CHEM 2430 – Organic Chemistry I – Fall 2015

Instructor: Paul Bracher

Quiz #6

Due: Wednesday, December 9th, 2015

12:00 p.m. (to the metal mailbox outside Monsanto Hall 103)

Student Name (Printed)	
Student Signature	

Instructions & Scoring

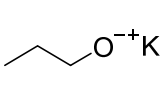
- Please write your answers on the official answer sheet. No answers marked in this booklet will be graded. Submissions submitted electronically will not be graded.
- You may use any resources you wish and collaborate with others.
- Any questions should be posted to the Blackboard discussion board so all students have equal access to the information.
- Your quiz answer sheet may be photocopied.

Problem	Points Earned	Points Available
I		40
II		16
III		18
IV		10
V		16
TOTAL		100

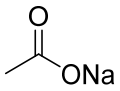
The Last Quiz!

Problem I. Multiple choice (40 points total; +4 points for a correct answer, +1 point for an answer intentionally left blank, and 0 points for an incorrect answer). For each question, select the best answer of the choices given. Write the answer, legibly, in the space provided on the answer sheet.

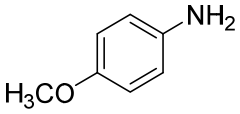
(1) _____ Which of the following compounds is the strongest Brønsted–Lowry base?



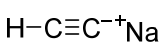
(a)



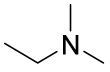
(b)



(c)



(d)

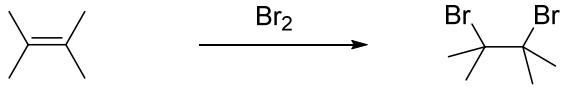


(e)

(2) _____ Which of the following compounds has the highest melting point?

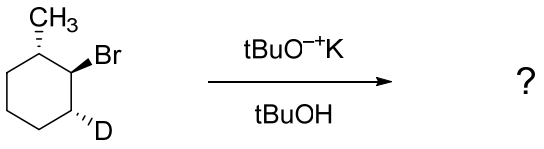
(a) ethane
(b) propane
(c) 2,2,3,3-tetramethylbutane
(d) 2,3,4-trimethylpentane
(e) octane

(3) _____ What statement does not accurately describe at least one step or aspect of the mechanism for the reaction drawn below?

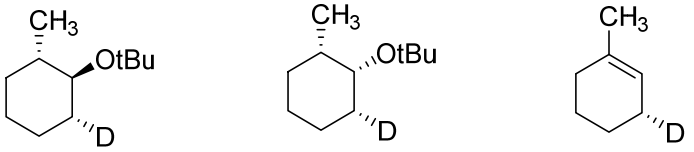


(a) a bromide anion serves as a nucleophile
(b) the π bond on the alkene serves as an electrophile
(c) the addition of the Br groups takes place with anti geometry
(d) an intermediate with a three-membered ring forms
(e) the final product is saturated (degree of unsaturation = zero)

(4) _____ What is the <u>major product</u> of the reaction shown below?



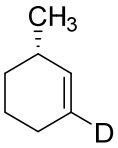
A



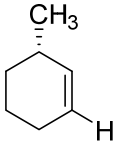
(a)

(b)

(c)

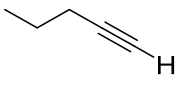


(d)



(e)

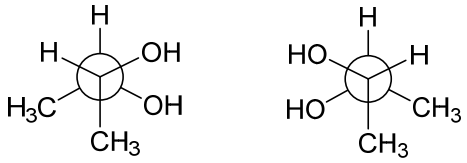
(5) _____ Which of the following statements is <u>not</u> correct regarding compound **B**?
(Note: "1 eq." is the abbreviation for one molar equivalent, i.e., one mole per mole)



B

(a) compound **B** has 8 hydrogen atoms
(b) compound **B** has two carbon atoms that are *sp* hybridized
(c) compound **B** is named 1-pentyne
(d) compound **B** reacts with 1 eq. NaH to produce 1 eq. H_2 gas
(e) compound **B** reacts with 1 eq. H_2/Pd-C to produce 1 eq. 1-pentene

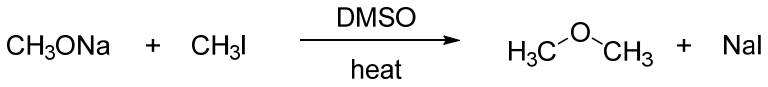
(6) _____ What term best describes the relationship of the molecules drawn below as Newman projections **C** and **D**?



