88. Properties of the transition metals and their compounds

Topic
The periodic table, transition metals.

Timing
60 min.

Description
Students extend their knowledge of the Periodic Table by examining the transition metals and their compounds.

Apparatus and equipment (per group)
- Test-tubes
- Access to a bar magnet
- Dropping pipette. Use the type of teat pipette (usually fitted to Universal Indicator bottles) that does not allow squirting – eg Griffin.

Chemicals (per group)
- Samples of some transition metals (copper, iron, nickel, zinc)
- Access to solutions of:
  - Copper(II) sulfate \(0.01 \text{ mol dm}^{-3}\)
  - Iron(III) chloride \(0.1 \text{ mol dm}^{-3}\) (Irritant)
  - Nickel(II) chloride \(0.1 \text{ mol dm}^{-3}\)
  - Ammonia solution \(2 \text{ mol dm}^{-3}\)

As many solid samples of transition metal compounds as possible in closed containers for observation of colours.

Teaching tips
This experiment is a good test of observational skills, and students’ attention could be drawn to this. In the reaction with water very little happens and when forming the complexes some colour changes could be missed.

If students have not used an inverted filter funnel over a metal sample with an inverted test-tube to collect any gas produced then some discussion may be required.

Background theory
Knowledge of the reactions of Group 1 metals with water for comparison.
Safety

Wear eye protection.

The transition metal compounds may be harmful or irritant, as may their solutions, depending on the concentration.

Ammonia vapour irritates eyes, lungs and the respiratory system

Answers

1. They are hard, dense and shiny. They are good conductors of heat and electricity. They are also malleable and ductile.
2. Transition metals react with water very slowly, if at all.
3. As well as the above they also form coloured compounds. They form compounds that can have more than one formula.
Properties of the transition metals and their compounds

Introduction

The Periodic Table allows chemists to see similarities and trends in the properties of chemical elements. This experiment illustrates some properties of the common transition elements and their compounds.

What to record

What was observed. A table may be useful.

What to do

1. Test the metal samples for hardness and ability to bend without breaking. Complicated apparatus is not needed for this! Record your answers qualitatively.
2. Find out which samples are magnetic.
3. Set up an experiment to see if the metals react with water. (This may need to be left for some time).
4. Take a small sample of a solution of copper(II) sulfate (approximately 2 cm³), add ammonia solution to it a few drops at a time. Record your observations. Add ammonia solution until there is no further change.
5. Repeat with the other solutions of transition metal compounds.
Safety

Wear eye protection.
The transition compounds may be harmful or irritant.
Ammonia vapour irritates eyes, lungs and the respiratory system.

Questions

1. Describe the physical properties of transition metals.
2. How do transition metals react with water?
3. What properties do the compounds of transition metals have in common?