The homework questions in this packet are similar to the ones found on the actual written exam. The attached charts are given on the written exam but no formulas will be given. Answers to the problems may be found on the last pages of the packet so that you may check your work.

1. Determine the number of pounds in 12,000.0 grams to the nearest 0.001 lb.

2. Determine the number of grams in 7.642 pounds to the nearest 0.1 g.

3. Using the data below, calculate and **report** the moisture content of the sample.

Tare Weight	152.4 g
Tare + Wet Soil	1168.5 g
Tare + Dry Soil	1003.0 g

MC = ☐

4. Using the data below, calculate and **report** the moisture content of the sample.

Tare Weight	0.750 lb
Tare + Wet Soil	7.733 lb
Tare + Dry Soil	7.268 lb

MC = ☐

5. Using the data below, calculate and **report** the plastic limit of the soil.

Tare Weight	13.67 g	
Tare + Wet Soil	32.52 g	**PL =**
Tare + Dry Soil	29.88 g	

6. Calculate and **report** the plastic limit of the soil.

Tare Weight	13.44 g	
Tare + Wet Soil	25.60 g	**PL =**
Tare + Dry Soil	23.35 g	

7. A one-point liquid limit test was conducted. Determine the LL of the soil if the moisture content of the soil is 32.3 % at 27 blows. *(Hint: see the attached k-factor chart)*

8. A one-point liquid limit test was conducted. Determine the LL of the soil if the moisture content of the soil is 27.8 % at 22 blows. *(Hint: see the attached k-factor chart)*

9. Determine the **reported** liquid limit of the soil from a 1-point test.

Tare Weight	13.00 g
Tare + Wet Soil	28.51 g
Tare + Dry Soil	27.22 g
# Blows	25

LL = ☐

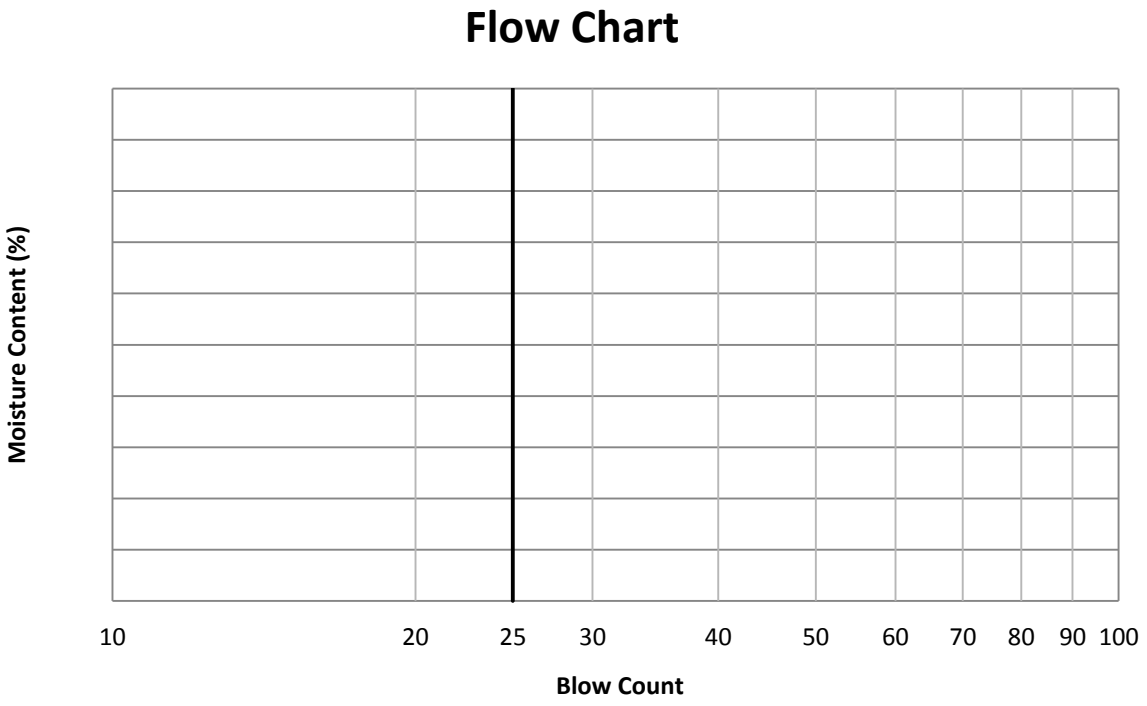
10. Determine the **reported** liquid limit of the soil from a 1-point test.

