DETAILED SOLUTIONS

MADE EASY

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MPSC 2019 : Main Exam
ASSISTANT ENGINEER

CIVIL ENGINEERING

Test 5

Subjectwise Test-5: Geo-Technical Engineering, Surveying, Estimating, Costing and Valuation

ANSWER KEY

1.	(d)	**11.**	(c)	**21.**	(c)	**31.**	(d)	**41.**	(a)
2.	(a)	**12.**	(c)	**22.**	(c)	**32.**	(c)	**42.**	(a)
3.	(c)	**13.**	(a)	**23.**	(d)	**33.**	(d)	**43.**	(d)
4.	(c)	**14.**	(c)	**24.**	(b)	**34.**	(c)	**44.**	(c)
5.	(b)	**15.**	(b)	**25.**	(d)	**35.**	(d)	**45.**	(d)
6.	(a)	**16.**	(c)	**26.**	(d)	**36.**	(d)	**46.**	(a)
7.	(c)	**17.**	(d)	**27.**	(b)	**37.**	(d)	**47.**	(a)
8.	(b)	**18.**	(d)	**28.**	(d)	**38.**	(b)	**48.**	(d)
9.	(c)	**19.**	(d)	**29.**	(b)	**39.**	(d)	**49.**	(b)
10.	(c)	**20.**	(a)	**30.**	(b)	**40.**	(d)	**50.**	(d)

DETAILED EXPLANATIONS

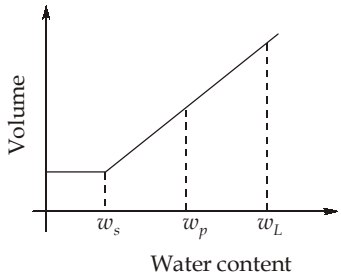
1. (d)

$$Se = w.G_s$$

Since soil is fully saturated $S = 1$

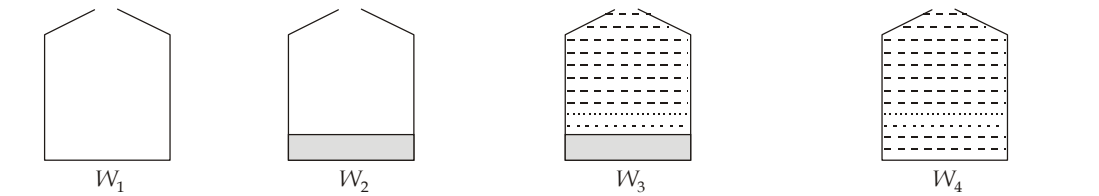
$$w = \frac{e}{G_s} = \frac{0.5}{2.5} = 0.2 \simeq 20\%$$

2. (a)



w_s = Shrinkage limit
w_p = Plastic limit
w_L = Liquid limit

3. (c)



(Empty pycnometer) (Pycnometer + dry soil) (Pycnometer + soil + water) (Pycnometer filled with water)

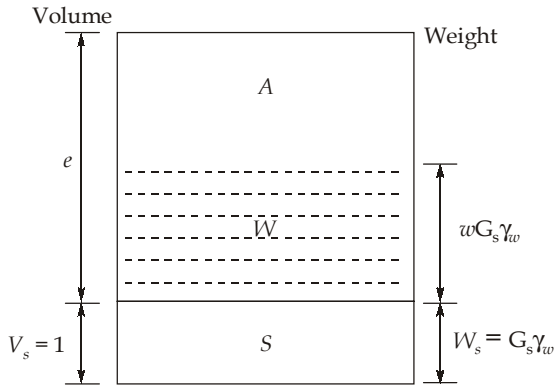
Given, $W_2 - W_1 = 200$ gm
$W_3 = 1605$ gm
$W_4 = 1480$ gm

$$G_s = \frac{W_2 - W_1}{(W_4 - W_1) - (W_3 - W_2)} = \frac{W_2 - W_1}{(W_4 - W_3) + (W_2 - W_1)}$$

