PRACTICE QUESTIONS

for SSC-JE : CBT-2

Soil Mechanics

Civil Engineering

04 Soil Mechanic

Q.1 A partially saturated soil is classified as :
(a) One Phase Soil (b) Two Phase Soil
(c) Three Phase Soil (d) Four Phase Soil

Q.2 Aeolian soils are
(a) Residual soils
(b) Wind deposits
(c) Gravity deposits
(d) Water deposits

Q.3 Bulk unit weight of soil is 18.5 kN/m^3, water content available is 22% and the specific gravity of the soil solid is 2.85. The void ratio of the soil is
(a) 0.84 (b) 0.74
(c) 0.63 (d) 0.91

Q.4 Which of the following methods is not used for measuring in-situ density of compacted soils?
(a) Cassagrande's Method
(b) Water Displacement Method
(c) Sand Replacement Method
(d) Water Balloon Method

Q.5 A soil has liquid limit = 32%, plastic limit = 18%, shrinkage limit = 8% and natural moisture content = 22%. What will be its liquidity index and plasticity index?
(a) 0.67 and 15% (b) 0.285 and 14%
(c) 0.67 and 25% (d) 0.33 and 20%

Q.6 Which one of the following expresses the degree of disturbance of undisturbed clay sample due to remoulding?
(a) Thixotropy (b) Dilatancy
(c) Sensitivity (d) Plasticity

Q.7 The maximum possible value of group index of soil is :
(a) 5 (b) 10
(c) 15 (d) 20

Q.8 Which of the following is not a clay mineral?
(a) Alite (b) Montmorillonite
(c) Illite (d) Kaolinite

Q.9 In which soil structure are the particles arranged more or less parallel to each other?
(a) Single grained (b) Honeycomb
(c) Flocculent (d) Dispersed

Q.10 The optimum moisture content of a clay soil is 34%. If its compaction test is conducted at 30% moisture content, its structure will be
(a) Flocculated (b) Single grained
(c) Honeycomb (d) Dispersed

Q.11 A soil mass has coefficients of horizontal and vertical permeability as 9×10^{-7} m/s and 9×10^{-7} m/s respectively. The transformed coefficient of permeability of an equivalent isotropic soil mass is :
(a) 9×10^{-7} cm/s (b) 9×10^{-5} cm/s
(c) 18×10^{-7} cm/s (d) 18×10^{-5} cm/s

Q.12 In a pumping out test, the drawdown is 5 m. If the coefficient of permeability of the soil is 10^{-4} m/s radius of influence will be about
(a) 250 m (b) 300 m
(c) 150 m (d) 200 m

Q.13 If the coefficient of permeability for the soil is 10^{-7} cm/s, then the soil can be classified as :
(a) Clay (b) Silt
(c) Sand (d) Gravel

Q.14 A fully saturated capillary zone of thickness 2.8 m exists above water table in a fine silty sand deposit. What is the pore water pressure at 1.3 m above the water table? (Take $\gamma_w = 10$ kN/m^3).
(a) 15 kN/m^2 (b) –13 kN/m^2
(c) –15 kN/m^2 (d) 13 kN/m^2

Q.15 For a void ratio of 0.60, the relationship between the specific gravity of soil solids (G_s) and the hydraulic gradient (i) for the quicksand condition is :
(a) $G_s = 0.6i + 1$ (b) $G_s = i + 0.6$
(c) $G_s = 1.6i + 1$ (d) $G_s = 1.6i - 1$

Q.16 Rise of water table above the ground surface causes
(a) Equal increase in pore water pressure and total stress.
(b) Equal decrease in pore water pressure and total stress.
(c) Increase in pore water pressure but decrease in total stress.
(d) Decrease in pore water pressure but increase in total stress.

Q.17 During seepage through an earthen mass, the direction of seepage is :
(a) Parallel to the equipotential lines
(b) Perpendicular to the stream lines
(c) Perpendicular to the equipotential line
(d) Along the direction of gravity

Q.18 The Westergaard's analysis is used for
(a) Homogeneous soils
(b) Cohesive soils
(c) Sandy soils
(d) Stratified soils

Q.19 The contact pressure distribution under a rigid footing on a cohesionless soil would be
(a) Uniform throughout
(b) Zero at centre and maximum at edges.
(c) Zero at edges and maximum at centre.
(d) Maximum at edges and minimum at centre.

