RYERSON UNIVERSITY
DEPARTMENT OF CIVIL ENGINEERING
CVL434–Geotechnical Properties of Soils
Winter 2011-Quiz 1
TYPE 1

Date: January 31, 2011 Time: 120 minutes
Closed Book Exam with Cheat-Cheat Sheet Answer All Questions

Name_____ **Ryerson ID:**_____

Q1. Which person from Canada served as the former President of International Society on Soil Mechanics and Geotechnical Engineering?

A	B	C	D
AW Skempton	L. Bjerrum	NR Morgenstern	BB Broms

Q2: Which Canadian City hosted an International Conference on Soil Mechanics and Foundation Engineering in 1965?

A	B	C	D
Toronto	Montreal	Vancouver	Ottawa

Q3: Which kind of deposits does ***loess*** belong to

A	B	C	D
Lacustrine deposits	Glacial deposits	Aeolian soil deposits	Alluvial deposits

Q4: Which kind of deposits does ***drift*** normally refer to

A	B	C	D
Lacustrine deposits	Glacial deposits	Aeolian soil deposits	Alluvial deposits

Q5: Which kinds of soil do landslides normally belong to?

A	B	C	D
Lacustrine deposit	Gravity transported soil	Glacial deposit	Alluvial deposit

Q6: Which kinds of soil does sand dune shown in Fig. 2.5 belong to?

A	B	C	D
Lacustrine deposit	Alluvial deposit	Aeolian deposit	Glacial deposit

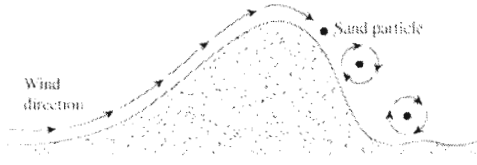


Figure 2.5 Sand dune

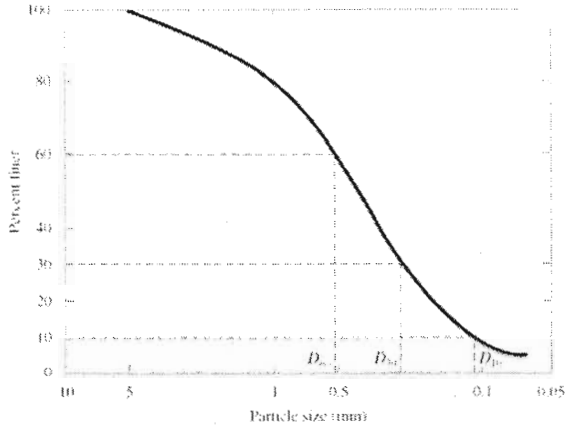
Q7: This kind of soil is usually found in low-lying area with water table is near or above ground surface? It has a high moisture content ranging from 200 to 300 %, a highly compressibility and a large secondary consolidation settlement.

A	B	C	D
Chemical weathering soil	Glacial deposits	Organic soil	Residual soil

Q8: Which one is not the soil classification systems commonly used in practice?

A	B	C	D
Unified System	AASHTO	USDA	MIT

Q9-11: Related to the figure on the right



Q9: What is the size of D_{30}, the diameter corresponding to 30 % finer?

A	B	C	D
0.24	0.39	0.45	0.08

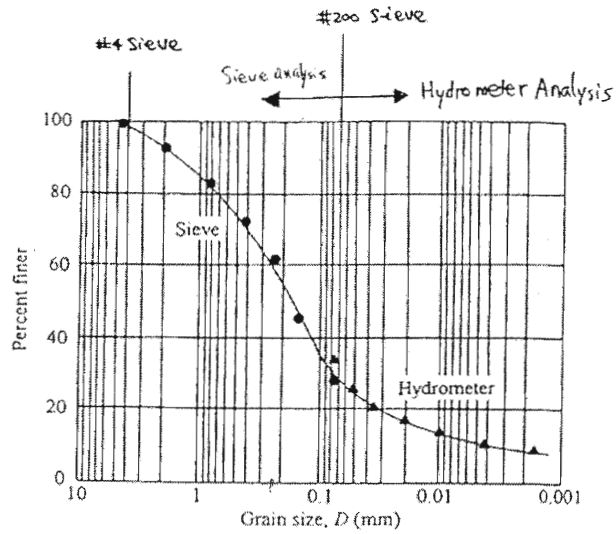
Q10: Which number is the closest one to the uniformity coefficient $Cu=D_{60}/D_{10}$ of the soil?

