

Qualitative Analysis (Separate)

* Indicates that these are some examples only: you could be asked about any substance / reaction.

5.1—Typical properties of transition metals

Transition metals tend to:

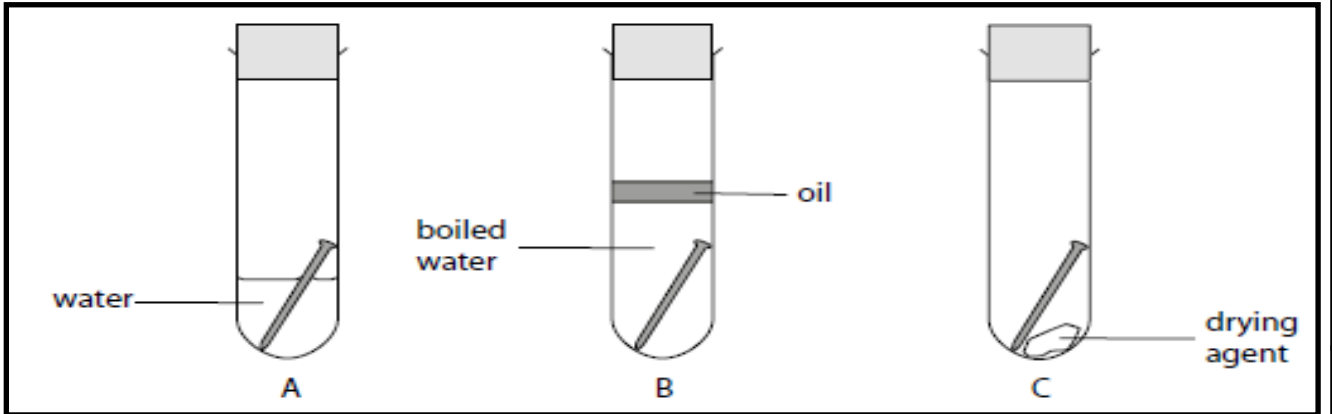
- a) have **high** melting points (due to the strong **electrostatic** forces between the positive **cations** and sea of delocalised **electrons** needing **high** amounts of energy to overcome them).
- b) have **high** density.
- c) form **coloured** compounds (non-transition metals tend to form **white** compounds).
- d) act as **catalysts** for reactions. Different reactions will have different **catalysts**.

5.2—Corrosion of metals

Corrosion is caused by metals being **oxidised**, often by reaction with **oxygen** in the air and in water

5.3—Prevention of rusting

The **only** metal that can rust is **iron**. Other metals are said to corrode.



In the diagram, only the nail in test tube **A** will rust. This is because it is exposed to both **oxygen** and **water**.

The nail in test tube **B** is not exposed to **oxygen**, so cannot rust (boiling water removes any dissolved gases from it).

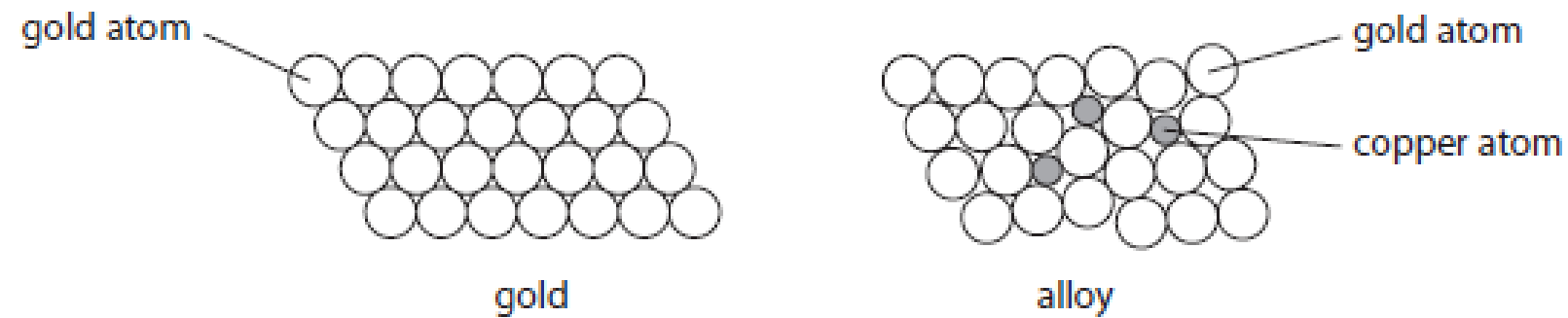
The nail in test tube **C** is not exposed to **water**, so cannot rust (the drying agent absorbs moisture).

5.4—Electroplating

Electroplating is using the process of **electrolysis** to coat one metal in another. There are two main reasons:

- a) to improve the **appearance** by coating in a more expensive (and often less **reactive**) metal. This often happens for metals that are used in **jewellery**: they are made of a cheaper metal, such as steel, then covered with **gold** or **silver**.
- b) to improve the resistance to **corrosion** by coating in a more reactive metal (this is known as sacrificial protection). **Zinc** metal is often used for this, in a process known as **galvanising**. The more reactive **zinc** is coated over a less reactive metal, such as iron. The top layer **corrodes** first, meaning the metal structure of the iron lasts longer.

5.5—Alloying



In pure metals, all the metal cations are the **same** size. This means that, when a force is applied, the **layers** of cations can **slide** easily, making pure metals very **malleable**. *NB. You can interchange the word cations for atoms in this description.* (The electrons still hold the cations together, which is why the metal doesn't break).

In alloys, some of the cations are **different** sizes. This **distorts** the regular arrangement, so the layers cannot **slide** as easily, making alloys **stronger** than pure metals.

5.6—Steels

Steels are alloys made by mixing **iron** with other metals, or with **carbon**. The resulting steel's properties depends on the types of metals (and/or carbon) which has been added, as well at the amount of each.

Stainless steel is often used in cutlery and professional cookware. The iron is mixed with metals such as chromium. The chromium reacts with **oxygen** in air and water to produce a cover of chromium oxide, which prevents the **iron** from reacting with the **oxygen**. When it is scratched, more chromium reacts.

Mild steel is made by mixing iron with small amounts of carbon. It is relatively **strong**, but fairly easy to **shape**. It is used in **construction** and for making car **body** panels.

Alloy steels are harder still than mild steel, and can be used for lots of uses, depending on the properties of the specific alloy.

5.7—Uses of metals lined to their properties

<u>Metal</u>	<u>Density, g cm⁻³</u>	<u>Relative strength</u>	<u>Resistance to corrosion</u>	<u>Relative electrical conductivity</u>
Aluminium	2.70	1.0	Very good	1.8
Copper	8.92	1.7	Very good	2.0
Gold	19.3	1.1	Excellent	1.9
Magnalium (Mg/Al alloy)	2.5	3.8	Very good	1.2
Brass (Cu/Zn alloy)	8.55	2.2	Good	1.6

Aluminium is used in overhead **electrical** cables: although it is not as good a **conductor** as copper, it is far less **dense**. Its low **density**, as well as its resistance to **corrosion**, is also the reason that it is used to make food and drinks **cans**. Both copper and gold have very high resistance to **corrosion** and are very good electrical **conductors**. **Copper** tends to be used in electrical wires, however, as it is much **cheaper**.

Magnalium is used for **aircraft** parts, due to its very high **strength**, **resistance** to corrosion and low **density**. Brass is used to make plug pins, rather than pure copper, due to its higher **strength**.

NB. The values used here are used for illustrative purposes only: they do not necessarily bear reference to actual values.