

## d) Spontaneous vs. Non-Spontaneous

### i) Definitions:

When an oxidizing and reducing agent are mixed there are two possible outcomes:

Spontaneous - The reactants will spontaneously start to react in a redox reaction

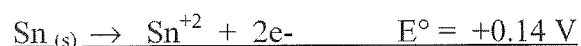
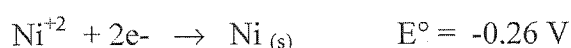
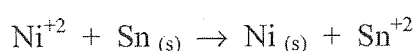
Non-Spontaneous - The reactants will not react or will only react in reverse.

### ii) Predicting – Method A

Overall  $E^\circ_{\text{cell}}$  is positive (+), reaction is spontaneous

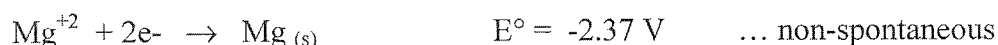
Overall  $E^\circ_{\text{cell}}$  is negative (-), reaction is non-spontaneous

### iii) Example: Will a redox reaction proceed if $\text{Ni}^{+2}$ is mixed with $\text{Sn}_{(s)}$ ?



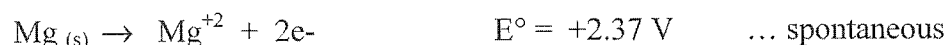
$$E^\circ_{\text{cell}} = -0.12 \text{ V} \quad \text{NO! Non-spontaneous}$$

### iv) Example: Will $\text{Mg}^{+2}$ undergo oxidation, reduction or no reaction?



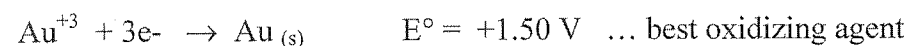
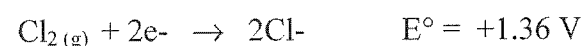
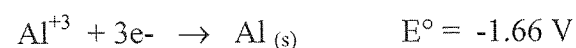
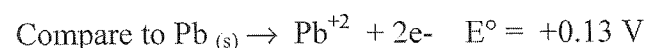
NO reaction!

### v) Example: Will $\text{Mg}_{(s)}$ undergo oxidation, reduction or no reaction?



Thus,  $\text{Mg}_{(s)}$  will undergo oxidation.

### vi) Example: Which of $\text{Fe}^{+3}$ , $\text{Al}^{+3}$ , $\text{Cl}_2(g)$ , or $\text{Au}^{+3}$ will best oxidize $\text{Pb}_{(s)}$ ?



### vii) Predicting – Method B

If oxidizing agent is higher in table than reducing agent – Spontaneous

If both species are oxidizing agents – Non-spontaneous

If both species are reducing agents – Non-spontaneous

If reducing agent is higher in table than oxidizing agent – Non-spontaneous