Tare Weight	14.25 g
Tare + Wet Soil	25.39 g
Tare + Dry Soil	23.03 g
# Blows	24

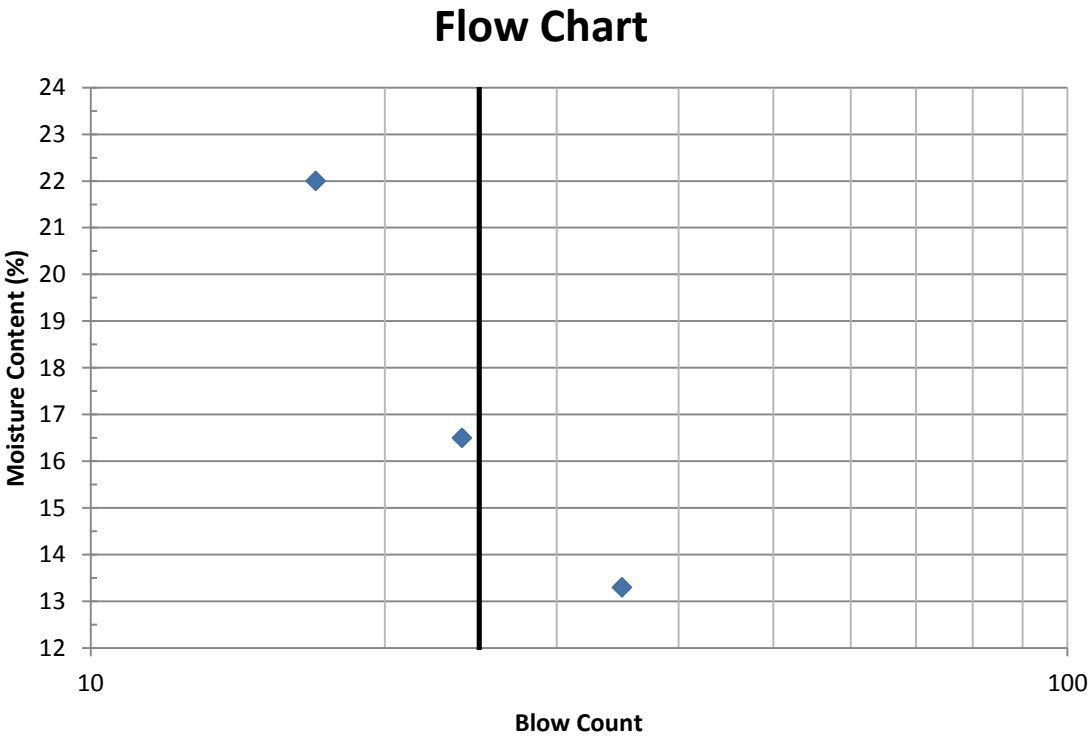
LL = ☐

11. You have generated the following data from a three-point liquid limit test. Plot the necessary data and determine the liquid limit of the soil.

Blows to ½" closure	**17**	**23**	**32**
Tare + Wet Soil	26.50 g	26.21 g	25.99 g
Tare + Dry Soil	24.35 g	23.48 g	23.80 g
Tare Weight	18.31 g	15.68 g	17.05 g
Moisture Content (%)			



12. Based on the flow chart below, determine the **reported** liquid limit of the soil.



13. Given the following information, **report** the plasticity index (PI).

	LL	PL	PI
a.	32	17	
b.	10	Can Not Be Determined	
c.	25	11	
d.	Can Not Be Determined	3	
e.	23	24	
f.	28	9	
g.	8	8	

14. The following data was generated by conducting liquid limit and plastic limit tests. **Report** the calculated moisture contents, liquid limit, plastic limit, and the plasticity index of the soil.

