



MACHAKOS UNIVERSITY

University Examinations 2021/2022

SCHOOL OF PURE AND APPLIED SCIENCES

DEPARTMENT OF PHYSICAL SCIENCES

FOURTH YEAR SECOND SEMESTER EXAMINATION FOR

BACHELOR OF SCIENCE (APPLIED PHYSICS AND TECHNOLOGY)

SPH 469: GEOTHERMAL ENERGY TECHNOLOGY

DATE:

TIME:

INSTRUCTIONS:

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

SECTION A

QUESTION ONE (30 MARKS)

- Define geothermal energy. (2 marks)
- List six manifestations in geothermal field. (6 marks)
- Define a feed point within the geothermal reservoir engineering context. (3 marks)
- Explain the origin of geothermal energy. (3 marks)
- Describe geothermal well stage testing and give its disadvantage. (3 marks)
- State three down hole measurements that can be done during stage testing. (3 marks)

- g) Give an alternative method other than stage testing that can be done after well completion and explain its limitation. (3 marks)
- h) Give two reasons that justify renewability of geothermal energy. (4 marks)
- i) State the objective intended to be achieved during a well completion test. (3 marks)

SECTION B

QUESTION TWO

- a) List five countries with geothermal energy and state the aspect they share in common. (4 marks)
- b) Using a diagram, show a temperature profile for a well.
 - i. With a water loss at a 2000 m depth
 - ii. With two water loss points at 1000 m and 2000 m respectively
 - iii. With a water gain at 1000 m and a water loss at 200 m respectively (6 marks)
- c) Distinguish between binary and ordinary geothermal power plants using well labeled diagrams. (4 marks)
- d) Some researchers from Machakos University report that the temperature gradient at Olkaria Geothermal field is 60 ° C per kilometer of depth, determine the temperature 2000 metres deep. (6 marks)

QUESTION THREE (20 MARKS)

- a) Explain the three characteristics of a geothermal reservoir and illustrate with a diagram. (5 marks)
- b) Any geothermal energy harnessing company is composed of over seven departments.
 - i. List five technical departments the entity must have. (5 marks)
 - ii. Explain the point in time at which each department becomes into play. (5 marks)
 - iii. Describe the role played by each department. (5 marks)

QUESTION FOUR (20 MARKS)

- a) Explain the working principle of a separator in steam pipe line that separates steam from water. (3 marks)

- b) Describe flow measurements by lip pressure and silencer method (5 marks)
- c) Temperature profiles for three geothermal wells A, B and C are shown in figure 1. For each well, explain the information relayed to the reservoir scientist. (6 marks)

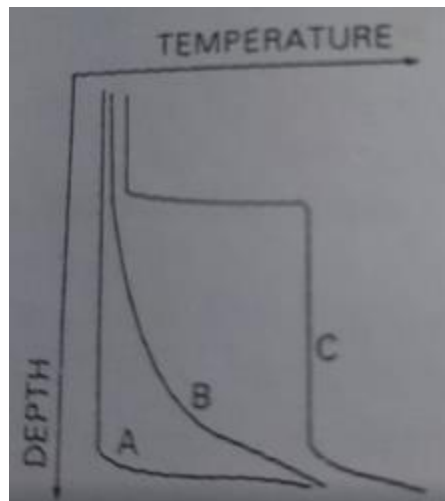


Figure 1: Temperature profiles for wells A, B and C

- b) State the significance of fitting a well with a metal casing and explain why the lowest should be slotted. (6 marks)

QUESTION FIVE (20 MARKS)

- a) In liquid dominated reservoirs, completion test is done by injecting cold water, explain how the following parameters are done:
- i. Water loss/gain points are identified (4 marks)
 - ii. Permeability is determined (3 marks)
- b) List the steps for the normal New Zealand well completions procedure. (7 marks)
- c) Explain three geothermal energy problems. (6 marks)