



**Paddington Academy**

The best in everyone™

Part of United Learning

## **AS LEVEL CHEMISTRY**

### **1.2.2 BONDING AND STRUCTURE**

### **1.3.1 PERIODICITY**

## **ASSESSED HOMEWORK**

Answer all questions

Max 90 marks

Name	.....		
Mark	...../90	.....%	Grade .....

1. Magnesium fluoride,  $\text{MgF}_2$ , has ionic bonding.

(i) How does *ionic bonding* hold particles in  $\text{MgF}_2$  together?

.....  
.....

[2]

(ii) Draw a 'dot-and-cross' diagram for magnesium fluoride,  $\text{MgF}_2$ . Show outer electron shells only.

[2]

(iii) Magnesium fluoride is produced when magnesium reacts with fluorine.

Complete the half-equations below to show the formation of the ions in magnesium fluoride in this reaction.



[2]

(iv) A student found that magnesium fluoride has different electrical conductivities when solid and when dissolved in water.

Explain these **two** observations.

.....  
.....  
.....  
.....

[2]

[Total 8 marks]

2. The ions present in  $\text{Ca}(\text{OH})_2$  are  $\text{Ca}^{2+}$  and  $\text{OH}^-$ .

Draw a 'dot-and-cross' diagram of  $\text{Ca}(\text{OH})_2$ . Show outer electron shells only.

[Total 2 marks]

3. Limestone contains the ionic compound,  $\text{CaCO}_3$ . Limestone decomposes when it is heated strongly, forming an ionic compound,  $\text{CaO}$  and a covalent compound,  $\text{CO}_2$ .



- (a) State what is meant by *ionic bonding*.

.....  
 .....

[1]

- (b) Draw 'dot and cross' diagrams to show the bonding in  $\text{CaO}$  and  $\text{CO}_2$ . Show outer electron shells only.

CaO	CO <sub>2</sub>

[3]

- (c) Complete the electronic configuration in terms of sub-shells for calcium in  $\text{CaO}$ .

1s<sup>2</sup> .....

[1]

[Total 5 marks]

4. Chemists have developed models for bonding and structure. These models are used to explain different properties of metals and non-metals.

(i) Draw a labelled diagram to show the currently accepted model for *metallic bonding*.

[2]

(ii) What feature of this model allows metals to conduct electricity?

.....  
.....

[1]

[Total 3 marks]

5. Fluorine, F<sub>2</sub>, has covalent bonding.

(i) State what is meant by a *covalent* bond.

.....  
.....

[2]

(ii) Draw a '*dot-and-cross*' diagram to show the covalent bonding in fluorine. Show outer electron shells only.

[1]

[Total 3 marks]

6. Sodium reacts with excess oxygen to form sodium peroxide,  $\text{Na}_2\text{O}_2$ .

$\text{Na}_2\text{O}_2$  is used in laundry bleaches. When added to water a reaction takes place forming an alkaline solution and hydrogen peroxide,  $\text{H}_2\text{O}_2$ .

(i) Construct a balanced equation for the formation of sodium peroxide from sodium.

.....

[1]

(ii) Construct a balanced equation for the reaction of sodium peroxide with water.

.....

[1]

(iii) Draw a 'dot-and-cross' diagram for a molecule of  $\text{H}_2\text{O}_2$ . Show outer electrons only.

[2]

[Total 4 marks]

7. In water treatment plants, care must be taken as chlorine can react with nitrogen compounds to form the highly explosive compound, nitrogen trichloride,  $\text{NCl}_3$ . Molecules of  $\text{NCl}_3$  have a bond angle of  $107^\circ$ .

(i) Name the shape of an  $\text{NCl}_3$  molecule.

.....

[1]

(ii) Explain why a molecule of  $\text{NCl}_3$  has this shape and a bond angle of  $107^\circ$ .

.....  
.....  
.....  
.....  
.....

[3]

[Total 4 marks]

8. Chemists have developed models for bonding and structure which are used to explain different properties.

Ammonia,  $\text{NH}_3$ , is a covalent compound.

(i) Explain what is meant by a *covalent bond*.

.....

[1]

(ii) Draw a '*dot-and-cross*' diagram to show the bonding in  $\text{NH}_3$ .

Show **outer** electrons only.