$$= \frac{200}{(1480 - 1605) + 200}$$

$$= \frac{200}{-125 + 200} = \frac{200}{75} = 2.67$$

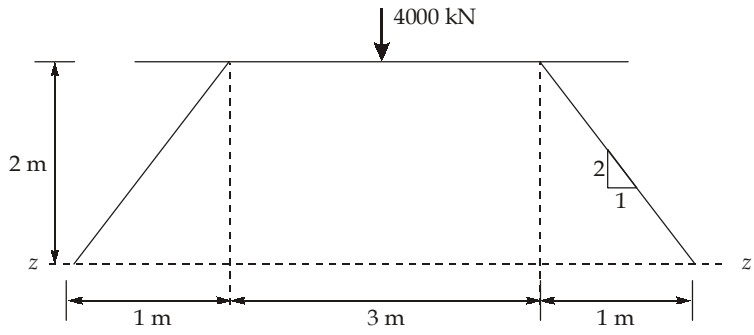
4. (c)



$$\gamma = \frac{W}{V} \qquad \left[V_s = \frac{W_s}{G_s\gamma_w}\right]$$

$$= \frac{G_s\gamma_w + wG_s\gamma_w}{1+e} = \frac{(1+w)G_s\gamma_w}{(1+e)}$$

5. (b)



$$\sigma_{zz} = \frac{4000}{(5\times5)} = \frac{4000}{25} = 160\ \text{kN/m}^2$$

6. (a)

$$I = 1-\left[\frac{1}{1+\left(\frac{R}{z}\right)^2}\right]^{3/2}$$

$$R = \frac{D}{2}$$

$\therefore$

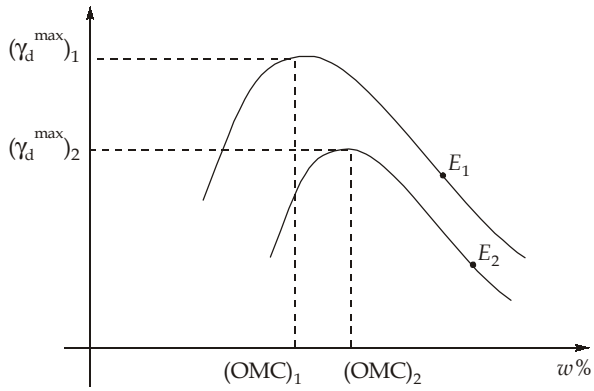
$$I = 1-\left[\frac{1}{1+\left(\frac{D}{2z}\right)^2}\right]^{3/2}$$

7. (c)

Boussinesq's solution assumes that the soil deposit is isotropic. Actual sedimentary deposits are generally anisotropic. There are generally thin layers of sand embedded in homogenous clay strata.

Westergaard's solution assumes that there are thin sheets of rigid material sandwiched in a homogenous soil mass. Therefore westergaard's equation represent more closely the actual sedimentary deposits.

8. (b)



$$E_1 > E_2 \qquad \text{(E-compective effort)}$$

$$\left(\gamma_d^{max}\right)_1 > \left(\gamma_d^{max}\right)_2$$

$$(OMC)_1 < (OMC)_2$$

9. (c)

- Proctor test is used to determine optimum moisture content.
- Vane test determines insitu shear strength of very soft clay.
- Penetration test is used to determine bearing capacity.
- Hydrometer test is used for grain size analysis.

10. (c)

Permeability is minimum at or slightly above OMC. Beyond OMC, the permeability may show a slight increase but it always remains much smaller then dry side of optimum.

