Lakehead
UNIVERSITY

CHEMISTRY 2211
FINAL EXAMINATION

Name: _____ Student #: _____

CHEMISTRY	2211	FA, FB, FC
SUBJECT	COURSE NO.	SECTION

ORGANIC CHEMISTRY	CRAIG MACKINNON
COURSE TITLE	INSTRUCTOR

6 DECEMBER, 2003	13:00 - 16:00 (1pm-4pm), 3 HOURS
EXAM DATE	EXAM TIME & DURATION

INSTRUCTIONS:

For Part A: Answer multiple choice and short-answer directly on the exam sheet.

For Part B: Answer in the examination booklets provided.

A calculator is permitted.

The last page (p. 10) contains spectroscopic tables. You may remove this page from the exam. Use the back of this page for scrap work. Do not remove any other pages from the exam.

Mark value of each question is indicated in parentheses beside the question. The total is 61. Value of the exam is 40% towards your final grade in the course

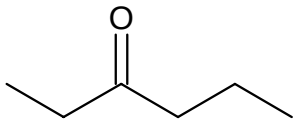
There are 7 questions on 10 pages. Be sure your exam is complete.

This examination paper MAY NOT be taken from the examination room.

PART A: TO BE COMPLETED DIRECTLY ON THE EXAMINATION PAPER

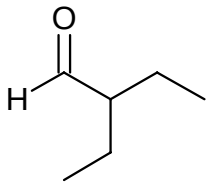
Question 1 Multiple choice - circle the letter corresponding to the correct answer. (1 point each, 12 total)

(i) What is the name of this compound?



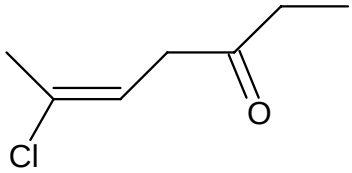
(a) hexanone
(b) 3-hexanone
(c) ethyl butanone
(d) propyl propanone
(e) ethyl butyl ketone

(ii) What is the name of this compound?



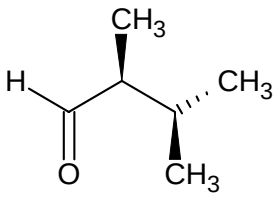
(a) pentanal
(b) 3-pentanal
(c) 3-hexanal
(d) ethylbutanal
(e) 2-ethylbutanal

(iii) What is the name of this compound?



(a) 6-chloroheptenone
(b) (*E*)-6-chloro-5-heptenone
(c) (*E*)-6-chloro-5-hepten-3-one
(d) (*Z*)-6-chloro-5-heptenone
(e) (*Z*)-6-chloro-5-hepten-3-one

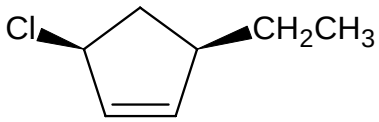
(iv) What is the name of this compound?



(a) (2*S*, 3*R*)-2,3-dimethylbutanal
(b) (2*R*, 3*S*)-2,3-dimethylbutanal
(c) (*S*)-2,3-dimethylbutanal
(d) (*R*)-2,3-dimethylbutanal
(e) 2,3-dimethylbutanal

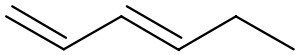
Question 1 (continued)

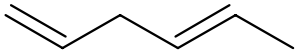
(v) What is the name of this compound?

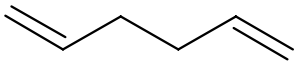


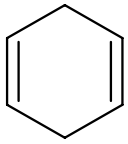
(a) *cis*-3-chloro-5-ethylcyclopentene
(b) *trans*-3-chloro-5-ethylcyclopentene
(c) (*E*)-3-chloro-5-ethylcyclopentene
(d) (*Z*)-3-chloro-5-ethylcyclopentene
(e) 3-chloro-5-ethylcyclopentene

(vi) A compound has an absorption in the UV-visible spectrum at 236 nm. Which of the following is the most likely structure for the compound?

(a) 

(b) 

(c) 

(d) 

(e) both (a) and (d)

(vii) In a 1-step reaction, (*R*)-2-bromobutane is created from (*S*)-2-butanol. Therefore, the reaction occured by which mechanism?

