cttp
Center for Training
Transportation Professional

The homework questions in this packet are similar to the ones found on the actual written exam. The attached formula sheet may be used during testing. Charts and tables that are required will be provided for the exam. Answers to the problems are given on the last page of the packet so that you may check your work.

1. If you have 12.682 lbs of material, how many grams of material do you have? *Report your answer to the nearest 0.1 g.*

2. 15,000 grams of material is how many kgs of material? *Report your answer to the nearest 1 kg.*

3. If the NMAS of an aggregate stockpile is 1 inch, determine the minimum mass (weight) required under AASHTO R 90 to be collected for a field sample.

Table 1—Recommended Sample Sizes

Nominal Maximum Size		Minimum Mass	
mm	(in.)	kg	(lb)
90	(3 1/2)	175	(385)
75	(3)	150	(330)
63	(2 1/2)	125	(275)
50	(2)	100	(220)
37.5	(1 1/2)	75	(165)
25.0	(1)	50	(110)
19.0	(3/4)	25	(55)
12.5	(1/2)	15	(35)
9.5	(3/8)	10	(25)
4.75	(No. 4)	10	(25)
2.36	(No. 8)	10	(25)

4. You are required by specifications to determine the decant value of fine aggregate for concrete. The aggregate has a NMAS size of No. 4. Determine the minimum sample mass (grams) required.

Nominal Maximum Size	Minimum Mass, g
4.75 mm (No. 4) or smaller	300
9.5 mm (3/8 in.)	1000
19.0 mm (3/4 in.)	2500
37.5 mm (1 1/2 in.) or larger	5000

5. You are asked to complete a sieve analysis under AASHTO T 27. If the nominal maximum aggregate size is 2 inches, what is the minimum required mass (grams) of the test sample?

Nominal Maximum Size Square Openings, mm (in.)	Minimum Mass of Test Sample, kg (lb)
9.5 (3/8)	1 (2)
12.5 (1/2)	2 (4)
19.0 (3/4)	5 (11)
25.0 (1)	10 (22)
37.5 (1 1/2)	15 (33)
50 (2)	20 (44)
63 (2 1/2)	35 (77)
75 (3)	60 (130)
90 (3 1/2)	100 (220)
100 (4)	150 (330)
125 (5)	300 (660)

6. You are asked to determine the coarse aggregate specific gravity of a sample under AASHTO T 85. Determine the minimum test sample size (grams) required if the NMAS of the sample is 3/4 inch.

Nominal Maximum Size, mm (in.)	Minimum Mass of Test Sample, kg (lb)
12.5 (1/2) or less	2 (4.4)
19.0 (3/4)	3 (6.6)
25.0 (1)	4 (8.8)
37.5 (1 1/2)	5 (11)
50 (2)	8 (18)
63 (2 1/2)	12 (26)
75 (3)	18 (40)
90 (3 1/2)	25 (55)
100 (4)	40 (88)
112 (4 1/2)	50 (110)
125 (5)	75 (165)
150 (6)	125 (276)

7. Determine the number of times a 28,000 g field sample can be split to produce a test sample of at least 1700 g.

8. For the size of aggregate and moisture condition of each, select the appropriate methods of reduction. Choose all that apply.

Aggregate	Moisture	Split	Quarter	Sector	Mini-Stockpile
Fine	≤ SSD	◯	◯	◯	◯
Fine	> SSD	◯	◯	◯	◯
Mixed	≤ SSD	◯	◯	◯	◯
Mixed	> SSD	◯	◯	◯	◯
Coarse	≤ SSD	◯	◯	◯	◯
Coarse	> SSD	◯	◯	◯	◯

9. Determine the **reported** % passing the # 200 sieve for a washed sample which had a dry weight before washing of 2568 g and an after wash dry weight of 2532 g.

10. Determine the **reported** % decant loss for a sample which had a dry weight before washing of 1300.0 g and an after wash dry weight of 1277.6 g.

