

SAN JOSE CITY COLLEGE
INTRODUCTION TO CHEMISTRY 32B – Spring 2009

Name: KEY ID#: _____
Instructor: Dr. T. Johnson Time Allowed: 1h 20 min
April 1, 2009 Chapters 15, 16 and 18
Bettelheim/Brown 106 Points

LEARNING FESTIVILE (III)

I hereby affirm that I will abide by the Academic Integrity Code of San Jose City College.

Your Signature: _____

Instructions: The exam consists of 20 multiple choice (3 points each) and 12 short answer questions (46 points). Indicate your answers to the multiple choice questions by writing the letter choice in the space provided in the answer sheet, below. Write your short answers in the space provided. A periodic table is attached at the end of the exam. The periodic table can be detached. Answer ALL the questions. Make efficient use of your time. Do the problems which are easy first, and leave the more difficult ones to last. Don't spend too much time on any one problem. Remember to use significant figures when reporting numerical answers. Note: Partial credit is given where possible if, and only if, you support your answer by detailing your work, including possible/partial structures and/or providing your reasoning. **SHOW YOUR WORK.** Select the BEST answer to the multiple choice questions below. Indicate your answers to the multiple choice questions by writing the letter choice on a scantron (You may also place the answer in the space provided in the answer sheet, below, but this will not be graded).

- 1 C
- 2 B
- 3 E
- 4 E
- 5 E
- 6 E
- 7 C
- 8 D
- 9 D
- 10 D
- 11 B
- 12 B
- 13 C
- 14 B
- 15 D
- 16 B
- 17 E
- 18 D
- 19 B
- 20 D

MULTIPLE CHOICE QUESTIONS (40 POINTS)

- Which compound is a secondary amine?
 - trimethylamine
 - isopropylamine
 - diethylamine
 - N,N-dimethylethylamine
 - N-ethyl-N-methylpropylamine
- Which of the following compounds do not contain a stereocenter?
 - 2-chloropentane
 - 3-chloropentane
 - 3-chloro-1-butene
 - A and B
 - none of the above
- Which of the following compounds do not contain stereocenter?
 - 1-phenyl-1-propanol
 - 2-methylcyclopentanol
 - 1-chloro-2-propanol
 - A and B
 - none of the above
- All of the following are properties of amines except:
 - those that can form hydrogen bonds have higher boiling points than expected for their molecular weight
 - those with low molecular weights are water soluble
 - they frequently have offensive odors
 - they act as bases in many reactions.
 - they react with acid halides to form amides
- Arrange the four compounds in order of increasing boiling point: (i.e. lowest to highest)
(1) $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_3$, (2) $\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$, (3) $\text{CH}_3\text{CH}_2\text{CH}_2\text{NH}_2$, (4) $\text{NH}_2\text{CH}_2\text{CH}_2\text{OH}$
 - 2,1,3,4
 - 1,3,4,2
 - 1,2,3,4
 - 1,4,3,2
 - 1,3,2,4
- If methylamine reacts with hydrochloric acid, the major product will be
 - ammonium chloride
 - dimethylammonium chloride
 - trimethylammonium chloride
 - methylammonium hydroxide
 - methylammonium chloride

7. All of the statements about carboxylic acids are true except
- A. they undergo substitution reactions involving the -OH group.
 - B. at low molecular weights they are liquids with sharp stinging odors.
 - C. when they behave as acids, the -COOH group gains H^+ and thus, is protonated.
 - D. they form hydrogen bonds, causing their boiling points to be higher than expected on the basis of molecular weight.
 - E. they react with bases to form salts which are often more soluble than the original acid.
8. Consider these four compounds: (1) CH_3OH , (2) CH_3SH , (3) $(\text{CH}_3)_2\text{NH}$, (4) $\text{C}_6\text{H}_5\text{NH}_2$
Which is the strongest base?
- A. compound 1
 - B. compound 2
 - C. compounds 1 and 2 are equally the strongest bases
 - D. compound 3
 - E. compound 4
9. When two carboxylic acids combine, water and which of the following compounds is formed?
- A. alcohol
 - B. ester
 - C. amide
 - D. anhydride
 - E. ketone
10. Compounds that are classified as diastereomers can exist as:
- A. Molecules having no stereocenters
 - B. Molecules that have the same carbon skeleton, are non super imposable and are non mirror images of each other with the same M.F.
 - C. Molecules that have the same carbon skeleton, are non super imposable and are mirror images of each other with the same M.F.
 - D. A and B
 - E. A and C
11. Fisher esterification can involve the reaction of ethanoic acid with ethanol in the presence of H_2SO_4 to produce?
- A. methyl esters
 - B. ethanoate *ethyl ethanoate ✓*
 - C. ethyl amide
 - D. ethanamine
 - E. acetic acid
12. When hexanedioic acid reacts with a 1,6 -hexane-di-amine at high temperature (250°C) and pressure (15 ATM) the major product is:
- A. a polyester, aka- (Dacon)
 - B. a polyamide, aka- (Nylon)
 - C. a polycarbamate, aka- (Lexan)
 - D. a polyamide, aka- (Kevlar)
 - E. none of the above

