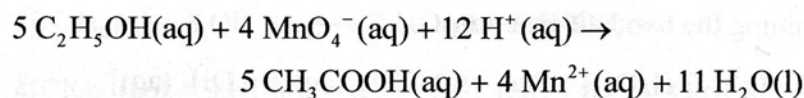
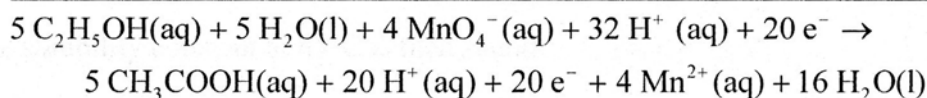
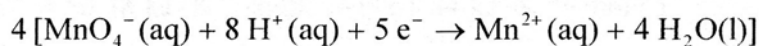
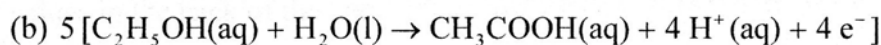
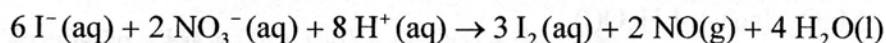
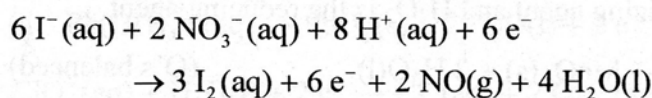
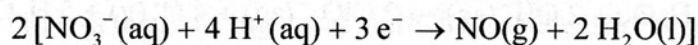
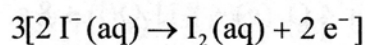
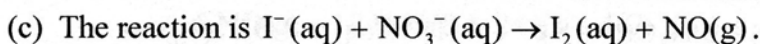


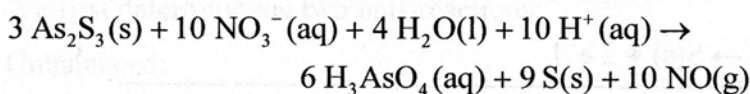
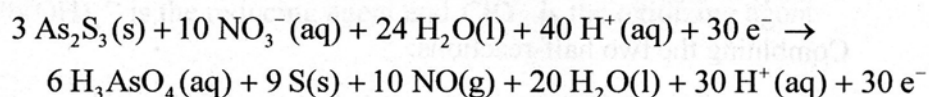
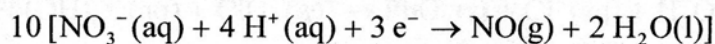
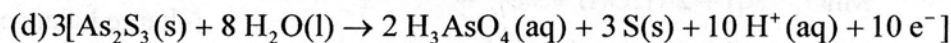
Fe^{2+} is the reducing agent and $\text{Cr}_2\text{O}_7^{2-}$ is the oxidizing agent.



$\text{C}_2\text{H}_5\text{OH}$ is the reducing agent and MnO_4^- is the oxidizing agent.

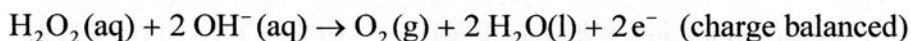
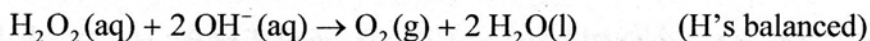
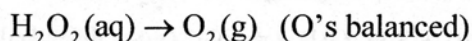
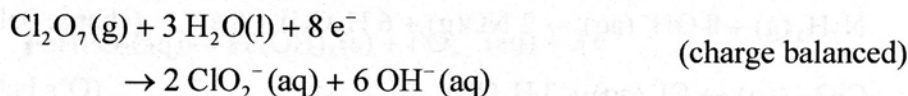
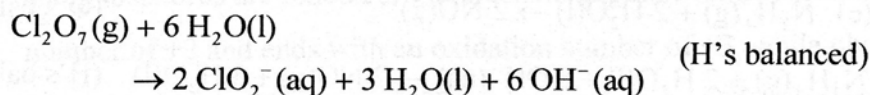


I^- is the reducing agent and NO_3^- is the oxidizing agent.

