



POSTAL BOOK PACKAGE 2026

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CIVIL ENGINEERING

Objective Practice Sets

Soil Mechanics and Foundation Engineering

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Properties of Soils

Q.1 Consider the following statements:

1. In three phase system, soil contains solids, water and air.
2. In two phase system, soil contain solid and air in dry system or solid and water in wet phase.

Which of the following is correct?

- (a) Both statements are correct
- (b) Statement 1 is correct and 2 is false
- (c) Statement 2 is correct and 1 is false
- (d) Both statements are false

Q.2 Which of the following can be used for determination of water content in the field as well as in laboratory?

- (a) Oven drying method
- (b) Pycrometer method
- (c) Rapid moisture meter method
- (d) Torsion balance moisture meter method

Q.3 Consider the following statements regarding hydrometer analysis for sedimentation analysis

1. Meniscus correction is always positive
2. Temperature correction is negative if temperature is above 27°C
3. Temperature correction is positive if temperature is below 27°C

Which of the following statement(s) is/are correct?

- a) Only 1
- b) 1 and 2
- c) 2 and 3
- d) 1, 2 and 3

Q.4 The difference between maximum void and minimum void ratio of a sand sample is 0.30. If the relative density of this sample is 66.6% at a void ratio of 0.40, then the void ratio of this sample at its loosest state will be:

- (a) 0.40
- (b) 0.60
- (c) 0.50
- (d) 0.75

Directions : Each of the next items consists of two statements, one labelled as 'Statement (I)' and the other as 'Statement (II)'. Examine these two statements

carefully and select the answers to these items using the codes given below:

Codes:

- (a) Both Statement (I) and Statement (II) are individually true; and Statement (II) is the correct explanation of Statement (I)
- (b) Both Statement (I) and Statement (II) are individually true; but Statement (II) is NOT the correct explanation of Statement (I)
- (c) Statement (I) is true; but Statement (II) is false
- (d) Statement (I) is false; but Statement (II) is true

Q.5 Statement (I): In a partially saturated soil, void ratio remains constant with change in water content.

Statement (II): In saturated soil mass, void ratio changes with change in water content due to change in volume of solids.

Q.6 Statement (I): If a non-plastic soil is mixed with high plastic soil (clay), then plasticity of clay reduces.

Statement (II): Due to mixing, liquid limit and plastic limit both reduces but loss in liquid limit is less than loss in plastic limit.

Q.7 Minimum value of relative compaction is _____

Q.8 When a soil sample is placed in an oven for 24 hr at 105°C,

1. hygroscopic moisture is lost
2. capillary water is lost
3. free water is lost
4. structural water is lost

Which of the above statements are correct?

- (a) 1, 2 and 4
- (b) 2 and 4
- (c) 1, 2, 3 and 4
- (d) 1, 2, and 3

Q.9 Consider the following regarding consistency index

1. If consistency index > 1 , then soil is in either solid or semi solid state.

2. If consistency index is between 0 and 1, then soil is in plastic state.
3. If consistency index is less than zero, then soil is in liquid state.
4. Consistency index is directly related to liquidity index.

Which of the above statements are correct?

- (a) 1, 2 and 4 (b) 1, 2 and 3
(c) 2, 3 and 4 (d) 1, 2, 3 and 4

Q.10 Which of the following can be determined for both undisturbed and remoulded soils?

- (a) Liquid limit (b) Plastic limit
(c) Shrinkage limit (d) None of these

Q.11 The minimum water content at which the soil just begins to crumble when rolled into threads of 3 mm diameter is known as

- (a) liquid limit
(b) plastic limit
(c) shrinkage limit
(d) optimum water content

Q.12 Water content is accurately determined by

- (a) Calcium carbide method
(b) Sand bath method
(c) Alcohol method
(d) Oven-drying method

Q.13 Which of the following statement(s) is(are) true about sensitivity of soil?

