Chemguide – answers

ELECTRON AFFINITIES

1. a) 142 kJ of energy is *evolved* when the change takes place.

   b) The first electron affinity is the energy released when 1 mole of gaseous atoms each acquire an electron to form 1 mole of gaseous 1- ions.

   c) $O_{(g)} + e^- \longrightarrow O^-_{(g)}$

2. a) As you go down the group, the number of protons in the nucleus increases, for example from 17 in chlorine to 35 in bromine – an increase of 18 protons. But the number of screening electrons increases by exactly the same number – from 10 inner electrons in chlorine to 28 inner electrons in bromine.

   That means that in all the elements in the group, an incoming electron feels a net pull from the nucleus of 7+. But as you go down the group, the incoming electron ends up progressively further from the nucleus, and so the attraction is less. A smaller attraction means that less energy will be released.

   b) This argument holds true for fluorine up to a point, but there is an additional factor you have to think about. Fluorine is a small atom, and you are putting the new electron into an already electron-rich space. This causes extra repulsions which cuts down the effect of the closeness of the electron to the nucleus.

3. In both cases, the incoming electron is going into a 2p orbital, and so the screening and distance from the nucleus is much the same for both atoms. However, oxygen has one fewer proton in the nucleus, and so the attraction is less. A smaller attraction means that less energy will be released.

4. a) $O^-_{(g)} + e^- \longrightarrow O^{2-}_{(g)}$

   b) The large positive value means that lots of energy has to be put in to force another electron into the O^- ion. This is because you are having to force a negative electron into a space which already carries a negative charge.

   c) In the oxygen case, the first electron to be added is going into a relatively small atom, and there is significant repulsion from the electrons already there (similar to the fluorine case discussed above). Sulphur is a bigger atom, and the effect of this repulsion is relatively less.

   This effect also cuts down the amount of energy needed to force the second electron in to sulphur relative to the amount needed for oxygen. The electrons are spread over a larger space in sulphur, and so the repulsions aren't as great.

   (Note: (b) and (c) overlap slightly. As long as you have covered all the points, it doesn't matter particularly where exactly you have said them.)