ANSWERS AND EXPLANATIONS

1. *Ans. (d)*

$$\frac{\partial u}{\partial x}+\frac{\partial v}{\partial y} = 1 - 1 = 0$$

As it satisfy the continuity equation for incompressible flow is

$$w_2 = \frac{1}{2}\left[\frac{\partial v}{\partial x}-\frac{\partial u}{\partial y}\right]$$

$\Rightarrow$ $1/2[0 - 2] = -1$

Since it is not zero and it is not irrotational.

2. *Ans. (b)*

It is $\frac{I_c \sin^2\theta}{Ah_c}$

3. *Ans. (d)*

With increase in specific speed of pump, decrease in head occurs.

4. *Ans. (a)*

Reynold Number = $\frac{3200\pi\times 8}{\pi/8\times 8^2\times 4} = 400$

Hence flow is laminar flow.

5. *Ans. (c)*

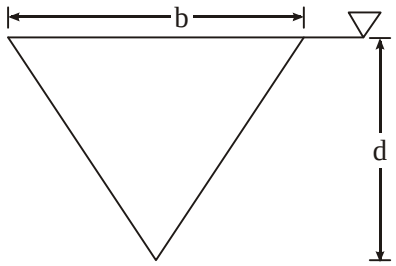
Statement-II is wrong.

6. *Ans. (a)*

7. *Ans. (d)*

The centre of pressure for certain given body is:

Triangle with base at the free surface



$$h_p = \frac{d}{2}$$

8. *Ans. (d)*

For neutral equilibrium GM = 0

$$\frac{L}{D} = \frac{1}{\sqrt{8S(1-S)}}$$

$$= \frac{1}{\sqrt{8\times 0.6\times 0.4}}$$

$$= \frac{1}{4}\frac{1}{\sqrt{0.3\times 0.4}} = \frac{1}{4}\sqrt{\frac{100}{3\times 4}}$$

$$= \frac{5}{4\sqrt{3}}$$

9. *Ans. (c)*

The hydraulic gradient line and energy gradient line are parallel to each other, the hydraulic gradient is

$$-\frac{dP}{dz} = \frac{8\mu V_{av}}{R^2} = \frac{32\mu V_{av}}{D^2}$$

Discharge is constant

$$Q = AV_{av}$$

$\therefore$ $V_{av} = \frac{Q}{\pi/4D^2}$

$\therefore$ $\frac{dP}{dz} = \frac{32\mu\times 4Q}{pg\pi D^4}$

The hydraulic gradient is inversely proportional to D^4 in laminar flow.

In the case of rough turbulent flow, the hydraulic gradient is inversely proportional to D.

10. *Ans. (b)*

Fitting Type	*K-Value*
• 45° elbow	0.4
• 90° elbow	0.9
• Purap foat valve	1.5
• Clase return bend	2.2
• Cate valve wide open	0.02
• Clope valve wide open	10

11. *Ans. (d)*

12. *Ans. (a)*

13. *Ans. (b)*

14. *Ans. (d)*

15. *Ans. (d)*

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

17. ***Ans. (b)***

18. ***Ans. (a)***

19. ***Ans. (b)***

20. ***Ans. (b)***

21. ***Ans. (c)***

22. ***Ans. (c)***

Flash point is lowest temperature at which the vapour of bitumen can be ignited in air.

23. ***Ans. (a)***

20 - 30% silt content in an alluvial soil for production of structural bricks.

24. ***Ans. (a)***

Moulded bricks are to be dried before burning upto 3% moisture content.

25. ***Ans. (c)***

If a sustances is scratched by topaz and not by quartz them hardness lie between 7 to 8.

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

For lime concrete :

- Slump value is 550 mm to 75 mm.
- Flexural strength at 90 days is 0.2 N/mm^2
- Compressive strength at 90 days is 1.5 N/mm^2
- Compressive strength at 28 days is 1.2 N/mm^2

27. ***Ans. (a)***

Bitumen consist of 87% of carbon, 11% of hydrogen and 2% of oxygen.

28. ***Ans. (d)***

In filling cracks in masonry structure plastic bitumen is used.

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

Rought timber : Partially dressed timber having only the branches removed.

Standing timber : Timber in tree.

Imperge timber : Timber with resin.

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

A solid foundation or structure laid below ground level to support or strength a building called "underpinning."

Props used to support or hold up something called "sharing".

31. ***Ans. (d)***

Coff. of curvature

$$C_C = \frac{D30^2}{D10.D60}$$

Coff. of uniformity

$$C_u = \frac{D60}{D10}$$

32. ***Ans. (d)***

Aluminosilicates are the major component of kaoline and other clay minerals.

33. ***Ans. (c)***

Clay has three types of mineral

- Kaolinite
- Illite
- Montmorillonite

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

By increasing compacting effort, OMC decreases and dry density increases.

35. ***Ans. (d)***

All are deflocculating 'or' disperging agents.