11. Determine the AASHTO T 11 reported % passing the #200 for the following results:

6.37	
12.78	

10.62	
9.43	

12. Choose all of the applicable steps needed to **prepare** a sample for conducting a sieve analysis test.

◯ Process sample over # 40 sieve	◯ Wash sample to remove dust
◯ Air dry sample	◯ Process sample over # 4 sieve
◯ Immerse in water for 12 hours	◯ Mix and reduce field sample to testing size
◯ Oven dry sample	◯ Immerse in water for 15 – 19 hours
◯ Break apart clay lumps	◯ Collect a representative field sample
◯ Retain + #4 material for testing	◯ Dry sieve over # 200 to remove dust
◯ Retain - #4 material for testing	◯ Check dry weight against minimum mass

cttp
Center for Training
Transportation Professional

13. Given the following AASHTO T 27 sieve analysis data for an ARDOT base aggregate sample, calculate the reported % passing for each sieve.

Dry Weight of Sample 10782.8 g

After Wash Dry Weight of Sample 9800.0 g

Sieve	Wt. Retained	Cumulative Wt. Retained	% Retained	Calculated % Passing	Reported % Passing
1 1/2"	0.0				
1"	1878.3				
3/4"	1179.6				
3/8”	1555.5				
# 4	1455.7				
# 10	1107.1				
# 40	2072.2				
# 200	497.4				
Pan	45.3				

a) What is the MAS?

b) What is the NMAS?

c) Does this sample meet the minimum size requirements?

(Refer to AASHTO T 27 or problem # 5 chart)

d) Calculate the acceptance check.

e) Can these results be reported for acceptance?

f) Compute the dust ratio (DR) for the sample.

14. Given the following AASHTO T 27 sieve analysis data for a fine ARDOT concrete aggregate sample, answer the following questions:

Dry Weight of Sample 723.3 g

After Wash Dry Weight of Sample 718.0 g

Sieve	Cumulative Wt. Retained	% Retained	Calculated % Passing	Reported % Passing
1/2"	0.0	0.0	100.0	100
3/8"	0.0	0.0	100.0	100
# 4	0.0	0.0	100.0	100
# 8	106.5	14.7	85.3	85
# 16	276.3	38.2	61.8	62
# 30	439.0	60.7	39.3	39
# 50	600.4	83.0	17.0	17
# 100	701.6	97.0	3.0	3
# 200	712.6	98.5	1.5	1.5
Pan	715.3			

a) What is the MAS?

b) What is the NMAS?

c) Does this sample meet the minimum size requirements?

(Refer to AASHTO T 27 – Section 6.3)

Fine Aggregate—The size of the test sample of aggregate, after drying, shall be 300 g minimum.

d) Calculate the acceptance check.

e) Can these results be reported for acceptance?

f) Determine the decant value for the sample.

g) Calculate the fineness modulus (FM) for the sample

15. Choose all of the applicable steps needed to **prepare** a sample for determining moisture content.

◯ Process sample over # 40 sieve	◯ Wash sample to remove dust
◯ Air dry sample	◯ Process sample over # 4 sieve
◯ Immerse in water for 12 hours	◯ Mix and reduce field sample to testing size
◯ Oven dry sample	◯ Immerse in water for 15 – 19 hours
◯ Break apart clay lumps	◯ Collect a representative field sample
◯ Retain + #4 material for testing	◯ Dry sieve over # 200 to remove dust
◯ Retain - #4 material for testing	◯ Check wet weight against minimum mass

16. Determine the moisture content of the following sample:

Wet Weight	1600.6 g
Dry Weight	1542.5 g

17. Determine the moisture content of the following sample:

Tare Wt.	200.0 g
Wet Wt. + Tare	1060.8 g
Dry Weight + Tare	1025.4 g

18. Choose all of the applicable steps needed to **prepare** a sample for coarse aggregate specific gravity testing.

◯ Process sample over # 40 sieve	◯ Wash sample to remove dust
◯ Air dry sample	◯ Process sample over # 4 sieve
◯ Immerse in water for 12 hours	◯ Mix and reduce field sample to testing size
◯ Oven dry sample	◯ Immerse in water for 15 – 19 hours
◯ Break apart clay lumps	◯ Collect a representative field sample
◯ Retain + #4 material for testing	◯ Dry sieve over # 200 to remove dust
◯ Retain - #4 material for testing	◯ Check dry weight against minimum mass

19. Choose all of the applicable steps needed to **prepare** a sample for fine aggregate specific gravity testing.

◯ Process sample over # 40 sieve	◯ Wash sample to remove dust
◯ Air dry sample	◯ Process sample over # 4 sieve
◯ Immerse in water for 12 hours	◯ Mix and reduce field sample to testing size
◯ Oven dry sample	◯ Immerse in water for 15 – 19 hours
◯ Break apart clay lumps	◯ Collect a representative field sample
◯ Retain + #4 material for testing	◯ Dry sieve over # 200 to remove dust
◯ Retain - #4 material for testing	◯ Check dry weight against minimum mass