13. An acid anhydride is formed by
- Repeated loss of water molecules from carboxylic acid leaving many carbon-carbon double bonds.
 - Addition of water to two carboxylic acid molecules.
 - Removal of water from two carboxylic acid molecules
 - Repeated reaction of acid with water forming polymers.
 - Removal of water from one carboxylic acid molecule, leaving behind a carbonyl group and an alkene.

14. Arrange these compounds in order of increasing acidity: (i.e. weak = 1, strong = 3)
benzoic acid (1), benzyl alcohol (2) and phenol (3).

- 1,2,3
- 2,3,1
- 3,2,1
- 1,3,2
- 3,1,2

15. Reaction of an ester with a strong base is called

- hydrolysis
- Fisher Esterification
- saponification
- both A and C
- trans (or reverse) esterification

16. What is the compound in willow tree bark that is responsible for its ability to relieve pain?

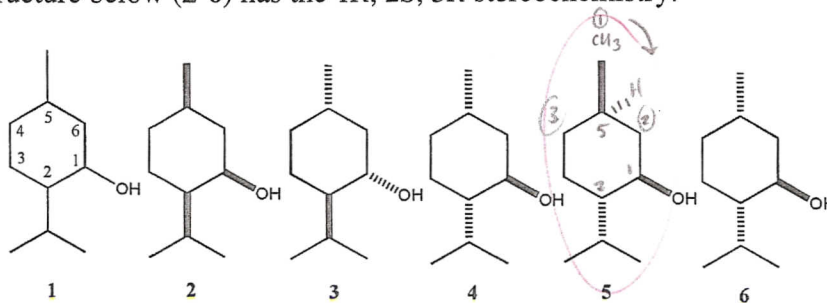
- acetaminophen
- salicin (salicylic acid)
- phenacetin
- acetanalide
- none of the above

17. The Elutant in Thin Layer Chromatography (TLC) is part of the . .

- stationary phase
- mobile phase
- solvent front
- both A and C
- both B and C

18. Menthol is the main component in peppermint oil and has the 1*R*, 2*S*, 5*R* stereochemistry. Identify which structure below (2-6) has the 1*R*, 2*S*, 5*R* stereochemistry.

- 2
- 3
- 4
- 5
- 6

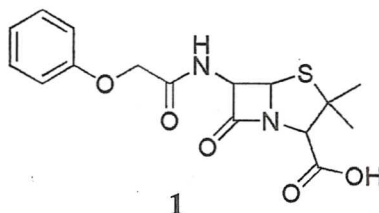


19. Which molecule is chiral?

- A. CH_3OH
- B. CH_3CHBrOH
- C. CH_3Cl
- D. CH_2ClBr
- E. CH_2FCI

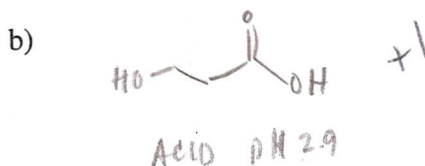
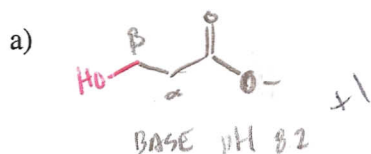
20. The penicillin's are an important class of broad spectrum antibiotics. How many stereoisomers exist for penicillin V (1)?