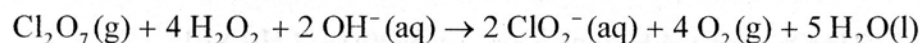
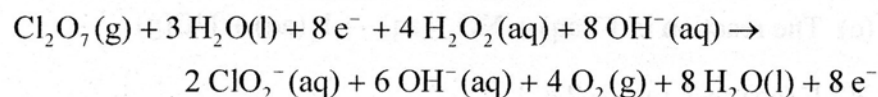
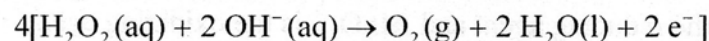
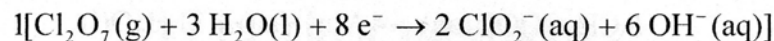


As_2S_3 is the reducing agent (both As and S are oxidized) and NO_3^- is the oxidizing agent.

12.6 (a) $\text{Cl}_2\text{O}_7(\text{g}) \rightarrow 2 \text{ClO}_2^-(\text{aq}) + 3 \text{H}_2\text{O}(\text{l})$ (O's balanced)

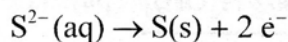
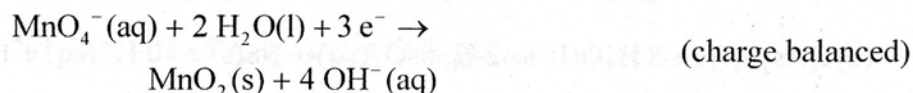
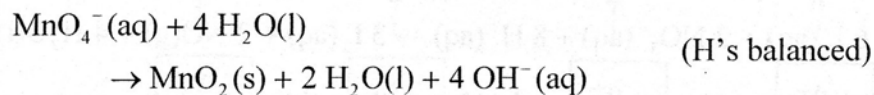


Combining the two half-reactions:

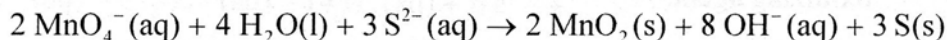
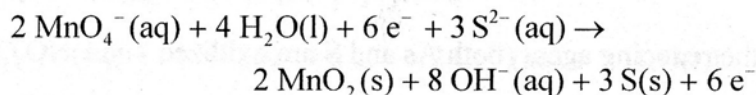
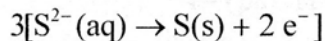
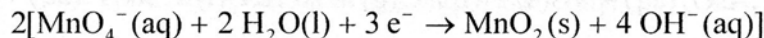


Cl_2O_7 is the oxidizing agent and H_2O_2 is the reducing agent.

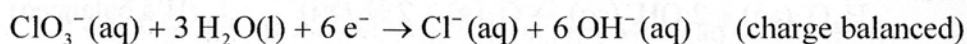
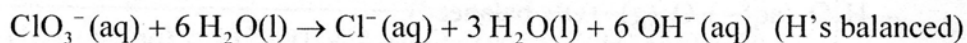
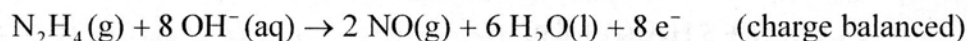
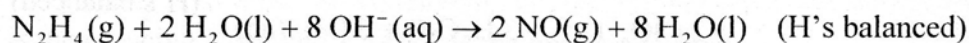
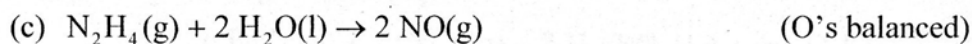
(b) $\text{MnO}_4^-(\text{aq}) \rightarrow \text{MnO}_2(\text{s}) + 2 \text{H}_2\text{O}(\text{l})$ (O's balanced)



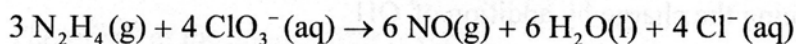
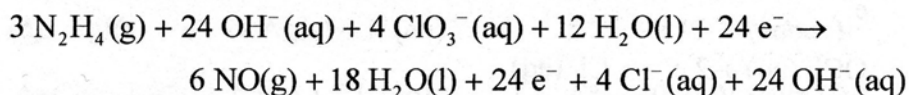
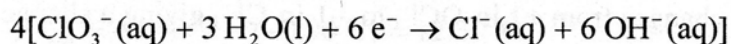
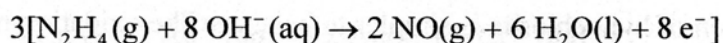
Combining the two half-reactions:



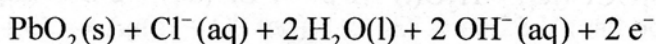
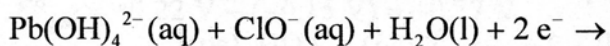
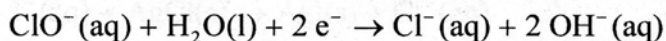
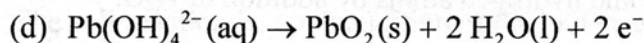
MnO_4^- is the oxidizing agent and S^{2-} is the reducing agent.



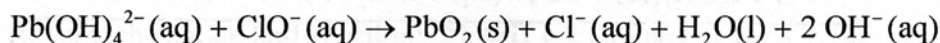
Combining the two half-reactions:



N_2H_4 is the reducing agent and ClO_3^- is the oxidizing agent.



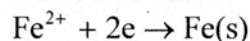
or



$\text{Pb}(\text{OH})_4^{2-}$ is the reducing agent and ClO^- is the oxidizing agent.

12.22 The unknown metal ions are reduced, increasing the weight of the unknown metal electrode. The cell can be written as

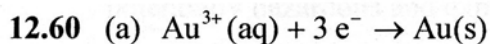
$\text{Fe}(\text{s})|\text{Fe}^{2+}(\text{aq})||\text{M}^+(\text{aq})|\text{M}(\text{s})$ showing that the M^+/M electrode is the cathode, because this is where reduction is occurring.



$$E^\circ = -0.44 \text{ V}$$

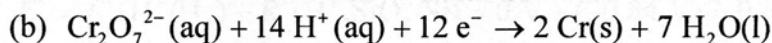
$$E^\circ (\text{cathode}) = +1.24 \text{ V} + E^\circ (\text{anode})$$

$$E^\circ (\text{cathode}) = +1.24 \text{ V} + (-0.44 \text{ V}) = +0.80 \text{ V}$$



$$\text{current} = (6.66 \mu\text{g Au}) \left(\frac{10^{-6} \text{ g}}{1 \mu\text{g}} \right) \left(\frac{1 \text{ mol Au}}{196.97 \text{ g Au}} \right) \left(\frac{3 \text{ mol e}^{-}}{1 \text{ mol Au}} \right)$$

$$\left(\frac{9.6485 \times 10^4 \text{ C}}{1 \text{ mol e}^{-}} \right) \left(\frac{1 \text{ A}}{1 \text{ C} \cdot \text{s}^{-1}} \right) \left(\frac{1}{1800 \text{ s}} \right) = 5.44 \times 10^{-6} \text{ A}$$



$$\text{time} = (6.66 \mu\text{g Cr}) \left(\frac{10^{-6}}{1 \mu\text{g}} \right) \left(\frac{1 \text{ mol Cr}}{52.00 \text{ g Cr}} \right) \left(\frac{6 \text{ mol e}^{-}}{1 \text{ mol Cr}} \right)$$

$$\left(\frac{9.6485 \times 10^4 \text{ C}}{1 \text{ mol e}^{-}} \right) \left(\frac{1 \text{ A}}{1 \text{ C} \cdot \text{s}^{-1}} \right) \left(\frac{1}{0.100 \text{ A}} \right) = 0.741 \text{ s}$$

12.90 Consider $\text{Al}^{3+}(\text{aq}) + 3 \text{e}^{-} \rightarrow \text{Al}(\text{s})$ ($E^{\circ} = -1.66$). With this half-reaction as the anode reaction and one or both of the given reduction reactions, a cell with a positive potential can be constructed. Two adjacent filled teeth, simultaneously in contact with the aluminum, could behave as two independent cells at different potentials, corresponding to the two possible reduction half-reactions. Current will then flow between them, stimulating the pain sensors.

The two possible cell reactions are

