



TECHNICAL UNIVERSITY OF MOMBASA

FACULTY OF APPLIED AND HEALTH SCIENCES

DEPARTMENT OF PURE & APPLIED SCIENCES

UNIVERSITY EXAMINATION FOR:

BACHELOR OF TECHNOLOGY IN APPLIED CHEMISTRY

ACH 4406 : FUEL CHEMISTRY & TECHNOLOGY (PAPER 2)

END OF SEMESTER EXAMINATION

SERIES: DECEMBER 2016

TIME: 2 HOURS

DATE: Pick Date Dec 2016

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) What type of energy is produced and wasted during most energy transformations? Support your answer by sketching two processes, and the energy conversions that occur in these processes. Propose one way in each of the processes through which this wasted energy can be utilized. (7 Marks)
- (b) Briefly explain how material and energy balances help in energy conservation. (2 Marks)
- (c) What is the difference between 'primary' and 'secondary' energy sources? Give 2 examples of each. (6 Marks)
- (d) What is 'energy sustainability'? Give 3 ways through which energy sustainability can be attained. (5 Marks)

Question TWO

- (a) Based on moisture and fixed carbon content, give the 3 classifications of coal. (6 Marks)
- (b) With the aid of a sketch, outline the evolution process of coal structure. (5 Marks)
- (c) Briefly discuss the procedure for coal macerals and microlythotype analysis. (5 Marks)

(d) Normal coal exists as a solid. However it can be converted into a gas or liquid for more convenient utilization as an energy source. Explain the following processes; (4 Marks)

- i. Coal gasification.
- ii. Coal liquefaction.

Question THREE

(a) With regard to petroleum geology, discuss the following terminology; (6 Marks)

- i. Source rock.
- ii. Reservoir rock.
- iii. Seal.

(b) Discuss 3 attributes of a good source rock. (5 Marks)

(c) Outline the components of the following sectors of the petroleum industry: (3 Marks)

- i. Upstream,
- ii. Midstream,
- iii. Downstream.

(d) With the aid of a flowchart, briefly explain the process of petroleum refining from crude oil to refined products. (6 Marks)

Question FOUR

(a) Wind, solar and hydro power are renewable alternatives to fossil fuels. Evaluate the reliability of the 3 sources as options for future energy sustainability. (6 Marks)

(b) With the aid of a well labeled diagram, explain how electricity is produced from geothermal sources of energy. (4 Marks)

(c) For each of the following energy sources; nuclear, solar, wind, hydro and geothermal, give 1 advantage and 1 disadvantage to its utilization for electricity production. (10 Marks)

Question FIVE

(a) With regard to the CO₂ cycle, illustrate and explain why biomass is considered a renewable source of energy. (4 Marks)

(b) Discuss and distinguish the following biomass power generation modes; (6 Marks)

- i. Combustion
- ii. Gasification combustion
- iii. Mixed burning
- iv. Gasification mixed burning

(c) Using equations, illustrate the chemical reactions of a fuel cell at: (4 Marks)

- i. Anode
- ii. Cathode

(d) Hydrogen is currently considered as the fuel (energy carrier) for the future. However, H₂ does not exist independently in nature. Suggest and briefly discuss 3 ways of renewably producing H₂. (6 Marks)