



THE MOMBASA POLYTECHNIC UNIVERSITY COLLEGE

Faculty of Engineering & Technology

DEPARTMENT OF CIVIL AND BUILDING ENGINEERING

Dc/o8, DCC/o8, DBC/o8, HD/Bridging/o9

SEMESTER EXAMINATIONS

APRIL/MAY 2010 SERIES

SOIL MECHANICS

TIME: 2 HOURS

Instructions to Candidates

This paper consists of **FIVE** questions.

Attempt question **ONE** and any other **THREE** Questions.

Non-programmable pocket calculator may be used.

If question Qn.2 is attempted, fig. 2.1 must be handed in with the answer script.

Question ONE

(a) (i) For civil engineering purposes, define the term **SOIL**. **(2 Marks)**

(ii) Explain the following terms:

- Residual soil
- Transported soil **(2 Marks)**

(iii) Using basic structural units, illustrate the lattice structure of kaolinite clay mineral. **(4 Marks)**

(b) From the basic principles, derive the expression:

$$\gamma_b = (G_s + eS_r)\gamma_w / (1 + e).$$

Symbols have the usual meaning. **(12 Marks)**

(c) In its natural condition, a soil has a mass of 2350g and a volume of $1.25 \times 10^{-3} m^3$. After being completely dried in an oven, the mass of the sample was 2065g. The value of G_s for the soil is 2.71.

Determine:

- (i) The bulk density
- (ii) The bulk unit weight
- (iii) Water content
- (iv) dry unit weight
- (v) Void ratio
- (vi) Porosity
- (vii) Degree of saturation
- (viii) Air Content **(20 Marks)**

Question TWO

(a) Define the following terms as used in soil mechanics:

- (i) Liquid limit
- (ii) Plastic limit
- (iii) Liquidity index
- (iv) Shrinkage limit

(6.5 Marks)

- (b) A liquid limit test carried out on a sample of a soil gave the following results:

Cone penetration (mm)	16.0	18.0	19.5	22.3
Water content (%)	39.3	40.9	43.1	44.7

A plastic limit test gave 24%,

Determine:

- (i) Liquid limit
- (ii) Plasticity index
- (iii) Classification of the soil, using the chart provided. **(13½ Marks)**

Question THREE

- (a) With a well labeled sketch, describe the falling head permeameter test. **(16 Marks)**
- (b) A falling head permeameter has a diameter of 100mm and the length of the soil sample is 150mm. the diameter of the stand pipe is 20.0mm. during the test the head decreased from 1300mm to 800mm in 140s. Calculate the coefficient of permeability in mm/s. **(4 Marks)**

Question FOUR

- (a) The following readings were taken in a shear box test on a soil:

Normal Load (N)	91	182	273
Shear Load (N)	68	91	118

The shear box measured 60mm square.

Determine the cohesion and angle of friction of the soil. **(12 Marks)**

- (b) Undisturbed samples were taken from a compacted fill material and subjected to consolidated undrained triaxial tests. Results were:

Cell Pressure (kN/m²)	Deviator stress (kN/m²)	Pore water pressure (kN/m²)
200	650	50
400	770	200
600	880	350

Determine the values of the cohesion and the angle of internal friction with respect to effective stress. **(8 Marks)**

Question FIVE

A standard compaction test was carried out in a 105mm diameter mould of volume 0.001m^3 .

The results were:

Moisture content (%)	10.0	11.0	12.0	13.0	14.0
Mass of wet soil (g)	2043	2175	2209	2225	2195

Specific gravity of the solids = 2.65

Determine:

- (i). Maximum dry density in kg/m^3 ,
- (ii). Optimum moisture content (%),
- (iii). % age air voids at optimum moisture content,
- (iv). The saturation line,
- (v). The 5% air voids line

(20 Marks)