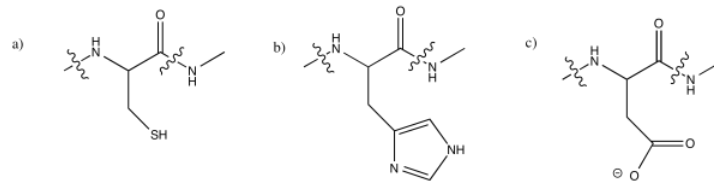
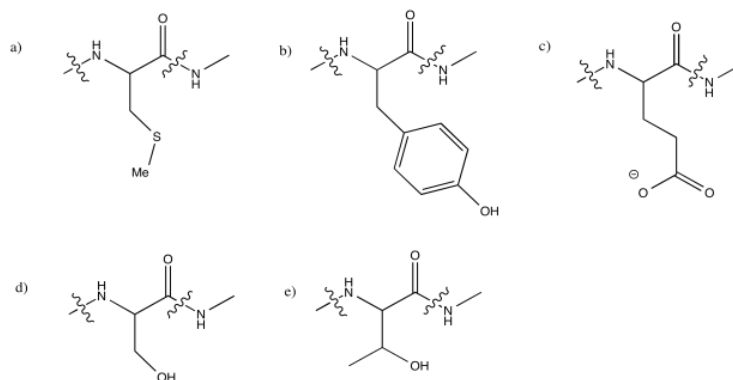


## 2.8: Solutions for Selected Problems

### Exercise 2.1.1:

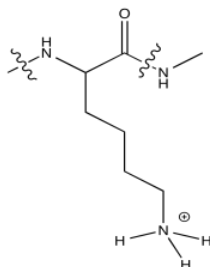


### Exercise 2.1.2:



### Exercise 2.1.3:

At neutral pH, lysine would normally be protonated. It would not have a lone pair on the nitrogen to coordinate a metal ion.



### Exercise 2.4.6:

The  $pK_a$  of an  $\alpha$ -position is typically about 20, although it can vary depending on what other groups are nearby. That is too high to build up a significant amount of the deprotonated species in water, which has a  $pK_a$  (in water) of 14.

### Exercise 2.4.7:

- The  $pK_a$  of the side chain of histidine is about 6.0; upon changing from pH 7 to pH 5, this group would become protonated and positively charged. The positive charge would be more stabilising (or less destabilising) toward  $Fe^{2+}$  than  $Fe^{3+}$ ; the reduction potential would increase.
- The  $pK_a$  of the side chain of histidine is about 3.7; upon changing from pH 4 to pH 3, this group would become protonated and positively charged. The positive charge would be more stabilising (or less destabilising) toward  $Fe^{2+}$  than  $Fe^{3+}$ ; the reduction potential would increase.
- The  $pK_a$  of the side chain of histidine is about 4.2; upon changing from pH 4 to pH 5, this group would become deprotonated and negatively charged. The negative charge would be more stabilising (or less destabilising) toward  $Fe^{3+}$  than  $Fe^{2+}$ ; the reduction potential would decrease.

### Exercise 2.5.1:

$Ti^{4+}$  and  $Ca^{2+}$

### Exercise 2.5.2:

$F^-$  and  $HO^-$

Exercise 2.5.3:

- a.  $Co^{2+}$  with  $NO_2^-$
- b.  $Mg^{2+}$  with  $CH_3CO_2^-$
- c.  $Cu^+$  with  $RS^-$
- d.  $Fe^{2+}$  with  $N_2$
- e.  $Zn^{2+}$  with imidazole

Exercise 2.5.4:

Choose the best match for the following metal ions.

- a.  $Fe^{3+}$  with asp
- b.  $Cu^+$  with met
- c.  $Zn^{2+}$  with his
- d.  $Cu^{2+}$  with his
- e.  $Co^{3+}$  with glu

Exercise 2.5.5:

Choose the amino acid residue that would have the effect on the metal ion as described, based on HSAB principles.

- a. Increase the reduction potential of  $Cu^{2+}$ : met.
- b. Decrease the reduction potential of  $Fe^{3+}$ : glu.
- c. Make  $Cu^+$  easier to oxidise: his.
- d. Make  $Fe^{2+}$  easier to oxidise: asp.
- e. Make  $Fe^{3+}$  easier to reduce: cys.

Exercise 2.7.1:

a) 0  $\beta$  b) 1.73  $\beta$  c) 2.83  $\beta$  d) 3.87  $\beta$  e) 4.89  $\beta$  f) 5.92  $\beta$

Exercise 2.7.2:

a) approx. 4  $\beta$  b) approx. 4  $\beta$  c) approx. 2  $\beta$  d) approx. 3  $\beta$   
e) approx. 5  $\beta$  f) approx. 0  $\beta$  g) approx. 6  $\beta$

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