Chemguide – answers

REDOX POTENTIALS FOR OTHER SYSTEMS

1. a) The left-hand half-cell would be a standard hydrogen electrode which consists of hydrogen gas at 1 bar pressure flowing over an electrode of platinum foil coated in porous platinum. That is immersed in a beaker of dilute sulphuric acid with a hydrogen ion concentration of 1 mol dm^{-3}.

   That is connected via a salt bridge to a similar half-cell, except that chlorine gas flows over the platinum electrode rather than hydrogen. The beaker contains a solution containing chloride ions (for example, sodium chloride solution) with a concentration also of 1 mol dm^{-3}.

   The potential difference between the two half-cells is measured using a high resistance voltmeter. The temperature should be 298 K.

   b) The positive sign of the E^0 value implies that the position of the Cl_2/Cl^- equilibrium lies to the right of the position of the hydrogen equilibrium.

   c)
$$Pt_{(s)}\ [H_{2(g)}]\ |\ 2H^+_{(aq)}\ ||\ Fe^{3+}_{(aq)}\ ,\ Fe^{2+}_{(aq)}\ |\ Pt_{(s)}$$

$$E^0 = +\ 0.77\ v$$

   On the right-hand side, the convention is that the species losing electrons is written closest to the electrode. In this case, it is the Fe^{2+}ions which lose the electrons. You don't need to write the E^0 value. It was just easier for me to take the whole diagram from the Chemguide page than to modify it.

2. a) Oxidation is loss of electrons, so oxidising agents are good at taking electrons from other things. The equilibrium which lies furthest to the right (taking electrons best) is the Au^{3+}/Au one. The best oxidising agent is therefore Au^{3+}.

   b) Following the same logic as in part (a), you need the equilibrium with the greatest tendency to move to the right. That is the one with the more positive E^0 value. Chlorine is the (slightly) stronger oxidising agent.

   c) These are all the reverse changes of the equilibria as written. That means that you need to choose the system whose equilibrium lies furthest to the left - the least positive one in these cases. That means that converting iron(II) into iron(III) ions is the easiest of these three reactions.