SET – A

1. Which of the following stones is more resistant to fire?
   A. Lime stone
   B. Marble
   C. Granite
   D. Compact sandstone

2. Which of the following timber defect is caused by fungus?
   A. upsets
   B. foxiness
   C. dry rot
   D. wet rot

3. As per IS 1077, common burnt clay bricks of class designation "35" has
   A. maximum compressive strength as 35 MPa
   B. average compressive strength not less than 350 kg/cm^2.
   C. minimum compressive strength as 35 MPa
   D. compressive strength more than 35 MPa

4. The rate of heat evolution of the following four compounds in descending order is
   1. C_3S 2. C_2S 3. C_3A 4. C_4AF
   A. 1, 2, 3, 4
   B. 3, 1, 4, 2
   C. 3, 4, 1, 2
   D. 3, 4, 2, 1

5. If p is the standard consistency of cement, the amount of water used in conducting the initial setting time test on cement is
   A. 0.65 p
   B. 0.85 p
   C. 0.50 p
   D. 1.10 p

6. The aggregate for concrete should comply with the requirements of
   A. IS 2386
   B. IS 383
   C. IS 455
   D. IS 457

7. For mass plain concrete, plums above 160mm and up to any reasonable size may be used up to a maximum limit of X percent by volume of concrete, where X =
   A. 10
   B. 15
   C. 20
   D. 25

8. As per IS 456, the characteristic yield strength of different steel shall be assumed as
   A. maximum yield stress/ 0.2 percent proof stress
   B. minimum yield stress/ 0.2 percent proof stress
   C. proof stress/ 0.2 maximum yield stress
   D. proof stress/ 0.2 minimum yield stress

9. The maximum permissible limit of chlorides as Cl in the water suitable for concrete not containing embedded steel is
   A. 2000ml
   B. 2500ml
   C. 3000ml
   D. 3500ml

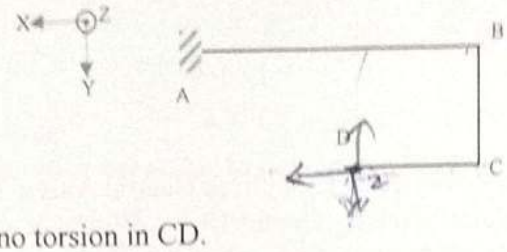
10. The plums in the plain concrete should distribute evenly and should not be closer than -------- *(Fill the correct option)* from surface (IS 456).
   A. 100mm
   B. 150mm
   C. 200mm
   D. 250mm

11. Choose correct statement
   A. Summation of normal stresses are unchanged while transforming into other frames.
   B. The analyses of dams, retaining walls, pipeline are examples of plane strain problem.
   C. The plane stress problems are in which in one direction normal stress is zero but not strain.
   D. All of the above

12. Choose the correct statement for unidirectional pressure (p)
   A. The centre of the Mohr's Circle is at the origin.
   B. The centre of the Mohr's Circle is at a distance of p.
   C. The radius of Mohr's Circle is p/2.
   D. None of the above

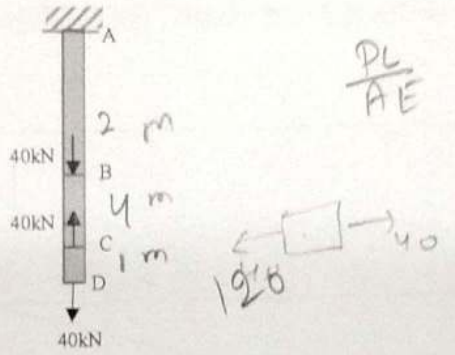
13. Choose the correct statement
   A. Drucker and Prager failure surface is in the form of cone.
   B. Octahedral shear stress is related to the root-mean-square of the principal stress differences.
   C. Tresca criterion is easier to visualize in terms of Mohr's Circle as compared to Von-Mises.
   D. All of the above

14. Pick the correct statement for the frame shown below. The joint D is subjected to point loads of same magnitude in all three (x, y, z) positive directions of axes.



A. There is no torsion in CD.
B. There is no torsion in BC.
C. There is no torsion in AB.
D. All the members carry torsion.

15. A rod of 10mm² area of cross section, as shown in the figure (AB=2BC=4CD=1000mm) has E=200 GPa is subjected to loads at different locations. Find change in length in section AB.



A. 20mm decrease
B. 20mm increase
C. 0.2mm increase
D. 0.4mm increase

16. Elastic stress in a straight rod, fixed at the ends, due to temperature change is

A. αT. E/(1-ν)
B. αT.E(1-ν)
C. αT.E
D. αTE(1-2ν)

where, α, T, E and ν are coefficient of linear expansion, temperature change, Modulus of Elasticity, and Poisson's Ratio respectively.