[1]

(iii) Name the shape of the ammonia molecule.

Explain, using your '*dot-and-cross*' diagram, why ammonia has this shape and has a bond angle of  $107^\circ$ .

shape: .....

explanation: .....

.....

.....

.....

.....

.....

.....

[3]

[Total 5 marks]

9. The shape of a water molecule is different from the shape of a carbon dioxide molecule.

(i) Draw the shapes of these molecules and state the bond angles.

water	carbon dioxide
bond angle in water = .....	bond angle in carbon dioxide = .....

[4]

(ii) Explain why a water molecule has a different shape from a carbon dioxide molecule.

.....

.....

.....

.....

[2]

[Total 6 marks]

10. Ammonia reacts with hydrogen chloride,  $\text{HCl}$ , to form ammonium chloride,  $\text{NH}_4\text{Cl}$ .

$\text{NH}_4\text{Cl}$  is an ionic compound containing  $\text{NH}_4^+$  and  $\text{Cl}^-$  ions.

(i) Complete the electron configuration of the  $\text{Cl}^-$  ion.

$1s^2$  .....

[1]

(ii) Draw a 'dot-and-cross' diagram to show the bonding in  $\text{NH}_4^+$ .

Show **outer** electrons only.

[1]

(iii) State the shape of, and bond angle in, an  $\text{NH}_4^+$  ion.

shape: .....

bond angle: .....

[2]

(iv) A student investigated the conductivity of ammonium chloride.

She noticed that when the ammonium chloride was solid it did **not** conduct electricity. However, when ammonium chloride was dissolved in water, the resulting solution did conduct electricity.

Explain these observations.

.....  
.....  
.....  
.....  
.....  
.....

[2]

[Total 6 marks]



11. Compounds with covalent bonding often have polar bonds. Polarity can be explained in terms of electronegativity.

(i) Explain the term *electronegativity*.

.....  
.....  
.....

[2]

(ii) Use a suitable example to show how the presence of a polar bond can be explained in terms of electronegativity.

You may find it useful to draw a diagram in your answer.

.....  
.....  
.....

[2]

[Total 4 marks]

12. Liquid ammonia,  $\text{NH}_3$ , and water,  $\text{H}_2\text{O}$ , both show hydrogen bonding.

(i) Draw a labelled diagram to show hydrogen bonding between two molecules of liquid **ammonia**.

[3]

(ii) Water has several anomalous properties as a result of its hydrogen bonding.

Describe and explain **one** anomalous property of water which results from hydrogen bonding.

.....  
.....  
.....  
.....

[2]

[Total 5 marks]

13. Some polar molecules are able to form hydrogen bonds.  
Draw a diagram to show an example of hydrogen bonding.

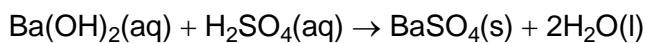
[Total 2 marks]

14. At room temperature, **X** is a liquid which does **not** conduct electricity. What does this information suggest about the bonding and structure in **X**?

.....  
.....  
.....

[Total 2 marks]

15. Sulphuric acid was added to aqueous barium hydroxide until the solution was just neutralised, forming the insoluble salt, BaSO<sub>4</sub>, and water.



The electrical conductivity of the solution steadily decreased as the sulphuric acid was added.

Explain why the electrical conductivity decreased.

.....  
.....  
.....

[Total 2 marks]

16. The metal magnesium reacts with the non-metal chlorine to form a compound magnesium chloride,  $MgCl_2$ , which has ionic bonding.

(i) State what is meant by an *ionic bond*.

.....  
.....

[1]

(ii) '*Dot-and-cross*' diagrams are used to model which electrons are present in the ion.

Draw a '*dot-and-cross*' diagram, including outer electron shells only, to show the ions present in magnesium chloride,  $MgCl_2$ .

[2]

(iii) A student finds that solid magnesium chloride and pure water do not conduct electricity. The student dissolved the magnesium chloride in the water and the resulting solution **does** conduct electricity.