- A. 2
- B. 4
- C. 6
- D. 8
- E. 16



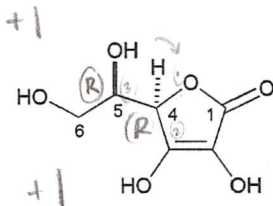
Short Answer Problems:

1. Draw the structure of the species (protonated or deprotonated) of β -hydroxypropanoic acid when it is placed in a solution of: a) Santa Cruz Tap H_2O (pH is 8.2), and b) pure lemon juice (pH 2.9). [2 points]

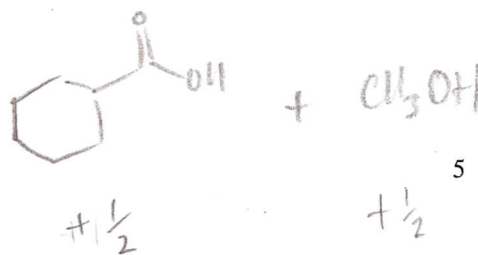
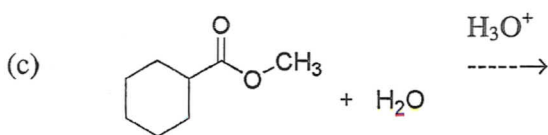
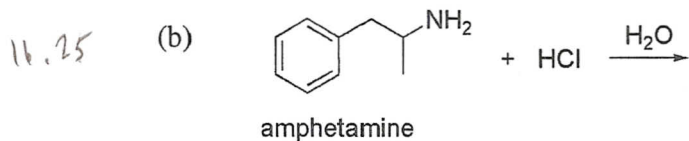


1 pt just OH
O-
2 pt OH, O- +
correct
structure

2. Assign *R/S* configurations to the chiral centers in ascorbic acid (vitamin C). [2 pts]

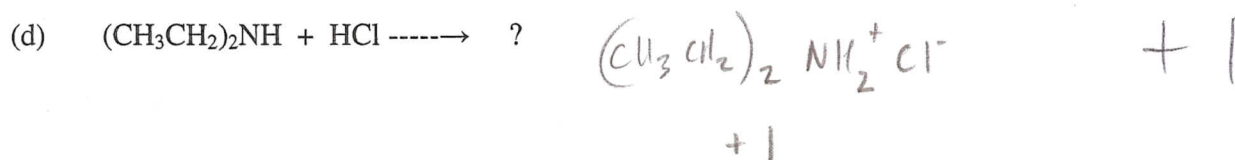
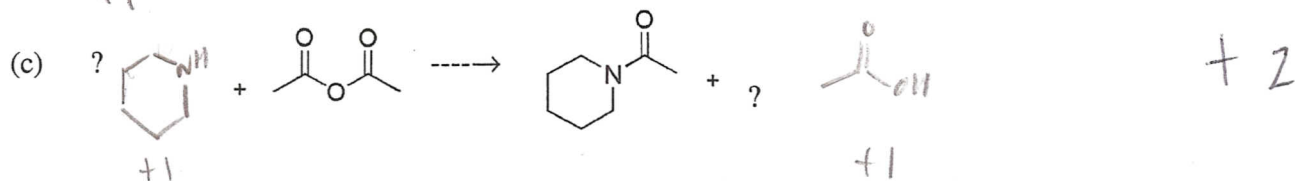
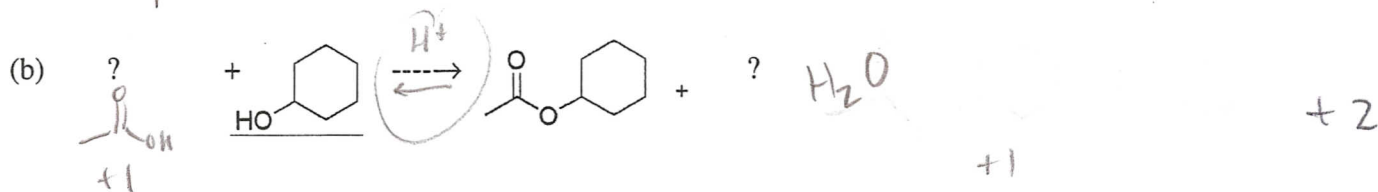
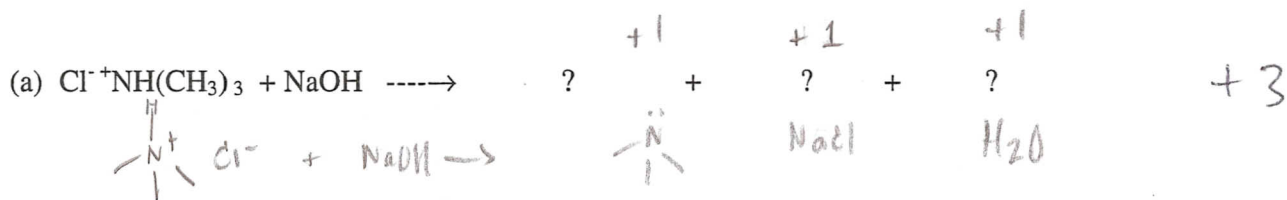


