ANSWERS AND EXPLANATIONS

1. ***Ans. (b)***

2. ***Ans. (c)***

3. ***Ans. (b)***

4. ***Ans. (b)***

5. ***Ans. (b)***

6. ***Ans. (b)***

7. ***Ans. (b)***

8. ***Ans. (a)***

9. ***Ans. (c)***

10. ***Ans. (b)***

11. ***Ans. (a)***

12. ***Ans. (d)***

13. ***Ans. (c)***

14. ***Ans. (a)***

15. ***Ans. (a)***

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

Black cotton soils show maximum volume change due to the mineral present in it that is montmorillonite.

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

For protective material

$$\frac{(D15)_{filter}}{(D85)_{protecting\ material}} < 5$$

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

$$OCR = \frac{\text{Maximum previous effective stress}}{\text{Existing effective stress}}$$

19. ***Ans. (c)***

Apparent cohesion is due to increase in density and capillary moisture in pores.

20. ***Ans. (c)***

Bulk density

$$\gamma_m = 20\ kN/m^3$$

Degree of saturation

$$S = 0.7$$

Sp. Gravity

$$G = 2.65$$

Critical hydraulic gradient

$$i_c = \frac{G-1}{1+e}$$

Density $\quad \gamma_m = \left(\frac{G+Se}{1+e}\right)\gamma_w$

$$\gamma_m = \left(\frac{2.65+0.7.e}{1+e}\right)10$$

$$20 = \left(\frac{2.65+0.7e}{1+e}\right)10$$

$$2.65 + 0.7e = 2 + 2e$$

$$1.3e = 0.65$$

$$e = 0.5$$

$$\therefore \quad i_c = \frac{2.65-1}{1+0.5}$$

$$i_c = \frac{1.65}{1.5} = 1.10$$

21. ***Ans. (b)***

$$m_v = \frac{a_v}{1+e_0}$$

$$a_v = \frac{\Delta e}{\Delta \bar{\sigma}} = \frac{0.7-0.5}{12-10} = \frac{0.2}{2}$$

$$a_v = 0.1\ m^2/t$$

$$m_v = \frac{0.1}{1+0.36} = 0.073\ t/m^2$$

22. ***Ans. (b)***

Discharge

$$Q = KH\frac{N_f}{N_D}$$

$$K = \sqrt{K_x.K_y} = 4 \times 10^{-5}$$

$$Q = (4 \times 10^{-5}) \times 2 \times \frac{4}{8}$$

$$= 4 \times 10^{-5}\ m^3/sec$$

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

Sheep foot rollers are recommended for compacting cohesive soil and it is mostly used to compressore of earth dam.

24. ***Ans. (d)***

$\beta_{max} = 30^o$

β_{max} = f = friction angle = 30^o

Passive earth pressure coefficient

$$K_P = \frac{1+\sin\phi}{1-\sin\phi} = \frac{1+\sin 30^o}{1-\sin 30^o}$$

$$K_P = \frac{1+1/2}{1-1/2} = \frac{3/2}{1/2} = 3$$

Active earth pressure cofficient

$$K_a = \frac{1-\sin\phi}{1+\sin\phi} = \frac{1}{3}$$

$$\frac{K_P}{K_a} = 9$$

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

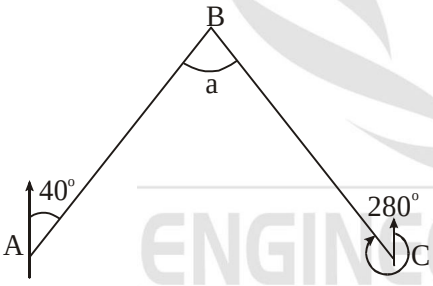
By increasing the compacting effort dry density is increased and optimum moisture content decreases because increased compacting effort causes expulsion of more pore air.

26. ***Ans. (b)***

BB of BC = FB of BC + 180^o

FB of BC = 280^o – 180^o

FB of BC = 100^o



BB of AB = FB of BA + 180^o

= 40^o + 180^o

∴ Included angle, a

= BB of AB – FB of BC

= 220^o – 100^o = 120^o

27. ***Ans. (d)***

The compass needle is made of islander symmetrical bar of magnested steel or iron it is hung from a concical jewel bearing supported on a sharp, hardened steel pivat.

