The transition elements – student sheet

The purpose of this experiment is to examine some of the solution chemistry of the transition elements.

In particular, you will be looking for evidence of complex formation and change in oxidation state – two important general characteristics of transition elements.

You must wear eye protection.

Instructions

1. Cover the worksheet with a clear plastic sheet.
2. Put two separate drops of the solutions of each of the elements from vanadium to zinc in the appropriate boxes. Observe and comment.
3. Do the experiments for each solution of each element as described below on one of the drops in each box only (the other drop will act as a reference). In each case, observe carefully and try to give explanations for your observations.

Vanadium (V)	Add one drop of dilute hydrochloric acid and a small piece of zinc.
Chromium (Cr)	Add one drop of silver nitrate solution.
Manganese (Mn)	Add one drop of iron(II) solution.
Iron (Fe)	Add one drop of potassium iodide solution. After one minute, add one drop of starch test solution.
Cobalt (Co)	Add one drop of ammonia solution.
Copper (Cu)	Add one drop of ammonia solution.
Zinc (Zn)	Add two drops of sodium hydroxide solution.

Solutions of transition metal ions	**V**	**Cr**	**Mn**	**Fe**	**Co**	**Cu**	**Zn**

Questions

1. Which element among the ones that you have tested does not behave as a transition element?
2. Why is this?

Health, safety and technical notes

- Wear eye protection throughout (splash-resistant goggles to BS EN166 3).
- Potassium chromate, K_2CrO_4, 0.2 mol dm^{-3} is a carcinogen, mutagen and skin sensitiser. It is also toxic to aquatic life. Wear splash-proof eye protection if transferring large amounts. Avoid skin contact.
- Potassium manganate(VII), 0.2 mol dm^{-3} is hazardous to the aquatic environment. Avoid direct contact and store in the dark, stains glass, plastic, clothing and skin.
- Ammonia solution, $NH_3(aq)$, 3 mol dm^{-3} is CORROSIVE and a respiratory irritant.
- Ammonium vanadate(V), NH_4VO_3, 0.2 mol dm^{-3} (acidified with sulfuric acid) is a mutagen and very TOXIC if inhaled (but not by other routes).
- Sodium hydroxide solution, NaOH(aq), 1 mol dm^{-3} is CORROSIVE.
- Cobalt nitrate, 0.5 mol dm^{-3} is a carcinogen, mutagen, reproductive toxin, skin and respiratory sensitiser and hazardous to the aquatic environment.
- Copper(II) sulfate solution, $CuSO_4(aq)$, 0.2 mol dm^{-3} causes eye damage and is hazardous to the aquatic environment.
- Silver nitrate, $AgNO_3(aq)$, 0.1 mol dm^{-3} is a skin/eye irritant. Keep separate from organic waste containers.
- Zinc powder, Zn(s) is FLAMMABLE and hazardous to the aquatic environment.
- The following are of low hazard:
    - Hydrochloric acid, HCl(aq), 1 mol dm^{-3}
    - Potassium thiocyanate, KSCN(aq), 0.1 mol dm^{-3}
    - Potassium iodide, 0.2 mol dm^{-3}
    - Starch solution
    - Iron(III) nitrate, $Fe(NO_3)_3.9H_2O(aq)$, 0.2 mol dm^{-3}
    - Iron(II) sulfate, $FeSO_4.7H_2O(aq)$, 0.2 mol dm^{-3}