

IMPERIAL COLLEGE LONDON

**BSc and MSci DEGREES – JUNE 2014, for Internal Students of the
Imperial College of Science, Technology and Medicine**

**This paper is also taken for the relevant examination for the
Associateship**

ORGANIC CHEMISTRY I

Monday 16th June 2014, 09:30-11:45

**PLEASE NOTE THAT IT IS DEPARTMENTAL POLICY THAT THESE
EXAM QUESTIONS MAY REQUIRE UNDERSTANDING OF ANY
PRIOR CORE COURSE.**

**USE A SEPARATE ANSWER BOOK FOR EACH QUESTION.
WRITE YOUR CANDIDATE NUMBER ON EACH ANSWER
BOOK.**

1.02 – Alkanes, Alkenes, Alkynes

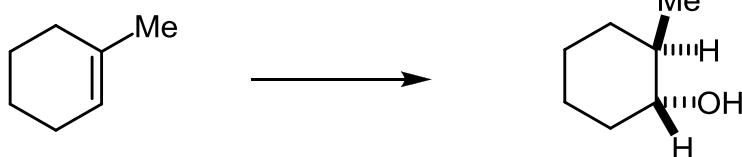
Answer **ALL** parts of this question.

- a) Draw Newman projections showing the two types of eclipsed and the two types of staggered conformations that occur during σ -bond rotation about the C2 and the C3 atoms of butane. Write down the names of all four conformations and comment on their relative energies.

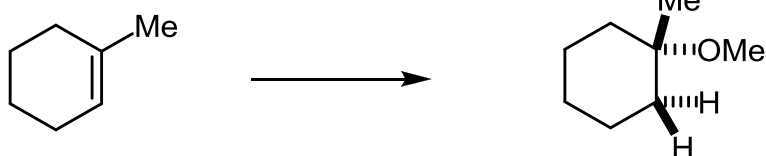
(4+2+2 marks)

- b) Give suitable reagents for **THREE** of the following transformations:

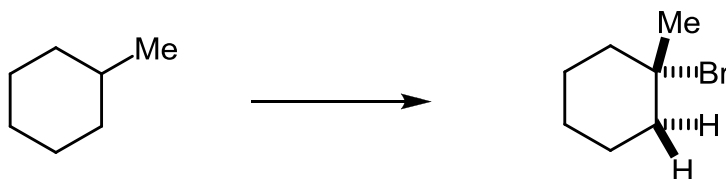
i)



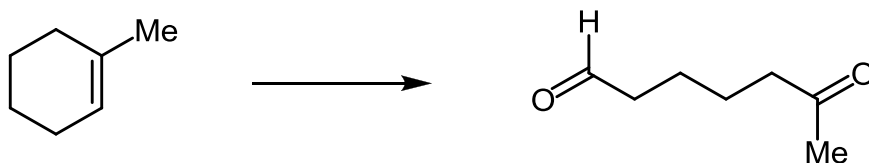
ii)



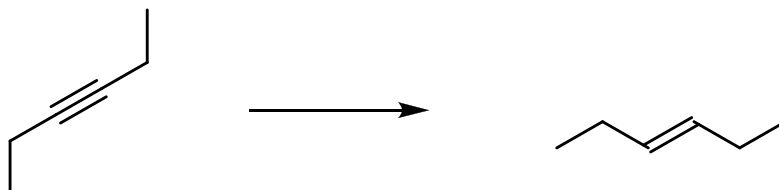
iii)



iv)



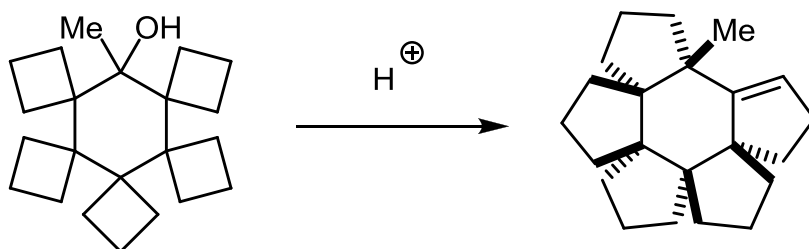
v)



(9 marks)

QUESTION CONTINUED OVERLEAF

- c) For the following transformation provide an annotated curly arrow mechanism and explain any issues of selectivity.

