MACHAKOS UNIVERSITY

University Examinations for 2021/2022 Academic Year

SCHOOL OF PURE AND APPLIED SCIENCES

DEPARTMENT OF PHYSICAL SCIENCES

FOURTH YEAR FIRST SEMESTER EXAMINATION FOR

BACHELOR OF SCIENCE IN ANALYTICAL CHEMISTRY

SAN 402: GEOCHEMICAL PERSPECTIVES AND PETROCHEMISTRY

DATE: 26/8/2022 **TIME: 2.00-4.00 PM**

INSTRUCTIONS:

- The paper consists of **two** sections.
- Section **A** is **compulsory** (30 marks).
- Answer any **two** questions from section **B** (each 20 marks).

QUESTION ONE (20 MARKS)

a) Define the following terms (4 marks)

i. Nucleosynthesis

ii. Geochemistry

iii. Cosmochemistry

b) Explain the significance of the following tests in crude oil testing. (3 marks)

i. Pour point

ii. Flash Point

iii. Surface tension Effect

c) Explain why neutrons are preferred to protons when preparing new isotopes of the lighter elements (2 marks)

d) Draw the structure of one natural polymer (1 mark)

e) Define the addition polymerization and condensation polymerization reactions giving one example in each case. (3 marks)

f) Describe the major processes in nitrogen cycle (4 marks)

g) Illustrate the main steps in the chain-growth radical bromination polymerization reactions mechanism of $CH_3(CH_2)_2CH_2$- (5 marks)

h) Starting from the point carbon dioxide dissolves in the ocean, describe the carbonate chemical equilibria in the ocean. (8 marks)

QUESTION TWO (20 MARKS)

a) There are 82 protons in a lead nucleus. Explain why the lead nucleus does not burst apart due to their mutual electrostatic repulsion? (6 marks)

b) List three applications of Kevlar (2 marks)

c) Draw the following polymer structures as applied in control architecture of polymers.

i. linear chain polymer

ii. star polymers

iii. slight branched

iv. "combed" polymer (4 marks)

d) Discuss the following products found in crude oil. (8 marks)

i. Olefins

ii. Naphthene

iii. Aromatics

iv. Naphthalenes

QUESTION THREE (20 MARKS)

a) Discuss the processes by which minerals form in nature giving the temperature and pressure ranges for each of these processes (2 marks)

b) Define geothermal gradient and give an example of where one can find a low geothermal gradient and a high geothermal gradient. (2 marks)

c) Define the following:

i. closed system,

ii. open system,

iii. isolated system,

iv. phase, and

v. component. (5 marks)

d) Define alkylation & isomerization as applied in crude oil refinery. (2 marks)

e) Draw a shorthand of styrene monomer and polystyrene with 3 repeating monomer units.

(2 marks)

f) Explain the horizontal process used in fossil fuel extraction (2 marks)

g) Discuss what happens when neutron interact with matter (5 marks)

QUESTION FOUR (20 MARKS)

a) If a stable nucleus breaks into its constituent nucleons, does it mean energy was added to the nucleus, or energy was released by the nucleus. Explain your answer. (6 marks)

b) Porphyrins are found in crude oil. Discuss how they contribute to increased vanadium, nickel, and iron elements content in the crude. (4 marks)

c) With aid of a diagram, explain, how the following work:

i. Isotope Ratio Mass Spectrometers (IRMS) (5 marks)

ii. Temperature Conversion Elemental Analyzer (TC/EA). (5 marks)

QUESTION FIVE (20 MARKS)

a) Explain the Supernovae explosions (2 marks)

b) Lithosphere; Hydrosphere; Biosphere and Atmosphere are formed by the cooling of hot molten rock also known as magma. Discuss each sphere giving two industrial raw materials obtained from them. (6 marks)

c) Describe Step-growth polymerization as used to prepare poly (hexamethylene adipamide) (6 marks)

d) Define disproportionation as a chain termination method and illustrate this chain termination mechanism with an example (6 marks)