# **Organic Chemistry**

有机化学双语教学 试卷及参考答案(部分)

王 梅

大连理工大学

Name:

## Student

Number:

Department: Chemistry

Class:

# **Dalian University of Technology**

Course: Organic Chemistry (1)

Band: A

School (Department): School of Chemical Engineering

Date: January 10, 2005 Total: 5 pages

	1	2	3	4	5	6	7	8	Total
Standard points	20	12	8	20	6	20	6	8	100
Scores									

1. Give a systematic or a trivial name for each of the following formulas or write a molecular structure as required for each given name (20 points, 2 points for each name or structure).

(1)

(2)

(3)

$$\bigcap_{N}^{CN}$$

Ph-O-CH<sub>2</sub>CH=CH<sub>2</sub>

(5)

(6) 
$$\begin{array}{c} CH_3 \\ C=C \\ CH_3 \end{array}$$

- (7) 2-formylthiophene
- (8) 1-pentyl amine (write the most stable Newman projection)
- (9) (1S,2S)-1-fluoro-2-isopropylcyclohexane (write the most stable conformation)
- (10) (2R,3S)-2,3-dihydroxybutanoic acid (write a Fischer projection)
- 2. As required, compare physical and chemical properties for each of the following groups (12 points, 3 points for each problem).

groups (12 points, 3 points for each problem).

(1) 
$$CHO$$
  $CHO$   $CHO$ 

(4) 
$$CH_3O$$
— $CH=CH_2$   $NC$ — $CH=CH_2$   $(C)$ — $CH=CH_2$ 

(the reaction rate of the above compounds with Br<sub>2</sub>)

3. Identify the following pairs of compounds as identical, enantiomers or diastereomers (8 points, 2 points for each problem).



4. Give major products of the following reactions, when the reactions are stereoselective, show the stereostructures of the products by three-dimentional formula (20 poins, 2 points for each product).

(4) 
$$H_3C$$
  $\longrightarrow$   $\stackrel{\oplus}{N}(CH_3)_3OH$   $\stackrel{\ominus}{\longrightarrow}$ 

(6) 
$$H_3C$$
 $C=C$ 
 $H$ 
 $CHCl_3$ 
 $NaOH$ 

(8) 
$$CH_3COOH$$
  $H_2SO_4$   $NaOCH_3$   $CH_3OH$ 

5. Show all steps in the mechanism for the formation of the product (6 points).

$$\begin{array}{c|c} & & & \\ \hline \\ CH_2CH_2CH_2OH & & Br \\ \hline \end{array}$$

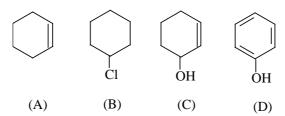
6. Design synthetic routes for the following products from the indicated starting compounds and other necessary reagents (20 points, 6 points for each product of problem (1) and (3); 4 points for each product of problem (2) and (4)).

(1) from 
$$HC = CH$$
 to  $CH_3 CH_2CH_3$ 

Br 
$$|$$
 (3) from  $(CH_3)_2CHCHCH_3$  to  $(CH_3)_2CHCH_2CHO$ 

(4) from	CH₃CHCH₂OH	to CH <sub>3</sub> CHCH <sub>2</sub> NH <sub>2</sub>
	CH <sub>3</sub>	CH <sub>3</sub>

7. There are 4 compounds (**A**, **B**, **C** and **D**) in 4 test tubes, please distinguish each compound by simple testing methods (6 points).



8.	Choose correct answers	for the	following	questions (	8	points.	2	points f	or each	probler	1)
ο.	Choose confect answers	101 the	TOHOWING	questions (	O	pomis,		pomis i	or cacii	שוטטוק.	ш

- (1) Valence bond theory is normally used to explain\_\_\_\_\_
- (A) the reactivity of molecules
- (B) the spatial shape of molecules
- (C) the polarizability of molecules
- (D) the stability of molecules

(2) For a configuration	retention reaction, we can confirm that during the reaction
the	of the chiral carbon atom does not change.
(A) relative configuration	on (C) rotation direction of polarized-light
(B) absolute configurati	on (D) R/S designation
(3) A pair of enantiomer (A) distillation	rs can be isolated by  (C) sublimation
(B) recrystallization	(D) resolution
(= / <u> </u>	(= /

- (4) The characteristics of E2 mechanism is \_\_\_\_\_\_.
- (A) a two step, second-order reaction
- (B) a one step, first-order reaction
- (C) a two step, first-order reaction
- (D) a one step, second-order reaction

### 参考答案及评分标准 (Band: A)

课程: 有机化学(上) 班级: 英强班 20021-2 院(系): 化工学院 日期: 2005年1月10日

- 1. Give a systematic or a trivial name for each of the following formulas or write a molecular structure as required for each given name (20 points, 2 points for each name or structure).
- (1) (2S,4R)-4-ethyl-2-methylcyclohexane
- (2) (3R)-3-methoxy-1-cyclopentenecarboxylic acid
- (3) 3-cyanopyridine
- (4) allyl phenyl ether
- 7-methyl-bicyclo[4.2.1]nonane
- *t*-butyl (Z)-2-methyl-2-butanoate
- (7)

(8)

(9)

- CH2CH2CH3

- (10)
- 2 . As required, compare physical and chemical properties for each of the following groups (12 points, 3 points for each problem).
- (1) C > A > B
- (2) B > A > C (3) A > C > B (4) A > C > B

- 3. Identify the following pairs of compounds as identical, enantiomers or diastereomers (8 points, 2 points for each problem).
- (1) diastereomers (2) identical (3) enantiomers (4) enantiomers
- 4. Give major products of the following reactions, when the reactions are stereoselective, show the stereostructures of the products by three-dimentional formula (20 poins, 2 points for each product).

(3) 
$$\begin{array}{c} Br \\ (CH_3)_2CHCHCH_2CH_3 \\ (racemate) \end{array}$$

NCCH<sub>2</sub>—CHCI 
$$H_3$$
CI  $H_3$ CI

ÔСН<sub>3</sub>

5. Show all steps in the mechanism for the formation of the product (6 points).

6. Design synthetic routes for the following products from the indicated starting compounds and other necessary reagents (20 points, 6 points for each product of problem (1) and (3); 4 points for each product of problem (2) and (4)).

