TECHNICAL UNIVERSITY OF MOMBASA

FACULTY OF APPLIED AND HEALTH SCIENCES

DEPARTMENT OF PURE & APPLIED SCIENCES

UNIVERSITY EXAMINATION FOR:

BACHELOR OF TECHNOLOGY IN ANALYTICAL CHEMISTRY

ACH 4410 : GREEN CHEMISTRY

END OF SEMESTER EXAMINATION

SERIES: APRIL 2016

TIME: 2 HOURS

DATE: 12 May 2016

PAPER I

Instructions to Candidates

You should have the following for this examination

-Answer Booklet, examination pass and student ID

This paper consists of **FIVE** questions. Attempt question ONE (Compulsory) and any other TWO questions.

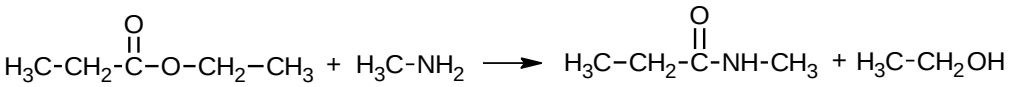
Do not write on the question paper.

Question ONE

(a) Benzene and toluene are excellent solvents that have been widely used in chemical manufacturing. Explain potential impacts of these solvents on the environment, including human health. (8 marks)

(b) (i) Define the principal of atom economy in organic synthesis. (1 mark)

(ii) Determine the atom economy of the following substitution reaction to form N-methyl propamide;



(3 marks)

(iii) State the atom efficiency of the reaction if the alcohol by-product can be quantitatively recovered and marketed. (1 mark)

(c) Highlight the merits, indicating the issues addressed, of reducing intermediate derivatives in organic synthesis. (4 marks)

(d) Give any FOUR advantages of applying biocatalysis in organic synthesis. (4 marks)

(e) Highlight the advantages and disadvantages of heterogeneous catalysts in organic synthesis. (6 marks)

(f) State THREE basic principles of Green Chemistry that aim to reduce risk in the laboratory. (3 marks)

Question TWO

(a) (i) Describe the characteristics of supercritical CO_2. (8 marks)

(ii) Provide TWO examples of applications of supercritical CO_2 in chemical processes. (4 marks)

(b) (i) State the desired characteristics of energy sources in chemical synthesis. (4 marks)

(ii) Highlight the merits of the application of microwaves in organic synthesis. (4 marks)

Question THREE

(a) State the issues addressed by the application of catalysis, rather than the use of stoichiometric reagents in organic synthesis. (4 marks)

(b) Explain the effect of solvation with water in the S_N2 substitution reaction between bromomethane and ammonia, if

(i) reaction is in aqueous medium (8 marks)

(ii) water is present in catalytic amounts. (6 marks)

(c) Write a reaction equation for the catalytic industrial preparation of methanol. (2 marks)

Question FOUR

(a) The Haber process has remained the standard for the industrial preparation of ammonia.

(i) Outline the merits of the process that meet green principles. (6 marks)

(ii) Highlight weaknesses of the Fe-based catalyst and approaches to improving catalyst performance. (10 marks)

(b) (i) Write a reaction equation showing the a common method for industrial manufacture of methylene oxide. (2 marks)

(ii) Give TWO uses of ethylene oxide. (2 marks)

Question FIVE

(a) Describe the transesterification of triglycerides with methanol using appropriate reaction equation(s) (6 marks)

(ii) State the advantages of using biofuels as alternative energy sources. (4 marks)

(b) Describe the general structure and functioning of a hydrogen fuel cell. (10 marks)