Soil Mechanics Test 1

Number of Questions: 25 **Time: 60 min.**

Directions for questions 1 to 25: Select the correct alternative from the given choices.

1. Which of the following is a type of chemical weathering
(A) oxidation (B) wedging
(C) abrasion (D) temperature effect

2. Which of the following is the characteristic of a flocculated clay structure
(A) low shear strength
(B) low permeability
(C) low compressibility
(D) None of these

3. In oven drying method a temperature of 60°C to 80°C is preferred when
(A) high organic soils are present
(B) Gypsum is present
(C) inorganic particles are present
(D) high clay content is present

4. When $C_u > 4$ and C_c is lies between 1 and 3 the soil can be classified as
(A) uniformly graded soil
(B) well graded soil
(C) gap graded soil
(D) Coarse grained soil

5. The notations GP and SM represent
(A) silty gravel and silty sand
(B) clayey gravel and clayey sand
(C) well graded gravel and well graded sand
(D) poor graded gravel and silty sand

6. A soil is said to be highly permeable when
(A) $K > 10^{-1}$ cm/sec (B) $K > 10^{-3}$ cm/sec
(C) $K < 10^{-1}$ cm/sec (D) $K < 10^{-3}$ cm/sec

7. The process of softening of soil due to increase in water content caused by melting of ice formed in soil is
(A) frost heave (B) frost boil
(C) Thawing (D) Capillary fringe

8. Effective stress in soil increased if the flow is
(A) downwards (B) zig-zag
(C) upwards (D) uniform

9. Space between any two adjacent flow lines and adjacent equi potential lines is called
(A) flow net (B) flow line
(C) flow field (D) flow path

10. The chart used to find the vertical stress on westergaard's equation is known as
(A) influence chart
(B) isobar chart
(C) Fenske's chart
(D) None of the above

11. Match the following

	Source of Transportation		Type of Soil
1.	River	i.	colluvial soil
2.	Gravitation	ii.	Aeolian soil
3.	Wind	iii.	Alluvial soil
4.	Lakes	iv.	Lacustrine soil

(A) (1 – iii), (2 – i), (3 – ii), (4 – iv)
(B) (1 – ii), (2 – iii), (3 – iv), (4 – i)
(C) (1 – iv), (2 – iii), (3 – i), (4 – ii)
(D) (1 – i), (2 – iv), (3 – ii), (4 – iii)

12. A sample of soil deposit has a void ratio of 1. If the void is reduced to 0.3 by compaction, the % volume loss is
(A) 58% (B) 56%
(C) 54% (D) 34%

13. The following data is obtained from the liquid limit test conducted on soil sample

No. of blows	20	25	30	35	40
Water content	64.2	63.9	62.5	61.9	61.8

(A) 61.9% (B) 61.8%
(C) 63.9% (D) 64.2%

14. In falling head permeability test on a sample 13.4 cm high and 48.4 cm^2 in cross sectional area, the water level in a stand pipe of 5.25 mm internal diameter dropped from a height diameter dropped from a height of 65 cm to 25 cm in 20 min. The coefficient of permeability ($\times 10^{-4}$ cm/sec) is
(A) 0.58 cm/sec (B) 0.47 cm/sec
(C) 0.53 cm/sec (D) 0.54 cm/sec

15. A glass container with pervious bottom has a sand with void ratio = 0.6. If the specific gravity of sand particles = 2.65, area of c/s = 20 m^2, head of water required to cause quick sand condition is (take L = 10 m)
(A) 10.1 m (B) 11.3 m
(C) 10.8 m (D) 10.3 m

16. In a flow net there are 10 flow channel and 20 equipotential drops, the quantity of seepage if head loss is 4 m and $k = 3 \times 10^{-5}$ m/s is
(A) 24×10^{-5} m^3/s (B) 6×10^{-5} m^3/s
(C) 8×10^{-5} m^3/s (D) 22×10^{-5} m^3/s

Common Data for Questions 17 and 18:
A soil profile consists of a surface layer of sand 4 m thick (γ = 1.8 t/m^3), an intermediate layer of clay 3.8 m thick (γ = 2.3 t/m^3) and the bottom layer of gravel 5 m thick (γ = 1.98 t/m^3). The water table is at upper surface of clay layer (take $_w$ = 0.98 t/m^3)

17. Effective stress at 7.8 m from the surface is
(A) 8.58 t/m^3 (B) 8.64 t/m^3
(C) 12.21 t/m^3 (D) 8.58 t/m^3

18. Effective stress at 12.8 m from the surface is
(A) 14.9 t/m^3 (B) 17.21 t/m^3
(C) 14.8 t/m^3 (D) 15.3 t/m^3

A saturated clay has water content 39.3% and bulk sp-gravity 1.84

19. Specific gravity of soil is
(A) 2.73 (B) 2.78
(C) 2.74 (D) 2.79

20. Void ratio of soil is
(A) 1.05 (B) 1.2
(C) 1.07 (D) 1.8

21. (i) Soil with largest void ratio has less permeability
(ii) Permeability of partially saturated soils is considerably smaller than that of fully saturated soils
(A) (i) is true and (ii) is false
(B) (i) is false and (ii) is true
(C) (i) and (ii) are false
(D) (i) and (ii) are true

22. The Plastic limit and liquid limit of the soil are 33% and 45% respectively. The percentage of clay fraction 30%. The activity of clay is
(A) 0.3 (B) 0.4
(C) 2.5 (D) 2.8

