Comparison with Group 1 elements

4.1.3.1 · Atomic structure and the periodic table · revision notes

How the transition metals (the central block, e.g. Cr, Mn, Fe, Co, Ni and Cu) compare with the Group 1 metals in melting point, density, strength, hardness and reactivity with oxygen, water and halogens. This is in GCSE Chemistry only, not in Combined Science. Questions often give data to compare.

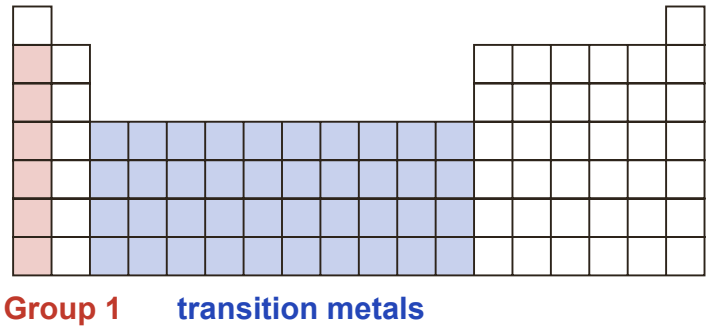
Key facts

- Transition metals: central block of the periodic table (examples: Cr, Mn, Fe, Co, Ni, Cu)
- Compared with Group 1: much higher densities (Li, Na and K float on water)
- Compared with Group 1: much less reactive with oxygen, water and halogens
- Compared with Group 1: much higher melting points
- Compared with Group 1: stronger and harder (Group 1 metals can be cut with a knife)

Notes

What the transition metals are

- The **transition metals** (transition elements) are in the central block of the periodic table, between Group 2 and Group 3.

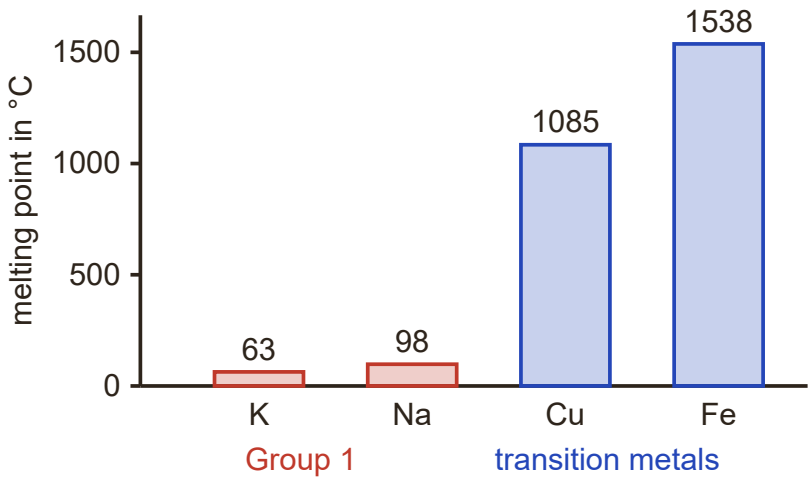


The transition metals are the central block, between Group 2 and Group 3.

- The examples you need are chromium (Cr), manganese (Mn), iron (Fe), cobalt (Co), nickel (Ni) and copper (Cu).
- They are metals with similar properties to each other, which are different from the properties of the Group 1 metals.

Physical properties compared with Group 1

- **Melting point**: transition metals have much higher melting points (iron about 1540 °C) than Group 1 metals (sodium about 98 °C).



Transition metals melt at far higher temperatures than Group 1 metals.

- **Density**: transition metals have much higher densities (copper about 9 g/cm^3). Lithium, sodium and potassium are less dense than water (1 g/cm^3), so they float.
- **Strength and hardness**: transition metals are strong and hard. Group 1 metals are soft and can be cut with a knife.

Reactivity compared with Group 1

- **Water**: Group 1 metals react vigorously with cold water, forming hydrogen and an alkaline solution. Transition metals react very slowly or not at all: copper does not react, and iron only rusts slowly when both water and oxygen are present.
- **Oxygen**: Group 1 metals tarnish quickly in air, so they are stored under oil. Transition metals react only slowly with oxygen at room temperature.
- **Halogens**: Group 1 metals react vigorously. Transition metals react less vigorously and usually need heating, e.g. hot iron wool reacts with chlorine to form iron(III) chloride.
- So transition metals are much **less reactive** than Group 1 metals. Together with their strength, this makes them useful for structures, pipes and tools.