Q.20 Soils that has never been subjected to an effective pressure greater than the existing overburden pressure is called
(a) Normally consolidated
(b) Pre-consolidated
(c) Under-consolidated
(d) Over-consolidated

Q.21 The natural void ratio of a saturated clay strata 3 m thick is 0.90. The final void ratio of the clay at the end of consolidation is expected to be 0.71. The total consolidation settlement of the clay strata is :
(a) 30 cm (b) 25 cm
(c) 20 cm (d) 15 cm

Q.22 The ratio of settlement at any time t to the final settlement is known as
(a) Coefficient of consolidation
(b) Degree of consolidation
(c) Consolidation index
(d) Consolidation of undisturbed soil

Q.23 Settlement due to creep in soils is contingent on
(a) Primary consolidation
(b) Secondary consolidation
(c) Initial settlement
(d) Compaction settlement

Q.24 A clay layer of 5 m is underlain by impervious rock and overlain by sand. The effective drainage path for the rate of settlement of this clay layer is
(a) 2.5 m (b) 5 m
(c) 2 m (d) 4 m

Q.25 An initial cross-sectional area of a clay sample was 25 sq. cm. The failure strain was 25% in an unconfined compression test. The corrected area of the sample at failure would be
(a) $\frac{80}{3}$ cm^2 (b) $\frac{50}{3}$ cm^2
(c) $\frac{100}{3}$ cm^2 (d) $\frac{200}{3}$ cm^2

Q.26 In direct shear test, proving ring is used to measure :
(a) Displacement
(b) Shear load
(c) Compressive load
(d) All of the above

Q.27 In the consolidated drained test on a saturated soil sample, pore water pressure is zero during
(a) Consolidation stage only
(b) Shearing stage only
(c) Both consolidation and shearing stage
(d) Loading stage

Q.28 Rise of water table in cohesionless soils upto ground surface reduces the ultimate bearing capacity approximately by
(a) 10% (b) 25%
(c) 50% (d) 75%

Q.29 Which of the following assumption is not made for the friction circle method of slope stability analysis ?
(a) Friction is fully mobilised
(b) Total stress analysis is applicable
(c) The resultant is tangential to friction circle
(d) The resultant passes through the centre of friction circle

Q.30 Active earth pressure of a soil is defined as the lateral pressure exerted by the soil when:
(a) The retaining wall is at rest.
(b) The retaining wall tends to move away from the backfill.
(c) The retaining wall moves towards the backfill.
(d) None of the above

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Answer Keys

1. (c)	2. (b)	3. (a)	4. (a)	5. (b)	6. (c)	7. (d)
8. (a)	9. (d)	10. (a)	11. (b)	12. (c)	13. (a)	14. (b)
15. (c)	16. (a)	17. (c)	18. (d)	19. (c)	20. (a)	21. (a)
22. (b)	23. (b)	24. (b)	25. (c)	26. (b)	27. (c)	28. (c)
29. (d)	30. (b)					

Detailed Solutions

1. (c)

- Partially saturated soil are three phase soil.

- Fully saturated soil and dry soil are two phase soil.

Fully Saturated Soil | Dry Soil

2. (b)

Soils deposited by wind are known as Aeolian soils.

3. (a)

Given :

Bulk unit weight, $\gamma = 18.5\ \text{kN/m}^3$

Water content, $w = 22\%$

Specific gravity, $G_s = 2.85$

Dry density of soil, $\gamma_d = \dfrac{\gamma}{1+w} = \dfrac{18.5}{1+0.22} = 15.16\ \text{kN/m}^3$

Also, $\gamma_d = \dfrac{G_s \cdot \gamma_w}{1+e}$

$\Rightarrow$ $e = \dfrac{G_s \cdot \gamma_w}{\gamma_d} - 1$

$= \dfrac{2.85 \times 9.81}{15.16} - 1 = 0.84$

4. (a)

The following methods are generally used for the determination of in-situ density of compacted soils :

(a) Water displacement method
(b) Submergence mass density method
(c) Sand replacement method
(d) Water balloon method
(e) Radiation method

5. (b)

Given : $w_l = 32\%,\ w_n = 22\%,\ w_P = 18\%$

Liquidity Index, $I_L = \dfrac{w_n - w_P}{w_l - w_P}$

$= \dfrac{22-18}{32-18} = \dfrac{4}{14} = 0.285$

Plasticity Index, $I_P = w_l\,(\%) - w_P\,(\%)$

$= 32 - 18 = 14\%$

6. (c)

- Sensitivity is a measure of the loss in strength of soils as a result of remoulding and is thus indicative of the effect of remoulding on the consistency of a cohesive soil.
- Thixotropy is the property of certain clays by virtue of which they regain, if left alone for a time, a part of the strength lost due to remoulding, at unaltered moisture content.