1. It is ratio of confined compressive strength of disturbed soil to that of remoulded soil.
 2. Gravels are sensitive in nature.
- (a) Both 1 and 2
(b) Statement 1 is true but 2 is false
(c) Statement 2 is true but 1 is false
(d) Both statements are false

Q.14 When water content is decreased, reduction in volume is observed in

- (a) liquid state (b) plastic state
(c) semisolid state (d) All of these

Q.15 A clayey soil has saturated moisture content of 18%. Its saturation percentage is 70%. The soil is allowed to absorb water and saturation increases to 92% after some time. Assume specific gravity of soil to be 2.72, the water content of soil in later case is

- (a) 20.26 (b) 23.66
(c) 21.24 (d) 25.61

Q.16 A natural deposit of loose, dry sand of 6 m thickness, having unit weight of 15 kN/m^3 is compacted and surface settles by 0.5 m. Relative density of sand after compaction is 90%. The dry unit weight in loosest state is 11 kN/m^3 . Calculate the dry unit weight in the densest state in kN/m^3

- (a) 16.85 (b) 17.29
(c) 18.36 (d) 19.46

Q.17 One cubic metre of soil weighs 1624 kg and after drying, 1400 kg. If specific gravity of solids is 2.65, determine the degree of saturation of soil

- (a) 45.23% (b) 47.49%
(c) 50.51% (d) 16%

Q.18 A sampler with a volume of 45 cm^3 is filled with a soil sample. When the soil is poured into a graduated cylinder, it displaces 25 cm^3 of water. The value of porosity of the soil is

- (a) 0.8 (b) 0.44
(c) 0.5 (d) 0.58

Q.19 800 g of wet sandy sample was placed in a pycnometer. The mass of the pycnometer, sand and water full to the top is 2200 g and mass of pycnometer filled with water only is 1800 g. The value of water content if $G = 2.65$ is _____

Q.25 In a liquid limit test, the moisture content at 10 blows was 70% and that at 100 blows was 20%, the liquid limit of the soil is

- (a) 35% (b) 61.67%
(c) 50.1% (d) 65%

Q.21 The liquid limit and plastic limit of soil are 50% and 30% and percentage of particles coarser than 2 microns in clay is 60%. Then activity of soil is

- (a) 0.33 (b) 0.5
(c) 1.0 (d) 1.33

Q.22 Which of the following is not an assumption of Stoke's law (Grain size analysis of soils)?

- (a) The falling soil particle (grain) is spherical
(b) The velocity of a free fall of a single sphere is in suspension of infinite extent
(c) An average value of specific gravity of grains is used in computing the Stoke's formula
(d) The finer particles of soil do not have tendency for floc formation

Q.23 A sample of dry soil having specific gravity of 2.74 and having a mass of 133.7 g is uniformly dispersed

in water to form 1000 cc of suspension. The density of suspension immediately after it is prepared will be

- (a) 1085 kg/m³ (b) 951 kg/m³
(c) 134 kg/m³ (d) 400 kg/m³

Q.24 If the material of the base of the Casagrande's standard liquid limit test apparatus is softer than the standard hard rubber, then

- (a) the liquid limit will always increase
(b) the liquid limit will always decrease
(c) the liquid limit may sometimes increase and sometimes decrease, depending upon the soil type
(d) the liquid limit will not be affected

Q.25 The addition of coarser particle soils like sand or silt causes

- (a) decrease in liquid limit as well as in plasticity index
(b) decrease in liquid limit and increase in plasticity index
(c) increase in liquid limit as well as in plasticity index
(d) decrease in liquid limit and no change in plasticity index

Q.26 A soil attains the maximum dry unit weight of 18.6 kN/m³ at a water content of 15%, during a compaction test. If specific gravity of soil is 2.7, then air content of the soil per m³ of soil is

- (a) 0.45 (b) 0.95
(c) 0.045 (d) 4.5

Q.27 The following index properties were determined for four soil samples A, B, C and D.

Soil	A	B	C	D
Liquid Limit	0.50	0.49	0.43	0.47
Plastic Limit	0.23	0.17	0.21	0.26

Which one of these soil samples contains maximum clay particles?

