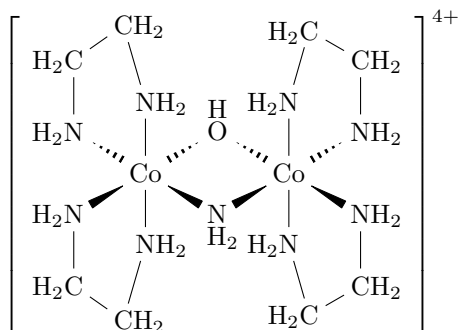


2/19: I) Do the following problems from Chapter 9: 7; 9; 12a,b,e; 20; 23.

**9.7** Give structures for the following:

a. Bis(en)Co(III)- $\mu$ -amido- $\mu$ -hydroxobis(en)Co(III) ion.

*Answer.*

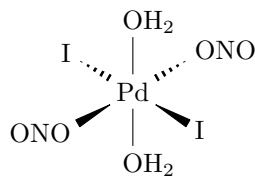


□

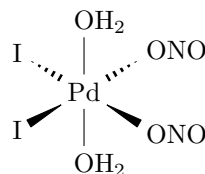
b. DiaquadiiododinitritoPd(IV), all isomers.

*Answer.* There are six stereoisomers of diaquadiiododinitritoPd(IV). We will classify them into five groups by the relative positions of like ligands as follows. One group will contain two enantiomers.

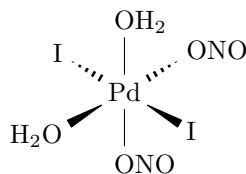
1. All like ligands *trans*.



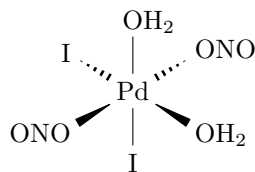
2. *trans*-aqua, *cis*-everything else.



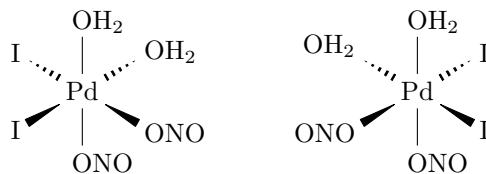
3. *trans*-iodo, *cis*-everything else.



4. *trans*-nitrito, *cis*-everything else.

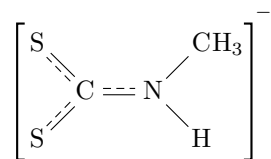


5. All like ligands *cis*.



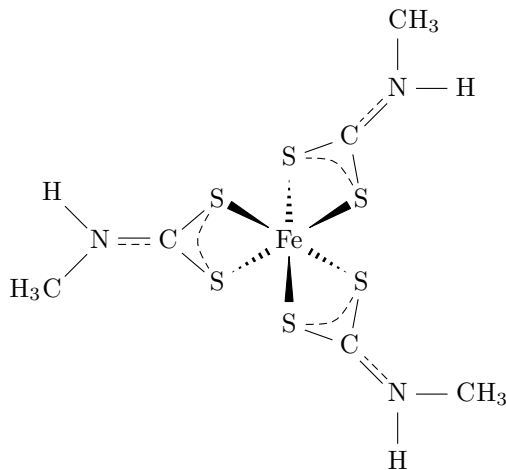
□

c.  $\text{Fe}(\text{dtc})_3$ , all isomers, where dtc is

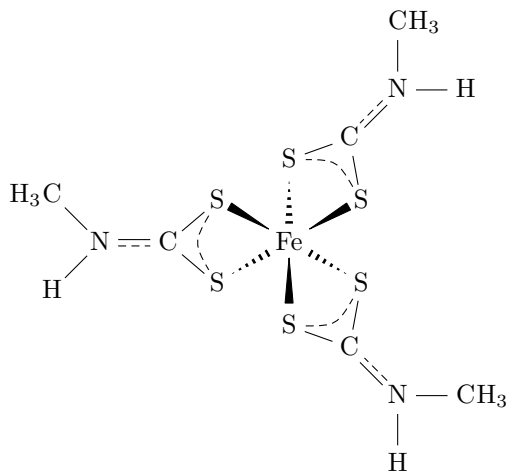


*Answer.* There are four stereoisomers of  $\text{Fe}(\text{dtc})_3$ . We first divide into  $\Lambda$  and  $\Delta$  types, and then further subdivide into one with a  $C_3$  rotation axis and the other without.