36. ***Ans. (a)***

Meniscus correction = +ve

Temperature correction = ±ve

Dispersing agent correction = –ve

Net $C = +C_m - C_D \pm C_T$

37. ***Ans. (d)***

Casagrande's appratus is used to determine liquid limit.

Hydrometer is used to do grain size analysis for fine soils.

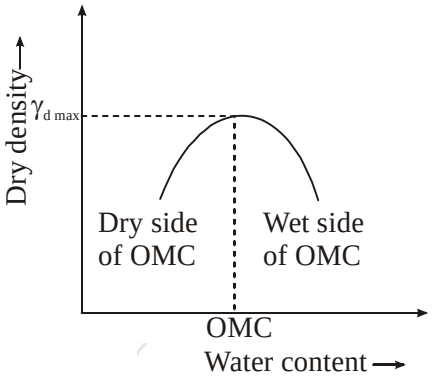
Plate load test is used to deter mine the safe bearing capacity of soil.

Odometer is used to determine consolidation characteristics.

38. ***Ans. (c)***

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

Compaction curve is



At dry side of OMC; dry density increases by increasing water content and at wet side of OMC, dry density decreases by increasing water content.

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

- Wet clay → Grid Roller
- Crushed Rock → Smooth wheel Roller
- Fill Soil → Pneumatic tyred roller
- Sands → Vibrator

41. ***Ans. (a)***

Phreatic line is upper zone of saturation in earthen dams. It has atmospheric pressure (zero gauge - pressure) on it and it is a parabolic line.

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

In sedimentation analysis, flow is assumed to be laminar and for laminar flow through soils the Reynolds number should be less than 1.

For pipe flow

$$R_c \le 2000$$

For flow through parellel plates

$$R_e \le 1000$$

43. ***Ans. (b)***

Ductile material has long plastic elongation range.

44. ***Ans. (d)***

Total load = 2 × 2 = 4 kN

S.F. at A = 4 kN

S.F. at C = 4 kN

S.F. at B = 0 kN

Max. S.F. at A = 4 kN

45. ***Ans. (c)***

Resistance strain gauge is the device which is used to measure normal stress on the surface of a stressed object.

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

$$\frac{\omega^2 w L^3}{3gE}$$

47. ***Ans. (c)***

$$\text{Ratio} = \frac{4EI}{L} \times \frac{L}{3EI} = \frac{4}{3}$$

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

$$\tau = \frac{T.r}{I_p.w};\ \frac{\tau_1}{\tau_2} = \frac{w_2}{w_1}$$

$$\frac{\tau_0}{\tau_2} = \frac{1.5 \times 2\pi}{3 \times 2\pi};\ \tau_2 = 140 \text{ MPa}$$

49. ***Ans. (d)***

Deflection of simply supported beam of length

$$L = (a + b) \text{ is } \frac{wa^2b^2}{3EI(a+b)}$$

50. ***Ans. (c)***

Area of circular disc = πr^2

$$\text{Area of hole} = \pi\left(\frac{r}{2}\right)^2 = \frac{\pi r^2}{4}$$

$$\text{Remaining Area} = \frac{3\pi r^2}{4}$$

Taking moment of the area about 'O' and dividing remaining area, to find centroid

$$\bar{x} = \frac{\pi r^2 / 4 \times r/2 - \pi r^2 \times 0}{3/4\pi r^2} = \frac{r}{6}$$

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

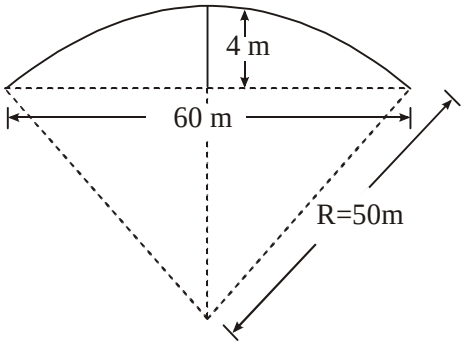
Ductility of material is estimated by

- Percentage elongation method.
- Percentate reduction in area method.

52. ***Ans. (d)***

Material	***Poisson's Ratio***
• Bronze	0.34
• Concrete	0.1 – 0.2
• Brass	0.34
• Wrought iron	0.3

53. ***Ans. (a)***



Mid ordinate,

$$M = R - \sqrt{R^2 - (L/2)^2}$$

$$= 50 - \sqrt{(50)^2 - (60/2)^2}$$

$$= 10 \text{ m}$$

Alternatively

Length of long chord,

$$L = 2R \sin \theta/2$$

$$\Rightarrow \quad 60 = 2 \times 50 \sin \theta/2$$

$$\Rightarrow \quad \sin \theta/2 = 0.6$$

$$\Rightarrow \quad \theta/2 = 36.87^o$$

Mid ordinate,

$$m = R(1 - \cos \theta/2)$$

$$= R \text{ versin } \theta/2$$

$$= 50 \times (1 - \cos 36.87^o)$$

$$= 50 \times 0.2$$

$$= 10 \text{ m}$$

54. ***Ans. (c)***

Versine of full chord,

$$V = \frac{L^2}{8R}$$

Versine at quarter point

$$= \left(\frac{L}{4}\right)^2 + (R - V)^2 = (R - V_1^2)$$

$$V_1 = \frac{3L^2}{32} \text{ (Neglecting } V^2 \text{ and } V_1^2)$$

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

Weight given to any observed is given to 'it's' accuracy.

