



DEDAN KIMATHI UNIVERSITY OF TECHNOLOGY

UNIVERSITY EXAMINATIONS 2021-2022
FOR THE DEGREE IN MASTER OF SCIENCE IN GEOTHERMAL ENERGY TECHNOLOGY

GET 3005: GEOCHEMICAL EXPLORATION

DATE:

TIME: 3 HOURS

INSTRUCTIONS

- 1) TIME ALLOCATED – 3 hours
 - 2) There are FOUR QUESTIONS in this paper
 - 3) Attempt ALL FOUR questions, i.e., all questions are compulsory
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Question 1 [30 marks] – This question is Compulsory

- a) Define the following terms. *(2 marks)*
 - i. Geochemistry
 - ii. Biogeochemistry
 - iii. Geothermometers
 - iv. Photogeochemistry
- b) Outline any four objectives of geochemical exploration. *(2 marks)*
- c) Give any four types of geothermal fluids and their relevance to exploration studies. *(4 marks)*
- d) Why does geothermal fluid salinity increase with depth/age? *(4 marks)*
- e) Analysis of gases from fumaroles can pose a great challenge to exploration geochemists. Describe how these challenges have been addressed so far. *(5 marks)*
- f) During geochemical explorations, analysis of some parameters demands that it be carried on site. Provide four examples of such parameters. *(2 marks)*
- g) Describe briefly the any two techniques employed for the analysis of the following of chemical species during geochemical exploration. *(8 marks)*
 - i. Gases
 - ii. Cations
 - iii. Anions
 - iv. Isotopes
- h) Briefly explain the three main classifications of geothermal water resources. *(3 marks)*

Question 2 [10 marks] – This question is Compulsory

- a) For chemical geothermometers, a number of assumptions are always made. Enumerate four assumptions that are applicable to these systems. (2 marks)
- b) Explain two limitations of Na-K-Ca geothermometer in geochemical exploration. (2 marks)
- c) Describe any three geochemical exploration methods. (6 marks)

Question 3 [10 marks] – This question is Compulsory

- a) During a geochemical exploration exercise, clearly explain why one would prefer glass containers over plastic ones. (3 marks)
- b) What is the significance of geochemistry in drilling and operation phase of a power plant? (1 mark)
- c) Give four reasons why trace elements are of interest to geochemists, though they may constitute only a small fraction of a system of interest. (4 marks)
- d) What factors would guide the choice of sampling sites during exploration. (2 marks)

Question 4 [10 marks] – This question is Compulsory

- (a) Define chemical geothermometry. (1 mark)
- (b) During a recent visit to two geographical sites, a researcher recorded silica concentrations of 155 mg/kg (ppm) for water samples from both sites. The first site, A, was a geyser while the other site, B, was a hot spring. Estimate sub-surface temperatures for site A and B using silica geothermometer concept. (3 marks)

Hint:

$$t^{\circ}\text{C} = \frac{1309}{5.19 - \log(\text{SiO}_2)} - 273.15 \quad \text{for conductive system;}$$
$$t^{\circ}\text{C} = \frac{1522}{5.75 - \log(\text{SiO}_2)} - 273.15 \quad \text{for adiabatic system.}$$

- (c) Explain three interventions employed to address scaling and corrosion challenges at the geothermal energy production plants? (6 marks)