C **D**

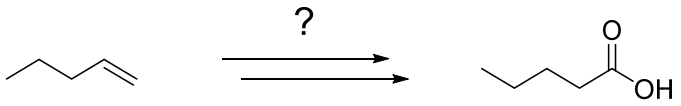
(a) identical compounds
(b) stereoisomers with the exact same melting point
(c) stereoisomers with different melting points
(d) structural/constitutional isomers
(e) too unstable to exist (since they have "Texas carbons")

(7) _____ What statement best describes the following reaction?



(a) this is an S_N1 reaction; doubling the concentration of sodium methoxide will double the rate
(b) this is an S_N2 reaction; the σ* antibonding orbital of the C–I bond is attacked by methoxide
(c) this is an E2 reaction; doubling the concentration of sodium methoxide will double the rate
(d) this is an S_N1 reaction; an unhybridized p orbital is attacked by methoxide
(e) none of the above statements are correct

(8) _____ Which of the following routes is the most appropriate to prepare pentanoic acid (**F**) from 1-pentene (**E**)?



E **F**

(a) $\xrightarrow[H_2O]{H_2SO_4}$ $\xrightarrow[\text{pyridine}]{\text{TsCl}}$ $\xrightarrow[t\text{BuOH}]{t\text{BuOK}}$

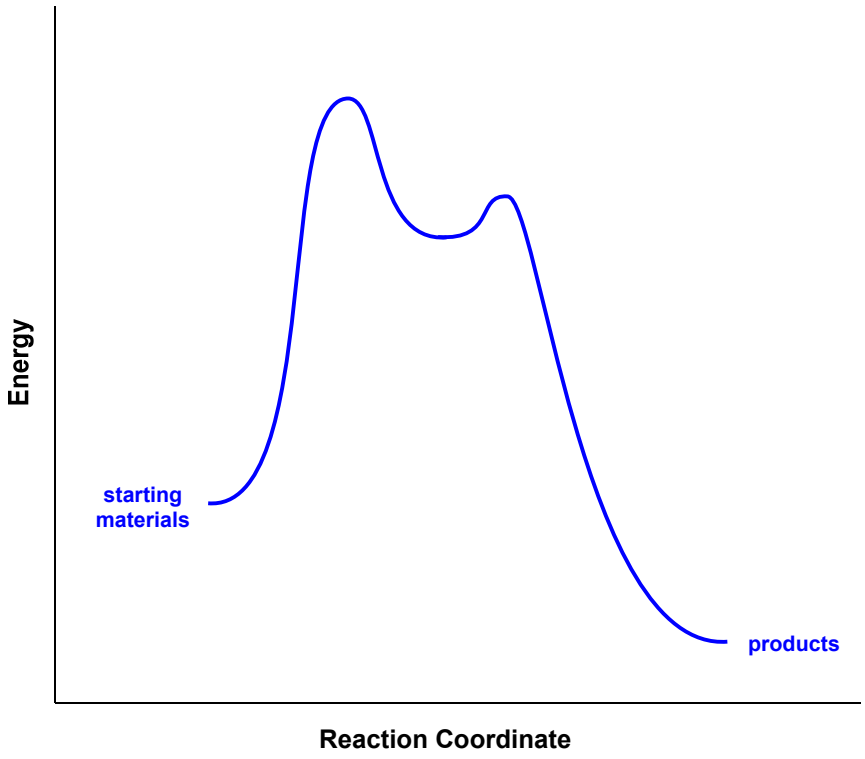
(b) $\xrightarrow[2.\ H_2O_2,\ NaOH]{1.\ BH_3\text{-THF}}$ $\xrightarrow[H_2SO_4,\ H_2O]{K_2Cr_2O_7}$

