

AQA – Electrode potentials and electrochemical cells – A2 Chemistry P1 & P3

1. No.6

0 6

This question is about vanadium ions.

Table 3 shows some standard electrode potential values.

Table 3

	$E^\ominus / \text{V}$
$\text{O}_2(\text{g}) + 4\text{H}^+(\text{aq}) + 4\text{e}^- \rightarrow 2\text{H}_2\text{O}(\text{l})$	+1.23
$\text{VO}_2^+(\text{aq}) + 2\text{H}^+(\text{aq}) + \text{e}^- \rightarrow \text{VO}^{2+}(\text{aq}) + \text{H}_2\text{O}(\text{l})$	+1.00
$\text{VO}^{2+}(\text{aq}) + 2\text{H}^+(\text{aq}) + \text{e}^- \rightarrow \text{V}^{3+}(\text{aq}) + \text{H}_2\text{O}(\text{l})$	+0.34
$\text{V}^{3+}(\text{aq}) + \text{e}^- \rightarrow \text{V}^{2+}(\text{aq})$	-0.26
$\text{Fe}^{2+}(\text{aq}) + 2\text{e}^- \rightarrow \text{Fe}(\text{s})$	-0.44
$\text{Zn}^{2+}(\text{aq}) + 2\text{e}^- \rightarrow \text{Zn}(\text{s})$	-0.76
$\text{V}^{2+}(\text{aq}) + 2\text{e}^- \rightarrow \text{V}(\text{s})$	-1.20
$\text{Mg}^{2+}(\text{aq}) + 2\text{e}^- \rightarrow \text{Mg}(\text{s})$	-2.38

0 6 . 1

Use the data in **Table 3** to explain why Zn reduces an aqueous solution of VO_2^+ ions to V^{2+} ions, but does not reduce it any further.**[2 marks]**

0 6 . 2

Identify the species in **Table 3** that can reduce an aqueous solution of VO_2^+ to V**[1 mark]**

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Two half-cells $\text{Fe}^{2+}(\text{aq}) / \text{Fe}(\text{s})$ and $\text{VO}^{2+}(\text{aq}) / \text{V}^{3+}(\text{aq})$ are connected.

Calculate the EMF of this cell.

Give the conventional representation for this cell.

Give a half-equation for the reaction that occurs at the negative electrode.

[3 marks]

EMF _____

Cell representation

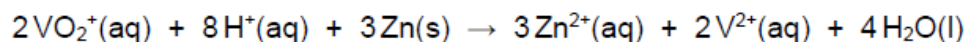
Half-equation

0 6 . 4

0.151 g of impure NH_4VO_3 is added to dilute sulfuric acid to form a solution containing aqueous VO_2^+ ions.

All the VO_3^- ions are converted to VO_2^+ ions.

These VO_2^+ ions are reduced to aqueous V^{2+} ions by reaction with an excess of zinc.

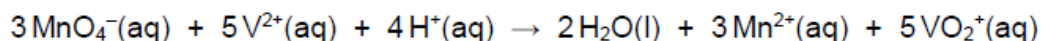


The excess of zinc is removed by filtration and washed.

The filtrate, containing the V^{2+} ions, is titrated with a $0.0200 \text{ mol dm}^{-3}$ solution of acidified KMnO_4

29.43 cm^3 of KMnO_4 solution are needed to oxidise all the V^{2+} ions to VO_2^+ ions.

The ionic equation for the reaction of MnO_4^- ions with V^{2+} ions is



Calculate the percentage purity of the NH_4VO_3

Give your answer to 3 significant figures.

[4 marks]

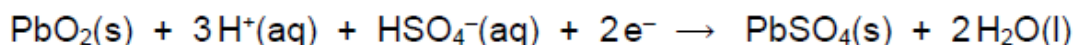
Percentage purity _____

2. No.17

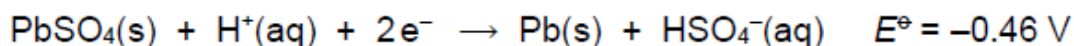
A cell with EMF = +2.15 V is made from two electrodes.

The half-equations for the two electrodes are shown.

positive electrode:



negative electrode:



What is the standard electrode potential of the $\text{PbO}_2 / \text{PbSO}_4$ electrode?

[1 mark]

A -2.61 V

☐

B -1.69 V

☐

C +1.69 V

☐

D +2.61 V

☐

3. 03/No.21

Which statement about chloride ions is correct?

[1 mark]

A They are oxidised by concentrated sulfuric acid.

☐

B They form a cream precipitate with silver nitrate solution.

☐

C They form a cobalt(II) complex with a tetrahedral shape.

☐

D They have the electron configuration $1\text{s}^2 2\text{s}^2 2\text{p}^6 3\text{s}^2 3\text{p}^4$

☐