

UNIVERSITY OF FORT HARE

GLG 312
Geochemistry and
Hydrogeology

Main Examination: JUNE 2023

Time: 3 Hours

Marks: 100

Subject: Geology

One paper

This paper consists of 3 pages including the cover page.

Internal Examiners:

External Examiner:

Mr S Sinuka

Dr S Misra

Dr B Pharoe

INSTRUCTIONS

Answer all questions.

SECTION A: HYDROGEOLOGY

QUESTION 1

[25]

Groundwater flow problem:

During one of the groundwater exploration exercises, two wells (BH1 and BH2) were drilled on the eastern periphery of the Golf Course area in Alice, Eastern Cape Province. This was carried out with the aim of supplying clean groundwater for domestic use and to understand the aquifer properties such as specific yield, porosity, and storativity in the area. Recently, the third well BH3 was sunk 500 m east of BH1. The distance between BH1 and BH2 is 200 m.

Given the following data:

Well#	Surface elevation (m)	Depth to water table (m)
BH1	4250	110
BH2	4330	85
BH3	4390	95

Determine:

- Hydraulic heads for the three wells. (5)
- Groundwater flow direction in the area. You are expected to produce a groundwater flow net or water level elevation map showing groundwater flow lines and equipotential lines. Use a map scale of 1:2000 for plotting. (20)

QUESTION 2

[25]

Briefly discuss the application of Darcy's law in hydrogeology. Your response should define the law and describe the scientific basis of the law in groundwater flow through porous media. Illustrate and discuss Darcy's permeameter.

SECTION B: GEOCHEMISTRY

QUESTION 3

[25]

Oxygen is the most common oxidizing agent when the environment is in contact with the atmosphere. In mining activities, oxygen can react with pyrite and lead to acid mine drainage (AMD). Give all reactions that can lead to the production of natural acidic solution step by step until all the pyrite is used up. You must balance the equations in each step.

QUESTION 4

[25]

A geochemical cycle is the pathway that chemical elements take in the atmosphere, mantle surface and crust of the Earth. An important way to view the chemical interactions that occur on the Earth is to consider the Earth as a closed system with a set of reservoirs and fluxes between the reservoirs.

With the aid of a diagram, explain the global geochemical cycle.