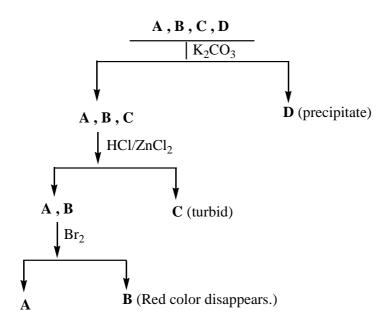
(1)

PhC 
$$\stackrel{\text{Na}}{=}$$
  $\stackrel{\text{Ph}}{=}$   $\stackrel{\text{H}}{=}$   $\stackrel{\text{Br}}{=}$   $\stackrel{\text{Br}}{=}$   $\stackrel{\text{Br}}{=}$   $\stackrel{\text{Br}}{=}$   $\stackrel{\text{Br}}{=}$   $\stackrel{\text{Ph}}{=}$   $\stackrel{\text{Ph}}{=}$ 

(3)
$$\frac{\text{Br}}{(\text{CH}_3)_2\text{CHCHCH}_3} \xrightarrow{t-\text{BuONa}} (\text{CH}_3)_2\text{CHCH} = \text{CH}_2 \xrightarrow{1) \text{BH}_3 / \text{THF}}$$

$$\frac{(\text{CH}_3)_2\text{CHCH}_2\text{CH}_2\text{OH}}{(\text{CH}_3)_2\text{CHCH}_2\text{CH}_2\text{OH}} \xrightarrow{\text{Cr}_3 / \text{Py} / \text{HCl (PCC)}} (\text{CH}_3)_2\text{CHCH}_2\text{CHO}$$

7. There are 4 compounds (**A**, **B**, **C** and **D**) in 4 test tubes, please distinguish each compound by simple testing methods (6 points).



- 8. Choose correct answers for the following questions (8 points, 2 points for each problem).
- (1) B
- (2) B
- (3) D
- (4) D

Name:

Dalian University of Technology

Student
Number:

Course: Organic Chemistry (2)
School (Department): School of Chemical Engineering

Department:
Chemistry

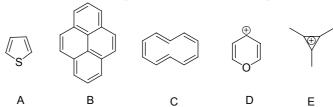
Class:

Date: July 21, 2005
Total: 5 pages

Total: 5 pages

	1	2	3	4	5	6	Total
Standard points	15	22	8	20	15	20	100
Scores							

- 1. Give answers to each of the following questions (15 points, 5 points for (1); (2) and (3), each 2 points; (4) and (5), each 3 points).
- (1) Which of the following compounds are aromatic compounds?



(2) Which of the following compounds is the initiator for a radical reaction?

 $(CH_3CO)_2O$   $(C_6H_5CO_2)_2$   $(CH_3CO)_2$   $(PhNH)_2$ A B C D

(3) The nucleophilic addition of HCN to an aldose will form two diaster eomers, which are  $\phantom{-}$  .

A. anomers (正位异构体) C. mesomers B. epimers (差向异构体) D. enantiomers

(4) Which of the following reagents can be used as a simple testing method to distinguish pentanal, 2-pentanone and 3-pentanone in 3 test-tubes?

A. Tollen's reagent and KI/I<sub>2</sub>

B. Tollen's reagent and I<sub>2</sub>/NaOH

C. Lucas reagent and KI/I<sub>2</sub>

D. Lucas reagent and I<sub>2</sub>/NaOH

(5) Which of the following reagents can be used as a simple testing method to distinguish  $CH_3COCH_3$  (acetone), PhCOPh (diphenyl ketone) and  $CH_3COOCH_3$  in 3 test-tubes?

A. NaHSO<sub>3</sub> and NH<sub>2</sub>OH C. Na<sub>2</sub>SO<sub>3</sub> and NH<sub>2</sub>OH B. NaHSO<sub>3</sub> and PhNHNHPh D. Na<sub>2</sub>SO<sub>3</sub> and PhNHNHPh

2. Give major products of the following reactions (22 points, 2 points for each major product).

$$(1) \qquad \overset{\text{O}}{\text{HC}} \overset{\text{O}}{-} \overset{\text{O}}{\text{C}} - \text{NMe}_2 \qquad \overset{\text{NaBH}_4}{-} \overset{\text{}}{-}$$

(2) 
$$PhCH_2CCH_2Ph$$
 +  $PhCCPh$  NaOH

(3) 
$$\begin{array}{c} H_3CH_2C \\ H_3C \end{array} C = N \begin{array}{c} OH \\ \end{array} \begin{array}{c} H_2SO_4 \\ \end{array}$$

$$\begin{array}{c|c} OCH_3 & \\ \hline & Br_2 \\ \hline & FeBr_3 \end{array}$$

(6) 
$$O_2N$$
  $CF_3COOH$ 

(7) 
$$NO_2$$
  $NaNH_2$   $NH_3$ 

(8) 
$$\begin{array}{c} O \\ C-NH_2 \\ \hline CH_3 \end{array}$$

(9) 
$$CH_2$$
= $CHCOOEt$  +  $O$   $N$  ,  $H^+$   $H_3O$   $H_3O$ 

(10) PhCH<sub>2</sub>CH 
$$\xrightarrow{\text{H}^+}$$
 HSCH<sub>2</sub>CH<sub>2</sub>CH<sub>2</sub>SH  $\xrightarrow{\text{H}^+}$  1) BuLi  $\xrightarrow{\text{2}}$  CH<sub>2</sub>=CHCH<sub>2</sub>Br

3. Show all of the steps in the mechanism for the following reaction and explain why the aldehyde is formed rather than the ketone (8 points).

OHOH 
$$Ph-C-CH$$
  $H_2SO_4$   $Ph-C-CHO + H_2O$   $Ph$ 

4. Prepare the following compounds using the indicated starting materials and other necessary reagents (20 points, (1) and (4), each 6 points; (2) and (3), each 4 points).

