Chem 130, Eppley

KEY

In Class 11: Redox Reactions

Assign the oxidation states of all the elements in the following compounds:

Ti	$CrPO_4$	KHC_2O_4	$CuCl_4^{2-}$	K_3FeCl_6	SF_4
Ti 0	Cr +3 P +5 O −2	K +1 H +1 C +3 O −2	Cu +2 Cl −1	K +1 Fe +3 Cl −1	S +4 F −1

For the following incomplete redox reaction, fill in the blanks in the reaction with plausible products. **Label the oxidizing agent, reducing agent, and "conjugate" oxidizing agent and reducing agent. Your tables will help you predict possible products! Note that the reaction does not have to be balanced! Predict whether the reaction is favorable or not based on the reduction potentials.**

one possible

reduced oxidizing agent: Co^{3+} + oxidized reducing agent: Mn^{2+} → "conj" oxid. agent: MnO_2 + "conj" reducing agent: Co^{2+}

$E^\circ_{red} = 1.92V$ $E^\circ_{ox} = -1.23V$ $E^\circ_{red} = 1.23V$

$E^\circ_{rxn} = 1.92V - 1.23V = 0.69V$

>0 ∴ spontaneous (favored reaction)

Explain the following statement related to redox using equations, calculations, and words!

Cu metal "dissolves" (i.e. undergoes redox) in HNO_3 but not in HCl (note: upon dissolution a blue aqueous solution forms!).

E°_{rxn} (−) $Cu + HCl \rightarrow Cu^{2+} + H_2$

oxidized Cu, $E^\circ_{ox} = -.342V$; $H^+ \rightarrow H_2$ reduced, $E^\circ_{red} = 0.00V$

$E^\circ_{rxn} = 0 + -.342V$
$= -.342V$
<0 ∴ not spontaneous

E°_{rxn} (+) $Cu + HNO_3 \rightarrow Cu^{2+} + NO$ + etc.

oxidized Cu, $E^\circ_{ox} = -.342V$; H^+ $E^\circ_{red} = 0$; NO_3^- $E^\circ_{red} = 0.96V$ ← easier to reduce

$E^\circ_{rxn} = 0.96V - 0.342V = 0.618V$
>0 ∴ favored

Extra problem:

$Cr^{3+} + MnO_4^- \rightarrow Cr_2O_7^{2-} + MnO_2$

Cr^{3+}: oxidized reducing agent; MnO_4^-: reduced oxidizing agent; $Cr_2O_7^{2-}$: conj oxid. agent; MnO_2: conj reducing agent

>0 ∴ favored!

$E^\circ_{rxn} = E^\circ_{red} + E^\circ_{ox}$
(MnO_4^-) (Cr) $1.637V$ $1.33V$
$= 0.307V$