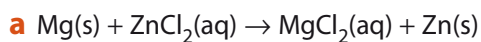


# Chapter 14

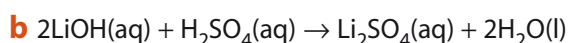
## Electrode potentials and fuel cells

Print out and complete this worksheet to generate a summary for Chapter 14.

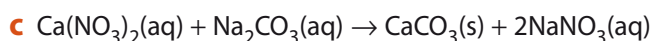
1 Write ionic equations for the following reactions:



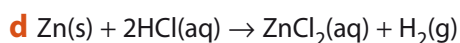
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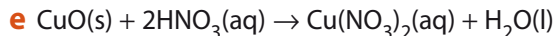
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2 Give the oxidation number of the element in bold in each of the following.



3 Explain what is meant by:

a oxidation

.....

## Chapter 14 Electrode potentials and fuel cells

**b** reduction

.....

**c** an oxidising agent

.....

**d** a reducing agent

.....

**4** Write a balanced half-equation, including electrons, for each of the following:

**a**  $\text{Mg(s)} \rightarrow \text{Mg}^{2+}(\text{aq})$

.....

**b**  $\text{Br}^{-}(\text{aq}) \rightarrow \text{Br}_2(\text{l})$

.....

**c**  $\text{Cr}^{2+}(\text{aq}) \rightarrow \text{Cr}^{3+}(\text{aq})$

.....

**d**  $\text{MnO}_4^{-}(\text{aq}) + \text{H}^{+}(\text{aq}) \rightarrow \text{Mn}^{2+}(\text{aq}) + \text{H}_2\text{O}(\text{l})$

.....

**e**  $\text{ClO}_3^{-}(\text{aq}) + \text{H}^{+}(\text{aq}) \rightarrow \text{Cl}^{-}(\text{aq}) + \text{H}_2\text{O}(\text{l})$

.....

**f**  $\text{SO}_2(\text{g}) + \text{H}_2\text{O}(\text{l}) \rightarrow \text{SO}_4^{2-}(\text{aq}) + \text{H}^{+}(\text{aq})$

.....

**5** Use your answers to Question 4 to construct an overall balanced equation for each of the reactions between:

**a**  $\text{Mg(s)}$  and  $\text{Br}_2(\text{l})$

.....

.....

.....

Balanced equation:

.....

**b**  $\text{Cr}^{2+}(\text{aq})$  and  $\text{MnO}_4^{-}(\text{aq}) + \text{H}^{+}(\text{aq})$

.....

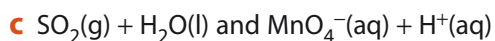
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Balanced equation:

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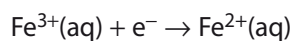
## Chapter 14 Electrode potentials and fuel cells



Balanced equation:

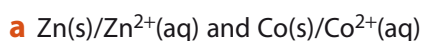
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- 6** Draw a fully labelled diagram to illustrate the measurement of the standard electrode potential of:

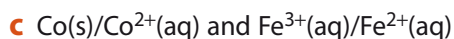
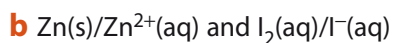


- 7** Use the electrode potentials in the table to determine the voltage produced by the three cells that follow.

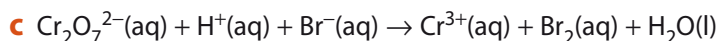
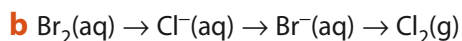
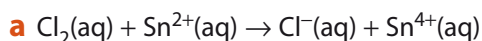
Reaction	$E^\circ/\text{V}$
$\text{Zn}^{2+}(\text{aq}) + 2\text{e}^- \rightleftharpoons \text{Zn}(\text{s})$	-0.76
$\text{Co}^{2+}(\text{aq}) + 2\text{e}^- \rightleftharpoons \text{Co}(\text{s})$	-0.28
$\text{Sn}^{4+}(\text{aq}) + 2\text{e}^- \rightleftharpoons \text{Sn}^{2+}(\text{aq})$	+0.15
$\text{I}_2(\text{aq}) + 2\text{e}^- \rightleftharpoons 2\text{I}^-(\text{aq})$	+0.54
$\text{Fe}^{3+}(\text{aq}) + \text{e}^- \rightleftharpoons \text{Fe}^{2+}(\text{aq})$	+0.77
$\text{Br}_2(\text{aq}) + 2\text{e}^- \rightleftharpoons 2\text{Br}^-(\text{aq})$	+1.09
$\text{Cr}_2\text{O}_7^{2-}(\text{aq}) + 14\text{H}^+(\text{aq}) + 6\text{e}^- \rightleftharpoons 2\text{Cr}^{3+}(\text{aq}) + 7\text{H}_2\text{O}(\text{l})$	+1.33
$\text{Cl}_2(\text{aq}) + 2\text{e}^- \rightleftharpoons 2\text{Cl}^-(\text{aq})$	+1.36



## Chapter 14 Electrode potentials and fuel cells



- 8** Use the electrode potential data from Question 7 to determine whether each of the following reactions is feasible:



- 9** For specialist use, a cell using lithium and fluorine has been proposed. The cell operates at temperatures of around  $500^{\circ}\text{C}$  using molten electrolytes. It gives a voltage of 5.26 V.

Use the data in the table to calculate the voltage produced under standard conditions.

Reaction	$E^{\circ}/\text{V}$
$\text{Li}^{+}(\text{aq}) + \text{e}^{-} \rightleftharpoons \text{Li}(\text{s})$	-3.03
$\text{F}_2(\text{g}) + 2\text{e}^{-} \rightleftharpoons 2\text{F}^{-}(\text{aq})$	+2.87

**Chapter 14 Electrode potentials and fuel cells**

- 10** Give two advantages and two problems associated with the use of a fuel cell based on hydrogen as a source of electrical power in a vehicle.

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