(1) from 
$$to$$
  $CI$ 

(2) from 
$$O O O O O CH_2OCCH_3$$
 to  $CH_2OCCH_3$ 

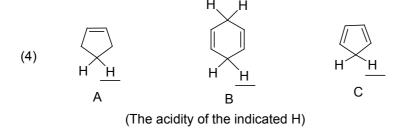
(4) from 
$$CH_3CCH_2COC_2H_5$$
 to  $H_3C-C-CH-CH_2Ph$ 

5. Compare chemical properties for each of the following groups (15 points, 3 points for each question).

(2) 
$$A B C D$$

(The rate of Friedel-Crafts reactions, 傅克反应)

(The rate of the reaction with NBS) (N-bromosuccinimide, 溴代丁二酰亚胺)



- 6. Deduce the molecular structures of the following compounds according to the given reaction phenomena ((1) and (2), each 10 points; 2 points for each compound).
- (1) When a neutral compound  $\bf A$  ( $C_{11}H_{14}O_2$ ) is heated in a dilute HCl solution, compound  $\bf B$  ( $C_9H_{10}O$ ) is obtained. The reaction of  $\bf B$  with Br<sub>2</sub>/NaOH and sequential acidification affords an acid  $\bf C$  ( $C_8H_8O_2$ ). In a solution of glycol,  $\bf B$  reacts with NH<sub>2</sub>NH<sub>2</sub>/NaOH at reflux to yield compound  $\bf D$  ( $C_9H_{12}$ ). The reaction of  $\bf B$  and benzaldehyde in an alcoholic NaOH solution gives compound  $\bf E$  ( $C_{16}H_{14}O$ ). Compound  $\bf D$  can be oxidized by KMnO<sub>4</sub> to form  $\it m$ -benzenedicarboxylic acid. Please give the structures of  $\bf A$   $\bf E$ .
- (2) There are two different D-aldopentoses  $\bf A$  and  $\bf B$ . They react respectively with phenylhydrozine to form the same phenylosazone  $\bf C$ . An optically inactive alditol  $\bf D$  is obtained when  $\bf A$  is reduced by hydrogen and a metal catalyst. Ruff degradation of  $\bf B$  gives a D-aldotetrose  $\bf E$ . Oxidation of  $\bf E$  by HNO<sub>3</sub> affords a mesomeric tartaric acid (酒石酸). Please give structures of  $\bf A \bf E$  in Fischer projection.

## 参考答案及评分标准 (Band: A)

课程:有机化学(下)班级:英强班 2002-1-2院(系):化工学院日期:2005 年 7 月 21 日

- 1. Give answers to each of the following questions (15 points, 5 points for (1); (2) and (3), each 2 points; (4) and (5), each 3 points).
- (1) A, B, D, E
- (2) B
- (3) B
- (4) B
- (5) A
- 2. Give major products of the following reactions (22 points, 2 points for each major product).
- (1)  $HOH_2C$   $\stackrel{O}{\longleftarrow}$   $C-NMe_2$
- Ph Ph
- (3)  $CH_3CH_2\overset{O}{C}-NHCH_3$
- CHO

(5) OCH<sub>3</sub>

(7) NO<sub>2</sub> NH<sub>2</sub>

(8) NH<sub>2</sub>

$$\begin{array}{c} O & O \\ CH_2CH_2\overset{\prime\prime}{C}-OEt \end{array}$$

(10) S S S S PhCH<sub>2</sub>CH
PhH<sub>2</sub>C H PhH<sub>2</sub>C CH<sub>2</sub>CH=CH<sub>2</sub>

PhCH<sub>2</sub>CH<sub>2</sub>CH<sub>2</sub>CH<sub>2</sub>CH<sub>3</sub>

16

3. Show all of the steps in the mechanism for the following reaction and explain why the aldehyde is formed rather than the ketone (8 points).

Because the carbocation  $Ph_2^{\bigcirc C-CH_2}$  is less stable than  $Ph_2^{\bigcirc C-CH_2}$ , the ketone  $Ph_2^{\bigcirc C-CH_2}$  is not formed.

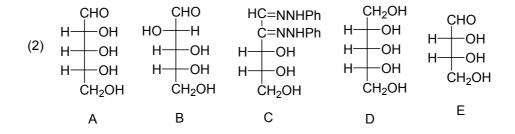
4. Prepare the following compounds using the indicated starting materials and other necessary reagents (20 points, (1) and (4), each 6 points; (2) and (3), each 4 points).

- 5. Compare chemical properties for each of the following groups (15 points, 3 points for each question).
- (1) B > C > D > A
- (2) B > A > D > C
- (3) A > C > B

(4) C > B > A

- (5) C > A > B
- 6. Deduce the molecular structures of the following compounds according to the given reaction phenomena ((1) and (2), each 10 points; 2 points for each compound).

(1) 
$$CH_3$$
  $CH_3$   $CH_$ 



#### Name:

#### \_\_\_\_

# **Dalian University of Technology**

Student

Number:

Department:

Chemistry

Class:

Course: Organic Chemistry (1) Band: A

School (Department): School of Chemical Engineering

Date: January 9, 2006 Total: 5 pages

	1	2	3	4	5	6	7	Total
Standard points	14	10	26	9	5	20	16	100
Scores								

- 1. Give a systematic name for each of the following formulas or write a molecular formula for each given name (14 points).
- (a)

(b)

(c)

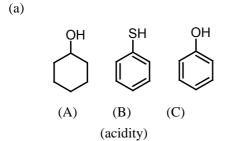
(d)

$${\displaystyle \mathop{\mathsf{OH}}_{-}} \\ \mathsf{HC} \bar{=} \mathsf{CCH}_2 \mathsf{CHCH}_3 \\$$

(e)

- (f) 4-oxopentanenitrile
- (g) (2*S*,3*R*)-3-chloro-2-butanol (Fischer projection)

2. As required, compare physical and chemical properties for each of the following groups (10 points).



(b)  $\overbrace{Cl} \qquad \overbrace{Br} \qquad \overbrace{Cl} \qquad \overbrace{Br} \qquad \overbrace{Br} \qquad (D)$  (S<sub>N</sub>2 reaction rate)