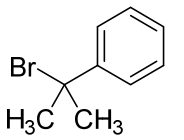
(c) $\xrightarrow[H_2O]{H_2SO_4}$ $\xrightarrow[H_2SO_4,\ H_2O]{K_2Cr_2O_7}$

(d) $\xrightarrow[2.\ H_2O_2,\ NaOH]{1.\ BH_3\text{-THF}}$ $\xrightarrow{\text{PCC}}$

(e) $\xrightarrow[\text{pyridine}]{SOCl_2}$ $\xrightarrow[2.\ S(CH_3)_2]{1.\ O_3}$

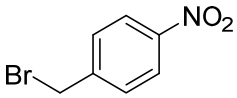
(9) _____ Which of the following compounds would react fastest with cyanide ion ($^{-}$CN) in a reaction described by the following energy diagram?





(a)

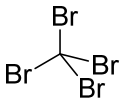
(b)



(c)

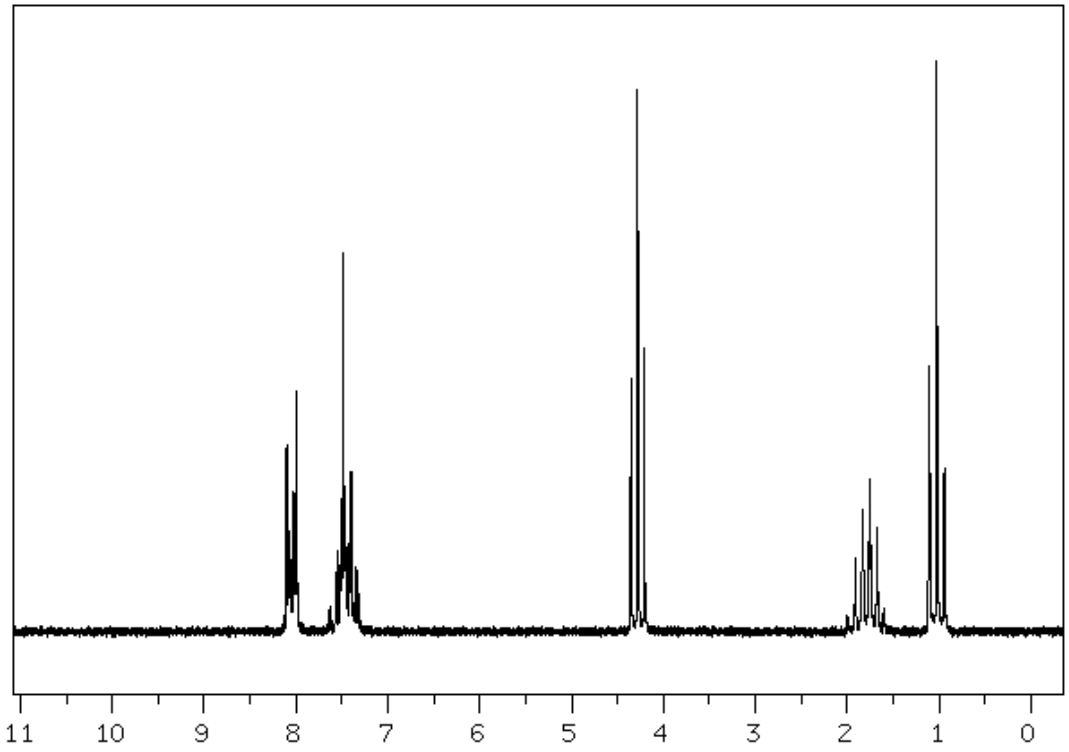
CH_3Br

(d)

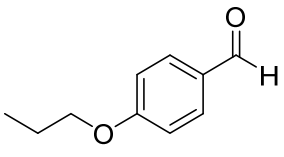


(e)

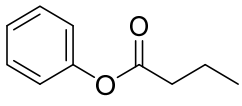
(10) _____ The NMR spectrum shown below corresponds to what compound?



