CHEM 346 – Organic Chemistry I – Fall 2014

Instructor: Paul Bracher

Hour Examination #2

Wednesday, October 15th, 2014

6:00–8:00 p.m. in Macelwane Hall 334

| 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.

- Please write your name on the front *and* back of the answer sheet.

- You may use one letter-sized sheet of handwritten notes and your plastic model kit. No electronic resources are permitted and you may not communicate with others.

- Your exam answer sheet may be photocopied.

| Problem	Points Earned	Points Available
I		25
II		27
III		28
IV		20
TOTAL		100

This exam focuses on Chapters 5 through 8 in Janice Smith's *Organic Chemistry*, 4th ed.

Problem I. Multiple choice (25 points total; +5 points for a correct answer, +2 points 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) _____   For the reaction drawn below, how will the rate change if the concentration of NaF dissolved in the reaction mixture is doubled?
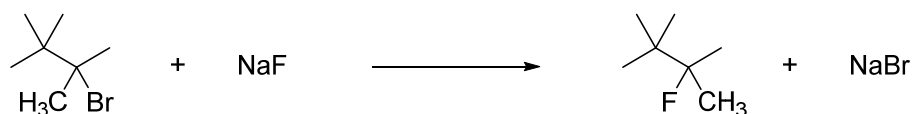

(a) the new rate will be approximately one-fourth of the previous rate
(b) the new rate will be approximately one-half of the previous rate
(c) the new rate will be approximately equal to the previous rate
(d) the new rate will be approximately double the previous rate
(e) the new rate will be approximately quadruple the previous rate

(2) _____   What is the best name for compound **A**?
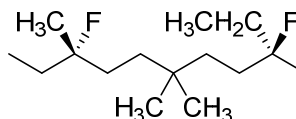
A

(a) *meso*-3,9-difluoro-3,6,6,9-tetramethylundecane
(b) (2R,8S)-2-ethyl-2,8-difluoro-5,5,8-trimethyldecane
(c) (3S,9R)-9-ethyl-3,9-difluoro-3,6,6-trimethyldecane
(d) (3S,9R)-3,9-difluoro-3,6,6,9-tetramethylundecane
(e) (3R,9S)-3,9-difluoro-3,6,6,9-tetramethylundecane

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

B   **C**
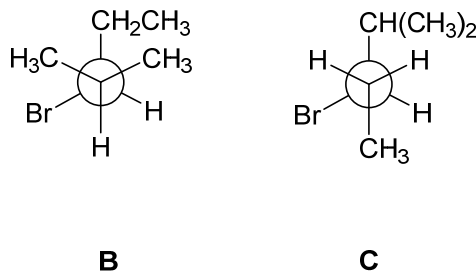
(a) enantiomers
(b) diastereomers
(c) identical compounds
(d) structural/constitutional isomers
(e) none of the above

(4) _____   Which of the following isomers of C_7H_{14} would release the least heat upon hydrogenation with one equivalent of H_2 to produce 3-methylhexane? Note: all of these starting materials produce the identical product.
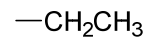

(a)   (b)   (c)

(d)   (e)
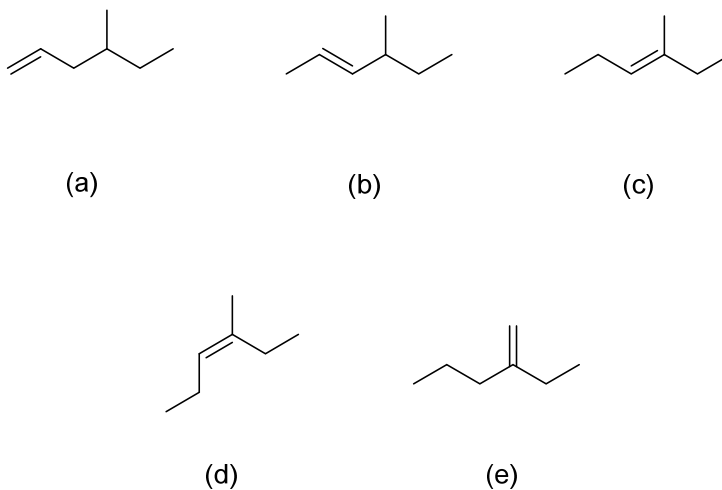
(5)   _____   Given the data provided in Problem II (below), which of the following groups is most consistent with the identity of the mystery R group in that problem?
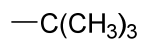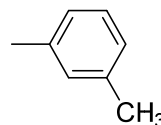
$-CH_3$ $-CF_3$ $-CH_2CH_3$

(a)   (b)   (c)

$-C(CH_3)_3$

CH_3

(d)   (e)

"(6)"   _____   Which of the following titles would make the most intriguing movie about organic chemistry?