7. (d)

$$\text{G.I.} = 0.2a + 0.005ac + 0.01bd$$

According to this formula, the minimum possible value of group index is zero. Maximum possible value is 20.

8. (a)

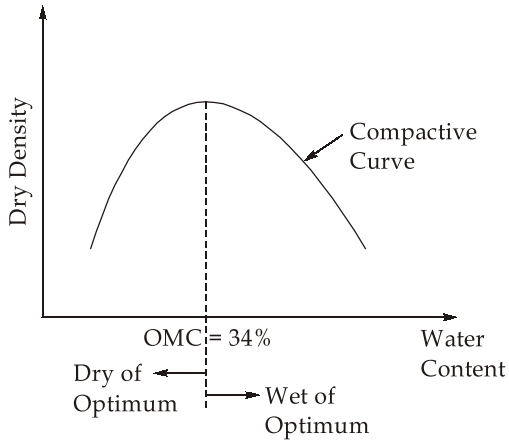
Different clay mineral :

(i) Kaolinite
(ii) Montmorillonite
(iii) Illite

9. (d)

Dispersed structure develops in clays that have been remoulded. The particle develops more or less parallel orientation.

10. (a)



Given : Moisture content = 30% (< OMC) ⇒ Dry of optimum

Hence, structure after compaction will be flocculated.

11. (b)

Given : $K_H = 9 \times 10^{-7}$ m/s

$K_V = 9 \times 10^{-7}$ m/s

$\therefore \quad K_{eq} = \sqrt{K_H \times K_V} = \sqrt{9\times10^{-7} \times 9\times10^{-7}}$

$= 9 \times 10^{-7}$ m/s $= 9 \times 10^{-5}$ cm/s

12. (c)

Pumping out test is the field method of determination of permeability of soil.

In pumping out test,

Radius of influence, $R = 3000S\sqrt{K}$

S = Drawdown = 5 m

K = Coefficient of permeability

$= 10^{-4}$ m/s

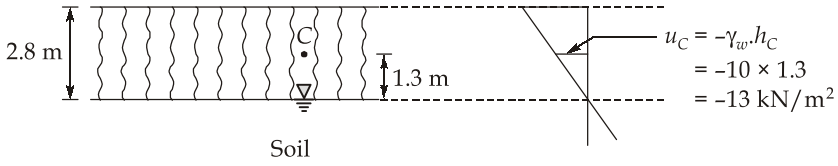
$\therefore \quad R = 3000 \times 5 \times \sqrt{10^{-4}} = 150$ m

13. (a)

Typical values of permeability are as listed in the table below :

Soil Type	Coefficient of Permeability (cm/s)
Gravel	> 1
Sand	$1 - 10^{-3}$
Silt	$10^{-3} - 10^{-6}$
Clay	$< 10^{-6}$

14. (b)



15. (c)

For quick sand condition

$$i = \frac{G_s - 1}{1 + e}$$

Given : $e = 0.60$

$\Rightarrow$ $G_s = 1.6i + 1$

16. (a)

If the water table is above the ground level, the variation in G.W.T. level will not affect the effective stress as there is equal increase in pore water pressure and total stress.

17. (c)

During seepage through earth mass, direction of seepage is

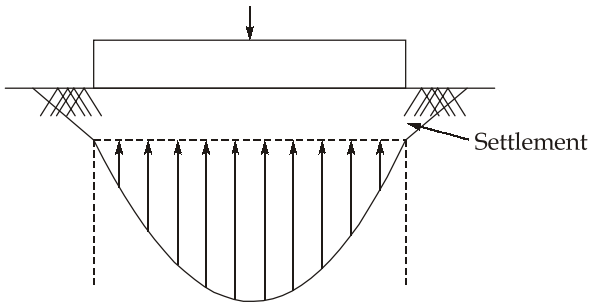
- perpendicular to the equipotential lines
- parallel to the flow line

18. (d)

Westergaard's solution represents more closely the actual sedimentary deposits, i.e., the soil condition in a layered soil deposits are perhaps more closely simulated by the Westergaard's assumption.

