UNIVERSITY OF JOHANNESBURG

PROGRAM	:	BACHELOR CIVIL ENGINEERING
SUBJECT	:	**GEOTECHNICAL ENGINEERING 3A11**
CODE	:	**GTG3A11 / GTGCIA3**
DATE	:	EXAMINATION JULY 2019
DURATION	:	08:00 - 11:00
WEIGHT	:	50: 50
TOTAL MARKS	:	100

ASSESSOR	:	PROF. M. FERENTINOU
MODERATOR	:	PROF. F. N. OKONTA.
NUMBER OF PAGES	:	3 PAGES, 1 APPENDIX, GRAPH PAPER,

INSTRUCTIONS	:	ONLY ONE POCKET CALCULATOR PER CANDIDATE MAY BE USED. QUESTIONS PAPERS MUST BE HANDED IN. ANSWER ALL QUESTIONS. COMPLETE THE FRONT PAGE OF THE EXAMINATION BOOKLET CORRECTLY WITH RESPECT TO DETAILS CONCERNING YOUR, STUDENT NUMBER, DATE, AND QUESTIONS ANSWERED.

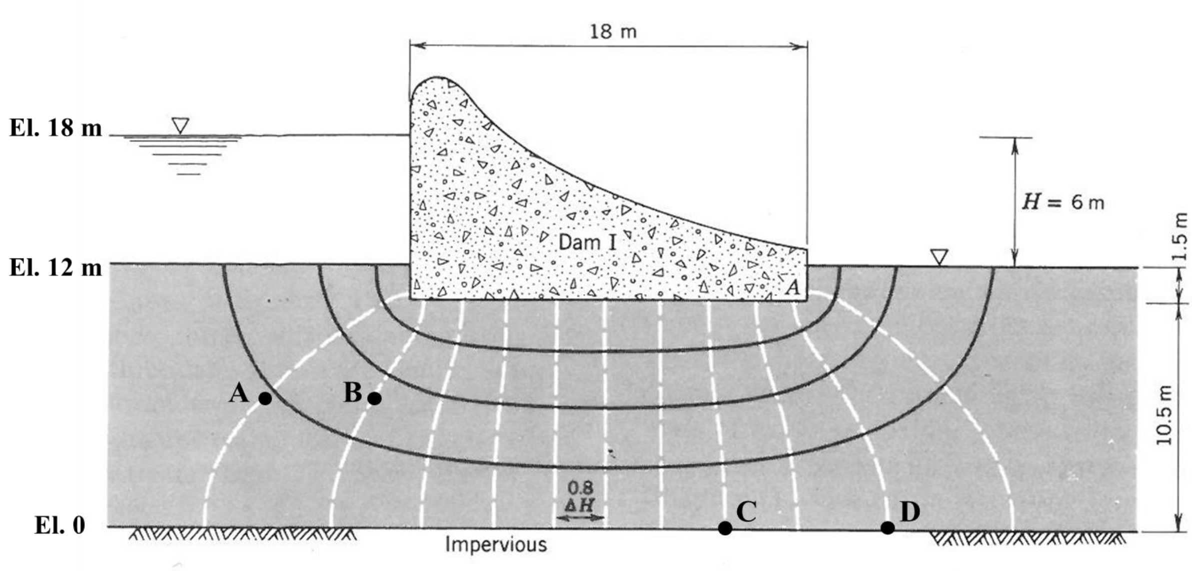
Note: You are required to show how your answers are obtained graphically by means of either neat approximate plots and analytically derived answers, or scaled plots and graphical constructions.

QUESTION 1 **(15 marks)**

The density of an earth fill material was determined in situ and was found to be ρ = 1.74kN/m^3. During in situ measurements the water content was found to be w = 8.6%. The void ratio of the sand material was determined in the lab and found to be at the loosest and densest possible soil packing states 0.642 and 0.462 respectively. The G_s value is 2.60. Calculate the void ratio, and relative density of sand earth fill.

QUESTION 2 **(25 marks)**

The flow net in the figure illustrates the seepage that takes place under an impermeable concrete dam. The flow net consists of four full flow channels and 11.8 head drops. The elements of the flow net have been checked to be reasonably "square". The vertical and horizontal scales of the drawing are equal. The soil has a permeability k = 2.5 x 10^{-4} m/s.



a. Identify the maximum equipotential line and indicate its total head. [3]
b. Identify the minimum equipotential line and indicate its total head. [3]
c. Assuming that the vertical and horizontal scale of the figure are the same, is this soil isotropic or anisotropic? Justify your answer. [4]
d. If the soil has a permeability of k = 2.5 x 10^{-4} m/s, what is the flow per unit depth (perpendicular to the plane of the drawing)? [3]
e. Determine the pressure head at points A, B, C, and D. Note: Points A and B have an elevation of 6 m. [12]

QUESTION 3 **(25 marks)**

The sediment sequence in the flat bottom of a valley consists of 4m of sand layer overlying 6m of clay. Beneath the clay is a sand layer of 2m thickness, and below that layer, there is impermeable igneous bedrock. The water table in the sand layer is 2m below ground level.

The water in the lower layer of sand is under artesian pressure, corresponding to a stand – pipe level of 4m above ground level. The saturated unit weight of the clay, is 22kN/m^3, and that of the sand is 19kN/m^3. The dry unit weight of the sand is 16kN/m^3. Plot total stresses, pore water pressures and effective vertical stresses against depth.

QUESTION 4 **(25 marks)**

A soil profile from top to bottom, comprises a 10m layer of sand, overlying an 8m layer of clay, below which is another layer of sand. For the clay, m_v = 0.83m^2/MN and c_v = 4.4m^2/year. The water table is at the surface level but is to be lowered permanently by 4m, the initial lowering taking place over a period of 40 weeks. Calculate the final settlement due to the consolidation of the clay, assuming no change in the weight of the sand, and the settlement two years after the start of lowering.

QUESTION 5 **(10 marks)**

Draw the Mohr circle, for the stress condition below.