

**Birzeit University**  
**Faculty of Engineering**  
**Department of Civil and Environmental Engineering**

**ENCE 331, Soil Mechanics**

**Homework assignment #3**  
**Due on Thursday, Oct. 15<sup>th</sup>, 2020 @ 11:59 PM.**

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**Problem 1:**

During Atterberg limit tests in the soil mechanics laboratory, the students obtained the following results from a clayey soil.

*Liquid limit tests:*

<b>Number of blows, <math>N</math></b>	<b>Moisture content (%)</b>
14	38.4
16	36.5
20	33.1
28	27.0

*Plastic limit tests:*

Students conducted two trials and found that  $PL = 17.2\%$  for the 1<sup>st</sup> trial and  $PL = 17.8\%$  for the second trial.

- Draw the flow curve and obtain the liquid limit.
- What is the plasticity of the soil? (Hint: Use an average value of  $PL$ )
- Determine the flow index.
- Determine the liquidity index of the soil if the in-situ moisture content is 21%, and comment on the probable engineering behavior of this soil.

**Problem 2:**

During a shrinkage limit test, a  $19.3 \text{ cm}^3$  saturated clay sample with a mass of 37 g was placed in a porcelain dish and dried in the oven. The oven-dried sample had a mass of 28 g with a final volume of  $16 \text{ cm}^3$ .

- Determine the shrinkage limit and the shrinkage ratio.

**Problem 3:**

In a shrinkage limit test, a sample of saturated clay was dried in the oven. The dry mass of the soil was 22.5 g. when the moisture content is at the shrinkage limit, the soil reaches a constant total volume,  $V_f = 10.3 \text{ cm}^3$ .

- calculate the shrinkage limit of the soil. (Given:  $G_s = 2.72$ )

### Problem 4:

The sieve analysis of ten soils and the liquid and plastic limits of the fraction passing through the No. 40 sieve are given below.

- Classify the soils by the AASHTO classification system and give the group index for each soil.

Soil	Sieve analysis—Percent finer			Liquid limit	Plasticity index
	No. 10	No. 40	No. 200		
1	98	80	50	38	29
2	100	92	80	56	23
3	100	88	65	37	22
4	85	55	45	28	20
5	92	75	62	43	28
6	97	60	30	25	16
7	100	55	8	—	NP
8	94	80	63	40	21
9	83	48	20	20	15
10	100	92	86	70	38

### Problem 5:

Classify the following soils using the Unified soil classification system.

Sieve size	Percent passing				
	A	B	C	D	E
No. 4	94	98	100	100	100
No. 10	63	86	100	100	100
No. 20	21	50	98	100	100
No. 40	10	28	93	99	94
No. 60	7	18	88	95	82
No. 100	5	14	83	90	66
No. 200	3	10	77	86	45
0.01 mm	—	—	65	42	26
0.002 mm	—	—	60	17	21
Liquid limit	—	—	63	55	36
Plasticity index	NP	NP	25	28	22

**Problem 6:**

For an inorganic soil, the following grain-size analysis is given. Knowing that the liquid limit is 23, and Plastic limit is 19.

- AASHTO soil classification system. Give the group index.
- Unified soil classification system. Give group symbol and group name (specific classification).

U.S. sieve no.	Percent passing
4	100
10	90
20	64
40	38
80	18
200	13

**Problem 7:**

9% of a soil is retained on No. 4 sieve, and 11% passes the No. 200 sieve. It is also known that 10%, 30%, and 60% of the soil is smaller than 0.1 mm, 0.8 mm, and 1.9 mm, respectively. When Atterberg limit tests are conducted, it is found that the liquid limit is 32% and the plastic limit is 24%.

Classify this soil according to the Unified soil classification system and give group symbol and group name.