20. Calculate and report the specific gravities and absorption of the coarse aggregate sample.

SSD Weight	3075.2 g
Submerged Weight	1903.2 g
Dry Weight	3040.5 g

a) Apparent Specific Gravity _____

b) Bulk Specific Gravity _____

c) Bulk Specific Gravity SSD _____

d) % Absorption _____

21. Calculate and report the specific gravities and absorption of the coarse aggregate sample.

SSD Weight	2127.2 g
Submerged Weight	1335.3 g
Dry Weight	2110.0 g

a) Apparent Specific Gravity _____

b) Bulk Specific Gravity _____

c) Bulk Specific Gravity SSD _____

d) % Absorption _____

22. Using the fine aggregate specific gravity data collected below, calculate and report the specific gravities and absorption for the sample.

Wt. of Pyc + Water	1233.0 g
Wt. of SSD Specimen	502.1 g
Wt. of Pyc + Water + Specimen	1541.1 g
Wt. of Dry Specimen	495.8 g

a) Apparent Specific Gravity _____

b) Bulk Specific Gravity _____

c) Bulk Specific Gravity SSD _____

d) % Absorption _____

23. Using the fine aggregate specific gravity data collected below, calculate and report the specific gravities and absorption for the sample.

Wt. of Pyc + Water	1128.4 g
Wt. of SSD Specimen	500.9 g
Wt. of Pyc + Water + Specimen	1438.1 g
Wt. of Dry Specimen	492.3 g

a) Apparent Specific Gravity _____

b) Bulk Specific Gravity _____

c) Bulk Specific Gravity SSD _____

d) % Absorption _____

24. Given the following information, determine the combined Gsb and absorption of the aggregate blend proposed for an asphalt mix design.

Material	Blend %	Gsb	% Absorption
¾" Chip	23 %	2.691	0.8 %
1/2" Minus	40 %	2.588	1.5 %
Man. Sand	25 %	2.610	1.3 %
River Sand	12 %	2.700	0.6 %

a) Gsb_{comb} _____

b) % Abs_{comb} _____

25. Given the following sieve analysis, determine the combined **Gsb_{ssd}** and absorption of the sample.

Sieve	% Passing
3/4"	100
1/2"	82
3/8”	68
# 4	35
# 8	20
# 16	17
# 30	15
# 50	10
# 100	5
# 200	1.3

Coarse	Absorption	0.8 %
	Gsa	2.724
	Gsb	2.664
	Gsb_{ssd}	2.686
Fine	Absorption	1.7 %
	Gsa	2.696
	Gsb	2.575
	Gsb_{ssd}	2.620

a) Gsb $_{ssd\ comb}$ _____

b) % Abs_{comb} _____

26. Choose all of the applicable steps needed to **prepare** a sample for conducting a test for deleterious material.

◯ Process sample over # 40 sieve	◯ Wash sample to remove dust
◯ Air dry sample	◯ Process sample over # 4 sieve
◯ Immerse in water for 12 hours	◯ Mix and reduce field sample to testing size
◯ Oven dry sample	◯ Immerse in water for 15 – 19 hours
◯ Break apart clay lumps	◯ Collect a representative field sample
◯ Retain + #4 material for testing	◯ Dry sieve over # 200 to remove dust
◯ Retain - #4 material for testing	◯ Check dry weight against minimum mass

27. Choose all of the applicable steps needed to **prepare** a sample for determining the percentage of crushed particles.

◯ Process sample over # 40 sieve	◯ Wash sample to remove dust
◯ Air dry sample	◯ Process sample over # 4 sieve
◯ Immerse in water for 12 hours	◯ Mix and reduce field sample to testing size
◯ Oven dry sample	◯ Immerse in water for 15 – 19 hours
◯ Break apart clay lumps	◯ Collect a representative field sample
◯ Retain + #4 material for testing	◯ Dry sieve over # 200 to remove dust
◯ Retain - #4 material for testing	◯ Check dry weight against minimum mass

28. The following concrete aggregate sample contains deleterious material. Determine if the sample will meet the ARDOT standard specification for coarse aggregate.