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

There are three method of orienting plane table

- ***By through compass :*** It is a crude method and cannot be used where local attraction is sulpected.
- ***By back sighting :*** It is the most accurate method of orientation.
- By resection.

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

	BS	IS	FS	
1.	a			
2.	c		b	CP
3.	e		d	CP
4.		f		
5.			g	

30. ***Ans. (a)***

Due to the till of staff, staff reading increases and levels are decreased.

31. ***Ans. (a)***

Zenith distance = θ – δ

$\Rightarrow$ δ – θ = 90 – α

$\Rightarrow$180 – (δ + θ) = 90 – α

δ = 21°15′N

When, δ < θ

Zenith-distance

= 43°30′ – 21°15′ = 22°15′

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

Formula

True × True = Wrong × Wrong

$20 \times l_1 = 20.05 \times 2000$

$l_1 = 2005$ m

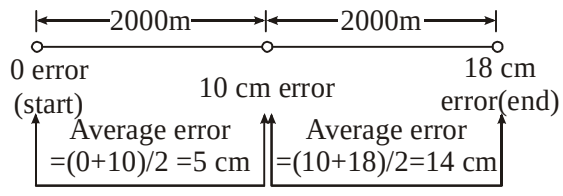
$20 \times l_2 = 20.14 \times 2000$

$l_2 = 2014$ m

So length, $l = l_1 + l_2$

= 2005 + 2014 = 4019 m

Here



33. ***Ans. (b)***

Optical square : 90^o

Open cross staff : 90^o

French cross staff : 45^o, 90^o

Theodolite : any angle

34. ***Ans. (b)***

When water is mixed with cement C-S-H (Cement silicate hydrate) gel cames out as a product.

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

Concrete cement depends on ally water-cement ratio.

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

42^o and 25^o should be as maximum and minimum pitch for good stair case.

37. ***Ans. (b)***

38. ***Ans. (b)***

39. ***Ans. (b)***

40. ***Ans. (c)***

41. ***Ans. (d)***

Kelly ball test is the simplest field method adopted to find consistency of concrete.

42. ***Ans. (a)***

According to IS : 3495 - 1976

The rating of efflorescence should not be more than moderate up to class 12.5 N/mm^2 compressive strength of bricks.

43. ***Ans. (a)***

In a bar of different sections, the resultant strain is the algebraic sum of the individual strain.

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

A beam which is fixed at one end and is free at other end, it is called cantilever beam. The examples for it are portico slabs and sunshades.

45. ***Ans. (a)***

It is also called encastered beam. All framed structures are examples of fixed beams.

46. ***Ans. (b)***

$$V_1 = \frac{1}{2}.P_1.\Delta_1$$

$$= \frac{1}{2}P_1.\frac{P_1L}{AE}$$

$$\Rightarrow \quad V_1 = \frac{1}{2}\frac{P_1^2L}{AE}$$

$$V_2 = \frac{1}{2}\frac{P_2^2L}{AE} \text{ (Similarly)}$$

$$V_1 + V_2 = \frac{(P_1+P_2).L}{2AE}$$

$$V_{net} = V_1 + V_2 + \frac{P_1P_2L}{AE}$$

$$V > V_1 + V_2$$

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

Brittle metal in tension always fails about 90^o with longitudinal axis.

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

the temperature at which the creep becomes an important consideration is called HOMOLOGUS TEMPERATURE and this temperature is nearly half of the melting point.

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

It is stress condition's approach uniformly as the distance from the point of application of the load increase.

50. ***Ans. (a)***

When one of the principal stresses at the point is large in comparison to the other, the situation resembles uniaxial tension test. Therefore all theories give nearly the same results.

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

Moment equilibrium equation can be obtaine from the stress tensor of a point in a body when it is in equilibrium.