A	B	C	D
2.2	3.0	4.0	5.0

Q11: What is closest one to the coefficient of gradation ($Cc=D_{30}^2/[D_{10}D_{60}]$)of the soil?

A	B	C	D
3.8	2.8	1.0	2.4

Q12-14: Related to the figure on the right



Q12: What is the size of D_{60}, the diameter corresponding to 60 % finer?

A	B	C	D
0.23	0.31	0.05	0.48

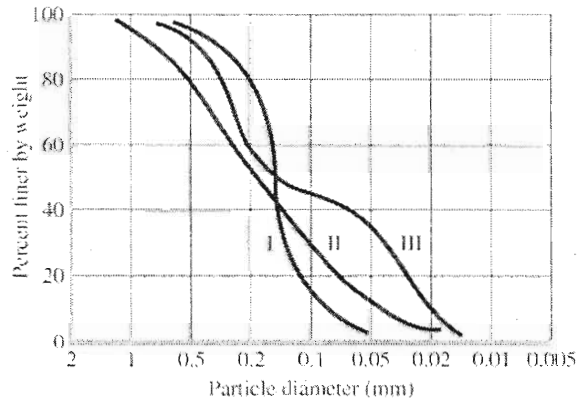
Q13: Which number is the closest one to the uniformity coefficient $Cu=D_{60}/D_{10}$ of the soil?

A	B	C	D
6	20	40	50

Q14: What is closest one to the coefficient of gradation ($Cc=D_{30}^2/[D_{10}D_{60}]$)of the soil?

A	B	C	D
1.8	2.8	3.8	6.4

Q15-17: Related to figure on the right



Q15: Which curve represents a well-graded soil?

A	B	C	D
I	II	III	I&II

Q16: Which curve represents a poorly-graded soil?

A	B	C	D
I	II	III	I&II

Q17: Which curve represents a gap-graded soil?

A	B	C	D
I	II	III	I&II

Q18-22: A *moisture* soil block has these values: volume V=7.08x10^{-3} m^3, mass m=13.95 kg, moisture content w=10.0 %, and specific gravity, Gs=2.66

Q18: What is the bulk unit weight, γ_B? (Unit: kN/m^3)

A	B	C	D
1.97	19.33	17.57	14.95

Q19: What is the void ratio of this soil, e?

A	B	C	D
0.35	0.26	0.48	0.41

Q20: What is the saturation degree S (%)?

A	B	C	D
76	42	55	50

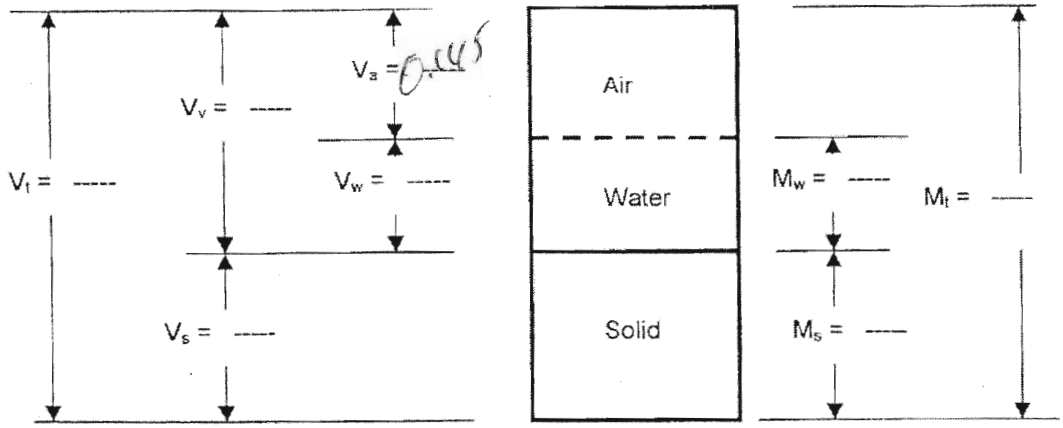
Q21: Which is the volume occupied by water, Vw? (Unit: x10^{-3}m^3)

A	B	C	D
1.268	1.395	2.312	1.044

Q22: What is the mass of soil block when it is fully saturated? (Unit: kg)

A	B	C	D
13.95	16.22	15.22	14.99

Q23-28: A 1 m^3 sample of moist soil block weighs 2000 kg. The water content is w=10.0 %. Assume specific gravity of soil particle Gs=2.70. Answer the following questions:



Q23: What is the bulk unit weight, γ_B? (Unit: kN/m^3)

A	B	C	D
12.8	19.6	17.6	20.0

Q24: Which is the volume occupied by water, Vw? (Unit: m^3)

A	B	C	D
0.268	0.295	0.112	0.182

Q25: What is the void ratio of this soil, e?