Liquid Limit

Blows to ½" closure	24	
Tare + Wet Soil	32.61 g	**MC =**
Tare + Dry Soil	28.20 g	
Tare Weight	15.45 g	**LL =**

Plastic Limit & PI

Tare + Wet Soil	30.58 g	**MC =**
Tare + Dry Soil	28.62 g	**PL =**
Tare Weight	16.52 g	**PI =**

15. Classify the following soils as clay, silt, or granular based on the percent passing the # 200 sieve and plasticity index. *(Hint: see attached Table 1)*

% Passing # 200	PI	Granular	Silt	Clay
38	9	◯	◯	◯
15	6	◯	◯	◯
42	16	◯	◯	◯

16. Find the dry weight of soil if a soil sample that contains 7.6% moisture weighs 2752.1 g.

17. A soil sample weighs 4488.0 grams and contains 10.3 % moisture. Find the dry weight of soil.

18. Find the change (Δ) in moisture content needed if a soil contains 5.6 % moisture and a moisture content of 15.7 % is desired.

19. Find the change (Δ) in moisture content needed if a soil contains 3.3 % moisture and a moisture content of 11.0 % is desired.

20. You have 2368.4 g of air-dried sample that is to be used in a proctor compaction test. The air-dried moisture content is 5.3 %. In order to start the test proctor test, you wish to create a sample that has a moisture content of 13.5 %. How many milliliters of water should you add to the sample?

21. You have 5622.0 g of air-dried sample that is to be used in a proctor compaction test. The air-dried moisture content is 1.8 %. In order to start the test proctor test, you wish to create a sample that has a moisture content of 6.4 %. How many milliliters of water should you add to the sample?

22. A **dry** sample weight of 2673.2 g was determined for a proctor point. The desired moisture interval is 2.0 %. Determine how many milliliters of water would be needed for each 2.0 % increase in moisture content.

23. A soil sample for a proctor point has a moisture content of 7.5 % and **wet** sample weight of 2570.0 grams. If the desired moisture interval is 1.0 %. Determine how many milliliters of water would be needed for each 1.0 % increase in moisture content.

24. Determine the **reported** % moisture for each of the results obtained using a speedy moisture tester. Assume a standard sample size of 20 g. *(Hint: See attached Speedy Moisture Conversion Chart)*

Sample Size	20 g	Reported % Moisture
Dial Reading	12.5 %	

Sample Size	40 g	Reported % Moisture
Dial Reading	5.2 %	

Sample Size	10 g	Reported % Moisture
Dial Reading	13.7 %	

Sample Size	40 g	Reported % Moisture
Dial Reading	4.6 %	

Sample Size	10 g	Reported % Moisture
Dial Reading	9.8 %	

Sample Size	20 g	Reported % Moisture
Dial Reading	8.1 %	

25. List what sieve is used to process soil for each proctor.

AASHTO	Method	Sieve
T 99	A	
T 99	C	
T 180	D	

26. List what size mold is used for each proctor.

AASHTO	Method	Mold Size
T 99	A	
T 99	C	
T 180	D	

27. Based on the following sieve analysis, determine which proctor and correction (ARDOT, AASHTO, or None) would be required for an ARDOT construction project for this soil.

ARDOT Specifications	
% Retained on # 4	Proctor
10% Maximum	T 99 A
11 % - 30 %	T 99 C
31 % Minimum	T 180 D

Sieve Analysis	
Sieve	% Passing
2”	100
¾”	100
# 4	73
# 200	30

Proctor _____ Correction _____

28. Based on the following sieve analysis, determine which proctor and correction (ARDOT, AASHTO, or None) would be required for an ARDOT construction project for this soil.

ARDOT Specifications	
% Retained on # 4	Proctor
10% Maximum	T 99 A
11 % - 30 %	T 99 C
31 % Minimum	T 180 D

Sieve Analysis	
Sieve	% Passing
2”	100
¾”	100
# 4	92
# 200	65

Proctor _____ Correction _____

29. Based on the following soil sieve analyses, choose which proctor, method, and type of adjustment (if any), would be required to accurately determine the maximum dry density and optimum moisture content of the soil for an ARDOT project.

a.