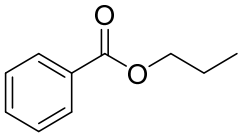
Chemical Shift (ppm)	Multiplicity	Integration
8.04	doublet	24
7.65–7.30	unclear	36
4.28	triplet	23
1.78	sextet?	24
1.03	triplet	35



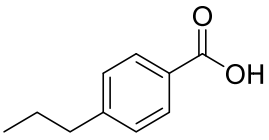
(a)



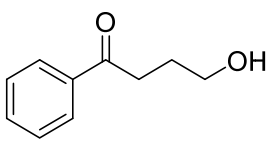
(b)



(c)

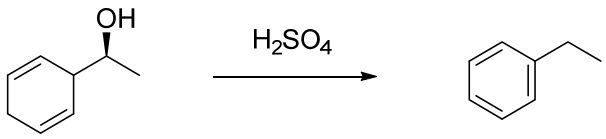


(d)



(e)

Problem II. Mechanism (16 points). Draw a sensible mechanism for the following reaction. Remember to use proper "curved arrow notation" to account for the redistribution of electrons in the making and breaking of bonds. Show all significant resonance forms that account for the stability of the intermediates in the reaction.



G **H**

Problem III. (18 points) Roadmap Problem. Provide structures for compounds **J**, **K**, and **N** given the information listed below.

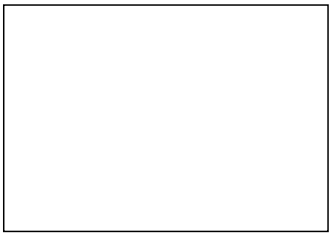
Compound **J** is a single, pure compound with a pK_a of ~25 and no optical activity. The infrared spectrum of **J** has a sharp absorption near 3300 cm^{-1}, and its electron-impact mass spectrum has an M^+ peak at 68 m/z. The ^1H NMR spectrum of **J** has four signals. When **J** is treated with sodamide followed by methyl iodide, compound **K** is the major product. High-resolution mass spectrometry of **K** reveals it to have a molecular formula of C_6H_{10}. When compound **K** is heated in aqueous acid, two products (**M** and **N**) are produced in roughly equal yield. **N** has a ^{13}C NMR spectrum with six signals and an MS with a molecular ion peak at 100 m/z. The infrared spectrum of **N** has a strong absorption at 1715 cm^{-1}. The ^1H NMR spectrum of **N** has five signals, whose chemical shifts, multiplicities, and integrations are given below.

<u>Compounds & Reactions</u>

J

1. $NaNH_2$
2. CH_3I

K

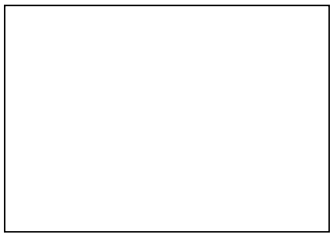


H_2SO_4
H_2O, heat

mixture of

compound **M** +

N



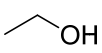
<u>Pertinent Spectral Data for Associated Compound</u>

- IR spectrum has a sharp peak ~3300 cm^{-1}
- M^+ peak at 68 m/z
- pK_a of ~25
- ^1H NMR spectrum has 4 signals

- High-resolution MS gives a molecular formula of C_6H_{10}

- ^{13}C NMR spectrum has 6 signals
- M^+ peak at 100 m/z
- IR spectrum has strong absorption at 1715 cm^{-1}
- ^1H NMR spectrum in has peaks at δ 2.41 (quartet, 2H), 2.39 (triplet, 2H), 1.60 (multiplet, 2H), 1.06 (triplet, 3H), 0.92 (triplet, 3H)

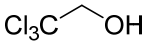
Problem IV. Explanations (10 points). Briefly explain the trend in acidity of the compounds listed below. Use drawing(s), if appropriate.



P

ethanol

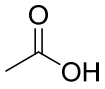
pK_a = 15.9



Q

2,2,2-trichloroethanol

pK_a = 12.0

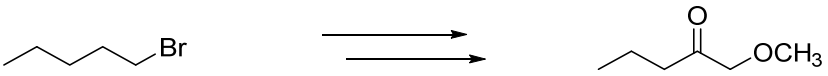


R

ethanoic acid

pK_a = 4.8

Problem V. Synthesis (16 points). Provide a synthetic route—i.e, a sequence of reactions—to produce compound **T** from 1-bromopentane (**S**) and any other reagents you wish.



S **T**