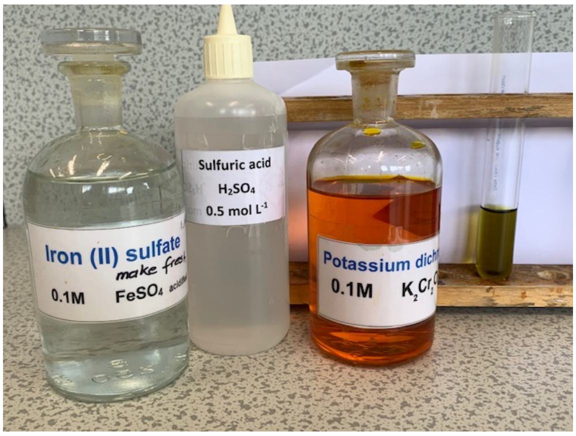
Sample Assessment Question

Iron(II) sulfate and acidified potassium dichromate



Very pale green iron(II) sulfate solution is added to orange potassium dichromate solution that has been acidified (with a little sulfuric acid).

The product (seen in the test tube) is a green solution.

Explain both the oxidation process and the reduction process occurring.
In your explanation you should

- Justify each process in terms of either electron transfer or oxidation numbers
- State the observations that would be made and link them to the species present for this reaction
- Use your balanced equations to help justify your explanations.

The very pale green solution of iron(II) sulfate (green due to Fe^{2+}) and the orange potassium dichromate solution (orange due to $Cr_2O_7^{2-}$) react to form pale orange Fe^{3+} and green Cr^{3+}, which causes an overall colour change to a green solution.

Reactant: Fe^{2+}	Product: Fe^{3+}
$Fe^{2+} \rightarrow Fe^{3+} + e^-$ *Balance the charge by adding electron to the more positive side.* This is oxidation because each Fe^{2+} has lost one electron. Loss of electrons is oxidation.	
Fe^{2+} is the reducing agent / reductant.	
Reactant: $Cr_2O_7^{2-}$	Product: Cr^{3+}
$Cr_2O_7^{2-} \rightarrow 2Cr^{3+}$ *Balance the 'Cr'*	
$Cr_2O_7^{2-} \rightarrow 2Cr^{3+} + 7H_2O$ *Balancing the 'O' by adding H_2O*	
$Cr_2O_7^{2-} + 14H^+ \rightarrow 2Cr^{3+} + 7H_2O$ *Balancing the 'H' by adding H^+*	
$Cr_2O_7^{2-} + 14H^+ + 6e^- \rightarrow 2Cr^{3+} + 7H_2O$ *Balance the charge by adding electrons to the more positive side. (2- + 14+ = 12+ ; there was 6+ on the right).* This is reduction because each $Cr_2O_7^{2-}$ has gained six electrons. Gain of electrons is reduction	
$Cr_2O_7^{2-}$ is the oxidising agent / oxidant.	
Overall: *Multiply the whole $Fe^{2+} \rightarrow Fe^{3+} + e^-$ equation by 6 to get $6e^-$ and then combine, cancelling out the $6e^-$ on each side).* $6Fe^{2+} + Cr_2O_7^{2-} + 14H^+ \rightarrow 6Fe^{3+} + 2Cr^{3+} + 7H_2O$	

Section from supplied table

In the assessment you will be supplied with a larger table to extract your information from.

Species	Name of species	Appearance
$Cr_2O_7^{2-}/H^+$	dichromate ion	orange solution
Cr^{3+}	chromium(III) ion	green solution
Fe	iron	grey solid
Fe^{2+}	iron(II) ion	pale green solution
Fe^{3+}	iron(III) ion	pale orange solution
H_2O	water	colourless liquid
K^+	potassium ion	colourless solution
SO_4^{2-}	sulfate ion	colourless solution

Note:

Of course, you don't have to explain how the equations were balanced. It has been added here ***in italics*** to help you see how the equations were derived, balanced and combined to give the over all redox equation.

You can also explain oxidation and reduction in terms of oxidation numbers rather than the number of electrons lost or gained, e.g.

Fe^{2+} has been oxidised to Fe^{3+} because the oxidation number of "Fe" has increased from +2 in Fe^{2+} to +3 in Fe^{3+}. (Increase in oxidation number is oxidation).

$Cr_2O_7^{2-}$ has been reduced to Cr^{3+} because the oxidation number of "Cr" has decreased from +6 in $Cr_2O_7^{2-}$ to +3 in Cr^{3+}. (Decrease in oxidation number is reduction).