GROUP 2: ATOMIC AND PHYSICAL PROPERTIES

1. As you go down the group, you are adding extra layers of electrons which take up more space. The additional protons in the nucleus are exactly compensated for by the same number of extra screening electrons, so there is no other effect to think about.

2. a) First ionisation energy is the energy needed to remove the most loosely held electron from each of one mole of gaseous atoms to make one mole of singly charged gaseous ions.

   b) First ionisation energy falls as you go down the group.

   You have to consider the charge on the nucleus, the amount of screening, and the distance of the electron from the nucleus. As you go down the group, the extra charge on the nucleus is exactly offset by the extra screening electrons. The only factor affecting the ionisation energy is the distance from the nucleus. The further away the outer electrons get, the less strongly they are attracted, and the lower the ionisation energy.

3. a) Electronegativity is a measure of the tendency of an atom to attract a bonding pair of electrons.

   b) When the atoms form bonds there will be bonding pairs of electrons – each pair made of one from the Group 2 element and one from whatever it is bonding to. (This applies just as well to the formation of ionic bonds as to covalent ones. In the case of the ionic bond, the bonding pair ends up very close indeed to the more electronegative atom in the bond - so close that we consider that the electron from the Group 2 metal has been transferred entirely to the other element.)

   In both beryllium and magnesium, the bonding pairs will feel a net pull of 2+ from the metal nucleus – the number of protons minus the number of screening electrons. But in the case of beryllium, the bonding pairs will be closer to the nucleus than they are in magnesium, because beryllium is a smaller atom than magnesium. The bonding pairs are more strongly attracted in beryllium and therefore the electronegativity of beryllium is greater than that of magnesium.

4. a) In a metallic bond, the outer (bonding) electrons become delocalised over the entire metal structure. The atoms are held together by attractions between the positively charged nuclei and the delocalised electrons.

   b) Atomisation energy is the energy needed to produce 1 mole of separated atoms in the gas state starting from the element in its standard state (the state you would expect it to be in at approximately room temperature and pressure).

   c) The chart shows no obvious trend in atomisation energies for these five elements. If atomisation energy is a good guide to the strength of the metallic bonds, then you can't say that the metallic bond is getting weaker as you go down the group, because the atomisation energies aren't decreasing in any regular way.