Structure and Bonding [S]

1. Ionic compounds are formed between metals and non-metals.

    a. Draw a diagram to show the formation of a magnesium ion from an atom: **[3]**

    b. Explain, using abbreviated electronic configurations (e.g. 2:8:1), why the formula of aluminium chlorine is $AlCl_3$: **[3]**

    c. Define the term *ionic bond*: **[2]**

    d. Potassium fluoride is a typical ionic substance.

        i. Draw a diagram to show the ions in solid potassium fluoride: **[2]**

        ii. Explain why solid potassium fluoride cannot conduct electricity: **[2]**

iii. Explain why calcium fluoride has a higher melting point than potassium fluoride: **[3]**

2. Covalent substances form when non-metal atoms share electrons.

    a. Hydrogen sulphide (H_2S) is a typical simple molecular substance.

        i. Define the term *molecular*: **[2]**

        ii. Explain why hydrogen sulphide is a gas at room temperature and pressure: **[3]**

        iii. Draw a dot-and-cross diagram to show the structure of a hydrogen sulphide molecule: **[2]**

b. Giant covalent structures are enormous lattices of atoms interconnected by covalent bonds.

   i. Define the term *covalent bond*: **[2]**

   ii. Draw a diagram to show the structure of graphite: **[3]**

   iii. Explain how graphite can conduct electricity: **[2]**

   iv. Diamonds are used in cutting of other materials. Explain why in terms of their structure and bonding: **[3]**

3. A definitive property of metals is that their atoms readily lose electrons.

    a. State the term used to describe loss of electrons: **[1]**

    b. Draw a diagram to show the structure of lithium: **[3]**

    c. Define the term *metallic bonding*: **[2]**

    d. Explain why aluminium has a higher melting point than sodium: **[3]**

    e. State and explain whether molten calcium conducts electricity: **[2]**

Structure and Bonding [S]

1. Ionic compounds are formed between metals and non-metals.

    a. Draw a diagram to show the formation of a magnesium ion from an atom: **[3]**

    atom drawn with EC of 2:8:2 [1]

    ion drawn with EC of 2:8 [1]

    square brackets and 2+ charge on ion [1]

    b. Explain, using abbreviated electronic configurations (e.g. 2:8:1), why the formula of aluminium chloride is $AlCl_3$: **[3]**

    aluminium (2:8:3) needs to lose 3 electrons [1]

    chlorine (2:8:7) can only take 1 electron [1]

    so you need three chlorines for every aluminium [1]

    c. Define the term *ionic bond*: **[2]**

    the electrostatic attraction [1]

    between oppositely charged ions [1]

    d. Potassium fluoride is a typical ionic substance.

        i. Draw a diagram to show the ions in solid potassium fluoride: **[2]**

        alternating K and F ions (at least 2x3 rectangle) [1]

        + charge on K ions and – charge on F ions [1]

        ii. Explain why solid potassium fluoride cannot conduct electricity: **[2]**

        conducting requires freely moving charged particles [1]

        the ions in solid KF cannot move [1]

iii. Explain why calcium fluoride has a higher melting point than potassium fluoride: **[3]**

the ionic charges in CaF_2 are higher [1]

the forces (ionic bonds) holding it together are stronger [1]

so it takes more energy to separate the ions [1]

2. Covalent substances form when non-metal atoms share electrons.

   a. Hydrogen sulphide (H_2S) is a typical simple molecular substance.

      i. Define the term *molecular*: **[2]**

      composed of a group of atoms [1]

      held together by covalent bonds [1]

      ii. Explain why hydrogen sulphide is a gas at room temperature and pressure: **[3]**

      the forces between hydrogen sulphide molecules are weak [1]

      they require little energy to overcome [1]

      even room temperature provides enough energy to completely separate the molecules [1]

      iii. Draw a dot-and-cross diagram to show the structure of a hydrogen sulphide molecule: **[2]**

      One shared pair of electrons between the S and each of the two Hs [1]

      Four other electrons around the S [1]

b. Giant covalent structures are enormous lattices of atoms interconnected by covalent bonds.

i. Define the term *covalent bond*: **[2]**

the electrostatic attraction [1]

between two nuclei and a shared pair of electrons between them [1]

ii. Draw a diagram to show the structure of graphite: **[3]**

Two layers of carbon atoms [1]

Each layer consisting of at least 2 hexagons and containing a carbon atom with 3 covalent bonds [1]

One C-C covalent bond and some delocalised electrons between the layers labelled [1]

iii. Explain how graphite can conduct electricity: **[2]**

Conducting electricity requires freely moving charged particles [1]

The delocalised electrons in graphite are freely moving and charged [1]

iv. Diamonds are used in cutting of other materials. Explain why in terms of their structure and bonding: **[3]**

Diamond is held together by lots of C-C covalent bonds [1]

These bonds are very strong [1]

Lots of energy, or a huge force, is required to break them [1]

3. A definitive property of metals is that their atoms readily lose electrons.

    a. State the term used to describe loss of electrons: **[1]**

    oxidation [1]

    b. Draw a diagram to show the structure of lithium: **[3]**

    regular arrangement of Li^+ ions (at least 2x3 rectangle) [1]

    some delocalised electrons [1]

    the same number of delocalised electrons as Li^+ ions [1]

    c. Define the term *metallic bonding*: **[2]**

    the electrostatic attraction [1]

    between positive metal ions and the sea of delocalised electrons [1]

    d. Explain why aluminium has a higher melting point than sodium: **[3]**

    in aluminium the charges on the ions are higher [1]

    the metallic bonding between ions and delocalised electrons is stronger [1]

    more energy is required to separate the ions [1]

    e. State and explain whether molten calcium conducts electricity: **[2]**

    Conducting electricity requires freely moving charged particles [1]

    Both the positive metal ions AND the delocalised electrons in molten calcium are freely moving and charged [1]