17. In an element, strains were measured as $\varepsilon_x=2.0\times10^{-4}$, $\varepsilon_y=4.0\times10^{-4}$, and $\varepsilon_z=4.0\times10^{-4}$. Find summation of spherical component of the stresses ($\sigma_x+\sigma_y+\sigma_z$). Take $E=2\times10^5$ MPa; $\nu=0.3$

A. 500 MPa
B. 285.7 MPa
C. 192.3 MPa
D. 125 MPa

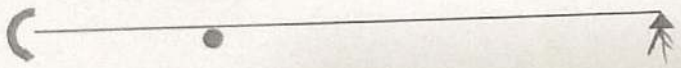
18. A circular shaft of 10cm radius is subjected to a torque of 10π kN-m, the maximum shear stress (in MPa) developed in the shaft is

A. 2
B. 20
C. 200
D. 2000

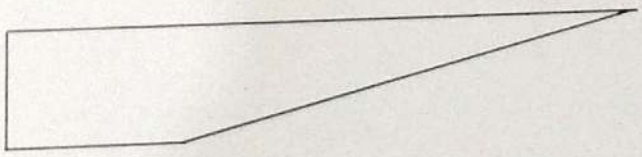
19. The bending stress (MPa) in a fibre distant 3cm from Neutral Axis at the mid-span of a simply supported beam of rectangular section (Depth=10cm, Width=6cm) carrying a uniformly distributed load of 2kN/m on whole span (span = 2m) is

A. 10
B. 6×10^{-6}
C. 6×10^{-3}
D. 6

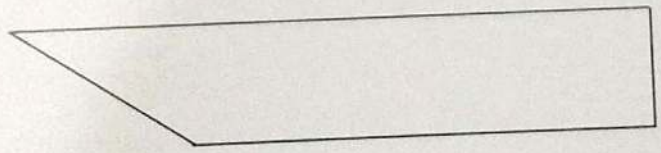
20. The correct shape of Shear Force diagram for the following simply supported overhanging beam is



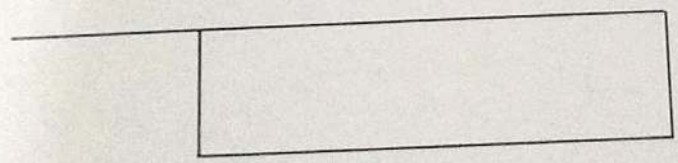
A.



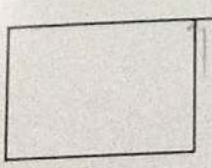
B.



C.



D.



21. The increase in volume in a thin cylinder 4mm thick, 200mm internal diameter, 1m long, due to 4MPa internal pressure is (Take E=200 GPa, ν=0.25)

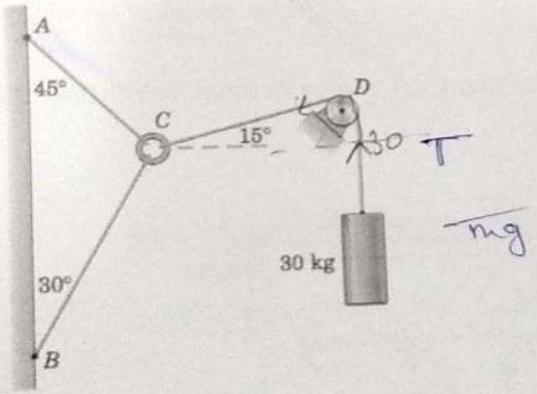
A. 5 cc
B. 5000 cc
C. 5000π cc
D. 5π cc

22. The maximum shear stress due to flexure in a beam of circular cross section is

A. $\frac{4F}{3\pi R^2}$
B. $\frac{5F}{4\pi R^2}$
C. $\frac{3F}{4\pi R^2}$
D. $\frac{3F}{2\pi R^2}$

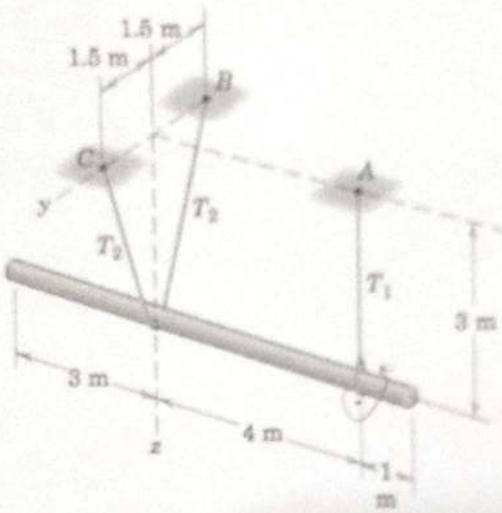
where, F is shear force, and R is the radius of cross section.