- (a) A (b) B
(c) C (d) D

Q.28 Consider the following statements:

- I. Consistency as applied to clay is an indicator of its moisture content.
- II. Rock dust particles even of clay size, are non-plastic.

III. Liquidity index can have a negative value.

Which of the above statements are CORRECT?

- (a) I, II and III (b) I and II
(c) II and III (d) I and III

Q.29 A soil may be classified as soil of medium plasticity, if the plasticity index (PI) lies between

- (a) 0 to 11 (b) 11 to 22
(c) 22 to 36 (d) 36 to 51

Q.30 Consider the following statements:

1. A soil is said to be well graded when it has good representation of particles of all sizes.
2. A soil is said to be uniformly graded if it has an excess of certain particles and deficiency of others.
3. Uniformity coefficient is the measure of particle size range.

Which of these statements is/are correct?

- (a) only 2 (b) both 2 and 3
(c) both 1 and 3 (d) 1, 2 and 3

Q.31 Consider the following statements:

1. Increase in volume of a soil sample without external constraints on submergence in water is termed as the 'free swell of soil'.
2. Clay soil rich in montmorillonite exhibits very low swelling characteristic.
3. Generally, free swell of soil sample ceases when its water content reaches the plastic limit.

Which of these statements are correct?

- (a) 1 and 2 (b) 1 and 3
(c) 2 and 3 (d) 1, 2 and 3

Q.32 Clays are compressible because of

1. expulsion of water in between soil layers
2. bending of particles on elastic sheet
3. slipping of particles to different positions of greater density

Which of these statement/s is/are correct?

- (a) Only 3 (b) Both 1 and 3
(c) Both 2 and 3 (d) 1, 2 and 3

Q.33 A soil has liquid limit of 50% and plastic limit of 30%. When the soil at its liquid limit was dried, the percentage decrease in volume was 40% of its dry volume. When it was dried from its plastic limit the percentage decrease in volume was 20%

of its dry volume. Shrinkage limit of soil will be

- (a) 10% (b) 20%
(c) 25% (d) 50 %

Q.34 A fill having a volume of 1,50,000 cum is to be constructed at a void ratio of 0.8. The borrow pit soil has a void ratio of 1.4. The volume of soil required (in cubic metres) to be excavated from the borrow pit will be

- (a) 1, 87,500 (b) 2, 00, 000
(c) 2, 10, 000 (d) 2, 50, 000

Q.35 The water content of a saturated soil and the specific gravity of soil solids were found to be 32% and 2.65, respectively. Assuming the unit weight of water to be 10 kN/m³, the saturated unit weight (kN/m³) and the void ratio of the soil are

- (a) 18.93, 0.848 (b) 18.54, 0.32
(c) 18.93, 0.424 (d) 18.54, 0.424

Q.36 A soil is composed of solid spherical grains of identical specific gravity and diameter between 0.08 mm and 0.008 mm. If the terminal velocity of the largest particle falling through water without flocculation is 0.6 mm/s, then for the smallest particle, would be

- (a) 0.006 mm/sec (b) 0.06 mm/sec
(c) 5 mm/sec (d) 50 mm/sec

Q.37 The consistency of a saturated cohesive soil is affected by

- (a) water content
(b) particle size distribution
(c) density index
(d) coefficient of permeability

Q.38 The laboratory test on a sample yield the following results, natural moisture content = 20%, liquid limit 65%, plastic limit 35%, % of clay size fraction = 25%. The liquidity and activity (as per the expression proposed by skempton) of the soil, respectively are :

- (a) -0.5, 1.2 (b) 0.5, 1.2
(c) -1.5, 0.833 (d) 1.5, 0.833

Q.39 The clay mineral, whose structural units are held together by potassium bond is

- (a) Halloysite (b) Illite
(c) Kaolinite (d) Smectite

Q.40 The correct sequence of plasticity of minerals in soil in an increasing order is

- (a) silica, kaolinite, illite, montmorillonite
(b) kaolinite, silica, illite, montmorillonite
(c) silica, kaolinite, montmorillonite, illite
(d) kaolinite, silica, montmorillonite, illite

Q.41 In comparison to Atterberg limits of normal soils, the expansive soils have which of the following?

