04-05 Chemical Bonding and Materials

Set A **Answer key**

A From the lesson

8 MARKS

1 **B** ionic bonding [1]

Magnesium is a metal and oxygen is a non-metal. Magnesium loses 2 electrons and oxygen gains them, so ions form and attract each other.

2 **B** graphite [1]

Each carbon atom in graphite uses only 3 of its 4 outer electrons, so one electron per atom is free to move.

3 **B** Each carbon atom is bonded to four others by strong covalent bonds. [1]

A large amount of energy is needed to break the many strong covalent bonds in the giant network.

4 **B** 2 [1]

Each oxygen atom has 6 outer electrons and shares 2 of them. This makes a double bond, which is two shared pairs.

5 **(a)**

A sodium atom loses 1 electron to form a sodium ion, Na^+. [1]

A chlorine atom gains 1 electron to form a chloride ion, Cl^-. [1]

(b)

Ionic bond. [1]

It is the electrostatic attraction between the oppositely charged ions. [1]

B Practice

28 MARKS

6 **B** phosphorus and oxygen [1]

Covalent bonds form between non-metals. Phosphorus and oxygen are both non-metals. The other pairs are a metal and a non-metal, which form ionic bonds.

7 **A** electrostatic forces of attraction between positive metal ions surrounded by a 'sea of delocalised electrons' [1]

Metal atoms lose their outer electrons to form positive ions. The attraction between oppositely charged particles is electrostatic.

8 **A** Copper has a 'sea' of delocalised electrons. [1]

The delocalised electrons are mobile charge carriers. The positive ions stay in fixed positions.

9 **D** $Ca_3(PO_4)_2$ [1]

Calcium forms Ca^{2+} and phosphate is PO_4^{3-}. Three Ca^{2+} (+6) balance two PO_4^{3-} (−6).

10 **C** giant ionic structure, because it has free-moving ions [1]

The ions are fixed in the solid but move freely when dissolved.

A A metal conducts as a solid, and pure water is a poor conductor.

B A metal conducts as a solid.

D Pure water is a poor conductor. The ions in the solution carry the current.

11 **B** air, tungsten, sodium bromide [1]

Tungsten is a metallic element, sodium bromide is an ionic compound and air is a gaseous mixture. The order in the list does not matter.

12 **D** D [1]

In D, atoms of two different elements join to form particles of a new compound, so a new substance is made.

13 **C** In an alloy there is attraction between positive ions and a 'sea of delocalised electrons'. [1]

An alloy still has metallic bonding. It can contain a non-metal, as steel contains carbon, and it is a mixture, so brass has no chemical formula.

14 **(a)(i)** Sodium sulfate [1]

(ii) Graphite [1]

(iii) Sulfur dioxide and sodium sulfate [1]

Both contain sulfur and oxygen.

(iv) Dry ice [1]

(v)

Graphite [1]

(vi)

Any one: dry ice, CO_2 *or* sulfur dioxide, SO_2 *or* sodium sulfate, Na_2SO_4. [1]

(b)

Correct number of electrons: a nitrogen atom with 3 shared pairs and 1 lone pair, and each hydrogen atom with 1 shared pair. [1]

Correct number of atoms: one nitrogen atom bonded to three hydrogen atoms. [1]

15 **(a)**

A giant metallic structure, a lattice of positive ions [1]

in a sea of delocalised electrons. [1]

(b)(i)

$Sc_2(SO_4)_3$ [1]

Sc_2O_3 shows that scandium forms Sc^{3+} and sulfate is SO_4^{2-}.

(ii)

$Sc(OH)_3$ [1]

16 **(a)**

The correct ratio of two Li^+ ions to one O^{2-} ion. [1]

Each ion shown with its charge: Li^+ with no outer electrons and O^{2-} with 8 outer electrons, in square brackets. [1]

(b)

Li_2O: solid [1]

CH_4: gas [1]

(c)(i)

Li_2O has a giant ionic lattice. [1]

As a solid, the ions are held in fixed positions and cannot move freely to conduct electricity. [1]

(ii)

CH_4 consists of simple molecules. [1]

The weak intermolecular forces of attraction need little energy to overcome, so the melting and boiling points are low. [1]