Pre-lab 6, Question 5
How to determine oxidation numbers

When we assign oxidation numbers to the atoms in a molecule, we are treating every compound as though it is an ionic salt (even when we know it is not), and are determining the charge on each "ion" in the compound. Each atom gets its own oxidation number. We assign these charges based on a few simple rules.

All atoms in their elemental state (H_2, He, Cu, O_2, N_2, etc) have an oxidation number of 0.

The oxidation state of a monatomic ion (a single atom with a charge, such as Na^+, Fe^{3+}, F^-) is the same as the charge on the ion.

Group I metals (Li^+, Na^+, K^+, etc) are almost always +1 in compounds.

Group II metals (Be^{2+}, Mg^{2+}, Ca^{2+}, Ba^{2+}, etc) are nearly always +2 in compounds.

Hydrogen is almost always +1, except when it is:
0 in elemental hydrogen (H_2 gas)
-1 in metal hydrides such as $LiAlH_4$ (these are rare).

Oxygen is almost always –2, except when it is:
0 in elemental oxygen (O_2 gas)
–1 in peroxides such as H_2O_2.
Oxygen will be positive when paired with fluorine.

Fluorine in a compound is always –1.

Chlorine, bromine, and iodine in a compound are always –1 unless bonded with oxygen.

The oxidation states of all the atoms in an ion (such as NO^{3-} or SO_4^{2-}) add up to the charge on the ion. The oxidation states of all the atoms in a neutral molecule add up to 0.

In simple ionic compounds (NaCl, $FeBr_3$, etc) the oxidation numbers are the same as the actual charges on the ions.

So to find the oxidation numbers in Question 5,

a) $MnCl_2$ – determine the oxidation state of the chloride ions. $MnCl_2$ is neutral, so the negative charge of the two chlorines has to be balanced by the positive charge on the Mn.

b) MnO_4^- – determine the oxidation state of the O atoms. MnO_4^- has an overall –1 charge, so the positive charge on the Mn must be one less than the total negative charge of the oxygens.

Do problems c) and d) similarly.