(c)  $\begin{array}{cccc} \text{CH}_3\text{CH}_2\text{OCH}_3 & \text{CH}_3\text{COOH} & \text{CH}_3\text{CH}_2\text{CH}_2\text{OH} \\ \text{(A)} & \text{(B)} & \text{(C)} \\ & & \text{(boiling point)} \end{array}$ 

(the reactivity towards the addition of HCl)

3. Give major products of the following reactions, when necessary, show the stereochemistry of the products (26 points).

(a)

$$\begin{array}{c}
H_3C \\
Br
\end{array} = C \xrightarrow{CH_3} \frac{H_2/Pt}{Pt} ( ) \xrightarrow{acetone} ( )$$

(b)

(c) 
$$CF_3CH=CH_2 + HCI \longrightarrow ( )$$

$$\begin{array}{c} \text{(d)} \\ \text{H}_{3}\text{C} \\ \text{C} \\ \text{H} \end{array} \begin{array}{c} \text{C} \\ \text{CH}_{3} \\ \end{array} \begin{array}{c} \text{KMnO}_{4} \text{ /OH}^{-} \\ \text{cold, dilute} \end{array} \begin{array}{c} \text{(} \\ \text{)} \\ \text{(} \\ \text{)} \end{array} \begin{array}{c} \text{(} \\ \text{)} \\ \text{(} \\ \text{)} \end{array}$$

(e) 
$$CH_3CH=CH_2 + HBr \xrightarrow{ROOR} ($$

(f)
$$H_3C = C + CHBr_3 + CHBr_3$$
(OH)

(h)

$$\begin{array}{c} & & & \\ & \downarrow \\ \text{CH}_3\\ \text{CH}_3\text{CHCH=CH}_2 \\ & & \\ &$$

4. Determine whether the compounds in the following groups are enantiomers, diastereomers or the same comopounds (9 points).

(a)

(b)

(c)

$$CH_3$$
  $H$   $CH_3$   $Br$   $CH_3$   $CH_3$ 

(d

(e)

$$H$$
 $CH_3$ 
 $OH$ 
 $HO$ 
 $CH_3$ 
 $CH_3$ 
 $CH_3$ 

- 5. Determine whether each of the following statement is true or false (5 points).
- (a) The enationers have the same rate of reaction with (R)-2-butanol.
- (b) Hofmann eliminations are second order reactions.
- (c) The enantiomers can be separated by distillation.
- (d) The  $S_{\rm N}1$  reaction leads to racemization of an optically active alkyl halide.
- (e) The rate of the E1 reaction increases with increasing the strength of nucleophiles.

- 6. Synthesis of the compounds from the indicated staring materials. More than one step may be necessary (24 points).
- (a) CH<sub>3</sub>CH<sub>2</sub>CH<sub>2</sub>CHO from HC = CH

(c)
$$H_3C C H From H_3C C CH_3$$
(d)
$$H_3C C H From H T C CH_3$$

$$OTS CH OTS$$

from

- 7. Deduced the molecular structures according to the given reaction phenomena (16 points).
- (a) Show the structures of **A**, **B** and **C** in the following reaction scheme. What is the relationship of **C** and **D**?

(b) A cyclic compound  $\underline{\mathbf{A}}$  ( $C_7H_{11}Br$ ) reacts with  $Br_2/CCl_4$  to form a tribromo-substituted compound  $\underline{\mathbf{B}}$ . In water  $\underline{\mathbf{A}}$  changes to two alcoholic compounds  $\underline{\mathbf{C}}$  and  $\underline{\mathbf{D}}$  which are constitutional isomers.  $\underline{\mathbf{D}}$  is a tertiary alcohol. Compound  $\underline{\mathbf{A}}$  reacts with NaOH in alcohol to form a conjugate diene  $\underline{\mathbf{E}}$ . After  $\underline{\mathbf{E}}$  is oxidized by  $O_3$  and then hydrolyzed in the presence of zinc dust, OHCCH<sub>2</sub>CH<sub>2</sub>COCH<sub>3</sub> and OHCCHO were obtained. Please give the structures of  $\underline{\mathbf{A}}$ ,  $\underline{\mathbf{B}}$ ,  $\underline{\mathbf{C}}$ ,  $\underline{\mathbf{D}}$  and  $\underline{\mathbf{E}}$  (Don't consider stereoisomers).

# 参考答案及评分标准 (Band: A)

课程:有机化学(上)班级:英强班 2003-1-2院(系):化工学院日期:2006 年 1 月 9 日

- 1. Give a systematic name for each of the following formulas or write a molecular formula for each given name (14 points, 2 points for each name or structure).
- (a) 3-hydroxy-5-nitrobenzaldehyde
- (b) bicyclo[3.2.1]octane
- (c) N-methyl 4-ethylhexanamide
- (d) 4-hydroxy-1-pentyne or 4-pentyn-2-ol
- (e) ethyl (S)-1-methyl-2-cyclopentenecarboxylate

- 2. As required, compare physical and chemical properties for each of the following groups (10 points, 2 points for each problem).
- (a) (B) > (C) > (A)

(b) (D) > (B) > (A) > (C)

(c) (B) > (C) > (A)

(d) (A) > (B) > (C)

- (e) (B) > (A) > (C)
- 3. Give major products of the following reactions, when necessary, show the stereochemistry of the products (26 points, 2 points for each product).

(c) CF<sub>3</sub>CH<sub>2</sub>CH<sub>2</sub>CI

(e) CH<sub>3</sub>CH<sub>2</sub>CH<sub>2</sub>Br

(f) 
$$\begin{array}{c} CBr_2 \\ C-C \\ H \end{array}$$

- (h) (CH<sub>3</sub>)<sub>2</sub>COHCH<sub>2</sub>CH<sub>3</sub>
- (CH<sub>3</sub>)<sub>2</sub>CHCH<sub>2</sub>CH<sub>2</sub>OH
- 4. Determine whether the compounds in the following groups are enantiomers, diastereomers or the same comopounds (9 points, (a), (c), (d) and (e), each 2 points; 1 point for (b)).
- (a) enantiomers (b) the same compounds (c) diastereomers
- (d) enantiomers (e) diastereomers
- 5. Determine whether each of the following statement is true or false (5 points, each 1 point).
- (a) F (b) T (c) F (d) T (e) F
- 6. Synthesis of the compounds from the indicted starting materials. More than one step may be necessary (20 points, 5 points for each product).