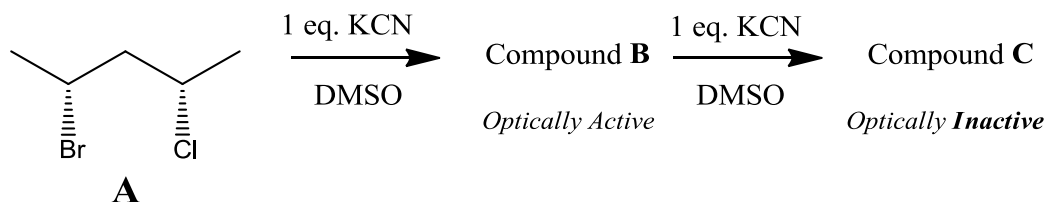


(8 marks)

1.03 – Haloalkanes, Alcohols and Amines

Answer **ALL** parts of this question.

a) Consider the following reactions of compound **A**, which is optically active.



i) Give the structure of compound **B** and show the curly arrow mechanism for its formation, clearly identifying any stereochemistry. Classify the nature of the reaction mechanism.

(3 marks)

ii) Give the rate law which governs the rate of formation of product **B** and draw the energy profile diagram for the reaction.

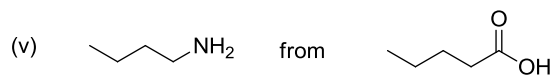
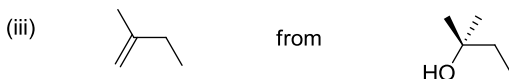
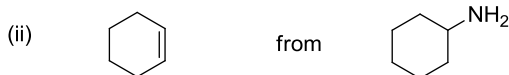
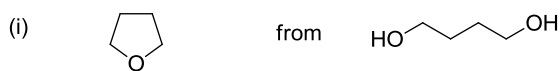
(2 marks)

iii) Give the structure of compound **C**, and explain why it is no longer optically active.

(3 marks)

b) Propose syntheses for **THREE** of the following **FIVE** molecules from the indicated starting materials. Make use of any other reagents or solvents you need (more than one synthetic step may be needed). In case your reaction yields a mixture of products, you should specify reagents and conditions that will maximise the yield of the specified product.

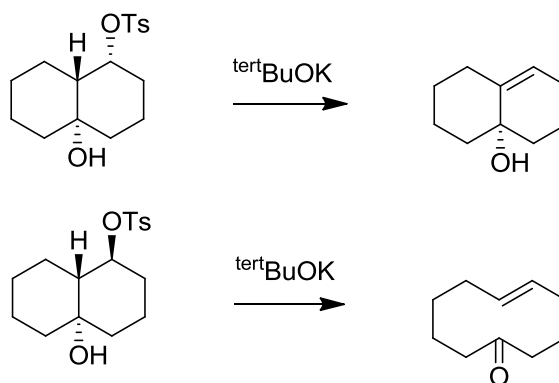
(9 marks)



QUESTION CONTINUED OVERLEAF

- c) Treatment of the following two decalin isomers with strong base (Potassium tert-butoxide) results in the formation of a different product for each isomer. Provide a curly arrow mechanism to explain the formation of each product, and explain the origin of the different reactivity of each isomer.

(8 marks)

