ANSWERS AND EXPLANATIONS

1. *Ans. (c)*

2. *Ans. (d)*

Weight of bar

$$w = \frac{\pi}{4}D^2L$$

$$dL = \frac{wL}{2AE} = \frac{L^2}{2E}$$

Hence it is proportional to L^2 but independent of D.

3. *Ans. (b)*

When a material can be drawn into smaller section by application of tension is called ductility.

4. *Ans. (c)*

It is circular tanks with flexible joint at base.

5. *Ans. (b)*

The neutral axis is a line of intersection of neutral plane or neutral layer on a cross-section. the neutral axis of a beam passes through the centroid of the section. At the neutral axis bending stress and bending strain is zero.

6. *Ans. (d)*

Let the depth of the beam be d maximum shear stress = 3/2 (Average shear stress)

$$3 = \frac{3}{2}\times\frac{50000}{100\times D}$$

$$D = \frac{3\times 50000}{2\times 3\times 100}$$

$$D = 250 \text{ mm}$$

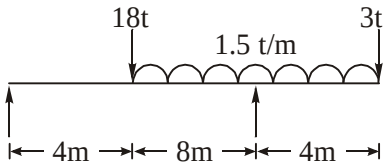
7. *Ans. (a)*

The deflection curve is defined as the line to which the longitudinal axis of a beam deflects or bends under given load. This curve is also known as elastic line or elastic axis.

8. *Ans. (d)*

The effective length of column with given end condtions is a length of an equivalent column of the same material and cross-section with hinged ends. The effective length of column depends upon end conditions.

9. *Ans. (a)*



10. *Ans. (b)*

Due to lime strength increases but it also has property of swelling. So maximum dry density decreases.

11. *Ans. (c)*

According to diagram, the maximum distance of the load from the centre '0' is $\frac{D\sqrt{2}}{6}$.

12. *Ans. (c)*

By increasing compaction energy OMC-decreases and maximums dry density increases.

By increasing coarse-grains permeability increases and chanes of pore-air of getting expelled increases hence compaction increases.

13. *Ans. (d)*

By increasing fineness and hence the plasticity, permeability decreases and finally compaction decreases so, OMC increases and less dry unit weight.

14. *Ans. (a)*

Final Area after failure

$$A_f = \frac{A_0}{1-e_L}$$

$$A_0 = 140 \text{ mm}^2$$

$$e_L = \text{Strain} = \frac{0.4}{40} = 10^{-2} = 0.01$$

$$\therefore \quad A_f = \frac{140}{1-0.01} = 141.414$$

15. *Ans. (c)*

In loose saturation sands due to seismic disturbance or dynamic loading, volume decrease hence pore pressure change is positive. Due to built up of sudden pore-pressure, sudden decrease in effective stress takes place and decrease in shear strength is recorded. Consequently large settlement of foundation suddenly accrue along with vertical liquid upflow of muddy water, such a phenomenon is called 'liquifaction of sand.'

16. ***Ans. (a)***

It is most suitable for cohesionless soils.

17. ***Ans. (a)***

Net allowable bearing capacity of soil

$$q_{net} = 0.41\ SnC_w$$

Where, S = Permissible settlement
= 45 mm
N = SPT number = 7
C_w = Water table correction factor
= 0.6

$$q_{net} = 0.41 \times 45 \times 7 \times 0.6$$

$$q_{net} = 77.49\ kN/m^2$$

18. ***Ans. (c)***

Sensitivity	Permeability
> 1	Insensitivity
2 – 4	Normal/Less-Sensitivity
4 – 8	Medium-Sensitivity
8 – 16	Extra-Sensitive
> 16	Quick/unstable

