

## CHEMICAL BONDING DIAGNOSTIC TEST

### **Instructions to Students**

**Answer all questions on the separate answer sheet provided**

This paper consists of 9 items that evaluate your understanding of chemical bonding.

Each question has two parts: a multiple-choice response followed by a multiple-choice reason.

For each item, you are asked to make one choice from the multiple-choice response section and record your answer in the box provided.

Then choose one of the reasons from the multiple-choice reason section that best matches your answer to the first part and record your answer in the other box.

**Remember it is important to select a reason**

Do not forget to record your name and other details on your Answer Sheet

### **Note to the teacher**

Please collate your students' answer sheets and mail them to the address below. We will mark and return all answer sheets.

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# CHEMICAL BONDING DIAGNOSTIC TEST

## ANSWER SHEET

Name: \_\_\_\_\_

Name of College: \_\_\_\_\_

Class: \_\_\_\_\_ Age: \_\_\_\_\_ years Date: \_\_\_\_\_

- |    |        |                          |        |                          |
|----|--------|--------------------------|--------|--------------------------|
| 1. | Answer | <input type="checkbox"/> | Reason | <input type="checkbox"/> |
| 2. | Answer | <input type="checkbox"/> | Reason | <input type="checkbox"/> |
| 3. | Answer | <input type="checkbox"/> | Reason | <input type="checkbox"/> |
| 4. | Answer | <input type="checkbox"/> | Reason | <input type="checkbox"/> |
| 5. | Answer | <input type="checkbox"/> | Reason | <input type="checkbox"/> |
| 6. | Answer | <input type="checkbox"/> | Reason | <input type="checkbox"/> |
| 7. | Answer | <input type="checkbox"/> | Reason | <input type="checkbox"/> |
| 8. | Answer | <input type="checkbox"/> | Reason | <input type="checkbox"/> |
| 9. | Answer | <input type="checkbox"/> | Reason | <input type="checkbox"/> |

## CHEMICAL BONDING DIAGNOSTIC TEST

1. Sodium chloride, NaCl, exists as a molecule.

- A True                      B False.

**Reason:**

- 1 The sodium atom shares a pair of electrons with the chlorine atom to form a simple molecule.
- 2 After donating its valence electron to the chlorine atom, the sodium ion forms a molecule with the chloride ion.
- 3 Sodium chloride exists as a lattice consisting of sodium ions and chloride ions.
- 4 Sodium chloride exists as a lattice consisting of covalently bonded sodium and chlorine atoms.

2. Silicon carbide has a high melting point and high boiling point. This information suggests that the bonds in silicon carbide are

- A weak                      B strong

**Reason:**

- 1 Silicon carbide is a simple molecular solid.
- 2 Silicon carbide is a macromolecule composed of covalently bonded atoms.
- 3 Silicon carbide is a macromolecule composed of covalently bonded molecules.
- 4 A large amount of energy is required to break the intermolecular forces in silicon carbide.

3. Element C (electronic configuration 2,8,18,8,2) and Element E (electronic configuration 2,7) reacts to form an ionic compound  $CE_2$ .

A True                                  B False

**Reason:**

- 1 An atom of C will share one pair of electrons with each atom of E to form a covalent molecule,  $CE_2$ .
- 2 A macromolecule consisting of covalently bonded atoms of C and E.
- 3 Atoms of C will each lose two electrons and twice as many atoms of E will each gain one electron to form an ionic compound  $CE_2$ .
- 4 An atom of C will lose one electron to an atom of E to form an ionic compound CE.

4. The compound formed between magnesium and oxygen can be used as a heat resistant material to line the walls of furnaces.

A True                                  B False

**Reason:**

- 1 The lattice of magnesium oxide resembles that of silicon dioxide.
- 2 The covalent bonds between magnesium and oxygen atoms are strong.
- 3 The intermolecular forces between the magnesium oxide molecules are weak.
- 4 There are strong ionic forces between magnesium and oxide ions in the lattice.

