

CHEMISTRY 104-4
Prof. Treichel
Feb. 14, 2006

NAME Key
Section _____ T.A. _____

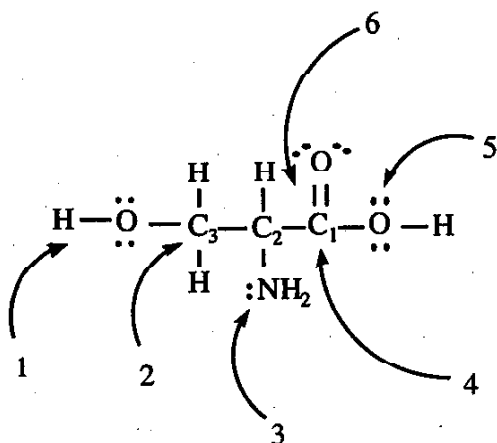
EXAM 1

1. This exam has 7 pages counting the cover page. If a page is missing, take the exam to a proctor immediately.
2. PRINT your name now at the top of this page, and your name or initials at the top of the remaining pages.
3. Points for each question are indicated for a total of 100 points.
4. The exam should be completed in 75 minutes. Budget your time for each question. Check your work after completing the exam.

Page 2		/16
Page 3		/16
Page 4		/20
Page 5		/18
Page 6		/ 12
Page 7		/18
Total		/100

Name/Initials _____

1. (16 points) The Lewis structure of serine, one of the naturally occurring amino acids, is drawn below. The questions that follow are about this compound. The carbon atoms are labeled with subscripts for the purpose of this question. The first 6 questions refer to the numbers accompanying the arrows in the figure.



1. Name the functional group labeled 1

alcohol

2. What is the hybridization of C₃?

sp³

3. What is the H-N-H bond angle (approx.)?

109° (107°)

4. What is the molecular geometry around C₁?

trigonal planar

5. What is the electron pair geometry at this oxygen?

tetrahedral

6. What orbitals overlap to form the π bond between C₁ and O?

C(2p) + O(2p)

7. Is this molecule chiral; and if it is chiral, with which atom is chirality of this molecule associated?

answer: yes, C₂

8. Which H in this compound is acidic?

- a) this molecule is not an acid
- b) H bonded to O
- c) H bonded to N
- d) H bonded to C₂
- e) H bonded to C₃

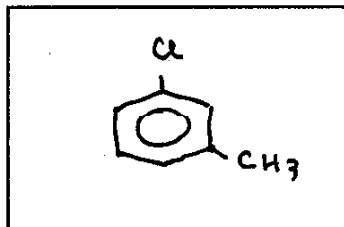
answer b

(-CO₂H hydrogen)

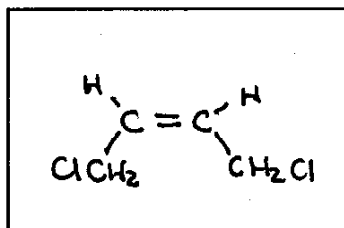
Name or initials _____

2. (16 pts) a) Draw structures for the compounds named in the boxes below (3 pts each).

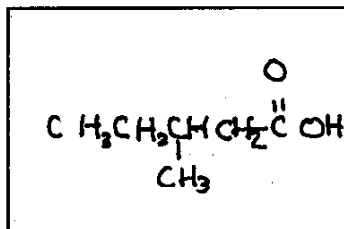
a) 1-chloro-3-methylbenzene



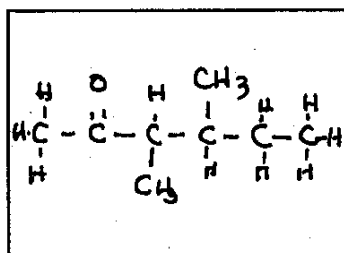
b) 1,4-dichloro-cis-2-butene



c) 3-methylpentanoic acid



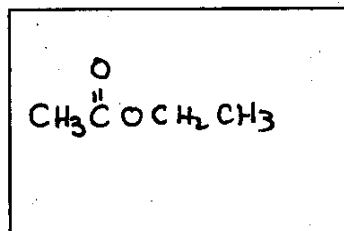
d) 3,4-dimethyl-2-hexanone



e) A 10 g sample of ethanol is divided into two equal parts. One part is oxidized using acidic $\text{Cr}_2\text{O}_7^{2-}$ to form an acid. Then, the acid and the remaining alcohol are combined to form an ester. What is name and formula of the ester? (2 pts each part)

Name ethyl ethanoate

(ethyl acetate)



Name or initials _____

3. (4 pts) Multiple choice

d 1. Which of the following is NOT a property of hexane?

