Chapter 2
Origin of Soil and Grain Size

1. Physical properties of soil depend on
   (a) size of soil grains.
   (b) shape of soil grains.
   (c) chemical composition of soil grains.
   (d) all of the above.

2. Granite, gabbro and basalt are some common types of
   (a) minerals.
   (b) igneous rocks.
   (c) sedimentary rocks.
   (d) metamorphic rocks.

3. Which of the following is not a sedimentary rock?
   (a) Slate
   (b) Sandstone
   (c) Limestone
   (d) Shale

4. Which of the following minerals is the most resistant to weathering?
   (a) Olivine
   (b) Feldspar
   (c) Orthoclase
   (d) Quartz

5. Which of the following rocks is coarse textured?
   (a) Basalt
   (b) Granite
   (c) Rhyolite
   (d) All of the above

6. As a result of consolidation/cooling of magama, which of the following minerals crystallizes first?
   (a) Quartz
   (b) Muscovite
   (c) Biotite
   (d) K-feldspar

7. The chemical formula of halite is
   (a) NaCl
   (b) CaCO₃
   (c) CaMg(CO₃)
   (d) CaSO₄.2H₂O
8. The clay minerals are a product of chemical weathering of
   (a) feldspars.
   (b) ferromagnesians.
   (c) micas.
   (d) all of the above.

9. Which of the following is not a clay mineral?
   (a) Biotite
   (b) Kaolinite
   (c) Illite
   (d) Montmorillonite

10. The soils transported and deposited by wind are called
    (a) alluvial soils.
    (b) aeolian soils.
    (c) lacustrine soils.
    (d) glacial soils.

11. The soils formed by the weathered products at their place of origin are called
    (a) transported soils.
    (b) fills.
    (c) alluvial soils.
    (d) residual soils.

12. At a construction site, the subsurface investigation indicates the presence of a residual soil
deposit. The grain size of the soil at this site will generally
    (a) not vary with depth.
    (b) decrease with depth.
    (c) increase with depth.
    (d) increase up to some depth and then decrease.

13. Limestone is a
    (a) mineral.
    (b) sedimentary rock.
    (c) igneous rock.
    (d) metamorphic rock.

14. Which of the following is not a metamorphic rock?
    (a) Marble
    (b) Gneiss
    (c) Dolomite
    (d) Quartzite

15. Which of following statements does not describe the characteristics of the soil deposits
formed from braided streams?
    (a) The grain sizes usually range from gravel to silt.
    (b) Clay-sized particles are generally not found.
    (c) The soil in a given pocket lens is generally non-uniform.
    (d) At any given depth, the void ratio and unit weight may vary over a wide range within
        a lateral distance of only a few meters.
16. The soil deposit laid down by glaciers consists of sand, silt, clay, gravel and boulders, and is usually called
   (a) Drift.
   (b) Moraines.
   (c) Dunes.
   (d) Loess.

17. Select the incorrect statement.
   (a) Organic soils are usually found in low-lying areas where the water table is near or above the ground surface.
   (b) Organic soils are highly compressible.
   (c) The moisture content of organic soils may range from 200 to 300%.
   (d) Organic soil deposits are usually encountered in desert areas.

18. The particles smaller than 0.075 mm are referred to as
   (a) clay.
   (b) silt.
   (c) sand.
   (d) fines.

19. A silica tetrahedron unit consists of
   (a) 2 oxygen atoms.
   (b) 4 oxygen atoms.
   (c) 2 silicon atoms.
   (d) 4 silicon atoms.

20. Kaolinite consists of repeating layers of elemental silica-gibbsite sheets in a
   (a) 1:1 lattice.
   (b) 1:2 lattice.
   (c) 2:1 lattice.
   (d) 2:2 lattice.

21. The surface area of the montmorillonite particles per unit mass is about
   (a) 15 m²/g.
   (b) 80 m²/g.
   (c) 800 m²/g.
   (d) none of the above.