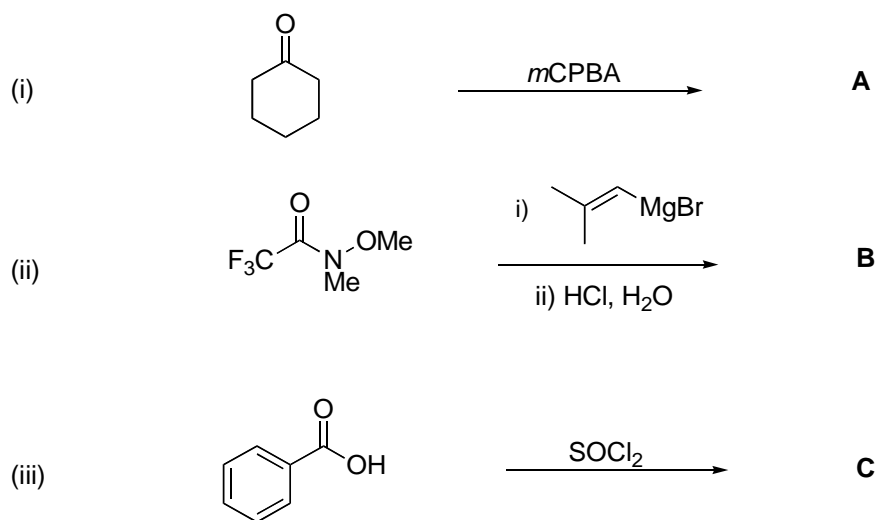


1.04 – Carbonyl and Carboxyl Groups

Answer **ALL** parts of this question

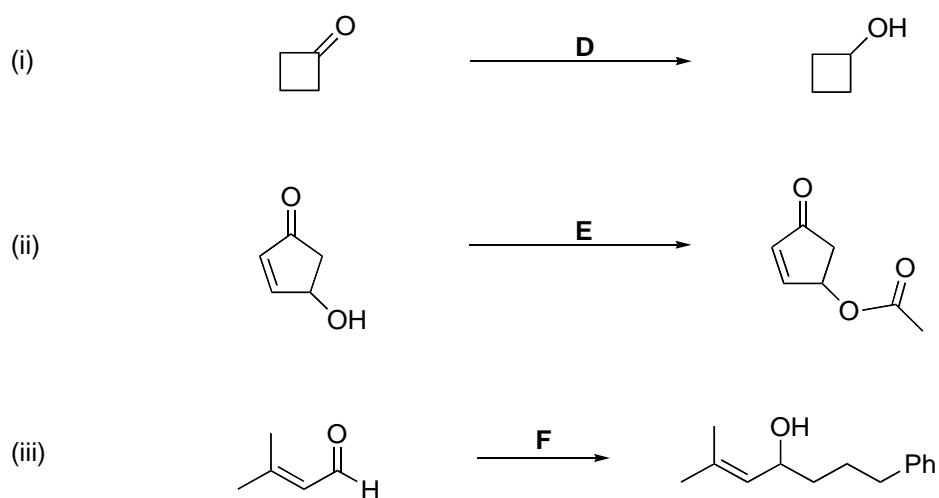
- a) Draw the structure of the product obtained for **TWO** out of the following **THREE** reactions.

(6 marks)



- b) Provide the missing reagents for **TWO** of the following **THREE** reactions.

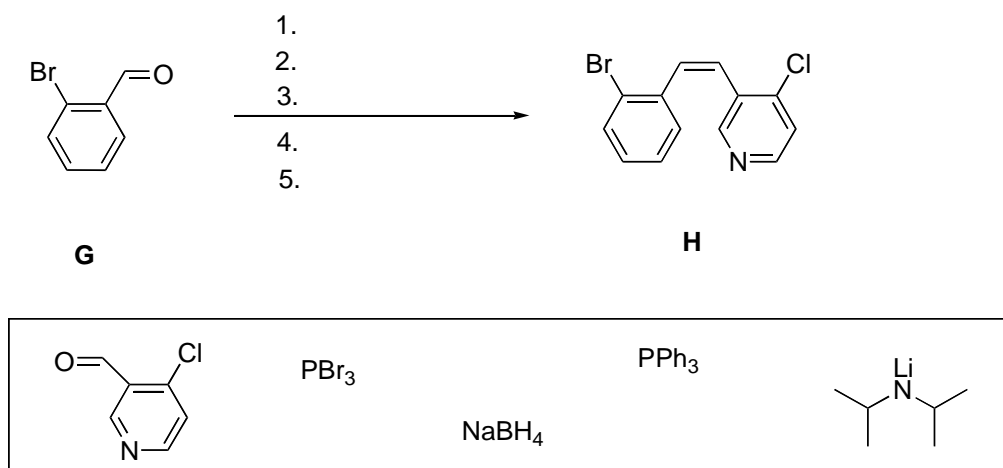
(6 marks)



QUESTION CONTINUED OVERLEAF

- c) Compound **G** was recently converted into compound **H** in five steps that used the reagents shown in the box below. Write down the reagents that were used in each of the five steps 1, 2, 3, 4 and 5.

(6 marks)



- d) Provide a curly arrow mechanism for the reaction shown below, which takes place under acid catalysis.

(7 marks)