A	B	C	D
0.350	0.259	0.485	0.405

Q26: What is the saturation degree S (%)?

A	B	C	D
76	40	56	51

Q27: What is the mass of soil block when it is fully saturated? (Unit: kg)

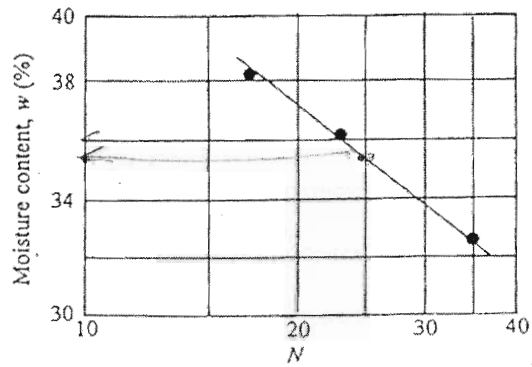
A	B	C	D
1895	2012	2280	2145

Q28: What is the dry unit weight of this soil block assumed volume is constant when it is dry? (Unit: kN/m^3)

A	B	C	D
1818	2000	1783	1982

Q29: The test data is shown in the figure, what is the liquid limit of this soil?

A	B	C	D
38.2	36.2	35.5	32.5



Q30: Mass of wet soil in drying dish= 462 g, After drying at 110°C, sample and dish mass = 364 g , The dish mass alone = 39 g. Determine the water content of soil? (%)

A	B	C	D
23.2	21.2	30.2	34.5

Q31: A layer of clay has a plastic limit of 40 and a liquid limit of 75. What is the plasticity index?

A	B	C	D
40	35	75	32.5

Q32-33: For a given sandy soil, e_{max}=0.75, e_{min}=0.46, and Gs=2.68.

Q32: What is the void ratio of soil when Relative Density Dr=78% and water content w=9%?

A	B	C	D
0.65	0.56	0.52	0.48

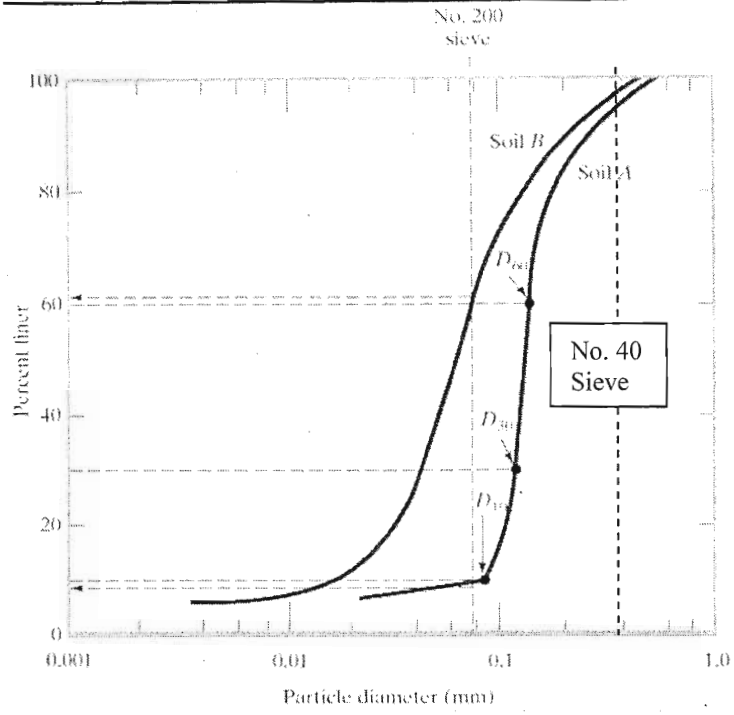
Q33: What is the moist unit weight when Dr=78% and w=9%?(kN/m^3)

A	B	C	D
16.5	17.6	18.2	18.8

Q34-41: The particle-size distributions of two soils are given in the figure below. The liquid and plastic limits of the minus No. 40 fraction of the soils are as follows:

Site	Soil A	Soil B
Liquid limit	30	26
Plastic limit	22	20

Classify both soils using the AASHTO system.



