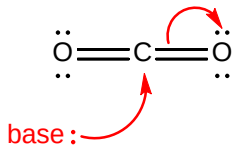
Answers to Exercise 10.2
Lewis Acids and Lewis Bases

1. A Lewis base is an electron pair donor (which means that it *shares* a pair of electrons – not that it gives them away).

   A Lewis acid is an electron pair acceptor (which means that it has a pair of electrons shared with it – not that it takes them away).

2. *The red arrows show how each Lewis acid can accept an electron pair from a Lewis base.*

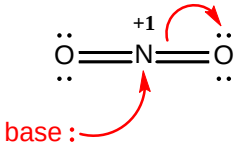
(a) Lewis acid



C is partially positive

C can accept electrons by shifting one pair of C-O bonding electrons onto O as a lone pair

(b) Lewis acid



N has a + charge

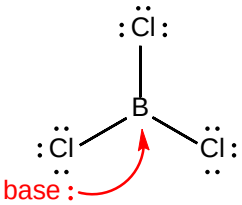
N can accept electrons by shifting one pair of N-O bonding electrons onto O as a lone pair

(c) not Lewis acid

Anions are not usually Lewis acids.

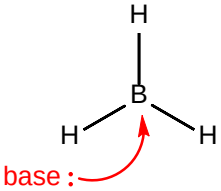
Accepting an electron pair would increase the negative charge.

(d) Lewis acid



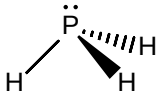
B is partially positive and electron-deficient

(e) Lewis acid



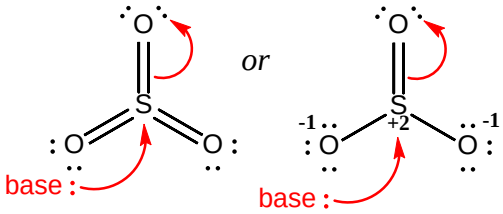
B is partially positive and electron-deficient

(f) not Lewis acid



P is partially negative, and it has no place for an extra bond to a Lewis base.

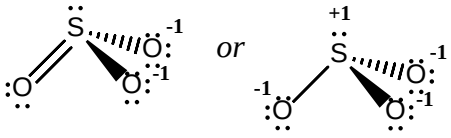
(g) Lewis acid



S is partially positive

S can accept electrons by shifting one pair of S-O bonding electrons onto O as a lone pair

(h) not Lewis acid



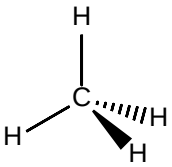
Anions are not usually Lewis acids.

Accepting an electron pair would increase the negative charge.

(i) not Lewis acid

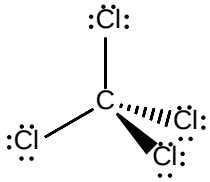
While N is triple bonded to another atom, it is another N, so neither N is positive or partially positive. Accepting a pair of electrons on one N would also put a negative charge on the other N.

(j) not Lewis acid



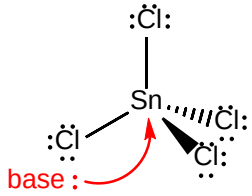
C has no place for an extra bond to a Lewis base. Neither do any of the H.

(k) not Lewis acid



C has no place for an extra bond to a Lewis base. Neither do any of the Cl.

(l) Lewis acid



Sn is large enough to bond to up to six atoms at once so it can make a fifth bond to a Lewis base.
Sn is partially positive so it can accept an electron pair.

3.

$P(CH_3)_3$ has an electron-rich phosphorus atom with a lone pair to share with a Lewis acid.

The electronegative chlorine atoms pull electron density away from the phosphorus atom in PCl_3. As such, the phosphorus atom cannot readily share its lone pair, and it is not a good Lewis base.

Some students might suggest that one of the chlorine atoms in PCl_3 could donate a lone pair; however, neutral halogen atoms do not often behave this way since they would have to adopt a positive charge (meaning that it is particularly unlikely for the more electronegative halogens).