These problems address topics from the NCEES FE Civil CBT Exam Specifications at https://ncees.org/wp-content/uploads/FE-Civil-CBT-specs-1.pdf, see below.

YouTube Playlist

FE Civil Review 2022

Geotechnical Engineering

NCEES Fundamentals of Engineering (FE)
CIVIL CBT Exam Specifications

Effective Beginning with the July 2020 Examinations

Knowledge	Number of Questions
12. Geotechnical Engineering	**10–15**

A. Index properties and soil classifications
B. Phase relations
C. Laboratory and field tests
D. Effective stress
E. Stability of retaining structures (e.g., active/passive/at-rest pressure)
F. Shear strength
G. Bearing capacity
H. Foundation types (e.g., spread footings, deep foundations, wall footings, mats)
I. Consolidation and differential settlement
J. Slope stability (e.g., fills, embankments, cuts, dams)
K. Soil stabilization (e.g., chemical additives, geosynthetics)

Notes
V1.0 published 2/28/2022
V1.1 updates to consolidation questions, pagination 3/1/2022
V1.2 updates per live stream 3/4/2022
V1.3 title sheet 3/29/2022

A. Index properties and soil classifications

Question 1: A soil sample is a non-cohesive sand, without gravel (100% passing a number 4 sieve), some silt fines (8% passing a number 200 sieve), a uniformity coefficient of 8 and a coefficient of curvature of 2.5. Using the Unified Soil Classification System, this soil can best be classified as:

A. SW – Well-graded sand

B. SP – Poorly graded sand

C. SM – Silty Sand

D. SW-SM – Well-graded sand with silt

A. Index properties and soil classifications

Question 2: A soil sample is found to have particle distribution such that 100% passes a number 200 sieve with a liquid limit of 70 percent and a plastic limit of 40 percent. Using the Unified Soil Classification System, this soil can best be classified as:

A. CL – Lean clay

B. ML – Silt

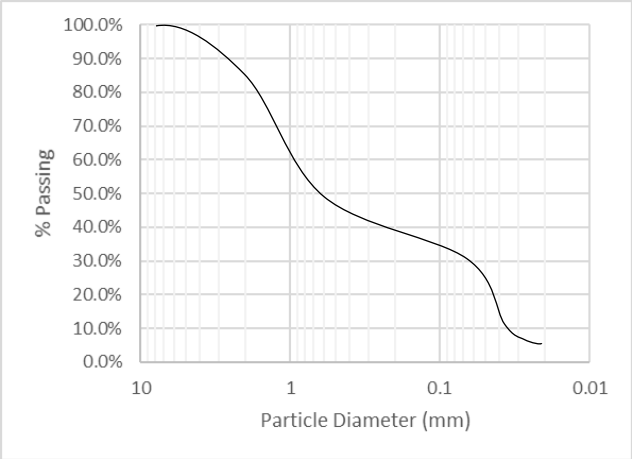
C. CH – Fat clay

D. MH – Elastic silt

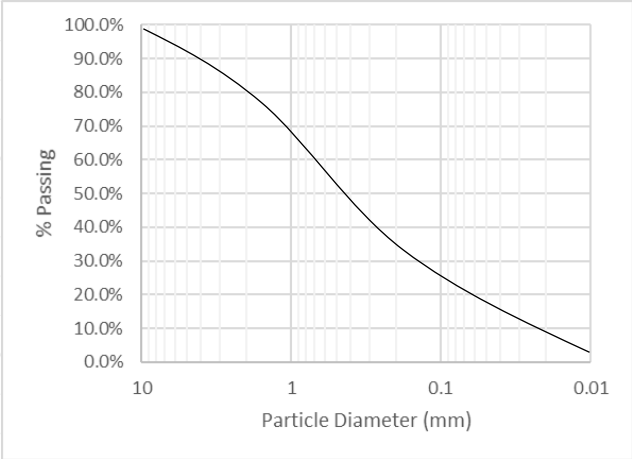
A. Index properties and soil classifications

Question 3: Results of sieve analyses are plotted below. The plot that best represents a uniformly graded sand is most likely:

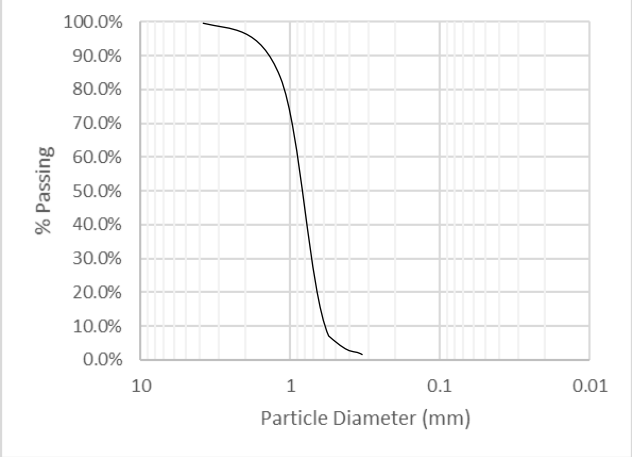
Plot A



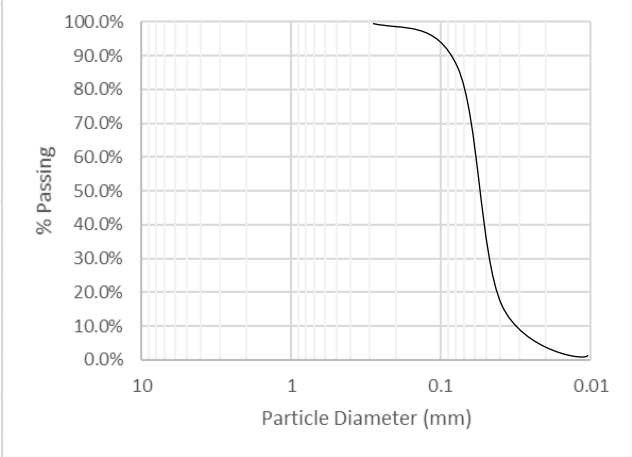
Plot B



Plot C



Plot D



A. Plot A

B. Plot B

C. Plot C

D. Plot D

B. Phase relations

Question 4: The three major phases of soil can be characterized most completely by which of the following:

A. clay, silt, sand/gravel

B. cohesive, non-cohesive, organic

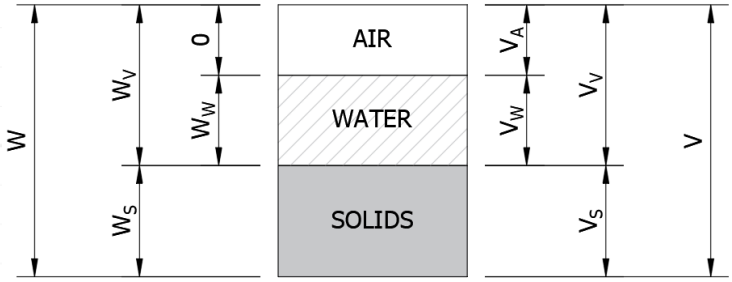
C. earth, fire, water

D. solids, water, air

B. Phase relations

Question 5: A soil sample obtained in the field has a weight of 135 pounds and volume of 1.0 ft^3. When oven-dried, the sample weight is 122 pounds. The water content is most nearly:

A phase diagram is given below for reference (this diagram is in the Handbook).



A. 10%

B. 11%

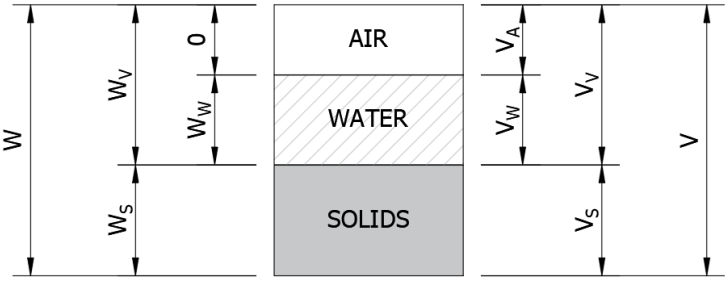
C. 12%

D. 24%

B. Phase relations

Question 6: A soil sample has a volume of 150 cm^3 and a mass of 240 g when completely saturated. When oven-dried, the sample has a mass of 140 g. The specific gravity of the soil is most nearly:

A phase diagram is given below for reference (this diagram is in the Handbook).



