

Try all questions

Any missing data to be reasonably assumed

Question 1 (20 Points)

- a) A saturated silty clay sample has a natural water content of 23%. The specific gravity of the soil is 2.7.

Find I) the porosity and II) bulk or total unit weight.

(5 Points)

- b) The following Figure shows the results of sieve analysis test:

(7 Points)

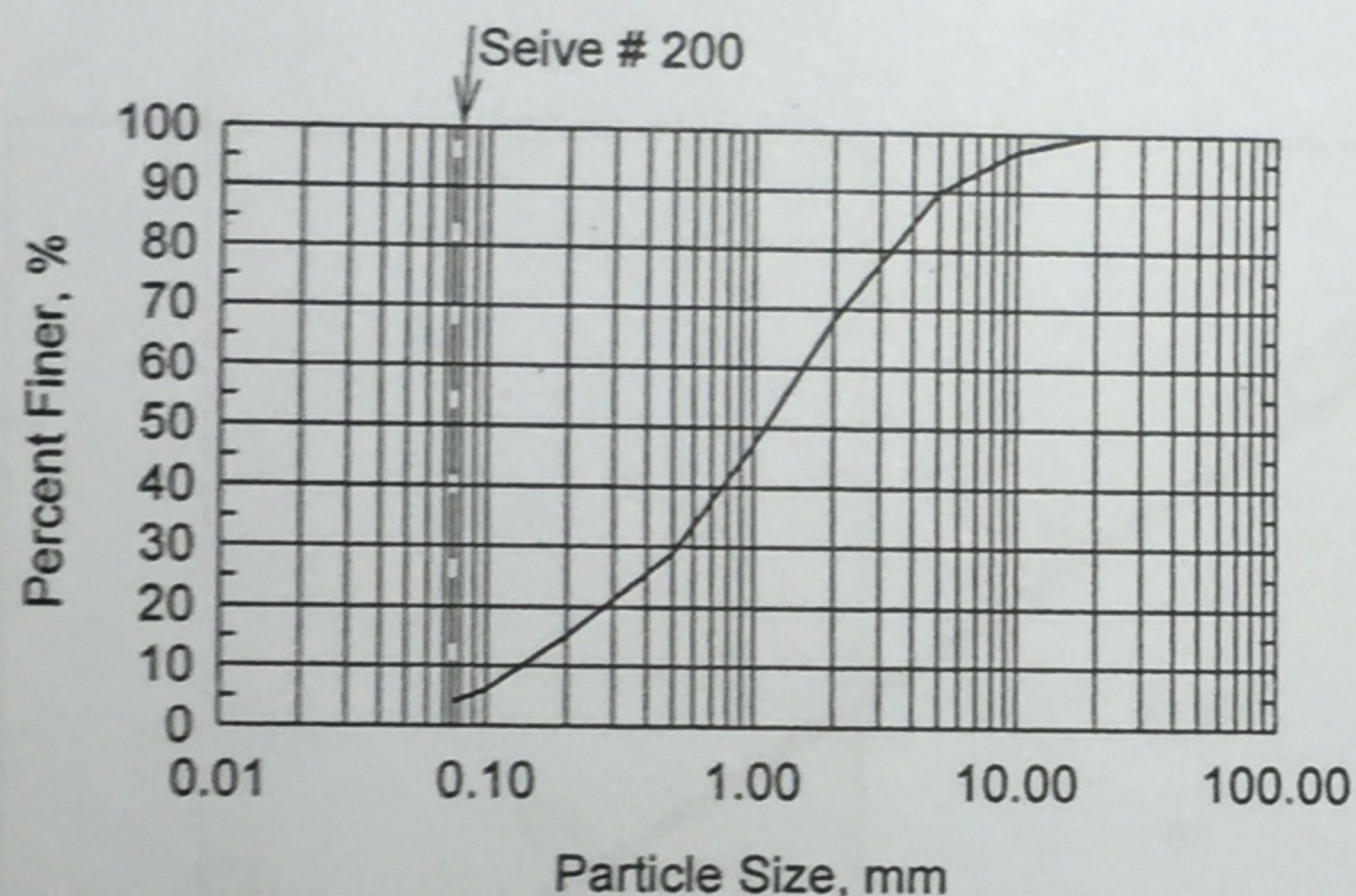


Figure 1

Determine

- (I) Effective Size
- (II) The Uniformity Coefficient
- (III) The Curvature Coefficient
- (IV) Percentage of Gravel
- (V) Percentage of Sand
- (VI) Percentage of Fines
- (VII) The classification according to the Unified Soil Classification System

- c) The sieve analysis results on a soil sample showed that

(8 Points)

Sieve Number	Sieve Diameter, mm	% Passing
4	4.75	100
200	0.075	22.5

The Atterberg Limits results of the fines part (الجزء الناعم من عينة التربة) of the sample from the Casagrande Cup and Plasticity tests are given as:

Question 1 (cont'd)

Two determinations for the plastic limit gave water contents of 20.3% and 20.8%.

Determine:

- (I) Fines Content
- (II) Sand Content
- (III) the liquid limit of the fine part,
- (IV) the plastic limit of the fine part,
- (V) the plasticity index of the fine part,
- (VI) according to the plasticity chart in the following page, is the fine part of the soil clay or silt?
- (VII) Classify the soil according to the Unified Soil Classification System.