(a) The Cation in the Hat
(b) Yield of Dreams
(c) The Dukes of Hazardous Waste
(d) The Texas Carbon Massacre
(e) Star Wars: The Empire Strikes the Back Side

Problem II. Reaction Diagram (27 points). Consider the reaction of alkyl bromide **D** with sodium methoxide to form compounds **E** and **F**. R is an achiral mystery group that is bonded to the structure by a carbon atom.

$[\alpha] = -10°$ mM^{-1} dm^{-1} $[\alpha] = -30°$ mM^{-1} dm^{-1}
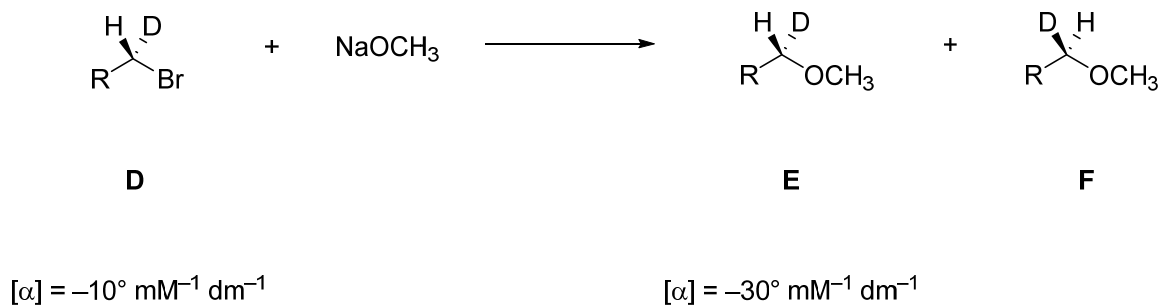
(1) (17 points) Draw two superimposed diagrams for the above reaction on the (same) set of axes found on your answer sheet. First, with a solid line, plot the reaction diagram for an S$_N$1 mechanism. Second, with a dashed line, plot the reaction diagram for an S$_N$2 mechanism. Assume the reaction is exothermic. Draw the Lewis structure of any intermediates. Label the position of **D**, **E**, and **F** on your plot.


Reaction Coordinate
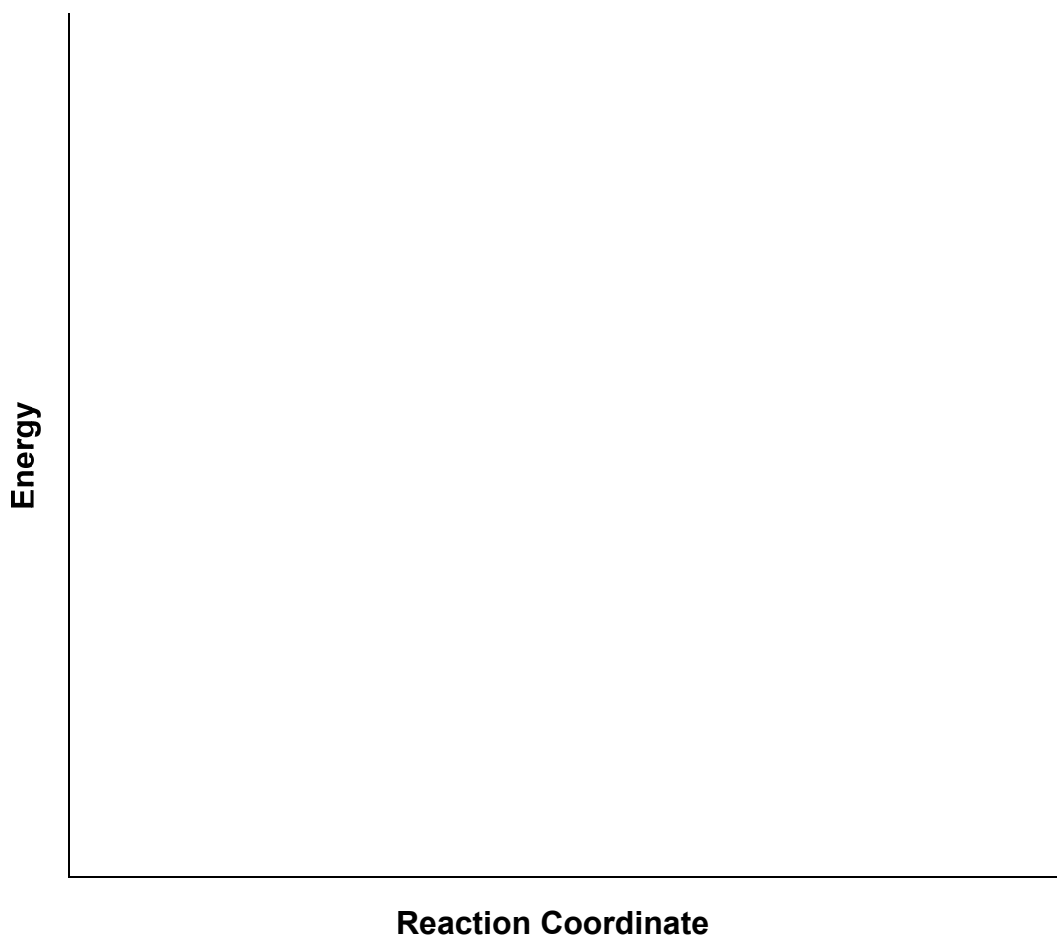
(2) (10 points) A reaction mixture containing pure **D**, sodium methoxide, and an achiral solvent is placed in a polarimetry cell. Using a polarimeter, you observe the sample rotates light counterclockwise by 50 degrees. At the end of the experiment, the rotation is 30 degrees clockwise. If you assume the conversion of **D** to **E** and **F** is clean and complete (i.e., no **D** remains and it is all converted to either **E** or **F**), what is ratio of the rates of the reactions? Express your answer as the relative rate of $S_N1:S_N2$. Assume both reactions are irreversible under the conditions of the experiment (i.e., once you make **E** or **F**, the reverse reaction to re-form **D** does not take place). Specific rotation data for **D** and **E** are given in the figure above. I suggest working your answer on scratch paper and then transferring it to your answer form.