22. Which of the following carries a net negative charge on its surfaces?
   (a) Clay
   (b) Silt
   (c) Sand
   (d) Gravel

23. When water is added to the clay, the innermost layer of double-layer water, which is held very strongly by clay, is called
   (a) free water.
   (b) adsorbed water.
   (c) absorbed water.
   (d) double-layer water.
24. For clayey and silty soils, the specific gravity of particles may vary from
   (a) 1.6 to 1.9.
   (b) 2.6 to 2.9.
   (c) 3.6 to 3.9.
   (d) none of the above.

25. Sieve analysis is carried out for soil particle sizes
   (a) smaller than 4.75 mm.
   (b) larger than 4.75 mm.
   (c) smaller than 0.075 mm.
   (d) larger than 0.075 mm.

26. Hydrometer analysis for particle-size distribution curve is based on
   (a) Stokes’ law.
   (b) Bernoulli’s principle.
   (c) Archimedes’ principle.
   (d) Terzaghi’s effective stress principle.

27. Particle size distribution curve is used for
   (a) determining the percentages of different particle-size fractions in a soil.
   (b) comparing different soils.
   (c) classifying soils.
   (d) all of the above.

28. Effective size of soil particles denoted by
   (a) $D_{10}$.
   (b) $D_{30}$.
   (c) $D_{60}$.
   (d) $D_{10}$.

29. U.S. sieve number 200 refers to
   (a) 0.425 mm.
   (b) 0.212 mm.
   (c) 0.150 mm.
   (d) 0.075 mm.

30. For a granular soil, effective size ($D_{10}$) = 0.09 mm, and coefficient of uniformity ($C_u$) = 4.56. What will be the diameter corresponding to 60% finer?
   (a) 0.02 mm
   (b) 0.41 mm
   (c) 50.67 mm
   (d) None of the above

31. Calculation of the coefficient of gradation ($C_c$) of soil requires
   (a) $D_{10}$.
   (b) $D_{30}$.
   (c) $D_{60}$.
   (d) all of the above.
32. A soil in which the particle sizes are distributed over a wide range is termed
   (a) poorly graded soil.
   (b) well graded soil.
   (c) gap graded soil.
   (d) granular soil.

33. Small sand particles located close to their origin are generally
   (a) angular.
   (b) subangular.
   (c) subrounded.
   (d) rounded.

34. Flaky particles have
   (a) very high sphericity.
   (b) high sphericity.
   (c) low sphericity.
   (d) very low sphericity.

35. If $D_e$ is the equivalent diameter, and $V$ is the volume of a soil particle, then
   (a) $D_e \propto V$
   (b) $D_e \propto V^{1/2}$
   (c) $D_e \propto V^{1/3}$
   (d) $D_e \propto V^3$
Answers, Hints and Discussion

1. (d)  
2. (b)  
3. (a)  
4. (d)  
5. (b)  
6. (c)  
   *Hint:* See Figure 2.2.  
7. (a)  
   *Hint:* See the Table on page 24.  
8. (d)  
9. (a)  
10. (b)  
11. (d)  
12. (c)  
13. (b)  
14. (c)  
15. (c)  
16. (a)  
17. (d)  
18. (d)  
   *Hint:* See Table 2.3.  
19. (b)  
20. (a)  
21. (c)  
   *Discussion:* (a) is correct for kaolinite, and (b) for illite.  
22. (a)  
   *Discussion:* The negative charge on the clay particle surfaces results from both isomorphous substitution and a break in continuity of the particle structure.  
23. (b)  
24. (b)  
25. (d)  
26. (a)  
27. (d)  
28. (a)  
29. (d)  
   *Hint:* See Table 2.5.
30. (b)  
Discussion: Eq. (2.7): \( D_{60} = (C_u)(D_{10}) = (4.56)(0.09) = 0.41 \text{ mm} \)

31. (d)  
Hint: See Eq. (2.10).

32. (b)

33. (a)

34. (d)

35. (c)  
Hint: See page 62.