SL & HL Answers to Metallic bonding questions

1. In diamond the four outer pairs of electrons around each carbon atom are strongly bonded to four other carbon atoms to give a giant tetrahedral shape so that all the electrons are localised and not free to move. In graphite three of the pairs of electrons are localised to form strong bonds with three other carbon atoms to give a planar layers of hexagonal rings. The other two electrons are delocalised and are free to move between the layers so making graphite a good conductor of electricity.

2. i. Malleable means that a substance can be moulded or formed into thin sheets by hammering.

ii. Gold, like all metals conducts electricity as it contains delocalised electrons which are free to move. It is malleable as the close-packed layers of positive ions held in the crystal lattice can relatively easily slide over each other or be rearranged without deforming.

3. The melting point of a metal depends upon the way the atoms are packed, the size of the cations and the charge carried by each cation. The alkali metals are all packed the same way and each cation carries a charge of 1+. However as the atomic number increases the size of the cation also increases so the charge density of the ions is less. This means the attraction to electrons is less so less energy is required to break the attractive forces holding the crystal structure together.

4. The charge on tin and lead ions is the same (2+). Tin ions have a smaller atomic radius than lead ions but their ionic radii are very similar (Sn^{2+} 1.18×10^{-10} m; Pb^{2+} 1.19×10^{-10} m) Assuming the metal atoms pack the same way one would assume that lead would have a slightly lower melting point. The fact that lead has a higher melting point may suggest that the packing arrangement in their crystal structures is different.

5. Because chromium and iron atoms have similar atomic radii the chromium atoms can replace some of the iron atoms in steel to form stainless steel without significantly altering the crystal structure. As the radii of the cations are similar and the charge on the cations remains the same the attractive forces are not significantly altered and the melting points are similar.