UNIVERSITY OF JOHANNESBURG

PROGRAM	:	BACHELOR OF ENGINEERING TECHNOLOGY *ENGINEERING : CIVIL*
SUBJECT	:	**GEOTECHNICAL ENGINEERING 2B**
CODE	:	**GTECIB2**
DATE	:	NOVEMBER EXAMINATION 23 NOVEMBER 2019
DURATION	:	(X-PAPER) 08:30 - 11:30
FULL MARKS	:	100
TOTAL MARKS	:	100

EXAMINER	:	PROF G C FANOURAKIS
MODERATOR	:	DR B A HARRISON
NUMBER OF PAGES	:	3 PAGES AND 5 ANNEXURES

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. PROGRAMMABLE CALCULATORS ARE PERMITTED (ONLY ONE PER STUDENT). WHERE RELEVANT, TAKE ACCELERATION DUE TO GRAVITY AS 10 m/s^2.
REQUIREMENTS	:	GRAPH PAPER

QUESTION 1

Briefly discuss how soil particle size distribution, shape and texture affect the permeability of a soil.

[5]

QUESTION 2

A flow net through an earth dam is shown in Figure 1 (attached).

2.1 If the dam is 100 m long and the coefficient of permeability (k) is 7 x 10^{-7} m/sec, calculate the total seepage through the dam in m^3/sec. (5)

2.2 Determine the critical hydraulic gradient (i_c) if the soil has a dry density of 1800 kg/m^3 and a saturated moisture content of 20 %. (3)

2.3 Determine the water level "h" in the stand pipe shown. (3)

[11]

QUESTION 3

A lake comprises 4 m of water overlying 5 m of clay. The clay has a unit weight (γ) of 19 kN/m^3.

3.1 Plot the variation in total stress, pore water pressure and effective stress with depth. (3)

3.2 What would be the value of the pore water pressures at the top and bottom of the clay layer, immediately after a drop in the water table of 2m? (2)

[5]

QUESTION 4

The results of a consolidated undrained triaxial test carried out on a soil sample are given below. Assuming the cross-sectional area at failure of each specimen to have been 1414 mm^2, determine the total and effective shear strength parameters of this soil.

Specimen No.	Cell Pressure (kPa)	Axial Load at Failure (N)	Pore Water Pressure (kPa)
1	67	312	20
2	167	469	80
3	267	654	135

[20]

QUESTION 5

Determine the magnitude of the resultant thrust, per unit length, acting on the gabion wall, shown in Figure 2 (attached).

[22]

QUESTION 6

Determine the factor of safety for the slope shown in Figure 3 (attached).

[18]

QUESTION 7

Figure 4 shows the plan of a rectangular foundation which transmits a uniform contact pressure of 240 kPa. Using Steinbrenner's method, and the chart provided, determine the vertical stress caused by this loading at a depth of 5 m below A.

[9]

QUESTION 8

The results of a laboratory consolidation test, on a clay, are given below.

Pressure (kPa)	Void Ratio (e)
23,94	1,112
47,88	1,105
95,76	1,080
191,52	0,985
383,04	0,850
766,08	0,731

8.1 Plot the e – log P curve on Figure 5 (attached).

8.2 Determine the preconsolidation pressure.

PLEASE HAND IN FIGURE 5 WITH YOUR SCRIPT

[10]