1. More liquid limit
2. Less plastic limit
3. Less shrinkage limit
4. More volumetric shrinkage

Select the correct answer using the codes given below:

- (a) 1, 2, 3 and 4 (b) 1, 3 and 4 only
(c) 2 and 3 only (d) 1, 2 and 4 only

Q.42 Consider the following statements:

1. Each year, black cotton soil appreciably shrinks during dry season and swells during rainy season. This alternate cycle of shrinking and swelling causes severe stresses in structures supported directly by such soil.
2. Black cotton soil contains predominantly a clay mineral called kaolinite, which is responsible for causing appreciable shrinking and swelling.
3. Shrinking and swelling of black cotton soils are observed only upto a certain depth below the ground level. Below that level, there is neither shrinking nor swelling.

Which of these statements is/are correct?

- (a) 1, 2 and 3 (b) 3 only
(c) 2 and 3 only (d) 1 and 3 only

Q.43 Consider the following statements:

1. Peat and muck are organic soils.
2. Peat is an inorganic soil whereas muck is an organic soil.
3. Indurated clay is a type of clay which does not soften under prolonged wetting.

Which of these statements is/are correct?

- (a) 1, 2 and 3 (b) 2 only
(c) 3 only (d) 1 and 3 only

Q.44 The porosity of a certain soil sample was found to be 80% and its specific gravity was 2.7; the critical hydraulic gradient will be estimated as

- (a) 0.34 (b) 0.92
(c) 1.0 (d) 1.5

Q.45 Consider the following statements:

1. Activity is a property typical of clay soils.
2. An activity value of 7 in a clay soil is indicative of the presence of montmorillonite mineral.
3. An activity value of 7 in a clay soil is indicative of the presence of illite mineral.

Which of these statements are correct?

- (a) 1, 2 and 3 (b) 1 and 2 only
(c) 1 and 3 only (d) 2 and 3 only

Q.46 Statement (I): Clays exhibit more hygroscopicity than sands.

Statement (II): Clays are colloidal and consequently their specific surface is very high.

- (a) Both Statement (I) and Statement (II) are individually true and Statement (II) is the correct explanation of Statement (I).
(b) Both Statement (I) and Statement (II) are individually true but Statement (II) is not the correct explanation of Statement (I).
(c) Statement (I) is true but Statement (II) is false.
(d) Statement (I) is false but Statement (II) is true.

Q.47 Consider the following statements:

1. Illite is largely responsible for the swelling and shrinkage behaviour of clayey soils.
2. A differential free swell value of 55% indicates a soil with low degree of expansiveness.
3. Higher the plasticity index of a soil, greater its swelling potential.
4. A low shrinkage limit of a soil indicates possibility of swelling at low water content.

Which of the above statements are correct?

- (a) 1 and 2 (b) 2 and 3
(c) 1 and 4 (d) 3 and 4

Q.48 A sample of dry soil is coated with a thin layer of paraffin and has a mass of 460 g. It displaced 300 cc of water when immersed in it. The paraffin is peeled off and its mass was found to be 9 g. If the specific gravity of soil solids and paraffin are 2.65 and 0.9 respectively, the voids ratio of soil is nearly

- (a) 0.92 (b) 0.71
(c) 0.59 (d) 0.48

Q.49 The plastic limit and liquid limit of a soil are 30% and 42% respectively. The percentage volume change from liquid limit to dry state is 35% of the dry volume. Similarly, the percentage volume

change from plastic limit to dry state is 22% of the dry volume. The shrinkage ratio will be nearly

- (a) 4.2 (b) 3.1
(c) 2.2 (d) 1.1

Q.50 The ratio of a given volume change in a soil, expressed as percentage of the dry volume, to the corresponding change in water content is called

- (a) Specific gravity of soil solids
(b) Mass-specific gravity of soils
(c) Shrinkage ratio of soils
(d) Density ratio of soils

Q.51 Theoretically possible maximum dry unit weight of soil having $G = 2.65$ and $OMC = 15\%$ is _____ kN/m^3 .

