KNOCKHARDY NOTES

A LEVEL CHEMISTRY

ELECTRODE POTENTIALS

A T A G L A N C E

THE ELECTROCHEMICAL SERIES

- Species are arranged in order of their standard electrode potentials
- **All equations are written as reductions ...** gaining electrons

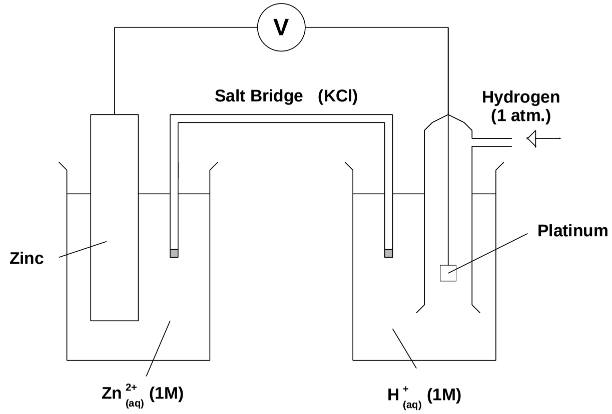
$F_{2(g)} + 2e^-$	$\rightleftharpoons$	$2F^-_{(aq)}$	+2.87 V
$MnO_4^-{}_{(aq)} + 8H^+_{(aq)} + 5e^-$	$\rightleftharpoons$	$Mn^{2+}_{(aq)} + 4H_2O_{(l)}$	+1.52 V
$Cl_{2(g)} + 2e^-$	$\rightleftharpoons$	$2Cl^-_{(aq)}$	+1.36 V
$Cr_2O_7^{2-}{}_{(aq)} + I4H^+_{(aq)} + 6e^-$	$\rightleftharpoons$	$2Cr^{3+}_{(aq)} + 7H_2O_{(l)}$	+1.33 V
$Br_{2(l)} + 2e^-$	$\rightleftharpoons$	$2Br^-_{(aq)}$	+1.07 V
$Fe^{3+}_{(aq)} + e^-$	$\rightleftharpoons$	$Fe^{2+}_{(aq)}$	+0.77 V
$I_{2(s)} + 2e^-$	$\rightleftharpoons$	$2I^-_{(aq)}$	+0.54 V
$Cu^{2+}_{(aq)} + 2e^-$	$\rightleftharpoons$	$Cu_{(s)}$	+0.34 V
$2H^+_{(aq)} + 2e^-$	$\rightleftharpoons$	**$H_{2(g)}$**	**0.00 V**
$Fe^{2+}_{(aq)} + 2e^-$	$\rightleftharpoons$	$Fe_{(s)}$	-0.44 V
$Zn^{2+}_{(aq)} + 2e^-$	$\rightleftharpoons$	$Zn_{(s)}$	-0.76 V

- **Highest positive value = best oxidising agent**
- **A species with a more positive potential (E° value) will oxidise one** (reverse the equation) **with a lower E° value**

e.g. $Cr_2O_7^{2-}$ (E° = +1.33V) **will oxidise** **Br^- to Br_2** (E° = +1.07V)
and **I^- to I_2** (E° = +0.54V)
BUT NOT **Cl^- to Cl_2** (E° = +1.36V)

By combining half equations and their E° values you can predict whether, or not, a redox reaction will take place. In theory, a redox ***reaction should proceed if the E° value is positive.*** *In reality, it has to be greater than about +0.40V.*

STANDARD HYDROGEN ELECTRODE



temperature	298K (25°C)
solution conc.	1M (1 mol dm^{-3}) with respect to H^+ ions
gases	1 atmosphere pressure
E° value	0.00V.
salt bridge	filled with saturated potassium chloride solution; it enables the circuit to be completed

CELL DIAGRAMS

These give a diagrammatic representation of what is happening in a cell.

V

$Zn_{(s)} \;\vdots\; Zn^{2+}_{(aq)} \;\|\; Cu^{2+}_{(aq)} \;\vdots\; Cu_{(s)}$

ANODE CATHODE

- Place the half cell with the more positive E° value on the RHS.
  Draw it out as shown to indicate that ...
- the cell **reaction goes from left to right**
- the **electrons go round the external circuit from left to right**
- the **cell voltage is E°(RHS) - E°(LHS)**. *In this way it must be positive*
- **oxidation** takes place **at the anode**, reduction at the cathode