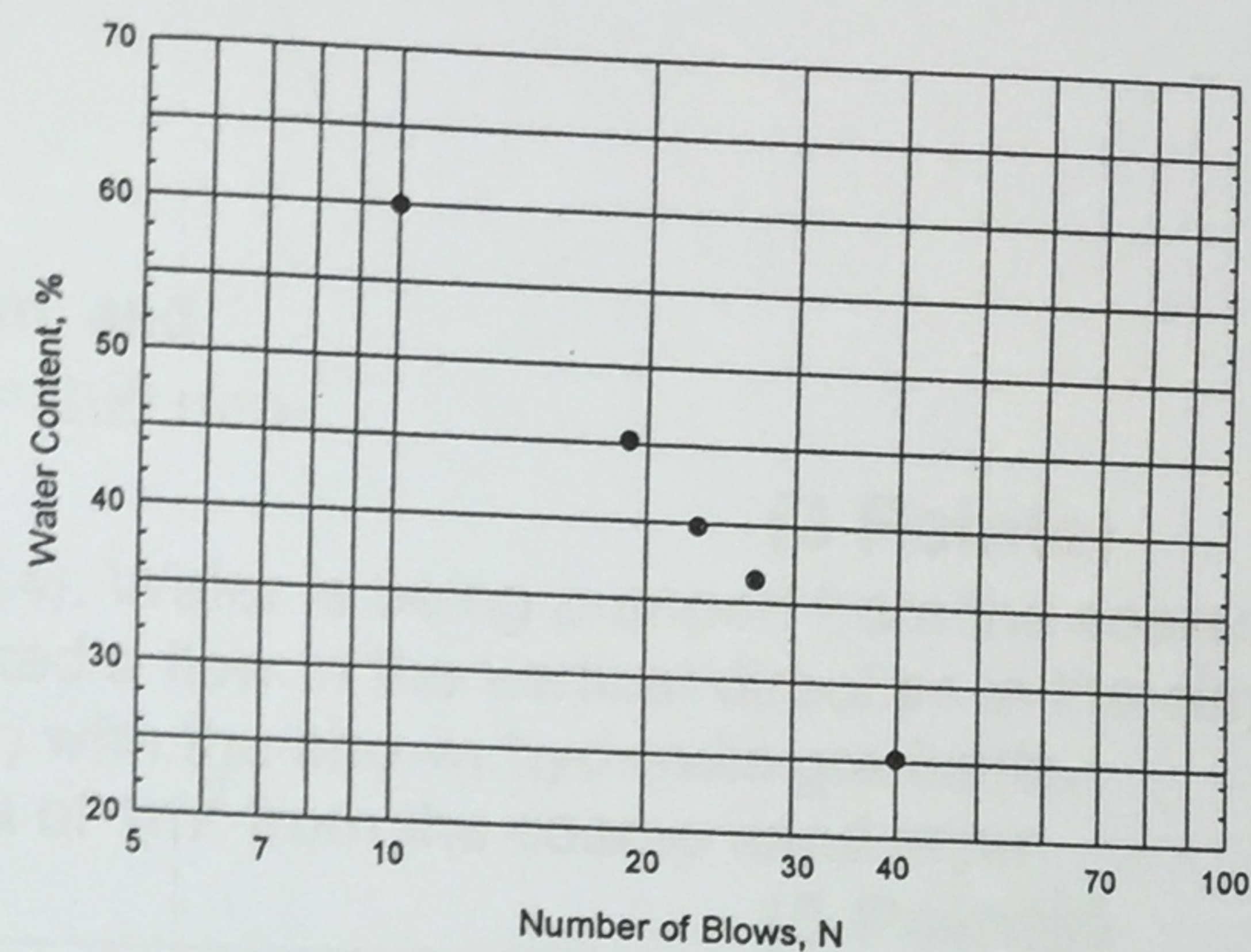


Figure 2

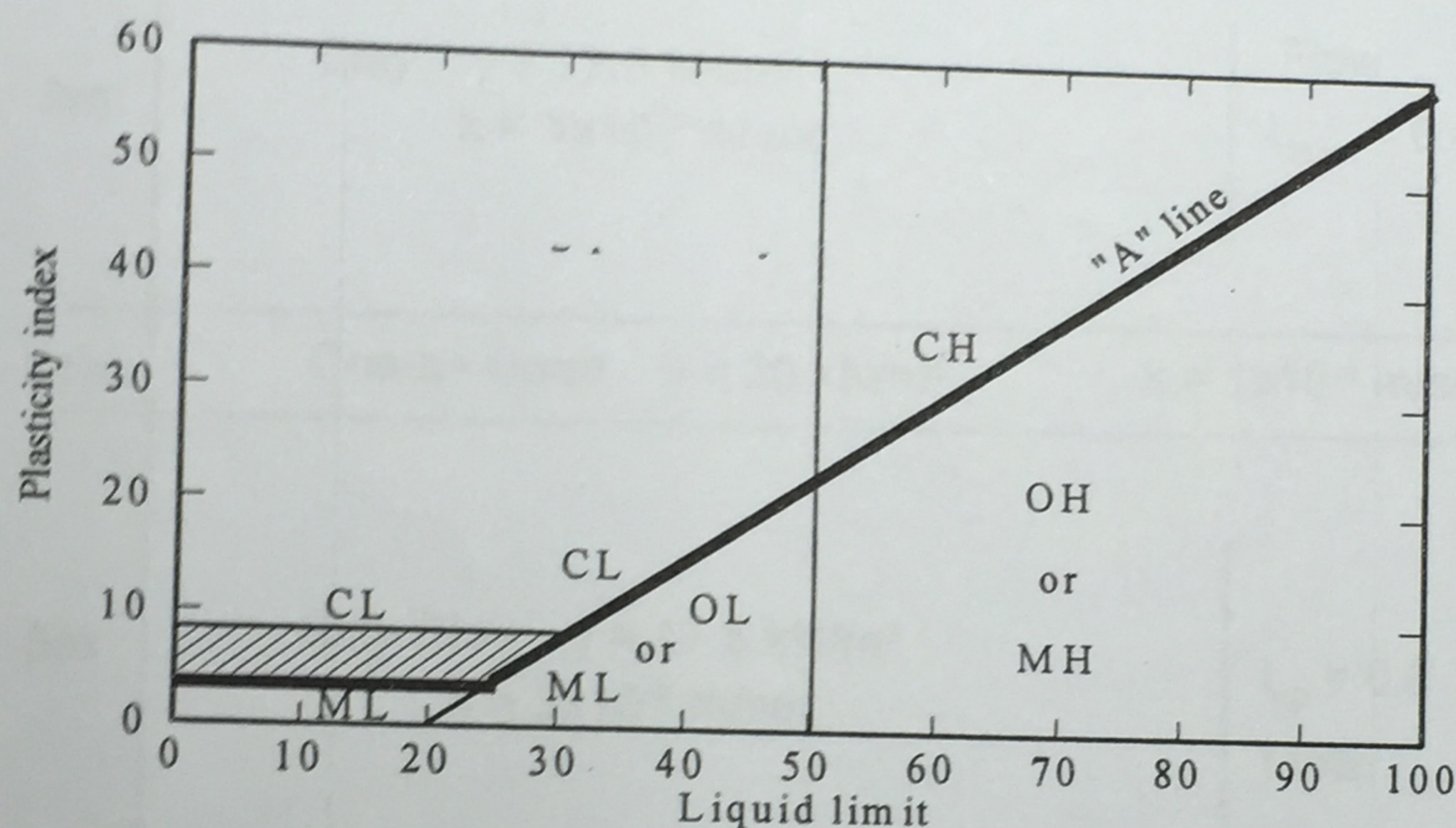


Figure 3

Question 2 (15 Points)

- a) Define the permeability of soils. (عرف نفاذية التربة) **(2 Points)**
- b) Briefly explain the factors influence permeability of soils. **(3 Points)**
(إشرح باختصار ماهي العوامل التي تؤثر في معامل النفاذية للتربة)
- c) Briefly explain why we need to know about coefficient of permeability of soils. **(2 Points)**
(إشرح باختصار لماذا نحتاج لمعامل النفاذية للتربة)
- d) A silt sample is prepared for a falling head permeability test. Calculate the coefficient of permeability of the silt sample in cm/sec given the following parameters of the test:

Question 2 (cont'd)

Area of the soil sample = 1400 mm^2 ,

Length of the soil sample = 70 mm ,

Area of the stand pipe = 50 mm^2 ,

At time $t = 0$, the head difference = 400 mm , and

At time $t = 2.5 \text{ hours}$, the head difference = 200 mm

(3 Points)

- e) A soil profile is shown in the following Figure (4). Water is being pumped from the coarse sand layer at steady state. The pumping created a flow in the vertical direction in the clay and silty clay layers as shown in the Figure (4) with the shown hydraulic gradients. Compute the flow rate in m^3/day per unit area of 1 m^2 from the coarse sand layer.

(5 Points)