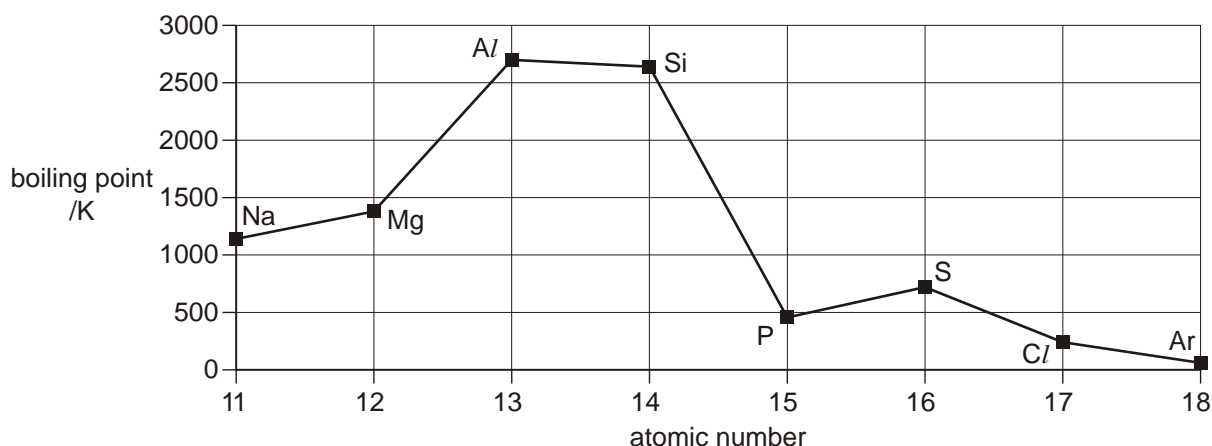
Explain these observations.

.....  
.....  
.....  
.....  
.....  
.....

[3]

[Total 6 marks]

17. The diagram below shows the variation in the boiling points of elements across Period 3 of the Periodic Table.



- (a) In the table below for the elements Mg, Si and S,

- complete the structure column using the word *giant* or *simple*.
- complete the bonding column using the word *metallic*, *ionic* or *covalent*.

element	structure	bonding
Mg		
Si		
S		

[3]

- (b) Explain why silicon has a much **higher** boiling point than phosphorus.

.....

.....

.....

.....

[2]

- (c) Explain why the boiling point **increases** from sodium to aluminium.

.....

.....

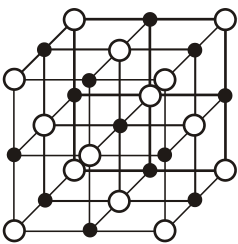
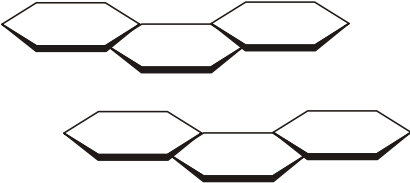
.....

[2]

[Total 7 marks]

18. In this question, one mark is available for the quality of spelling, punctuation and grammar.

Many physical properties can be explained in terms of bonding and structure. The table below shows the structures and some properties of sodium chloride and graphite in the solid state.

substance	sodium chloride	graphite
structure		
electrical conductivity of solid	poor	good
melting and boiling point	high	high
solubility in water	good	insoluble

Explain these properties in terms of bonding and structure.

[7]

Quality of Written Communication [1]

[Total 8 marks]

29. This question refers to the elements in the first three periods of the Periodic Table:

										H											He
Li	Be											B	C	N	O	F	Ne				
Na	Mg											Al	Si	P	S	Cl	Ar				

Identify an element from the first three periods that fits each of the following descriptions.

- (i) The element that forms a 2- ion with the same electronic configuration as Ne.  
 .....

[1]
- (ii) The element that forms a 3+ ion with the same electronic configuration as Ne.  
 .....

[1]
- (iii) The element that has the electronic configuration  $1s^2 2s^2 2p^6 3s^2 3p^3$ .  
 .....

[1]
- (iv) An element that forms a compound with hydrogen with tetrahedral molecules.  
 .....

[1]
- (v) An element that forms a compound with hydrogen with pyramidal molecules.  
 .....

[1]
- (vi) The element that forms a chloride  $XC_l^2$  with a molar mass of  $95.3 \text{ g mol}^{-1}$ .  
 .....

[1]
- (vii) The element with the largest atomic radius.  
 .....

[1]
- (viii) The element in Period 3 with the highest boiling point.  
 .....

[1]

[Total 8 marks]