ARDOT Concrete Aggregate Specifications

UNIVERSITY OF ARKANSAS

Coarse Aggregate

% Passing (AASHTO T 27)

Sieve	ARDOT Standard	AASHTO # 57
1 1/2"	100	100
1"	60 - 100	95 - 100
3/4"	35 - 75	
1/2"		25 - 60
3/8"	10 - 30	
# 4	0 - 5	0 - 10
# 8		0 - 5

Decant Loss (AASHTO T 11) * 1%

* May be increased to 1.5% if decant loss of fine aggregate does not exceed 1%
May be increased to 1.8% if decant loss of fine aggregate doesn't exceed 0.5%

Deleterious

Coal & Lignite (AASHTO T 113)	0.25%
Clay Lumps (ARDOT 302)	0.25%
Soft Fragments (ARDOT 302)	5%
Total Deleterious	5%

Fine Aggregate

% Passing (AASHTO T 27)

Sieve	ARDOT Standard
3/8"	100
# 4	95 - 100
# 8	70 - 95
# 16	45 - 85
# 30	20 - 65
# 50	5 - 30
# 100	0 - 5

Decant Loss (AASHTO T 11) * 2%

Deleterious

Coal & Lignite (AASHTO T 113)	0.25%
Clay Lumps (ARDOT 302)	0.50%
Soft Fragments (ARDOT 302)	2%

Sample Weight (coarse fraction)	9445.2 g
Clay Lumps	20.6 g
Soft Fragments	435.2 g
Organic Material	35.8 g

29. Determine the % of crushed particles in the following sample:

Sample Weight (coarse fraction)	3578.6 g
Weight of Crushed Material	3351.1 g

Basic Aggregates Formulas

$$\%\ P_{\#200}\ (wash) = \frac{(D_B - D_A)}{D_B}\ x\ 100\%$$

$$DR = \frac{\%\ P_{\#200}}{\%\ P_{\#40}} \qquad AC = \frac{(In - Out)}{In}\ x\ 100\%$$

$$FM = \frac{\sum \%\ Ret}{100} \qquad (\#100, \#50, \#30, \#16, \#8, \#4, ⅜", ¾", 1½", 3", \dots)$$

$$\%\ Cr. = \frac{Wt.\ of\ Crushed}{Wt.\ of\ Dry\ Sample}\ x\ 100\%$$

$$\%\ Del. = \frac{Wt.\ of\ Deleterious}{Wt.\ of\ Dry\ Sample}\ x\ 100\%$$

$$Gsa = \frac{A}{(A - C)} \qquad Gsb = \frac{A}{(B - C)}$$

$$Gsb_{ssd} = \frac{B}{(B - C)} \qquad \%\ Abs = \frac{(B - A)}{A}\ x\ 100\%$$

$$Gsa = \frac{A}{(B + A - C)} \qquad Gsb = \frac{A}{(B + S - C)}$$

$$Gsb_{ssd} = \frac{S}{(B + S - C)} \qquad \%\ Abs = \frac{(S - A)}{A}\ x\ 100\%$$

$$G_{comb} = \frac{100}{\left(\frac{P_1}{G_1} + \frac{P_2}{G_2} + \cdots\right)} \qquad A_{comb} = \frac{(P_1A_1 + P_2A_2 + \cdots)}{100}$$

Answers

1. 5752.6 g

2. 15 kg

3. 50 kg or 110 lb

4. 300 g

5. 20,000 g

6. 3000 g

7. 4

8.

Aggregate	Moisture	Split	Quarter	Sector	Mini-Stockpile
Fine	≤ SSD	●			
Fine	> SSD		●	●	●
Mixed	≤ SSD	●	●		
Mixed	> SSD		●		
Coarse	≤ SSD	●	●		
Coarse	> SSD	●	●		

9. 1.4%

10. 1.7%

11. 6.4 % 11 %

13 % 9.4 %

12.

Process sample over # 40 sieve	Wash sample to remove dust
Air dry sample	Process sample over # 4 sieve
Immerse in water for 12 hours	● Mix and reduce field sample to testing size
● Oven dry sample	Immerse in water for 15 – 19 hours
Break apart clay lumps	● Collect a representative field sample
Retain + #4 material for testing	Dry sieve over # 200 to remove dust
Retain - #4 material for testing	● Check dry weight against minimum mass

Answers

13.