5. Graphite can conduct electricity because it has delocalised electrons.

A True    B False

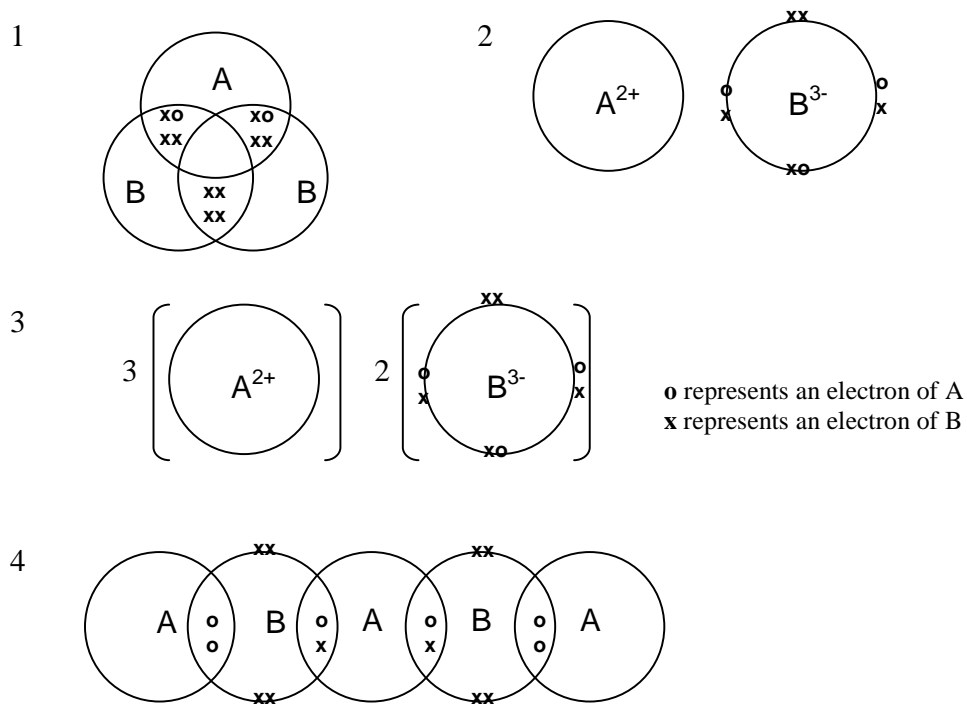
**Reason:**

- 1 Only three of the four valence electrons of a carbon atom are involved in bonding and the fourth electron is delocalised.
- 2 Electrons escape from the covalent bonds in graphite and are free to move within the molecule.
- 3 Graphite can conduct electricity because it has layers of carbon atoms which can slip over each other.
- 4 Graphite can conduct electricity because in graphite, some carbon atoms are delocalised and they conduct electricity.

6. An atom of element A has two electrons in its outermost shell while an atom of element B has five electrons in its outermost shell. When A reacts with B, the compound will be

A covalent    B ionic

**Reason:**



7. Sulphur atoms form rings consisting of eight atoms ( $S_8$ ) covalently bonded together. From this information, it can be concluded that sulphur is a
- A     macromolecule    B     simple molecular compound.

**Reason:**

- 1     Simple molecular solids consist only of small molecules made up of two to four atoms.
- 2     Simple molecular solids consist of molecules with weak intermolecular forces between molecules.
- 3     Macromolecules contain molecules which are covalently bonded together.
- 4     When the atoms of an element are covalently bonded, they will form macromolecules

8. Water ( $H_2O$ ) and hydrogen sulphide ( $H_2S$ ) have similar chemical formulae and structures. At room temperature, water is a liquid and hydrogen sulphide is a gas. This difference in state is due to
- A     forces between molecules.  
 B     forces within molecules.

**Reason:**

- 1     The difference in the forces attracting water molecules and those attracting hydrogen sulphide molecules is due to the difference in strength of the O-H and the S-H covalent bonds.
- 2     The bonds in hydrogen sulphide are easily broken, whereas those in water are not.
- 3     The hydrogen sulphide molecules are closer to each other, leading to greater attraction between molecules.
- 4     The forces between water molecules are stronger than those between hydrogen sulphide molecules.

9. A product XYZ has a smooth, thick, cream-like texture. Based on this, product XYZ would be classified as a

- A simple molecular substance.
- B macromolecule.

**Reason:**

- 1 This cream-like substance is made up of layers of covalently bonded atoms.
- 2 The thick, cream-like texture results from weak covalent bonding throughout the substance.
- 3 The molecules in the substance experience weak forces between them and hence move to accommodate changes in the shape of the solid.
- 4 The bonds within the molecules of the substance break easily to accommodate the changes in shape of the solid.

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Reference:

Tan, K. C. D., & Treagust, D. F. (1999). Evaluating students' understanding of chemical bonding. *School Science Review*, 81 (294), 75 – 82.

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