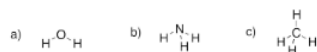
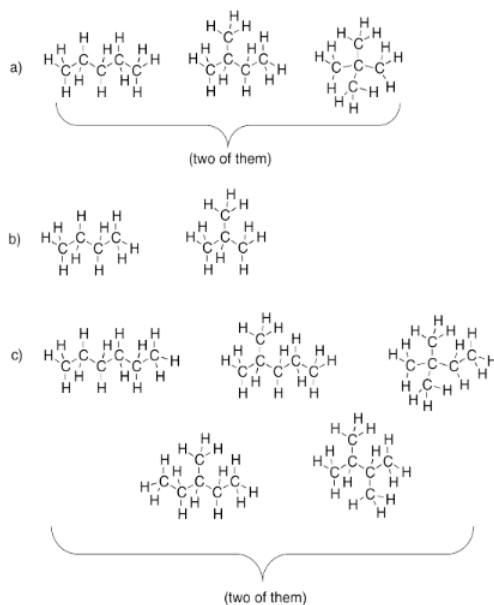


## 4.16: Solutions to Selected Problems

### Exercise 4.1.1:

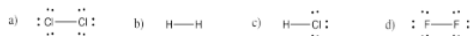


### Exercise 4.1.2



Answers to Exercise 4.1.2, a through c. Underneath answers a and c are brackets surrounding the answers, labelled "(two of them)".

### Exercise 4.2.1:



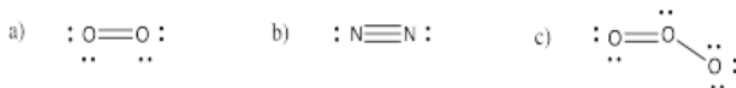
Answers to Exercise 4.2.1, a through d. In order: chlorine gas, hydrogen gas, hydrochloric acid, and fluorine gas.

### Exercise 4.2.2

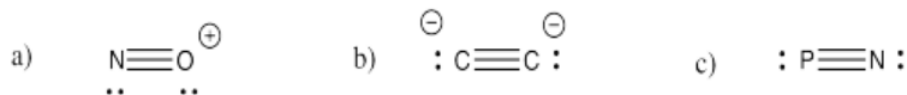


Answers to Exercise 4.2.2, a through d. In order: hydroxide, magnesium chloride, thiol, and hypochlorite.

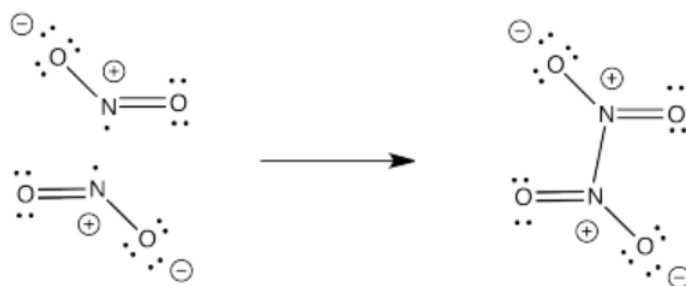
### Exercise 4.3.1



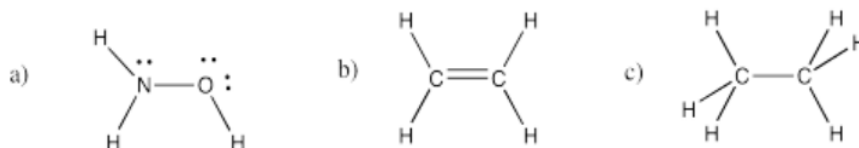
### Exercise 4.3.2:



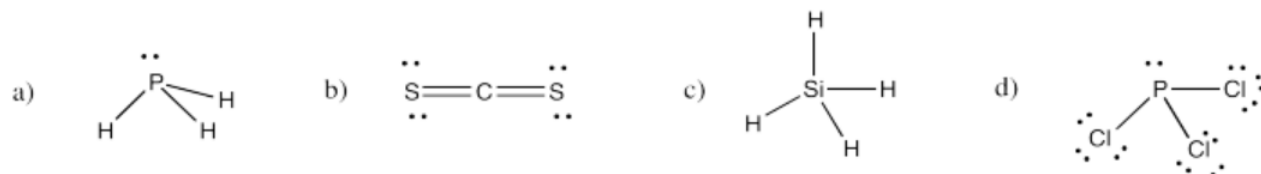
### Exercise 4.3.3:



#### Exercise 4.4.1:

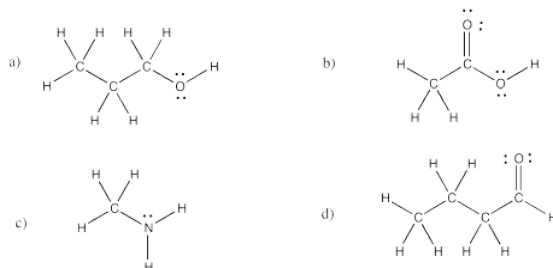


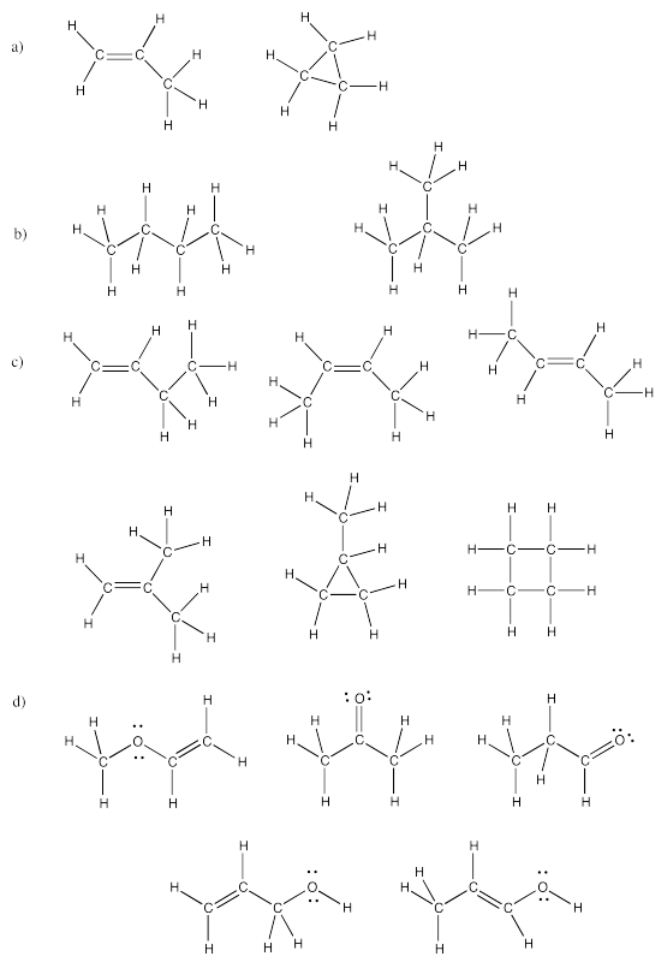
#### Exercise 4.4.2:

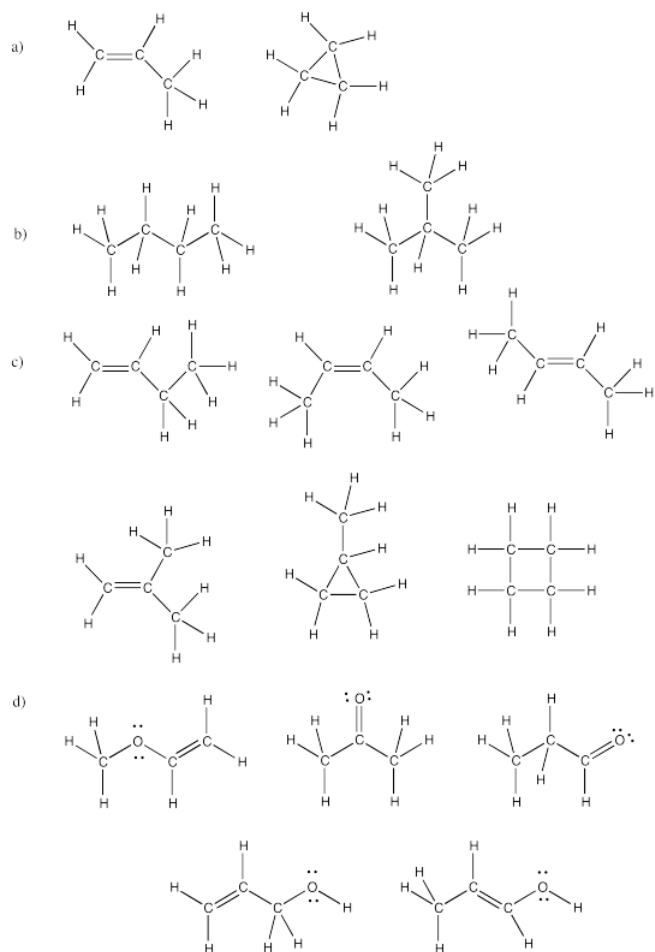


Answers to Exercise 4.4.2, a through d. In order: PH<sub>3</sub>, carbon disulfide, SiH<sub>4</sub>, and phosphorus trichloride.

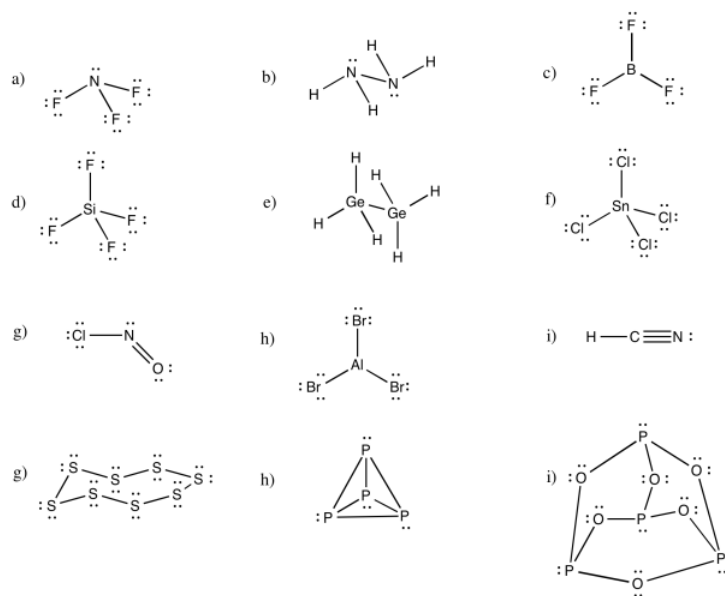
#### Exercise 4.4.3:



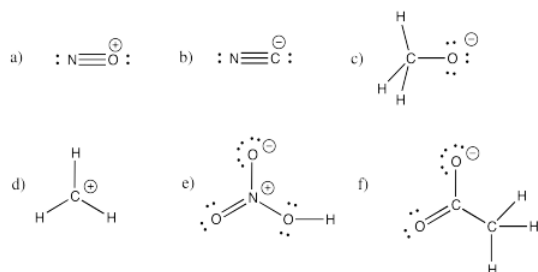




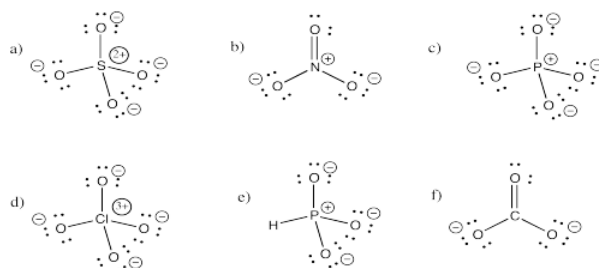
#### Exercise 4.4.5



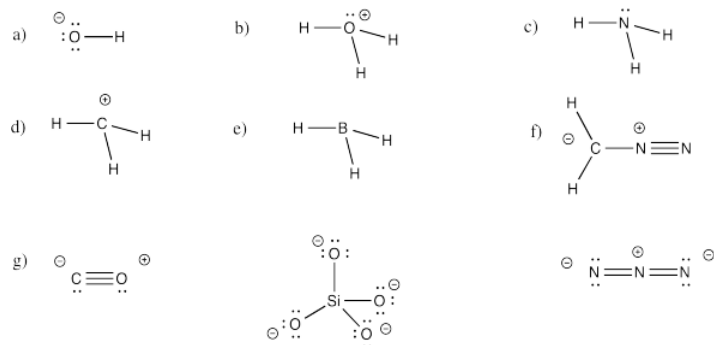
#### Exercise 4.5.1:



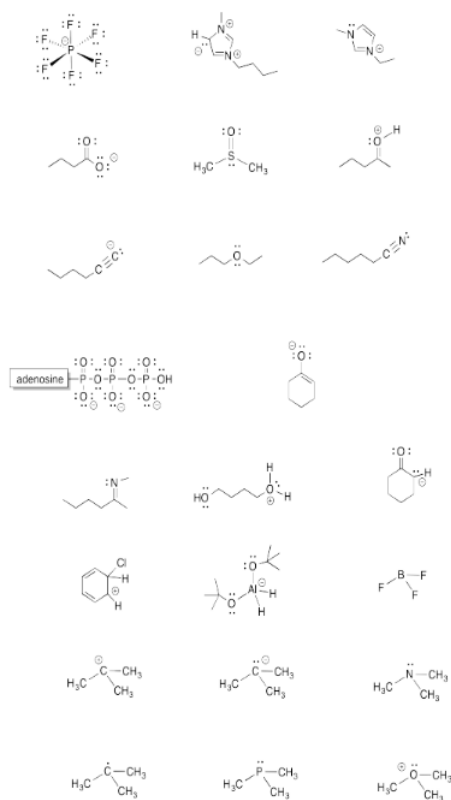
### Exercise 4.5.2:



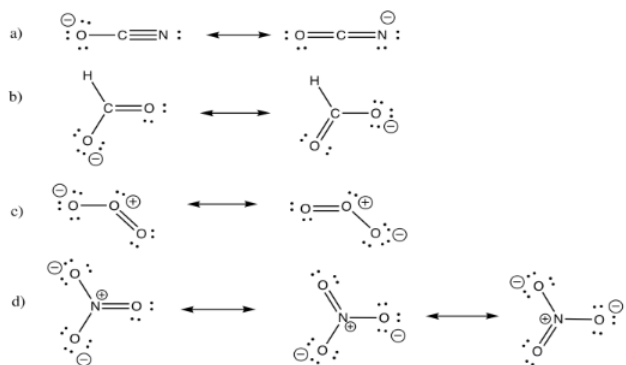
### Exercise 4.5.3:



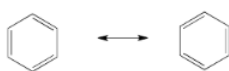
### Exercise 4.5.4:



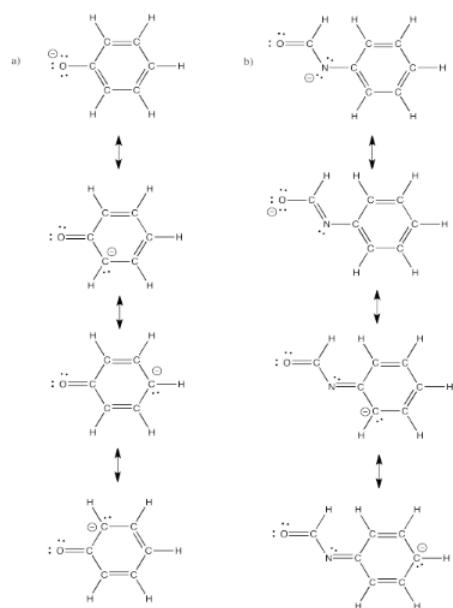
#### Exercise 4.6.1:



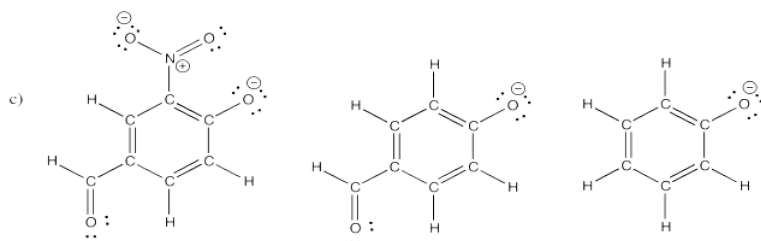
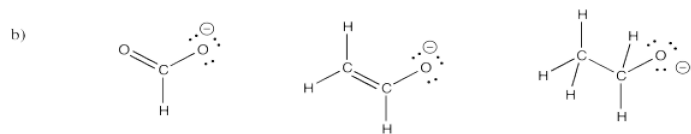
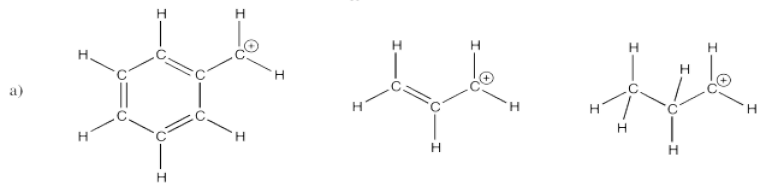
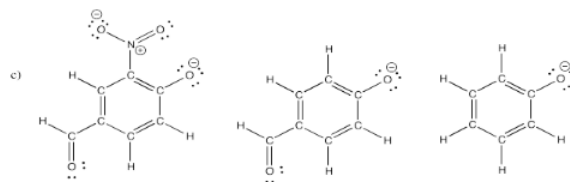
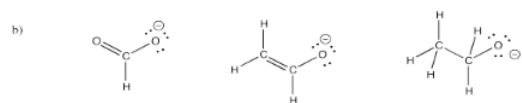
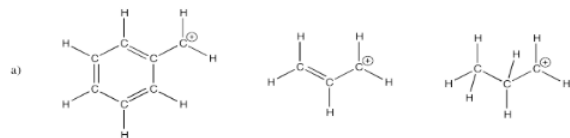
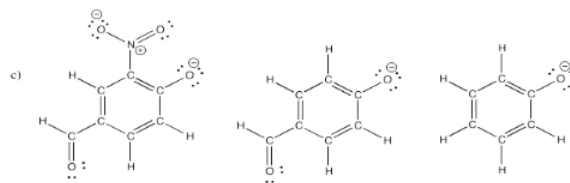
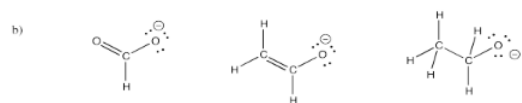
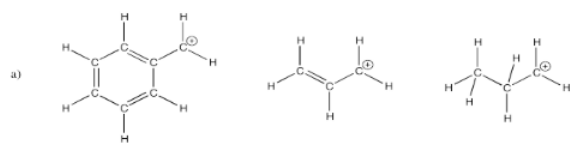
#### Exercise 4.6.2:



#### Exercise 4.6.3:



#### Exercise 4.6.4:



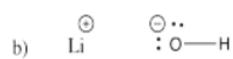
### Exercise 4.6.5:



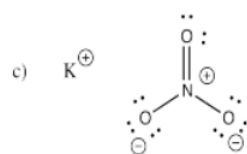




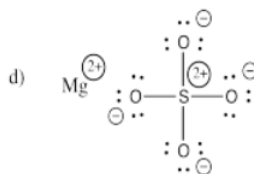
potassium bromide



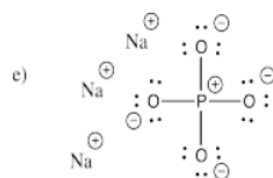
lithium hydroxide



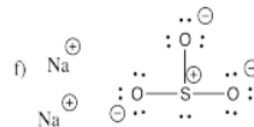
potassium nitrate



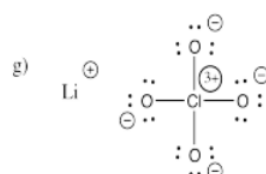
magnesium sulfate



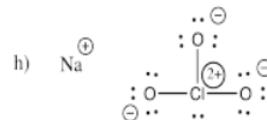
sodium phosphate



sodium sulfite



lithium perchlorate



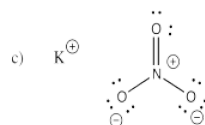
sodium chlorate



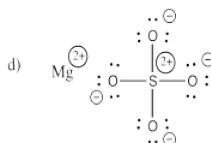
potassium bromide



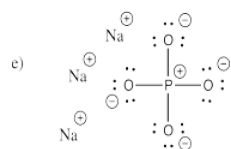
lithium hydroxide



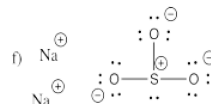
potassium nitrate



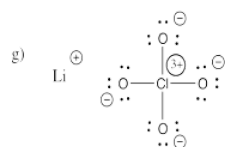
magnesium sulfate



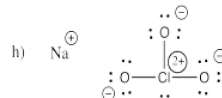
sodium phosphate



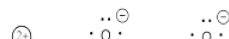
sodium sulfite

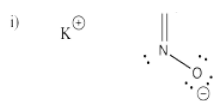


lithium perchlorate

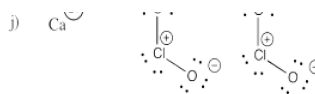


sodium chlorate

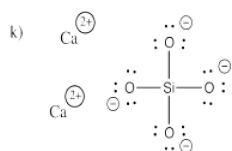




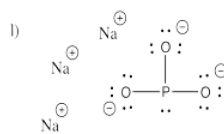
potassium nitrite



sodium chlorite



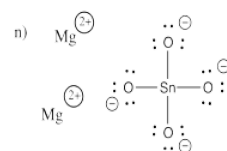
calcium orthosilicate



sodium phosphite

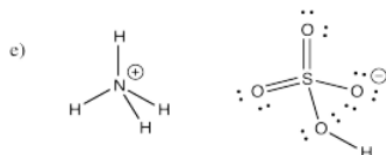
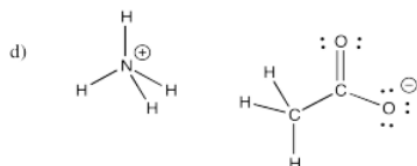
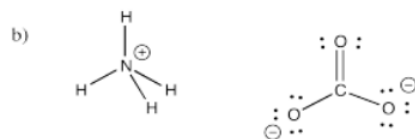
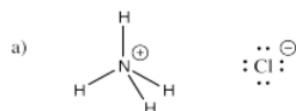


