**Justifying the properties of substances**

**2022**

(a) Use your knowledge of structure and bonding to explain why solid lithium bromide, LiBr(*s*), dissolves

in water. Use of a diagram is required in your answer to illustrate the dissolving process.

(b) Carbon, C(*s*), occurs naturally as both graphite and diamond. Graphite readily conducts electricity, while

diamond is an electrical insulator. Use your knowledge of structure and bonding to explain this difference in

electrical conductivity.

**2021**

(a) Copper, Cu(s) is used for electrical wiring in a rocket, due to its ability to conduct electricity and be stretched into wires (ductility).

Use your knowledge of structure and bonding to explain both of those properties.

(b)

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**2020**

(a) The electrical conductivity of silicon dioxide and potassium chloride in different states is given below.

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Use your knowledge of structure and bonding to explain these observations.

(b) Solid potassium chloride, KCl(*s*), is soluble in water. Chlorine gas, Cl2(*g*), is not readily soluble in

water. Use your knowledge of structure and bonding to explain the difference in solubility of these two

substances in water.

*You should include a diagram in your answer to illustrate the dissolving of KCl(s) in water.*

**2019**

(a) Sodium, Na(*s*), is malleable, whereas sodium iodide, NaI(*s*), is brittle.

Explain these observations by referring to the structure and bonding of each substance.

(b) Compare the solubilities of iodine, I2(*s*), in water, H2O*(l)* – a polar solvent, and in cyclohexane,

C6H12*(l)* – a non-polar solvent. Use your knowledge of structure and bonding to explain the solubility

of iodine in these two solvents.

**2018**

(a)Complete the table below by choosing the appropriate type of solid that matches the properties shown

in the table.

Types of solid: **Ionic**, **Metallic**, **Covalent Network**, **Molecular**.



(b) Explain why Solid **A** does not conduct electricity in the solid state, but will conduct when molten or

when dissolved in water. Refer to the particles, structure, and bonding of this substance.

(c) Elaborate on the differences in the melting points of solids **B** and **D** with reference to their

particles, structure, and bonding.

**2017**

(a) Circle the substance which has the lowest melting point.

Al(*s*) MgCl2(*s*) S8(*s*)

Justify your choice, referring to the attractive forces between the particles of ALL three substances.

(b) Circle the substance which is malleable.

Al(*s*) MgCl2(*s*) S8(*s*)

Justify your choice by referring to the structure and bonding of your chosen substance.

You may include a diagram or diagrams in your answer.

**2016**

**(a)** Carbon (graphite) conducts electricity when it is solid, whereas zinc chloride, ZnCl2, will not conduct electricity when solid, but will conduct when molten.

Justify this statement in terms of the particles, structure, and bonding for both substances.

**(b)** Solid zinc chloride, ZnCl2(*s*), is soluble in water. Dry ice, CO2(*s*), is not readily soluble in water.

Justify these statements in terms of the particles, structure, and bonding of these substances.

You may include a diagram or diagrams in your answer.

**2015**

(a) Phosphorus trichloride, PCl3, is a liquid at room temperature, and does not conduct electricity.

Explain these two observations in terms of the particles, structure, and bonding of PCl3.

(b) Consider each of the solids copper, Cu, silicon dioxide, SiO2, and potassium chloride, KCl.

Complete the table below by identifying which of these solids have the listed physical properties:

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Justify TWO of your choices in terms of the particles, structure, and bonding of these solids. You may use diagrams in your justification.

**2014**

(a) Graphene is a new 2-dimensional material made of carbon atoms. Graphene can be described as a ‘one

atom-thick’ layer of graphite. A diagram of graphene and two of its properties is shown below.



Use your knowledge of structure and bonding to explain the two properties of graphene given above.

(b) Solid Mg and I2 were tested for three physical properties. The table below shows the results of the tests.



Use your knowledge of structure and bonding to explain the results of the tests.

(c) Use your knowledge of structure and bonding to explain the dissolving process of sodium chloride in

water. Support your answer with an annotated (labelled) diagram.

**2013**

(i) Explain why chlorine is a gas at room temperature, but copper chloride is a solid at room temperature.

In your answer, you should refer to the particles and the forces between the particles in both substances.

### (ii) Using your knowledge of structure and bonding, explain why, although both graphite and copper are good conductors of electricity, copper is suitable for electrical wires, but graphite is not.

### 2012

(i) Silicon dioxide has a melting point of 1770°C.

### Explain why silicon dioxide has a high melting point by referring to the particles and the forces between the particles in the solid.

### (ii) Contrast both the electrical conductivity, and solubility in water, for both zinc, Zn, and zinc chloride, ZnCl2, using your knowledge of structure and bonding.

### 2011

### 1. The diagrams below show 3-D structural representations of diamond and graphite. Diamond and graphite are both made up of carbon atoms, but these atoms are arranged differently in each solid.

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### (i) Describe the electrical conductivity and hardness of diamond and graphite.

### (ii) Discuss the electrical conductivity and hardness of both diamond and graphite, using your knowledge of structure and bonding.

### 2. The diagrams below show structural representations of the two solids ice, H2O, and sodium chloride, NaCl.

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Ice melts at 0°C and sodium chloride melts at 801°C.

(a) (i) On each diagram above, circle ONE of the forces of attraction which must be overcome for the

substance to melt.

### Give a reason for your choice.

### (ii) Discuss the low melting point of ice and the high melting point of sodium chloride, using your knowledge of structure and bonding.

### (b) Sodium chloride dissolves in water.

Discuss how and why sodium chloride dissolves in water, using your knowledge of structure and

bonding.

### Include a labelled diagram in your answer.

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