Q34-38: For SOIL A using AASHTO

Q34: What is the percentage of total sample passing sieve No. 200 for Soil A?

A	B	C	D
61	30	12	8

Q35: Based on the sample passing sieve No. 200, we can **exclude** this classification.

A	B	C	D
A-1	A-2	A-3	A-4

Q36: What is the Plasticity Index (PI) of Soil A?

A	B	C	D
30	22	12	8

Q37: What is the AASHTO Classification (without GI)of Soil A?

A	B	C	D
A-1-a	A-3	A-2-4	A-2-5

Q38: What is the *Group Index (GI)* of **Soil A**?

A	B	C	D
-4	0	2	3

Q39-41: For SOIL B using AASHTO

Q39: Based on the percentage finer than sieve No. 200, we can exclude this classification

A	B	C	D
A-3	A-4	A-5	A-6

Q40: What is the AASHTO Classification of Soil B?

A	B	C	D
A-3	A-4	A-5	A-6

Q41: What is the *Group Index* (GI) of Soil B?

A	B	C	D
0	1	2	3

Q42-50: Classify both soils in Q34-41 using the Unified Soil Classification System.

Q42-44: For SOIL A using USCS

Q42: What is the type of Soil A?

A	B	C	D
Gravels	Sands	Silts and Clays	Organic Soils

Q43: What is the Cc and Cu of Soil A?

A	B	C	D
C_u>6 &C_c>1	C_c<6 & C_u>1	C_c>6 & C_u<1	C_c<6 & Cu<1

Q44: What is the USCS soil symbol for Soil A?

A	B	C	D
SP	SC	SP-SC	SW

Q45-46: For SOIL B using USCS

Q45: What is the location of Soil B in the plasticity chart?

A	B	C	D
Fall within hatched area	Above U-line	On U-line	Below A-line

Q46: What is the USCS soil symbol for Soil B?

A	B	C	D
CL	ML	OL	CL-ML

Q47-50: For two given soils shown in Table below. Classify them using USCS

Soil	Finer than No.4 (%)	Finer than No.200 (%)	LL	PI
D	99	76	60	32
E	92	48	30	8

Q47: What is the type of Soil D?

A	B	C	D
Gravels	Sands	Silts and Clays	Organic Soils

Q48: What is the USCS soil symbol for Soil D?

A	B	C	D
CL	ML	OL	CH

Q49: What is the type of Soil E?

A	B	C	D
Gravels	Sands	Silts and Clays	Organic Soils

Q50: What is the USCS soil symbol for Soil E?

A	B	C	D
GM	GC	SM	SC

Table 3.5 Unified Soil Classification System (Based on Material Passing 75-mm Sieve)

Criteria for Assigning Group Symbols				Group Symbol
Coarse-Grained Soils More than 50% of retained on No. 200 sieve	**Gravels** More than 50% of coarse fraction retained on No. 4 sieve	Clean Gravels Less than 5% fines[a]	$C_u \geq 4$ and $1 \leq C_c \leq 3$[c] $C_u < 4$ and/or $1 > C_c > 3$[c]	GW GP
		Gravels with Fines More than 12% fines[d,e]	*PI* < 4 or plots below "A" line (Figure 3.20) *PI* > 7 and plots on or above "A" line (Figure 3.20)	GM GC
	Sands 50% or more of coarse fraction passes No. 4 sieve	Clean Sands Less than 5% fines[b]	$C_u \geq 6$ and $1 \leq C_c \leq 3$[c] $C_u < 6$ and/or $1 > C_c > 3$[c]	SW SP
		Sands with Fines More than 12% fines[b,e]	*PI* < 4 or plots below "A" line (Figure 3.20) *PI* > 7 and plots on or above "A" line (Figure 3.20)	SM SC
Fine-Grained Soils 50% or more passes No. 200 sieve	**Silts and Clays** Liquid limit less than 50	Inorganic	*PI* > 7 and plots on or above "A" line (Figure 3.20)[f] *PI* < 4 or plots below "A" line (Figure 3.20)[f]	CL ML
		Organic	$\frac{\text{Liquid limit - oven dried}}{\text{Liquid limit - not dried}} < 0.75$; see Figure 3.20: OL zone	OL
	Silts and Clays Liquid limit 50 or more	Inorganic	*PI* plots on or above "A" line (Figure 3.20) *PI* plots below "A" line (Figure 3.20)	CH MH
		Organic	$\frac{\text{Liquid limit - oven dried}}{\text{Liquid limit - not dried}} < 0.75$; see Figure 3.20: OH zone	OH
Highly Organic Soils	Primarily organic matter, dark in color, and organic odor			Pt