sodium hypochlorite



calcium orthosilicate

### Exercise 4.7.3:

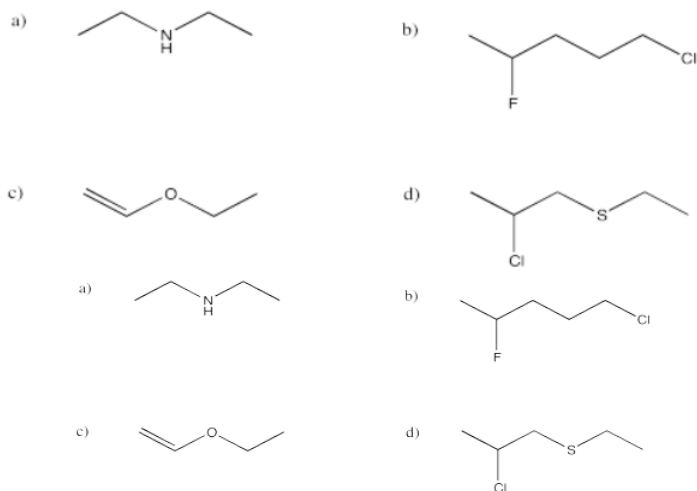


### Exercise 4.7.4:

- a) bromide b) oxide c) fluoride d) carbonate e) nitrate f) nitrite  
g) sulfide h) sulfate i) sulfite j) persulfate k) carbide l) nitride m) arsenide

n) phosphate o) phosphite p) iodide q) iodate r) periodate

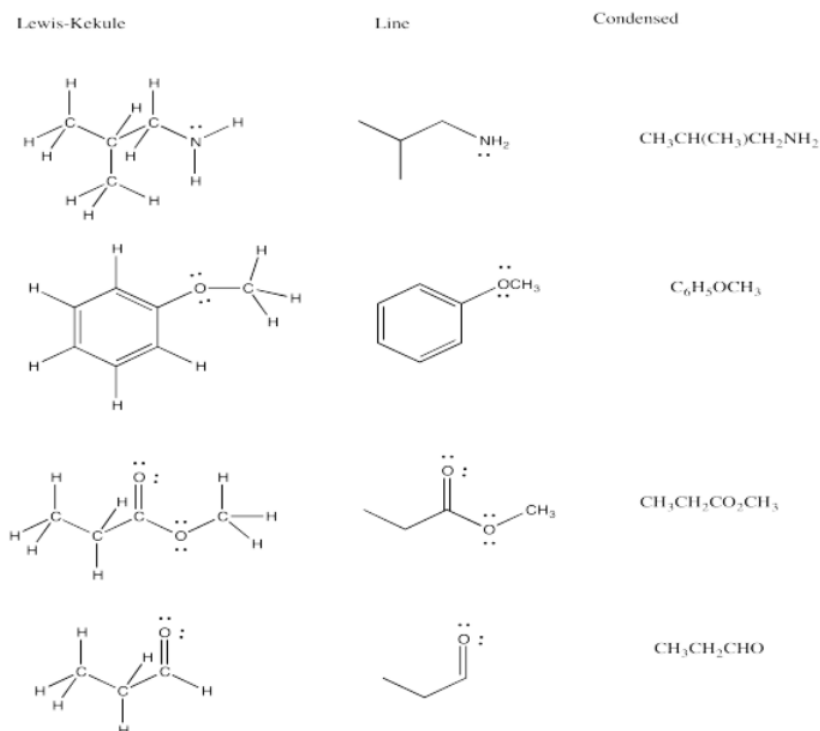
### Exercise 4.8.1:



### Exercise 4.8.2:











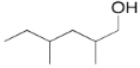
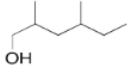






- a)  $(\text{CH}_3)_2\text{CHCH}_2\text{CH}_2\text{CN}$  b)  $\text{CH}_3\text{CH}_2\text{CH}(\text{OH})\text{CH}_3$   
 c)  $(\text{CH}_3)_2\text{CHCOCH}_2\text{CH}_3$  d)  $\text{CH}_3\text{CH}_2\text{CONHCH}_2\text{CH}_3$

### Exercise 4.8.3:

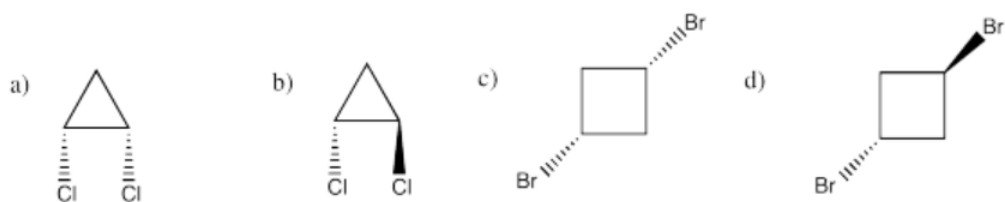


Answers to Exercise 4.8.3, with Lewis-Kekule structures, bond-line structures, and condensed formulae.

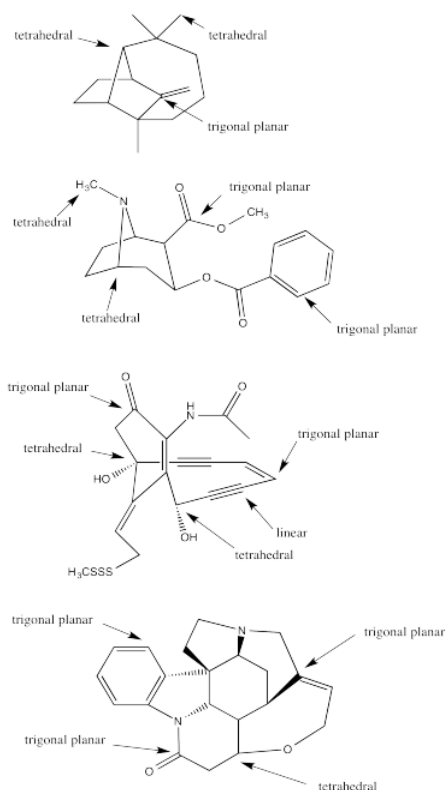
### Exercise 4.8.4:

		Yes
		No
		No
		Yes
		Yes
		No
		No
		Yes
		No

#### Exercise 4.9.1:

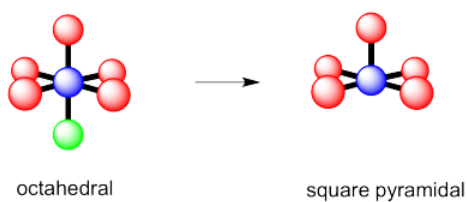


#### Exercise 4.9.2:

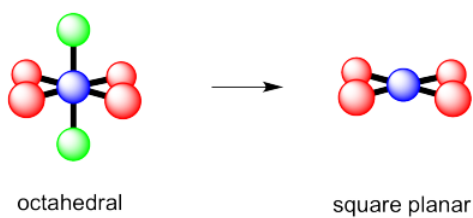


### Exercise 4.10.1:

- octahedral.
- 



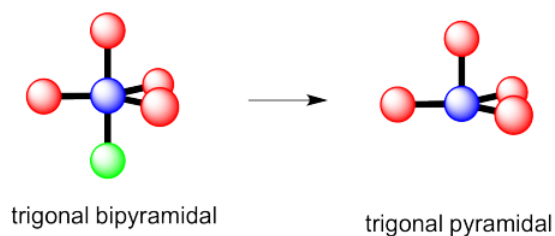
c)



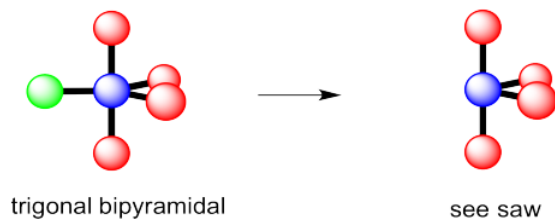
### Exercise 4.10.2:

- trigonal bipyramidal
- This time there could be two different answers.

