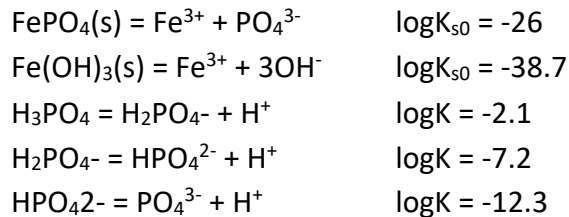


## Precipitation and dissolution, redox

### 1) Iron precipitation

A wastewater contains  $10^{-4}$  M phosphate. Fe(III) is added to the system to precipitate phosphate. Is  $\text{FePO}_4(\text{s})$  or  $\text{Fe}(\text{OH})_3(\text{s})$  precipitated at  $\text{pH}=7$ ?



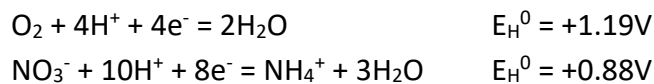
### 2) Oxidation numbers

Assign the oxidation numbers to each atom in the following compounds:

$\text{NO}_3^-$ ,  $\text{N}_2\text{O}$ ,  $\text{SCN}^-$ ,  $\text{SO}_3^{2-}$ ,  $\text{SO}_4^{2-}$ ,  $\text{CH}_4$ ,  $\text{CO}_2$ ,  $\text{CH}_3\text{OH}$ ,  $\text{C}_6\text{H}_6$ ,  $\text{C}_6\text{H}_5\text{OH}$

### 3) Reduction potentials

Derive the overall reaction and the direction of the reaction from the following half reactions:



a) Calculate the  $\Delta E^0$  for the overall redox reaction.

b) The  $E_{\text{H}}^0$  values are given for  $\text{pH} = 0$ . Calculate the standard reduction potentials at  $\text{pH}=7$ . What is  $\Delta E^0(\text{W})$  for the overall reaction at  $\text{pH} 7$ ?

c) What is the Gibbs free energy of this process at  $\text{pH} 7$ ? Is this reaction thermodynamically feasible?

d) What is this process called? Where does this process occur and what effects does it have on the environment?

### 4) pe-pH diagram for As

Construct the pe-pH diagram for the following As species. Use  $\text{pO}_2 = 0.2$ .

As species	Reaction	log(K)
As(5)	$\text{H}_2\text{AsO}_4^- = \text{HAsO}_4^{2-} + \text{H}^+$	-6.76
As(3)	$\text{H}_3\text{AsO}_3 = \text{H}_2\text{AsO}_3^- + \text{H}^+$	-9.23
As(5)/As(3)	$\text{H}_3\text{AsO}_3 + \text{H}_2\text{O} = \text{H}_2\text{AsO}_4^- + 3 \text{H}^+ + 2\text{e}^-$	-21.14

