

**ANSWERS AND EXPLANATIONS**

1. **Ans. (b)**

Young's elastic modulus is same for all type of steels

$$E_{\text{steel}} = 2 \times 10^5 \text{ N/mm}^2$$

2. **Ans. (d)**

$$k = \frac{3A_1}{3A_1 + A_2}$$

3. **Ans. (b)**

$$P_{\text{cr}} = \frac{\pi^2 EI}{L_{\text{eff}}^2 A}$$

$$P_{\text{cr}} = \frac{\pi^2 EA r^2}{L_{\text{eff}}^2 A}$$

$$P_{\text{cr}} = \frac{\pi^2 E}{(L_{\text{eff}} / r)^2}$$

$$P_{\text{cr}} = \frac{\pi^2 E}{\lambda^2}$$

4. **Ans. (a)**

5. **Ans. (d)**

6. **Ans. (a)**

As per IS : 800 - 2007

7. **Ans. (d)**

8. **Ans. (d)**

Box type section has maximum polar moment of inertia for the given area.

9. **Ans. (b)**

10. **Ans. (a)**

$$V_{\text{sb}} = 0.87 f_y A_{\text{sb}} \sin \alpha$$

$A_{\text{sb}}$  = Area of bentup steel

11. **Ans. (a)**

For concrete:

Maximum direct compressive strain = 0.0020

Maximum bending compressive strain = 0.0035.

12. **Ans. (c)**

13. **Ans. (a)**

Portland slag cement has better sulphate resisting properties.

14. **Ans. (c)**

15. **Ans. (b)**

16. **Ans. (a)**

The assumption that 'the shear in any flanged section is taken by the web only' causes shear stress

$$\tau_v = \frac{46 \times 1000 \text{ N}}{230 \times (450 - 50)}$$

$$= \frac{V}{B.d}$$

$$= \frac{46000}{230 \times 400}$$

$$= 0.5 \text{ N/mm}^2$$

17. **Ans. (c)**

18. **Ans. (a)**

As per IS : 456 - 2000

$$t_v = \frac{V_u}{Bd}$$

$$= \frac{20000 \times 1.5}{200 \times 300}$$

$$= 0.5 \text{ N/mm}^2$$

19. **Ans. (d)**

20. **Ans. (a)**

HGL will never be above EGL.

21. **Ans. (a)**

After half the water has spilled out the vertex of the paraboloid will touch the bottom of cylinder thus pressure will be zero.

22. **Ans. (b)**

"mm of mercury" is the least pressure unit.

23. **Ans. (a)**

Tensile stress resisted by liquid is known as surface Tension.

24. **Ans. (b)**

In triangular section, most economical channel should be inclined at 45°.

25. **Ans. (c)**

$$x = \frac{200 \times 1000}{1.59 \times 9.81 \times 1000}$$

$$= 12.82 \text{ m}$$

26. Ans. (b)

The pressure difference may be given as

$$\begin{aligned}
 P_1 - P_2 &= P_g(h_2 - h_1) \\
 \Rightarrow 22.6 \times 10^3 &= 57.4 \times 10^3 \\
 &= \rho \times 9.81 \times (8 - 5) \\
 \Rightarrow 22600 &= \rho \times 29.43 \\
 \Rightarrow \rho &= 768 \text{ kg/m}^3
 \end{aligned}$$

27. Ans. (c)

Let the percentage of cube remain above interface is P. The bouyancy force is  $P_w(0.01P) \times 15^3g + 13.6P_w(1 - 0.01P) \times 15^3g$ . This will be equal to weight of the cube

$$\begin{aligned}
 &= 8.6P_w 15^3g \\
 \therefore 0.01P + 13.6(1 - 0.01P) &= 8.6 \\
 12.6 \times 0.01P &= 13.6 - 8.6 = 5 \\
 P &= 39.7\%
 \end{aligned}$$

28. Ans. (b)

For velocity components of a two or three dimensional flow continuity equation

$$\frac{\partial u}{\partial x} + \frac{\partial v}{\partial y} + \frac{\partial w}{\partial z} = 0$$

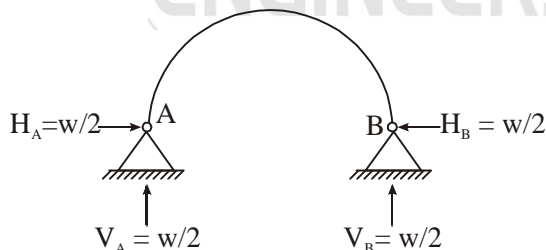
Should be satisfied.