3. Draw the major organic product formed from the reactions below. [3 pts]

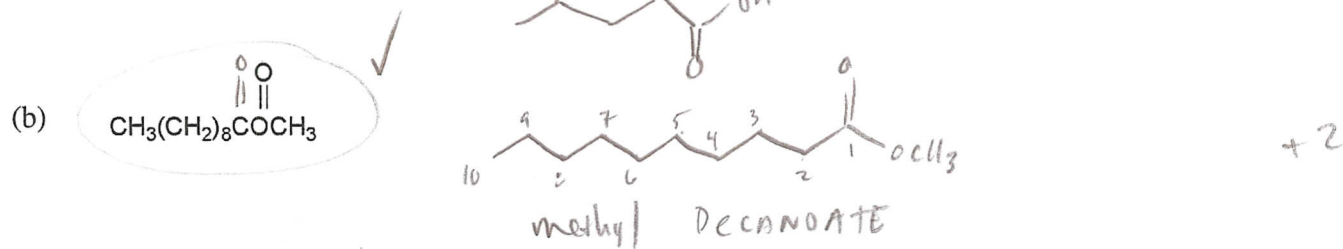
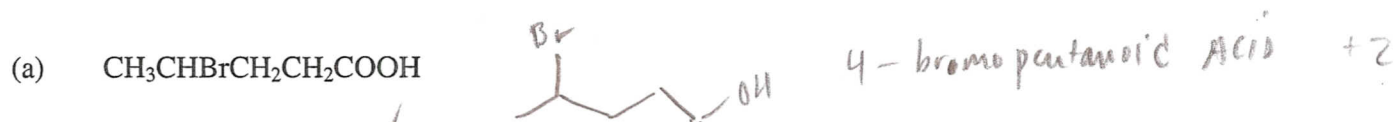


7
7

4. Draw the missing structure(s) (reactants or products) in the following reactions: [8 pts]

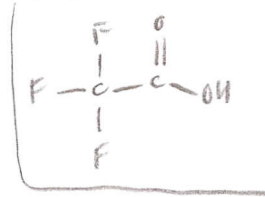


5. Give IUPAC names for the following compounds or salt. [8 pts]



6. Which would you expect to be a strongest acid, CF_3COOH , CCl_3COOH , $\text{CH}_3(\text{CH}_2)_4\text{COOH}$, CH_3COOH ? Explain your reasoning. [2 pts]

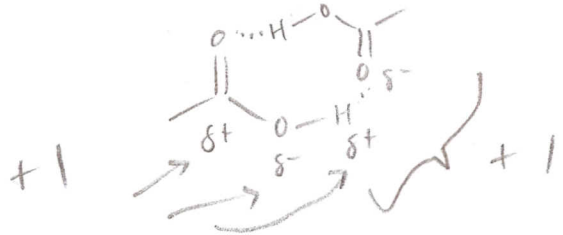
$\frac{b}{c}$ CF_3 most electro-negative w/ drawing group(s) attached...



CF_3COOH
+1
+2

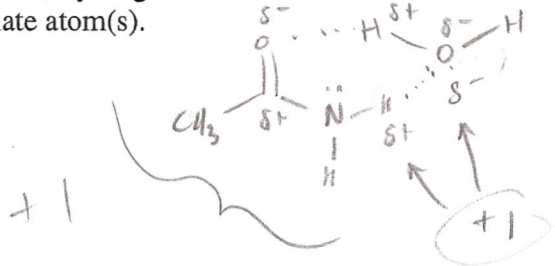
7. Show how: [4 pts]

(a) acetic acid, CH_3COOH , hydrogen bonds to other molecules of acetic acid to form a dimer and include the δ^- and δ^+ charges on the appropriate atom(s).



+2

(b) acetamide, NH_2COCH_3 hydrogen bonds to water molecules and include the δ^- and δ^+ charges on the appropriate atom(s).