Q.52 Consider the following statements

1. Black cotton soil contains predominantly a clay mineral called kaolinite, which is responsible for causing appreciable shrinkage and swelling.
2. Shrinking and swelling of black cotton soils are observed only upto a certain depth below the ground level. Below that level, there is neither shrinkage nor swelling.

Which of the above statement(s) is/are CORRECT?

- (a) 1 only (b) 2 only
(c) Both 1 and 2 (d) Neither 1 and 2

Q.53 A sample of dry soil is coated with a thin layer of paraffin and has a mass of 450 gm. It displaced 295 cc of water when immersed in it. The paraffin is peeled off and its mass was found to be 9 gm. If the specific gravity of soil solids and paraffin are 2.65 and 0.9 respectively, then the void ratio of soil is equal to _____.

Q.54 A given cohesionless soil has $e_{\max} = 0.88$ and $e_{\min} = 0.48$. In the field the soil is compacted to a mass density of 1800 kg/m^3 at a water content of 11%. Take the mass density of water as 1000 kg/m^3 and G_s as 2.65. The relative density (in %) of the soil is _____.

Q.55 The porosity (n) and the degree of saturation (S) of a soil sample are 0.7 and 40% respectively. In a 200 m^3 volume of the soil, the volume (expressed in m^3) of air is _____.

Q.56 A sample of soil was prepared by mixing a quantity of dry soil with 10% by mass of water. A cylindrical compacted specimen of 16 cm diameter and 13 cm deep, having 6% air content was prepared. The mass of water in kg required to prepare this wet soil mixture is _____.
($G = 2.68$)($\rho_w = 1000 \text{ kg/m}^3$)

Q.57 The in-situ void ratio of a granular soil deposit is 0.5 and the maximum and minimum void ratios obtained for the same soil in the laboratory are 0.75 and 0.25 respectively. If the specific gravity of soil is 2.7 then the soil is in _____ condition.

- (a) Loose (b) Medium dense
(c) Dense (d) Very loose

Q.58 The plasticity index of a soil sample is 4 times its flow index. The toughness index of the sample would be

- (a) 4 (b) 1.0
(c) 2 (d) 0.25

Q.59 Statement (I): The aggregate physical properties in coarse grained soil are function of relative density and particle shape.

Statement (II): Single grained structure is formed when the soil grains settle out independently due to mass derived forces.

- (a) Both Statement (I) and Statement (II) are individually true and Statement (II) is the correct explanation of Statement (I).
(b) Both Statement (I) and Statement (II) are individually true but Statement (II) is not the correct explanation of Statement (I).
(c) Statement (I) is true but Statement (II) is false.
(d) Statement (I) is false but Statement (II) is true.

Multiple Select Questions (MSQ)

Q.60 Which of the following relation(s) are correct?

- (a) $e = \frac{n}{1-n}$ (b) $\gamma_{\text{sat}} = \frac{G+e}{1+e} \gamma_w$
(c) $n = \frac{e}{1+e}$ (d) $e = \frac{w \cdot G}{S}$

where, e = void ratio, n = porosity,
 w = water content, S = degree of saturation
 γ_{sat} = saturated unit weight of soil
 γ_w = unit weight of water

Q.61 A sample of wet silty clay soil has a mass of 126 kg. The following data were obtained from laboratory tests on the sample:

Wet density (ρ_t) = 2.1 g/cm^3

Specific gravity (G_s) = 2.7

Water content (w) = 15%

With reference to this information identify the true results:

- (a) Dry density = 1826.0 kg/m^3
(b) Porosity = 32%
(c) Void ratio = 0.48
(d) Degree of saturation = 84.6%

Q.62 There are two borrow areas A and B which have soils with void ratios of 0.80 and 0.70 respectively. The in place water content is 20% and 15% respectively. The fill at the end of construction will have a total volume of 10000 m^3 , bulk density of 20 kN/m^3 and a placement water content of 22%. The cost of excavation of soil and transportation is Rs. 200/- per 100 m^3 for area A and Rs. 220/- per 100 m^3 for area B. Assume $G_s = 2.65$. With reference to the information given above which of the following option(s) is/are correct?

