 of methane gas at room temperature and pressure has the same mass as 100 cm^3 of hydrogen gas under the same conditions.

10. If 0.1 mol of magnesium atoms reacts with a solution containing 0.1 mol of hydrochloric acid, 0.1 mol of hydrogen molecules will be produced. (Hint – you may need to look up or work out the balanced equation for this reaction.)

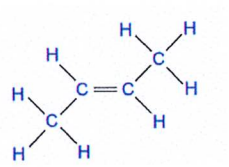
Appendix 6 Organic Chemistry

1. Complete the table below. LEARN how to name the first 12 alkanes.

Name	Molecular Formula	Structural
Methane		
Ethane		
_____ane	C_3H__	
_____ane	C_4H__	
	C_5H_{12}	
	C_6H_{14}	
	C_7H_{16}	
	C_8H_{18}	
	C_9H_{20}	
	$C_{10}H_{22}$	
	$C_{11}H_{24}$	
	$C_{12}H_{26}$	

Appendix 7Organic Chemistry—2 Functional

2. Complete the table below. LEARN what each of these functional groups are and how they are represented.

Name of functional group	Example	Uses
Alkene C=C	But-2-ene 	Alkenes are used to make plastics in addition polymerisation. They are used to make alcohols, and haloalkenes. They are used a s a chemical feedstock for many reactions.
Alcohol -OH		
Carboxylic acid		
Haloalkane		
Ester		
Aldehyde		
ketone		
Addition polymer		
Polyester (condensation polymer)		

Appendix 8 The Fundamentals Application Questions

The Atom

Draw and label the sub-atomic structure of the atom

In the element sodium, Na, it has a mass number of 23 and a proton number of 11. Calculate the number of electrons/ protons / neutrons in this element.

Explain why the atom has no overall charge

Explain why sodium atoms will form ions with a +1 charge. Use a half equation to support your answer

Chemical formula

Identify the number of different elements, total number of atoms and the Mr (RFM) of these formulae

$Mg(OH)_2$

$(NH_4)_2SO_4$

$Ca(NO_3)_2$

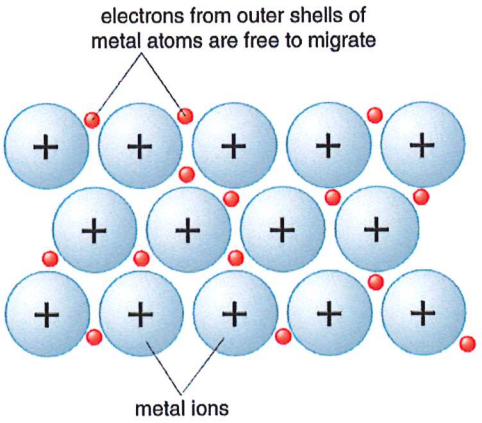
Work out the chemical formula if these ions form ionic compounds

1. K+ and Cl^-
2. O^{2-} and Mg^{2+}
3. Na^+ and CO_3^{2-}
4. Al^{3+} and OH^-

Bonding: ionic, covalent, metallic and intermolecular

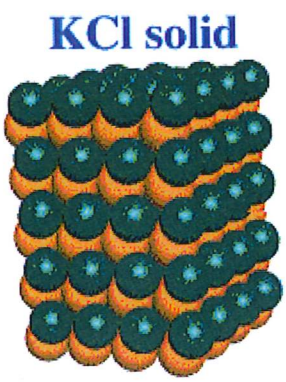
Using the diagram below to help, explain why metals

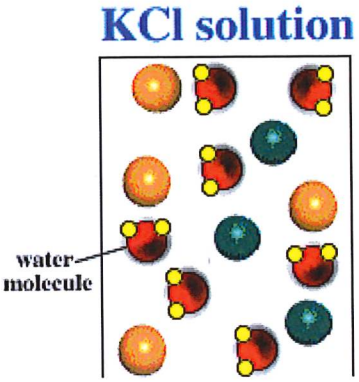
1. conduct heat/ electricity



2. have a high melting point

3. Name the attraction between the electrons and positive ions (not a 'metallic' bond).



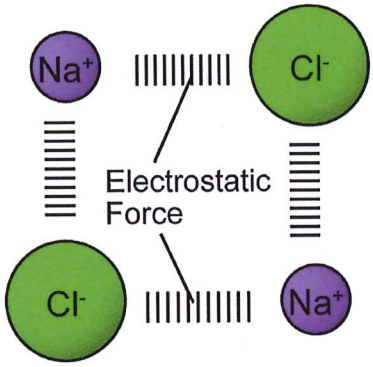


Ionic compounds

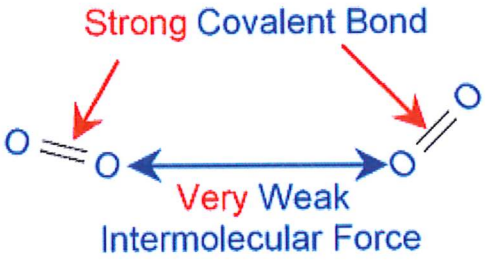
Define an ionic bond.

