# Exam III

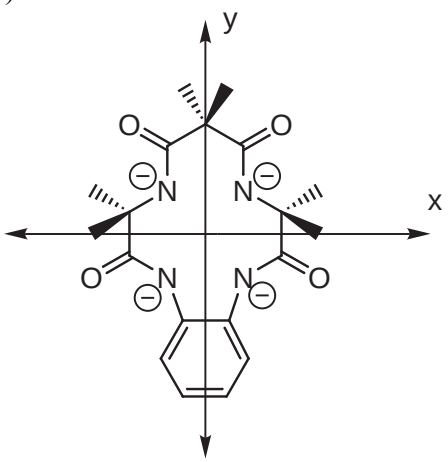
**Please read through each question carefully, and make sure you provide all of the requested information.**

1. A series of octahedral metal compounds are made from 1 mol $Mn^{3+}$, 3 mol $Cl^-$, and excess CO. The compound incorporates as much CO as needed to fill in the vacant inner sphere binding sites.

a) Compound I exists as two isomers. If we treat the isolated compounds with $AgNO_3$, 1 mol of AgCl is formed. What are the structures of the two isomers? What is the relationship between the two isomers? [8 points]

b) Compound II also exists as two isomers. A conductivity meter shows no activity- a solution of the compound does not conduct electricity. What are the structures of the two isomers? What is the relationship between the two isomers? [8 points]

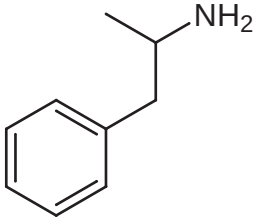
2. The following compound is typical of the Collins' type ligands. (We'll be discussing this more when we discuss catalysis on Tuesday.)




a) Circle the atom(s) that bind to the metal. [2 points]

b) Given the arrangement of the ligand on the coordinate axes, which d-orbital interacts the most with the ligand? [6 points]

3. Amphetamines were initially studied for their properties as appetite suppressants and cough medicines. Amphetamine has the following structure:




In your brain, amphetamines interact with a neuroreceptor that typically binds endorphins, causing a release of dopamine and noradrenaline and resulting in euphoria. The natural endorphins are polypeptides and the neuroreceptor recognizes them because they have a particular amino acid at the end of the molecule. This amino acid is mimicked by amphetamine.

a) What amino acid is amphetamine mimicking in structure? [4 points]

b) Is that amino acid hydrophobic or hydrophilic? [4 points]

4. I perform the following ligand replacement reaction:

$$[Fe(en)_3]^{4+} + 6\ OH^- \rightarrow [Fe(OH)_6]^{2--} + 3\ en$$

a) Draw the d-orbital splitting diagrams for the two compounds. [8 points]

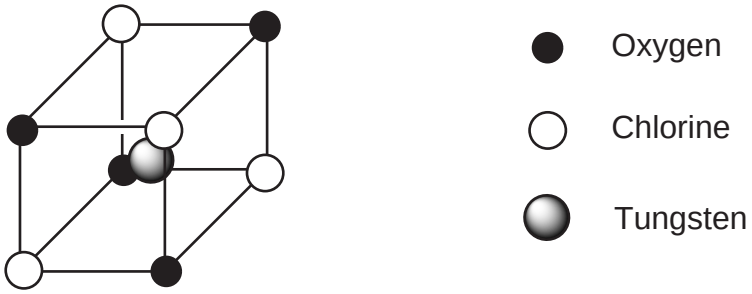
b) Which compound will interact more strongly with a magnet? [2 points]

c) If the starting material is a blue-green color, what is the size of $\Delta_o$, in kJ/mol. [4 points]

d) What color could you expect the product to be? [4 points]

5. Show how the ethanolamine ion ($H_2N\text{-}CH_2\text{-}CH_2\text{-}O^-$) can act as a bidentate ligand. You may need to draw a Lewis structure for this. Draw both isomers for Co(ethanolamine)$_3$. [8 points]

6. The unit cell below describes a fictitious compound containing Tungsten (W), Oxygen and Chlorine.



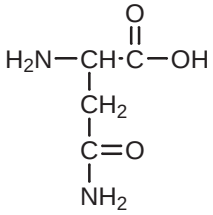

a) How many chlorine atoms are in the unit cell? [3 points]

b) How many total atoms are in the unit cell? [4 points]