If the lone pair occupies one of the axial positions, it would be pretty close to three other atoms.

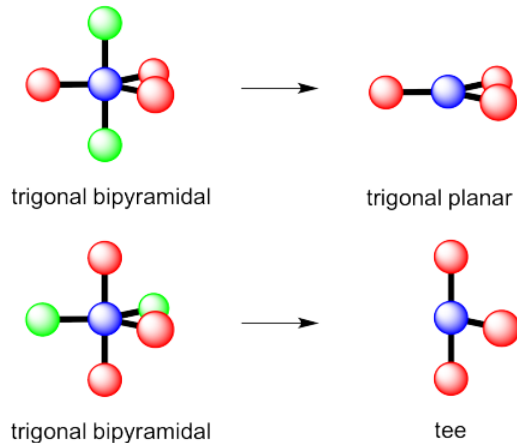


If the lone pairs occupies one of the equatorial positions, it would be pretty close to only two other atoms. The other equatorial atoms are pretty far away.

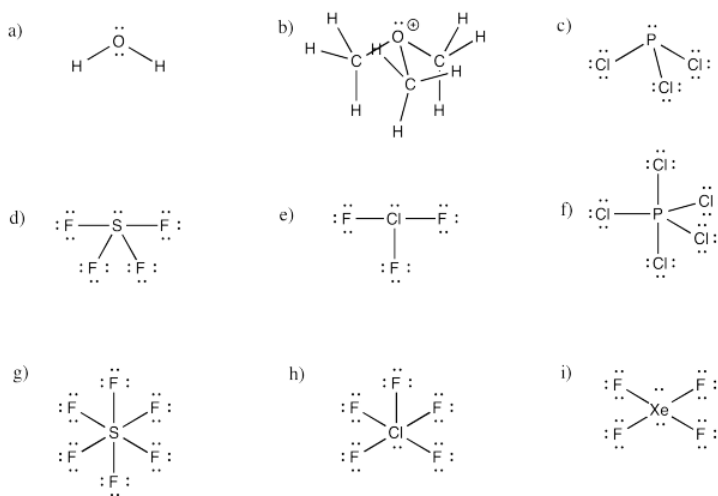


The rule is that the lone pair goes in the less crowded position, so this molecule would be see-saw shaped.

c) Again, there are two possible geometries. One of them would be trigonal planar, a pretty common geometry.



### Exercise 4.10.3:



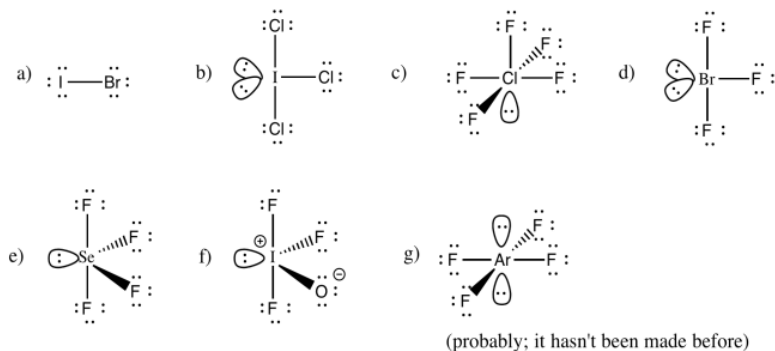
### Exercise 4.10.4

a) bent b) pyramidal at O, although tetrahedral at C c) pyramidal

d) see-saw e) tee f) trigonal bipyramidal

g) octahedral h) square pyramidal i) square planar

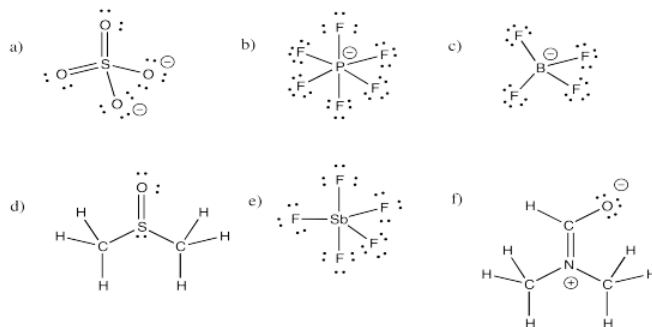
### Exercise 4.10.5:



### Exercise 4.10.6:

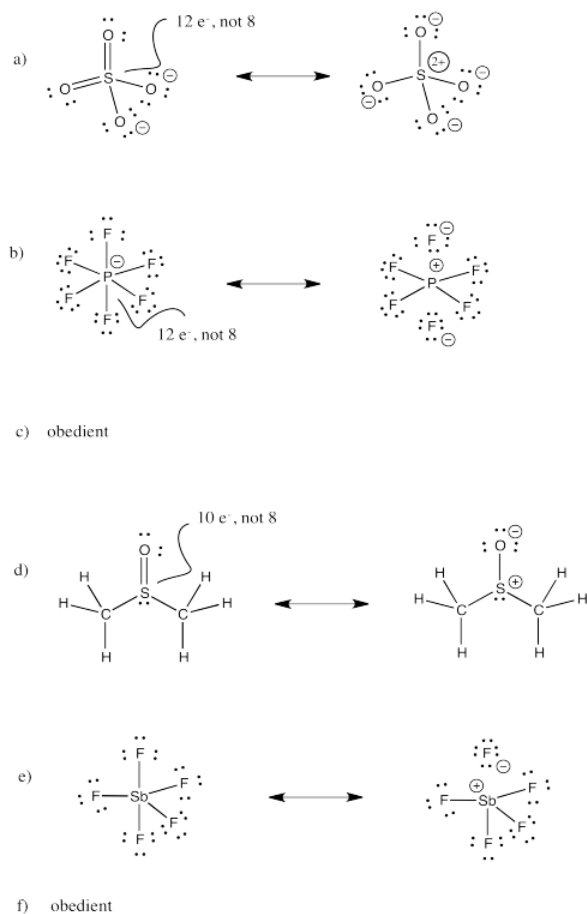
You may be able to imagine some other possibilities for this number of neighbors, but  $\text{IF}_7$  adopts a pentagonal bipyramid shape.

