

## Soils Study Guide

### General Conversions

- 1) There are \_\_\_\_\_ grams in one pound.

### Terminology

- 2) Air dried soil requires drying the soil at temperatures which do not exceed \_\_\_\_\_ ° F whereas oven drying requires a temperature of \_\_\_\_\_ ± \_\_\_\_\_ ° F.

### Sampling

- 3) Sample containers should prevent the loss of \_\_\_\_\_ and \_\_\_\_\_.
- 4) The minimum number of samples required to enclose an area is \_\_\_\_\_.
- 5) Layers of soil may be identified by a change in soil types, \_\_\_\_\_, or \_\_\_\_\_.

### Preparation of Soils

- 6) A mortar and \_\_\_\_\_ tipped pestle may be used to pulverize a soil sample.
- 7) In the dry preparation of soils, you must dry the soil at a temperature not exceeding \_\_\_\_\_ ° F.
- 8) When pulverizing samples, you may reduce the individual grain sizes of the material.      True      False

### Moisture Content

- 9) The accuracy of the scales required to determine the moisture content of a sample depends on the sample \_\_\_\_\_ being tested.
- 10) The minimum sample size required for material which passes the # 40 sieve is \_\_\_\_\_ g.

- 11) When using a controlled temperature oven to determine the moisture content of normal soils, the oven must maintain a temperature of \_\_\_\_\_  $\pm$  \_\_\_\_\_ °F.
- 12) Moisture contents are reported to the nearest \_\_\_\_\_ %.

### **Plastic Limit**

- 13) A scale which is readable to at least \_\_\_\_\_ gram(s) is required for the plastic limit test.
- 14) A \_\_\_\_\_ glass plate or \_\_\_\_\_ paper may be used as a rolling surface (provided that it does not add fibers or paper fragments to the sample).
- 15) Soil preparation for the plastic limit test includes \_\_\_\_\_ drying the soil, and processing the soil over the # \_\_\_\_\_ sieve.
- 16) When rolling a PL sample, roll the specimen at a rate of \_\_\_\_\_ to \_\_\_\_\_ strokes per minute until the mass forms a thread of \_\_\_\_\_ mm ( $\approx$  1/8") in diameter.
- 17) If the first thread formed by the soil breaks apart before reaching the correct size, the soil is at its' PL and should be placed into a moisture tin.    True            False
- 18) It is permissible to roll the thread of soil to a diameter of less than 3mm (1/8") as long as the soil holds together.            True            False
- 19) When the soil is determined to be at its' plastic limit, the soil pieces are collected and placed into a moisture tin and covered with a lid. At the completion of rolling of the entire sample or approximately \_\_\_\_\_ grams, the tin is \_\_\_\_\_ and placed in an oven to \_\_\_\_\_.
- 20) Plastic limit is reported to the nearest \_\_\_\_\_ number.

## **Liquid Limit**

- 21) Scales which read to 0.1 gram are acceptable for use in a LL test.  
True      False
- 22) Check points on the LL device are points of \_\_\_\_\_, cup wear areas, \_\_\_\_\_ play and loose screws.
- 23) The calibration of the LL device should be checked before using the device.  
True      False
- 24) The LL device is calibrated correctly when the cup drop is \_\_\_\_\_ mm in height, and a clicking sound is heard without the cup rising from the calibration tool.
- 25) Soil preparation requires \_\_\_\_\_ drying of the material, and processing over the \_\_\_\_\_ sieve.
- 26) When mixing soil and water, it is permissible to add dry soil after the testing has begun.      True      False
- 27) After mixing, the soil is placed into the cup to a depth of \_\_\_\_\_ mm. The extra soil is returned to the mixing dish and \_\_\_\_\_.
- 28) The soil in the cup is then cut by the grooving tool, using up to \_\_\_\_\_ strokes. No further cuts may be made once any \_\_\_\_\_ shows in the cup bottom.
- 29) If the depth of the soil in the cup is over the top of the grooving tool when cutting the groove, the soil is too \_\_\_\_\_ in the cup.
- 30) The device crank shall be turned at a rate of \_\_\_\_\_ revolutions per second.
- 31) It is not permissible to hold the device while cranking.      True      False
- 32) You should stop cranking when the soil flows together for a continuous distance of about \_\_\_\_\_ mm or (1/2 inch) and record the number of \_\_\_\_\_.
- 33) When cranking the LL device, it is permissible to start and stop or change speed as long as you count the blows.      True      False
- 34) If performing the one-point method, you must complete a verification test before taking a moisture content sample of the soil.      True      False