TOTAL : 100

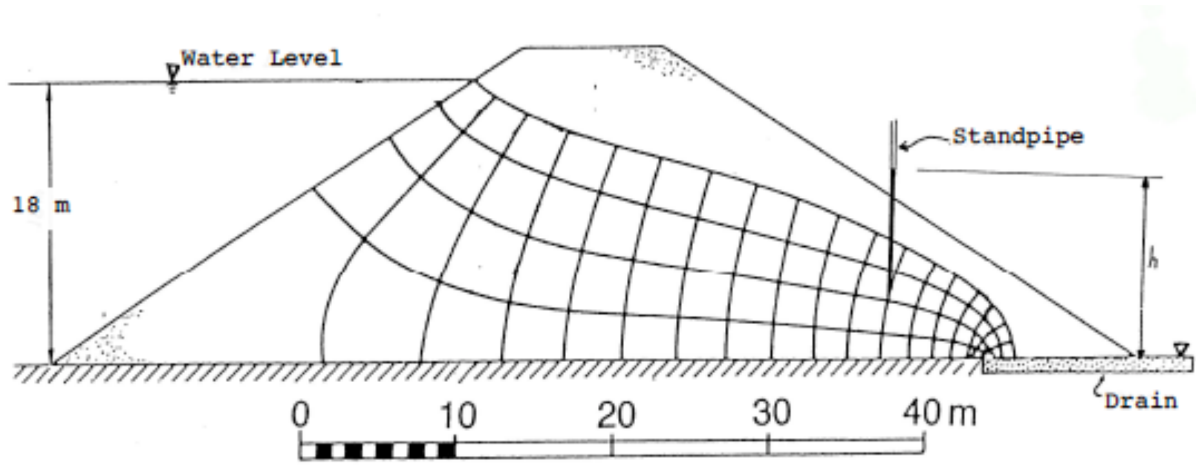


Figure 1

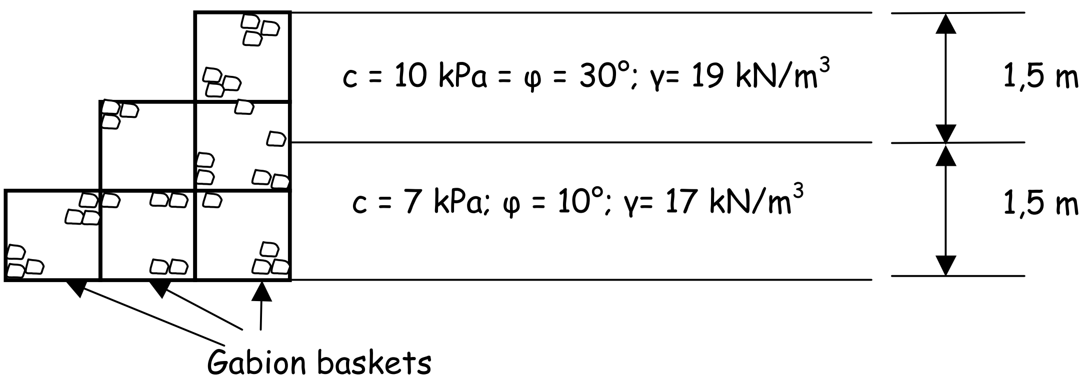