Sieve	% Passing
2"	100
¾"	85
# 4	58
# 200	10

Proctor	
Adjustment	

b.

Sieve	% Passing
2"	100
¾"	100
# 4	97
# 200	73

Proctor	
Adjustment	

30. Determine the volume of the mold to the nearest 0.0001 ft^3 using the following information. *(Hint: see attached Water Density chart)*

Empty Mold Weight	9.825 lb.
Mold Filled w/Water	11.900 lb.
Temperature of Water	70 °F

31. Determine the volume of the mold to the nearest 0.0001 ft^3 using the following information. *(Hint: see attached Water Density chart)*

Empty Mold Weight	15.244 lb.
Mold Filled w/Water	19.936 lb.
Temperature of Water	74 °F

32. Determine the wet density (lb/ft^3) and dry density (lb/ft^3) of the soil from the laboratory data shown below.

Mold Volume	0.0333 ft^3	**WD =**
Empty Mold Weight	9.775 lb.	
Mold + Soil Weight	13.953 lb.	**DD =**
Moisture Content	14.2 %	

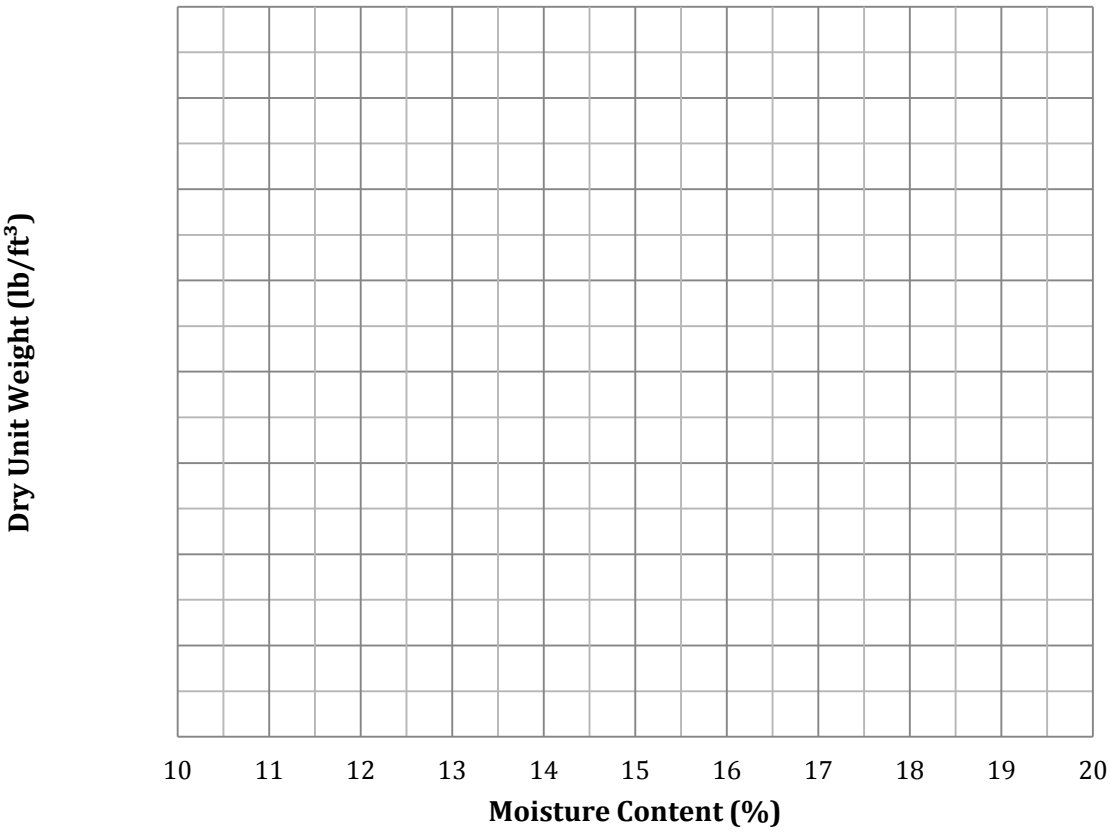
33. Determine the wet density (lb/ft^3) and dry density (lb/ft^3) of the soil from the laboratory data shown below.