11. (c)

$$i_{cr} = i = \frac{G_s - 1}{1 + e} \qquad \text{(For quick sand condition)}$$

$$i = \frac{G - 1}{1 + 0.5}$$

$$G = 1.5i + 1$$

12. (c)

$$q = kH\frac{N_f}{N_d}$$

$$= 4\times10^{-5}\frac{m}{\min}\times6\text{m}\times\frac{6}{18}$$

$$= 8\times10^{-5}\ \text{m}^2/\text{min} = 8\times10^{-5}\times60\times24\ \text{m}^2/\text{day}$$

$$= 0.115\ \text{m}^2/\text{day} = 0.115\ \text{m}^3/\text{day/m}$$

13. (a)

Constant head method for the determination of permeability is more suited for sandy soil since permeability of sandy soil is quite high whereas for clayey soil, variable head method is more suitable since permeability of clayey soil is very less and it will be difficult to maintain constant head for a very long time.

14. (c)

$$\text{Compression index, } C_C = \frac{e_1 - e_2}{\log_{10}\bar{\sigma}_2 - \log_{10}\bar{\sigma}_1} = \frac{\Delta e}{\log_{10}\left(\frac{\bar{\sigma}_2}{\bar{\sigma}_1}\right)}$$

$$\Delta H = \frac{C_C}{1+e_o}H_o\log_{10}\left(\frac{\bar{\sigma}_2}{\bar{\sigma}_1}\right)$$

(ΔH = Total settlement)

15. (b)

$$T_v = \frac{C_v t}{d^2}$$

for $U < 60\%$

$$T_v = \frac{\pi}{4}\left(\frac{U}{100}\right)^2$$

Case-1:

$$U = 40\%,\ T_v = \frac{\pi}{4}(0.4)^2 = 0.1256$$

$$0.1256 = \frac{C_v\times178}{d^2}$$

$$\frac{C_v}{d^2} = \frac{0.1256}{178} \quad \ldots(1)$$

Case-2:

$$U = 60\%,\ T_v = \frac{\pi}{4}(0.6)^2 = 0.2827$$

$$T_v = \frac{C_v t}{d^2}$$

$$0.2827 = \frac{0.1256}{178} \times t$$

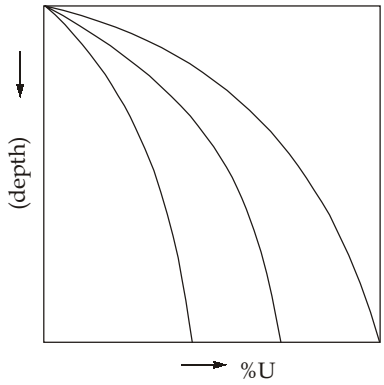
$$t = 400.5 \text{ days} \quad \ldots(2)$$

$\therefore$ Time between 40% and 60% consolidation

$$t_2 - t_1 = 400.5 - 178 = 222.5 \text{ days}$$

16. (c)

In a saturated clay layer undergoing consolidation with single drainage at top, the pore water pressure distribution would be



17. (d)

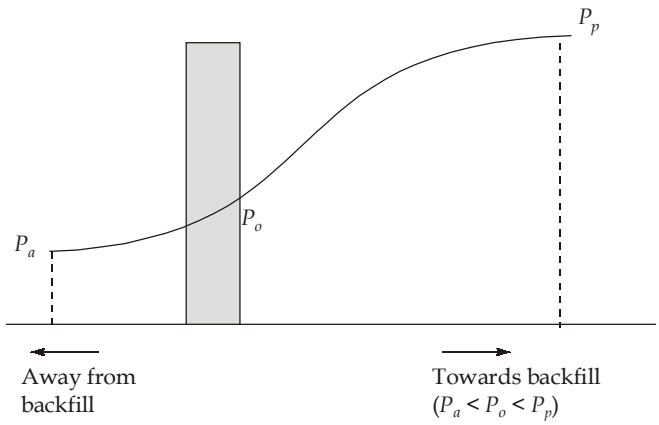
$$\sigma_{1f} = \sigma_{3f} \tan^2\left(45° + \frac{\phi}{2}\right) + 2c \tan\left(45° + \frac{\phi}{2}\right)$$

$$300 = \sigma_{3f} \tan^2\left(45° + \frac{30°}{2}\right) + 2 \times 35 \tan\left(45° + \frac{30°}{2}\right)$$

