

Chromium, molybdenum and tungsten – student sheet

In this experiment you will be looking at a group of transition elements chromium, molybdenum and tungsten. Follow the instructions below recording all your observations and try to give explanations where possible.

Procedure

1. Cover the worksheet with a clear plastic sheet.
2. Put one drop of each of the metal ion solutions in the appropriate boxes in the column headed ion. Observe and comment.
3. Put one drop of each of the metal ion solutions in the appropriate boxes in the remaining two columns.
4. Add one drop of hydrochloric acid to each drop in the column headed hydrochloric acid solution. Observe carefully, noting any changes over the next few minutes.
5. Add one drop of iron(II) solution to each drop in the column headed solution of iron(II) ions.
6. Add one drop of sodium hydroxide solution to the chromium drop in the box in the hydrochloric acid solution column. Observe any changes.

Element	Ion	Hydrochloric acid solution	Solution of iron(II) ions
Chromium (Cr)	CrO_4^{2-}		
Molybdenum (Mo)	$\text{Mo}_7\text{O}_{24}^{6-}$		
Tungsten (W)	WO_4^{2-}		

Questions

1. Using a data book if necessary, can you explain why these three elements are placed in the same group in the transition metal block? (Hint: Consider how the atomic structures of the alkali metals are similar to each other.)
2. Can you write an equation to explain the colour changes observed on adding acid or alkali to the chromium solution?

Health, safety and technical notes

Students must wear suitable eye protection – (splash proof goggles to BS EN166 3). Potassium chromate, 0.2 M KCrO_4 is a carcinogen, mutagen and skin sensitiser as well as a skin/eye irritant. Explosive or vigorous-burning mixtures can be formed with Aluminum and other metals and combustible materials.

Hydrochloric acid, 1 mol dm⁻³ HCl (aq), Ammonium molybdate, 0.05 mol dm⁻³ (NH₄)₆Mo₇O₂₄•4H₂O (aq), Sodium tungstate, 0.2 mol dm⁻³ Na₂WO₄•2H₂O (aq) and Iron(II) sulphate, 0.2 mol dm⁻³, FeSO₄•7H₂O (aq) are of low hazard.
Sodium hydroxide solution, 1 mol dm⁻³ NaOH (aq), is CORROSIVE.