Mold Volume	0.0752 ft^3	**WD =**
Empty Mold Weight	6446.5 g	
Mold + Soil Weight	11,286.3 g	**DD =**
Moisture Content	5.2 %	

34. You have conducted a "standard proctor" test using AASHTO T 99 – Method A. Using the data below, construct the moisture-density curve and determine the maximum dry density and optimum moisture content of the soil.

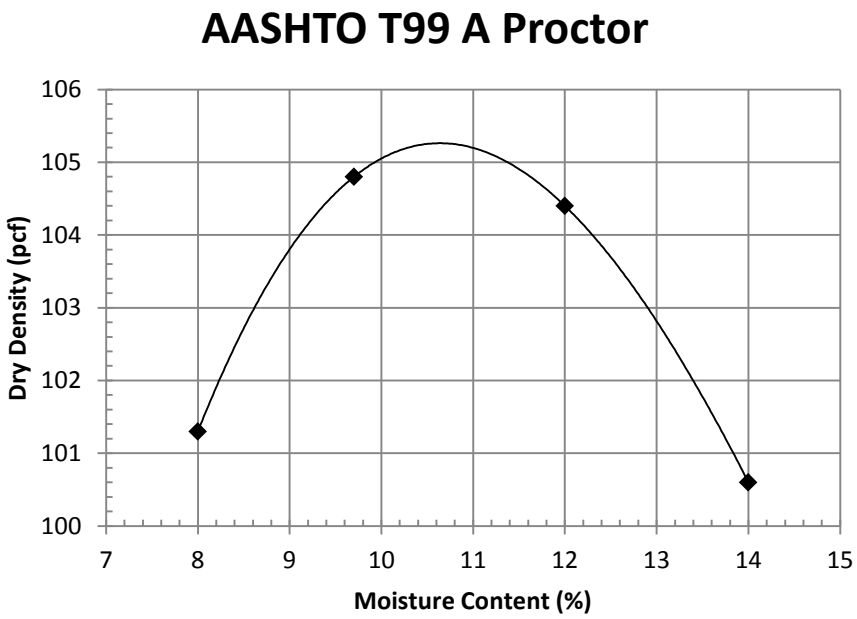
Note: Volume of Mold = 0.0330 ft^3

Compacted Wet Soil Weight (lb)	Moisture Content (%)	Wet Density (lb/ft^3)	Dry Density (lb/ft^3)
4.117	12		
4.413	14		
4.446	16		
4.305	18		



Maximum Dry Density (pcf) _____ Optimum MC (%) _____

35. An AASHTO T 99 Method A proctor is shown below along with laboratory test data for the soil. Determine the corrected maximum dry density and moisture content needed for field density testing. *Note: A worksheet is provided on the next page.*



Field Sieve Analysis

Sieve	% Passing
2 in.	100
3/4 in.	100
# 4	90.2
# 40	78.4
# 200	50.5

Gsb 2.568

Max. Dry Density		Optimum MC	
Corrected Max. Dry Density (pcf)		Corrected Optimum MC (%)	

Correction of Maximum Dry Density and Optimum Moisture for Oversized Particles
AASHTO T 99 and AASHTO T 180 Annex

P_c	Percent Coarse Material (0.1)	
P_F	Percent Fine Material (0.1)	
MC_C	Moisture Content of Coarse Material (0.1)	
MC_F	Moisture Content of Fine Material (0.1)	
MC_T	Corr. Total Moisture Content (0.1) $MC_T = \frac{[(MC_F \cdot P_F) + (MC_C \cdot P_C)]}{100}$	
D_F	Dry Density of Fine Material (0.1)	
Gsb	Bulk SpG of Coarse Material (0.001)	
k	Unit Weight of Coarse Material (0.001) k = Gsb x 62.4	
D_d	Corr. Total Dry Density (0.1) $D_d = \frac{(100\ x\ D_F\ x\ k)}{[(D_F\ x\ P_C) + (k\ x\ P_F)]}$	