- a) liquid at 25 °C b) colorless c) less dense than water d) soluble in water

a 2. Which term describes the reaction of an alkene and water?

- a) addition reaction b) substitution reaction c) polymerization reaction
d) esterification reaction

4. (16 pts) Match the description on the left with one of the answers in the right hand column. Place the letter for your answer in the blank at the left. There is only one correct answer, and each answer can be used only once. Some of the compounds in the second column will not be used.

P A chiral compound (can have optical isomers)

I A structural isomer of 2-propanone

L a compound with cis and trans isomers

A Compound formed by anaerobic fermentation of grapes

H a compound that can be reduced to a secondary alcohol

B another name for sodium acetate

F formed when benzene is treated with nitric and sulfuric acids

C and O two compounds that are structural isomers

A) $\text{CH}_3\text{CH}_2\text{OH}$

B) Sodium ethanoate

C) $\text{CH}_3\text{CH}_2\text{CH}_2\text{CONH}_2$

D) 2-methyl-1-pentene

E) $\text{C}_6\text{H}_5\text{CH}_3$

F) $\text{C}_6\text{H}_5\text{NO}_2$

G) 4-methylpentanal

H) 3-methyl-2-butanone

I) $\text{CH}_3\text{CH}_2\text{CHO}$

J) 2-methylpentane

K) 2-butyne

L) $\text{CH}_3\text{CH} = \text{CHCH}_2\text{CH}_3$

M) H_2O

N) salicylic acid

O) $\text{CH}_3\text{CH}_2\text{CONHCH}_3$

P) alanine (a naturally occurring amino acid)

Name or initials _____

5. (6 pts) You are asked to identify a colorless liquid. Analysis has determined that the elemental composition is C_3H_8O and you recognize that this formula requires that this be either a primary or secondary alcohol or an ether.

a) Working from the formula, what type of alcohol can this be? Circle all correct answers.

Primary secondary tertiary

What chemical test will determine the type of organic compound? What do you observe?

Other answers OK

b) TEST: Add $Cr_2O_7^{2-}$ to the unknown.

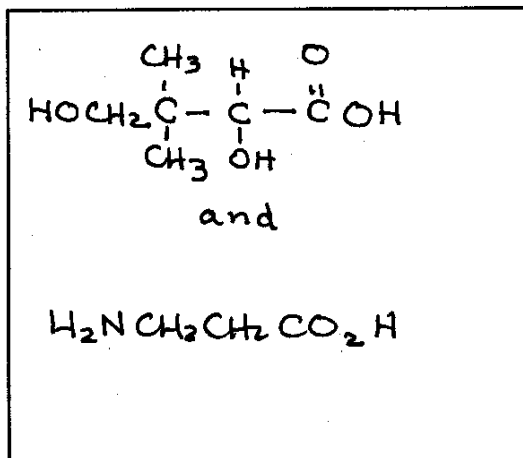
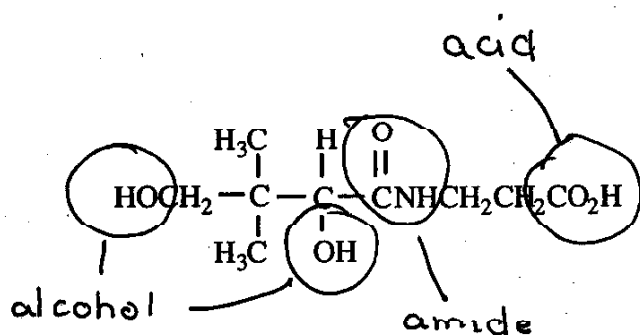
c) OBSERVATION: If the unknown is an ether? no color change
If it is an alcohol? a color change (yellow \rightarrow grey green)

1. (make ester and smell)

2. Solubility in H_2O

6. (8 pts) The molecule shown below is pantothenic acid, vitamin B₅.