29. Ans. (a)

30. Ans. (a)

Force or flexibility method cases redundant forces while stiffness or displacement method of analysis uses degrees off freedom.

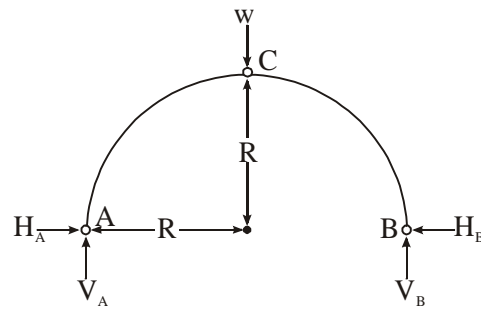
31. Ans. (a)



The vertical reaction at both supports is w/2. taking moment about crown for any half portion of the arch

$$H = V_A = V_B = \frac{w}{2}$$

32. Ans. (a)



Due to symmetry vertical reactions

$$V_A = V_B = \frac{W}{2}$$

Now from left

$$\begin{aligned}
 M_c &= 0 \\
 V_A \times R - H_A \times R &= 0 \\
 H_A = V_A &= \frac{W}{2} \\
 H_A = H_B &= \frac{W}{2}
 \end{aligned}$$

33. Ans. (c)

For 2D-rigid from

$$3m + r - 3j = 0$$

$$3m + r = 3j$$

To be stable and determinate.

34. Ans. (d)

$$\Sigma f_x = 0; \Sigma M_x = 0$$

$$\Sigma f_4 = 0; \Sigma M_4 = 0$$

$$\Sigma f_2 = 0; \Sigma M_2 = 0$$

35. Ans. (b)

36. Ans. (b)

37. Ans. (d)

38. Ans. (a)

39. Ans. (c)

Waves causes a pressure towards the down-stream side. Wave pressure depends upon the wave height. Wave height in meters may be given by the equation

$$(i) h_w = 0.032 \sqrt{VF} + 0.763 - 0.71(F)^{3/4}$$

For  $F < 32 \text{ km}$

(ii)  $h_w = 0.032\sqrt{FV}$  for  $F < 32$  km

Here  $V$  = Velocity of wind in kmph

$F$  = Fetch in km

$\therefore h_w = 0.032\sqrt{50 \times 80}$   
 $= 2.02$  m

40. **Ans. (c)**

For orifice type outlet

$m = 1/2$

Setting =  $H/D$

$= \frac{1}{2} \times \frac{3}{5} = \frac{3}{10} = 0.3$

41. **Ans. (d)**

IS : 1492 gives specifications of survey chain.

42. **Ans. (a)**

**ISO pars** : Line joining equal changes in magnetic declination.

**Aclinic lines** : Points of zero dip.

43. **Ans. (b)**

In survey work, it is preferable to use true meridians since they do not vary with time.

44. **Ans. (a)**

Electronic theodolites, absolute angle measurement is provided by a dynamic system with optoelectronic scanning, this is based on electro-optical technology. The electronic theodolites are provided with control panels with key boarder and liquid crystal displays.

45. **Ans. (a)**

Circular curve ranging is carried out by two theodolite method.

46. **Ans. (c)**

Closing error,  $e = +2^\circ$

Number of sides,  $N = 5$

Correction for First Line

$= \frac{e}{N} = \frac{2}{5} = 0^\circ 24'$

Correction for Second Line

$= \frac{2e}{N} = \frac{2 \times 2}{5} = 0^\circ 48'$

Correction for Third Line

$= \frac{3e}{N} = \frac{3 \times 2}{5} = 1^\circ 12'$

47. **Ans. (a)**

Maximum per. difference allowed while taking down the fore bearing and back bearing of a line is 15'.

