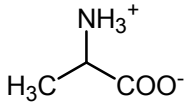
Third Exam Practice Test

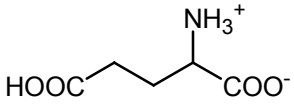
1. A mixture of aspartic acid, methionine and arginine can be separated by electrophoresis. Explain how this would be done and what exactly happens during the separation. What would be the ideal pH for conducting the separation? The isoelectric points for Asp, Met, and Arg are 2.77, 5.74, and 10.76 respectively.

2. The synthesis of alkylamines by direct substitution from simple alkyl halides and ammonia is usually complicated by overalkylation. However, this method is much more useful for the preparation of alpha-amino acids from the corresponding alpha-halo acids. Why isn't overalkylation a significant problem in the preparation of alpha-amino acids?

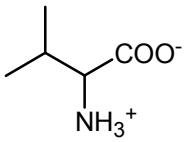
3. Use the simple nucleophilic substitution method involving ammonia and the other appropriate alpha-halo acids to propose reaction sequences suitable for the preparation of each of the following amino acids from the indicated starting materials and any other necessary reagents.



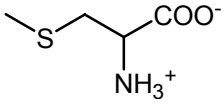
from 1-propanol



from cyclopentene



from ethylene oxide (epoxide) and propane



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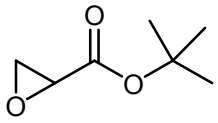
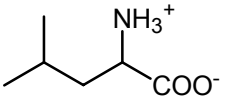


4. Use the Gabriel malonic ester methodology and propose reaction sequences suitable for the preparation of each of the following amino acids from the indicated starting materials and any other necessary reagents.



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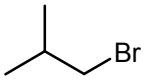

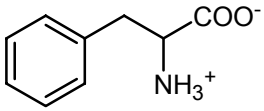

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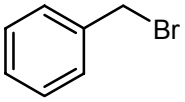

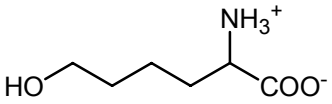

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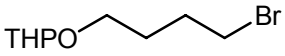
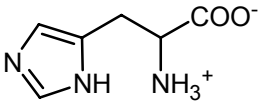


THPO is an alcohol protecting group that can be removed with acid.



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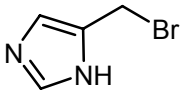
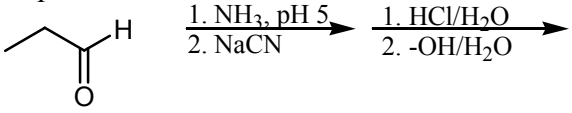
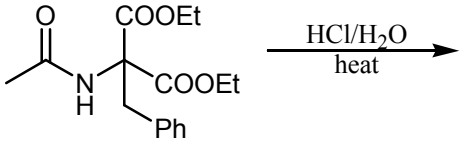
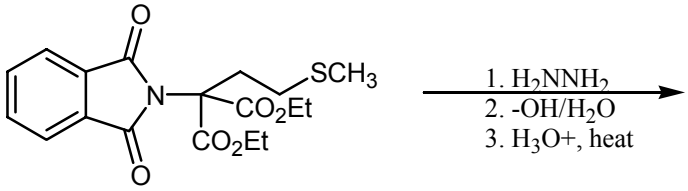


5. Give the expected major product from each of the following reactions or reaction sequences:







6. When an unknown polypeptide was treated with 3M HCl, the following amino acids were produced: Tyr, Asp, Val, Glu (1 mmol each), and Ala (2 mmol). Treatment with 1M HCl resulted in partial hydrolysis. The following fragments were isolated: Glu-Tyr-Ala, Ala-Ala, and Asp-Glu-Tyr. Suggest a structure for the peptide consistent with the data provided.

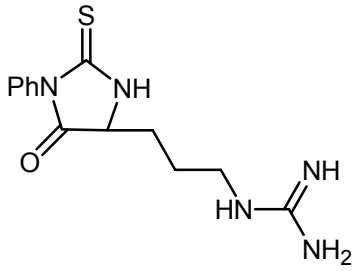
7. Draw the PTH derivative that was isolated after the second Edman degradation cycle involving the heptapeptide Tyr-Ile-glu-Asn-Cys-Pro-Ile.

8. Provide a sequence of reactions and the appropriate reagents suitable for the solid phase synthesis of the following tripeptide: Ala-Ile-Val.

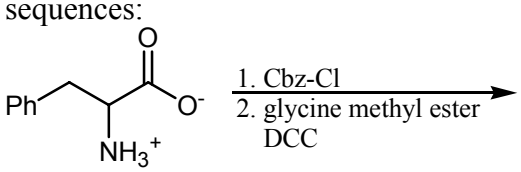
9. Suggest suitable starting materials needed to prepare each of the following amino acids by reductive amination:
   a) threonine
   b) tryptophan
   c) lysine

10. The structure of an unknown nonapeptide (B) was determined by a combination of methods. On the basis of the data provided, suggest a structure for this peptide. Recall that chymotrypsin cleaves peptide bonds at the C terminal end of Phe, Tyr, and Trp.

B $\xrightarrow{\text{chymotrypsin}}$ Ser-Pro-Phe + Arg-Pro-Pro-Gly-Phe + Arg

B $\xrightarrow{\text{Edman Degradation}}$ 

11. Draw the expected products of each of the following reactions or reaction sequences:

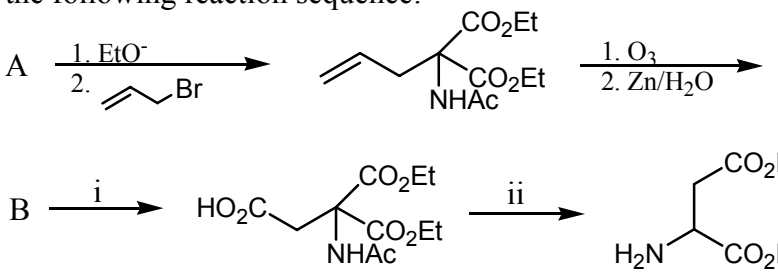


Thr-Ser-Lys $\xrightarrow[2.\ HCl/H_2O]{1.\ PhNCS/\ OH^-}$

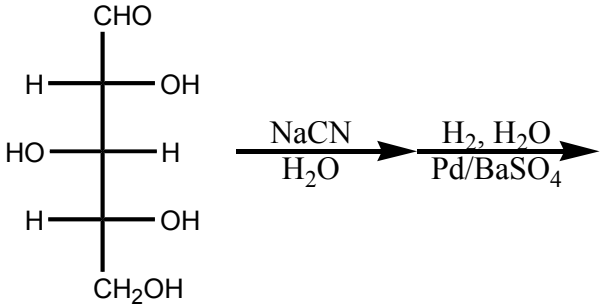
Ser-Lys $\xrightarrow[2.\ HCl/H_2O]{1.\ PhNCS/\ OH^-}$

12. Give possible Strecker syntheses for the following amino acids:
   a) methionine
   b) lysine
   c) tyrosine
   d) valine

13. Suggest structures for compounds A and B and provide the missing reagents for the following reaction sequence:



14. Draw the product(s) that is (are) formed from D-xylose in the Kiliani Fisher synthesis.



D-xylose

15. A D-hexose, annose (1) forms the same osazone as arpitose (2). Both give positive Tollens' tests but negative bisulfite tests. $NaBH_4$ converts annose to danitol (3) and arpitose to julitol (4). Both products are optically active. Sugars 1 and 2 can be formed from a D-Pentose, katherinose (5), which is converted to kristenitol (6) by $NaBH_4$. This product is optically inactive. Julitol can be obtained as well by the $NaBH_4$ reaction with L-melose (7). Identify 1 – 7 and give your reasoning.

16. A D-pentose, colleenose, is treated with a bacterium that causes epimerization at C-3 to give monose. Both pentoses afford optically inactive dicarboxylic acids with nitric acid. Colleenose was formed by a Fisher-Kiliani synthesis from carolynose, a tetrose which give an optically active compound with $NaBH_4$. Identify the three sugars. Show your reasoning.

17. While Americans in Atlanta were gladly making gum in gallon tanks, Alsatians in Aachen were gladly mixing grain in Germanic tons. One Alsatian names Fisher synthesized a D-hexose from a D-pentose, whose product with nitric acid was optically inactive. The nitric acid treatment of the D-hexose did give an optically active product, which could not be made by the nitric acid reaction with any L-hexose. Identify the D-hexose and show your reasoning.

18. This Fisher proof was from my final exam last year. Note the name of the D-hexose that Professor McNelis chose.

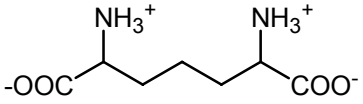
Determine the structure of D-hexose, Pamelose. Pamelose and its epimer kamarose are both formed by Kiliani-Fisher from D-pentose, clyrose. Treatment of D-hexose with $NaBH_4$ yields an optically active product. Treatment of D-pentose with $NaBH_4$ yields an optically inactive product. There is L-hexose that afforded Pamelose product but the product from kamarose has no other source.

19. Give a mechanism for the Edman degradation of Ala-Ala using phenylthilocyanate.

20. Give the mechanism for the coupling of Gly-Ala using DCC.

21. Dilbert Dunker and Gangrene McCloskey have transferred to Louisiana Subnormal to become bayou chemists. They wished to synthesize a polypeptide by the Merrifield method. After activating the polystyrene beads with benzyl chloride groups they added amino acid A, followed by deprotection and then amino acid B to form the first peptide bond with DCC. They repeated the process 9 times. When the treated the resin with strong acid to free the peptide, no product was obtained. What was the problem?

22. Propose syntheses for the following:



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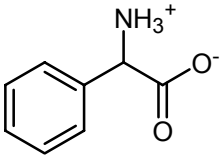
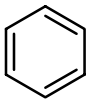


from 

*For more questions on amines, please see the Amines review sheet posted at http://homepages.nyu.edu/~pmt213.