Problem III. Explanations (28 points). For each question posed below, write the letter of your answer in the box on the answer sheet and provide a brief explanation (of no more than six sentences) for your choice. You should draw out any relevant structures or diagrams in your explanation.

(1) (9 points) Of compounds **H** and **J**, which is the better choice of solvent for the reaction between bromomethane (CH_3Br) and potassium thiomethoxide ($K^{+-}SCH_3$)?
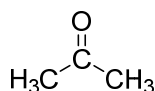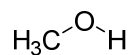
H   **J**

(2) (9 points) Of compounds **K** and **L**, which reacts faster with potassium cyanide (KCN) in DMSO to form a nitrile compound (R–CN)? (Note: Your explanation should include discussion touching on the subject of orbitals.)
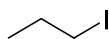

K   **L**

(3) (10 points) Of isomers **M** and **N**, which will react faster with sodium methoxide to produce an alkene? (Note: I want to see some sort of drawing or diagram in your explanation.)

M   **N**
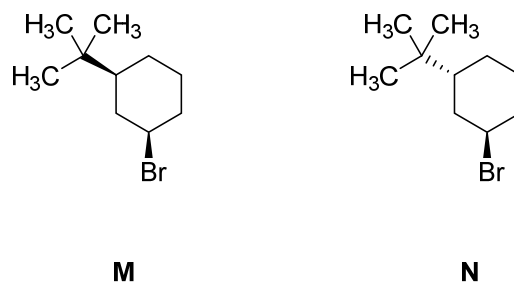
Problem IV. Synthesis (20 points).

(1) (10 points) Propose the alkyl halide that will react with sodium methoxide to synthesize compound **P** in highest yield, with the least amount of alkene side product(s).

an alkyl bromide $\xrightarrow[\text{CH}_3\text{OH}]{\text{NaOCH}_3}$

P
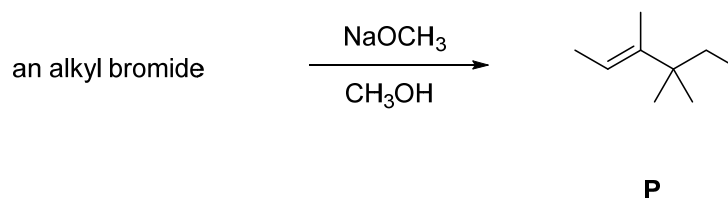
(2) (10 points) Plan a synthesis of compound **Q** starting from any inorganic reagents you wish and any alkyl bromides that contain six or fewer sp^3-hybridized carbon atoms.

any alkyl bromides with sp^3-
hybridized carbons and any other
necessary inorganic reagents

Q