19. (c)

Contact pressure on sand: If the footing is rigid, the settlement is uniform. The contact pressure increases from zero at the edges to a maximum at the centre.



20. (a)

A soil is said to be normally consolidated when the existing effective stress is the maximum that it have ever experienced in its stress history.

21. (a)

Consolidation settlement :

$$\Delta H = \frac{\Delta e}{1+e_o} H_o$$

$$= \frac{0.90-0.71}{1+0.9} \times 3 = 0.3 \text{ m} = 30 \text{ cm}$$

22. (b)

Degree of consolidation (U)

$$U = \frac{\text{Settlement at any stage}}{\text{Settlement at the end of consolidation}}$$

$$= \frac{\Delta h}{\Delta H}$$

23. (b)

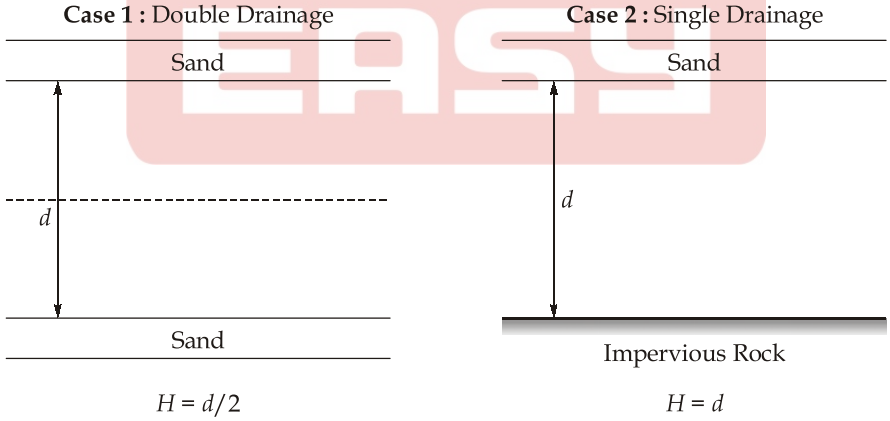
In secondary consolidation of soil volume change takes place at constant effective stress which is similar to creep phenomenon, in which deformation takes place at constant effective stress.

24. (b)

We know that

$$\text{Time factor, } T_V = \frac{C_V t}{H^2}$$

H = Maximum distance that water has to travel to reach a drainage face, i.e., length of longest drainage path



Here, $d = 5$ m

Case is single drainage.

Hence, effective drainage path (H) = 5 m.

25. (c)

$$A_f = \frac{A_o}{1-\varepsilon} = \frac{25}{1-(0.25)} = \frac{25}{\left(\frac{3}{4}\right)} = \frac{100}{3}\ \text{cm}^2$$

26. (b)

In direct shear test, the magnitude of the shear load is measured by means of a proving ring. The shear deformation as well as the vertical deformation (change in thickness) are measured during the test with the help of dial gauges.

27. (c)

Consolidated means drainage is allowed in first stage.

Drained means drainage is allowed in second stage.

So, in consolidated drained test, drainage is allowed in both the stages. Hence, pore water pressure is zero in both stages.

28. (c)

For cohesionless soil:

$$q_u = \gamma_{sat} D_f N_q + 0.5B\gamma_{sat} N_\gamma$$

If W.T. rises to G.L

$$q_u = \gamma_{sub} D_f N_q + 0.5B\gamma_{sub} N_\gamma$$

$$= \frac{\gamma_{sat}}{2} D_f N_q + 0.5B\frac{\gamma_{sat}}{2} N_\gamma \qquad \left(\gamma_{sub} \simeq \frac{\gamma_{sat}}{2}\right)$$

from above, it is clear that if water table rises to G.L. in the sand, bearing capacity approximately reduced by 50%.

29. (d)

This method is based on total stress analysis, but it enables the angle of shearing resistance to be taken into account. Also, it is based on the assumption that the resultant force 'R' on the rupture surface is tangential to a circle of radius 'R sin ϕ' which is concentric with the trial slip circle.

30. (b)

Lateral earth pressure can be divided into 3 categories depending upon the movement of retaining wall with respect to backfill soil :

Earth pressure at rest → Wall does not move at all

Active earth pressure → Wall moves away from the backfill

Passive earth pressure → Wall moves towards the backfill

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