### Exercise 4.11.1:



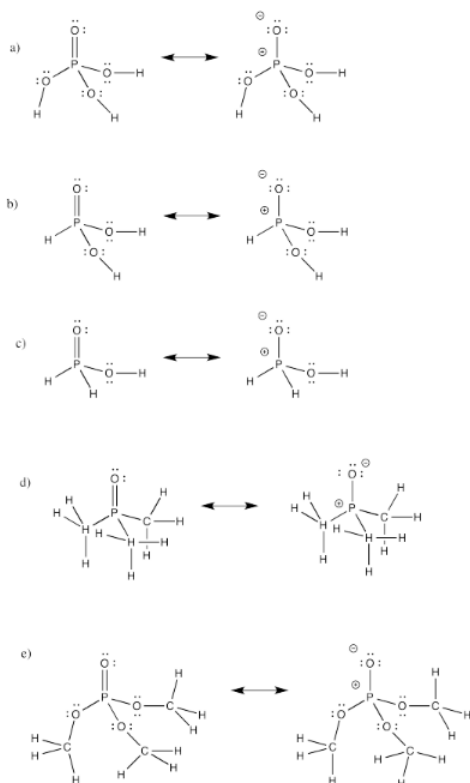
### Exercise 4.11.2:





Answers to Exercise 4.11.2, a through f, showing several Lewis structures with bonds being removed or the label "obedient".

### Exercise 4.11.3:



#### Exercise 4.12.2:

a) propane b) pentane c) hexane

#### Exercise 4.12.3:

a) 3-methylhexane b) 2,2-dimethylpentane c) 2,3-dimethylbutane  
d) 2,2,3,3-tetramethylpentane e) 3,5-dimethylheptane f) 4-ethyl-3,6-dimethyloctane

#### Exercise 4.12.4

a) cyclopentane b) cyclohexane c) cyclooctane  
d) methylcyclobutane e) 1,1,3-trimethylcyclopentane f) 1,3-dimethylcycloheptane

#### Exercise 4.12.5:

a) 1-hexene b) 2-methyl-2-pentene c) 1-methylcyclohexene d) 2,4,6-trimethyl-2-heptene

#### Exercise 4.12.6:

a) cyclopentene b) 1,1-dimethylcyclohexane c) 3-hexyne  
d) 4-methylcyclohexene e) 1-hexyne

#### Exercise 4.12.7:

a) tetrahedral b) trigonal planar c) linear

#### Exercise 4.12.8:

a) methylbenzene b) propylbenzene c) 1,2-dimethylbenzene or *o*-dimethylbenzene (also *o*-xylene)  
d) 1,3-dimethylbenzene or *m*-dimethylbenzene (also *m*-xylene) e) 1,4-diethylbenzene or *p*-diethylbenzene  
f) 2-ethyl-1,4-dimethylbenzene

### Exercise 4.12.9:

- a) 2,2-dimethylhexanal b) 2-methylcyclopentanone  
c) 3-nonanone d) 2,4-dimethyl-2-hexenal

### Exercise 4.12.10:

- a) butyl propanoate b) *N,N*-diethylbutanamide  
c) 6-methylheptanoic acid d) 4-pentenoic acid

### Exercise 4.12.11:

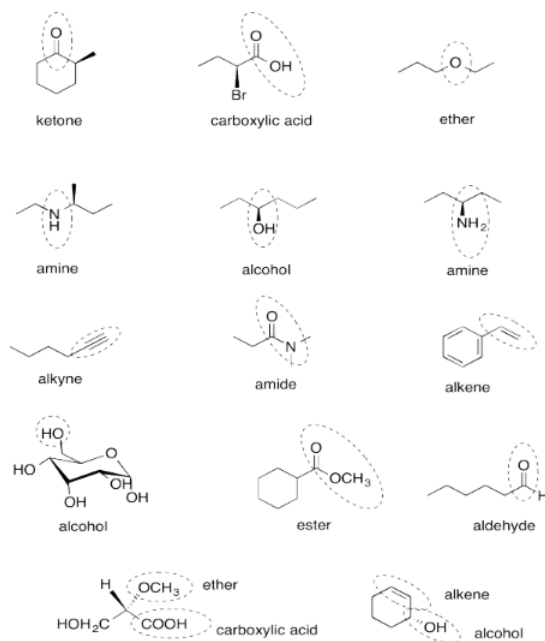
- a) 1-chloro-2-methylcyclohexane b) cyclooctanol c) ethyl cyclopentyl ether  
d) *N*-propylcyclohexylamine e), 5,5-dimethylheptan-2-ol f) 3-bromo-4,4-dimethyloctane  
g) dibutylamine i) methyl phenyl ether (or anisole) j) ethane thiol k) diethyl thioether  
l) triethylphosphine m) butanenitrile n) nitromethane

Note that sometimes a number is located directly in front of the suffix for the group to which it refers.

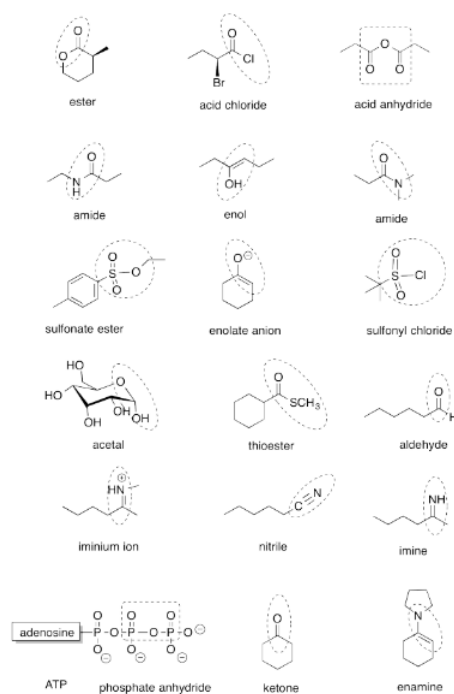
### Exercise 4.12.12

- benzene (or aromatic), ketone and ether
- bromide, amine and aldehyde
- alcohol, thiol and ester
- thioether, amide and alkene
- alkyne, alcohol and carboxylic acid

