Student 1: Low Excellence

NZQA Intended for teacher use only

When fresh iron (II) sulfate solution is added to acidified potassium permanganate solution, a pale green solution and a purple solution react to form an orange solution.

Justify why this is an oxidation-reduction reaction. Your answer should include:

- Species linked to the provided observations
- An explanation of oxidation and reduction in terms of electron transfer or oxidation number change
- Balanced half and full equations

Answer:

Reduction reaction:

2 The purple potassium permanganate solution reacts according to the following half equation and changes to colourless Mn^{2+} solution.

3 $MnO_4^- + 8H^+ + 5e^- \rightarrow Mn^{2+} + 4H_2O$

1 Each MnO_4^- gains five electrons and the Mn in the MnO_4^- has an oxidation number of +7 and this decreases to +2 in Mn^{2+}, so the MnO_4^- is reduced.

Oxidation reaction:

The pale green iron (II) solution changes to an orange Fe^{3+} solution according to the following half equation:

$Fe^{2+} \rightarrow Fe^{3+} + e^-$ x 5

3

$5Fe^{2+} \rightarrow 5Fe^{3+} + 5e^-$

5 Each Fe^{2+} loses one electron. The oxidation number of Fe^{2+} increases when it is oxidised to Fe^{3+}.

The overall balanced equation for the redox reaction is:

4 $MnO_4^- + 8H^+ + 5Fe^{2+} \rightarrow Mn^{2+} + 4H_2O + 5Fe^{3+}$