Figure 2

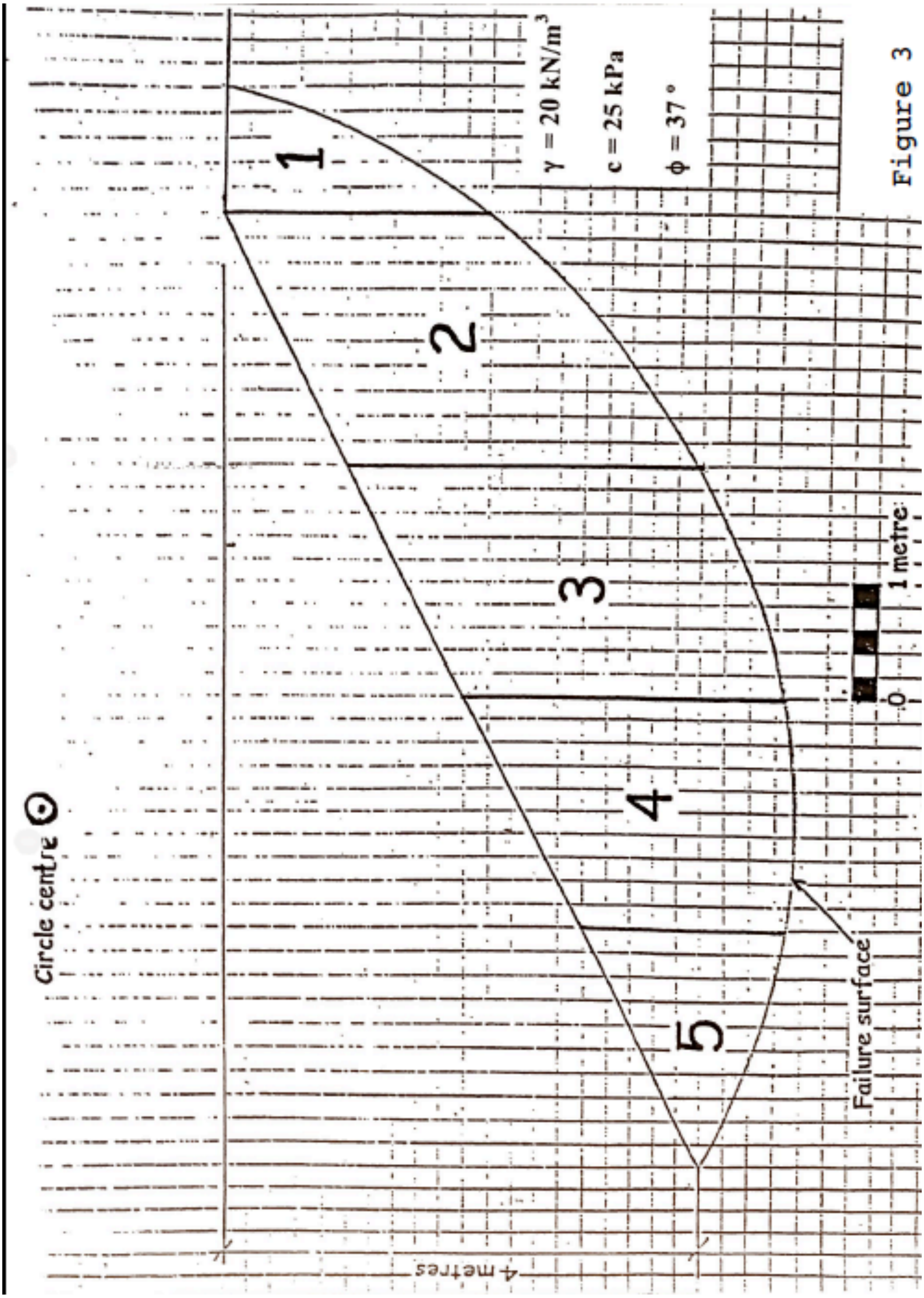
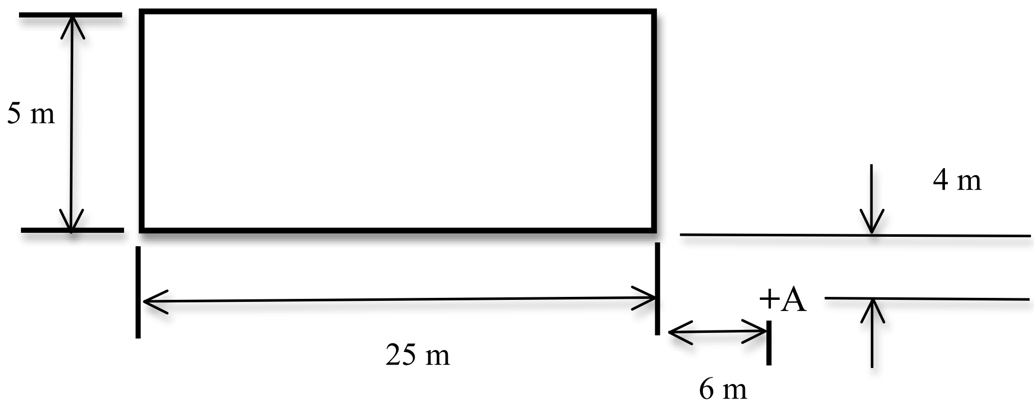

