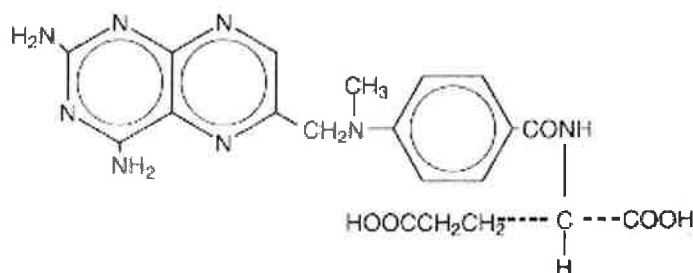


Chemistry 110B
SECOND EXAM
February 22, 2012

Name (print) _____

Note: Your exam should consist of 5 pages including this cover sheet. Skim the entire exam and solve the easiest problems first.



Molecular weight: 454.45
 $C_{20}H_{22}N_8O_5$

"Supply of Cancer Drug May Run Out in Months" by Gardiner Harris, *NYT*, February 10, 2012

Quoting from the article:

A crucial medicine to treat childhood leukemia is in such short supply that hospitals across the country may exhaust their stores within the next two weeks, leaving hundreds and perhaps thousands of children at risk of dying from a largely curable disease, federal officials and cancer doctors say.

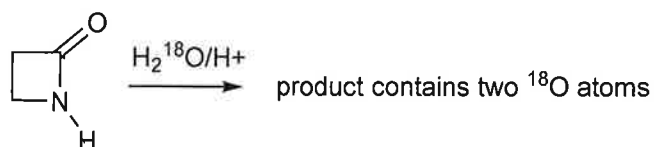
Ben Venue Laboratories was one of the nation's largest suppliers of injectable preservative-free **methotrexate**, but the company voluntarily suspended operations at its plant in Bedford, Ohio, in November because of "significant manufacturing and quality concerns," the company announced.

Since then, supplies of methotrexate have gradually dwindled to the point where oncologists now say they are fearful that shortfalls may occur at many hospitals within two weeks.

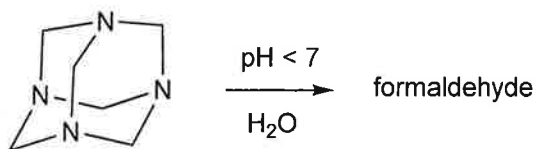
DO NOT OPEN THIS EXAM UNTIL INSTRUCTED TO DO SO

1. (a) Use a mechanism to account for the incorporation of two ^{18}O atoms into the product formed by acid-catalyzed hydrolysis of unlabeled β -propiolactam with ^{18}O -labeled water (H_2^{18}O). 12 pts

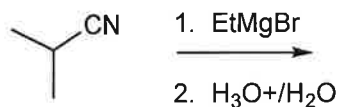
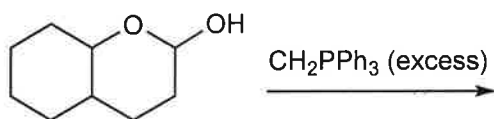
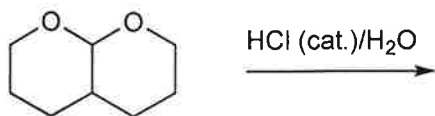
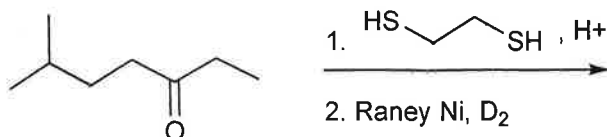
2



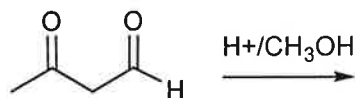
(b) Methenamine is a prodrug used for site-specific delivery of formaldehyde (an antiseptic). It is formulated in pill form that protects the molecule from the $\text{pH} < 7$ stomach environment. The pills then dissolve in the $\text{pH} > 7$ intestinal tract, where methenamine is stable. Once it is transferred to the $\text{pH} < 7$ urinary tract, Methenamine liberates 6 formaldehyde molecules. Write a mechanism to demonstrate how one formaldehyde molecule is produced. 12 pts



2. Predict the major product expected for each reaction shown. State "NR" if no reaction is expected. 5 pts ea

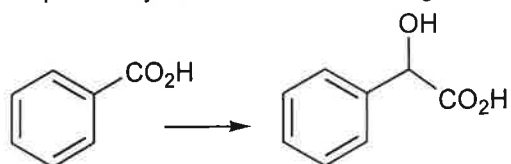


3. In acidic methanol, 3-oxobutanal is transformed into a new compound. Analyze the NMR and IR data and propose a structure for this product. (10 pts)

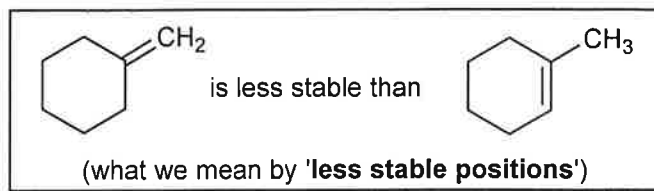


Product ¹H NMR: δ 2.19 ppm (s, 3H),
 2.75 (d, 2H), 3.38 (s, 6H), 4.89 (t, 1H);
 IR: 1715 cm⁻¹

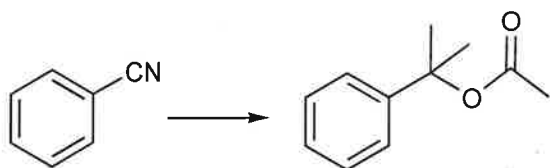
4. Propose a synthesis for the following transformation (show structures on the path, mechanisms not required). 10 pts



5. The Wittig reaction is useful for placing double bonds in **less stable positions**. For example, the following transformation can be accomplished using a Wittig reaction. (a) Show how you would use a Wittig reaction to do this (mechanisms not required). (b) Show how you do this *without* using a Wittig reaction, and explain why the Wittig reaction is a much better synthesis (the alternate route should **not** involve Wittig-type reactions like the Horner-Emmons reaction). 10 pts

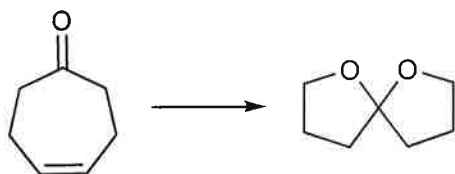


6. Propose an efficient synthesis of the following compound (mechanisms not required). 10 pts



7. A carboxylic acid with formula $C_5H_{10}O_2$ is treated with thionyl chloride to give compound **A**. Compound **A** has only one signal in its NMR spectrum. Draw the structure of the product that is formed when **A** is treated with a methanol/pyridine mixture. 6 pts

8. Propose a synthesis for the following transformation (show structures on the path, mechanisms not required). 10 pts



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Page	Points	Score
2	24	
3	40	
4	36	
Total	100	