**Topic Test: Covalent bonding (50) Name: \_\_\_\_\_\_\_\_\_\_**

**SECTION A – Multiple-choice questions**

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| **Instructions for Section A**  Answer **all** questions.  Choose the response that is **correct** or **best answers** the question.  A correct answer scores 1, an incorrect answer scores 0.  No mark will be given if more than one answer is completed for any question.  Marks will **not** be deducted for incorrect answers. |

**Question 1**

A covalent bond is likely to form when

1. a metal and a non-metal react together.
2. non-metal atoms share valence electrons to complete their outer shells.
3. an atom with a low number of valence electrons reacts with an atom with a high number.
4. the combined number of valence electrons between two atoms reacting is eight.

**Question 2**

The electron configuration of chlorine is 2, 8, 7. When it forms a compound with oxygen, the chemical formula is likely to be

**A.** OCl

**B.** O2Cl

**C.** OCl2

**D.** OCl7

**Question 3**

The diagram below shows an electron dot diagram of an oxygen molecule.



In an oxygen molecule there are

**A.** four non-bonding electron pairs and two bonding electron pairs

**B.** two non-bonding electron pairs and four bonding electron pairs

**C.** eight non-bonding electron pairs and two bonding electron pairs

**D.** eight non-bonding electron pairs and four bonding electron pair

**Question 4**

When comparing the three molecules O2, H2O and HI, the likely order of boiling point is, from lowest to highest,

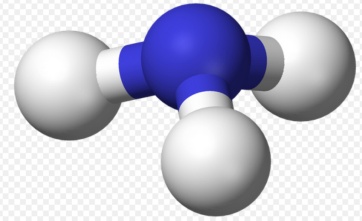
**A.** H2O, O2 and HI

**B.** O2, H2O and HI

**C.**  H2O, HI and O2

**D.** O2, HI, and H2O

*Use the following image of an ammonia molecule to answer Questions 5 and 6*



**Question 5**

The diagram shown is an example of a

**A.** ball-and-stick model showing ammonia has a trigonal pyramid shape.

**B.** ball-and-stick model showing ammonia has a tetrahedral shape.

**C.** space-filling model that shows ammonia has a tetrahedral shape

**D.** space-filling model that shows ammonia has a trigonal pyramid shape

**Question 6**

A knowledge of electronegativity, dipoles and molecular shape will lead to the conclusion that ammonia contains

**A.** no dipoles and is non-polar

**B.** dipoles but is non-polar

**C.** dipoles and is polar

**D.** covalent bonds but no dipoles

**Question 7**

Select the alternative that correctly lists the properties of molecular compounds.

**A.** low melting point, ductile and conducting electricity as a liquid

**B**. low melting point,lattice structure and brittle

**C.** high melting point, non-conductive of electricity and hard

**D.** low melting point, non-conductive of electricity as a solid and as a liquid

**Question 8**

Oxygen gas can be cooled to a liquid and then to a solid. A solid sample of oxygen contains

**A.** oxygen molecules held together in a set arrangement.

**B.** oxygen atoms held together with covalent bonds in a lattice structure

**C.** oxygen molecules covalently bonded to each other

**D.** oxygen molecules held together in a random arrangement

**Question 9**

A triple covalent bond can exist between

**A.** two atoms that have three electrons in their outer shell

**B.** two atoms that have five electrons in their outer shell

**C.** three different atoms that require an electron each to complete their outer shells

**D.** an atom with five electrons in the outer shell and an atom with seven electrons in its

outer shell

**Question 10**

Select the statement that best compares covalent molecules with covalent network lattices. In a covalent network lattice,