γ = 20 kN/m³
c = 25 kPa
ϕ = 37 °
Circle centre
1
2
3
4
5
0
1 metre
Failure surface
4 metres

Figure 3



Not to Scale

Figure 4

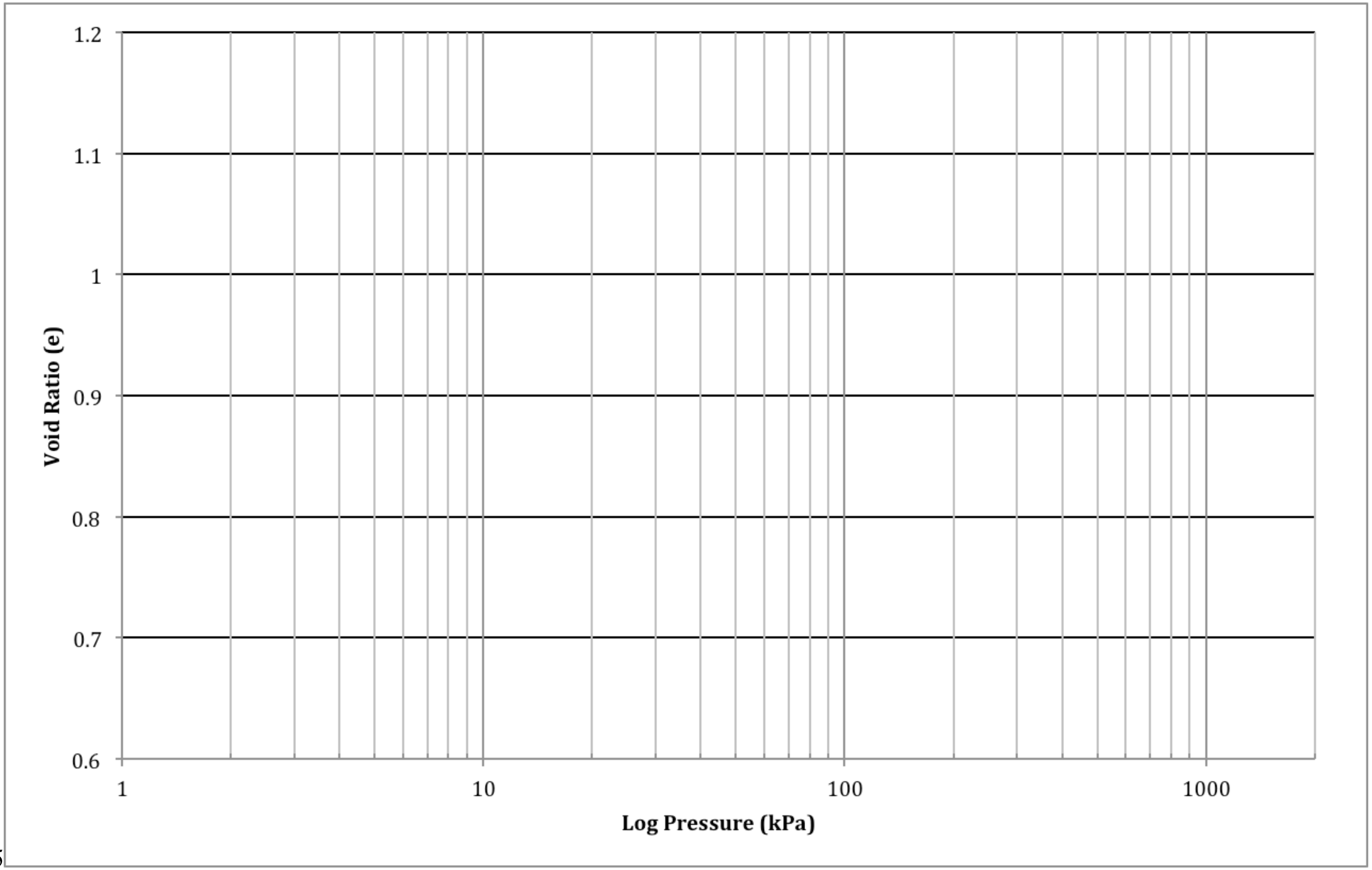


Figure 5

Influence factors I for vertical normal stress under the corner of a rectangular loaded area