Explain what is meant by a 'giant ionic lattice'.

Explain why solid ionic compounds don't conduct, but can when in solution or molten?



Explain why have ionic compounds high melting points.



Covalent compounds

Define a covalent bond.

Explain why simple covalent compounds have low boiling points.

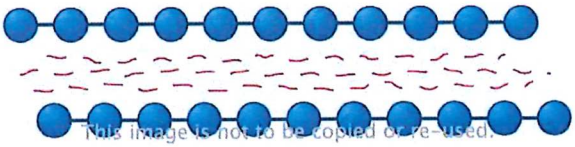
Explain why covalent compounds can't conduct electricity?

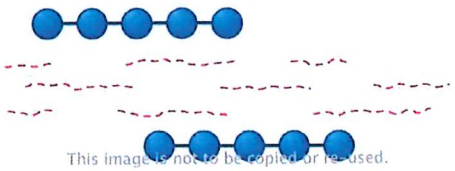
Intermolecular bonds

Define an intermolecular bond.

If an atom or molecular is bigger how does this affect the strength of the intermolecular bond?

How will this impact the molecules boiling point? Why?





•Find the empirical formula if a compound contains 0.2g Ca and 0.8g Br

•What is the concentration (g $dm^{-3)}$ of a solution when 2.5g has been dissolved in $100cm^3$

What mass of titanium is predicted to be made from 1000g of Na reacting?

$$TiCl_4 + 4\,Na \rightarrow Ti + 4\,NaCl$$

1. in the Q you will have been given a starting mass of one your molecules, e.g. 5g of HCl, use this and the RFM to moles (**n=mass/RFM**).

2. Refer to the molar ratio to find the moles of the desired molecule (big numbers).

3. Find the mass of the desired molecule (the one you are trying to predict) **mass= n x RFM.**

Answer these on lined paper or typed on a computer.

1 Group 1 of the periodic table contains the alkali metals lithium, sodium and potassium.
The alkali metals show a pattern in their reactivity with water.
This pattern is shown when small pieces of lithium, sodium and potassium are added separately to water.

Describe the reactions and what would be seen and explain the pattern in reactivity.

You may include equations as part of your answer.

(6)

*(b) The order of reactivity of chlorine, bromine and iodine can be determined by carrying out displacement reactions.

Explain how displacement reactions can be used to show the reactivity of these three elements.

(6)

-What is the trend in reactivity down the group?
-Explain the trend in reactivity.
-Use equations between Br_2 + NaI and then Br_2 + NaCl to prove this reactivity trend

Two substances, **A** and **B**, each form a colourless solution.
If the solutions are mixed in a beaker, **A** and **B** react to form a coloured product.
The rate of the reaction between **A** and **B** can be investigated by placing the beaker containing the mixture on a cross on a piece of paper and timing how long it takes for enough coloured product to be produced to make the cross invisible when viewed from above, through the solution.

	experiment 1	experiment 2	experiment 3
concentration of **A in solution** in g dm^{-3}	10	10	40
temperature in °C	20	40	40
time for cross to become invisible in s	320	80	20

Figure 13

Use the results of these experiments to explain, in terms of the behaviour of particles, the effect of changing temperature and the effect of changing the concentration of **A** in solution on the rate of this reaction.

Appendix 9—Research Project

Use your online research skills to see if you can find out as much about the topic as you can. Remember it you are a prospective A level chemist, you should aim to extend **your** knowledge. Remember to reference your work appropriately and DO NOT copy and paste.

You can make a 1-page summary for one topic from below.

Why is copper sulfate blue?

Copper compounds like many of the transition metal compounds have got vivid and distinctive colours – but why?

The hole in the ozone layer

Why did we get a hole in the ozone layer? What chemicals were responsible for it? Why were we producing so many of these chemicals? What is the chemistry behind the ozone destruction?