UNIVERSITY
— OF —
JOHANNESBURG

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| **PROGRAM** | : | NATIONAL DIPLOMA<br>*ENGINEERING : CIVIL* |
| **SUBJECT** | : | **GEOTECHNICAL ENGINEERING III** |
| **CODE** | : | **CEG3211** |
| **DATE** | : | NOVEMBER EXAMINATION<br>11 NOVEMBER 2017 |
| **DURATION** | : | (X-PAPER) 08:30 - 11:30 |
| **FULL MARKS** | : | 100 |
| **TOTAL MARKS** | : | 100 |

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| **EXAMINER** | : | PROF G C FANOURAKIS |
| **MODERATOR** | : | DR B A HARRISON |
| **NUMBER OF PAGES** | : | 3 PAGES AND 4 ANNEXURES |

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| **INSTRUCTIONS** | : | STUDENTS MAY BRING AN A4 SIZE SHEET OF PAPER INTO THE EXAMINATION VENUE. THIS SHEET MAY CONTAIN EQUATIONS / FORMULAE WHICH HAVE BEEN ORIGINALLY HANDWRITTEN (NOT PHOTOCOPIED) ON BOTH SIDES.<br><br>PROGRAMMABLE CALCULATORS ARE PERMITTED (ONLY ONE PER STUDENT).<br><br>WHERE RELEVANT, TAKE ACCELERATION DUE TO GRAVITY AS 10 m/s$^2$. |
| **REQUIREMENTS** | : | GRAPH PAPER |

## QUESTION 1

Describe how particle shape and texture affect the permeability of soil.

[5]

## QUESTION 2

A lake comprises 2 m of water overlying 4 m of clay.  The clay has a void ratio and specific gravity of 0,7 and 2,75, respectively.

2.1        Plot the variation in total stress, pore water pressure and effective stress with depth.     (5)

2.2        Re-draw the diagrams <u>immediately</u> after the water level of the lake drops by 1 m.     (7)

2.3        Re-draw the diagrams pertaining to a <u>long time</u> after the drop in the water level (mentioned in 2.2 above) has occurred.     (3)

[15]

## QUESTION 3

The following results were obtained from undrained shear box tests on a sandy clay.  The dimensions of the shear box were 60 mm x 60 mm.  In the case of all three tests, shear failure occurred at a displacement of 3 mm.

| Test | Normal load (N) | Shear force at failure (N) |
|------|-----------------|----------------------------|
| 1 | 200 | 210 |
| 2 | 400 | 241 |
| 3 | 800 | 298 |

3.1        Find the shear strength parameters c and $\varphi$.     (10)

3.2        If a specimen of the same soil is tested in triaxial compression at a cell pressure of 150 $kN/m^2$, determine the deviator stress at which failure will occur.     (6)

3.3        Briefly discuss the disadvantages of the shear box test in comparison to the triaxial test.     (4)

[20]

## QUESTION 4

Determine the magnitude of the resultant thrust for the retaining wall shown in Figure 1 (attached).

[24]

## QUESTION 5

A road cutting is to be excavated within a highly fissured (jointed) residual soil. A section through the proposed cutting is shown in Figure 2 (attached).

Determine, using the Hoek and Bray method of analysis and the soil properties included in this figure, the factor of safety for the slope shown when the tension crack contains no water.

[10]

## QUESTION 6

Using the charts provided, find the elastic (immediate) settlement of the foundation shown in Figure 3 (attached).

[15]

## QUESTION 7

A soil sample was recovered from the centre of a 10 m thick layer having a saturated moisture content of 30 %. The specific gravity of the clay was 2,75. The water table was at the ground surface. The results of a consolidometer test carried out on the clay sample are shown in Figure 4.

7.1    Determine the overconsolidation ratio (OCR).                        (8)

7.2    If a uniform surcharge applied to the surface of the clay caused a 80 kPa increase in stress at the middle of the layer, determine the consolidation settlement using $m_v = 2,5 \times 10^{-4}$ m$^2$/kN.                (3)

[11]

