## **Stage 2 Chemistry**

## **Birdwood**

HIGH SCHOOL **Topic 2: Elemental & Environmental Chemistry**

**Electronic config. periodic trends, oxide nature, molecular shape**

**Review Paper 2**

**DUE DATE:**

**Question 1**

Ammonia NH3, and hydrogen sulfide H2S are often the products of the anaerobic decomposition of organic matter.

1. Predict whether these two substances are likely to be gases, liquids or solids at normal temperatures and pressures. Unlikely to be solids as they are small covalent molecules. Likely to be gases. Ammonia has the more electronegative N and so has a higher boiling point, close to room temperature, so exists as both liquid and gas.
2. The shape of the H2S molecule is V-shaped. Briefly explain why it has this shape. Sulfur has two unbounded electron pairs that repulse the bonding electrons.

1. Draw the structural formulae of NH3.

Show any *non-bonding pairs* of electrons in each formula and *name the shape* of the molecule. Trigonal pyramidal

1. Explain why the ammonia molecule is *polar*. (8 marks)

Ammonia has polar bonds due to electronegativity difference between N and H.

Ammonia is an asymmetrical molecule and so has a positive and negative side, causing the molecule to be polar.

**Question 2**

Carefully consider the information given below about two substances, hydroxylamine and phosphine

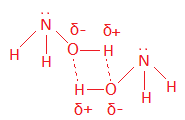
|  |  |  |  |
| --- | --- | --- | --- |
| Substance | Molar mass (g/mol) | Melting pt (0C) | Formula |
| **hydroxylamine** | 33 | 34 | NH2OH |
| **phosphine** | 34 | –1330C | PH3 |

1. Select one piece of information in the table that suggests these two substances are molecular compounds? Small non metal compounds
2. Which of the two substances has the higher melting point? Hydroxylamine
3. State the main type of secondary interaction operating between molecules of phosphine. Dispersion forces
4. A molecule of hydroxylamine is drawn below.

Molecules of hydroxylamine are able to display hydrogen bonding

Draw two molecules of hydroxylamine to show the hydrogen bonding between the molecules.

[Indicate the positive and negative dipoles on the atoms in hydrogen bond you draw.]



(6 marks)**Question 3**

Consider the following oxides

\*water, \*sodium oxide, \*aluminium oxide, \*phosphorus (V) oxide, \*sulfur (VI) trioxide.

1. Write the molecular formula for sulfur trioxide. SO3
2. State the shape of the sulfur trioxide molecule. Trigonal planar
3. Show, by writing equations, how aluminium oxide can react with both acids and bases.

Al2O3 + 6H+ -> 2Al3+ + 3H2O

Al2O3 + 2OH- -> 2AlO2- + H2O

1. Select a basic oxide from the list above, and write the equation for its reaction with water.

Na2O + H2O -> 2Na+ + 2OH- (6 marks)

**Question 4**

The table below shows some boiling temperatures (Tb) for three different substances:

|  |  |  |  |
| --- | --- | --- | --- |
| **Substance** | H2 | CH4 | HCl |
| **Tb (0C)** | -253 | -161.5 | -85 |

1. The atoms in a hydrogen molecule are held together by primary *covalent bonds*.
   1. Explain the meaning of the term *covalent bond*. A shared pair of electrons
   2. In what state would you find hydrogen at 250C? Gas
   3. State the *type of secondary interactions* that hold the hydrogen molecules together. Dispersion forces
2. Despite both methane and hydrogen being non-polar molecules, methane has a higher boiling point than hydrogen. Explain why they have different boiling points. Methane has a larger molecular weight and therefore more electrons. More electrons lead to stronger dispersion forces.
3. Using the idea of molecular polarity, explain why the boiling temperature of hydrogen chloride is higher than that of methane. The HCl bond is polar due to the difference in electronegativity and it is an asymmetrical molecule, meaning that the molecule is polar. This means that it will have positive and negative sections, which will be attracted to other polar molecules through electrostatic attraction.

(8 marks)

**Question 5**

Certain oxides can be used to reduce soil acidity.

Two such oxides are CaO and SiO2.

a) Of the two elements calcium and silicon, state which atom has the higher electronegativity. Si

b) Hence state the nature of the oxides of calcium and silicon. Ca is basic, Si is acidic

c) Hence explain why CaO will reduce soil acidity but SiO2 will not. Basic oxide will react with acid in the soil, whereas the acidic oxide of Si will not.

(5 marks)

**TOTAL MARK = 33**