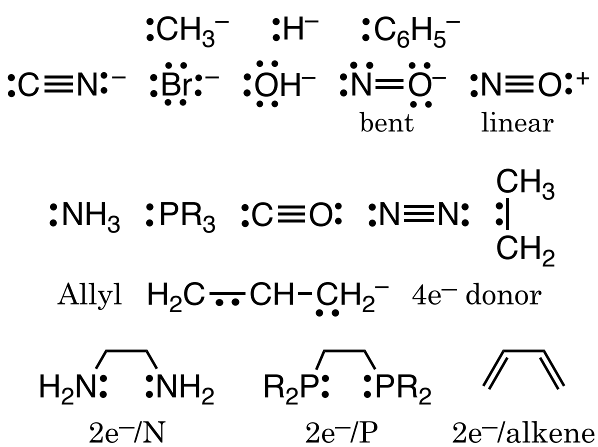
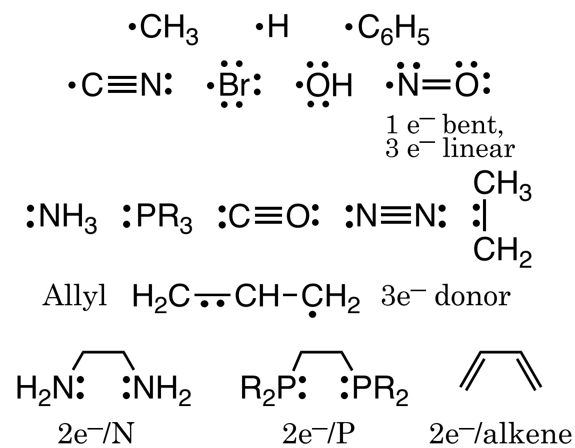
The Two Methods of Electron Counting

CLOSED SHELL LIGAND (IONIC)	NEUTRAL LIGAND (COVALENT)
All ligands are closed shell.	*All ligands are neutral.*
1. Metal ligand bonds are all coordination bonds and all contribute two electrons.	1. Ordinary covalent bonds contribute one electron, and coordination bonds contribute two electrons.
2. Find number of electrons on metal from the formal oxidation state (based on ligand and complex charges.)	2. Use the number of valence electrons on the neutral metal atom (count from the left edge of periodic table.)
3. Each M-M bond contributes 1 electron.	3. Subtract the charge on the complex.
Show the charges on each ligand!	*Show the electron count from each ligand!*

Examples





$[Co(CN)_2(CO)(PEt_3)_2]^-$

Closed shell		Neutral	
2 $:CN^-$	4	2 $\bullet CN$	2
$:CO$	2	$:CO$	2
2 $:P$	4	2 $:P$	4
Co(I)	<u>8</u>	Co(0)	9
	$18e^-$	1 e^-	-(-<u>1</u>)
			$18e^-$

$Os(CO)_4(CH_3)_2$

Closed shell		Neutral	
4 $:CO$	8	4 $:CO$	8
2 $:CH_3^-$	4	2 $\bullet CH_3$	2
Os(II)	<u>6</u>	Os(0)	<u>8</u>
	$18e^-$		$18e^-$

$Co(CO)_3H(CH_2{=}CH_2)$

Closed shell		Neutral	
3 $:CO$	6	3 $:CO$	6
$:H^-$	2	$\bullet H$	1
://	2	://	2
Co(I)	<u>8</u>	Co(0)	<u>9</u>
	$18e^-$		$18e^-$

You should be able to do problems by both the neutral ligand and closed shell methods. Remember that the names of these methods tell what you need to do to the ligand (use its neutral or closed shell form). For determining oxidation state, you have to use the closed shell method since oxidation states assume closed shell ligands.

Lisensky