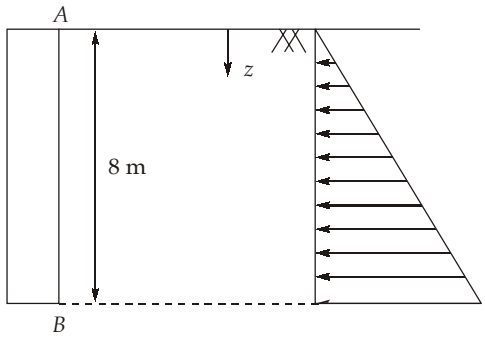
$$300 = \sigma_{3f} \times 3 + 70\sqrt{3}$$

$$\sigma_{3f} = \frac{300 - 70\sqrt{3}}{3} = 59.59 \text{ kN/m}^2$$

18. (d)



19. (d)



$$\gamma_d = \frac{G_s\gamma_w}{1+e} = \frac{2.65\times 9.81}{1+0.4} = 18.57 \text{ kN/m}^3$$

Active earth pressure

$$p_a = k_a\bar{\sigma}_z - 2c\sqrt{k_a}$$

$$c = 0$$

$$k_a = \frac{1-\sin 30°}{1+\sin 30°} = \frac{1}{3}$$

At the base of retaining wall (i.e. at B)

$$\bar{\sigma}_z = \gamma_d \times 8 = 18.57 \times 8 = 148.56 \text{ kN/m}^2$$

$$(p_a)_B = k_a\,\bar{\sigma}_z = \frac{1}{3}\times 148.56 = 49.52 \text{ kN/m}^2$$

21. (c)

- Loss in strength of soil due to remoulding at same water content is termed as sensitivity.
- Over a period of time soil regain a part of its lost strength is termed as thixotropy.
- When seepage takes place in upward direction, seepage pressure acts in upward direction and effective stress becomes equal to zero then this condition is known as quick sand condition or boiling condition.
- In liquefaction, due to dynamic/cyclic loading in loose saturated sand, effective stress decreases and decreases in shear strength is recorded.

23. (d)

$q_{nu} = CN_c$ (as per terzeghi) independent of depth and size of footing.

24. (b)

Negative skin friction or downward drag is a phenomenon which occurs when a soil layer surrounding a portion of the pile settles more than the pile. Such relative motion may occur when the clay stratum undergoes consolidation due to

1. A fill recently placed over the clay stratum.
2. Lowering of ground water table.
3. Reconsolidation occurring due to disturbance caused by the pile driving in sensitive clay stratum.

25. (d)

$$Q_{up} = Q_{fs} \qquad (Q_{eb} = 0, \text{ since pile is friction pile})$$
$$= \alpha C_u A_s$$
$$= \alpha C_u (4B \times L) = 0.8 \times 50 \times 4 \times 0.3 \times 10 = 480 \text{ kN}$$

26. (d)

- In plane survey, curvature effect of earth is ignored, whereas in geodetic surveys, curvature effect of earth is taken into account.
- Geodetic surveying is employed when area to be surveyed is more than 250 km^2 whereas for survey area less than 250 km^2 plane surveying is employed.

27. (b)

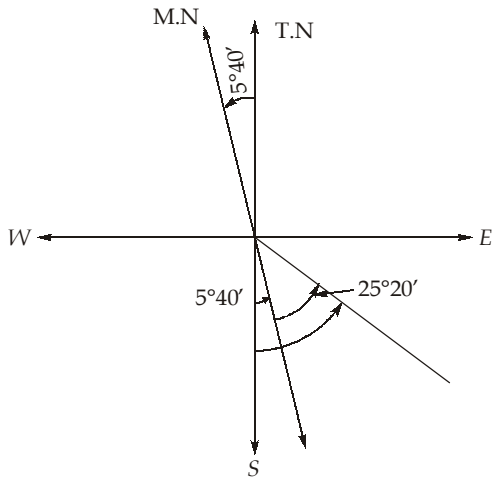
Length of line measured by erroneous chain of 20 m length = 634.4 m

$$\text{Actual length} = \text{wrong length} \times \left\{\frac{\text{wrong chain length}}{\text{Actual chain length}}\right\}$$
$$= 634.4 \times \left\{\frac{20.05}{20}\right\} = 635.986 \text{ m}$$

