FEDERAL UNIVERSITY OF TECHNOLOGY, OWERRI
SCHOOL OF ENGINEERING AND ENGINEERING TECHNOLOGY
DEPARTMENT OF AGRICULTURAL ENGINEERING
RAIN SEMESTER EXAMINATION 2005/2006 SESSION YEAR 2

COURSE CODE: ACE 202 - SOIL MECHANICS & BEHAVIOUR TIME: 3 HRS

INSTRUCTION: ANSWER FIVE (5) QUESTIONS IN ALL INCLUSIVE OF QUESTION NUMBER ONE *(1)*

1a. Show that for a partially saturated soil, the void ratio (e), the moisture content (w), the specific gravity (G_s), the volume of voids (V_v) and the volum. of water (V_w) are related by the expression. $e = \frac{wG_sV_v}{V_w}$

b. A soil sample had a mass of 6000g in its natural deposit. After being completely dried in an oven the mass of the sample was 5300g. The values for the specific gravity, G_s, and degree of saturation, S_r of the soil are 2.65 and 75% respectively. Determine (i) The moisture content (w), (ii) the void ratio (e) and (iii) the porosity (n) of the soil.

2a. The results of a sieve analysis on a soil were

Sieve size (mm)	Mass retained (g)
50.0	0
37.5	13
20.0	17
14.0	10
10.0	11
6.3	33
3.35	114.5
1.18	63.3
0.60	18.2
0.15	17.0
0.063	10.5

If the total mass of the sample was 311.0g, plot the particle size distribution curve and from the inspection of this curve.

i. Describe the soil.
ii. Determine the effective size (D_{10}).
iii. From the value of your coefficient of concavity, C_c, is the soil, uniformly, poorly or well graded.

b. The principles of soil sedimentation is based on the limiting velocity, V_s given by the Stoke's law. Write the expression for computing this limiting velocity, V_s and define all the terms used in the expression.

3a. Define the following terms (i) Flow nets (ii) Flow lines (iii) Flow fields (iv) Equipotential lines.

b. Determine the loss through seepage under a dam in m^3/day given that the coefficient of permeability K = 0.005mm/s and the level of water above the base of the dam is 15m upstream and 3m downstream and the number of flow lines and equipotential drops are 4 and 12 respectively. The length of the dam perpendicular to the place of seepage is 500m.

c. A sample of coarse sand 150m high and 55mm in diameter was tested in a constant head permeameter. Water percolated through the soil under a head of 400mm for 6.0seconds and the discharged water had a mass of 400g. Determine the coefficient of permeability k in cm/s or mm/s.

4a. State the Mohr-Coulomb failure criterion.
b. List the factors that determine the shear resistance of dry granular soils.
c. Determine the shear stress for a cohesive frictional soil if cohesion is 25KN/m^2, angle of internal friction is 15^0 and normal stress on shear plane is 80KN/m^2.

5a. Define the following terms:
(i) Consolidation (ii) Compaction (iii) Optimum moisture content.
b. The results of a standard compaction test on a soil sample are as follows:

M. C. (%)	4.4	6.3	8.4	10.0	12.7
ρ (kg/m^3)	1890	2060	2170	2190	2150

(i) Plot the curve of dry density versus moisture content.
(ii) From the curve, determine the optimum moisture content and maximum compaction.

6a. Explain the effective stress principle.
b. When is a soil said to be normally consolidated.
c. For an aquifer of thickness 3.5m, comprising an isotropic sand having coefficient of permeability 10^{-4} m/s and subject to water flow under a hydraulic gradient of 0.2, calculate the superficial velocity and flow rate of the water. *(Assume flow to be laminar).*