**A.**  the covalent bonds are stronger making the melting points higher.

**B.** the melting points are higher because the structure is entirely covalent bonds.

**C.** the melting points are higher due to the presence of a much greater number of covalent bonds.

**D.** the melting points are higher as due to presence of strong dipoles between the layers.

**SECTION B- Short-answer questions**

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| **Instructions for Section B**  Questions must be answered in the spaces provided in this book. To obtain full marks for your responses you should   * Give simplified answers with an appropriate number of significant figures to all numerical questions; unsimplified answers will not be given full marks. * Show all workings in your answers to numerical questions. No credit will be given for an incorrect answer unless it is accompanied by details of the working.   Make sure chemical equations are balanced and that the formulas for individual substances include an indication of state; for example, H2(g); NaCl(s) |

**Question 1** (9 marks)

Ammonia is a compound formed from the reaction between nitrogen and hydrogen.

**a**. Write the electron configuration for

**i**. nitrogen: \_\_\_\_\_\_\_\_\_\_\_\_\_\_ 1 mark

**ii**. hydrogen: \_\_\_\_\_\_\_\_\_\_\_\_\_\_ 1 mark

**iii**. Explain clearly how a knowledge of the electron configurations is used to determine the

chemical formula of ammonia. 2 marks

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**iv**. Draw an electron dot diagram for ammonia. 1 mark

**b. i**. Explain what a covalent bond is. 1 mark

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**ii**. Comment on the strength of a covalent bond. 1 mark

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**c**. Use the example of ammonia above to explain what the octet rule is. 2 marks

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**Question 2** (5 marks)

The chemical formula of carbon dioxide is CO2. A molecule is drawn below.



**a. i**. How many non-bonding electrons does this molecule have? \_\_\_\_\_\_\_\_\_ 1 mark

**ii**. How many bonding electrons does this molecule have? \_\_\_\_\_\_\_\_\_ 1 mark

**b**. Explain why carbon dioxide is a linear shaped molecule. 1 mark

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**c. i**. Draw on the molecule provided any dipoles carbon dioxide might contain. 1 mark

**ii**. Will carbon dioxide be a polar molecule? Explain your answer. 1 mark

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**Question 3** (6 marks)

Methane has a formula CH4.

**a. i**. Draw an electron dot diagram of a methane molecule. 1 mark

**ii**. What shape will this molecule be? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ 1 mark

**b**. Use methane to explain the difference between intermolecular bonds and intramolecular

bonds. 2 marks

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**c**. Methane has a low boiling point. Explain why. 2 marks

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**Question 4** (5 marks)

Chlorine, oxygen and nitrogen are all gases at room temperature. They are also linear diatomic molecules.

**a**. Draw a valence diagram of each molecule. 3 marks

**b**. Which molecule has the most non-bonding electrons? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ 1 mark

**c**. What type of intermolecular forces do these molecules have? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ 1 mark

**Question 5** (8 marks)

**a**. Hydrochloric acid has a formula HCl.

**i**. Draw the dipole on a HCl molecule. 1 mark

**ii**. Is HCl polar? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ 1 mark

**b**. Phosphine has a formula PH3.

**i**. Draw an electron dot diagram of PH3. 1 mark

**ii**. What shape will this molecule be? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ 1 mark

**iii**. Will phosphine be polar? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ 1 mark

**c. i**. Give an example of a molecule that has no dipoles. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ 1 mark

**ii**. Give an example of a molecule with dipoles that is non-polar. \_\_\_\_\_\_\_\_\_\_ 1 mark

**iii**. Give an example of a molecule that is polar. \_\_\_\_\_\_\_\_\_\_\_\_ 1 mark

**Question 6** (7 marks)

The diagram below is a representation of the carbon atoms in diamond.

Chart

Description automatically generated

**a. i**. Diamond is an example of an allotrope. What is an allotrope? 1 mark

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**ii**. Why does carbon form this arrangement? 1 mark

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**iii**. Why is the melting point of diamond much higher than that of covalently bonded molecules?

2 marks

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**b**. Graphite has a different structure to that of diamond. Use a sketch to show the arrangement of the

carbon atoms in diamond and to explain how the properties of graphite will differ to those of diamond.

3 marks

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