(a) S_N2 (b) S_N1
(c) E2 (d) E1
(e) cannot tell based on the information given

(viii) If a primary (1°) alcohol is reacted with an oxidising agent, the result will be

(a) a ketone
(b) an aldehyde
(c) a carboxylic acid
(d) no reaction will occur
(e) one of (b) or (c), depending on the strength of the oxidising agent

Question 1 (continued)

(ix) If a tertiary (3°) alcohol is reacted with an oxidising agent, the result will be

(a) a ketone

(b) an aldehyde

(c) a carboxylic acid

(d) no reaction will occur

(e) one of (b) or (c), depending on the strength of the oxidising agent

(x) The horizontal scale on an NMR experiment (the δ-scale) is arranged in order of increasing (from left to right)

(a) mass of the nucleus

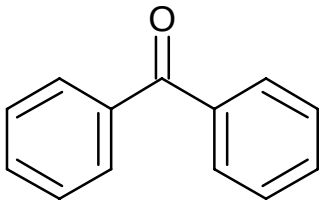
(b) shielding of the nucleus by electrons

(c) splitting of the peaks

(d) integration of the peaks (number of nuclei)

(e) stability of the group to chemical reaction

(xi) Which of the following fragment peaks is likely to appear in the mass spectrum of benzophenone, shown here?



(a) $m/e = 77$

(b) $m/e = 89$

(c) $m/e = 105$

(d) Both (a) and (b)

(e) Both (a) and (c)

(xii) What statement is true of all *S* stereoisomers?

(a) They are levorotatory

(b) They are dextrorotatory

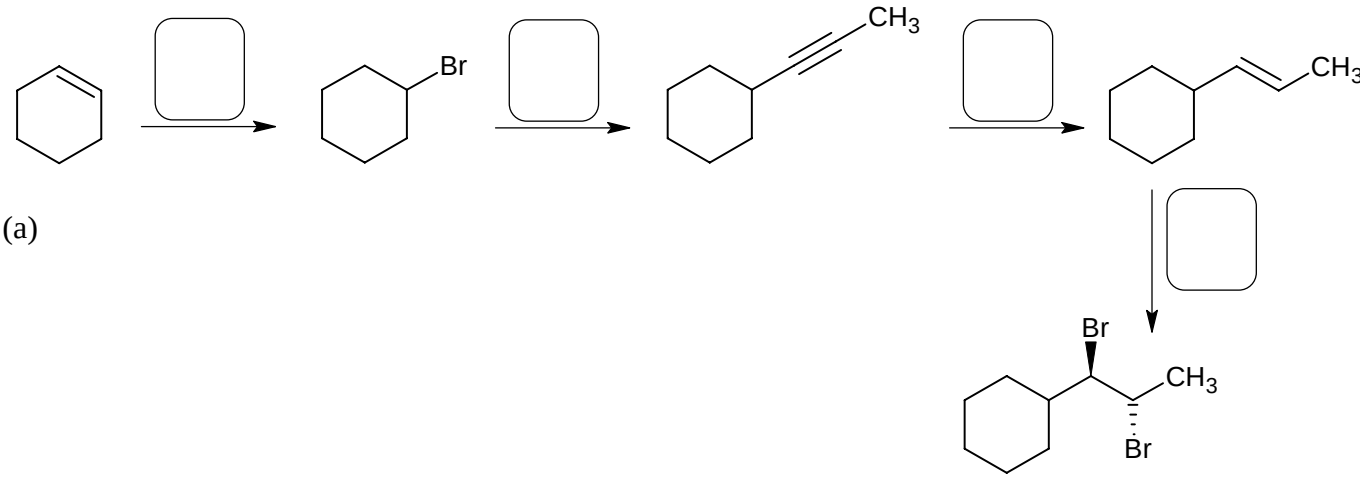
(c) They are mirror images of *R* isomers