28. (d)

Isogonic lines: Line joining points on earth surface of same magnetic declination.
Agonic lines: Line joining points of zero declination.
Isoclinic lines: Line joining the points where the dip of earth's magnetic field is same.
Aclinic lines: Line connecting points where magnitude dip is zero.

29. (b)



30. (b)

As *FB* of line *DA* – *BB* line *DA* = 180°, stations *A* and *D* are free from local attraction as differences of *FB* and *BB* of other lines are not equal to 180°, stations *B* and *C* are affected by local attraction.

31. (d)

Resection is method of locating the station occupied by the plane table when the position of that station is not being plotted from other stations.

32. (c)

In rise and fall method, we have a arithmetical check i.e. ΣBS – ΣFS = RL of last station – RL of 1st station = ΣRise – ΣFell.

33. (d)

This is a case of inverted staff

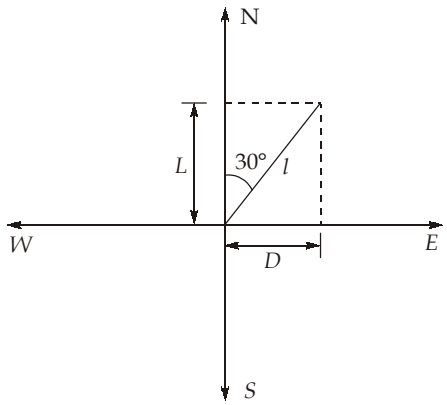
$$\text{R.L of roof slab} = \text{B.M} + \text{B.S} - \text{F.S}$$
$$= 135.15 + 1.050 - (-2.300) = 138.50 \text{ m}$$

35. (d)

Feature of contour of terrain:

- All points on a contour line are of the same elevation.
- No two contour lines can meet or cross each other except in the rare case of an overhanging vertical cliff.
- Closely spaced contour lines indicates steep slope.
- Widely spaced contour lines indicate gentle slope.
- Equally spaced contour lines indicate uniform slope.
- Closed contour lines with reducing level towards the centre indicate pond or other depression.
- A watershed or ridge line (line joining the highest point of a series of hills) and the thalweg or valley line (line joining the lowest point of a valley) cross the contour at right angles.

37. (d)



$$l = 10 \text{ m}$$

The departure of the line,

$$D = l\sin\theta = 10\sin 30° = 5 \text{ m}$$

38. (b)

$$\text{Multiplying constant} = \frac{f}{i} = \frac{24}{(1.2/10)\times 2}$$

$$= \frac{24\times 10}{2.4} = 100$$

39. (d)

Vertical curves are used to join road of different grade.

40. (d)

On map, $\text{scale} = \dfrac{\text{map distance}}{\text{ground distance}}$

$$\frac{1}{24000} = \frac{4\,\text{cm}}{\text{Ground distance}}$$

Ground distance/Actual length of runway

$= 24000 \times 4\ \text{cm} = 96000\ \text{cm} = 960\ \text{m}$

On photograph $\text{scale} = \dfrac{\text{Photo distance}}{\text{Ground distance}} = \dfrac{6\,\text{cm}}{960 \times 100\,\text{cm}} = \dfrac{1}{16000}$

44. (c)

Particular of items for Brick work	Quantity per mason per day
1. In lime or cement mortar in foundation.	1.25 Cu.m
2. In lime or cement mortar in superstructure.	1 Cu.m
3. In lime or cement mortar in arches.	0.55 Cu.m
4. Rubble stone masonary in lime or cement mortar.	1 Cu.m

46. (a)

A contract is an agreement between two parties enforced by law. It has some terms and conditions.

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