48. **Ans. (a)**

49. **Ans. (c)**

V-Scale reading is 50 it indicates horizontal position of telescope.

50. **Ans. (a)**

Primary consolidation is the volume change of soil due to squeezing out of water from soil due to constantly application of load.

51. **Ans. (c)**

Compression Index 'or' coefficient of compression

$|\epsilon| = \left| \frac{\Delta e}{\log_{10}(\bar{\sigma}_2 / \bar{\sigma}_1)} \right|$

$= \frac{0.8 - 0.7}{\log_{10}(40 / 20)}$

$C_c = \frac{0.1}{\log_{10}(2)}$

$C_c = 0.33$  unitless

52. **Ans. (a)**

Time factor

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

$t \propto d^2$

Where,  $d$  = Length of drainage path

$d_1 = \frac{H}{2}$

$d_2 = H$

So, 'd' is doubled then time taken will be four times.

So, the rate of compression will be four times slower.

53. **Ans. (c)**

As the above question 52 rate will be four times faster.

54. **Ans. (b)**

Average permeability perpendicular to the bedding planness.

$$K_1 = \frac{h_1 + h_2 + h_3 + \dots}{(h_1 / K_1) + (h_2 / K_2) + (h_3 / K_3) + \dots}$$

$$K_1 = \frac{4+1+2}{(4/2) + (1/1) + (2/4)}$$

$$K_1 = \frac{7}{t+1+(1/2)}$$

$$K_1 = \frac{7 \times 2}{7}$$

$$K_1 = 2 \text{ unit}$$

55. **Ans. (d)**

$$h_1 = h_2 = h_3 = h_4$$

(Same thickness)

$$K_1 : K_2 : K_3 = 1 : 2 : 4$$

So,  $K_1 = K; K_2 = 2K; K_3 = 4K$

$$K_{11} = \frac{K_1 h_1 + K_2 h_2 + K_3 h_3}{h_1 + h_2 + h_3}$$

$$= \frac{Kh + 2Kh + 4Kh}{h + h + h} = \frac{7}{3} K$$

$$K_1 = \frac{(h_1 + h_2 + h_3)}{(h_1 / K_1) + (h_2 / K_2) + (h_3 / K_3)}$$

$$K_1 = \frac{(h + h + h)}{(h / K) + (h / 2K) + (h / 4K)}$$

$$= \frac{3h}{7/4(h/K)} = \frac{12}{7} K$$

$$\frac{K_{11}}{K_1} = \frac{7}{3} \times \frac{7}{12} = \frac{49}{36}$$

56. **Ans. (a)**

'Laterite' is the soil which is formed due to leaching (washing out of chemical-compounds) process. It is generally found in hilly areas having humid climate.

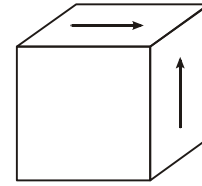
57. **Ans. (a)**

For clay it is 16% – 17%

For silt it is 6% – 8%

For sand it is < 1%

58. **Ans. (d)**



59. **Ans. (a)**

$$Q_A = \frac{ML}{6EI}; Q_B = \frac{ML}{3EI}$$

$$\Delta_{\max} = \frac{ML^2}{9\sqrt{3}EI}$$

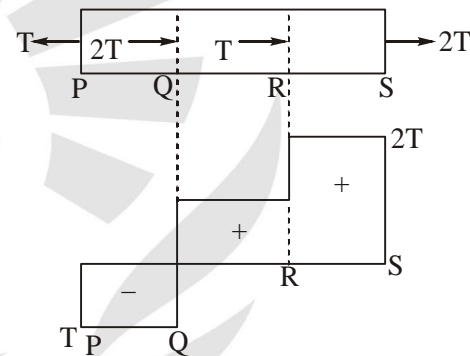
60. **Ans. (c)**

It increase shear and bending resistance of the section.