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

$$2P = 4.8 \times 10^{-4}\ m^3$$

$$S.F = 1.2$$

$$M_p = 120\ kN\text{-}m$$

$$M_p = f_{yf}z_p$$

$$f_y = \frac{120\times10^6}{4.8\times10^{-4}\times10^9}\ N\text{-}mm$$

$$= 250\ MPa$$

53. ***Ans. (c)***

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

55. ***Ans. (b)***

56. ***Ans. (d)***

57. ***Ans. (c)***

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

59. ***Ans. (c)***

60. ***Ans. (d)***

61. ***Ans. (a)***

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

63. ***Ans. (b)***

64. ***Ans. (b)***

65. ***Ans. (c)***

66. ***Ans. (a)***

67. ***Ans. (a)***

68. ***Ans. (c)***

69. ***Ans. (c)***

Lacey silt factor

$$= 1.76\sqrt{d_m}$$

$$= 1.76\sqrt{0.16} = 0.704$$

70. ***Ans. (c)***

$$= 1.76\sqrt{d_m}$$

$$f = 1.76\sqrt{d_m}$$

$$d_m = \left(\frac{f}{1.76}\right)^2 = 1.29 \simeq 1.3$$

71. ***Ans. (b)***

72. ***Ans. (d)***

73. ***Ans. (a)***

The vertical intercept between EGL and HGL is equal to the kinetic head. For a nozzle the cross-sectional area decreases in the direction of flow leading to an increase in the velocity of flow across the pipe. Since the kinetic head increase. The vertical intercept between EGL and HGL will increases.

74. ***Ans. (c)***

$$K_s = 0.10 \text{ mm}$$

$$\tau = 7.85 \text{ N/m}^2$$

$$\frac{\mu.k}{v} = \frac{0.0877 \times 0.10/1000}{0.93 \times 10^{-2} \times 10^{-4}}$$

$$= 9.42$$

Since roughness value lies between 4 and 100 and pipe act as in transition.

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

(a) and (c) both may be right.

76. ***Ans. (b)***

Human blood and toothpaste are not newtonian fluids.

77. ***Ans. (d)***

$$dQ = |d\Psi| = |\Psi_2 - \Psi_1|$$

At $(1, 3)\Psi_1 = \frac{3}{2}(3^2 - 1^2)$

$= 12$ units

At $(3, 3)\Psi_2 = 0$ units

$\therefore$ $dQ = 12$ units

78. ***Ans. (a)***

Coefficient of velocity can be determined by

- Jet distance measurement method

$$C_v = \frac{x}{\sqrt{4Hy}}$$

$$= \frac{x}{2\sqrt{Hy}}$$

- Velocity measurement method using Pitot tube at venacontracta.
- Momentum method

$$C_v = \frac{wzg}{w_1 y\sqrt{2gh}}$$

Where w_7 is weight of liquid discharged through the orifice.

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

$$h_f = \frac{8\mu VL}{PgR^2}$$

Using $Q = \pi R^2 V$

$$= \frac{8\mu QL}{\pi PgR^4}$$

80. ***Ans. (b)***

Manning equation $V = \frac{1}{n}R^{2/3}S_0^{1/2}$ has the dimension of roughness coefficient n as $[L^{-1/3}T]$. Owing to its simplicity and acceptable degree of accuracy in a variety of practical applications. The formula is the most widely used uniform flow formula in the world. It represents rough turbulent flow.

81. ***Ans. (c)***

$$C = T$$

$$0.36f_{ck}Bx_{ulise} = 0.87\ f_yA_{st}$$

$$A_{st} = \frac{0.36\times15\times200\times0.48\times300}{0.87\times415}$$

$$A_{st} = 430.74\ mm^2$$

82. ***Ans. (b)***

Steel Grade	x_{ulise}
• Mild Steel → Fe250	0.53d
• HYSD → Fe415	0.48d
• HTS → FE500	0.46d

83. ***Ans. (c)***

Deflection is less in doubly beams as compared to singly Reinforced beams of same size.

84. ***Ans. (b)***

Bond ensures that the strain in steel and concrete should be same.

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

For 90° bend anchorage value is $8.\phi$

86. ***Ans. (d)***

As per IS : 456 - 2000 Clause 26.5.2.1

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

As per IS : 456 - 2000, Clause 31.4.3.2

88. ***Ans. (a)***

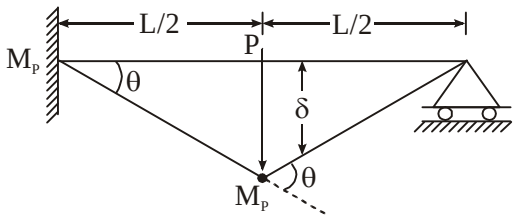
Shear stress diagram for rectangular RC-Beam is parabolic having zero at upper fibre and maximum at neutral-axis.

