

## Soils Study Guide

### Unit 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 \_\_\_\_\_.

### Preparation of Soils

- 5) A mortar and \_\_\_\_\_ covered pestle may be used to pulverize a soil sample.
- 6) In the dry preparation of soils, you may not exceed \_\_\_\_\_ °F when drying the soil.
- 7) When pulverizing samples, you may reduce the individual grain sizes of the material.      True      False

### Moisture Content

- 8) For moisture content determinations, scales must be readable and accurate to at least \_\_\_\_\_ % of the sample mass.
- 9) When using a controlled temperature oven to determine the moisture content of normal soils, the oven must maintain a temperature of \_\_\_\_\_ ± \_\_\_\_\_ °F.
- 10) Moisture contents are reported to the nearest \_\_\_\_\_ %.

### **Plastic Limit**

- 11) A scale which is readable to at least \_\_\_\_\_ gram(s) is required for the plastic limit test.
- 12) 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).
- 13) Soil preparation for the plastic limit test includes \_\_\_\_\_ drying the soil and processing the soil over the # \_\_\_\_\_ sieve.
- 14) 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.
- 15) 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
- 16) 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 \_\_\_\_\_.
- 17) Plastic limit is reported to the nearest \_\_\_\_\_ number.

### **Liquid Limit**

- 18) Scales which read to 0.1 gram are acceptable for use in a LL test.  
True            False
- 19) Check points on the LL device are points of \_\_\_\_\_, cup wear areas, \_\_\_\_\_ play and loose screws.
- 20) The calibration of the LL device should be checked \_\_\_\_\_ before using the device.
- 21) 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.

- 22) Soil preparation for liquid limit requires air drying of the material, and processing over the # \_\_\_\_\_ sieve.
- 23) After mixing, the soil is placed into the cup to a depth of \_\_\_\_\_ mm. The extra soil is returned to the mixing dish and \_\_\_\_\_.
- 24) 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.
- 25) 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.
- 26) The device crank shall be turned at a rate of \_\_\_\_\_ revolutions per second.
- 27) It is permissible to hold the device while cranking.            True            False
- 28) When cranking the LL device, it is permissible to stop and restart or change speed.  
True            False
- 29) 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 \_\_\_\_\_.
- 30) When performing the one-point method, you must complete a \_\_\_\_\_ test before taking a moisture content sample of the soil.
- 31) It is permissible to change the moisture content of the soil immediately prior to running a verification test.            True            False
- 32) For a one-point liquid limit test to be considered “verified”, the verification test must have a blow count between \_\_\_\_\_ and \_\_\_\_\_ blows and be within ± \_\_\_\_\_ blows of the previous test.
- 33) When performing a one-point method, you must record the blow count of the verification sample, and then take the moisture content across the point of \_\_\_\_\_.
- 34) Report the LL to the nearest \_\_\_\_\_ number.

- 35) When performing a three-point LL test, the point ranges required are 15 to \_\_\_\_\_, 20 to \_\_\_\_\_, and 25 to \_\_\_\_\_ blows.
- 36) 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 liquid limit test.
- 37) A verification test is required for each point when running a three-point liquid limit test.            True            False
- 38) Referee tests require the \_\_\_\_\_ point method, using the \_\_\_\_\_ grooving tool, and \_\_\_\_\_ water.

### **Plasticity Index**

- 39) 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**

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

### **Speedy Moisture Tester**

- 44) There are different sizes of speedy moisture testers, and each has their own special requirements for mass of sample used.      True      False
- 45) The dial reading of a speedy moisture tester represents the % moisture based on the \_\_\_\_\_ weight of the soil.
- 46) Regardless of the amount of soil placed into a standard sized speedy moisture tester, \_\_\_\_\_ scoops of calcium carbide reagent are placed into the tester.
- 47) When introducing the soil & reagent into the tester, you may mix them together and then secure the lid.      True      False
- 48) 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.
- 49) If at the completion of the shaking process, the dial is found to be decreasing in reading, the test is \_\_\_\_\_ due to a \_\_\_\_\_.
- 50) A speedy moisture tester dial reading of 13.4 % means that the reported moisture content of the soil is 13.4 %.      True      False

