

## Exercise 12.1

### Ligands

1. For each of the ligands listed below:

- Draw one valid Lewis diagram that shows the correct molecular geometry of all atoms in the ligand. *This may require you to have a “draft” Lewis diagram which you redraw after you work out the geometry.*  
*Include any non-zero formal charges on the appropriate atoms.*
- Identify which atom(s) can co-ordinate to a transition metal cation simultaneously
- Classify the ligand as monodentate, bidentate, tridentate, etc.
- Indicate how many molecules/ions of that ligand are required to make an octahedral complex (if it is the only ligand used)

(a) CO

(b) CO<sub>2</sub>

(c) N<sub>3</sub><sup>-</sup>

(d) NO<sub>2</sub><sup>-</sup>

*can co-ordinate to a transition metal cation in 3 different ways; can you think of them all?*

(e) C<sub>2</sub>O<sub>4</sub><sup>2-</sup> (oxalate ion)  
*commonly abbreviated as “ox”;*  
*C are connected to each other and each C has two O attached*

(f) NH<sub>2</sub>CH<sub>2</sub>CH<sub>2</sub>NH<sub>2</sub> (ethylenediamine)  
*commonly abbreviated as “en”;*  
*C are connected to each other and each C has one N attached; each “larger” atom has two H attached*