A. 2.5

B. 2.6

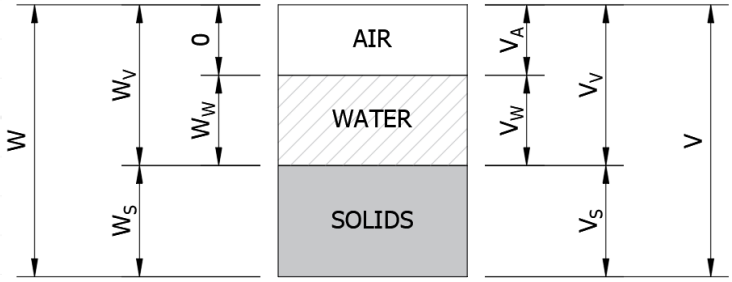
C. 2.7

D. 2.8

B. Phase relations

Question 7: A soil sample obtained in the field has a mass of 20 kg, total volume of 0.01 m^3 and specific gravity of 2.70. When oven-dried, the sample has a mass of 17.5 kg. The degree of saturation of the soil is most nearly:

A phase diagram is given below for reference (this diagram is in the Handbook).



A. 0.61

B. 0.65

C. 0.71

D. 0.88

C. Laboratory and field tests

Question 8: A test typically used to determine the maximum dry density of a soil is:

A. Sand-Cone Method

B. Nuclear Gauge

C. Sieve Analysis

D. Standard Proctor

C. Laboratory and field tests

Question 9: Soil testing at a construction site indicates a soil has an in-place dry unit weight of 115 pcf. This soil has maximum and minimum dry unit weights of 122 pcf and 100 pcf respectively. The relative density of the soil at the site is most nearly:

A. 68%

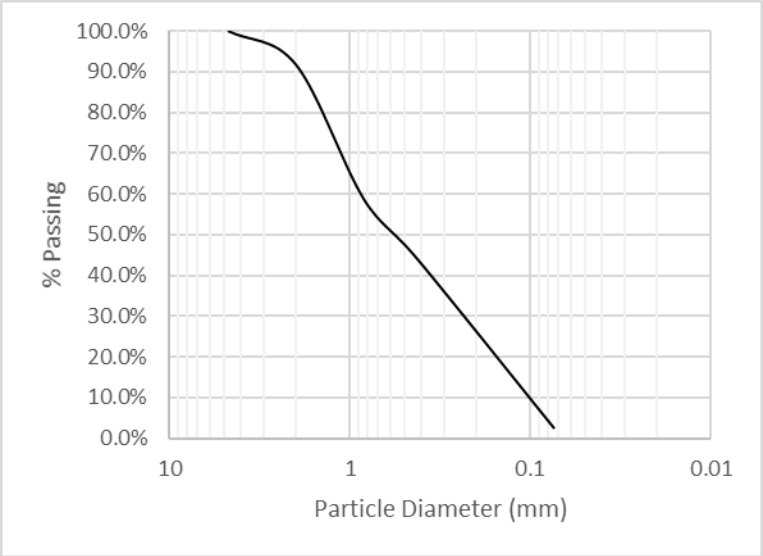
B. 72%

C. 86%

D. 94%

C. Laboratory and field tests

Question 10: Given the results of a sieve analysis below, the soil the uniformity coefficient and coefficient of curvature are most nearly:



A. 10 and 0.5

B. 10 and 2.5

C. 9 and 0.6

D. 9 and 2.8

D. Effective stress

Question 11: A uniform soil has a unit weight of 110 lb/ft^3. The water table is 6.5 feet below the surface. At a depth of 11 feet, the effective vertical stress in the soil is most nearly:

A. 800 lbs/ft^2

B. 900 lbs/ft^2

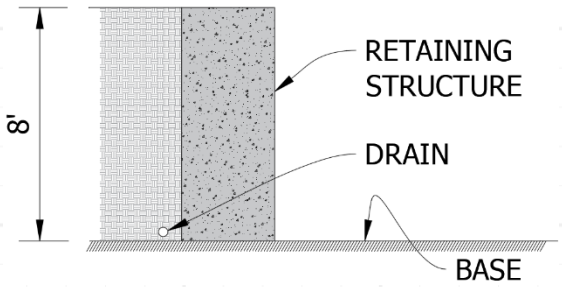
C. 1200 lbs/ft^2

D. 1900 lbs/ft^2

E. Stability of retaining structures (e.g., active/passive/as-rest pressure)

Note: see https://youtu.be/a0b8GrswZIM?t=4841 for a simplified example of a stability analysis.

Question 12: Consider the retaining structure below. The structure must resist the soil load indicated. The soil adjacent to the structure has a density of 115 lbs/ft^3 and a friction angle of 32°. A drain at the base of the structure creates an unsaturated, drained soil condition. The total horizontal force exerted on a one-foot width of retaining structure based on the horizontal active lateral earth pressure is most nearly:



A. 920 lbs

B. 1130 lbs

C. 2040 lbs

D. 3680 lbs

F. Shear strength

Question 13: A soil sample classified as a poorly graded sand subjected to a triaxial test. With a confining pressure of 10 psi, the sample fails at an axial load that causes a normal stress equivalent to 34 psi. The friction angle for this soil is most nearly:

A. 28°

B. 31°

C. 33°

D. 58°

G. Bearing capacity

Question 14: A square footing with width and length of 5 feet must resist an axial load of 80 kips at its center and moment of 20 kip-ft. If the allowable bearing capacity of the footing is 4,000 psf, which of the following best describes the bearing conditions of the footing:

A. The bearing capacity is inadequate and the base is entirely in compression.

B. The bearing capacity is inadequate and the base is partially in tension.

C. The bearing capacity is adequate and the base is entirely in compression.

D. The bearing capacity is adequate and the base is partially in tension.

H. Foundation types (e.g., spread footings, deep foundations, wall footings, mats)

Question 15: Identify which type of foundation that would be most appropriate for the type of given structures below.

Foundation Types:

A. Spread footing
B. Deep foundations (piles)
C. Wall footings
D. Mats

Structure type:	Foundation Type
a retaining structure used along the base of a slope, bearing on bedrock	
5-story residential structure with a basement in cohesive soils where shallow footings would cover greater than 50% but less than 100% of the foundation area	
bridge abutment, adjacent to a stream, with low bearing capacity cohesive soils	
2-story office building in non-cohesive soils with bearing capacity of 4,000 psf	

I. Consolidation and differential settlement

Question 16: Given a soil with a plasticity index of 40 and a plastic limit of 30, the recompression index can be estimated most nearly as:

A. 0.09

B. 0.45

C. 0.54

D. 0.63

I. Consolidation and differential settlement

Question 17: A buried stratum of clay that is 2-m thick will be subjected to a stress increase of 34 kPa at the center of the layer. The average (mid-depth) preconstruction soil overburden pressure is 50 kPa in the clay. Laboratory tests indicate the soil is overconsolidated with a past maximum consolidation stress of 74 kPa, void ratio of 1.5, compression index of 0.30 and recompression index of 0.05. Considering these conditions, the estimated decrease in the thickness of the clay layer is most nearly:

A. 0.02 cm

B. 0.90 cm

C. 2.0 cm

D. 5.4 cm

J. Slope stability (e.g., fills, embankments, cuts, dams)

Question 18: A cohesive soil (clay-silt mix) is on a slope with a slip surface of 75 feet at an angle of 30°. The soil above the slip surface weighs approximately 30 tons and has a friction angle of 21° and cohesion of 1.5 psi. The factor of safety against slope failure is most nearly:

A. 0.8

B. 1.0

C. 1.2

D. 1.5

K. Soil Stabilization

Question 19: Soil stabilization can is typically associated with all the following except:

A. Mechanical compaction

B. Application of chemical admixtures such as lime, fly-ash, cement, etc.

C. Installation of geotextile

D. Clearing, grubbing and excavation