(d) They consist of equal amounts of (+) and (-) isomers

(e) They are racemic mixtures

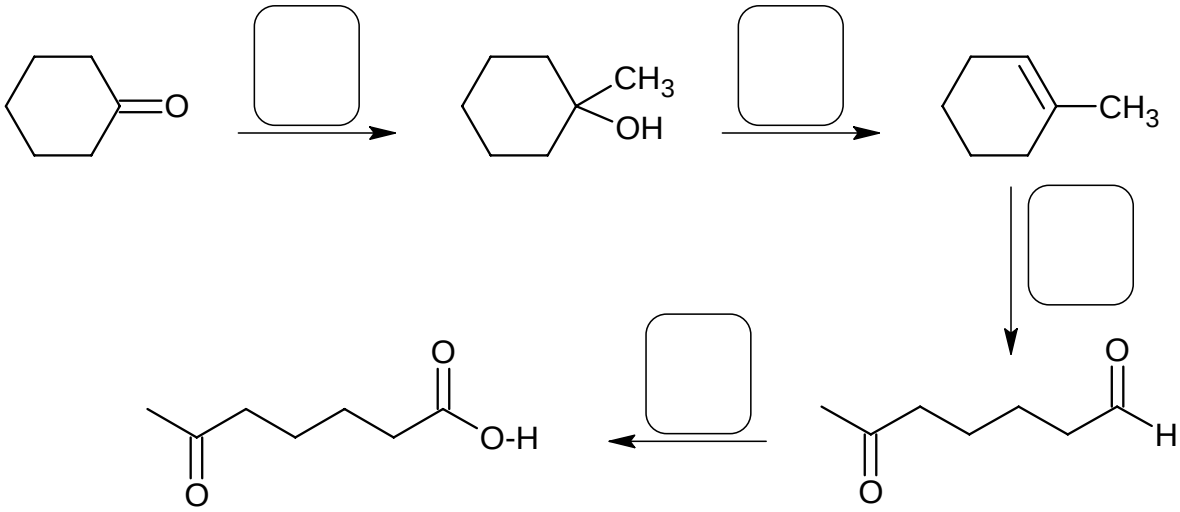
Question 2 Fill in the blanks: From the list at the bottom of the page, indicate the reagent required for each transformation. A reagent may be used more than once (*i.e.*, once in (a) and once in (b)). (1 point per box, 8 total)

(a)



(racemic mixture)

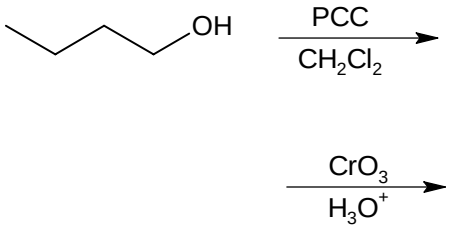
(b)

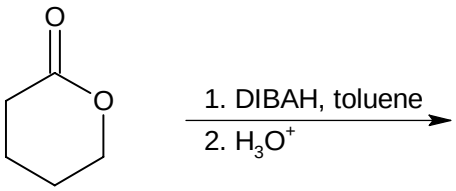


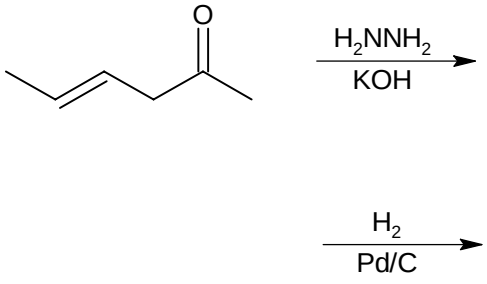
REAGENTS

A CH_3MgBr	**G** 1. O_3; 2. Zn/H_3O^+	**M** Li, NH_3
B $CH_3CH_2CH_2MgBr$	**H** Br_2, H_2O	**N** H_2SO_4, H_2O, THF, 50°C
C CH_3-C≡C:$^-$ Na^+	**I** HBr, ether	**O** OH^- (*aq*)
D CH_3-C≡C-H	**J** Br_2, $h\nu$	**P** PCC, CH_2Cl_2
E HIO_4, H_2O	**K** Br_2, CH_2Cl_2	**Q** Ag^+, NH_4OH (Tollen's Reagent)
F 1. OsO_4; 2. $NaHSO_3$, H_2O	**L** H_2, Pd/C	**R** H_2NNH_2, KOH

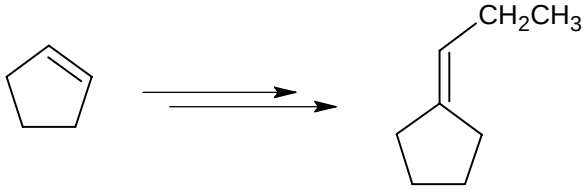
Question 3 Fill in the blanks: Give the major organic product(s) for reactions (a) to (c) (2 points each). For (d), supply reagents for the conversion (5 points); more than one step is necessary (11 total points for this question)

(a) 

(b) 

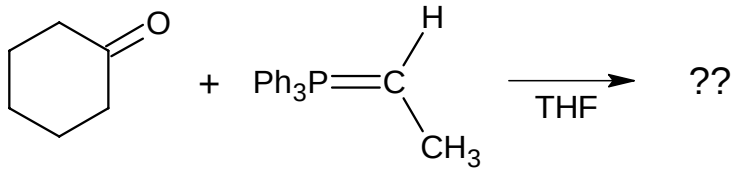
(c) 