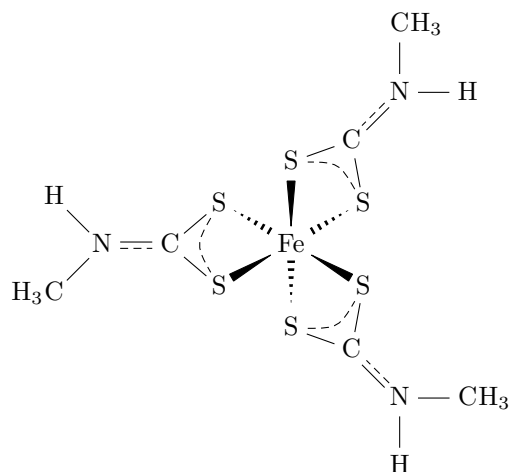
1.  $\Lambda$  form, has  $C_3$  axis.



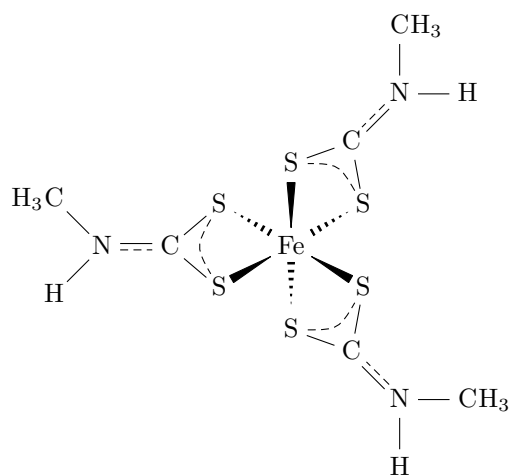
2.  $\Lambda$  form, does not have  $C_3$  axis.



3.  $\Delta$  form, has  $C_3$  axis.



4.  $\Delta$  form, does not have  $C_3$  axis.

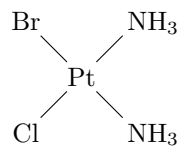


□

**9.9** Show structures for the following:

**a.** *cis*-Diamminebromochloroplatinum(II).

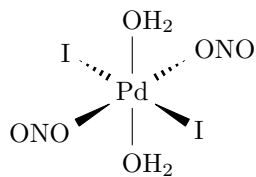
*Answer.*



□

**b.** Diaquadiiododinitritopalladium(IV), all ligands *trans*.

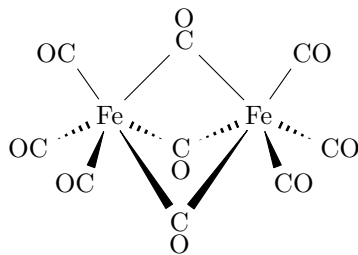
*Answer.*



□

**c.** Tri- $\mu$ -carbonylbis(tricarbonyliron(0)).

*Answer.*



□

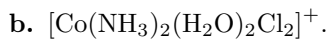
**9.12** Sketch all isomers of the following. Indicate clearly each pair of enantiomers.



*Answer.* There is one facial and one meridional isomer of  $[\text{Pt}(\text{NH}_3)_3\text{Cl}_3]^+$ . There are no enantiomers.

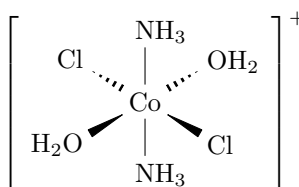


□

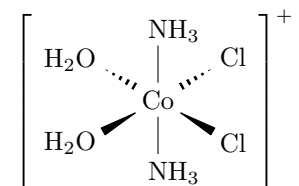


*Answer.*

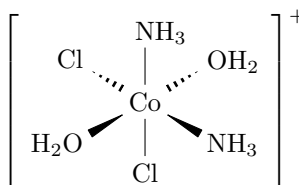
1. All like ligands *trans*.



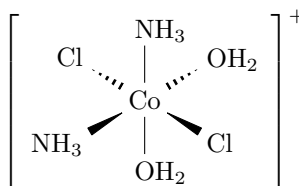
2. *trans*-ammine, *cis*-everything else.



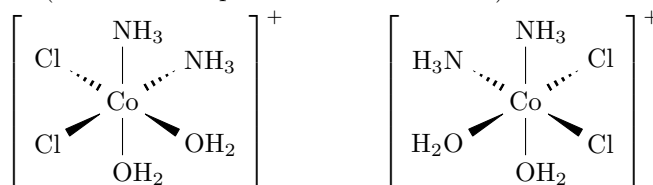
3. *trans*-aqua, *cis*-everything else.



4. *trans*-chloro, *cis*-everything else.



