

CM 1111 Tutorial 7

Question 1

Give the oxidation state of each element in the following compounds and ions:

- a) HF +I, -I
- b) FeCl₂ +II, -I
- c) XeF₆ +VI, -I
- d) Na₂SO₄ +I, +VI, -II
- e) PO₄³⁻ +V, -II
- f) [Cr(OH₂)₆]³⁺ +III, -II, +I
- g) Co₃O₄ +II (1 Co) , +III (2 Co), -II

Question 2

Which of the following reactions are redox-reactions? In those that are, identify the oxidation and reduction processes.

- a) N₂ + 3 Mg → Mg₃N₂ yes; Red: N⁰/N^{-III}; Ox: Mg⁰/Mg^{II}
- b) N₂ + O₂ → 2 NO yes; Red: O⁰/O^{-II}; Ox: N⁰/N^{II}
- c) 2 NO₂ → N₂O₄ no; simple dimerization: N^{IV} and O^{-II} on both sides
- d) SbF₃ + F₂ → SbF₅ yes; Red: F⁰/F^{-I}; Ox: Sb^{III}/Sb^V
- e) 6 HCl + As₂O₃ → 2 AsCl₃ + 3 H₂O no; Oxidation states remain the same
- f) 2 CO + O₂ → 2 CO₂ yes; Red: O⁰/O^{-II}; Ox: C^{II}/C^{IV}

Question 3

Perchloric acid HClO₄ is not only a strong acid, but also a strong oxidizer.

- a) What are the oxidation states of H, Cl and O in this compound? (+I, +VII, -II)
- b) Explain why perchlorates are explosion hazards and strong oxidizers.

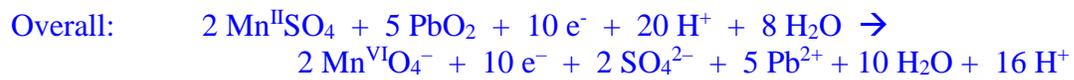
Cl atom is in an unusually high oxidation state of +VII. The most favorable oxidation state for Cl is -I, which is in line with its relatively high electronegativity and also fulfills the octet rule. In order to achieve this electron configuration, the Cl atom in perchlorate needs 8 electrons, which explains the strong oxidizing power.

Question 4

A few drops of an almost colorless solution of MnSO₄ was added to an orange suspension of PbO₂ in 5 mL half-concentrated HNO₃. Heating the mixture for a few minutes leads to a color change to dark-violet indicative of MnO₄⁻. Briefly explain what has happened and give the complete equation.

Mn²⁺ (colorless) has been oxidized to Mn⁷⁺ (dark-violet) by losing 5 electrons. Thus Pb⁴⁺ must be the oxidizer that accepts 2 electrons to form Pb²⁺ (refer to listed redox-potentials in books or other references). Since this reaction takes place in half-concentrated nitric acid, there must be protons available for balancing the charges in the equation.





After “eliminating” e^- , H_2O and H^+ on both sides:



With inclusion of nitrate anion:

