Chemistry 3B
Fall, 1992

Second Midterm
5 November 1992

Paul A. Bartlett

Your Name: _____

PLEASE CIRCLE YOUR SECTION NUMBER/NAME OF TA

101/Matthew Marx	301/Whitney Smith
102/Bruce Ellsworth	311/Adam Matzger
111/Jim Krom	312/Drew Thompson
112/Jason Martin	411/Stephen Mills
211/Corey Liu	412/Sun Yeoul Lee
212/Chad Peterson	511/Traci Hopkins

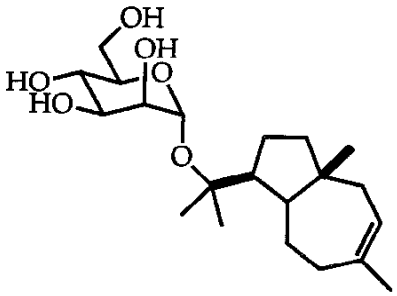
AT THE BEGINNING:

This exam has NINE pages;
make sure that you have them all.
Please write your answers in the boxes provided.
We will only grade the answers that are in the boxes; please do your scratch work on the backs of the pages.

I	(25 pts)	_____
II	(25 pts)	_____
III	(25 pts)	_____
IV	(45 pts)	_____
V	(40 pts)	_____
VI	(40 pts)	_____
Total	**(200 pts)**	_____

I. (25 points)

The following compound results from a combination of two types of natural products that we have studied this semester.

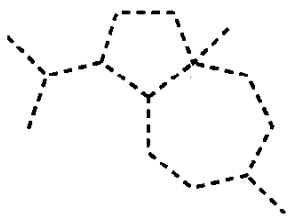


A. What is the name of the sugar in this structure?

B. Circle the correct characteristics of the sugar:

D-	or	L-
aldose	or	ketose
pentose	or	hexose
furanose	or	pyranose
α-	or	β-

C. Identify the isoprene units in the terpene part of the structure by circling the units or by darkening the appropriate bonds on the skeleton below. NOTE: There is more than one way to do this; choose the one that is compatible with the fact that farnesyl pyrophosphate is the biosynthetic precursor.

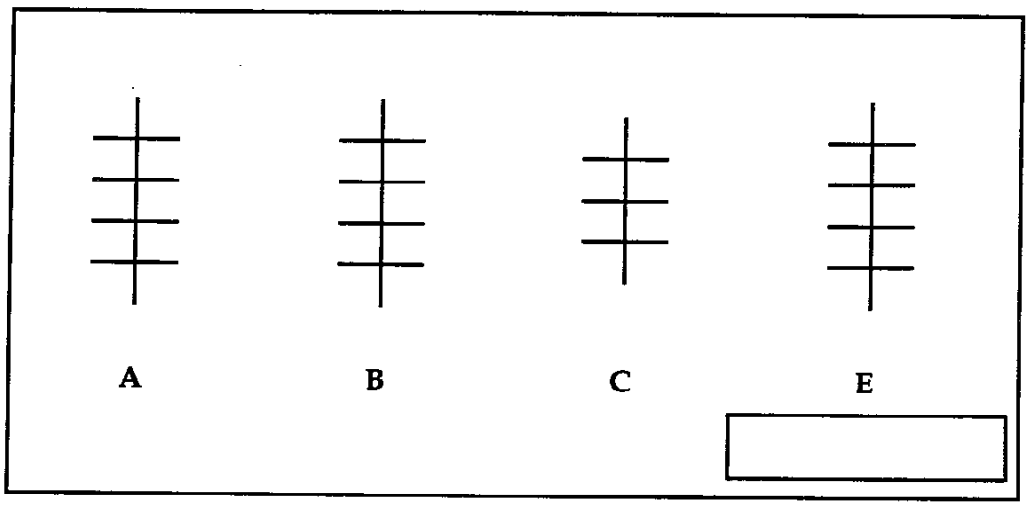


II. (25 points)

A sequence of transformations were carried out to determine the structure of a sugar, **A**:

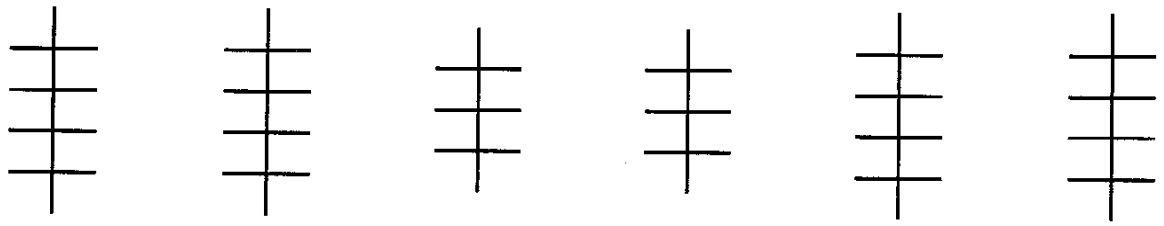
1. A D-aldohexose **A** gives an optically active alditol **B** on reduction with $NaBH_4$.
2. Ruff degradation of **A** gives an aldopentose **C**.
3. Reduction of **C** with $NaBH_4$ gives an optically active aldopentitol **D**.
4. Kiliani-Fischer chain extension of **C** gives two sugars, **A** and **E**.
5. Reduction of **E** with $NaBH_4$ gives an optically inactive alditol **F**.

A. Write the structures of **A, B, C,** and **E**.



B. What is the name of sugar E?

(Some more templates are provided below to help you solve the problem; please write your final answers above, because we will not grade any structures below.)

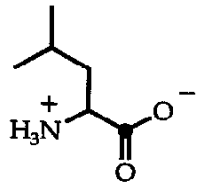


III. (25 points)

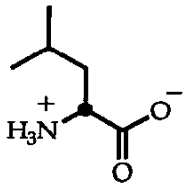
Using Na $^{14}C{\equiv}N$ as the source of ^{14}C, along with any other reagents or starting materials, show how to synthesize leucine with ^{14}C label at the designated carbons (•).

(Note: You do not have to resolve the amino acid into its enantiomers.)

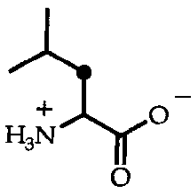
A.



B.

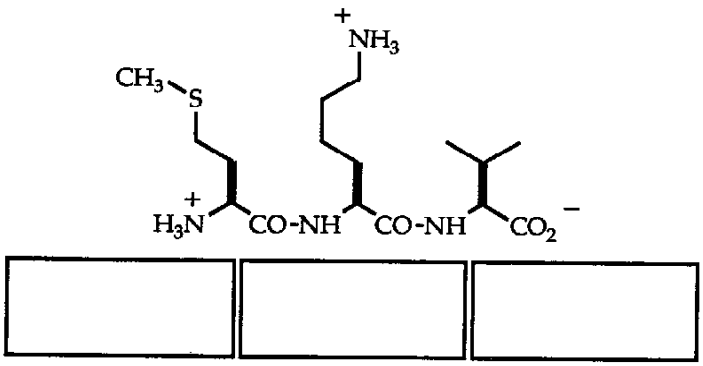


C.

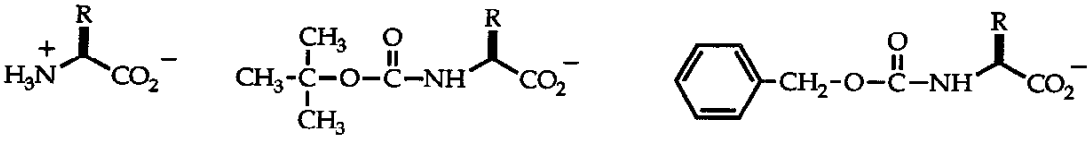


IV. (45 points)

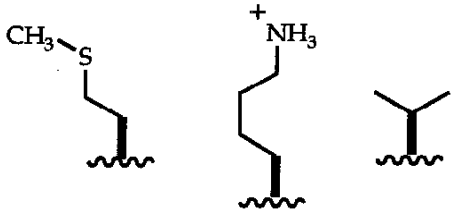
The need for "orthogonal" protecting groups is most obvious in the synthesis of peptides with acidic or basic side chains. Keeping this in mind, on the following page show how to synthesize the tripeptide below in an efficient manner (without producing any isomeric compounds or mixtures).



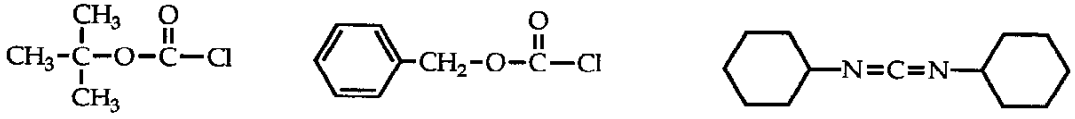
You may use as starting materials the following amino acid derivatives:

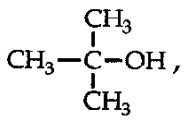
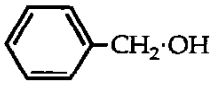


where R = the **unprotected** side chains:

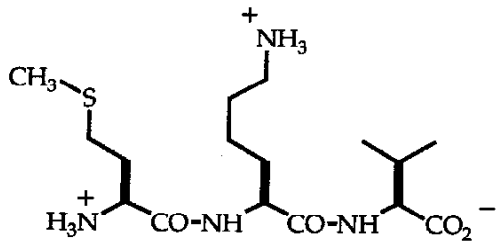


You may also use the following reagents:



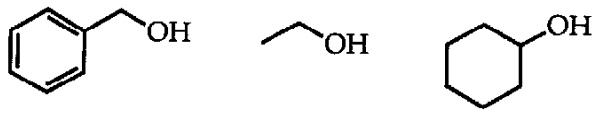
HCl, $SOCl_2$, CF_3CO_2H, Et_3N, H_2/Pt, CH_3OH,  , 

IV., continued



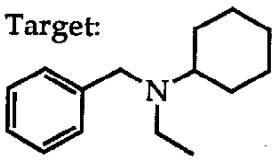
V. (40 points)

Show how to synthesize the amine below from the indicated starting materials.

Starting materials: 

You may use any other reagents that do not incorporate carbon into the product.

(Note: A route that requires separation of mixtures of products will not receive as much credit as one that will give only the desired compound.)

Target: 

VI. (40 points) An octapeptide was analyzed by the following steps.

1. Hydrolysis with 6N HCl at 110 °C for two hours, followed by amino acid analysis, indicated the composition:

   (Alanine, Arginine, Lysine, Phenylalanine, $Serine_2$, Threonine, Tyrosine)
   [abbreviated (Ala, Arg, Lys, Phe, Ser_2, Thr, Tyr)]

2. Treatment of the octapeptide with **carboxypeptidase A** gives Tyrosine as the first amino acid released.

3. Treatment of the octapeptide with **dansyl chloride**, followed by hydrolysis of the peptide bonds and amino acid analysis, indicated that only Alanine was labelled on the α-amino group.

4. Cleavage of the octapeptide with **trypsin** (which hydrolyzes at the carboxyl group (= to the right) of the "basic" amino acids) gives two tripeptides and a dipeptide. These were analyzed separately and found to have the following compositions:

   (Lys, Phe, Ser)
   (Ala, Arg, Ser)
   (Thr, Tyr)

5. Cleavage of the octapeptide with **chymotrypsin** (which hydrolyzes at the carboxyl group of "aromatic" amino acids) gives 2 tetrapeptide fragments.

A) What does **2.** tell you?

B) What does **3.** tell you?

C) What other amino acid in the octapeptide was labelled by dansyl chloride during step **3.** ?

D) There are two possible sequences for the octapeptide that are consistent with the information in steps **1.-4.** What are they? (You may use the amino acid abbreviations if you wish)

(N-terminus) (C-Terminus)

_____-_____-_____-_____-_____-_____-_____-_____

_____-_____-_____-_____-_____-_____-_____-_____

NOTE: Don't miss the questions on the next page!

E) Step 5 distinguishes between these two sequences. Put a star next to the sequence in answer D) that would give the result described in 5.

F) For the sequence that you have designated in E), complete the structure of the octapeptide by drawing in the side chains below. (If you didn't complete the sequence in part E), you can provide a best-guess below and then indicate which amino acid is which.)