61. **Ans. (a)**

$$\sqrt{\frac{L^2 - b^2}{3}} \text{ from A}$$

62. **Ans. (d)**



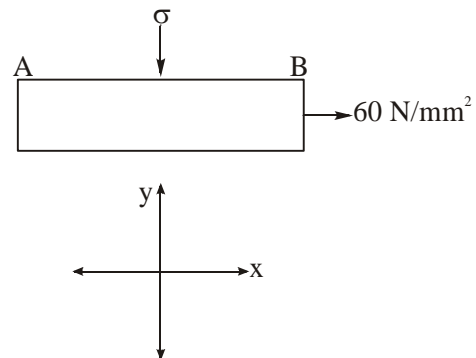
63. **Ans. (a)**

No stress will be induced in bar because stress is independent of temperature increment.

64. **Ans. (d)**

Tension is placed on any where so first 3 points are related to tension. So answer is any of the above.

65. **Ans. (c)**



$$\sigma_x = 60, \sigma_y = \sigma \text{ and } \mu = 0.3$$

$$\frac{\sigma_x}{E} - \mu \frac{\sigma_y}{E} = 0$$

$$60 = 0.3 \times \sigma$$

$$\sigma = 200 \text{ N/mm}^2$$

66. *Ans. (d)*

$$\text{Energy} = \frac{1}{2} \times \text{stress} \times \text{strain}$$

$$\text{Strain} \propto \text{Deflection}(y)$$

$$\text{Deflection} \propto \frac{L}{I}$$

$$\text{For rectangle } I = \frac{bd^3}{12}$$

$$I \propto d^3$$

$$\frac{y_1}{y_2} = \left( \frac{d_2}{d_1} \right)^2 = \frac{1}{8}$$

$$y_2 = 8y_1$$

Hence strain becomes 8 times.

67. *Ans. (a)*

The specimen in a charpy impact test is supported as a cantilever beam.

68. *Ans. (b)*

Elongation is measured with the help of extensometer while loads are measured on the main dial.

69. *Ans. (a)*

$\alpha/^{\circ}\text{C}$  for concrete

$$= 3 \times 10^{-4}/^{\circ}\text{C}$$

70. *Ans. (a)*

At freezing point of water, concrete sets freely.

71. *Ans. (a)*

Clamp burning has less initial cost as compared to kiln burning.

72. *Ans. (b)*

In tiles, 30% clay is mixed.

73. *Ans. (b)*

For the seasoning of timber in air 60 to 90 days is compulsory.

74. *Ans. (d)*

Specific gravity of wood depends upon

- Type of species.
- It has less than 1

75. *Ans. (c)*

Elastomers can extend upto 10 times their original dimensions.

76. *Ans. (c)*

In white or forge pig, furnaces is provided with insufficient fuel at low temperature.

77. *Ans. (a)*

Calcareous clay content 48% lime and magnesia and approx 35% silica in brick earth.

78. *Ans. (d)*

- Vibrating tables are used to compact moulds of concrete.
- Form vibrator are used when reinforcement is very tense and internal vibrator can not be used.
- Internal vibrator are used in depth members contain light and medium reinfor cement.

79. *Ans. (d)*

In ultrasonic pulse velocity test of concrete, ultrasonic pulse is generated by an electro-acoustical transducer.

80. *Ans. (c)*

81. *Ans. (c)*

82. *Ans. (c)*

83. *Ans. (c)*

84. *Ans. (a)*

85. *Ans. (a)*

86. *Ans. (c)*

87. *Ans. (d)*

88. *Ans. (b)*

89. *Ans. (c)*

90. *Ans. (a)*

91. *Ans. (c)*

92. *Ans. (c)*

93. *Ans. (c)*

94. *Ans. (a)*

95. *Ans. (a)*

96. *Ans. (c)*

97. *Ans. (b)*

98. *Ans. (b)*

99. *Ans. (b)*

100. *Ans. (d)*

