SAMPLE ASSESSMENT SCHEDULE

Chemistry 91164 (2.4): Demonstrate understanding of bonding, structure, properties and energy changes

Assessment Criteria

Achievement	Achievement with Merit	Achievement with Excellence
Demonstrate understanding involves describing, identifying, naming, drawing, calculating, giving an account of bonding, structure and properties of different substances and the energy involved in physical and chemical changes. This requires the use of chemistry vocabulary, symbols and conventions.	*Demonstrate in-depth understanding* involves making and explaining links between the bonding, structure and properties of different substances and the energy involved in physical and chemical changes. This requires explanations that use chemistry vocabulary, symbols and conventions.	*Demonstrate comprehensive understanding* involves elaborating, justifying, relating, evaluating, comparing and contrasting, or analysing links between bonding, structure and properties of different substances and the energy involved in physical and chemical changes. This requires the consistent use of chemistry vocabulary, symbols and conventions.

Evidence Statement

One	Expected Coverage	Achievement	Merit	Excellence
(a)	**See Appendix One.**	THREE of the following: • in (a) TWO Lewis structures correct OR TWO shapes correct (or equivalent) • in (b) THREE sets of electrons around S (in SO_2) OR FOUR sets of electrons around S (in H_2S) • in (c) C-Cl bond is polar • in (c) bonds in $CHCl_3$ are arranged tetrahedrally.	In (b) the arrangement of electrons around the central atom is used to explain the shape of the molecule AND in (c) the difference in electro negativities are used to explain the $CHCl_3$ is a polar molecule.	The shape of the molecule (in (b) and (c)) and the polarity of the molecule (in (b)) are explained and justified in terms of the regions of electron density, electron repulsion, bond polarity (in (c)) and symmetry / asymmetry.
(b)	The central atom in SO_2 has three regions of electron density (sets of electrons) around it. Two of these are bonding and one is non bonding. The non bonding pair contributes to the shape but is not considered part of the shape. The regions of electron density are arranged as far apart as possible from each other in a trigonal planar position. This is why the bond angle is 120^o. The central atom in H_2S has four regions of electron density around it. Two of these are bonding and two are non bonding. These four regions repel each other as far apart as possible. The regions of electron density are arranged as far apart as possible from each other in a tetrahedral position. This is why the bond angle is 109^o.			
(c)	The molecule of $CHCl_3$ is polar.			

	The molecule CH_2Cl_2 is polar. $CHCl_3$ and CH_2Cl_2 have four regions of electron density around the central C atom. These are all bonding pairs of electrons so the shape of both molecules is tetrahedral. The C-Cl bond is polar due to the difference in electronegativity between C and Cl. The C-Cl bonds are more polar than the C-H bond as the electronegativity of Cl is greater than the electronegativity of C and H. The bonds are arranged symmetrically in tetrahedral positions around the C atom. Because the bonds are arranged in tetrahedral positions and the C–Cl bonds are polar, both CH_3Cl and CH_2Cl_2 are polar molecules.			

NØ	No response or does not address the question.
N1	Provides some writing but does not fulfil any statement from the Achievement criteria column.
N2	Any ONE statement from the Achievement criteria column.
A3	Any TWO statements from the Achievement criteria column.
A4	Any THREE statements from the Achievement criteria column.
M5	Any ONE statement from the Merit criteria column.
M6	Gives BOTH statements from the Merit criteria column.
E7	Only minor error – omission or additional information – from the Excellence criteria column.
E8	All the evidence from the Excellence criteria column.

Two	Expected Coverage	Achievement	Merit	Excellence
(a)	**See Appendix Two.**	THREE of the following: • in (a) TWO solids described in terms of the type of solid and the type of particle • in (b) ONE step correct for either	In (b) ONE calculation correct. AND in (c) a property of magnesium or magnesium oxide linked to the particles in solid and the forces between the	In (b) the mass of magnesium is calculated AND in (c) the structure of magnesium and magnesium oxide, the bonding between particles, the mobility/non mobility of particles
(b) (i)	$n(O_2) = 15.4/32 = 0.481$ mol Energy released = $0.481 \times 1200 = 578$ kJ			
(b) (ii)	$M(Mg) = 24.0$ g mol^{-1} 1200 kJ released by 2 mol Mg 98.2 kJ released by $98.2 \times 2/1200$ mol Mg = 0.164 mol			

	m(mg) 0.164 × 24.0 = 3.93 g	calculation	particles.	and/or the strength of the forces between particles are used to justify the properties of the substances.
(c)	**Magnesium** atoms are held together in a 3–D lattice by metallic bonding in which valence electrons are attracted to the nuclei of neighbouring atoms. **Magnesium is malleable** because the force of attraction between the valence electrons and the nuclei of the magnesium atoms is non-directional. This means that the layers can slide over each other without breaking the metallic bond / disrupting the lattice structure. **Magnesium does not dissolve in water** because the metallic bonds are too strong to be broken by the attraction to the water molecules. **Magnesium oxide** is made up of positive magnesium ions and negative oxide ions held together by electrostatic attractions in a 3–D lattice. **Magnesium oxide** does not conduct electricity as a solid as these ions are not free to move. When molten the ions are free to move and carry the charge so magnesium oxide conducts electricity.	• in (c) structure of magnesium (or a metal) described • in (c) structure of magnesium oxide described.	OR In (c) 2 properties of magnesium or magnesium oxide linked to the particles in the solid and forces between the particles.	