23. The unit weight of sand back fill was found to be 1746 kg/m^3. The water content is 6.6% and unit weight of soil constituents is 2.6 g/cc. In laboratory the void ratio of loosest and densest states were found to be 0.842 and 0.622 respectively. The relatively density of soil is
(A) 1.23 (B) 1.86
(C) 1.18 (D) 1.15

24. A soil has the liquid limit of 50% and plastic limit of 30%. Then the classification of soil will be
(A) CL (B) CI
(C) CH (D) MH

25. Sedimentation method generally used in the field of soil mechanics is
(A) successive sedimentation
(B) observation of the amount of sediment per unit volume at a given point
(C) observation of total amount of soil in suspension above a given elevation
(D) observation of total sedimentation soil

Answer Keys

1. A	**2.** C	**3.** B	**4.** B	**5.** D	**6.** A	**7.** B	**8.** A	**9.** C	**10.** C
11. A	**12.** D	**13.** C	**14.** B	**15.** D	**16.** B	**17.** C	**18.** B	**19.** C	**20.** C
21. D	**22.** B	**23.** D	**24.** B	**25.** B					

Hints and Explanations

12. $\frac{V_1}{V_2} = \frac{1+e_1}{1+e_2}$ given: $e_1 = 1$

$e_2 = 0.3$

$\frac{V_1}{V_2} = \frac{1+1}{1+0.3} = \frac{2}{1.3}$

$V_1 = 1.53\ V_2$

$\%\ \text{loss in volume} = \frac{V_1 - V_2}{V_1} \times 100$

$= \frac{1.53V_2 - V_2}{V_1} \times 100$

$= \frac{0.53V_2}{V_1} \times 100 = 34\%$ Choice (D)

13. The liquid limit of soil is water content at which part of soil cut by a groove will flow together for a distance of 12 mm under an impact of 25 blows in casagrande's apparatus.

$w_L = 63.9\%$ Choice (C)

14. In falling head permeability test

$$K = \frac{a.\mathrm{L}}{A.t}\log_e\left(\frac{h_1}{h_2}\right)$$

Given

$$a = \frac{\pi d^2}{4} = \frac{\pi}{4}\left(52.5\times10^{-1}\right)^2 = 0.216\ \text{cm}^2$$

$L = 13.4$ cm
$A = 48.4$ cm^2
$h_1 = 55$ cm
$h_2 = 25$ cm
$t = 20$ min

$$k = \frac{0.216\times13.4}{48.4\times20}\times\log_e\left(\frac{65}{25}\right)$$

$= 28.61$ cm/min $= 0.47 \times 10^{-4}$ cm/sec Choice (B)

15. Head required to cause quick sand condition is

$$h = \frac{r^1 L + q}{r_w}$$

$r^1 = r_{sat} - r_w$

$$r_{sat} = \frac{r_w(G+e)}{1+e}$$

$$= \frac{9.8(2.65+0.6)}{1+0.6} = 19.9\text{kN/m}^3$$

$r^1 = 19.9 - 9.8 = 10.1\ \text{kN/m}^3$

In the given problem $q = 0$

$$\therefore \quad h = \frac{10.1 \times 10}{9.8} = 10.3\text{m}$$ Choice (D)

16. Seepage quantity

$$q = K.H.\left(\frac{N_f}{N_d}\right)$$

$N_f = 10$
$N_d = 20$
$K = 3 \times 10^{-5}$ m/s
$H = 4$m

$$q = 3 \times 10^{-5} \times 4 \times \left(\frac{10}{20}\right)$$

$= 6 \times 10^{-5}\ \text{m}^3/\text{s}$ Choice (B)

17. Effective stress = total stress – Pore water pressure total stress at 7.8 m from surface
$= (1.8 \times 4) + (3.8 \times 2.3)$
$= 15.94\ \text{t/m}^3$
Pore water pressure
$= 3.8 \times 0.98 = 3.724\ \text{t/m}^3$
$\therefore$ Effective stress = 15.94 – 3.72
$= 12.216\ \text{t/m}^3$ Choice (C)

18. Total stress at 12.8m from the surface is
$= (1.8 \times 4) + (3.8 \times 2.3) + (5 \times 1.98)$
$= 25.84\ \text{t/m}^3$
$\therefore$ Effective stress = $25.84 - (0.98 \times 8.8)$
$= 17.216\ \text{t/m}^3$ Choice (B)

19. $(G_m)_{sat} = 1.84$

$$\frac{\gamma_{sat}}{\gamma_w} = 1.84$$

$$e = \frac{wG}{s}[s=1]$$

$$\frac{(G+e)}{1+e} = 1.84$$

$$\frac{G + 0.393\,G}{1 + 0.393\,G} = 1.84$$

$G = 2.74$ Choice (C)

20. $e = \dfrac{wG}{s}$

$$e = 2.74 \times \frac{39.3}{100} = 1.07$$ Choice (C)

22. Activity of clay $= \dfrac{lp}{c}$

$$= \frac{W_L + W_R}{C} = \frac{45\ 33}{30} = 0.4$$ Choice (B)

23. Relative density $= \dfrac{e_{\max} - e_o}{e_{\max} - e_{\min}}$

$$\gamma_d = \frac{\gamma}{1+w} = \frac{r_W G}{1+e_O}$$

$$\frac{1.746}{1+\frac{6.6}{100}} = \frac{1 \times 2.6}{1+e_O}$$

$$1.637 = \frac{2.6}{1+e_O}$$

$e_o = 0.587$

$$\text{Relative density} = \frac{0.842\ \ 0.587}{0.842\ \ 0.622} = 1.15$$ Choice (D)