56. ***Ans. (b)***

1 cm = 100 m

So, For plan of 1 cm × 5 cm

$$= 100 \text{ m} \times 500 \text{ m}$$

$$= 5 \times 10^4 \text{ m}^2$$

$$= 5 \text{ ha}$$

If scale is 1 cm = 1 km

i.e., 1 cm = 1000 m

So, area of plan = 0.1 cm × 0.5 cm

$$= 0.05 \text{ cm}^2$$

57. ***Ans. (d)***

Analytic-line is an external focusing lens and adjusted such that the additive constant is 'zero.'

58. ***Ans. (c)***

In loose needle method, bearing of each line is measured separately, and instrument used is 'Compass.'

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

Given, R = 200 m

Coff of friction

f = 0.15

Design speed

V = 40 kmph

$$e = \frac{V^2}{127R}$$

$$e = \frac{(40)^2}{127 \times 200}$$

$$= 0.06299$$

$$e = 0.06299 \times 100\%$$

$$e = 6.3\%$$

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

Telemter : Distance measurement pricemeter

Sounding Sextant : Horizontal angle measurement.

Clinometer : Vertical angle measurement.

61. ***Ans. (c)***

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

63. ***Ans. (a)***

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

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

$$\delta = \frac{5wL^4}{384EI}$$

66. ***Ans. (b)***

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

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

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

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

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

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

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

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

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

76. ***Ans. (a)***

77. ***Ans. (a)***

General requirements in IS : 1642

Fire resistance of structure in IS : 1641

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

For isolated T-Beam

$$B_{eff} = B_f = \frac{l_0}{(l_0/B)+4} + b_w$$

$$B_f = \frac{6000}{(6000/3000)+4} + 250$$

B_f = 1250 mm

= 1.25 m

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

If $D_f/x_u \le 0.43$, stress in flange is uniform.

80. ***Ans. (a)***

81. ***Ans. (b)***

As per IS : 456 - 2000 clause 31.1.1(b)

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

Drops are used in flatslabs at the corners to resist the shear.

83. ***Ans. (d)***

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

For deformed bars, it is 0.12%.

85. ***Ans. (a)***

As per IS : 456 - 2000, clause 24.1

86. ***Ans. (a)***

87. ***Ans. (d)***

For triangular section

Shape factor = 2.34

88. ***Ans. (b)***

The major mode of failure in weld is 'Shear'

89. ***Ans. (c)***

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

$$\text{Shape factor} = \frac{Z_p}{Z_e}$$

$$Z_p = \frac{A}{2}(\bar{y}_1 + \bar{y}_2)$$

$$= \frac{\pi D^2}{8}\left(\frac{2D}{3\pi} + \frac{2D}{3\pi}\right)$$

$$= \frac{\pi D^3}{6\pi}$$

$$= \frac{D^3}{6}$$

$$Z_e = \frac{I}{y} = \frac{\pi D^4/64}{D/2}$$

$$= \frac{\pi D^3}{32}$$

$$\text{Shape factor} = \frac{D^3/6}{\pi D^3/32} = \frac{16}{3\pi}$$

91. ***Ans. (b)***

Sectional area

= (100–5)×10 + (100–5)×10

= 1900 mm^2

Allowable compressive – stress = 43 MPa

Capacity of section

= 43 × 1900

= 81.7 kN

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

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

Proof Stress :

Some materials like aluminium doesn't show their yield stress in it's stress strain curve.

So to find it's yield stress a line parellel to it's initial slope is drawn at an offset of 0.002 or 0.2% Strain and that line cuts the curve at a point. The stress corresponding to that point is valled proof stress.

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

95. ***Ans. (d)***

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

Flow velocity $\propto (Qf^2)^{1/6}$

Flow velocity $\propto \frac{1}{(Qf^2)^{-1/6}}$

So, flow velocity is improportional to $(Qf^2)^{-1/6}$

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

98. ***Ans. (b)***

Lacey's silt factor

$= 1.76\sqrt{d_m} = 1.76\sqrt{0.25}$

$= 1.76 \times 5 = 0.88$

99. ***Ans. (d)***

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

$d_{max} = 11\ R.s$

Where, $R = \frac{By}{B+2y} \simeq y$ $[\because B >> y)$

$= 11 \times 0.8 \times 0.0041$

$= 0.03608$

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