COPY 2

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MANA TOHU MĀTAURANGA O AOTEAROA

National Certificate of Educational Achievement
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Level 2 Chemistry, 2006

90308 Describe the nature of structure and bonding in different substances

Credits: Four
2.00 pm Monday 27 November 2006

Check that the National Student Number (NSN) on your admission slip is the same as the number at the top of this page.

A Periodic Table is provided on the RESOURCE SHEET in your Level 2 Chemistry package.

You should answer ALL the questions in this booklet.

If you need more space for any answer, use the page(s) provided at the back of this booklet and clearly number the question.

Check that this booklet has pages 2–9 in the correct order and that none of these pages is blank.

YOU MUST HAND THIS BOOKLET TO THE SUPERVISOR AT THE END OF THE EXAMINATION.

For Assessor's Use Only	Achievement Criteria		
	Achievement	Achievement with Merit	Achievement with Excellence
	Describe the bonding in simple molecules and the nature of types of solids ✓	Link selected properties of simple molecules and different types of solids to their structure ✓	Discuss properties of substances in terms of structure and bonding ✓
	Overall Level of Performance		E

You are advised to spend 45 minutes answering the questions in this booklet.

Assessor's use only

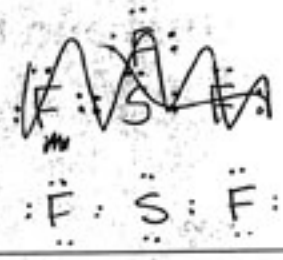
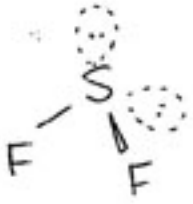
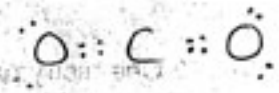
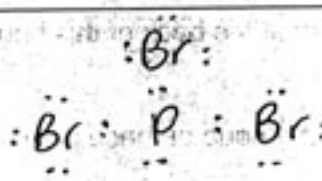
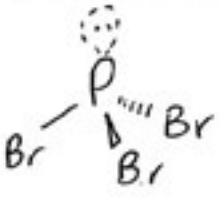
QUESTION ONE

Complete the table below by:

(a) drawing a Lewis structure (electron dot diagram) for each molecule

(b) drawing a diagram to show the shape of the molecule

(c) naming the shape of the molecule.

Formula of molecule	(a) Lewis structure	(b) Diagram of shape	(c) Name of shape
SF_2 6 14 20			V-shaped
CO_2 4 12 16		O = C = O	linear
PBr_3 5 7 5 21 8C			Trigonal Pyramid.

Well set out and clearly presented evidence

M

QUESTION TWO

The following table contains oxides of elements from the third row of the Periodic Table. Complete the table below by:

(a) stating the type of particle found in each substance as an **atom**, **ion** or **molecule**

(b) specifying the attractive force that exists between the particles in the solid state of the substance.

Solid	(a) Type of particle	(b) Attractive force between particles
sodium oxide	ion	Ionic bond
sulfur trioxide	Molecule	Van der Waals attractions
silicon dioxide	Atom	Covalent Bonds
aluminium oxide	ion	Ionic Bond

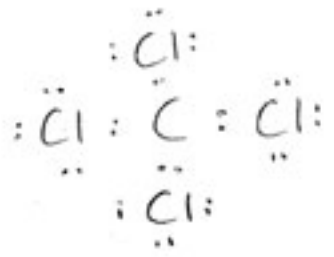
QUESTION THREE

Two ozone depleting substances are CCl_4 and CH_2Cl_2.

State whether the molecules are **polar** or **non-polar** and discuss the reasons for your choice. Include a Lewis structure of the molecules with your answer.

(a) CCl_4

4 7 32

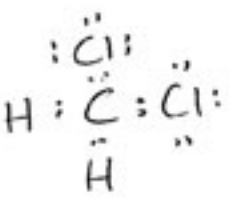


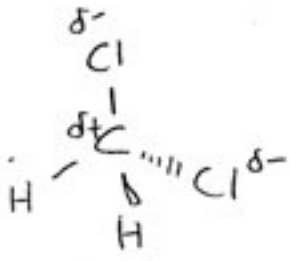
Non - Polar

The difference in electronegativity between C and Cl is big enough, that the bonds are polar, however due to the ~~pol~~ substance forming a tetrahedral shape the polar bonds are symetrical and they cancel eachother out, the molecule is therefore non-polar.//

(b) CH_2Cl_2

4 2 14 20





Polar.