**TOTAL : 100**

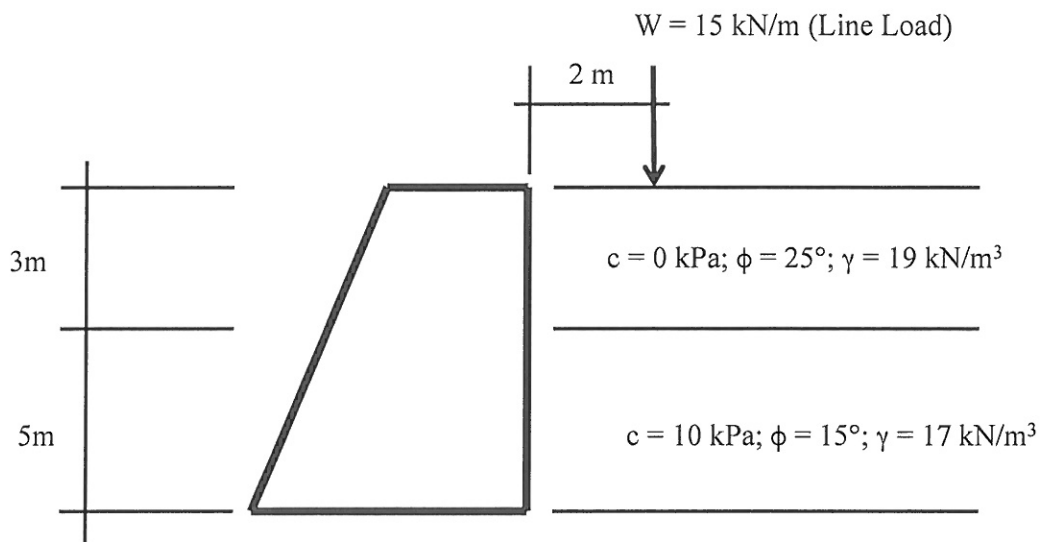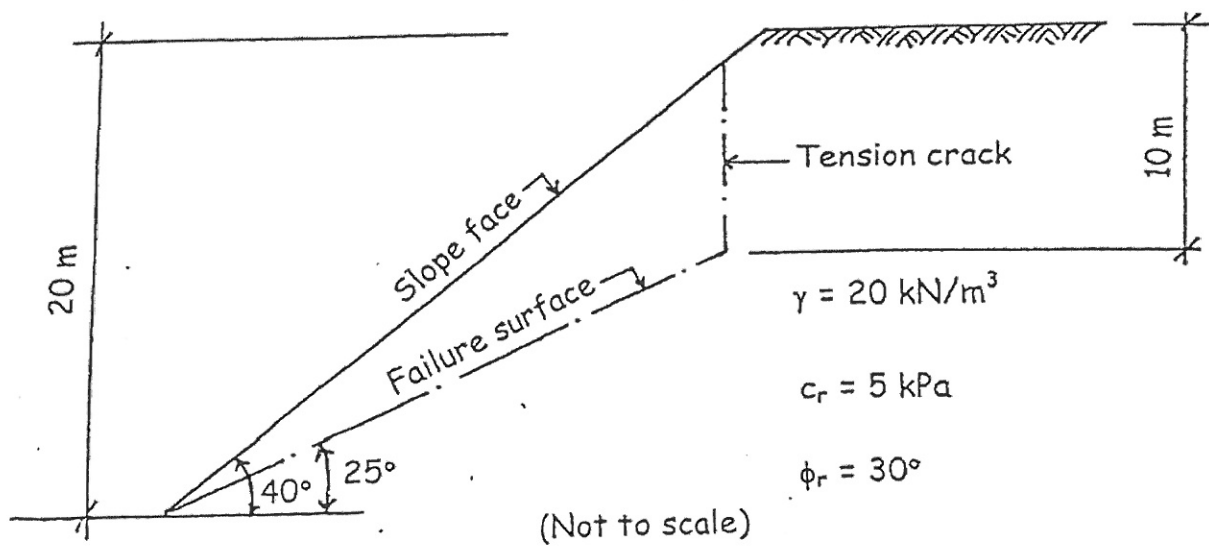W = 15 kN/m (Line Load)