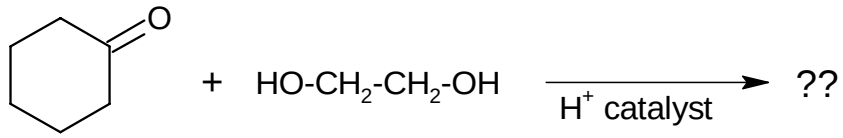
(d) Supply a synthetic route. More than one step is necessary.
You may use any reagent with 3 or fewer carbon atoms.



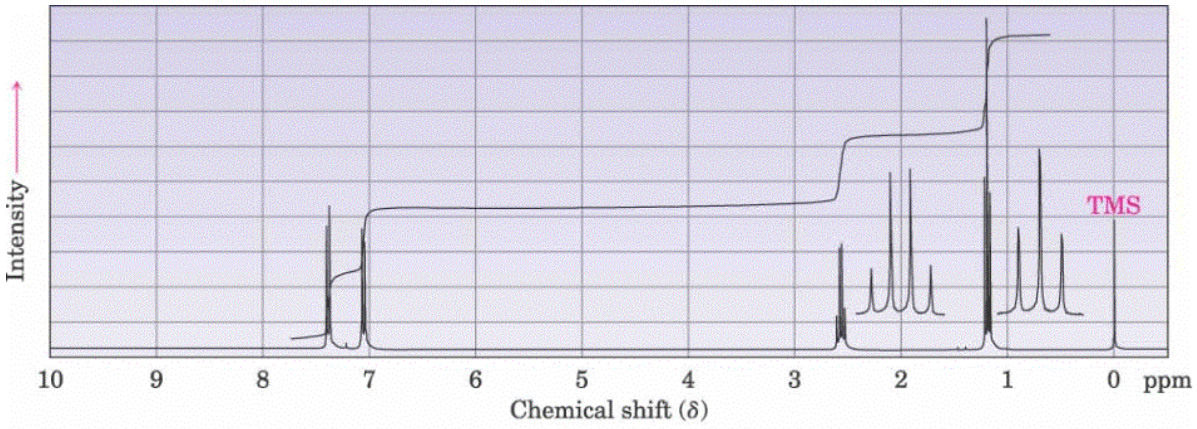
PART B: TO BE COMPLETED IN THE EXAM BOOKLET PROVIDED

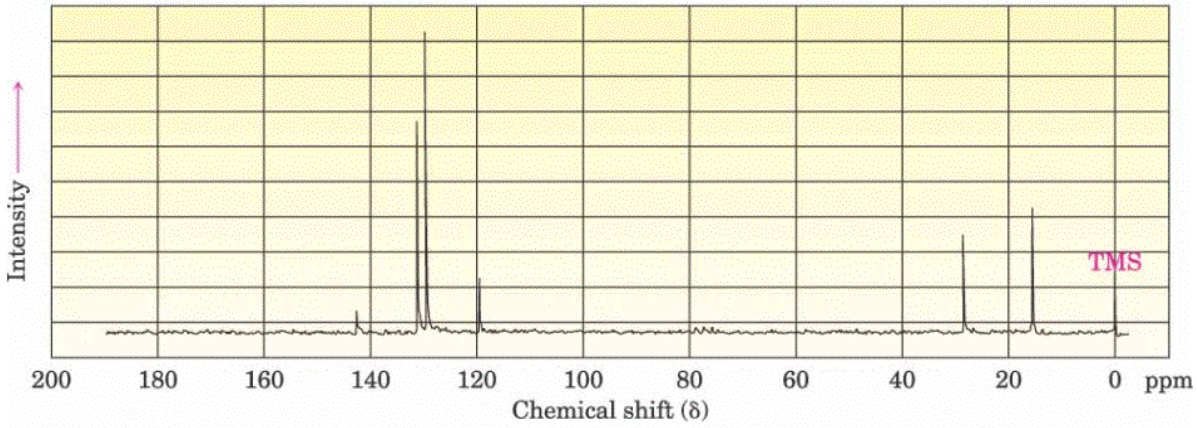
Question 4 Predict the products and provide a detailed mechanism for each of the following (4 points each, 8 total).

