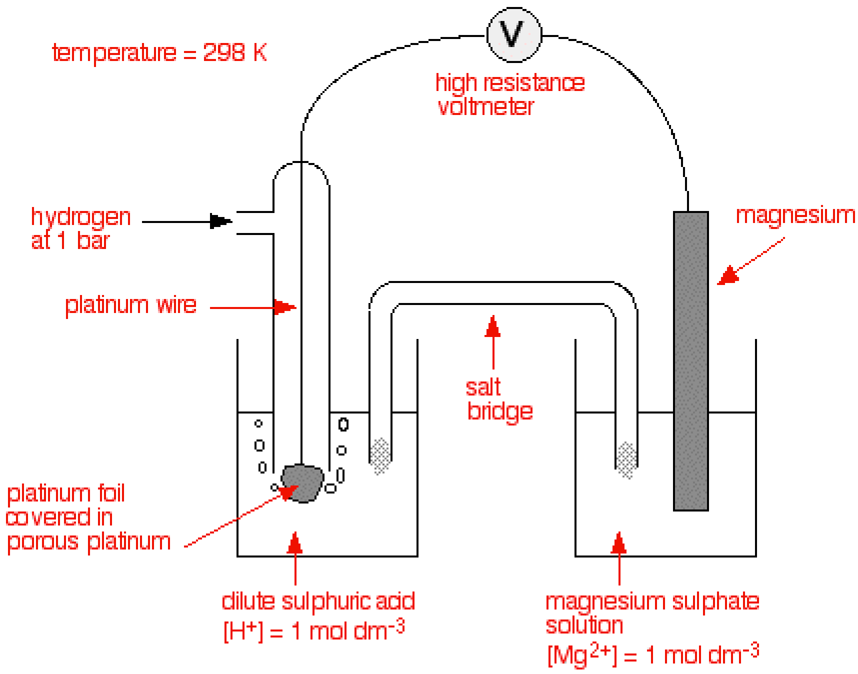
Chemguide – answers

STANDARD ELECTRODE POTENTIALS

1. a)



Be sure that your diagram contains all of the above labelling, including the conditions, and the fact that the voltmeter has to have a high resistance.

b) Replace the right-hand part of the apparatus by a silver rod dipping into silver nitrate solution containing silver ions at a concentration of 1 mol dm^{-3}. (Of the common silver salts, only silver nitrate is sufficiently soluble to be able to achieve this concentration. It is probably the one you would choose anyway, because it is the most familiar, and you have almost certainly used it to test for chlorides, bromides and iodides.)

c) The position of the magnesium equilibrium is further to the left than that of the hydrogen equilibrium, because magnesium is better at forming its ions than hydrogen is.

That means that more electrons will be left on the magnesium at equilibrium than there are left on the platinum by the hydrogen equilibrium. The magnesium is relatively the more negative electrode.

By convention, in measuring E^0 values, the hydrogen electrode is always taken as the left-hand electrode, and the sign of the E^0 value gives you the (relative) charge of the right-hand electrode.

d) E^0 values give a measure of the positions of the various equilibria relative to the hydrogen equilibrium and therefore also relative to each other. Magnesium has the more negative E^0 value showing that its equilibrium lies further to the left, and therefore that it forms its ions more readily.

e) Iron. (It has the most negative E^0 value, and so its equilibrium lies furthest to the left.)

f) The copper one. (It has the most positive E^0 value, and so its equilibrium lies furthest to the right.)

g) Cu^{2+}. (For the same reason as in part (f).)

h) Mg^{2+}. (The magnesium equilibrium lies furthest to the left, showing that the formation of Mg^{2+} ions is relatively easy. Forcing them back to Mg atoms is obviously going to be relatively difficult.)

2. a) There is a platinum electrode with hydrogen flowing over it. This is in contact with a solution containing hydrogen ions. That is connected via a salt bridge to a solution containing zinc ions with a solid zinc electrode immersed in it.

b) By convention, the sign attached to the voltage is the sign of the right-hand electrode. That means that the zinc is the negative electrode and the platinum the positive one.

c) The Zn^{2+}/Zn equilibrium lies further to the left than the hydrogen equilibrium, because zinc is better at forming ions than hydrogen is. That means that there will be a greater build-up of electrons on the zinc electrode than on the platinum.

That means that the zinc electrode is relatively more negative than the platinum one, which is what the voltmeter registers.

(I know this is asking essentially the same thing as Q1(c). But understanding the relationship between E^0 values and the positions of the various equilibria is key to understanding this topic, and so was worth asking twice.)