How to answer each type of question

Compare transition metals with Group 1 using data

2 to 4 marks | Grade 6

1. Pick out each property in the table.
2. Make a comparison for each one using a comparative word (higher, denser).
3. Quote a pair of values, with units, to support each comparison.

Example. The table gives data for four metals.

Metal	Melting point in °C	Density in g/cm^3
potassium	63	0.86
sodium	98	0.97
nickel	1455	8.9
iron	1538	7.9

Use the data to compare the transition metals with the Group 1 metals.

Model answer. Transition metals have much higher melting points, e.g. iron 1538 °C compared with sodium 98 °C (1). Transition metals have much higher densities, e.g. nickel 8.9 g/cm^3 compared with potassium 0.86 g/cm^3 (1). The Group 1 metals are less dense than water, so they float, but the transition metals would sink (1).

Compare the reactivity of a transition metal and a Group 1 metal

2 to 3 marks | Grade 5

1. Describe what the Group 1 metal does, including the products.
2. Describe what the transition metal does (slowly, or no reaction).
3. Use a comparative word: more vigorous, less reactive.

Example. Compare the reactions of sodium and iron with cold water.

Model answer. Sodium reacts vigorously with cold water (1), producing hydrogen and sodium hydroxide, an alkaline solution (1). Iron has no visible reaction with cold water; it only rusts slowly when oxygen is also present, so it is much less reactive (1).

Explain a use from the properties

2 marks | Grade 7

1. Link each property to what the use needs.
2. If asked about a Group 1 metal as well, say why it would not be suitable.

Example. Copper is used for hot water pipes. Sodium could not be used.
Explain why, using the properties of the two metals.

Model answer. Copper does not react with water, but sodium reacts vigorously with water (1). Copper is strong and hard with a high melting point, but sodium is soft with a low melting point (98 °C) (1).

Predict the properties of a transition metal

2 marks | Grade 5

1. Use the general properties of transition metals.
2. Make each prediction a comparison with the Group 1 metal named.

Example. Manganese is a transition metal.
Predict **two** ways in which the properties of manganese are different from those of potassium.

Model answer. Any two: manganese has a higher melting point (1); a higher density (1); it is harder / stronger (1); it is less reactive, e.g. with water or oxygen (1).

Don’t lose marks

- Saying transition metals do not react at all. Most react slowly: iron rusts, and hot iron reacts with chlorine.
- Describing only one group when the question asks you to compare.
- Not quoting data when the question says 'use the data'.
- Mixing up density with hardness or strength.

More tips

Memory tricks

- Group 1 metals are soft, light, low-melting and very reactive; transition metals are hard, dense, high-melting and much less reactive.
- We build with transition metals (iron, copper); we store Group 1 metals under oil.
- Think of a steel bridge compared with a knife cutting through sodium.

Exam technique

- 'Compare' needs a comparative word (higher, denser, less reactive) and a statement about both types of metal.
- Quote numbers with their units: 1538 °C, 7.9 g/cm^3.
- Stick to the properties in the specification: melting point, density, strength, hardness and reactivity with oxygen, water and halogens.

What each grade needs

What you need to be able to do, from the first marks up to the top grade.

Grade 3

Locate the transition metals in the table

They are the central block, between Group 2 and Group 3.

Grade 4

Compare melting points and densities

Transition metals have much higher melting points and densities than Group 1 metals.

Grade 4

Compare strength and hardness

Transition metals are strong and hard; Group 1 metals are soft enough to cut with a knife.

Grade 5

Compare reactivity with oxygen, water and halogens

Group 1 metals react vigorously; transition metals react slowly, or not at all, at room temperature.

Grade 6

Use data to compare the two groups

Quote values from a table, with units, to support each comparison.

Grade 7

Explain a metal's use from its properties

e.g. copper is used for water pipes because it does not react with water and is strong.

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