- 35) It is permissible to add water to the sample or dry the sample out immediately prior to running a verification test. True False
- 36) For the liquid limit test to be considered “verified”, the verification test must have a blow count between \_\_\_\_\_ and \_\_\_\_\_ blows and be within  $\pm$  \_\_\_\_\_ blows of the previous test.
- 37) When performing a one-point method, you must record the blow count of the \_\_\_\_\_ sample, and then take the moisture content across the point of \_\_\_\_\_.
- 38) Correction of the laboratory determined moisture content to represent the moisture content at 25 blows may be achieved by using a \_\_\_\_\_ - \_\_\_\_\_.
- 39) Report the LL to the nearest \_\_\_\_\_ number.
- 40) There are two methods for determining the LL of a soil, the one-point method and the three-point method. True False
- 41) When performing a three-point LL test, the point ranges required are 15 to \_\_\_\_\_, 20 to \_\_\_\_\_, and 25 to \_\_\_\_\_ blows.
- 42) The minimum difference between the highest and the lowest recorded blow counts must be equal to or greater than \_\_\_\_\_ to be a valid three point LL test.
- 43) A verification test is required for each point when running a three point LL test. True False
- 44) Referee tests require the \_\_\_\_\_ point method, using the \_\_\_\_\_ grooving tool, and \_\_\_\_\_ water.
- 45) If the LL or the PL could not be determined, or if the PL is  $\geq$  the LL, report the PI as \_\_\_\_\_.

### **AASHTO Soil Classification**

- 46) Clay particles are smaller in grain size than silt particles.      True      False
- 47) According to the AASHTO Soil Classification Chart, granular materials have less than or equal to \_\_\_\_\_ % passing the # 200 sieve.
- 48) According to the AASHTO Soils Classification Chart, silt / clay materials have more than \_\_\_\_\_ % passing the # 200 sieve.
- 49) Silty materials have a  $PI \leq$  \_\_\_\_\_, and clayey materials have a  $PI$  value  $\geq$  \_\_\_\_\_.

### **Speedy Moisture Tester**

- 50) Speedy moisture testers are used primarily for coarse grained soils.  
True      False
- 51) There are different sizes of speedy moisture testers, and each has their own special requirements for mass of sample used.      True      False
- 52) The dial reading of a speedy moisture tester represents the % moisture based on the \_\_\_\_\_ weight of the soil.
- 53) Regardless of the amount of soil placed into a standard sized speedy moisture tester, \_\_\_\_\_ scoops of calcium carbide reagent are placed into the tester.
- 54) When introducing the soil & reagent into the tester, you may mix them together and then secure the lid.      True      False
- 55) After securing the lid, you should raise the tester to a vertical position and then rotate the tester in a horizontal position until achieving \_\_\_\_\_ repetitive (identical) dial readings.
- 56) If at the completion of the shaking process, the dial is found to be decreasing in reading, the test is \_\_\_\_\_ due to a \_\_\_\_\_.
- 57) A speedy moisture tester dial reading of 13.4 % means that the reported moisture content of the soil is 13.4 %.      True      False

- 58) If a sample is expected to have 25 % moisture, the standard sized sample should be reduced by \_\_\_\_\_, and the reading on the dial \_\_\_\_\_ before reading the corrected % moisture from the chart.
- 59) If a sample is expected to have 1% moisture, the standard sized sample may be \_\_\_\_\_, and the dial reading is \_\_\_\_\_ before reading the corrected % moisture from the chart.

### **Moisture Density Relations**

- 60) Compaction at the optimum moisture content allows the soil particles to become closely packed and should create a stable soil structure.      True      False
- 61) The moisture density relationship is used to determine the \_\_\_\_\_ dry density and \_\_\_\_\_ moisture content of a soil.
- 62) For an AASHTO T 99, method A proctor, the soil will be compacted in a \_\_\_\_\_ inch mold, in \_\_\_\_\_ lifts, with \_\_\_\_\_ blows per lift, using a \_\_\_\_\_ lb hammer with a \_\_\_\_\_ inch drop.
- 63) The major difference between AASHTO T 99 (standard proctor) and AASHTO T 180 (modified proctor) is the compactive effort applied to the soil.  
True      False
- 64) The maximum % compaction usually allowed by the ARDOT is \_\_\_\_\_ % of the maximum laboratory dry density.
- 65) Preparation of soil for a proctor test requires completing a \_\_\_\_\_ analysis, \_\_\_\_\_ drying the material if needed, and processing the material over either the # \_\_\_\_\_ or the \_\_\_\_\_ inch sieve (*depending on the method required*).
- 66) Increases in moisture content between proctor points should be \_\_\_\_\_ and should not exceed \_\_\_\_\_ % except when heavy clays or organic soils with flat, elongated curves are encountered.
- 67) When mixing water with the soil, sample points which contain heavy clays must be allowed to season for a minimum of \_\_\_\_\_ hours before compaction.

