**Task 5: Chemistry Year 11: INVESTIGATION: Chemical Bonding SOLUTIONS**

**PRELAB: (Mark out of 25)**

1. Create a table similar to the following summarising the properties of materials with the different types of bonding. **(6 marks) – ½ mark deleted for incorrect answer**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Properties | Metallic | Covalent Network | Covalent Molecular | Ionic |
| Conductivity | ***High conductivity***  *Due to delocalised electrons* | ***No conductivity***  *Due to no delocalised electrons or charged ions* | ***No conductivity***  *Due to no delocalised electrons or charged ions* | ***Solid: No conductivity*** *due to fixed ions*  ***Solution or liquid: High conductivity***  *Charged ions dissociate and can move to charged electrodes* |
| Hardness | ***Hard****, but* ***malleable and ductile.***  *The strong electrostatic attraction is maintained when cations move due to the mobile delocalised electrons.* | ***Hard,*** *due strong covalent bonds between the atoms.*  *However* ***shattered*** *if sufficient force applied to overcome bonding strength* | *Varies in* ***softness****, many materials are* ***liquid and gas*** *at room temperature.*  *Due to weak intermolecular forces between the individual molecules.* | ***Har****d due to strong electrostatic attraction between charged ions. However can be* ***easily shattered*** *if force applied as like charged ions line up and repel each other.* |
| Solubility in water  (Covered in more detail in Sem 2) | ***None****, as electrostatic attraction between cations and delocalised electrons is much stronger than any attraction to the weaker polar charge on water* | ***None****, Covalent bond is very strong so won’t dissolve in water* | ***Some are soluble****, molecules with polar covalent bonds are soluble in water.*  *Molecules with no polarity (like oils and fats) will not dissolve* | ***Some are soluble***  *Charged ions are attracted to the polar water molecules.* |

1. Considering the properties of the materials think about what kind of experiments you could conduct to distinguish whether a material is ionic, covalent network, covalent molecular or metallic.

**Produce a detailed dichotomous key to show how would distinguish between the different types of substances. (8 marks)**

You will need at least 3 experiments to distinguish between all 4

The materials that you need to be able to distinguish are:

Sodium hydroxide, copper, silver nitrate, candle wax, sulphur, naphthalene, water, kerosene, ethanol, sucrose, sodium chloride, hydrochloric acid.

*Dichotomous key should have at least 3 experiments (3)*

*Bonding type clearly labelled in each step (2)*

*Logical order and good setting out (3)*

1. For each experiment write a short procedure and include an equipment summary. (**9 marks)**

*For each experiment : Description of experiment (2 marks)*

*Equipment list (1 mark)*

1. What safety precautions will you need to take (**2 marks**)

*½ mark per precaution (Must include electrical safety, 1 mark if no electrical safety)*

*Sufficient safety precautions to cover the experiments discussed: eg.*

*eg. Safety glasses*

*Closed in shoes*

*Don’t touch electrodes*

*Turn off electricity after taking measurements*

*Fume hoods*

*Long hair tied back*

**Laboratory (Mark out of 25)**

**Conduct Experiment 13**

In your write up you must include:

**Aim:**

**Method:** As per STAWA 11 Experiment 13

**Table of results** , it must be neatly ruled, include the substance, it’s state (ie solid, liquid, aqueous solution) and detailed observations, and any measurements which must include the correct units (**10 marks)**

*Ruled table: 1 mark*

*Suitable headings ie substance, measured current, observations, identification bonding (2 marks)*

*Units for current given: 2 marks*

*Observations written in: 2 marks*

*Correct identification of bonding : 3 marks (deduct ½ mark per incorrect one)*

**Discussion of results:** Which includes all of the discussion questions on Expt 13 **(10 marks, )**

1. **Pure substances (not solutions) which conduct electric current. Nature of the bonding. Charge carriers**

distilled water and ethanol would have had very low current due to their polar nature however equipment may not be sensitive enough to pick it up, so no substances also acceptable. (1)

1. **Pure substances that did not conduct electricity. Bonding type. Species that are present.**

Candle wax, naphthalene, sulphur did not conduct electricity in the solid or liquid state (1)

Kerosene did not conduct electricity in liquid state, ethanol and water would have had very low current (no current acceptable). (1)

Therefore there are no charged carriers present (1)

1. **Which of solutions (sucrose, NaCl, NaOH, HCl) conduct electric current. Species present and why they do, don’t conduct electricity.**

NaCl, NaOH and HCl conduct electricity,(1) therefore charged ions are present (1)

Sucrose does not conduct electricity so there are no charged ions (1)

1. **Solid state, NaCl, NaOH are ionic lattices. What happens when dissolved in water. (1 marks)**

When dissolved in water the cations and anions dissociate to form charged ions (1)

1. **Pure HCL is a covalent molecule. What happens to each HCl molecule when it dissolves in water.**

**(2 marks)**

HCl is a polar covalent molecule. When it dissolves in water the H+ and Cl- dissociate [as they are attracted to the polar water molecule] (1) and hence the ions are the charged carriers (1)

**Errors:** Discussion of any uncertainties or errors that arise in your measurements and ways to improve the experiment. **(3 marks)** *Anything reasonable eg*

*Uncertainties or errors : Analogue meters may not be sensitive enough to pick up low currents.*

*Digital meters may not be set at a sensitive enough setting.*

*NaOH : It was difficult to ensure all of NaOH was fully melted*

*Needed to ensure all measurements were done at the same voltage for a fair test*

**Conclusion:** Summarises your findings **(2 marks)**

*Summarise the results eg.*

*The covalent molecular materials were identified to be candle wax, naphthalene, sulfur as they showed no conductivity in both the liquid or solid state.*

*The pure liquids kerosene, ethanol and distilled water were covalent molecular as they showed no or low conductivity*

*The solution of sucrose was covalent molecular as it showed no current*

*NaOH, and NaCl were both identified to be ionic as they both conducted electricity in solutions (dissolved in water) but not in the solid form. Na OH and AgNO3 was identified to be ionic as it did not conduct electricity in the solid form but did in the liquid form*

*HCl is covalent molecular even though it conducts electricity in solution*

**VALIDATION TEST (MARK OUT OF 50) :** This will test your ability to distinguish between the different bonding types and interpret your experimental results.