(a)

HC
$$\equiv$$
CH  $\xrightarrow{\text{Pd/CaCO}_3}$  H<sub>2</sub>C=CH<sub>2</sub>  $\xrightarrow{\text{HBr}}$  CH<sub>3</sub>CH<sub>2</sub>Br

(d)

OTs
$$t\text{-BuO}$$
 $t\text{-BuOH}$ 

OH
 $t\text{-BuOH$ 

7. Deduce the molecular structures according to the given reaction phenomena (16 points, (a) 6 points, (b) 10 points, 2 points for each structure).

$$CH_3$$
 $C-CH=CH_2$ 
 $H_2CH_3C$ 
 $CH_3CH_2C(CH_3)OHCH_2CH_3$ 

A

B

A B (2S, 3R)-CH<sub>3</sub>CH<sub>2</sub>CH(CH<sub>3</sub>)CH(OH)CH<sub>3</sub> (2R, 3R)-CH<sub>3</sub>CH<sub>2</sub>CH(CH<sub>3</sub>)CH(OH)CH<sub>3</sub> C D

Compounds  ${f C}$  and  ${f D}$  are diastereomers.

Name:
Student

Number:

## **Dalian University of Technology**

Course: Organic Chemistry (2) Band: A Exam. form: close-book School (Department): School of Chemical Engineering

Department: Chemistry

Class:

	1	2	3	4	5	6	7	Total
Standard points	8	12	20	10	25	15	10	100
Scores								

Total: 6 pages

1. Give a right answer to each of the following questions (8 points).

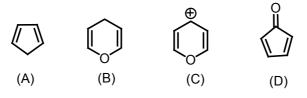
Date: July 4, 2006

In an aqueous acidic solution, which of the following compounds undergoes ring-opening reaction at a rapid rate.

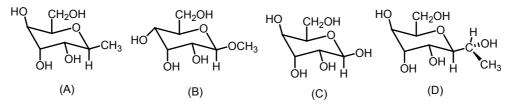
(b) Which of the following compounds is capable to reduce Tollen's reagent?

$$H_2C=CHCH_2OH$$
  $CH_3CH_2CHO$   $CH_3CH$   $CH_2$   $CH_3OCH=CH_2$  (A) (B) (C) (D)

(c) Which of the following compounds is aromatic?

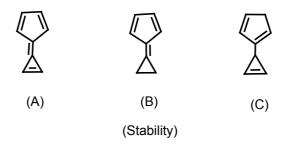


(d) Which of the following compounds displays mutarotation phenomena in basic solution?

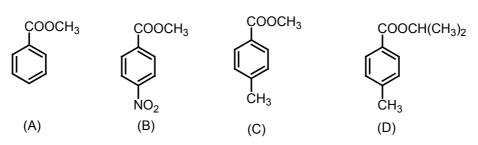


2. As required, compare physical and chemical properties for each of the following groups (12 points).

(a)

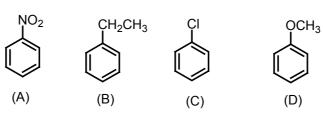


(b)



( The rate of hydrolysis in a basic aqueous solution )

(c)



( The rate of Friedel-Crafts alkylation reaction )

(The reactivity towards an aqueous NaOH solution)

3. Give the major products of the following reactions (20 points).

(a) 
$$PhCH_2CCH_2Ph + PhC-CPh$$
  $\Delta$  NaOH  $\Delta$ 

(b) 
$$O_{II}$$
 CH<sub>3</sub>CH<sub>2</sub>OCOCH<sub>2</sub>CH<sub>3</sub>  $O_{II}$  1) excess PhMgBr  $O_{II}$  2)  $O_{II}$   $O_{II}$   $O_{II}$ 

(d) 
$$Ph$$
 OH  $H_2SO_4$ 

(g) 
$$H_3C$$
  $O$   $CCH_3$   $OH^-/H_2O$ 

(h) 
$$H_{3}C$$
  $O-S_{1}CH_{3}$   $OH^{-}/H_{2}O$ 

4. Show all of the steps in the mechanism for the following reactions (10 points).

(b) 
$$H_3^{\bigoplus}$$
  $+$   $CH_3COCH_3 + H_2O$ 

5. Synthesis of the following products from the indicated starting compounds and other necessary reagents (25 points).

(a) from 
$$\begin{array}{cccc} & O & O & OH \\ II & II & II \\ EtOCCH_2COEt & to & PhCHCH_2CHCOOH \\ & CH_3 & \end{array}$$

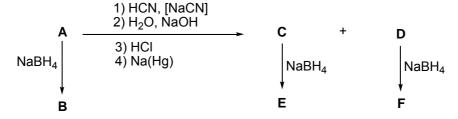
(b) from 
$$CH_2NHCH_2CH_2CH_2CH_3$$

(c) from 
$$\begin{array}{c} O \\ II \\ HC \equiv CCH_2CH_2CCH_3 \end{array} \quad \text{to} \quad \begin{array}{c} O \\ II \\ CH_3CH_2C \equiv CCH_2CH_2CCH_3 \end{array}$$

(d) from 
$$\begin{array}{c} CH_3 \\ \hline \\ CN \end{array}$$

(e) from to 
$$CH_2CH_2OH$$

6. Deduce the molecular structures according to the given reaction phenomena (15 points).
(a) Carbohydrate A is a D-aldotetrose. Compound B and E both rotate plane-polarized light.
Show the structures of A, B, C, D and E (7 points).