(a) 

(b) 

Question 5 The ^{13}C and ^{1}H NMR spectra are given for an unknown organic species with molecular formula C_8H_9Br. The integrations (from left to right) are 2:2:2:3. (The peak at 142 ppm in the ^{13}C spectrum is real.) Identify the compound. (6 points)



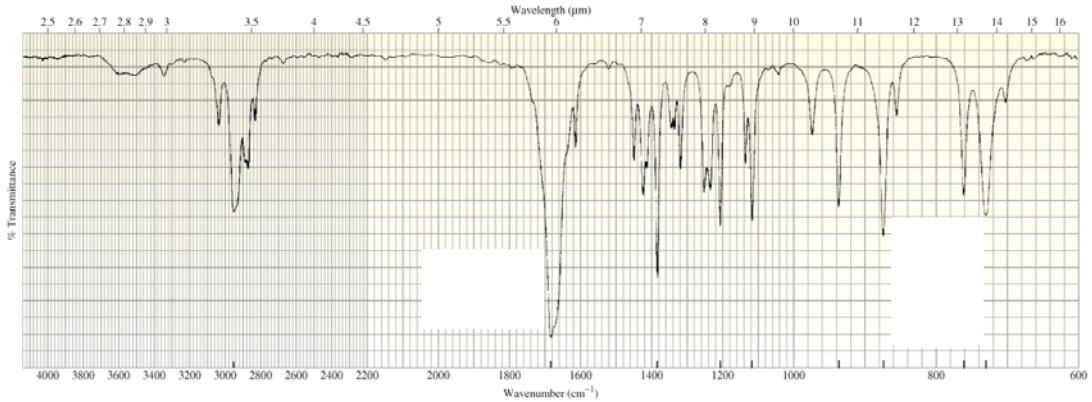


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Question 6 Do *2 of the following 3* (a) to (c). (3 points each, 6 total)

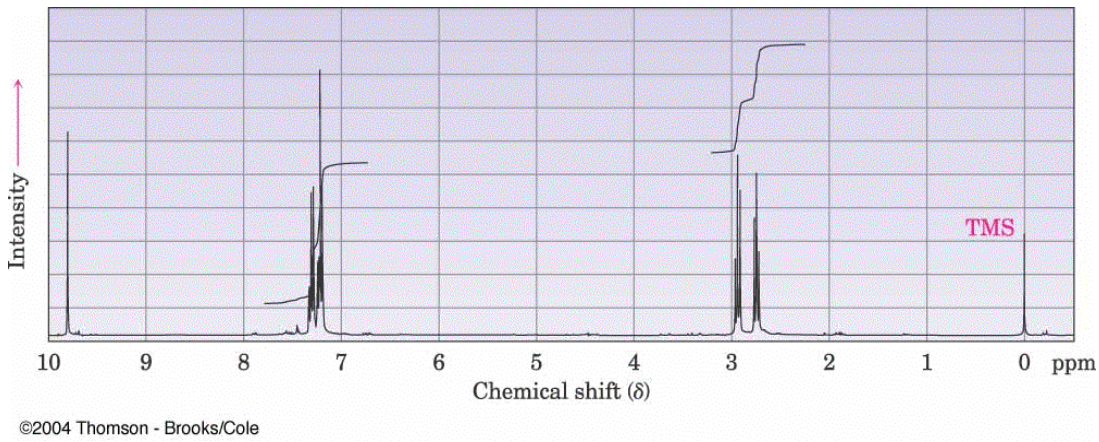
(a) An organic species is known to contain only C and H. The mass spectrum has only three significant peaks: *m/e* 29, 77, and 106. What is the identity of the compound?

(b) While cleaning an old lab, a chemist finds a bottle with only half a label. All that remains of the name of the compound is "...cyclohex..." The chemist ran an infrared spectrum in an attempt to identify the compound and obtained the following:



Is the compound cyclohexane, cyclohexene, cyclohexanone, cyclohexenone, or cyclohexanol? Justify your answer.

(c) The ^{1}H NMR spectrum of a compound $C_9H_{10}O$ is shown. The compound has an IR absorption at 1730 cm^{-1}. Propose a structure (note: aldehyde protons may not show coupling, so ignore any aldehyde protons for purposes of splitting patterns). The two signals at 2.8 and 3.0 ppm are both triplets. The integrations are, from left to right, 1:5 (for the group of peaks at ~7.2 ppm) :2:2.



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Question 7 Do *one of the following two* (a) or (b). Identify the organic compound based on the spectra given. (10 points)

(These were two questions like question 14-71 in the textbook, or Experiment 7)