The C-Cl bonds are polar due to the difference in ~~C and Cl electronegativity~~ electronegativity between C and Cl while C-H bonds are non-polar as the~~r~~ electronegativity of C and H are simalar. Although tetrahedral in shape the two C-Cl bonds are asymetric and ^therefore don't cancel eachother out the molecule is therefore polar.//

although all aspects outlined in the assessment schedule are present what any extraneous material that would cause doubt of students understanding.

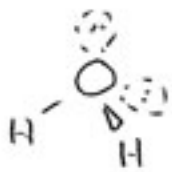
QUESTION FOUR

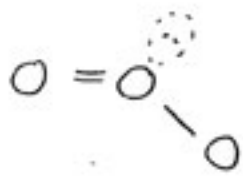
Assessor's use only

Molecules of water (H_2O) and ozone (O_3) each contain 3 atoms and both the molecules are bent. However, the bond angle in H_2O is significantly smaller than the bond angle in O_3.

Using Lewis structures, discuss the reasons for the difference in **bond angles** of these two molecules.

H_2O $\quad$ $H:\ddot{O}:H$ $\quad$ O_3 $\quad$ $\ddot{O}::\ddot{O}:\ddot{O}:$





The shape of a molecule is determined by the number of groups of paired electrons that surround the central atom. H_2O has four groups (2 bonded and 2 unbonded), while O_3 has 3 groups (2 bonded, 1 unbonded) as these groups repel to be as far apart as possible the bond angle between of H_2O is smaller as it must fit more electron groups around it's central atom than O_3 and so O_3 has a larger bond angle. The fact that both substances have three particles doesn't effect the bond angle as this doesn't effect the shape

poor choice of word

The evidence does not state bond angles or molecular shape However it is a good attempt borderline merit because there is an attempt to explain repulsion + bond angles, but not enough

M

QUESTION FIVE

The **physical properties** of some crystalline solids are stated below. For each example, explain why the substance has the property stated by relating the **property** to the **structure and bonding** within the solid.

NaCl

(a) Solid sodium chloride does not conduct electricity. However, if it is melted, sodium chloride will conduct electricity.

NaCl is an ionic solid made of positive and negative ions held together by strong electrostatic forces (ionic bond). As this bond is strong it holds the ions in a fixed position and the charged particles are therefore unable to move when placed in an electric field. Once molten however, these strong ionic bonds are broken and the ions are free to move so once in an electric field they will conduct as there will be a flow of charged particles. ✓

good answer logical and all points communicated

KCl

(b) Potassium chloride will not dissolve in non-polar solvents, but will dissolve in water.

Potassium chloride is an ionic solid made up K^+ and Cl^- which are held together by strong ionic bonds. As these bonds are strong, the solid is held tightly together with the particles in fixed positions. Non-polar solvents are unable to break these bonds as the attraction between K^+ and Cl^- is so strong. While the solvents attraction for the ions is weak. Water is polar and K^+ and Cl^- attraction to the water is greater than its attraction for eachother and water's attraction for the ions is greater than attractions between H_2O molecules. The KCl will therefore dissolve. ✓✓

good answer exactly what was required.

(c) Copper is easily shaped to form wires.

Assessor's use only

Copper is a metallic solid made up of positive metal ions and delocalised valence electrons which are attracted to the surrounding metal ions. These valence electrons are free moving and don't remain with any one ion - the bonding is therefore non-directional. Due to these non-directional bonds, layers of particles are able to slide past eachother easily while being drawn into wires without breaking as the delocalised valence electrons are still attracted to the surrounding metal ions. //

not perfect but is fine and overall answer shows good understanding

E

QUESTION SIX

The following table shows the melting and boiling points of chlorides of some elements of the third row of the Periodic Table.

	sodium chloride $NaCl$	magnesium chloride $MgCl_2$	phosphorus trichloride PCl_3	sulfur dichloride SCl_2
melting point/°C	801	712	–91	–80
boiling point/°C	1465	1418	74	59

(a) Describe the **trend** in melting and boiling points of chlorides across the third row of the periodic table by referring to the data in the table above.

They decrease as you move from left to right

(b) Discuss reasons for the differences in melting and boiling points of all FOUR chlorides, shown in the table above, by referring to the **particles** and **forces between the particles** in the solids.

NaCl and $MgCl_2$ are both ~~ionic~~ ionic solids ~~held together by strong~~ made of oppositely charged ions held together in strong ionic bonds. As these bonds are strong a lot of heat energy is required to break them and this is why the melting & boiling points are high. PCl_3 & SCl_2 are NOT metallic solids - not needed but not incorrect

PCl_3 and SCl_2 are molecular solids made of molecules held together by weak Van der Waals attractive forces. Little heat energy is therefore required to break these weak bonds and so ~~little~~ PCl_3 and SCl_2 have lower melting & boiling points than NaCl and MgCl.

this shows evidence of it being a force between molecules