5. All like ligands *cis* (these two compounds are enantiomers).

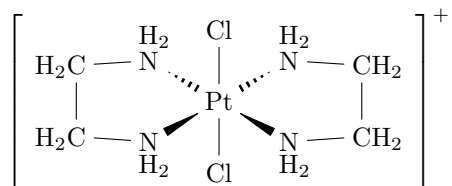


□

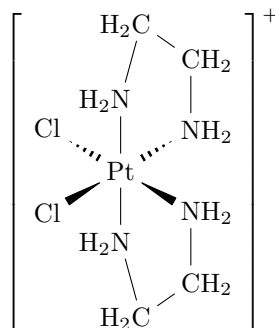
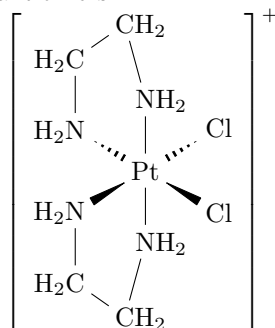
e.  $[\text{Pt}(\text{en})_2\text{Cl}_2]^{2+}$ .

*Answer.* There is one achiral isomer and one pair of chiral enantiomers.

1. Achiral isomer.

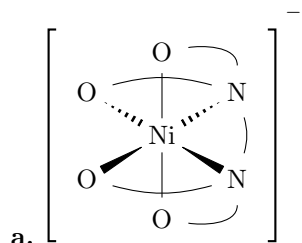


2. Chiral enantiomers.



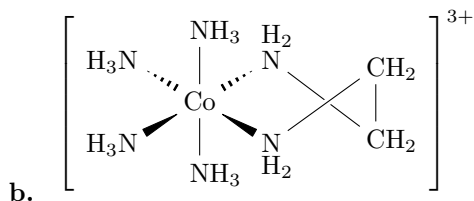
□

**9.20** Which of the following molecules are chiral?



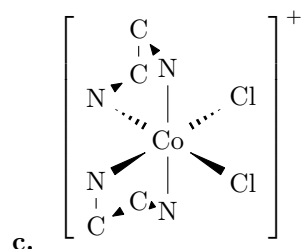
*Answer.* This molecule is chiral.

□



*Answer.* This molecule is achiral (if we assume that the ring on the right side largely lies in the plane with quickly reversing buckling or puckering, a reasonable hypothesis given the light N and C atoms).

□

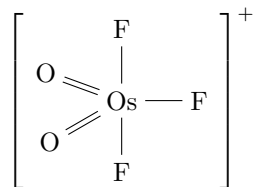


*Answer.* This molecule is chiral.

□

- 9.23** When *cis*-OsO<sub>2</sub>F<sub>4</sub> is dissolved in SbF<sub>5</sub>, the cation OsO<sub>2</sub>F<sub>3</sub><sup>+</sup> is formed. The <sup>19</sup>F NMR spectrum of this cation shows two resonances, a doublet and a triplet having relative intensities of 2 : 1. What is the most likely structure of this ion? What is its point group?

*Answer.* Since there are two resonances, there are two types of bonds. Additionally, the 2 : 1 ratio tells us that the doublet bonds are twice as strong as the triplet bonds. Thus, the most likely structure is



Its point group is  $C_{2v}$ .

□

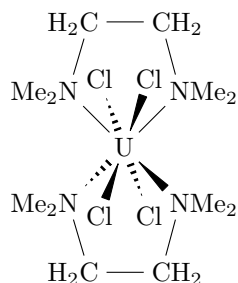


- II) The enthalpies of reaction of trimethylboron with  $\text{NH}_3$ ,  $\text{CH}_3\text{NH}_2$ ,  $(\text{CH}_3)_2\text{NH}$ , and  $(\text{CH}_3)_3\text{N}$  are  $-58$ ,  $-74$ ,  $-81$ , and  $-74$  kJ/mol, respectively. Why is trimethylamine out of sequence?

*Answer.* Trimethylboron is not a very small lewis acid like  $\text{BH}_3$  or  $\text{H}^+$ . Thus, its own steric bulk clashes with the considerable bulk of  $(\text{CH}_3)_3\text{N}$ , hindering the reaction in a non-negligible fashion. This hindrance lowers the magnitude of the reaction enthalpy more than the additional electron-donating methyl group can raise it.  $\square$

- III) The complex  $\text{UCl}_4(\text{tmeda})_2$  (where tmeda is an abbreviation for  $\text{Me}_2\text{N}-\text{CH}_2\text{CH}_2-\text{NMe}_2$ , which binds by chelation to metals through both N-atoms) has been shown by X-ray crystallography to have almost perfect  $D_{2d}$  symmetry. Carefully draw a stereochemically accurate picture of this 8-coordinate uranium complex based on what you know about geometrical preferences in 8-coordinate complexes.

*Answer.*



□