Sieve	Cum. Wt. Ret.	% Retained	Calculated % Passing	Reported % Passing
1 ½"	0.0	0.0	100.0	100
1"	1878.3	17.4	82.6	83
3/4"	3057.9	28.4	71.6	72
3/8"	4613.4	42.8	57.2	57
# 4	6069.1	56.3	43.7	44
# 10	7176.2	66.6	33.4	33
# 40	9248.4	85.8	14.2	14
# 200	9745.8	90.4	9.6	9.6
Pan	9791.1			

a. 1 1/2"
b. 1"
c. Yes
d. 0.09 %
e. Yes
f. 0.69

14.

Sieve	Cum. Wt. Ret.	% Retained	Calculated % Passing	Reported % Passing
1/2"	0.0	0.0	100.0	100
3/8"	0.0	0.0	100.0	100
# 4	0.0	0.0	100.0	100
# 8	106.5	14.7	85.3	85
# 16	276.3	38.2	61.8	62
# 30	439.0	60.7	39.3	39
# 50	600.4	83.0	17.0	17
# 100	701.6	97.0	3.0	3
# 200	712.6	98.5	1.5	1.5
Pan	715.3			

a. # 4
b. # 8
c. Yes
d. 0.38 %
e. No
f. 0.7 %
g. 2.94

15.

Process sample over # 40 sieve	Wash sample to remove dust
Air dry sample	Process sample over # 4 sieve
Immerse in water for 12 hours	● Mix and reduce field sample to testing size
Oven dry sample	Immerse in water for 15 – 19 hours
Break apart clay lumps	● Collect a representative field sample
Retain + #4 material for testing	Dry sieve over # 200 to remove dust
Retain - #4 material for testing	● Check dry weight against minimum mass

Answers

16. 3.8 %

17. 4.3 %

18.

	Process sample over # 40 sieve	●	Wash sample to remove dust
	Air dry sample	●	Process sample over # 4 sieve
	Immerse in water for 12 hours	●	Mix and reduce field sample to testing size
●	Oven dry sample	●	Immerse in water for 15 – 19 hours
	Break apart clay lumps	●	Collect a representative field sample
●	Retain + #4 material for testing		Dry sieve over # 200 to remove dust
	Retain - #4 material for testing	●	Check dry weight against minimum mass

19.

	Process sample over # 40 sieve		Wash sample to remove dust
	Air dry sample	●	Process sample over # 4 sieve
	Immerse in water for 12 hours	●	Mix and reduce field sample to testing size
●	Oven dry sample	●	Immerse in water for 15 – 19 hours
	Break apart clay lumps	●	Collect a representative field sample
	Retain + #4 material for testing		Dry sieve over # 200 to remove dust
●	Retain - #4 material for testing	●	Check dry weight against minimum mass

20. a. 2.673

b. 2.594

c. 2.624

d. 1.1 %

21. a. 2.724

b. 2.664

c. 2.686

d. 0.8 %

22. a. 2.641

b. 2.556

c. 2.588

d. 1.3 %

23. a. 2.696

b. 2.575

c. 2.620

d. 1.7 %

24. a. 2.630

b. 1.2%

25. a. 2.663

b. 1.1 %

26.

Process sample over # 40 sieve	Wash sample to remove dust
Air dry sample	● Process sample over # 4 sieve
Immerse in water for 12 hours	● Mix and reduce field sample to testing size
● Oven dry sample	Immerse in water for 15 – 19 hours
Break apart clay lumps	● Collect a representative field sample
● Retain + #4 material for testing	Dry sieve over # 200 to remove dust
Retain - #4 material for testing	● Check dry weight against minimum mass

27.

Process sample over # 40 sieve	Wash sample to remove dust
Air dry sample	● Process sample over # 4 sieve
Immerse in water for 12 hours	● Mix and reduce field sample to testing size
● Oven dry sample	Immerse in water for 15 – 19 hours
Break apart clay lumps	● Collect a representative field sample
● Retain + #4 material for testing	Dry sieve over # 200 to remove dust
Retain - #4 material for testing	● Check dry weight against minimum mass

28. Clay Lumps: 0.2%
Soft Fragments: 4.6% No – Fails on Total
Total: 5.2%

29. 93.6%