- (a) Volume of soil excavated from borrow area A is 11350.84 m^3 .
(b) Volume of soil excavated from borrow area B is 10720.23 m^3 .
(c) Borrow area A is more economical.
(d) Borrow area B is more economical

Q.63 The following index properties were determined for two soils A and B:

Index property	Soil A	Soil B
Liquid limit (%)	65	25
Plastic limit (%)	35	20
Water content (%)	50	40
sp. gr. of solids	2.70	2.65
Degree of saturation (%)	100	100

Based on above results, which of the following option(s) is/are correct?

- (a) Soil A contains more clay particles.
(b) Soil A will be a better foundation material upon remoulding.
(c) Soil B contains more clay particles.
(d) Soil B will be a better foundation material upon remoulding.

Q.64 A fine grained soil has 60% (by weight) silt content. The soil behaves as semi-solid when water content is between 15% and 28%. The soil behaves as fluid like when water content is more than 40%. Choose the correct option(s):

- The plasticity index of the soil is 15%.
- The activity of the soil is 0.20.
- The plasticity index of the soil is 12%.
- The activity of the soil is 0.30.

Q.65 The values of liquid limit, plastic limit and shrinkage limit of a soil were reported as below:

Liquid limit (w_L) = 60%

Plastic limit (w_p) = 30%

Shrinkage limit (w_s) = 20%

If a sample of this soil at liquid limit has a volume of 40 cm^3 and its volume measured at shrinkage limit was 23.5 cm^3 , then identify the true option(s):

- Specific gravity of soil solids (G_s) = 2.7
- Shrinkage ratio (R) = 1.755
- Volumetric shrinkage at liquid limit = 70.21%
- Volumetric shrinkage at plastic limit = 17.55%

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Answers	Properties of Soils								
1. (a)	2. (c)	3. (a)	4. (b)	5. (c)	6. (c)	7. 80	8. (d)	9. (b)	10. (c)
11. (b)	12. (d)	13. (d)	14. (d)	15. (b)	16. (b)	17. (b)	18. (b)	19. 24.53	20. (c)
21. (b)	22. (d)	23. (a)	24. (a)	25. (a)	26. (c)	27. (b)	28. (a)	29. (b)	30. (d)
31. (b)	32. (d)	33. (a)	34. (b)	35. (a)	36. (a)	37. (a)	38. (a)	39. (b)	40. (a)
41. (a)	42. (d)	43. (d)	44. (a)	45. (b)	46. (a)	47. (d)	48. (b)	49. (d)	50. (c)
51. 18.60	52. (b)	53. 0.713	54. 61.5	55. 84	56. 0.545			57. (b)	58. (a) 59. (b)
60. (a, b, d)		61. (a, b, c, d)		62. (a, b, c)		63. (a, b)		64. (c, d)	
65. (a, b, c, d)									

Explanations	Properties of Soils
<p>1. (a)</p> <p>In oven dried sample, soil contains solids and air, but in saturated sample, soil contains solids and water.</p>	<p>At loosest state, $e = e_{\max}$</p> <p>Given $e = 0.4$</p> <p>$e_{\min} = 0.3$</p> <p>R.D. = 66.6%</p>
<p>2. (c)</p> <p>Rapid torsion meter method can be used for determination of water content in the field as well as in laboratory.</p>	<p>To find e_{\max}, R.D. = $\frac{66.6}{100}$</p> <p>$= \frac{(e_{\max} - 0.4)}{(e_{\max} - 0.3)}$</p> <p>$e_{\max} = 0.60$</p> <p>$e_{\max} = 0.4 + 0.3 \times 0.666$</p> <p>$= 0.60$</p>
<p>3. (a)</p> <p>In hydrometer analysis, meniscus correction is always positive, temperature correction is positive if temperature is above 27° and it is negative if temperature is below 27°C.</p>	
<p>4. (b)</p> <p>Relative density = $\frac{e_{\max} - e}{e_{\max} - e_{\min}}$</p>	<p>5. (c)</p> <p>In a saturated soil mass, if water is added, volume of voids changes, hence void ratio changes but not due to change in volume of solids.</p>

