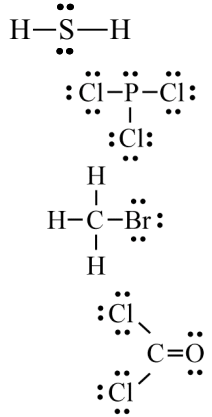
Assessment Schedule – 2005

Chemistry: Describe the nature of structure and bonding in different substances (90308)

Evidence Statement

Q	Evidence		Evidence contributing to Achievement	Evidence contributing to Achievement with Merit	Evidence contributing to Achievement with Excellence
1	(a) 	(b) bent / V−shape / angular trigonal pyramid / triangular pyramid tetrahedral trigonal planar	Lewis structure and shape correct for 2 molecules. (ie 2 rows correct) **OR** All Lewis structures correct All electrons must be clearly shown as pairs.	All Lewis structures and shapes correct (showing all non-bonding electrons and multiple bonding).	
2(a) (b)	CO_2 has non-polar molecules. The C−O bonds of CO_2 are polar due to the differing electronegativities of C and O. However, as there are only 2 electron repulsions about the central C atom, the polar bonds are symmetrical about the C atom / linear shape, and the effect of these polar bonds / bond dipoles is cancelled, so that the molecule is non-polar. SO_2 has polar molecules. The S−O bonds of SO_2 are polar due to the differing electronegativities of S and O. There are 3 electron repulsions about the central S atom (trigonal planar), however, the lone pair of electrons on the S atom causes the S−O bonds to occupy a bent or V shape around the central S. Therefore the effect of these polar bonds / bond dipoles is not cancelled, so that the molecule is polar.		Both polarities correct with a simple supporting statement involving 2 ideas (for each molecule). eg shape correct and symmetry / asymmetry of both molecules identified **OR** presence of C–O and S–O polar bonds identified and shape of molecule correct.	Both polarities correct and limited discussion / some linking of ideas eg refers to symmetry / asymmetry of bond arrangement with molecular shape, but no reference to why bonds are polar. ie • identifies bonds are polar • symmetry and asymmetry of bond arrangement (or bond dipoles) due to shape ie 'something' missing from E answer.	Both polarities correct and a full discussion of each compound that includes reference to: • electronegativity difference of atoms identified • polarity of bonds / bond dipoles identified • shape of molecule identified as a result of electron repulsions. • Lone pair of electrons on S of SO_2 leads to 3 e^- repulsions. • symmetry and asymmetry of polar bonds / bond dipoles due to shape of molecule.

Q	Evidence			Evidence contributing to Achievement	Evidence contributing to Achievement with Merit	Evidence contributing to Achievement with Excellence
3	(a) ions atoms molecules	(b) ionic bond / electrostatic forces **between ions** covalent bond Van der Waals / intermolecular / permanent dipole attraction (not VDW, not molecular bond).	(c) high high low	2 rows correct.	all correct	
4(a)	B Metallic C Molecular D Covalent network E Molecular F Ionic			All correct.		
4(b)	In the solid state, the **ions** are held in **fixed positions** by strong electrostatic attractions, or, ionic bonds. When molten, the charged **ions** are **separated** and **free to move** and conduct electricity.			One state explained. ie Recognises **ions** in the solid cannot move as held in fixed positions **OR** Recognises **ions** in liquid are separated and freely moving and so free moving charge can conduct electricity. (Reference to electrons incorrect.)	Correct comparison of conduction or lack of, for solid and liquid states.	

Q	Evidence	Evidence contributing to Achievement	Evidence contributing to Achievement with Merit	Evidence contributing to Achievement with Excellence
5(a) 5(b) 5(c)	**Silver atoms** are held together in a 3-D **lattice** by **metallic bonding**, in which valence electrons are attracted to the nuclei of neighbouring atoms. As this is a **non-directional** force, layers of atoms can slide over each other without breaking the metallic bond and disrupting the structure and breaking the metal. **Copper atoms** are held together in a 3-D **lattice** by **metallic bonding**, in which valence electrons are attracted to the nuclei of neighbouring atoms. Conduction of electricity requires **free moving charges**, which are the **moving valence electrons**. Silicon dioxide consists of **silicon and oxygen atoms** held together by **covalent bonds** in a tetrahedral arrangement, so that a **3-D network** exists. As the covalent bonds are **strong**, they are **difficult to overcome** and break, making it difficult to separate the atoms, so the structure has a high melting point.	One "very good" example (particle, force, property). **OR** Particles and force identified for 2 examples ((a) and (b) considered separately).	Properties for **2** substances are explained, but may lack some detail. Includes identifying type of particle and force between particles. If good answers (b) okay if only electrons referred to.	Type of particle (cannot be Ag^+ / Cu^{2+}), and force between particles identified. Model of ions in sea of electrons also acceptable. Nuclei (of atom) acceptable if clear. NOT protons. If good answers (b) okay if only electrons referred to. Properties for the **3** substances are correctly and clearly explained.
6	Iodine consists of I_2 **molecules** and weak **inter**molecular forces / weak Van der Waals forces exist **between** the molecules. As these attractions are weak, the molecules are **easily separated** and the melting point is low. Iodine molecules are **non-polar**, therefore iodine is soluble in a **non-polar solvent** such as cyclohexane. Since both molecules have similar weak intermolecular forces, then weak forces will exist between the two different molecules. Potassium iodide is an ionic solid consisting of **ions** held together by strong **ionic bonds** / electrostatic attractions. As these attractions are **strong**, **more energy** is needed to separate the ions (than the molecules of iodine) so that potassium iodide has a high melting point. Ionic solids are **soluble** in water as the ions are separated from the lattice due to attraction towards the **polar** water molecules.	One good answer. (If solubility of iodine in cyclohexane must refer to similar strengths of intermolecular forces.) Includes: • particle (must be clear that it is a molecule for I_2) • force • strength of force.	Full and correct discussion for three properties. eg melting point for both, solubility for one. Includes: • particle • force • strength of force.	Full and correct discussion for each property. ie Melting point for both and solubility for both. ie four properties. Includes: • particle • force • strength of force.

Judgement Statement

Achievement	Achievement with Merit	Achievement with Excellence
FOUR opportunities answered at Achievement level or higher. 4 × A	FOUR opportunities answered at Merit level or higher. 4 × M	FIVE opportunities answered with TWO at Excellence level, TWO at Merit level and ONE at Achievement. 2 × E *plus* 2 × M *plus* 1 × A