[a] Gravels with 5 to 12% fine require dual symbols: GW-GM, GW-GC, GP-GM, GP-GC.
[b] Sands with 5 to 12% fines require dual symbols: SW-SM, SW-SC, SP-SM, SP-SC.
[c] $C_u = \frac{D_{60}}{D_{10}}$; $C_c = \frac{(D_{30})^2}{D_{60} \times D_{10}}$
[d] If $4 \leq PI \leq 7$ and plots in the hatched area in Figure 3.16, use dual symbol GC-GM or SC-SM.
[e] If $4 \leq PI \leq 7$ and plots in the hatched area in Figure 3.16, use dual symbol CL-ML.

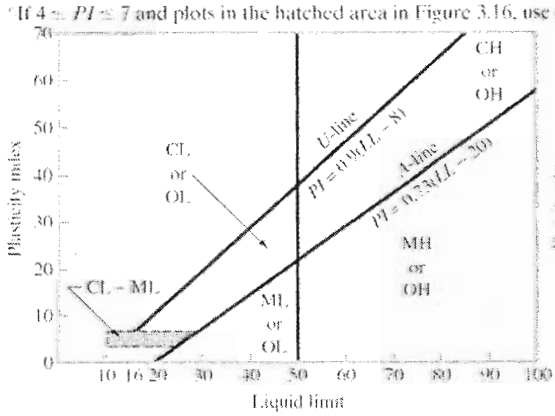


Figure 3.20 Plasticity chart

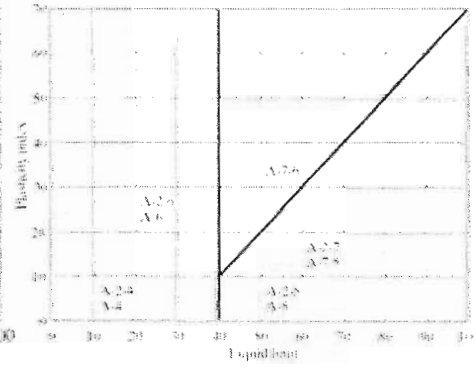


Figure 3.19 Range of liquid limit and plasticity index for soils in groups A-2, A-4, A-5, A-6, and A-7

Table 3.4 Classification of highway subgrade materials

General classification	Granular materials (35% or less of total sample passing No. 200)						
	A-1			*A-2*			
Group classification	*A-1-a*	*A-1-b*	*A-3*	*A-2-4*	*A-2-5*	*A-2-6*	*A-2-7*
Sieve analysis (percent passing)							
No. 10	50 max.						
No. 40	30 max.	50 max.	51 min.				
No. 200	15 max.	25 max.	10 max.	35 max.	35 max.	35 max.	35 max.
Characteristics of fraction passing No. 40							
Liquid limit				40 max.	41 min.	40 max.	41 min.
Plasticity index	6 max.		NP	10 max.	10 max.	11 min.	11 min.
Usual types of significant constituent materials	Stone fragments, gravel, and sand		Fine sand	Silty or clayey gravel and sand			
General subgrade rating	Excellent to good						

General classification	Silt-clay materials (more than 35% of total sample passing No. 200)			
Group classification	*A-4*	*A-5*	*A-6*	*A-7* *A-7-5** *A-7-6*†
Sieve analysis (percent passing)				
No. 10				
No. 40				
No. 200	36 min.	36 min.	36 min.	36 min.
Characteristics of fraction passing No. 40				
Liquid limit	40 max.	41 min.	40 max.	41 min.
Plasticity index	10 max.	10 max.	11 min.	11 min.
Usual types of significant constituent materials	Silty soils		Clayey soils	
General subgrade rating	Fair to poor			

*For A-7-5, $PI \leq LL - 30$
†For A-7-6, $PI > LL - 30$