### **Moisture Density Relations**

- 51) The moisture density relationship is used to determine the \_\_\_\_\_ dry density and \_\_\_\_\_ moisture content of a soil.
- 52) 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.
- 53) 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

- 54) 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*).
- 55) 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.
- 56) When mixing water with the soil, sample points which contain heavy clays must be allowed to season for a minimum of \_\_\_\_\_ hours before compaction.
- 57) 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.
- 58) After compaction of each lift, the surface of the compacted soil should be trimmed around the mold edges before adding soil for the next lift.      True      False
- 59) After the compaction of the final lift, the mold collar is removed and the soil is trimmed flush with the mold rim using a bevelled \_\_\_\_\_  
\_\_\_\_\_.
- 60) Hammer indentations may be filled with soil to correct deficiencies after the compaction of the final lift.      True      False
- 61) Holes created during the trimming process should be \_\_\_\_\_ with fine material.
- 62) At least \_\_\_\_\_ points are required over the optimum moisture content.
- 63) "Points" of a proctor curve shall bracket the \_\_\_\_\_ moisture content by samples which will \_\_\_\_\_ in mass to the maximum density, and then \_\_\_\_\_ in mass.
- 64) After plotting proctor points, a smooth curve is drawn to connect the points. The maximum dry density and optimum moisture content of the soil is found at the \_\_\_\_\_ of the curve.

### **Mold Volume**

- 65) During the determination of the volume of a mold, the temperature of the water needs to be known. True False
- 66) The volume of a 4" mold is required to be \_\_\_\_\_ ± \_\_\_\_\_ cubic feet and of a 6" mold to be \_\_\_\_\_ ± \_\_\_\_\_ cubic feet.

### **Proctor Adjustments**

- 67) 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.
- 68) For AASHTO T 99 A proctor, an AASHTO correction for oversized particles should be completed when there is more than a \_\_\_\_\_ % change in coarse particles between the field test and the proctor.
- 69) For AASHTO T 99 C and AASHTO T 180 D proctors according to ARDOT specifications, if particles are retained on the ¾" sieve, you should use the ARDOT \_\_\_\_\_ method when running the proctor.

### **Nuclear Density**

- 70) The nuclear density gauge directly measures \_\_\_\_\_ density and \_\_\_\_\_ content.
- 71) The moisture content reading has no effect on the dry density reading of a nuclear gauge test. True False
- 72) Prior to using a nuclear density gauge, a daily \_\_\_\_\_  
\_\_\_\_\_ must be performed.
- 73) 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.
- 74) To perform a standard count, the gauge is placed on the standard \_\_\_\_\_ with the rod in the \_\_\_\_\_ position.

- 75) 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  $\pm$  \_\_\_\_\_ %.
- 76) If a passing standard count cannot be achieved, you may use the gauge for acceptance purposes.      True      False
- 77) In preparation for density testing, remove dry or \_\_\_\_\_ materials and fill voids with \_\_\_\_\_ or native fines.
- 78) The maximum allowable fill is \_\_\_\_\_ % of the footprint of the gauge.
- 79) The test depth is equal to the \_\_\_\_\_ thickness.
- 80) Before removing the drill plate from location, it is a best practice to \_\_\_\_\_ the location of the plate and test hole location.
- 81) Prior to insertion of the rod, enter appropriate values for \_\_\_\_\_, \_\_\_\_\_, and \_\_\_\_\_ as required.
- 82) Density measurements on soils are made for at least \_\_\_\_\_ minute.
- 83) Once the rod is inserted into the soil to the correct depth, the gauge should be \_\_\_\_\_ back towards the rear of the hole.
- 84) When the gauge reading is completed, the first step a gauge operator should perform is to \_\_\_\_\_ the gauge rod.
- 85) The minimum limit for ARDOT standard compacted embankment materials is \_\_\_\_\_ %, and \_\_\_\_\_ % for base aggregates.
- 86) According to ARDOT specifications, the moisture content in the field should be \_\_\_\_\_ or \_\_\_\_\_ the optimum moisture content.
- 87) 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.
- 88) If testing within 2 feet of a large vertical soil structure, a \_\_\_\_\_ should be used.