COPY 2

NEW ZEALAND QUALIFICATIONS AUTHORITY
MANA TOHU MĀTAURANGA O AOTEAROA

National Certificate of Educational Achievement
TAUMATA MĀTAURANGA Ā-MOTU KUA TAEA

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.

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

Assessor's use only

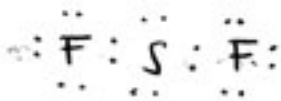
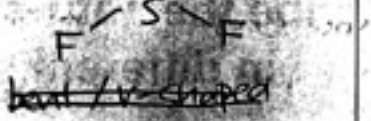
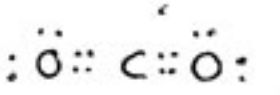
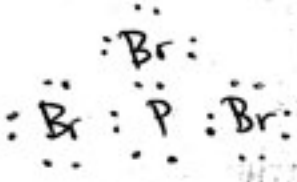
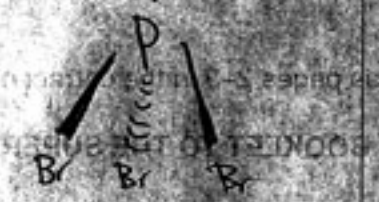
QUESTION ONE

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
6 ✱ SF_2 2✱			bent or V-shaped
4 12 CO_2 16			linear
5 21 PBr_3 2✱			trigonal pyramidal

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well set out and clear evidence presented

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 Na_2O	ION	strong electrostatic forces (ionic bonding)
sulfur trioxide SO_3	molecule	weak inter molecular forces (van der Waals-Force)
silicon dioxide SiO_2	atom	strong covalent bonds
aluminium oxide Al_2O_3	ION	strong electrostatic forces (ionic bonding)

M

QUESTION THREE

Two ozone depleting substances are CCl_4 and CH_2Cl_2.

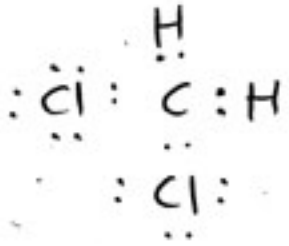
State whether the molecules are **polar** or **non-polar** and discuss the reasons for your choice. Include a Lewis structure of the molecules with your answer.

(a) CCl_4

Excellent answer.

CCl_4 is a non-polar molecule. The C-Cl bonds are polar due to the difference in electronegativity and the tetrahedral arrangement of polar bonds are symmetrical and therefore bond dipoles are cancelled out. (four electron clouds of same atom, which is Cl, around the central atom cancel out) This makes CCl_4 a non-polar molecule. //

(b) CH_2Cl_2



CH_2Cl_2 is a polar molecule and all the bonds are polar in this molecule, due to the difference in electronegativity. The tetrahedral arrangement of bonds are asymmetrical because the electron pairs (clouds) are from two different atoms and there is three lone pairs around the Cl atom. Therefore, the bond dipoles do not cancel out giving a net dipole. This makes CH_2Cl_2 a polar molecule. //

Needs lone pairs for polar.

The students answer showed a lack of understanding regarding asymmetry of molecule thus could not obtain an E.

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QUESTION FOUR

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 ⇒ H : Ö : H

O_3 ⇒ : Ö :: Ö : Ö :

H_2O is a polar molecule and has a bent shape. The O–H bonds are polar and the asymmetrical arrangement results in polar molecule, forming tetrahedral shape. There are four electron clouds but two of them are lone pairs which results in bent shape. The bond angle of H_2O should be smaller than the bond angle in O_3 (needed to state) because there are four electron clouds where as O_3 has angle three electron clouds forming trigonal planar shape O_3 has a bent shape because the arrangement of bonds are asymmetrical with the presence of lone pair around the central atom, O. Maximum repulsion causes different bond angles.

This answer did not fully explain & the concepts required. H is important to set the facts out - starting with the basic ones and then elaborating to show evidence of understanding. No angles or shapes

M. A1 A1.

QUESTION FIVE

Assessor's use only

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.

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

Sodium chloride (solid) is an ionic solid and Na^+ and Cl^- ions (positive and negative ions) are held together by strong electrostatic forces (strong ionic bonding) in a lattice structure, fixed in position. In molten state, ions (Na^+ and Cl^- ions) are free to move and carry charge to conduct electricity.

good answer.

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

KCl

Potassium chloride is a polar solute (substance) and is ionic. K^+ and Cl^- ions (positive and negative ions) are held together by strong ionic bonding (strong electrostatic forces) in a lattice structure. potassium chloride dissolve in water because they are both polar (water is a polar solvent and potassium chloride is polar solute). This fits into "like dissolves like." The attractive force between polar substances is weaker than the attractive forces within the water molecule so KCl will dissolve in water. (K^+ and Cl^- will become hydrated.)

KCl (potassium chloride) will not dissolve in non-polar solvents because KCl is polar molecule and the attractive force within KCl will be stronger and will stay as a molecule (KCl) rather than hydrated ions.

evidence claiming polar and ionic was not accepted

although this student had some understanding of dissolving, the answer centred around polarity and the evidence to show understanding was not present.

(o) Copper is easily shaped to form wires.

Assessor's use only

Copper is a metallic solid and its positive ions and ~~delocalised~~ delocalised electrons are held together by ~~weak~~ strong metallic bonding (strong non-directional electrostatic forces) in 2D structure. Copper is easily shaped ~~to~~ to form wires because its atoms can move into new positions (slide past each other) without breaking the bond.

M

positive ions was accepted if the remainder of description was clear and accurate but atoms is the correct answer.

Overall, this question was worth one grade. This student achieved most because 2 of the 3 answers showed understanding of the relationship between structure, bonding + a stated property.

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.

Melting and boiling points decreases across the table (to the 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 ionic substances.
NaCl and $MgCl_2$ are made up of positive and negative ions held together by strong ionic bonds (strong electrostatic forces).
The melting and boiling points of NaCl is high because (Na^+ and Cl^-) (Mg^{2+} and Cl^-)
its ions are held together by strong ionic bonding (strong electrostatic forces), and a lot of energy (eg. heat) is required to overcome this strong forces between ions. ✓ ∈

good description.

PCl_3 and SCl_2 are covalent molecular substances.
PCl_3 and SCl_2 are made up of molecules held together by weak intermolecular forces.
The melting and boiling points of PCl_3 and SCl_2 is low because the weak intermolecular forces between molecules require a little energy (eg heat) and these weak forces between molecules can be broken easily. // ✓

This meet requirement for excellence. A welcome addition to the answer would have been a statement recognising the molecule itself had strong covalent bonds within it