

Redox potentials, Cell Diagrams and EMF. Hydrogen–Oxygen Fuel Cell.

AIM

We are learning to:

- write cell diagrams
- work out e.m.f. of a cell from Redox potentials
- combine half–equations to write an overall equation

QUESTION

Use the following data to write the cell diagram, work out the e.m.f. and write the overall equation for the reaction of a hydrogen–oxygen fuel cell in alkaline conditions.

Half-equation	E° / V
$\text{O}_2(\text{g}) + 4\text{H}^+(\text{aq}) + 4\text{e}^- \rightleftharpoons 2\text{H}_2\text{O}(\text{l})$	+1.23
$\text{O}_2(\text{g}) + 2\text{H}_2\text{O}(\text{l}) + 4\text{e}^- \rightleftharpoons 4\text{OH}^-(\text{aq})$	+0.40
$2\text{H}^+(\text{aq}) + 2\text{e}^- \rightleftharpoons \text{H}_2(\text{g})$	0.00
$2\text{H}_2\text{O}(\text{l}) + 2\text{e}^- \rightleftharpoons 2\text{OH}^-(\text{aq}) + \text{H}_2(\text{g})$	–0.83

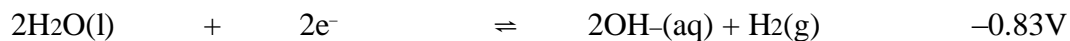
Which half equations do we need?

Conventions

The more **Positive** electrode will proceed in the **Forward** direction...

...this is **Reduction** and goes on the **Right** in the cell diagram.

WORKING THROUGH THE EXAMPLE

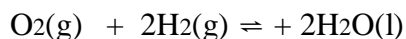
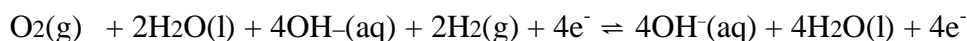
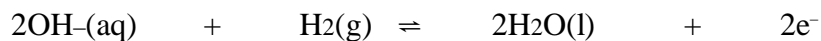


"hydrogen and hydroxide become water" "oxygen and water become hydroxide"



E.M.F =

To write out full equation, re-write with more negative electrode reversed



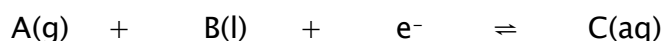
SUMMARY

to write the cell diagram

1) the more **Positive** electrode will proceed in the **Forward** direction

this is **Reduction** and goes on the **Right** in the cell diagram

2) to write out the electrodes



OX

read as "C becomes A and B"

write as Pt | C(aq), [A(g) + B(l)]

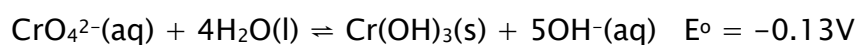
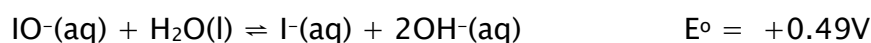
RED

read as "A and B become C"

write as [A(g) + B(l)], C(aq) | Pt

ASSESSMENT

What would the cell diagram be for the cell with e.m.f. +0.62V which would occur if these two half cells were joined under standard conditions?



- A** Pt | [CrO₄²⁻(aq) + 4H₂O(l)], [Cr(OH)₃(s) + 5OH⁻(aq)] || [I⁻(aq) + 2OH⁻(aq)], [IO⁻(aq) + H₂O(l)] | Pt
- B** Pt | [CrO₄²⁻(aq) + 4H₂O(l)], [Cr(OH)₃(s) + 5OH⁻(aq)] || [IO⁻(aq) + H₂O(l)], [I⁻(aq) + 2OH⁻(aq)] | Pt
- C** Pt | [Cr(OH)₃(s) + 5OH⁻(aq)], [CrO₄²⁻(aq) + 4H₂O(l)] || [I⁻(aq) + 2OH⁻(aq)], [IO⁻(aq) + H₂O(l)] | Pt
- D** Pt | [Cr(OH)₃(s) + 5OH⁻(aq)], [CrO₄²⁻(aq) + 4H₂O(l)] || [IO⁻(aq) + H₂O(l)], [I⁻(aq) + 2OH⁻(aq)] | Pt

ANSWER: D