36. Determine if the standard counts pass or fail. Prove your answer.

Log Book			New Standard Count	
Date	MS	DS	MS	DS
10/12/19	620	2193	638	2200
10/16/19	626	2229		
10/18/19	629	2210		
10/22/19	645	2240		

Does the moisture standard pass or fail? _____

Does the density standard pass or fail? _____

37. Determine if the standard counts pass or fail. Prove your answer.

Log Book			New Standard Count	
Date	MS	DS	MS	DS
4/11/20	648	2367	643	2328
4/12/20	662	2365		
4/14/20	650	2347		
4/16/20	648	2361		

Does the moisture standard pass or fail? _____

Does the density standard pass or fail? _____

38. The results of a field density test are shown below along with the soil's proctor data. Determine the reported % compaction for the test location.

Proctor		**Gauge**	
Max. Dry Density	119.3 pcf	WD	131.6 pcf
Opt. Moisture	12.1 %	DD	117.1 pcf
		% Moisture	12.4 %

39. The results of a field density test are shown below along with the soil's proctor data. Determine the % compaction for the test location. Report your answer to the nearest 0.1 %.

Proctor		**Gauge**	
Max. Dry Density	136.1 pcf	WD	145.6 pcf
Opt. Moisture	6.7 %	DD	137.1 pcf
		% Moisture	6.2 %

40. Based on the following information, determine the % compaction for the field density test conducted on an ARDOT job site. Report your answer to the nearest 0.1 %.

Field Soil Sieve Analysis	
Sieve	**% Passing**
2 in.	100.0 %
3/4 in.	100.0 %
# 4	93.5 %
# 200	41.1 %
Gsb	2.600

Proctor – AASHTO T 99 A	
Max. Dry Density (pcf)	108.1
Opt. Moisture Content	13.2 %
Corrected Values	
Max. Dry Density (pcf)	110.5
Opt. Moisture Content	12.5 %

Gauge Field Test	
WD (pcf)	116.0
DD (pcf)	104.1
% Moisture	11.4 %

This page left blank intentionally

Charts & Tables

# of Blows	k Factor
22	0.985
23	0.990
24	0.995
25	1.000
26	1.005
27	1.009
28	1.014

Table 1-Classification of Soils and Soil-Aggregate Mixtures

General Classification	Granular Materials (35 Percent or Less Passing 75µm)			Silt-Clay Materials (More Than 35 Percent Passing 75 µm)			
Group Classification	A-1	A-3	A-2	A-4	A-5	A-6	A-7
Sieve analysis, percent passing:							
2.0 mm (No. 10)	---	---	---	---	---	---	---
0.425 mm (No. 40)	50 max	51 min	---	---	---	---	---
75µm (No. 200)	25 max	10 max	35 max	36 min	36 min	36 min	36 min
Characteristics of fraction passing 0.425 mm (No. 40)							
Liquid Limit	---			40 max	41 min	40 max	41 min
Plasticity Index	6 max	Nonplastic (NP)		10 max	10 max	11 min	11 min
General rating as subgrade	Excellent to Good			Fair to Poor			