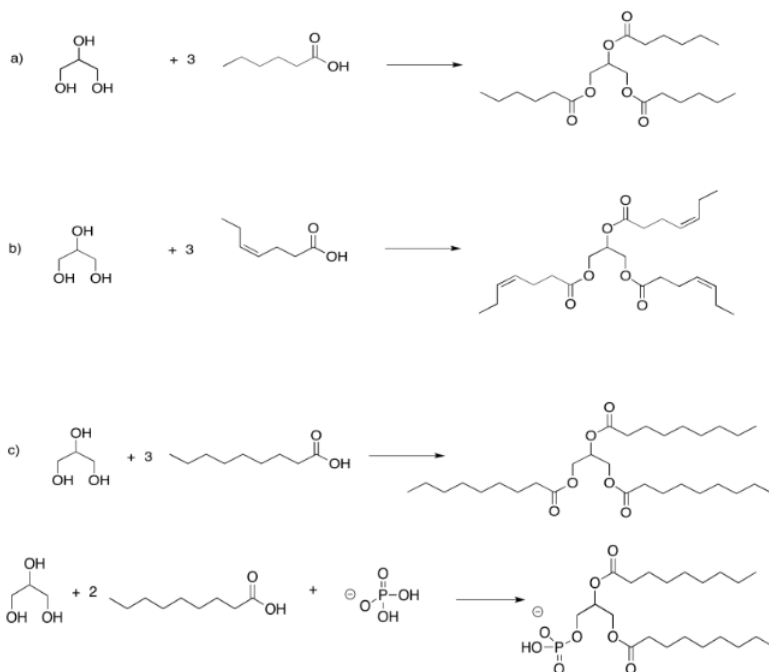
### Exercise 4.12.13

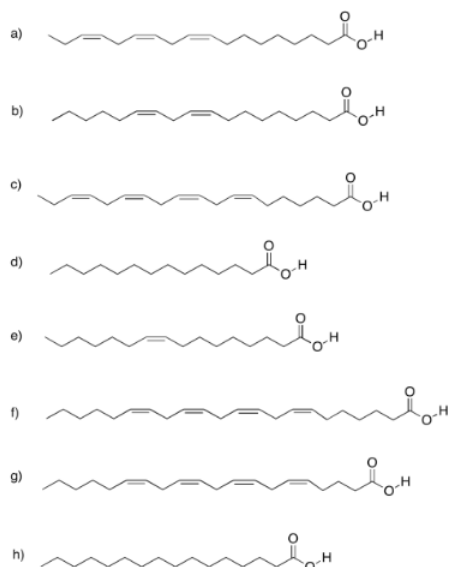


### Exercise 4.12.14

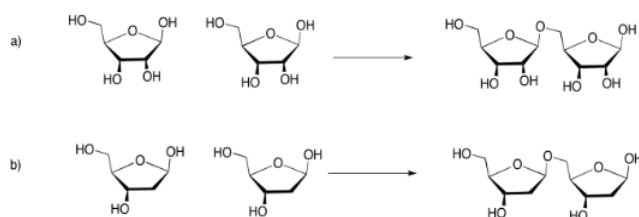


### Exercise 4.13.1:





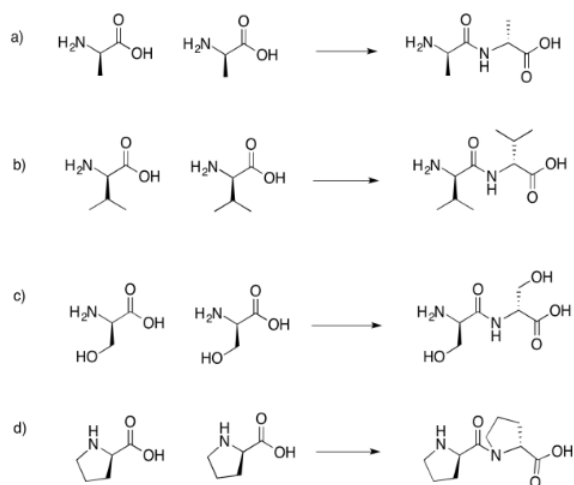
#### Exercise 4.13.4:



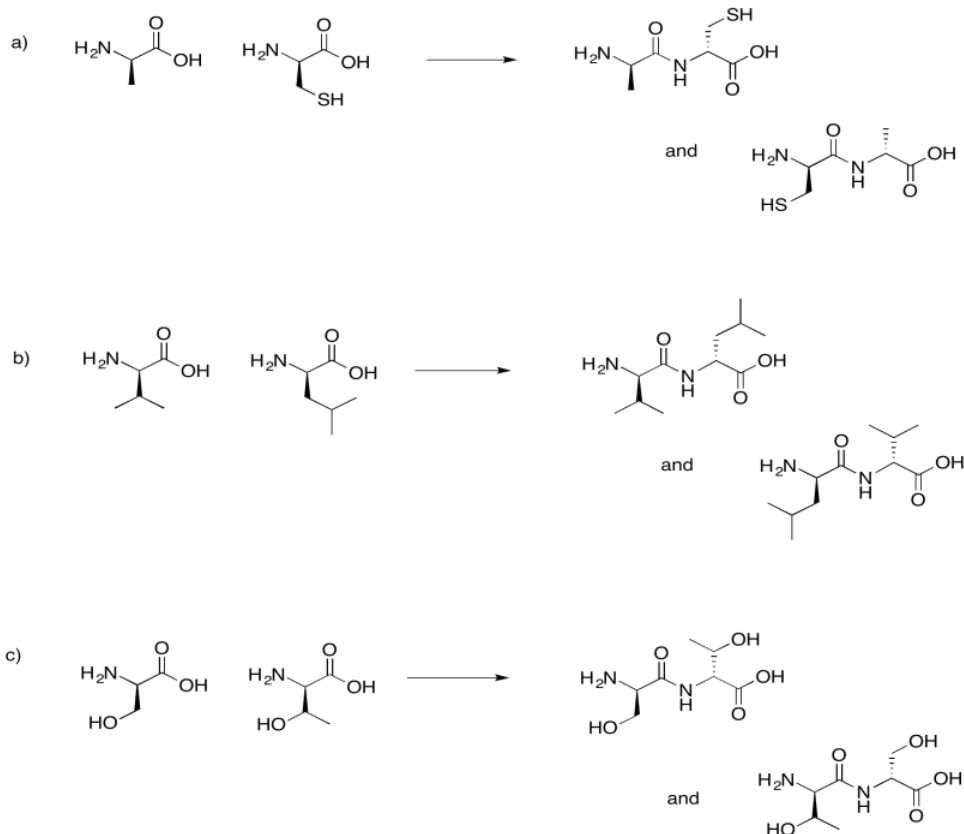
Answers to Exercise 4.13.4, a and b, showing formation of glycosidic linkages between ribose and deoxyribose, respectively.

#### Exercise 4.13.5:

If you don't know what the wedged and dashed lines in the drawing mean, don't worry about it. They just represent different orientations in space. You will learn about these representations in a later topic called "stereochemistry".

