Chapter 4
Plasticity and Structure of Soil

1. At a very low moisture content, soil behaves more like a
   (a) solid body.
   (b) semi-solid body.
   (c) plastic body.
   (d) liquid body.

2. The moisture content of soil at the point of transition from semisolid to plastic state is
   (a) shrinkage limit.
   (b) plastic limit.
   (c) liquid limit.
   (d) Atterberg limit.

3. Which of the following is an Atterberg limit?
   (a) Liquid limit
   (b) Plastic limit
   (c) Shrinkage limit
   (d) All of the above

4. Liquid limit is the moisture content in percent required to close a distance of 12.5 mm along the bottom of the groove in the soil pat placed in the cup of the liquid limit device after
   (a) 15 blows.
   (b) 20 blows.
   (c) 25 blows.
   (d) 30 blows.

5. The test results obtained from the liquid limit device are required to be plotted on
   (a) normal graph paper.
   (b) semi-logarithmic graph paper.
   (c) logarithmic graph paper.
   (d) plane paper.

6. As per the liquid limit test (ASTM D-4318), the relation between water content and log $N$ is approximated as
   (a) straight line.
   (b) circular curve.
   (c) hyperbolic curve.
   (d) parabolic curve.
7. If \( w_1 \) = moisture content of soil, in percent, corresponding to \( N_1 \) blows, and \( w_2 \) = moisture content of soil, in percent, corresponding to \( N_2 \) blows, the flow index is given as

(a) \( I_F = \frac{w_1 + w_2}{\log \left( \frac{N_2}{N_1} \right)} \)

(b) \( I_F = \frac{w_1 - w_2}{\log \left( \frac{N_1}{N_2} \right)} \)

(c) \( I_F = \frac{w_1 - w_2}{\log \left( \frac{N_2}{N_1} \right)} \)

(d) \( I_F = \frac{w_1 - w_2}{w_1 - w_2} \)

8. The plastic limit is the moisture content in percent at which the soil crumbles when rolled into threads of about

(a) 1 mm in diameter.
(b) 2 mm in diameter.
(c) 3 mm in diameter.
(d) 4 mm in diameter.

9. The plasticity index is the difference between

(a) liquid limit and plastic limit.
(b) plastic limit and shrinkage limit.
(c) liquid limit and shrinkage limit.
(d) none of the above.

10. If liquid limit = 36%, and plasticity index = 12%, then plastic limit will be

(a) 3%.
(b) 24%.
(c) 48%.
(d) none of the above.

11. Plasticity index equal to zero refers to

(a) nonplastic soil.
(b) low plastic soil.
(c) medium plastic soil.
(d) high plastic soil.

12. The plasticity index of low plastic soil ranges from

(a) 1 to 5.
(b) 5 to 10.
(c) 10 to 20.
(d) 20 to 40.
13. Activity, defined as the slope of line correlating plasticity index and percent finer than 2μ, is used as an index for
(a) classifying clay soils.
(b) defining Atterberg limits of clay soils.
(c) identifying the swelling potential of clay soils.
(d) none of the above.

14. Which one of the following soils can have in situ moisture content greater than its liquid limit?
(a) Sandy soils
(b) Silty soils
(c) Clayey soils
(d) Sensitive clayey soils

15. Plasticity index PI is related to flow index IF as
(a) $PI(\%) \approx IF(\%)$.
(b) $PI(\%) \approx 2IF(\%)$.
(c) $PI(\%) \approx 4IF(\%)$.
(d) $PI(\%) \approx 6IF(\%)$.

16. The moisture content of soil at which the volume of soil mass ceases to change is called
(a) plastic limit.
(b) shrinkage limit.
(c) liquid limit.
(d) Atterberg limit.

17. If volumetric shrinkage of a soil is 0%, then its linear shrinkage will be
(a) 0%.
(b) 25%.
(c) 50%.
(d) 100%.

18. The shrinkage limit of kaolinite can be equal to
(a) 10.
(b) 15.
(c) 20.
(d) 25.

19. Liquidity index $LI$ is expressed in terms of in situ moisture content $w$, plastic limit $PL$ and liquid limit $LL$ as
(a) $LI = \frac{PL - w}{LL - PL}$
(b) $LI = \frac{w - PL}{LL - PL}$
(c) $LI = \frac{w - LL}{LL - PL}$
(d) $LI = \frac{LL - w}{LL - PL}$
20. Soil deposits that are heavily overconsolidated may have a natural moisture content less than the plastic limit. In that case, the liquidity index,
(a) $LI < 1$
(b) $LI = 1$
(c) $LI > 1$
(d) $LI \geq 1$

21. If the *in situ* moisture content of a soil is equal to its liquid limit, then its consistency limit will be equal to
(a) 0.
(b) 0.5.
(c) 1.0.
(d) 2.0.

22. The $A$-line in the plasticity chart separates
(a) clays from the sands.
(b) clays from the silts.
(c) organic clays from the inorganic silts.
(d) inorganic clays from the inorganic silts.

23. The $A$-line in the plasticity chart is represented by the equation
(a) $PI = 0.73(LL - 8)$
(b) $PI = 0.73(LL - 20)$
(c) $PI = 0.9(LL - 8)$
(d) $PI = 0.9(LL - 20)$

24. The factor affecting the soil structure is
(a) shape and size of soil particles.
(b) mineralogical composition of soil particles.
(c) nature and composition of soil water.
(d) all of the above.

25. For very loose state of packing of spherical sand particles, the void ratio is
(a) 0.
(b) 0.35.
(c) 0.91.
(d) 1.0.

26. Honeycombed structure is generally found in
(a) fine sands.
(b) silts.
(c) both (a) and (b).
(d) coarse sands.

27. Clay deposits formed in the sea are highly
(a) dispersed structure.
(b) floculent structure.
(c) honeycombed structure.
(d) single-grained structure.
28. Which of the following soils has a highly complex structure?
   (a) Gravelly soil
   (b) Sandy soil
   (c) Silty soil
   (d) Clayey soil
Answers, Hints and Discussion

1. (a)
2. (b)
3. (d)
4. (c)
5. (b)
6. (a)
   *Hint:* See Eq. (4.1).
7. (c)
   *Hint:* See Fig. 4.5.
8. (c)
9. (a)
10. (b)
    *Discussion:* Eq. (4.5): Plastic limit, \(PL = 36\% - 12\% = 24\%\).
11. (a)
12. (b)
13. (c)
14. (d)
15. (c)
   *Hint:* See Eq. (4.6).
16. (b)
17. (a)
   *Hint:* See Eq. (4.23).
18. (d)
19. (b)
   *Discussion:* (d) is correct for consistency index (CI).
20. (a)
21. (c)
22. (d)
   *Hint:* See Fig. 4.19.
23. (b)
   *Hint:* See Fig. 4.19.
24. (d)
25. (c)
   *Discussion:* (b) is correct for very dense state of packing of spherical sand particles.
26. (c)
27. (b)
28. (d)