**4.5 Metallic bonding**

**Learning objectives**

* Describe the structure of, and bonding in, metals
* Explain some of the properties of metals in terms of structure and bonding
* Explain what is meant by an ‘alloy’ and how the properties of alloys are different from those of pure metallic elements

**Understandings:**

* A metallic bond is the electrostatic attraction between a lattice of positive ions and delocalized electrons.
* The strength of a metallic bond depends on the charge of the ions and the radius of the metal ion.
* Alloys usually contain more than one metal and have enhanced properties.

Metals are found on the left of the Periodic Table and have a small number of electrons in their outer shell. These elements are characterized by having a loose control over their outer shell electrons. The electrons are described as delocalised because they do not belong to any one metal atom but, rather, are able to move throughout the structure. Each electron is attracted by all the positive ions in the structure, so the whole lattice is held together.



**Metallic bond is the force of electrostatic attraction between the lattice of positives ions (cations) and the delocalized electrons.**



‘pool’ of delocalized

electrons

lattice of positive ions

The strength of the metallic bond is determined by:

* the number of delocalized electrons;
* the charge on the cation;
* the radius of the cation.

The transition elements tend to have very strong metallic bonds due to the large number of electrons that can become delocalized, from both 3d and 4s sub-shells.

**Question 1**

**The melting points of sodium and magnesium are 98 °C and 649 °C, respectively. State and explain three reasons why magnesium has a higher melting point than sodium.**

**Characteristic physical properties of metals**

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**Alloys:**

**Alloys are solid solutions of metals usually containing more than one metal, and held together by metallic bonding.**

Alloys consist of different metal ions and a sea of delocalized electrons. The smaller ions are able to ﬁt in the spaces between the larger ions in the lattice structure.

Alloys are produced by adding one metal element to another metal (or carbon) in the molten state, so that the different atoms can mix. As the mixture solidifies, ions of the different metals are scattered through the lattice and bound by the delocalized electrons, so they contain metallic bonds.

***Production of alloys is possible due to non-directional nature of the delocalized electrons, and the fact that the lattice can accommodate ions of different size.***

The alloy is often more chemically stable, and also often stronger and more resistant to corrosion.

**Question**

**In terms of structure explain why alloys are stronger than pure metal**



