Chem 313 Midterm 2 2 November 2015

Name Answer Key (This exam is out of 100 points.)

Student Number _____

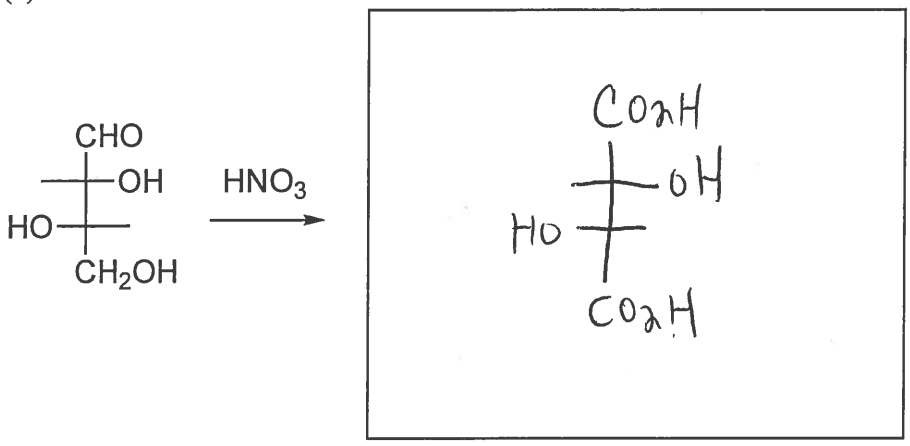
1. [40] _____
2. [8] _____
3. [14] _____
4. [18] _____
5. [20] _____

Total [100] _____

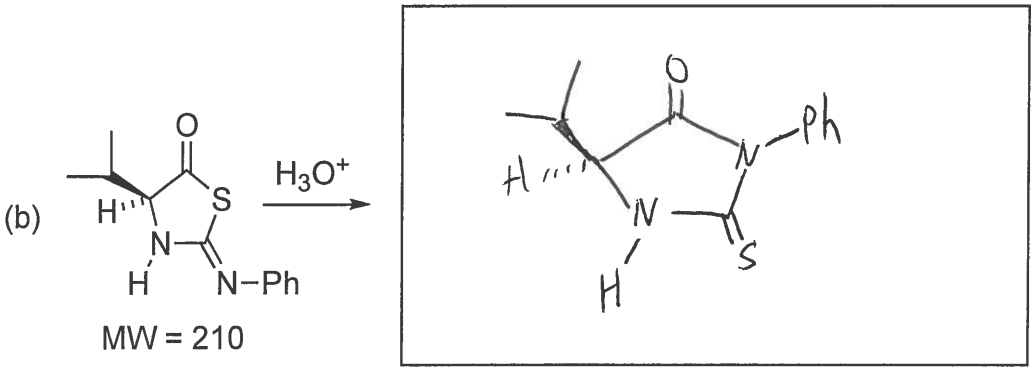
You may tear off the last page. If you do so, please be sure the staple remains intact.

1. [40 points] Predict the product(s) of the reactions below. No mechanisms are needed. Show stereochemistry where appropriate.

(a)

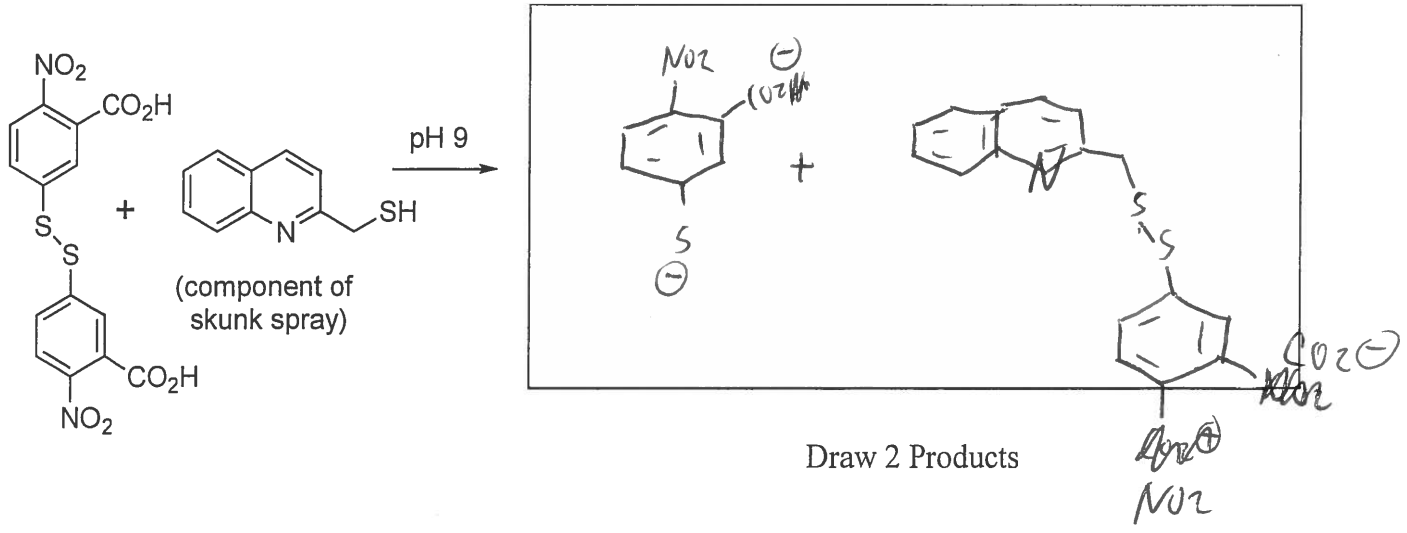


(b)



MW = 210

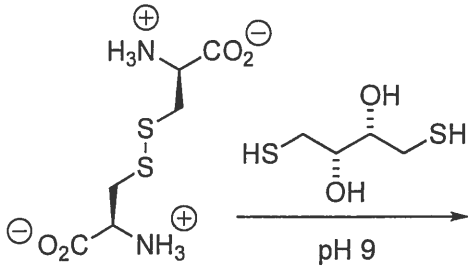
(c)

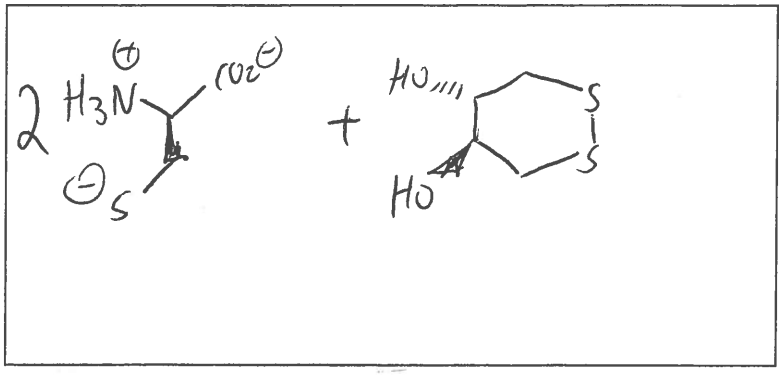


Draw 2 Products

1. (continued)

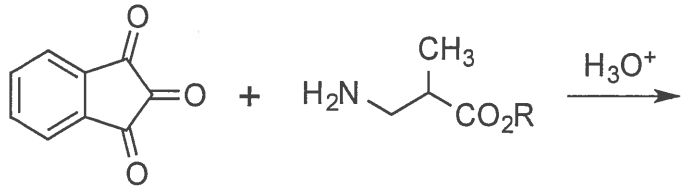
(d)

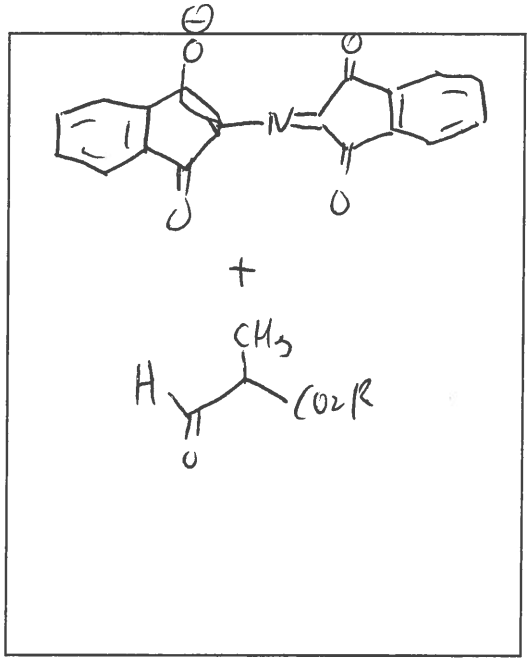




Draw all products

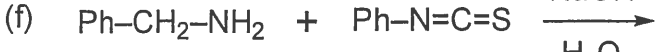
(e)

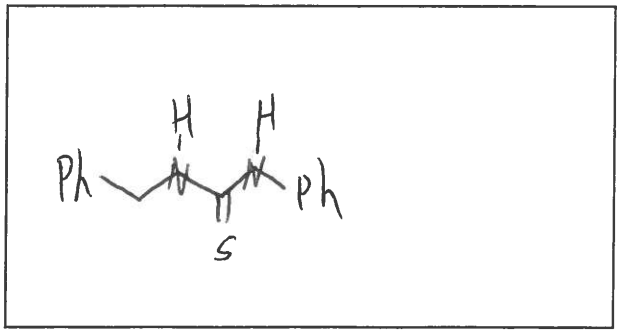




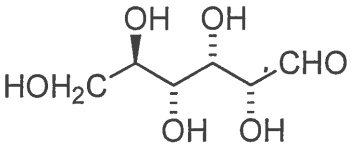
Draw Two Products

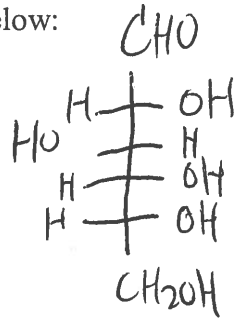
(f)



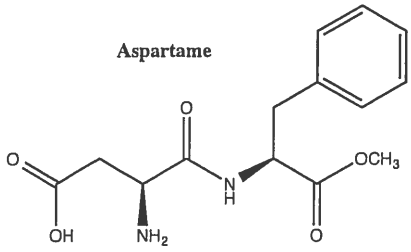


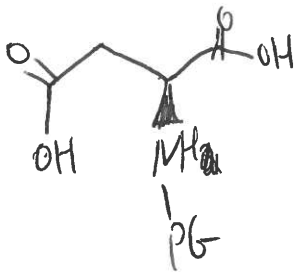
2. [8 points] Draw the Fischer Projection of the compound below:

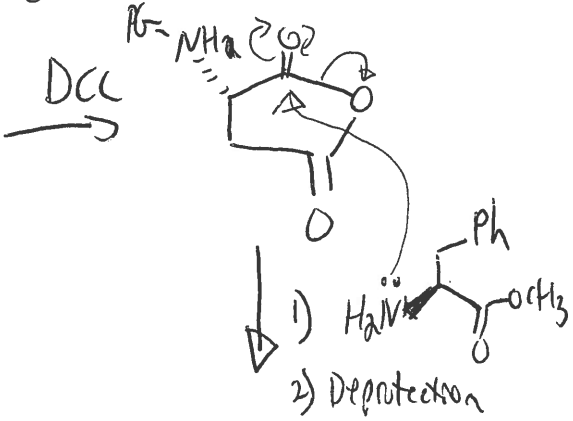




3. [14 points] From Wikipedia: "In the chemical synthesis of Aspartame, the two carboxyl groups of aspartic acid (R = CH_2CO_2H) are joined into an anhydride, and the amino group is protected by a compound that will prevent further reactions of that group. Phenylalanine (R = CH_2Ph) is converted to its methyl ester and combined with the *N*-protected aspartic anhydride; then the blocking group is removed from aspartic acid by acid hydrolysis." **(a)** Propose a synthesis of Aspartame starting from the *N*-protected (use PG) aspartic acid and methylated phenylalanine. Draw all structures. Use "deprotection" as conditions for removing the PG.



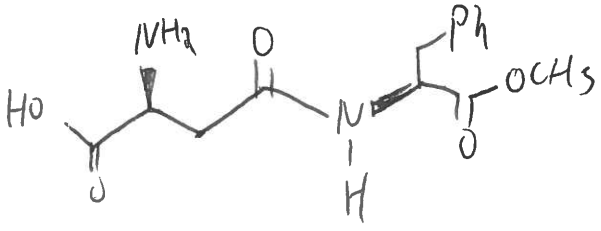




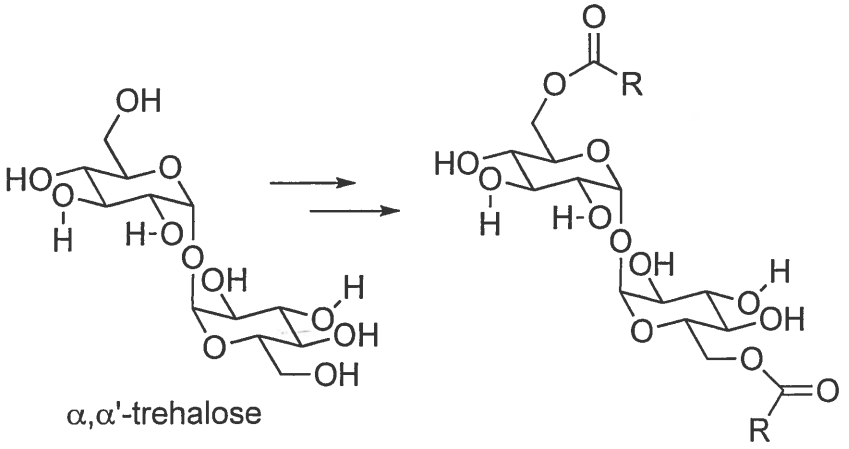
(mech. not necessary)

aspartame

(b) "The drawback of this technique is that a byproduct, the bitter-tasting β-form, is produced when the wrong carboxyl group from aspartic acid links to phenylalanine." Draw the Propose β-form of Aspartame.



4. [18 points] On a previous final exam, students were asked the following: "Propose a synthesis of the compound below, right, starting from α,α'-trehalose. Use any reagents you like, including activated ester RCOX, where X is anything you like. (Hint: the synthesis should require five steps.)"



α,α'-trehalose

A common answer that received only part marks was: (1) 2 equiv. TrCl, pyr.; (2) excess Ac_2O, pyr.; (3) dilute weak acid; (4) RCOCl, pyr.; (5) MeOH, MeO^-. (a) Why did this answer only receive part marks (i.e., what is the flaw?)?

$MeO^{\ominus}$ will remove both R(C=O)O-sugar linkages.

(b) Propose a 5-step synthesis that is worthy of full marks (structures are not needed).

1) 2 equiv. TrCl, pyr.