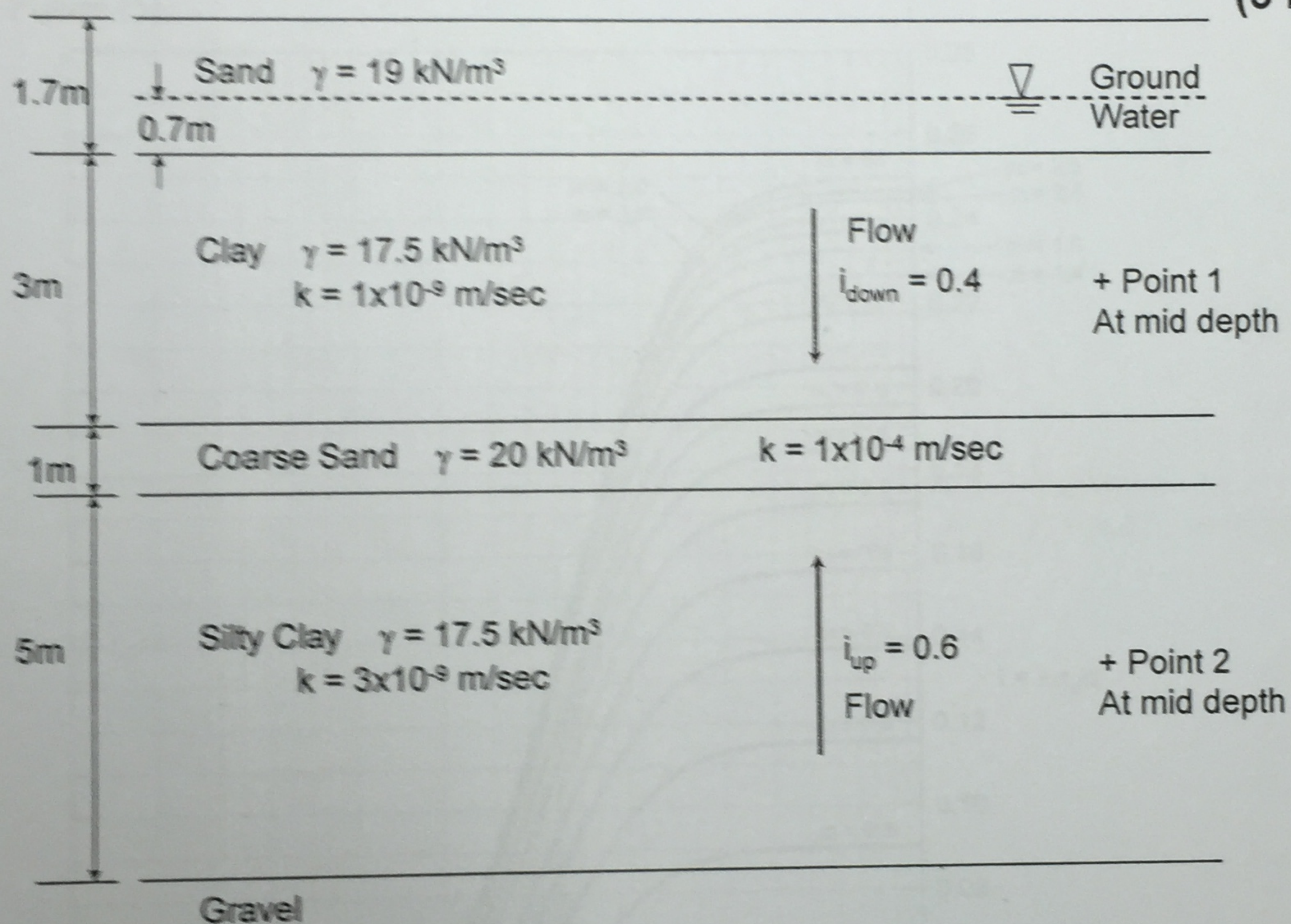


Figure 4

Question 3 (5 Points)

A pipe that is 1.5 m below the foundation level and close to a foundation as shown in the following Figure. The foundation rests on the top of soil and exerts a pressure of 10.0 t/m^2 at the ground surface. Using the attached Chart, determine the pressure exerted on the top of the pipe by the foundation at point X.

Question 3 (cont'd)