(b) Compound **A** ( $C_{11}H_{12}O_2$ ) can be obtained by the reaction of an aromatic aldehyde with acetone in dilute basic solution. Hydrogenation of **A** catalyzed by Pd/C affords compound **B** ( $C_{11}H_{14}O_2$ ). The reaction of **A** with I<sub>2</sub>/NaOH and sequential acidification gives  $CHI_3$  and compound **C** ( $C_{10}H_{10}O_3$ ). Both **B** and **C** can be oxidized by  $KMnO_4/OH^-$  to the same acid **D** ( $C_8H_8O_3$ ). Treatment of **D** with HI yields another acid **E** ( $C_7H_6O_3$ ). Intramolecular hydrogen bond is formed in compound E. Please give the structures of **A**, **B**, **C**, **D** and **E** (8 points).

7. There are 5 test-tubes. Each contains one of the following compounds .Please identify each of the following compounds using simple chemical testing methods and write testing reactions (10 points).

## 参考答案及评分标准 (Band: A)

课程:有机化学(下)班级:英强班 2003-1,2院(系):化工学院日期:2006 年 7 月 4 日

1. Give a right answer to each of the following questions (8 points, 2 points for each problem).

(a) A

(b) B

(c) C

(d) C

2. As required, compare physical and chemical properties for each of the following groups (12 points, 2 points for each problem).

(a) A > B > C

(b) B > A > C > D

(c) D > B > C > A

(d) B > C > A

(e) D > B > C > A

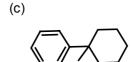
(f) D > A > C > B

3. Give the major products of the following reactions (20 points, 2 points for each product).

(a)



') Ph₃COH



(d)

PhCNHCH<sub>3</sub> 0

(e)



(f) P



(g)

(h)  $H_3C$ 

(i) CH<sub>3</sub>CHCH<sub>2</sub>CH<sub>2</sub>C

 $\begin{array}{c} \mathrm{CH_3CHCH_2CH_2CH_2OH} \\ \mathrm{OH} \end{array}$ 

4. Show all of the steps in the mechanism for the following reactions (10 points, 5 points for each mechanism).

(a) 
$$Ph \longrightarrow H$$
  $BF_3$   $Ph \longrightarrow H$   $Ph \longrightarrow H$ 

5. Synthesis of the following products from the indicated starting compounds and other necessary reagents (25 points, 5 points for each synthetic route).

(b) 
$$COOH$$
  $CI COOH$   $CI$ 

$$CH_3CH_2C \equiv C(CH_2)_3 \qquad CH_3 \qquad CH_3CH_2C \equiv C(CH_2)_3CCH_3$$

- 6. Deduce the molecular structures according to the given reaction phenomena (15 points).
- (a) Carbohydrate **A** is a D-aldotetrose. Compound **B** and **E** both rotate plane-polarized light. Show the structure of **A**, **B**, **C**, **D** and **E** (7 points, structures **A** and **E**, each 2 points; **B**, **C** and **D**, each 1 point).

CHO 
$$CH_2OH$$
  $CHO$   $CHO$   $CHO$   $CHO$   $CH_2OH$   $CHO$   $CH_2OH$   $CHO$   $CH_2OH$   $CHO$   $CH_2OH$   $CH_2OH$ 

(b) Compound **A** ( $C_{11}H_{12}O_2$ ) can be obtained by the reaction of an aromatic aldehyde with acetone in dilute basic solution. Hydrogenation of **A** catalyzed by Pd/C affords compound **B** ( $C_{11}H_{14}O_2$ ). The reaction of **A** with  $I_2/NaOH$  and sequential acidification gives  $CHI_3$  and compound **C** ( $C_{10}H_{10}O_3$ ). Both **B** and **C** can be oxidized by  $KMnO_4/OH^-$  to the same acid **D** ( $C_8H_8O_3$ ). Treatment of **D** with HI yields another acid **E** ( $C_7H_6O_3$ ). Intramolecular hydrogen bond is formed in compound **E**. Please give the structures of **A**, **B**, **C**, **D** and **E** (8 points, structures **A**, **B** and **E**, each 2 points; **C** and **D**, each 1 point).

7. There are 5 test-tubes. Each contains one of the following compounds .Please identify each of the following compounds using simple chemical testing methods and write testing reactions (10 points, 2 points for each compound).

Compound CH<sub>3</sub>CH<sub>2</sub>COOCH<sub>3</sub> does not react with any of the above reagents.

# Name: Student Number: Department: Chemistry

Class:

### **Dalian University of Technology**

Course: Organic Chemistry (1) Band: A

School (Department): School of Chemical Engineering

Date: January 18, 2007 Total: 6 pages

	1	2	3	4	5	6	7	8	Total
Standard points	8	6	24	15	15	14	8	10	100
Scores									

1. Give a name (either a systematic name or a trivial name) for each of the following formulas, when necessary, please designate E/Z and R/S configuration (8 points).

(a) (b) 
$$C = CH_3$$
  $C = CH_3$   $C = CH_3$   $C = CH_3$   $C = CH_3$   $CH_2CH_3$   $CH_2CH_3$ 

(c) 
$$CH_3$$
  $CH_3$   $N$   $NH_2$ 

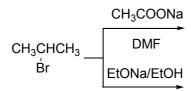
2. Write a molecular formula as required (6 points).

(a) (Z)-2-phenyl-2-butene (b) (2S,3S)-2,3-pentanediol (Fischer projection)

(c) (1*S*,3*S*)-3-methylcyclohexanecarboxamide (the most stable conformation)

3. Give major products of the following reactions, when necessary, please give three-dimensional formulas or Fischer projections (24 points).