b/ℓ z/ℓ	0	0,1	0,2	1/3	0,4	0,5	2/3	1	1,5	2	2,5	3	5	10	∞
0	0,000		0,250	0,250	0,250	0,250	0,250	0,250	0,250	0,250	0,250	0,250	0,250	0,250	0,250
0,2	0,000	0,137	0,204	0,234	0,240	0,244	0,247	0,249	0,249	0,249	0,249	0,249	0,249	0,249	0,249
0,4	0,000	0,076	0,136	0,187	0,202	0,218	0,231	0,240	0,243	0,244	0,244	0,244	0,244	0,244	0,244
0,5	0,000	0,061	0,113	0,164	0,181	0,200	0,218	0,232	0,238	0,239	0,240	0,240	0,240	0,240	0,240
0,6	0,000	0,051	0,096	0,143	0,161	0,182	0,204	0,223	0,231	0,233	0,234	0,234	0,234	0,234	0,234
0,8	0,000	0,037	0,071	0,111	0,127	0,148	0,173	0,200	0,214	0,218	0,219	0,220	0,220	0,220	0,220
1	0,000	0,028	0,055	0,087	0,101	0,120	0,145	0,175	0,194	0,200	0,202	0,203	0,204	0,205	0,205
1,2	0,000	0,022	0,043	0,069	0,081	0,098	0,121	0,152	0,173	0,182	0,185	0,187	0,189	0,189	0,189
1,4	0,000	0,018	0,035	0,056	0,066	0,080	0,101	0,131	0,154	0,164	0,169	0,171	0,174	0,174	0,174
1,5	0,000	0,016	0,031	0,051	0,060	0,073	0,092	0,121	0,145	0,156	0,161	0,164	0,166	0,167	0,167
1,6	0,000	0,014	0,028	0,046	0,055	0,067	0,085	0,112	0,135	0,148	0,154	0,157	0,160	0,160	0,160
1,8	0,000	0,012	0,024	0,039	0,046	0,056	0,072	0,097	0,121	0,133	0,140	0,143	0,147	0,148	0,148
2	0,000	0,010	0,020	0,033	0,039	0,048	0,061	0,084	0,107	0,120	0,127	0,131	0,136	0,137	0,137
2,5	0,000	0,007	0,013	0,022	0,027	0,033	0,043	0,060	0,080	0,093	0,101	0,106	0,113	0,115	0,115
3	0,000	0,005	0,010	0,016	0,019	0,024	0,031	0,045	0,061	0,073	0,081	0,087	0,096	0,099	0,099
4	0,000	0,003	0,006	0,009	0,011	0,014	0,019	0,027	0,038	0,048	0,055	0,060	0,071	0,076	0,076
5	0,000	0,002	0,004	0,006	0,007	0,009	0,012	0,018	0,026	0,033	0,039	0,043	0,055	0,061	0,062
10	0,000	0,000	0,001	0,002	0,002	0,002	0,003	0,005	0,007	0,009	0,011	0,013	0,020	0,028	0,032
15	0,000	0,000	0,000	0,001	0,001	0,001	0,001	0,002	0,003	0,004	0,005	0,006	0,010	0,016	0,021
20	0,000	0,000	0,000	0,000	0,000	0,001	0,001	0,001	0,002	0,002	0,003	0,004	0,006	0,010	0,016
50	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,001	0,001	0,002	0,006