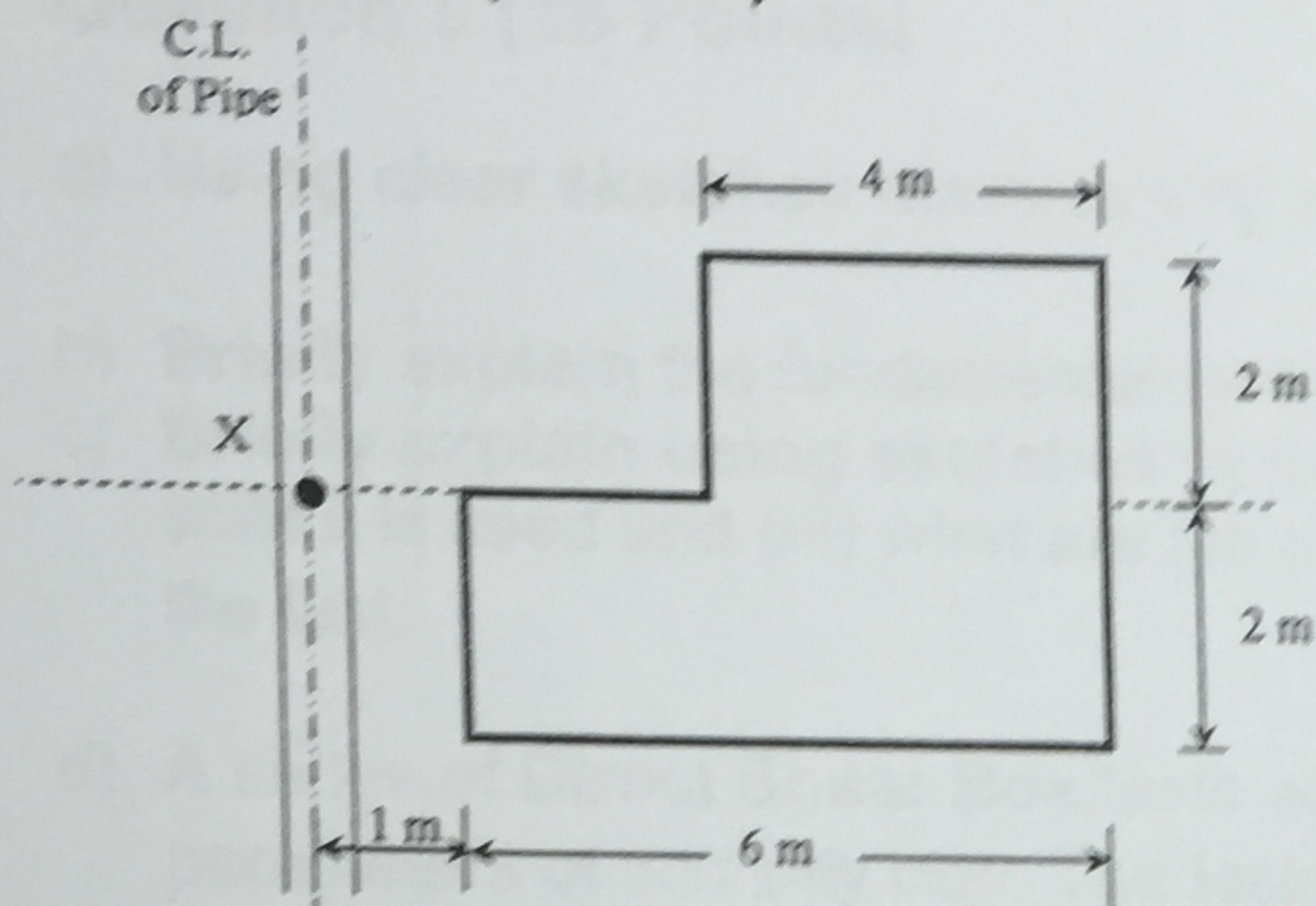
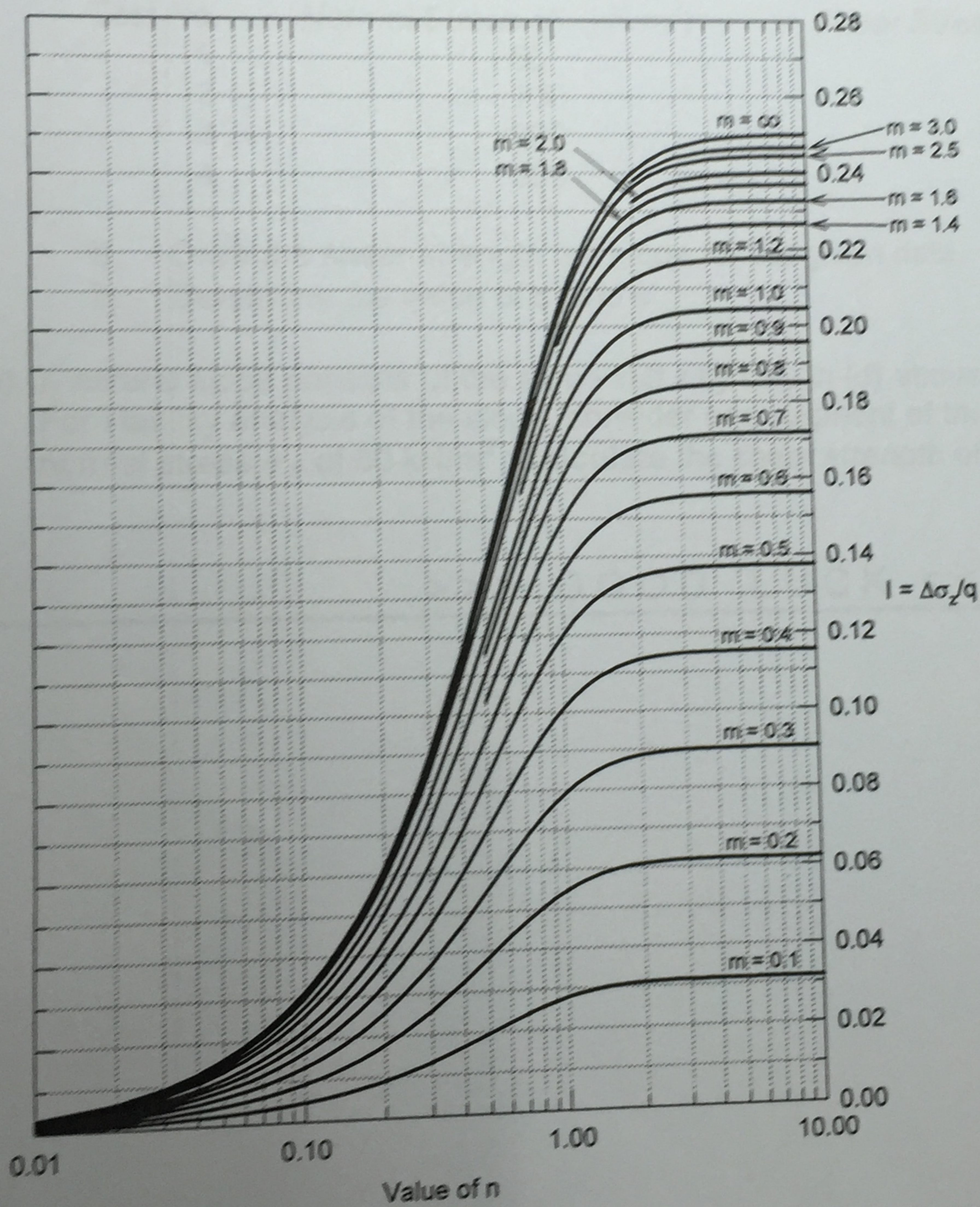


Figure (5)



Hint:
 $m = B/z$
 $n = L/z$

Figure (6)

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Question 5 (15 Points)

- a) Using clear sketches discuss why we need to know about shear strength of soils. (2 Points)
- b) Briefly explain the fundamental factors influence shear strength of soils. (2 Points)
- c) Briefly explain using sketches (I) the unconfined compression test, (II) For what type of soils it is used and (III) what are the shear strength parameters that can be obtained from the test. (2 Points)
- d) A series of Direct Shear Box tests were run to determine the drained shear strength parameters of stiff silty clay. The tests data are (6 Points)

Test No.	Normal Stress σ'_n (kN/m ²)	Shear Stress At Failure τ (kN/m ²)
1	50	33
2	100	51
3	200	88
4	500	189

- i) Draw the shear strength envelope for the given data.
- ii) Determine the value of c' and ϕ' .
- e) A natural slope consists of the same stiff silty clay in (d) above (it has the same c' and ϕ'). For stability analysis of the slope, consider one segment of the failure surface with effective normal stress σ'_n of 60 kN/m². Calculate the shear strength of the soil on the segment. (3 Points)

>>> GOOD LUCK <<<