19. ***Ans. (d)***

U-line is $I_P = 0.9(w_L - 8)$

A-line is $I_P = 0.73(w_L - 20)$

20. ***Ans. (a)***

$$q_u = 20\ kN/m^{2\backslash}$$

Cohesion $C = \frac{q_u}{2}$

$$C = \frac{20}{2} = 10\ kN/m^2$$

As per Mohr's theory,

$$S = C + \sigma_n \tan\phi$$

For pure-clays

$$\phi = 0$$

$$S = C$$

$$S = 10\ kN/m^2$$

21. ***Ans. (a)***

$$F.O.S = \frac{\tan\phi}{\tan\phi_m}$$

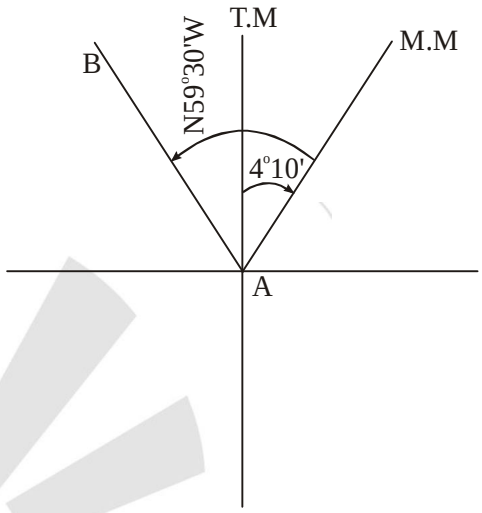
$$= \frac{\tan 45^o}{\tan 30^o} = \frac{1}{1/\sqrt{3}}$$

$$F.O.S. = \sqrt{3} = 1.732$$

22. ***Ans. (a)***

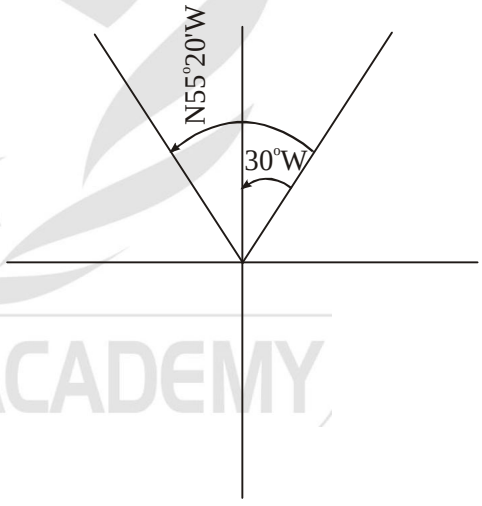
It is (Culmann's method) a graphical method based on coulomb's theory, it assumes failure plane as a planer.

23. ***Ans. (b)***



T.B = 59°30′ – 4°10′
= 55°20′

T.B in 1967 was N55°20′W



M.M = 360°0′ – 52°20′
= 307°40′

24. ***Ans. (b)***

Correction due to curvature and refraction

$$C = 0.0673\ D^2$$

But D = 1400 m = 1.4 km

$$\therefore \quad C = 0.0673 \times (1.4)^2$$

$$= 0.132\ m$$

25. ***Ans. (d)***

In two point problem two points are already determined but orientation is done by this method.

26. ***Ans. (d)***

Resection is the process of determining the socation of the station (on the map) occupied by the plane table.

27. ***Ans. (c)***

Alidade is a instrument, which is used to sight the object in plane table survey.

28. ***Ans. (c)***

Subtense bar is a horizontal bar on which horizontal readings are taken, Refraction correction is in vertical direction so it does not affect subtense bar readings.

29. ***Ans. (b)***

For area as given by trapezoidal method is

$$A = d\left[\left(\frac{0_0+0_n}{2}\right)+0_1+0_2+...0_{n-1}\right]$$

Now, since 'd' is not constant

$$\therefore \quad A_1 = 5\left[\frac{3+6}{2}+4+5.5+5\right]=95m^2$$

$$A_2 = 10\left[\frac{6+4.5}{2}+4\right] = 92.5\ m^2$$

Total area, $A = A_1 + A_2$

$= 95 + 95.5 = 187.5\ m^2$

30. ***Ans. (b)***

$L = (1 - P_l)Sl$

and $w = (1\ P_w)Sl$

Where, l = Length of photograph

P_l = Forward overlap

P_w = Side overlap

$L = (1 - 0.6) \times 200 \times 20$

$= 1600\ m = 1.6\ km$

$w = (1 - 0.3) \times 200 \times 20$

$= 2800\ m = 2.8\ km$

$Area = 1.6 \times 2.8 = 4.48\ km^2$

31. ***Ans. (c)***

Geodetic-surveying is the type of survey in which the curvature of the earth is takin into consideration and a very high standard of accuracy is maintained. It is used for large areas like survey of country.