89. ***Ans. (a)***

Due to torsion cracks are vertical.

90. ***Ans. (c)***

Possible mechanism



By applying

External work = Internal work

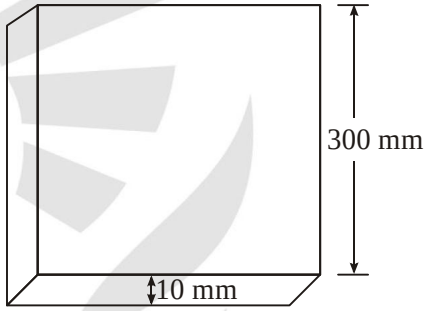
$$\Rightarrow \quad P.\delta = M_p.\theta + M_p.2\theta$$

$$\Rightarrow \quad P\left(\frac{L}{2}\theta\right) = 3M_p\theta$$

$$\Rightarrow \quad P = \frac{6M_P}{L}$$

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

92. ***Ans. (c)***



Rivet hole dia = 18 + 1.5 = 19.5 mm

Net area = $(300 - 19.5) \times 10 \times 10^{-2}$

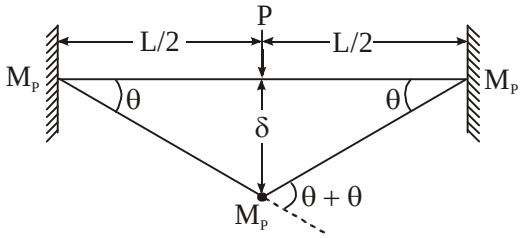
= $28.05\ cm^2$

93. ***Ans. (a)***

94. ***Ans. (b)***

Possible plastic linges/mechanisms are

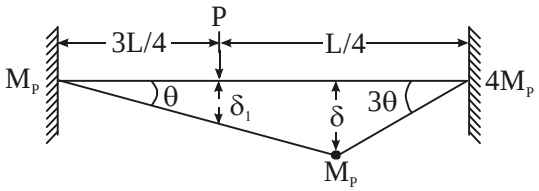
Internal work = Internal work



$$M_p\theta + M_p(\theta + \theta) \pm 4M_p\theta = P.\delta$$

$$7\ M_p\theta = P.\left(\theta.\frac{1}{2}\right)$$

$$P = \frac{14M_P\theta}{L} \quad ...(1)$$



$$M_p\theta + 4M_p(3\theta) + M_p(\theta + 3\theta) = P.\delta_1$$

$$17M_p\theta = P.\theta\frac{L}{2}$$

$$P = \frac{14M_P}{L} \quad ...(2)$$

$$\delta_1 = \frac{4\delta}{3L}\times\frac{L}{2}$$

$$\delta_1 = \frac{2\delta}{3L}$$

$$\delta_1 = \theta\times\frac{L}{2}$$

Ultimate load will be lesser of (1) and (2)

$$P = \frac{14M_P}{L}$$

95. ***Ans. (b)***

96. ***Ans. (b)***

For broad and moter gauge with single track impact factor

$$= 0.15 + \frac{8}{6+L}$$

Subjected to maximum of 'L'

For L = 6 m

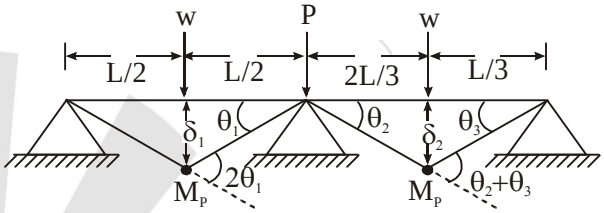
$$\text{Impact factor} = 0.15 + \frac{8}{12} = 0.82$$

So, for option, answer can be 0.75 (the closest one)

97. ***Ans. (d)***

98. ***Ans. (d)***

Possible mechanism conditions are



External work = Internal work.

99. ***Ans. (a)***

D < 0 for unstability

D = m + r – 2j

m + r – 2j < 0

(m + r) < 2j

100. ***Ans. (a)***

$\Rightarrow$ E = R – r

$\Rightarrow$ R = 3 + 1 + 1 + 1 = 6

r = 3 + 2 = 5

E = 6 – 5 = 1

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