+2

8. Consider the following silica gel (polar) TLC plate of compounds A, B and C developed in 50:50 Hexanes: Ethyl Acetate solvent mixture: Circle the best answer [3 pts]

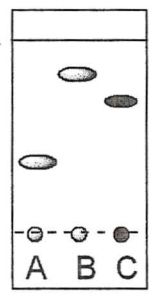
+1
+1
+1

Which Compound is the least polar? A (B) or C

Solvent front -->

Which Compound is the most polar? (A) B or C

Which compound would elute the farthest (i.e. closest to the solvent front) if you used acetone instead of hexanes as the eluting solvent? (A) B or C



+3

9. A lactone is a cyclic ester in which the carbonyl part and the oxygen atom are connected within a cyclic ring structure. Draw the structure of the reactant and product(s) resulting from treatment of 6-hydroxybutanoic acid with an acid catalyst. [3 pts].



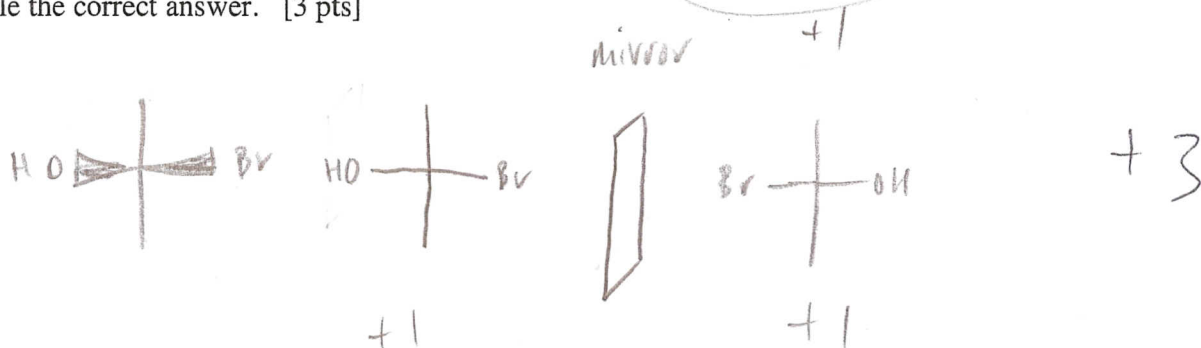
+1

+1

+1
 $\frac{12}{12}$

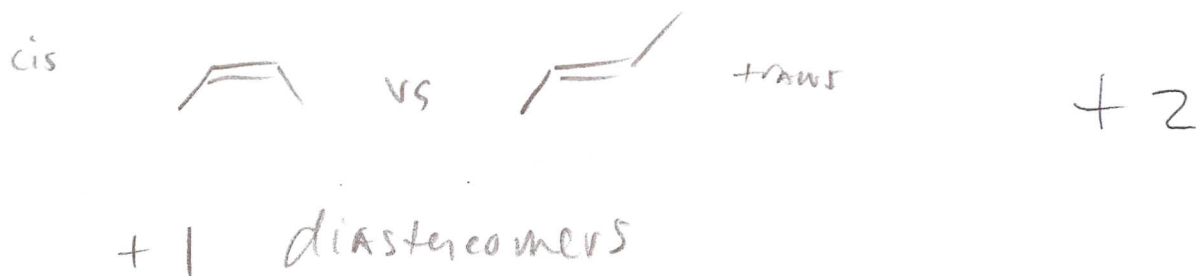
+3

10. Using Fischer projections, draw the structure of 2-Bromo-2-pentanol. Next, draw the mirror image of the structure you just drew. Are these compounds enantiomers, diastereomers or both? Circle the correct answer. [3 pts]



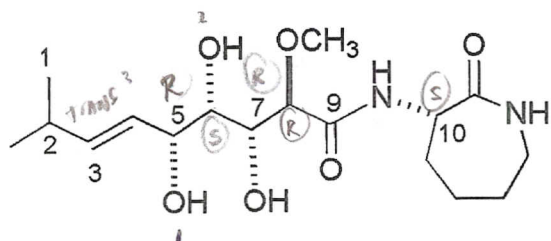
11. 2-butene exists as a pair of cis and trans isomers. Is cis-2-butene and/or trans-2-butene chiral or achiral? Circle the correct answer.

What is the stereochemical relationship between cis-2-butene and trans-2-butene. [2 pts]



Extra Credit.

12. Bengamide E (see below) is an important lactam anticancer therapeutic lead from the marine sponge *Jaspis coriacea*. Properly label the chiral center(s) as R/S and determine the stereochemistry of the C-3,C-4 double bond as cis? or trans? Circle the best answer. [6 pts]



5 = R
6 = S
7 = R
8 = R
10 = S

+6