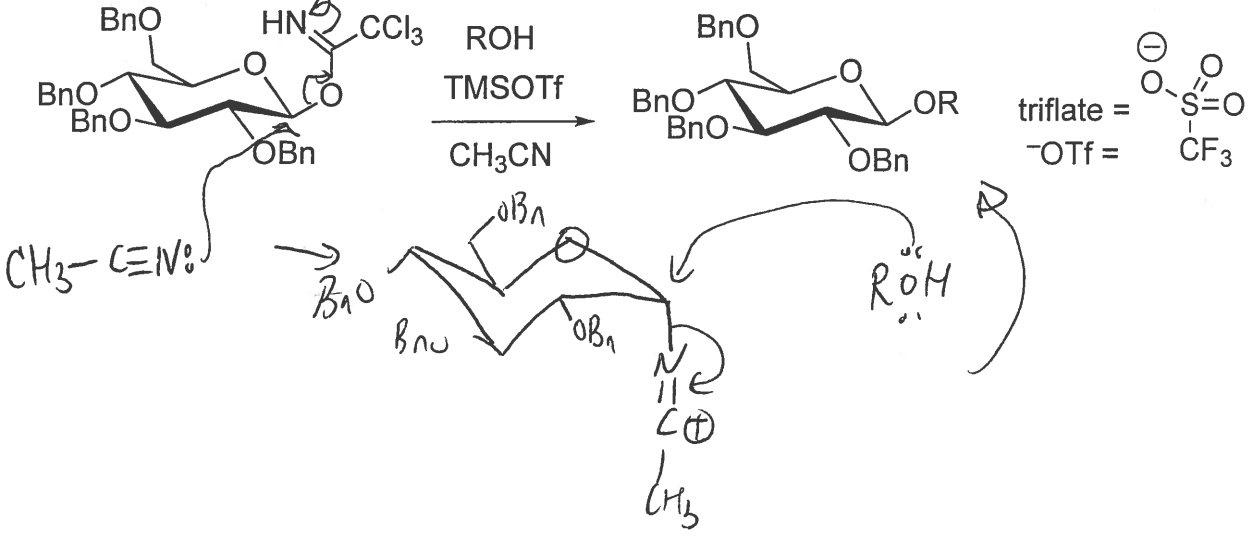
2) excess BnBr, NaH

3) dilute weak acid

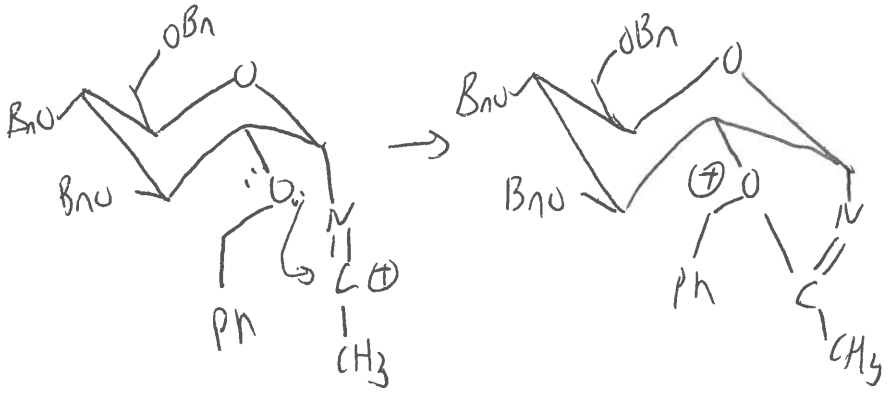
4) RCOCl, pyr

5) H_2, Cat.

5. [20 points] In forming bonds at the anomeric center, solvents such as acetonitrile can have a "nitrile effect," the results of which are shown below. (a) Propose a mechanism for this transformation. TMSOTf acts as a Lewis Acid to activate the trichloroacetimidate and make it a good leaving group: mechanistically, you can treat both together as a simple LG (like Br^-). Hint: Assume an oxocarbenium does not form.



(b) What effect, if any, do you think the stereochemistry at C2 has on this reaction? Use structures to help explain your answer.



The C2 OBn can stabilize the α-nitrilium.

The C2 epimer would likely stabilize the β-nitrilium.