- 68) After placing one lift of loose soil into the mold, lightly \_\_\_\_\_ the soil with the hammer prior to compaction until it is not in a \_\_\_\_\_ or fluffy state.
- 69) A wooden floor is an acceptable surface for compaction of a proctor point.  
True      False
- 70) The surface of the compacted soil should be trimmed around the mold edges before compaction of another lift.      True      False
- 71) After the compaction of the final lift, the mold collar is removed and the soil is trimmed flush with the mold rim using a \_\_\_\_\_.
- 72) Hammer indentations may be filled with soil to correct deficiencies after the compaction of the final lift.      True      False
- 73) Holes created in the trimming process should be patched with fine material.  
True      False
- 74) At least \_\_\_\_\_ points are required over the optimum moisture content.
- 75) "Points" of a proctor curve shall bracket the \_\_\_\_\_ moisture content by samples which will \_\_\_\_\_ in mass to the maximum density, and then \_\_\_\_\_ in mass.
- 76) After plotting proctor points, a smooth curve is drawn to connect the points. The peak of the curve determines the \_\_\_\_\_ dry density and the \_\_\_\_\_ moisture content for the soil.
- 77) Proctor curves may be drawn with two straight lines and a rounded peak.  
True      False
- 78) During the determination of the volume of a mold, the temperature of the water does not need to be known.      True      False
- 79) The volume of a 4" mold is required to be \_\_\_\_\_ ± \_\_\_\_\_ cubic feet and of a 6" mold to be \_\_\_\_\_ ± \_\_\_\_\_ cubic feet.

## **Proctor Adjustments**

- 80) If the field conditions of a density test would indicate a different proctor method to be run, you may perform a correction for oversized particles on the material instead.    True        False
- 81) Density tests which continually run way above the established maximum dry density may be an indicator that a new \_\_\_\_\_ or \_\_\_\_\_ should be completed.
- 82) If the % of coarse particles increases under field conditions, you should expect an \_\_\_\_\_ in the maximum dry density and a \_\_\_\_\_ in the optimum moisture content of the soil.
- 83) Coarse particle corrections are used to adjust the maximum density and optimum moisture content of a soil to account for the \_\_\_\_\_ found in field conditions.
- 84) For AASHTO T 99, method A and method B, an AASHTO correction for oversized particles should be completed when there is more than a 5% change in coarse particles between the field test and the proctor.        True        False
- 85) For AASHTO T 99, method C and AASHTO T 180, method D, according to ARDOT specifications, if particles are retained on the  $\frac{3}{4}$ " sieve, you should use the ARDOT \_\_\_\_\_ method when running the proctor.

## **Nuclear Density**

- 86) The nuclear density gauge directly measures \_\_\_\_\_ and \_\_\_\_\_.
- 87) The moisture content reading has no effect on the dry density reading of a nuclear gauge test.        True        False
- 88) Density measurements in soils are made with the source rod extended into the ground.        True        False

- 89) Prior to using a nuclear density gauge, a daily \_\_\_\_\_  
\_\_\_\_\_ must be performed.
- 90) The location for standardization of a density gauge must be at least \_\_\_\_\_ feet  
from any large objects, and at least \_\_\_\_\_ feet from any other radioactive  
sources.
- 91) To perform a standard count, the gauge is placed on the \_\_\_\_\_  
\_\_\_\_\_ with the rod in the \_\_\_\_\_ position.
- 92) To check the operation of a gauge, the density standard count must be within  
 $\pm$  \_\_\_\_\_ % of the average of the last four counts, while the moisture standard  
count must be within  $\pm$  \_\_\_\_\_ %.
- 93) If the standard count fails, you may try to establish a new standard count average  
by running \_\_\_\_\_ new standard counts.
- 94) If a passing standard count cannot be achieved, you must not use the gauge for  
acceptance purposes.            True            False
- 95) Remove dry or \_\_\_\_\_ materials and fill voids with \_\_\_\_\_ or native  
fines in preparation for testing.
- 96) It is allowable to fill more than 10% of the footprint of the gauge.  
True            False
- 97) The test depth is equal to the \_\_\_\_\_ thickness.
- 98) The test hole must be approximately \_\_\_\_\_ inches deeper than the test depth.
- 99) When removing the drill rod from the test hole prior to testing, it is permissible to  
hammer the drill rod sideways to loosen it.            True            False
- 100) Before removing the drill plate from location, it is a best practice to \_\_\_\_\_  
the location of the plate and test hole location.
- 101) Prior to insertion of the rod, \_\_\_\_\_, \_\_\_\_\_, and the  
appropriate \_\_\_\_\_ value should be entered into the gauge as  
required.
- 102) Density measurements on soils are made for at least \_\_\_\_\_ minute.

- 103) Once insertion of the rod is complete, lower the rod to the correct test depth and \_\_\_\_\_ back the gauge towards the rear of the hole.
- 104) When the gauge reading is completed, the first step a gauge operator should perform is to \_\_\_\_\_ the gauge rod.
- 105) The minimum limit for ARDOT standard compacted embankment materials is \_\_\_\_\_ %, and \_\_\_\_\_ % for base aggregates.
- 106) According to ARDOT specifications, the moisture content in the field should be \_\_\_\_\_ or \_\_\_\_\_ the optimum moisture content.
- 107) If soils are known to be high in other forms of hydrogen such as cement or contain hydrogen absorbers, a moisture \_\_\_\_\_ may need to be used.
- 108) If testing within 2 feet of a large vertical soil structure, a \_\_\_\_\_ should be used.