- a) Circle and name the functional groups in the structure on the left.
b) If pantothenic acid is hydrolyzed, what products would be formed? (Give formulas or structures in the box on the right)

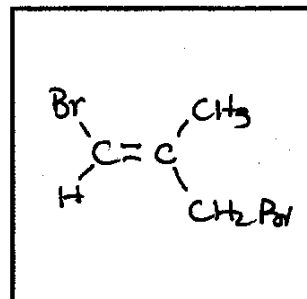
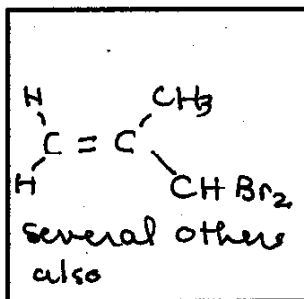
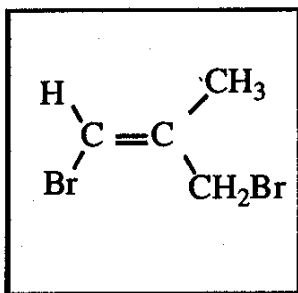


7. (4 pts) For the reaction of an alkane with a halogen (CH_4 with Cl_2 for example) a free radical reaction mechanism is proposed. Mechanisms of reactions are proposed in order to explain observations and facts about a reaction. List two observations about the $CH_4 + Cl_2$ reaction that are explained by a free radical mechanism.

1. initiated with light
2. more than one product (non-specific)

Name or initials _____

8. (12 pts, divided as noted) One of two geometric isomers of 1,3-dibromo-2-methylpropene ($C_4H_6Br_2$) is drawn in box 1, below. a) (6 pts) In box 2 draw a structural isomer and in box 3 draw a geometrical isomer of this compound.

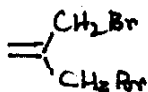


1,3-dibromo-2-methylpropene 2: a structural isomer

3: a geometric isomer with a 3 carbon chain

b) (1 pt) How many non-cyclic isomers with the formula $C_4H_6Br_2$ are possible? (Note, you have already identified 3 isomers of this formula in part a.)

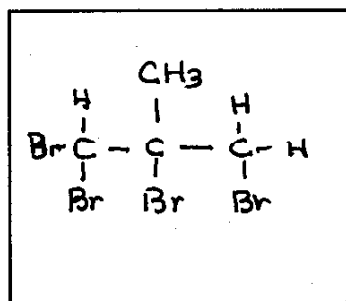
- 1) 1,3-cis
2) 1,3-trans and
3) 3,3-



Total no. of isomers of $C_4H_6Br_2$ 5

c) (4 pts) Draw the structure, and give the name of, the compound formed in a reaction of 1,3-dibromo-2 methylpropene with bromine (Br_2).

Name: 1,1,2,3-tetrabromo-
-2-methyl propane



d. (1 pt) Does the molecule that you have shown in the box

in part c) have a chiral carbon?

Yes

No

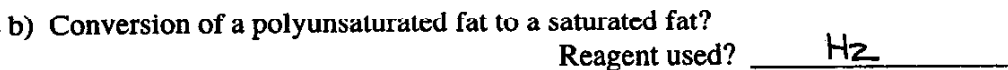
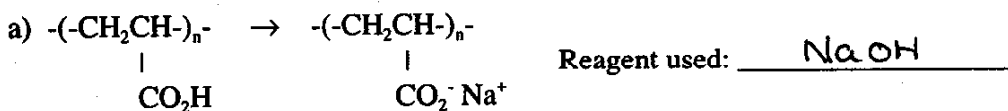
(If an incorrect structure is drawn for (c) then a different answer is possible)

Name or initials _____

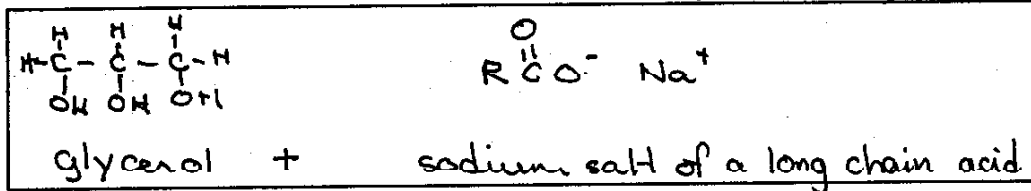
9. (4 pts) Often, the contents of an outdated aspirin bottle will smell like acetic acid (and the aspirin should be thrown away.) What has happened to cause this smell to occur? (very short word answer).

hydrolysis of aspirin

10. (6 pts) What reagents should be used to carry out the reactions described below?



11. (4 pts) What are the products of basic hydrolysis of a fat (names or structural formulas)?
(must give salt, not acid)



12. (4 pts) In lab, you accidentally spill a drop of dilute sodium hydroxide onto your polyester shirt. A short time later you discover that there is a hole in the fabric. What chemical reaction caused this hole? (short word answer)

hydrolysis of a polyester

13. (4 pts) Recently, a new polyester was made. The starting material was lactic acid whose structure is shown below. Complete the equation by giving the formula for this polymer