(a)



(b) 
$$CH_3 \longrightarrow CH_3 \longrightarrow \Delta$$
  $H_2SO_4 \text{ (cons.)} \longrightarrow \Delta$ 

(c)

$$\begin{array}{c|c} H_3C & CH_3 & CH_2I_2, Zn/Cu \\ H & H \end{array}$$

(d)

HC=CH 
$$\xrightarrow{1)\text{NaNH}_2}$$
  $\xrightarrow{2)\text{CH}_3\text{CH}_2\text{Br}}$ 

$$H_2O$$
HgSO<sub>4</sub>,  $H_2SO_4$ 

(e)

(f)

$$\begin{array}{c|c} C_2H_5 \\ H_3C & Br \\ H_3C & Br \\ C_2H_5 \end{array} \xrightarrow{\begin{array}{c} NaI \\ CH_3COCH_3 \end{array}}$$

4. Synthesis of the compounds from the given starting reactants (15 points).

(a)

from 
$$H_3CCH=CH_2$$

CH<sub>3</sub>CH<sub>2</sub>CHO

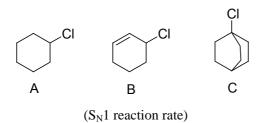
(b)

# (c) $\mbox{from } \mbox{H}_2\mbox{C=CHCH}_2\mbox{OH} \mbox{ to } \mbox{H}_2\mbox{C=CHCH}_2\mbox{NH}_2 \mbox{ (pure primary amine)}$

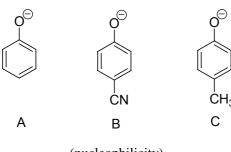
a racemate

5. As required, compare physical and chemical properties for each of the following groups (15 points).

(a)



(b)



(nucleophilicity)

(c)

N
H
C
N
B
C
(basicity)

(the reaction rate with Cl<sub>2</sub>/H<sub>2</sub>O)

(e)

Α

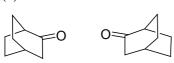
- 6. Deduce the molecular structures according to the given reaction phenomena (14 points).
- (a) Please give the full structures of **A**, **B**, **C** and **D** in the following reaction scheme.

(b) When compound  $\mathbf{A}$  ( $C_7H_{15}N$ ) is treated with  $CH_3I$ , a water soluble salt  $\mathbf{B}$  ( $C_8H_{18}NI$ ) is formed. A compound  $\mathbf{C}$  ( $C_5H_8$ ) and trimethylamine are yielded if  $\mathbf{B}$  is heated in an aqueous AgOH solution.  $\mathbf{C}$  can absorb an equivalent of  $H_2$ . When  $\mathbf{C}$  is treated with  $O_3$  and then hydrolyzed in the presence of zinc, pentanedial is obeained. Please give the structures of  $\mathbf{A}$ ,  $\mathbf{B}$  and  $\mathbf{C}$ .

7. Designate whether the following pairs are enantiomers, diastereomers or identical compounds (8 points).

(a)

(b)



(c)

$$CH_3$$
  $H$   $CH_3$   $CH_3$ 

(d)

- 8. Choose the correct answer for each of the following questions (10 points).
- (a) The E2 reaction is the \_\_\_\_\_
  - A. one step, first order reaction
  - B. one step, second order reaction
  - C. two step, first order reaction
  - D. two step, second order reaction
- (b) The enantiomers are different in \_\_\_\_\_\_.
  - A. the magnitude of rotation of plane-polarized light
  - B. the pH value
  - C. the melting point
  - D. the reaction rate with a chiral compound

(c) The	e rate of the $S_{\rm N}1$ reaction increase with _		·					
A.	increasing the strength of nucleophil	les						
B.	increasing the content of water in the solvent							
C.	increasing the number of small electron atom	ectr	on withdrawing groups on the attacked					
D.	decreasing the steric hindrance of the	all	xyl halide					
(d) whic	ch of the following statement is correct?	)						
A.	An optically active alkyl halide retains	its	special configuration in the $S_{N}2\ reaction.$					
B.	The m.p. of the linear alcohols are hi	ighe	er than the m.p. of the branched alcohols					
	with the same molecular mass.							
C.	The S <sub>N</sub> 1 reaction leads to racemization	ı of	an optically active alkyl halide.					
D.	If there is a symmetric element (a sym	me	tric plane, a symmetric center or an n-fold					
	alternative axis) in the molecule, the c	om	pound has no chirality.					
(a) A pa	pair of enantiomers can be separated by		·					
A.	recrystallization	C.	sublimation					
В.	resolution	D.	distillation					

### 参考答案及评分标准 (Band: A)

 课程: 有机化学(上)
 班级: 英强班

 院(系): 化工学院
 日期: 2007 年 1 月 18 日

1. Give a name (either a systematic name or a trivial name) for each of the following formulas, when necessary, please designate E/Z and R/S (8 points, 2 points for each name).

- (a) N-methyl (Z)-2-hexenamide
- (b) (R)-3-methyl-1-pentyne
- (c) 7,7-dimethylbicyclo[4.1.0]heptane
- (d) 2-aminopyridine

2. Write a molecular formula as required (6 points, 2 points for each structure).

(a) 
$$H_3C$$
  $C=C$   $H$  (b)  $CH_3$   $H$   $OH$   $OH$   $CC$ 

3. Give major products of the following reactions, when necessary, please give three-dimensional formulas or Fischer projections (24 points, 2 points for each product).

(e) 
$$H_3C$$
  $C=C$   $H_3$   $CH_3$   $H_3C$   $CH_3$   $H_3C$   $CH_3$ 

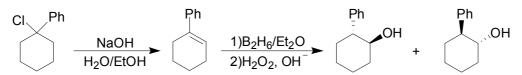
4. Synthesis of the compounds from the given starting reactants (15 points, 3 points for the first problem and 4 points for each of the other problems).

(a) 
$$CH_3CH=CH_2 \xrightarrow{1)BH_3, THF} CH_3CH_2CH_2OH \xrightarrow{CrO_3, HCl, Py} CH_3CH_2CHO$$

(c) OH 
$$H_2C=CHCH_2$$
  $P/Br_2 \rightarrow H_2C=CHCH_2Br$ 

H<sub>2</sub>C=CHCH<sub>2</sub>NH<sub>2</sub>

(d)



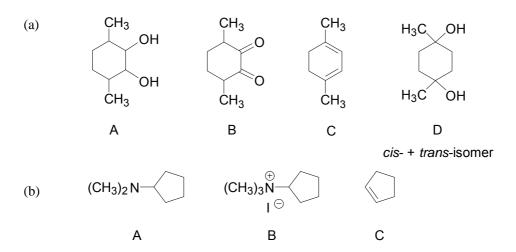
- 5. As required, compare physical and chemical properties for each of the following groups (15 points, 3 points for each problem).
- (a) B > A > C

(b) C > A > B

(c) C > B > A

(d) A > C > B

- (f) B > A > C
- 6. Deduce the molecular structures according to the given reaction phenomena (14 points, (a): 8 points; (b): 6 points).