2 m

3m          c = 0 kPa; $\phi$ = 25°; $\gamma$ = 19 kN/m³

5m          c = 10 kPa; $\phi$ = 15°; $\gamma$ = 17 kN/m³

**Figure 1**

20 m

Slope face

Failure surface

Tension crack

10 m

$\gamma$ = 20 kN/m³

$c_r$ = 5 kPa

$\phi_r$ = 30°

40°    25°

(Not to scale)
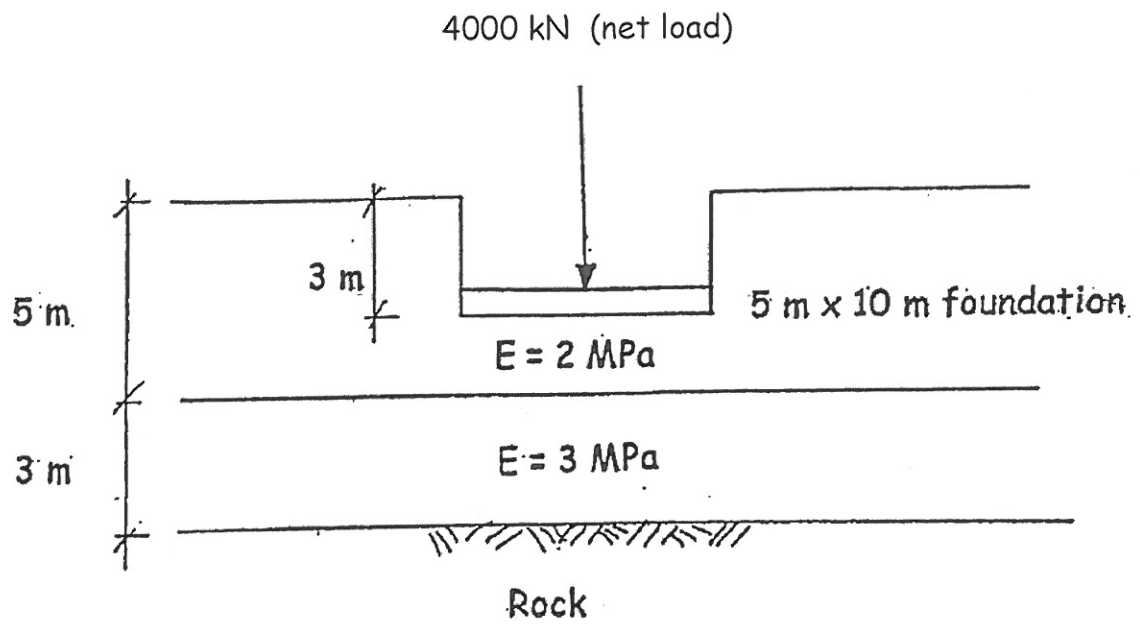
**Figure 2**

**Figure 3**