32. ***Ans. (b)***

Length of the chord = $2R \sin \Delta/2$

$2R \sin \Delta/2 = 50$

$R = 50$

$2 \times 50 \sin \Delta/2 = 50$

$\Delta/2 = 30^o$

$D = 60^o = \pi/3$ Radian

Length of Curve

$$R.\Delta = 50\frac{\pi}{3} = 52.36\ m$$

33. ***Ans. (d)***

A fluid is a tresca material with zero cohesion. In simple words, fluids is in a state of failure.

34. ***Ans. (a)***

$$\frac{dv}{dn}+\frac{dv}{dy}+\frac{dv}{dz} = 20(1) + 6(3) + 2$$

$= 40\ m/sec^2$

35. ***Ans. (c)***

$$L' = L - \frac{v_0 t_0}{2}$$

$$= L - \frac{v_0 L}{2v_0} = \frac{L}{2}$$

36. ***Ans. (d)***

Uplift pressure of dam controlled by

- Constructing cutoff under upstream face.
- Constructing drainage channels between dam and its foundation.
- By pressure grouting in foundation.

37. ***Ans. (a)***

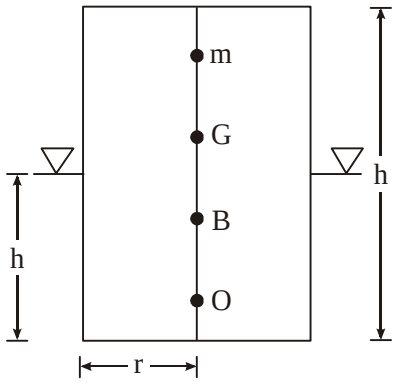
Draft tube used to increase the exit gradually area of reaction turbine.

38. ***Ans. (a)***

Prandtl mixing length is zero at the pipe wall.

39. ***Ans. (c)***

For unstable floation Gm < 0. i.e., metacentric height will be less then zero.



$$h'\pi r^2 = sh\pi r^2$$

$$h = h'/S$$

$$OB = h'/2$$

$$OG = h/2$$

$$BM = 1G/V$$

$$r = \frac{2}{3}h = \frac{\pi r^4/4}{\pi r^2 h'} = \frac{r^2}{4h'}$$

$$= \frac{r^2}{4Sh} = \frac{(2/3h)^2}{4Sh} = \frac{h}{9S}$$

$$BG = \frac{h}{2}(1-S)$$

$$Gm = Bm - BG$$

$$= \frac{h}{9S} - \frac{h}{2}(1-S) < 0$$

$$= 2 - 9S + 9S^2 < 0$$

$$= 2 - 6S - 3S + 9S^2 < 0$$

$$= 2(1-3S) - 3S(1-3S) < 0$$

$$= (1-3S)(2-3S) < 0$$

$$S > \frac{1}{3} \text{ and } S < \frac{2}{3}$$

So, $\frac{1}{3} < S < \frac{2}{3}$

40. ***Ans. (d)***

Streamlines are space curves drawn tangential to the velocity vector at all points in the flow field at any instant of time. Geometrically they represent eulerian approach for flow velocity description. They cannot intersect each other.

Streak line is the locas of the temporary location of all particles that have passed through a fixed point in the flow field.

41. ***Ans. (b)***

$$v = C_v\sqrt{2g(P_{stag} - P_{static})}$$

$$= 0.98 \times \sqrt{2.981 \times (3-0.5)}$$

$$= 6.86 \text{ m/s}$$

42. ***Ans. (c)***

$$\tau = \left(\frac{\partial p}{\partial x}\right).\frac{R}{z}$$

$$\tau = \left(-\frac{60}{15}\right) \times \frac{15}{100} \times \frac{1}{2}$$

$$\tau = 0.3 \text{ Kilopaskal}$$

43. ***Ans. (c)***

The head loss in both pipes will be same and it is proportional to $\frac{Q^2}{D^5}$.

$$\therefore \quad \frac{Q_1^2}{D_1^5} = \frac{Q_2^2}{D_2^5}$$

44. ***Ans. (a)***

45. ***Ans. (b)***

46. ***Ans. (d)***

47. ***Ans. (a)***

Manning's formula

$$V \propto R^{2/3}.S^{1/2}$$

48. ***Ans. (*)***

49. ***Ans. (c)***

The strain energy is minimum for the structure and it gives a unique solution.

