THE UNIVE RSITY OF ZAMBIA
SCHOOL OF MINES

UNIVERSITY FISRT SEMESTER - JUNE 2023

GGY3051 TEST I

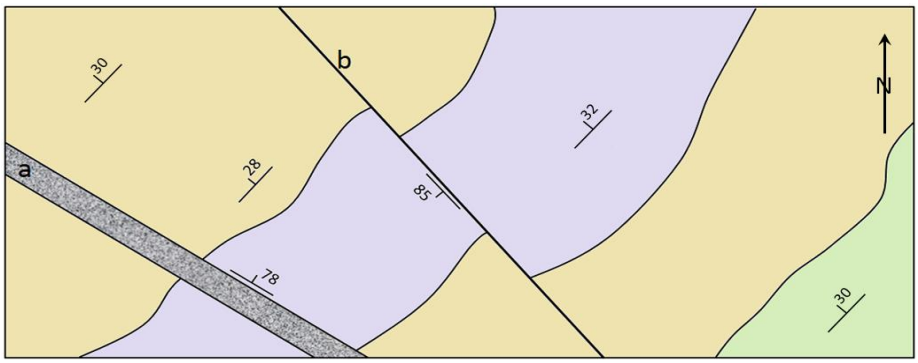
ENGINEERING GEOLOGY BELENDED CLASS

(THEORY)

INSTRUCTIONS: ANSWER ALL QUESTIONS

TIME 2HRS

Q1 Given the simple geological map below:



i Describe in words the general attitude (strike and dip) of the sedimentary beds of rocks.

The beds are striking NE [or trending NE-SW) and dipping NW at an average of about 30° **5**

ii Which of these beds is the youngest? **The bed on the western end on the map is the youngest** **5**

iii What is the approximate attitude of 'a'? **Approximately 120°/78°NE** **5**

iv Provide a geological description of the relative displacement of rocks a long the structure 'b'. **Right-lateral fault** **5**

v What kind of direct stress is associated with features like "b"? **Shear stress** **5**

vi Explain the difference between a strike line and a topographic contour.

A topographic contour line is an imaginary line on a map representing or connecting points of equal elevation on the ground surface. **5**

A strike line is an imaginary line which is parrallele to the strike direction and represents points of equal elevation on a geological feature.

30 marks

Q2 In engineering geology, ground mass can be defined as the volume of ground which will be affected by, or will affect the engineering works or process, and it is generally very much larger than the mass of material in direct contact with the engineering work. Briefly and clearly, explain the ground mass for:

i An underground tunnel

5 **For an undergound tunnel ground mass consists of the volume of ground affected by the withdrawal of ground support caused by tunnel excavation and that volume of ground from which water has been lost by drainage into the tunnel excavation to facilitate for the tunnelling works and process.**

ii A dam built in a deep valley

Dams built in valleys may be endangered by landslides from valley sides – these may be of some antiquity and of natural origin, but new movement may be triggered by the dam construction process. Therefore, the involved "mass" or ground mass would extend into these landslides, which could be
5 **situated well outside the actual construction site.**

iii A building with a shallow foundation

For a building, ground mass is that volume of ground which will be stressed by the extra load of the building and also the ground that will be affected by
5 **excavation of foundations.**

iv A road passing through a section of mountain

5 **For a road passing through a section of mountain, groundmass includes the road base or foundation and cut slopes on the mountain** **20 Marsk**

Q3 A rock mass of circular cross-sectional area, with a diameter of 2 m, was subjected to a load of 40kN. If the mass experienced a change of 20 cm in its original length of 4m and 8 cm in its diameter, calculate:

i Longitudinal and diametral strains

Assume compressional loading:

L=	4	m
D =	2	m
ΔL=	0.2	m
ΔD=	0.08	m

Longitudinal strain = 0.05 **3**

Diametral strain = 0.04 **3**

ii Poisson's Ratio

$\nu = \frac{\text{diametric strain}}{\text{longitudinal strain}}$ => **0.8** **4**

iii Modulus of Elasticity

$E = \text{Stress} / \text{Axial Strain} = \sigma/\varepsilon$

Stress = Force/ Area

Force = 40 kN

Area = 3.142 m^2

Stress = 12.73 kN/m^2

E = 254.61 kN/m^2 **5**

15 marks

Q4 A 500kg wedged block of granite rests on a dry, inclined road-cut slope of 40^o and the base of the block has a contact surface area of $2m^2$.· Assuming g = 9.8 m/s^2 :

i Determine the magnitudes of Normal and Shear stress imposed by the granite block on the slope

Weight = mass x acceleration due to gravity 4900 N

Normal force = 4900 x cos 40^o => 3753.6 N

Shear force = 4900 x sin 40^o => 3149.7 N

Normal stress= 1876.8 N/m^2 **4**

Shear stress = 1574.8 N/m^2 **4**

ii Calculate the factor of safety for the granite block on the slope

Factor of Safety = Normal Stress/ Shear Stress 1.2 **4**

iii Is the block of granite likely to slide down? Explain your answer

The block of granite is not likely to slide down because the factor of safety is greater than one. That is the stress promoting sliding [shear stress] is less than the stress stabilising the block [normal stress]. **4**

iv Mention two kinds of slope failures for which a factor of safety can be calculated

Translational (Plane failure and wedge failure) **4**

Q5 **20 Marks**

i Mention three characteristics of soil that influence groundwater infiltration and percolation.

Size of pores in soil / rock **2**

Total porosity of soil / rock **2**

Interconnectivity of soil / rock pores **2**

ii What is the difference between primary porosity and secondary porosity? Give one example of a geological material for primary porosity and one for secondary porosity.

Primary porosity is inherent pore spaces developed during formation of the rock, and is more pervasive or wide spread in the rock.

Secondary porosity developes after formation of the rocks, is related to secondary structures like rock fractures and can be localised. **2**

Examples of primary porosity: sandstone, conglomerate **0.5**

Examples of secondary pororsity: strucures in carbonate rocks lime limestone and dolomite **0.5**

iii Briefly explain three ways in which groundwater quality in bore holes can be safeguarded

Proper well construction **2**

Well location upstream/away from pollution sources – pit latrines, waste dumps, cemeteries, etc. **2**

Concrete platforms around well, & with proper drainage **2**

Animals must be kept away by a fence. **15 Marks**