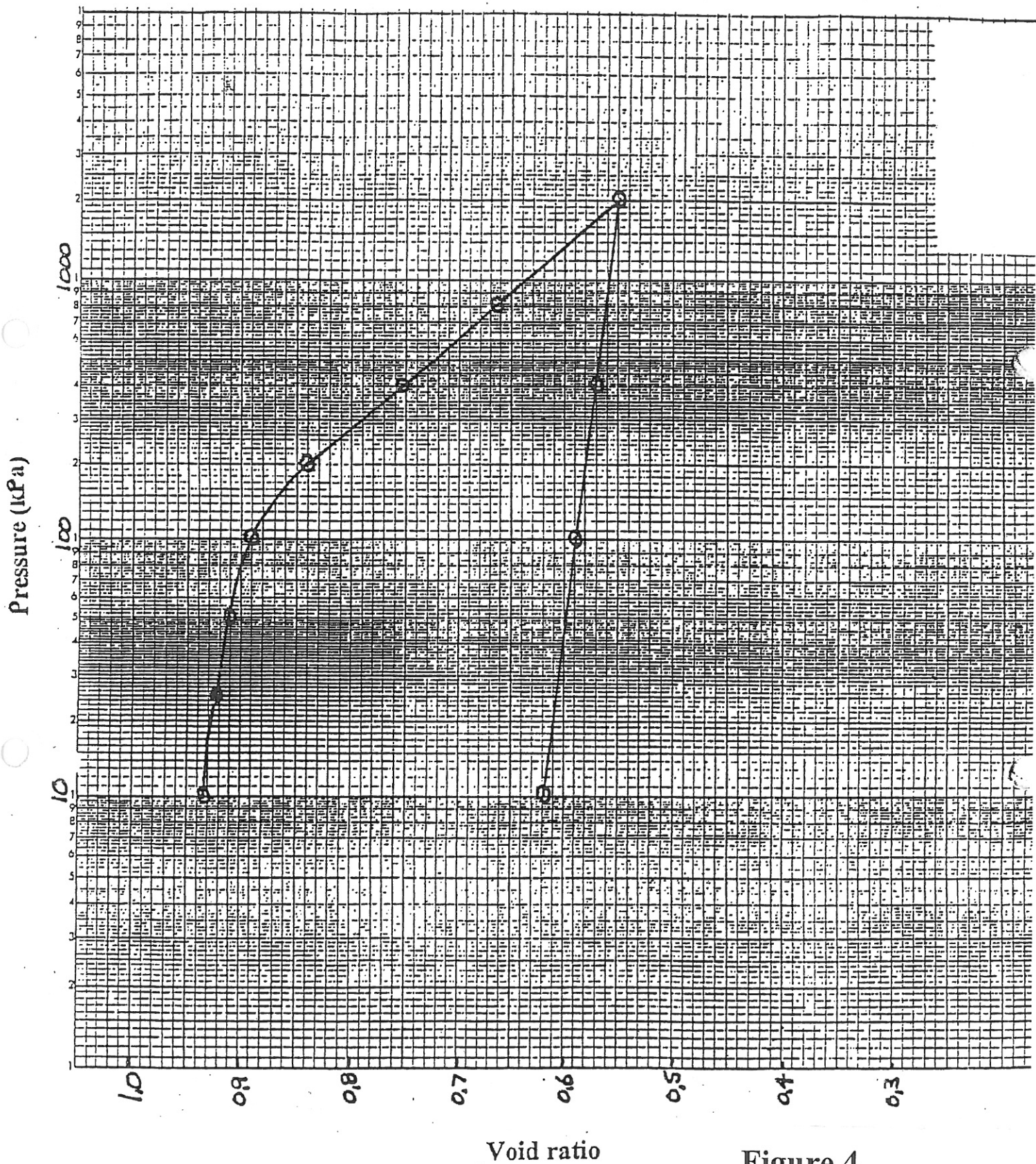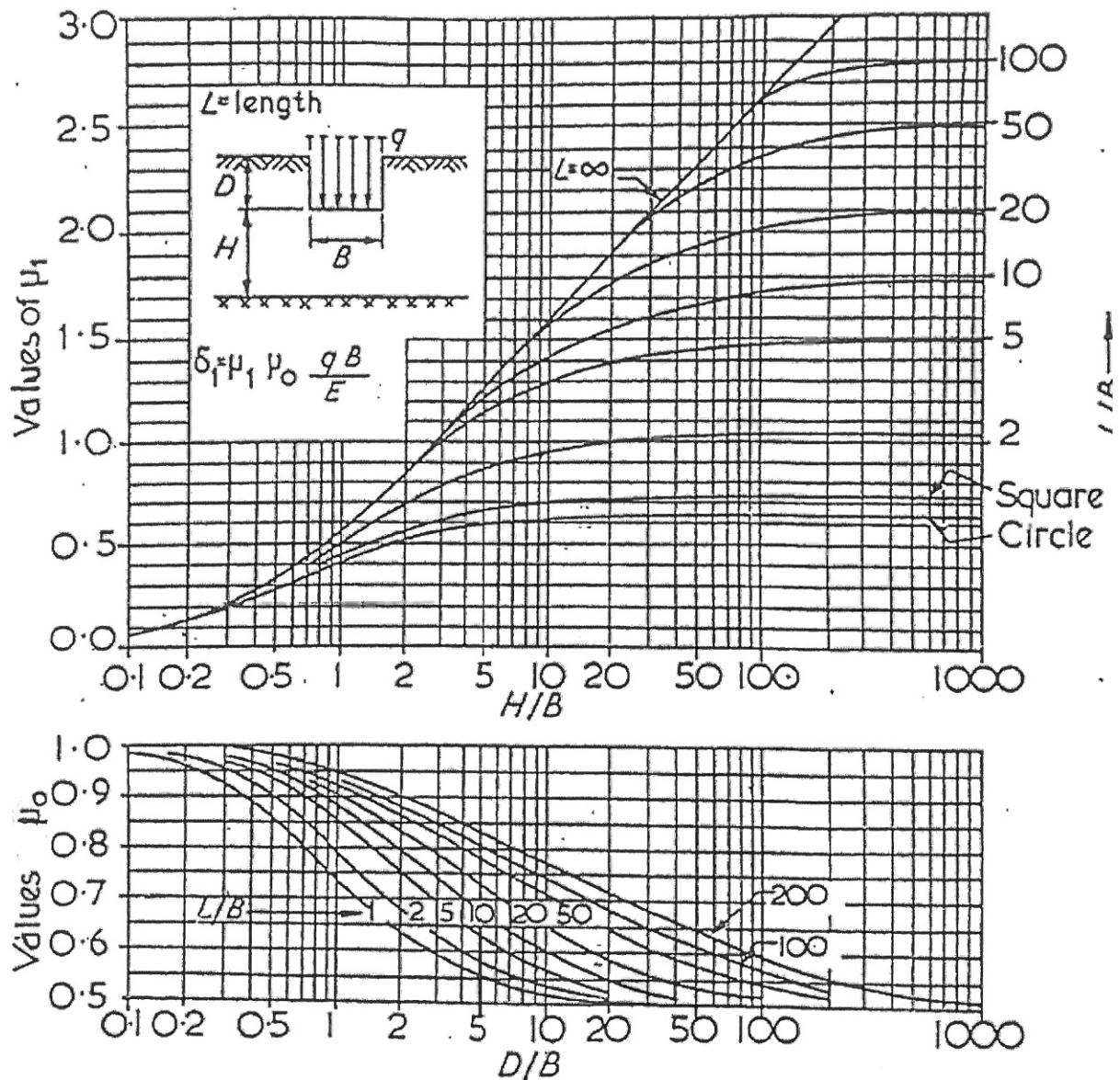**NAME:**                                                            **STUDENT No:**



Void ratio

Figure 4

HAND IN THIS FIGURE WITH YOUR SCRIPT

Diagrams for the factors $\mu_0$ and $\mu_1$ used in the calculation of the immediate average settlement of uniformly loaded flexible areas on homogeneous isotropic saturated clay, after Janbu, Bjerrum and Kjaernsli (1956)