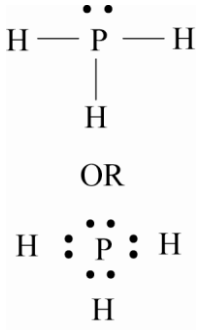
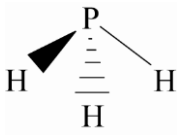
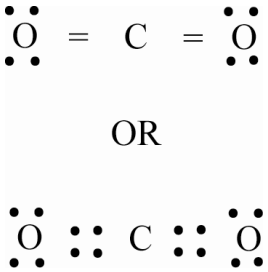
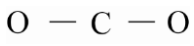
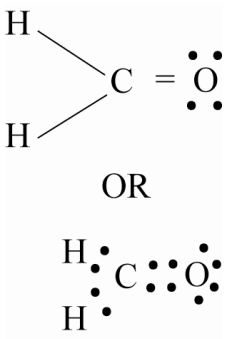
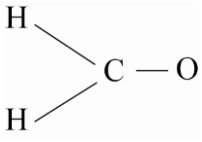
NØ	No response or does not address the question.
N1	Provides some writing but does not fulfil any statement from the Achievement criteria column.
N2	Any ONE statement from the Achievement criteria column.
A3	Any TWO statements from the Achievement criteria column.
A4	Any THREE statements from the Achievement criteria column.
M5	Any ONE statement from the Merit criteria column.
M6	Gives BOTH statements from the Merit criteria column.
E7	Only minor error – omission or additional information – from the Excellence criteria column.
E8	All the evidence from the Excellence criteria column.

Three	Expected Coverage	Achievement	Merit	Excellence
(a)	Endothermic because energy is absorbed to break the attractive forces	THREE of the	In (b) reason for why a reaction is	In (c) the structure of SiO_2 and Br_2, the

	between the molecules in the solid state.	following: • in (a) endothermic reaction described in terms of forces between particles • in (b) bonds broken and formed identified • in (b) correctly states the endothermic and exothermic processes • in (c) EITHER bonding OR structure of **SiO_2** described • in (c) EITHER bonding OR structure of Br_2 described.	exothermic or endothermic is linked to the energy required AND in (c) the melting point of SiO_2 and Br_2 linked to the particles in solid and the bonding. …… OR 3 properties of SiO2 or Br2 linked to the particles in the solid and the bonding.	bonding between particles, the strength of the forces between particles used to justify the difference in melting points and the differences in solubility (and links the different amount of energy to separate particles to melting point).
(b) (i)	Bonds broken between H-H and between O-O Bonds formed between H-O			
(b) (ii)	Bond breaking is endothermic as energy is required to separate the atoms in a bond. Bond forming is exothermic as energy is released as bonds form.			
(c)	Bonding in **SiO_2** is covalent bonds Bonding in **Br_2** is weak intermolecular forces of attraction. SiO_2 is made up of Si and O atoms. Each atom is covalently bonding to four others in a tetrahedral arrangement forming a covalent network solid. The covalent bonds are very strong and: • (for melting point) require a large amount of energy to overcome them, meaning SiO_2 has a high melting point • (for solubility) are too strong to be broken by the attraction to the water molecules. Br_2 is a molecular substance made up of molecules. There are weak intermolecular forces holding the molecules together and: • (for melting point) require only a small amount of energy to overcome them meaning Br_2 has a low melting point • (for solubility) the attraction of the water molecules is sufficient to separate the bromine molecules, meaning Br_2 is soluble in water.			

NØ	No response or does not address the question.
N1	Provides some writing but does not fulfil any statement from the Achievement criteria column.
N2	Any ONE statement from the Achievement criteria column.
A3	Any TWO statements from the Achievement criteria column.
A4	Any THREE statements from the Achievement criteria column.
M5	Any ONE statement from the Merit criteria column.
M6	Gives BOTH statements from the Merit criteria column.
E7	Only minor error – omission or additional information – from the Excellence criteria column.
E8	All the evidence from the Excellence criteria column.

Appendix One: Question One (a)

Molecule	Lewis structure	Diagram of Shape	Name of Shape
PH_3			Trigonal pyramid
CO_2			Linear
H_2CO			Trigonal planar

Appendix Two: Question Two (a)

Solid	Type of solid	Type of particle
Mg (magnesium)	metallic	atom
O_2 (oxygen)	molecular	molecule
MgO (magnesium oxide)	ionic	ions