SPEEDY MOISTURE TESTER CONVERSION CHART

%	0	.1	.2	.3	.4	.5	.6	.7	.8	.9
1	1.0	1.1	1.2	1.3	1.4	1.6	1.7	1.8	1.9	2.0
2	2.1	2.2	2.3	2.4	2.5	2.7	2.8	2.9	3.0	3.1
3	3.2	3.3	3.4	3.5	3.6	3.8	3.9	4.0	4.1	4.2
4	4.3	4.4	4.5	4.6	4.7	4.9	5.0	5.1	5.2	5.3
5	5.4	5.5	5.6	5.7	5.8	6.0	6.1	6.2	6.3	6.4
6	6.5	6.6	6.7	6.8	6.9	7.1	7.2	7.3	7.4	7.5
7	7.6	7.7	7.8	7.9	8.0	8.2	8.3	8.4	8.5	8.6
8	8.7	8.8	8.9	9.0	9.1	9.3	9.4	9.5	9.6	9.7
9	9.8	9.9	10.0	10.1	10.3	10.4	10.5	10.6	10.8	10.9
10	11.0	11.1	11.3	11.4	11.6	11.7	11.8	11.9	12.1	12.2
11	12.3	12.4	12.6	12.7	12.9	13.0	13.1	13.2	13.4	13.5
12	13.6	13.7	13.8	14.0	14.1	14.2	14.3	14.5	14.6	14.8
13	14.9	15.0	15.2	15.3	15.5	15.6	15.7	15.9	16.0	16.2
14	16.3	16.4	16.5	16.7	16.8	16.9	17.0	17.2	17.3	17.5
15	17.6	17.7	17.9	18.0	18.2	18.3	18.4	18.6	18.7	18.9
16	19.0	19.1	19.3	19.4	19.6	19.7	19.8	20.0	20.1	20.3
17	20.4	20.6	20.7	20.9	21.0	21.2	21.3	21.5	21.6	21.8
18	21.9	22.1	22.2	22.4	22.6	22.7	22.8	23.0	23.1	23.3
19	23.4	23.6	23.7	23.9	24.0	24.2	24.4	24.5	24.7	24.8
20	25.0	25.2	25.3	25.6	25.8	25.8	25.9	26.1	26.2	26.4
21	26.5	26.7	26.9	27.0	27.2	27.4	27.6	27.7	27.9	28.0
22	28.2	28.4	28.5	28.7	28.8	29.0	29.2	29.3	29.5	29.6
23	29.8	30.0	30.2	30.3	30.5	30.7	30.9	31.0	31.2	31.3
24	31.5	31.7	31.9	32.0	32.2	32.4	32.6	32.8	32.9	33.1
25	33.3	33.5	33.7	33.8	34.0	34.2	34.4	34.6	34.9	35.1
26	35.3	35.4	35.6	35.7	35.9	36.0	36.2	36.4	36.5	36.7
27	36.9	37.1	37.3	37.5	37.7	37.9	38.1	38.3	38.4	38.6

Density of Water (lb/ft^3)				
° F	**lb/ft^3**		° F	lb/ft^3
65	62.336		74	62.269
66	62.329		75	62.261
67	62.322		76	62.252
68	62.315		77	62.243
69	62.308		78	62.234
70	62.301		79	62.225
71	62.293		80	62.216
72	62.285		81	62.206
73	62.277		82	62.196

Answers

1. 26.455 lb

2. 3466.4 g

3. 19.5 %

4. 7.1 %

5. 16

6. 23

7. 33

8. 27

9. 9

10. 27

11. 34

12. 17

13. a. 15
b. NP
c. 14
d. NP
e. NP
f. 19
g. NP

14. MC = 34.6 LL = 34
MC = 16.2 PL = 16
PI = 18

15. Silt
Granular
Clay

16. 2557.7 g

17. 4068.9 g

18. 10.1 %

19. 7.7 %

20. 184 mL

21. 254 mL

22. 53 mL

23. 24 mL

24. 14.2 %
2.8 %
37.7 %
2.4 %
24.4 %
8.8 %

25. # 4
¾ inch
¾ inch

26. 4 inch
4 inch
6 inch

27. T 99 C – No Correction

28. T 99 A – AASHTO Correction

29. a. T 180 D – ARDOT Correction
b. T 99 A – No Correction

Answers

30. 0.0333 ft^3

31. 0.0754 ft^3

32. WD = 125.465 lb/ft^3

DD = 109.9 lb/ft^3

33. WD = 141.885 lb/ft^3

DD = 134.9 lb/ft^3

34.

WD	DD
124.8	111.4
133.7	117.3
134.7	116.1
130.5	110.6

Max. DD = 117.6 lb/ft^3

Opt. MC = 14.6 %

35. Max DD = 105.2 lb/ft^3

Opt. MC = 10.6 %

Corr. Max DD = 108.9 lb/ft^3

Corr. Opt. MC = 9.8 %

36. MS = Pass

DS = Pass

37. MS = Pass

DS = Fail

38. 98.2 %

39. 100.7 %

40. 94.2 %