- 7. Designate whether the following pairs are enantiomers, diastereomers or identical compounds (8 points, 2 points for each problem).
- (a) enantiomers

(b) identical

(c) identical

- (d) enantiomers
- 8. Choose the correct answer for each of the following questions (10 point, 2 points for each problem).
- (a) B

(b) D

(c) B

(d) C

(e) B

Name:

## **Dalian University of Technology**

Student

Number: Course: Organic Chemistry (2)

Band: A

rumoer.

School (Department): School of Chemical Engineering

Department:

Chemistry

Class:

Date: <u>July 11, 2007</u>

Total: 5 pages

	1	2	3	4	5	6	7	8	Total
Standard points	10	26	10	10	8	8	8	20	100
Scores									

- 1. Arrange the compounds of each group in order of the indicated property or reactivity (10 points).
- (a) Compare the rate of protonation of the following ketones.







(b) Compare the content of enol form existing in basic solution.

(c) Compare the reaction rate of the following compounds with HCN.

(d) Compare the rate of saponification of the following esters.

B B CH CHECCE! B



(e) Compare the acidity of phenol and its derivatives.

- 2. Give major products of the following reactions (26 points).
- (a)

(b)

CHO + CH<sub>3</sub>CH<sub>2</sub>NO<sub>2</sub> NaOEt H<sub>3</sub>Q 
$$\Delta$$

(c)

$$\begin{array}{cccc}
H_{1} & O & O \\
H_{1}C & \longrightarrow & ( )
\end{array}$$

 $\begin{array}{c}
O \\
O \\
O \\
NH, & \xrightarrow{Br_2} (
\end{array}$ 

(e)

(f)

$$CH_{3} CC \longrightarrow CO \longrightarrow CO$$

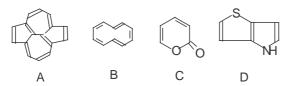
3. Show the missing structures (A-E) in the following reaction sequence (10 points).

4. Deduce the molecular structures of the compounds **A-E** according to the given reaction phenomena (10 points).

Oxidation of an L-aldohexose (**A**) by HNO<sub>3</sub> affords an optically active product (**B**). When (**A**) is degradated by Ruff degradation, an aldopentose (**C**) is obtained, which is also optically active. But after (**C**) is reacted with NaBH<sub>4</sub>, the reduced pro-duct (**D**) is optically inactive. Treatment of (**C**) by Kiliani-Fischer synthesis (the sequential reactions are: the reaction of (**C**) with HCN, followed by acidic hydrolysis, and then the reduction of the obtained carboxylic acid by Na-Hg within the range of pH value 3~5) gives L-aldohexose (**A**) and its epimer (**E**). Oxidation of (**E**) by HNO<sub>3</sub> forms an optically inactive dicarboxylic acid.

5. Show all steps in the mechanism for the following reaction (8 points).

- 6. As required, answer the following questions (8 points)
- (a) Designate which of the following compounds will be aromatic.



(b) Indicate which of the following compounds will react with Tollen's reagent.

(c) Indicate which of the following compounds cannot be used for synthetically application of Friedel-Crafts reaction.

(d) Indicate which experimental procedure is proper for the following reaction.

- A. To drop benzaldehyde into the basic solution of acetone.
- B. To drop acetone into the basic solution of benzaldehyde.
- C. To drop a basic solution of benzaldehyde into the EtOH solution of acetone.
- D. To drop a basic solution of acetone into the EtOH solution of benzaldehyde.

7. There are 5 test-tubes. Each contains one of the following compounds. Please identify each of the following compounds using simple chemical testing methods (8 points).

O OH O O O O O CH3C-CHCH3 PhC-OCH3 
$$CH_3CPh$$
  $CH_3C-CH_2CH_3$   $PhC-CH_2CH_3$ 

A B C D E

8. Show syntheses of the following compounds using the indicated starting materials and other necessary reagents (20 points).

(a)

(d)

from 
$$CH_2$$
= $CHCHO$ ,  $CH_3CCH_3$  and  $O$  to  $O$ 

### 参考答案及评分标准 (Band: A)

课程: 有机化学(下) 班级: 英强班 04-1-2 院(系): 化工学院 日期: 2007年7月11日

- 1. Arrange the compounds of each group in order of the indicated property or reactivity (10 points, 2 points for each question).
  - (a) C > A > B
- (b) C > A > B
- (c) B > C > A (d) B > A > C

(b)

- (e) A > C > B
- 2. Give major products of the following reactions (26 points, 2 points for each product).
- (a)

(c)

(d)

 $G_{1} G_{2} G_{2}$ 

(e)

(f)

(g)

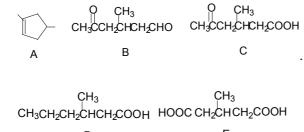
(i)

(h)

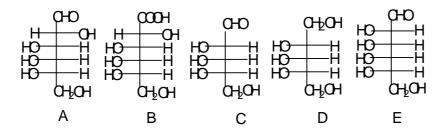


CH<sub>3</sub>CH<sub>2</sub>CH<sub>2</sub>CH<sub>3</sub>

3. Show the missing structures (**A-E**) in the following reaction sequence (10 points, 2 points for each structure).



4. Deduce the molecular structures of the compounds **A-E** according to the given reaction phenomena (10 points, 2 points for each structure).



5. Show all steps in the mechanism for the following reaction (8 points).

- 6. As required, answer the following questions (8 points, 2 points for each question).
- (a) A, C and D (b) A (c) B (d) B

7. There are 5 test-tubes. Each contains one of the following compounds. Please identify each of the following compounds using simple chemical testing methods (8 points, 2 points for each reaction).

Compound PhCOOCH<sub>3</sub> does not react with any of the above reagents.

8. Show syntheses of the following compounds using the indicated starting materials and other necessary reagents (20 points, 5 points for each target compound).

(d) 
$$\begin{array}{c} & & \\$$