50. ***Ans. (d)***

Bm at fixed support

$$= \frac{wL^2}{12} \text{ (hogging)}$$

Bm at mid span

$$= \frac{wL^2}{24} \text{ (sagging)}$$

51. ***Ans. (c)***

Clapeyron's theorem of three moments requires at least two spans. A fixed beam can be considered as follows

Now with the modified beam in the front of continuous beam. the tieam can be analyzed with three moment theorem.

52. ***Ans. (c)***

Some scientists lik Jean bernoulli (350 BC) and Leonardo da vinci (1435) imagined a small displacement of the bodies and found out the work done by various forces in the system and stated that if the body is in equilibrium then total work done by the system should be zero. This is ealled principle of nirtual work. The world virtual is used since in reality there is no actual displacement.

53. ***Ans. (d)***

The principle of super position is applicable when

- The material obey hooke's law.
- The effect of temperature changes are not taken into consideration.
- The support do not yield.

54. ***Ans. (d)***

All of the above is correct.

Solid state → Asphalt

Semi fluid → Mineral tar

Fluid → Petroleum

55. ***Ans. (a)***

56. ***Ans. (a)***

3 layers are applied such as primers, undercoats and finishing coats.

57. ***Ans. (a)***

Basalt or trap granite are used for railway ballast.

58. ***Ans. (a)***

Mud floor is best in winter and summer season to prevent warm and cool respectively.

59. ***Ans. (b)***

For road, the slump value is generally 25 mm used so it is 20 - 28 mm.

60. ***Ans. (b)***

List-I are following test and list-II and respective apparatus of this test.

61. ***Ans. (d)***

Blast furnace slag is the mixture of 45% CaO and 35% aluminum silicate.

62. ***Ans. (d)***

Radial sawing is less reconomical because is it cuts in radially direction hence clastage maximum in it.

63. ***Ans. (d)***

Attrition test is to be dene to calculate % of clear and teas of stone.

64. ***Ans. (a)***

65. ***Ans. (d)***

66. ***Ans. (c)***

As per codal recommendation, wind-load and earthquake loads are not considered simultaneously.

67. ***Ans. (c)***

As per IS : 800 - 2007 clause 3.7.2(c)

68. ***Ans. (a)***

For rectangular section,

$$\text{Shape-Factor} = \frac{Z_p}{Z_e}$$

$$= \frac{BD^2/4}{BD^2/6} = \frac{3}{2} = 1.5$$

69. ***Ans. (d)***

70. ***Ans. (a)***

71. ***Ans. (c)***

Shear strength as per IS code

$$f_{dsb} = \frac{f_u(n_n A_{nb} + n_s A_{sb})}{\sqrt{3}\, r_{mb}}$$

$$f_{dsb} = \frac{400}{\sqrt{3}\times 1.25}\left(1\times 0.78\times\frac{\pi}{4}\times 20^2\right)\times 10^{-3}$$

f_{dsb} = 45.27 kN

72. ***Ans. (c)***

As per IS code; clause (5.6)

Limit state of serviceability are

(i) Deflection

(ii) Vibration

(iii) Durability

(iv) Fire resistance

73. ***Ans. (b)***

74. ***Ans. (a)***

75. ***Ans. (d)***

Minimum is not suggested, but maximum is 4%.

76. ***Ans. (c)***

As per IS : 456 - 2000 table 16.

77. ***Ans. (c)***

78. ***Ans. (b)***

79. ***Ans. (a)***

It is taken as a 1 m width singly Reinforced beam.

80. ***Ans. (d)***

81. ***Ans. (a)***

$$E_c = 5000\sqrt{f_{ck}}$$

$$E_c \propto \sqrt{f_{ck}}$$

82. ***Ans. (c)***

83. ***Ans. (b)***

84. ***Ans. (a)***

85. ***Ans. (c)***

86. ***Ans. (c)***

87. ***Ans. (b)***

88. ***Ans. (d)***

89. ***Ans. (b)***

90. ***Ans. (a)***

91. ***Ans. (a)***

92. ***Ans. (d)***

93. ***Ans. (d)***

94. ***Ans. (a)***

95. ***Ans. (c)***

96. ***Ans. (c)***

97. ***Ans. (c)***

98. ***Ans. (a)***

99. ***Ans. (c)***

100. ***Ans. (c)***

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