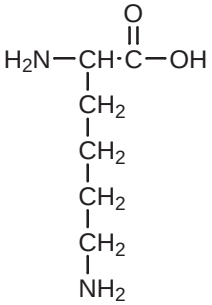
c) What is the coordination number of one of the oxygen atoms? [3 points]

d) Is this a close-packed structure? (circle one) [2 points] Yes No

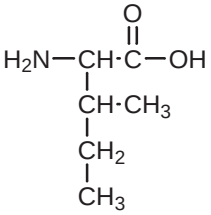
7. Use the following 6 amino acids to answer the following questions:



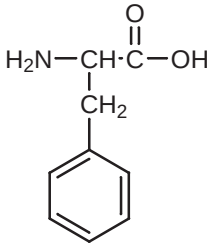
Asparagine (Asn)



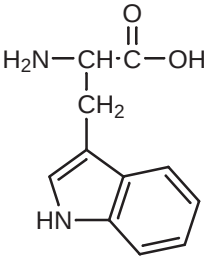
Lysine (Lys)



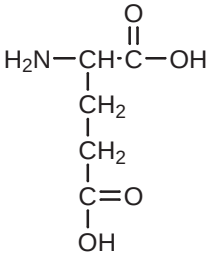
Isoleucine (Ile)



Phenylalanine (Phe)



Tryptophan (Trp)



Glutamic Acid (Glu)

Order the amino acids from the most hydrophobic to the most hydrophilic. [6 points]

If protons ($H^+$ ions) are required for a reaction to proceed, which amino acid(s) can supply that proton? [4 points]

Which amino acid(s) would be found in an active site that recognizes benzene? [4 points]

← benzene

Which amino acid(s) could exist as a positively charged side chain? [4 points]

Which amino acid(s) are both hydrogen bond donors and acceptors? [4 points]

Which amino acid(s) would you expect to find on the periphery of a protein that is bound to the surface of a membrane (extrinsic protein)? [4 points]

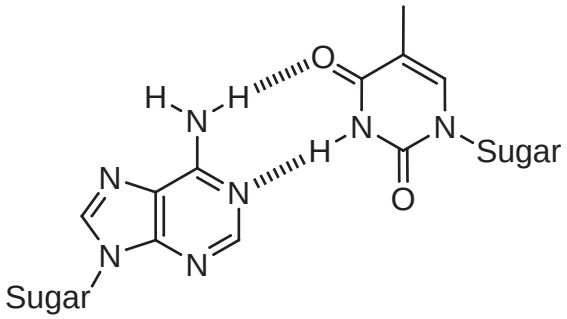
Which amino acid is the most polarizable? [4 points]

Extra Credit Question: [5 bonus points]

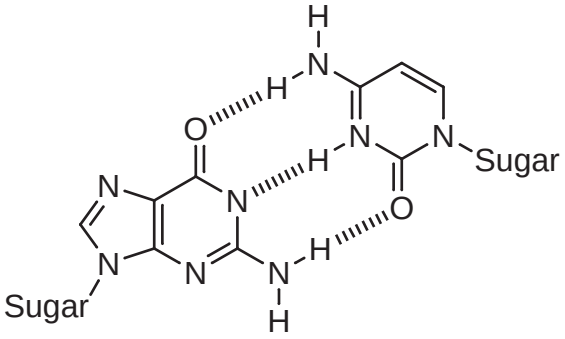
The following questions are based on Dr. Armitage's lecture, and the discussion that followed.

The figures below show the G-C and A-T base pairs, and the hydrogen bonds that are formed.

Is it more common to have a mutation with a G-C base pair or and A-T base pair? Why? How can we, as chemists, modify a base to rectify this problem? You may draw your suggestion on the figure.




A-T pair




G-C pair

| For official use only: |
|---|
| 1) _____ /16 |
| 2) _____ / 8 |
| 3) _____ / 8 |
| 4) _____ /18 |
| 5) _____ / 8 |
| 6) _____ /12 |
| 7) _____ /30 |
| subtotal _____/100 |
| Extra Credit: |
| Total _____/100 |

**Useful Stuff:** $h = 6.626 \times 10^{-34}$ J s
$c = 2.998 \times 10^{8}$ m/s
$N_A = 6.022 \times 10^{23}$ mol$^{-1}$