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Nickel and its compounds

Electron configuration

$[Ar]4s^2 3d^8$

Properties as a transition element

a) Forms colored compounds; for instance Ni^{2+} is green
b) Has variable oxidation states; +2, +3,
c) Forms complexes, e.g. $Ni(NH_3)_6^{2+}$.
d) Catalytic property: it is a catalyst in hydrogenation of alkenes, alkyne

Physical Properties

Nickel is a hard metal that is quite lustrous. It melts at 1452^0C and has a density of 8.90 $g\ cm^{-3}$. Nickel is used in making of alloys, electroplating of materials; and as a catalyst in the hydrogenation of fats and in making synthesis gas.

Reaction of air with nickel:
It reacts slowly at ordinary temperature but vigorously at high temperature to form nickel oxide
$2Ni(s) + O_2(g) \rightarrow 2NiO(g)$

Action of water:

Nickel decomposes steam at red heat to hydrogen
$Ni(s) + H_2O(g) \leftrightarrow NiO(s) + H_2(g)$

Action of acids:

Dilute hydrochloric acid sulphuric acids have slow action on nickel.
But nitric acid readily dissolves the metal.
$3Ni(s) + 8HNO_3(aq) \rightarrow 3Ni(NO_3)_2(aq) + 2NO(g) + 4H_2O(l)$

Action of halogen:
Chlorine reacts with nickel to form nickel (II) chloride.
$Ni(s) + Cl_2(g) \rightarrow NiCl_2(s)$

Action of sulphur

Sulpur reacts with nickel to form nickel sulphide
$Ni(s) + S(s) \rightarrow NiS(s)$

Qualitative analysis f nickel II ions
Common nickel II salts
Nickel (II) sulphate, $NiSO_4.7H_2O$
Nickel (II) carbonate, $NiCO_3$
$(NH_4)_2SO_4.NiSO_4.6H_2O$

Addition of dilute sodium hydroxide
Forms a green precipitate insoluble in excess
$Ni^{2+}(aq) + 2OH^-(aq) \rightarrow Ni(OH)_2(s)$

Addition of dilute ammonia solution
Forms a green precipitate soluble in excess
$Ni^{2+}(aq) + 2OH^-(aq) \rightarrow Ni(OH)_2(s)$
Then
$Ni(OH)_2(s) + 6NH3(aq) \rightarrow Ni(NH_3)_6^{2+}$

Confirming Ni^{2+} ions
Forms a pink ppt on addition of a few drops of ammonia followed by dimethylglyoxime.

Trial 1
When a pale green solid was heated, it decomposed to a green solid, Q, and a gas that turned lime water milky was evolved. Q dissolved in dilute nitric acid to give a green solution, R. On addition of dilute sodium hydroxide solution to R, a green precipitate, S, insoluble in excess alkali was obtained. S dissolved in aqueous ammonia to give a purplish blue solution.

(a) Identify compounds P, Q, S and solution R. (4 marks)
(b) Write equations for the reactions between;
(i) Q and nitric acid. (1½ marks)
(ii) R and sodium hydroxide.(1½ marks)
(iii) S and ammonia. (2 marks)