6. (c)

Due to mixing liquid limit and plastic limit both reduces but loss in liquid limit is more than loss in plastic limit.

7. (80)

Relative compaction

$$= 80 + 0.2 I_D$$

Min. value of $I_D = 0$

∴ Relative compaction = 80

8. (d)

When soil sample is placed in an oven for 24 hours at 105°C then :

- hygroscopic/adsorbed moisture is lost.
- capillary water is lost.
- free water is lost.
- structural water is not lost.

9. (b)

Consistency index,

$$I_C = \frac{W_L - W_N}{I_P} \propto \text{stiffness of soil}$$

The in-situ behaviour of a saturated, fine grained soil deposit at its natural water content may be studied by their consistency index/relative consistency.

Liquidity index,

$$I_L = \frac{W_N - W_P}{I_P}$$

10. (c)

Shrinkage limit can be determined for both undisturbed and remoulded sample of soil.

11. (b)

Minimum water content at which soil just begin to crumble when rolled into threads of 3 mm diameter is known as plastic limit.

12. (d)

Heating can be controlled in oven drying method for finding water content accurately. But in case of calcium carbide method. Sand-bath method and alcohol method heating can't be controlled.

13. (d)

Sensitivity is the ratio of unconfined compressive strength of undisturbed soil to that of remoulded soil.

Gravels are non-sensitive.

14. (d)

Volume is constant when water is below shrinkage limit i.e., solid state.

15. (b)

Initially $w = 18\%$, $S = 70\%$, $G = 2.72$

$$e = \frac{Gw}{S} = \frac{0.18 \times 2.72}{0.7} = 0.699$$

After absorption

$S = 92\%$

$$w = \frac{Se}{G} = \frac{0.92 \times 0.699}{2.72} = 23.66\%$$

16. (b)

$$\gamma_d = \frac{w_s}{V} = 15$$

$$V = 6 \times 1 \times 1 = 6 \text{ m}^3$$

$$w_s = 15 \times 6 = 90 \text{ kN}$$

After compaction,

$$V = 5.5 \times 1 \times 1 = 5.5 \text{ m}^3$$

γ_d after compaction

$$= \frac{90}{5.5} = 16.36 \text{ kN/m}^3$$

$$D_r = \frac{\gamma_{d\max}}{\gamma_d} \times \frac{\gamma_d - \gamma_{d\min}}{\gamma_{d\max} - \gamma_{d\min}}$$

$$0.9 = \frac{\gamma_{d\max}}{16.36} \times \frac{(16.36 - 11)}{\gamma_{d\max} - 11}$$

$$\Rightarrow \gamma_{d\max} = 17.29 \text{ kN/m}^3$$

17. (b)

$$m_w = 1624 - 1400 = 224 \text{ kg}$$

$$V_w = \frac{224}{1000} = 0.224 \text{ m}^3$$

$$m_s = m_d = 1400 \text{ kg}$$

$$V_s = \frac{m_d}{G\rho_w}$$

$$= \frac{1400 \times 1000}{2.65 \times 1} = 0.5283 \text{ m}^3$$

$$V_a = 1 - V_w - V_s$$

$$= 1 - 0.224 - 0.5283 = 0.2477$$

$$V_v = V_a + V_w$$

$$= 0.2477 + 0.2240 = 0.4717 \text{ m}^3$$

$$\text{Water content} = \frac{224}{1400} = 16\%$$