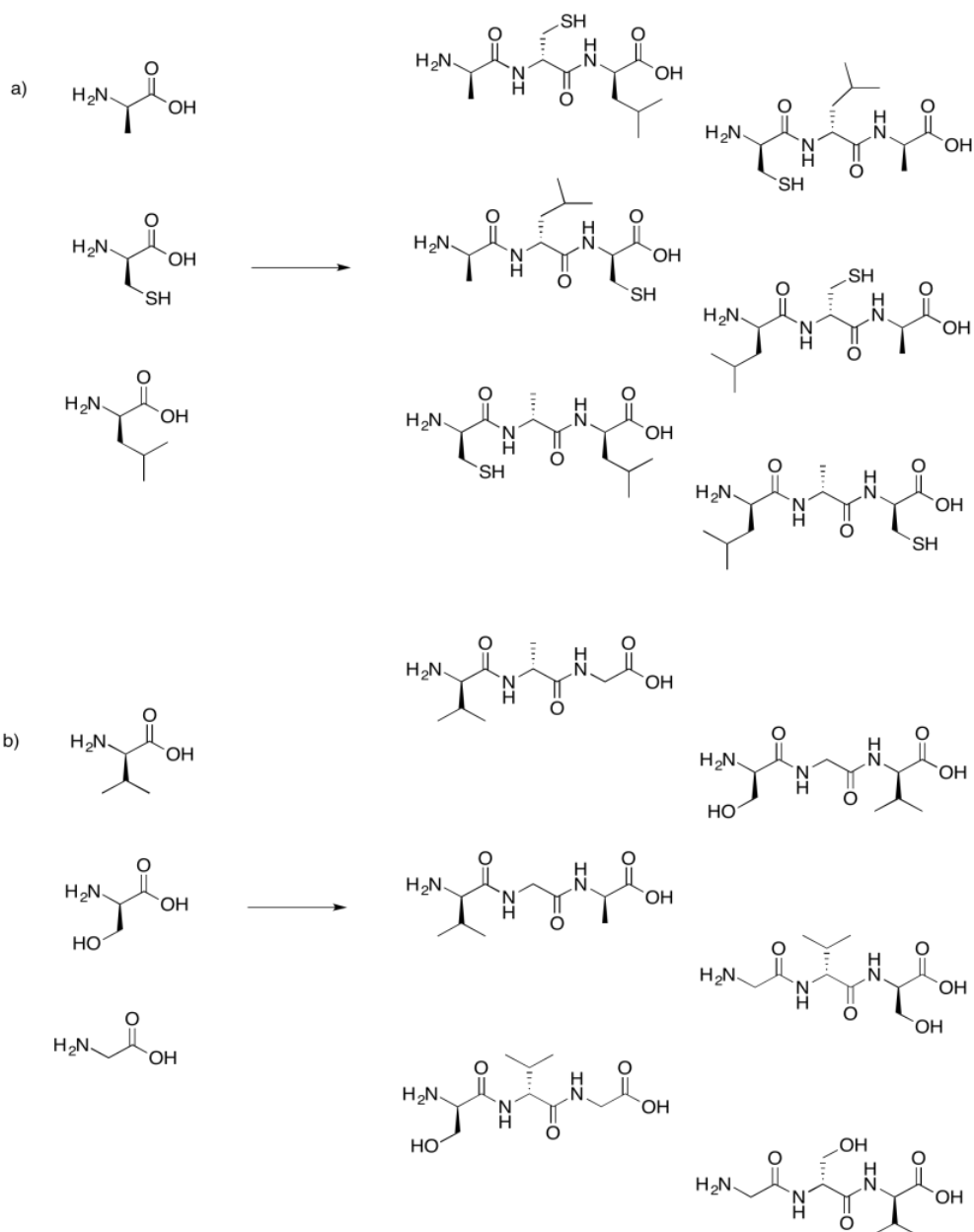


#### Exercise 4.13.6:

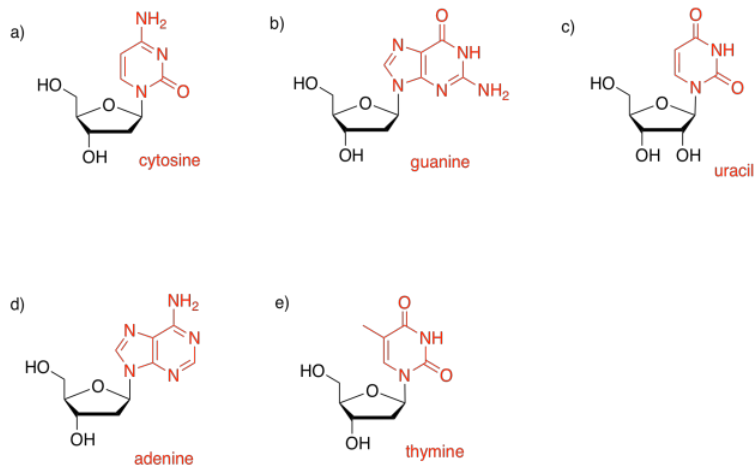


Answers to Exercise 4.13.6, a through c, showing different orientations of dipeptides formed from two amino acids.

[Exercise 4.13.7:](#)

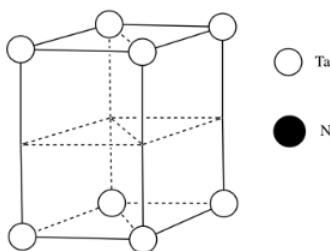


### Exercise 4.13.8:

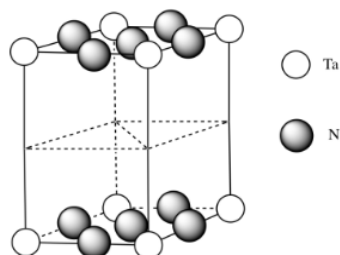


Exercise 4.15.1:

- $N^{3-}$  would get to a noble gas configuration.
  - $Ta^{3+}$  would balance the charge in TaN.
- c)



d)



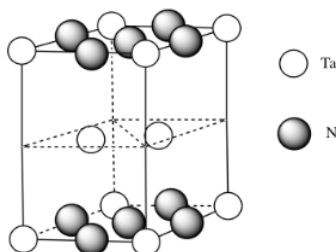
Answer to Exercise 4.15.1d, with unit cell filled in with tantalum and nitrogen on the top and bottom layers only.

e)  $\#Ta = (\frac{1}{6})(\frac{1}{2})(4)$  for the acute corners and  $(\frac{1}{3})(\frac{1}{2})(4)$  for the obtuse corners  $= \frac{4}{12} + \frac{4}{6} = \frac{4}{12} + \frac{8}{12} = 1$

(note that it's the same outcome as the corners of a cube)

f)  $\#N = (\frac{1}{4})(8)$  for the edges and  $(\frac{1}{2})(2)$  for the faces  $= 2 + 1 = 3$

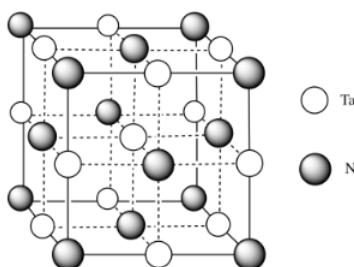
g) Need 2 more Ta.



Answer to Exercise 4.15.1d, with unit cell filled in with tantalum and nitrogen. There are two atoms of tantalum in layer two.

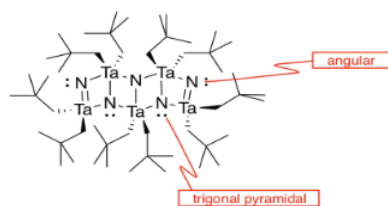
h) Each tantalum has three nitrogens above and three below it. It's almost octahedral, but the top layer of nitrogens is lined up above the bottom layer rather than being twisted 120 degrees to form an octahedron. The geometry is a trigonal prism.

i)



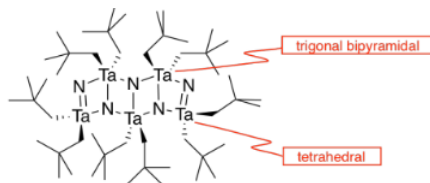
j)





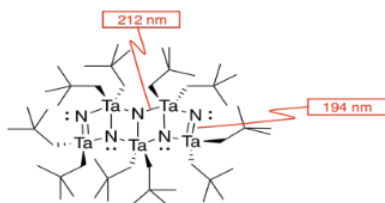
Structure of tantalum-nitrogen lattice, with geometries about different nitrogen atoms labelled as trigonal pyramidal and angular.

k)



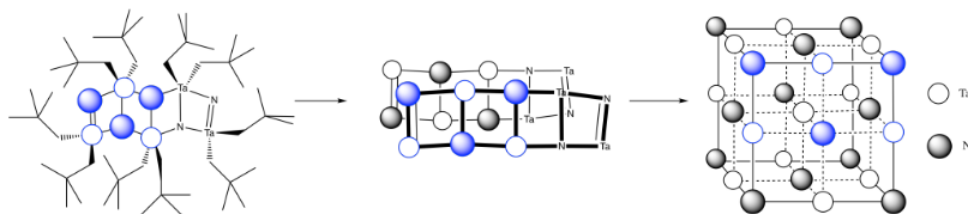
Answer to Exercise 4.15.1k. Structure of tantalum-nitrogen lattice, with geometries about different nitrogen atoms labelled as trigonal pyramidal and angular. The lone pairs are removed.

l) The double bonds hold the atoms more closely together than the single bonds.



Answer to Exercise 4.15.1k. Structure of tantalum-nitrogen lattice, with the single tantalum-nitrogen bonds labelled as 212 nanometers and the double bonds labelled as 194 nanometers.

m) You can imagine the molecules stacking together to make a cubic array of TaN.



Answer to Exercise 4.13.1m, showing how the structure of the tantalum-nitrogen solid can be modelled in different forms.

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