Balance the reaction $MnO_4^-(aq) + SO_3^{2-}(aq) \rightarrow MnO_2(s) + SO_4^{2-}(aq)$ in basic solution

Oxidation states:

MnO_4^-	SO_3^{2-}	MnO_2	SO_4^{2-}
+7, 4(–2)	+4, 3(–2)	+4, 2(–2)	+6, 4(–2)

Therefore, Mn gets reduced (+7 → +4) and S gets oxidized (+4 → +6)

1) Write down the half reactions (incomplete) :

$MnO_4^- \rightarrow MnO_2$ (a)

$SO_3^{2-} \rightarrow SO_4^{2-}$ (b)

2) These are already balanced in Mn and S

3) Balance O in (a) by adding H_2O's to the right-hand-side

$MnO_4^- \rightarrow MnO_2 + 2H_2O$

4) Balance H by adding H^+ to the left-hand-side

$MnO_4^- + 4H^+ \rightarrow MnO_2 + 2H_2O$

5) Balance charge by adding electrons

$MnO_4^- + 4H^+ + 3e^- \rightarrow MnO_2 + 2H_2O$

6) Convert to basic solution by replacing the H^+ with H_2O and adding the same number of OH^- ions to the other side

$MnO_4^- + 4H_2O + 3e^- \rightarrow MnO_2 + 2H_2O + 4OH^-$

7) Cancel any extra H_2O's

$MnO_4^- + 2H_2O + 3e^- \rightarrow MnO_2 + 4OH^-$

Do the same with the sulfur half reaction to get:

$SO_3^{2-} + 2OH^- \rightarrow SO_4^{2-} + H_2O + 2e^-$

8) Combine the two by multiplying the Mn rxn by 2 and the S rxn by 3 and add:

$2MnO_4^- + 4H_2O + 3SO_3^{2-} + 6OH^- + 6e^- \rightarrow 2MnO_2 + 8OH^- + 3SO_4^{2-} + 3H_2O + 6e^-$

9) Canceling yields:

$2MnO_4^- + H_2O + 3SO_3^{2-} \rightarrow 2MnO_2 + 2OH^- + 3SO_4^{2-}$