23. Three cables are joined at the junction ring C. The ratio of tension in cables BC to cable AC is



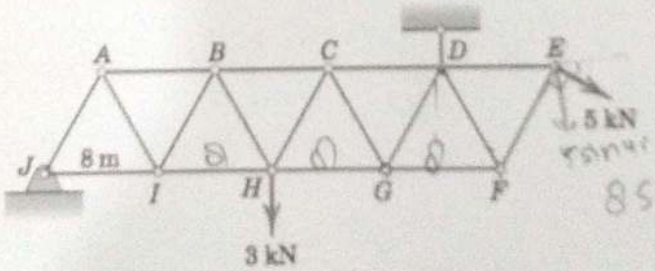
A. 1.50
B. 2.22
C. 1.78
D. 1.22

24. The horizontal steel shaft has a mass of 480 kg and is suspended by a vertical cable from A and by a second cable BC which lies in a vertical transverse plane and loops underneath the shaft. The tensions T_1 and T_2 in the cables respectively are



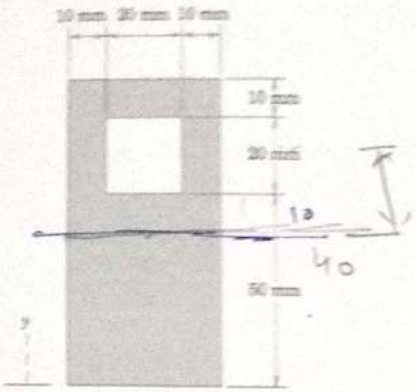
A. 1177 N and 1974 N
B. 120 N and 201 N
C. 120 N and 180 N
D. 1177 N and 7766 N

25. In the Warren truss (all equilateral triangles), shown in figure below, the force in member *DF* is



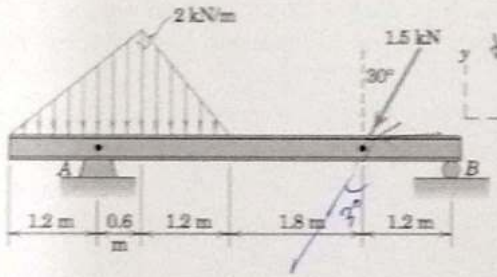
A. 2.5 kN (Comp)
B. $5\sqrt{3}$ kN (Tensile)
C. 5 kN (Comp)
D. $5/\sqrt{3}$ kN (Tensile)

26. The y-coordinate of the centroid of the shaded area is



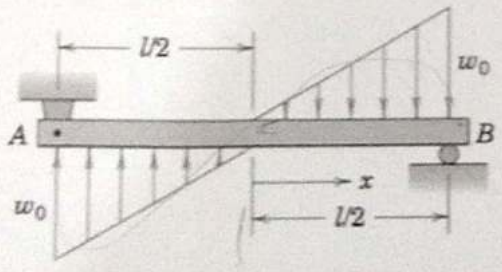
A. 37.1 mm
B. 42.9 mm
C. 34.5 mm
D. 32.4 mm

27. The reaction at support B for the beam subjected to a combination of distributed and point loads, as shown in figure, is



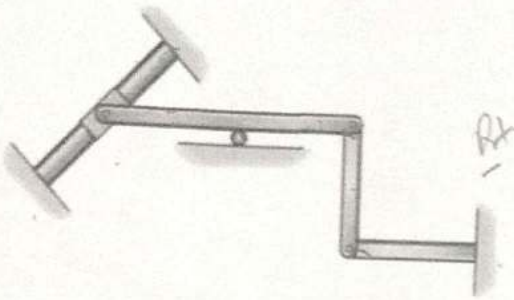
A. 1.375 kN
B. 1.75 kN
C. 1.224 kN
D. 2.25 kN

28. The magnitude of the bending moment at mid-span of the beam, shown in figure, is



A. $w_0 l^2/12$
B. $w_0 l^2/24$
C. maximum
D. zero

29. The following pin-connected structure is statically



A. indeterminate to the third degree.
B. indeterminate to the second degree.
C. indeterminate to the first degree.
D. determinate.

30. *(Choose most precise statement)* The difference between constructing an influence line and constructing shear or moment diagrams is that the
A. Influence lines represent the effect of moving loads, whereas shear and moment diagrams represent the effect of fixed loads.
B. Influence lines represent the effect of loads at a specified point on a member, whereas shear and moment diagrams represent the effect of loads at all points.
C. Influence lines represent the effect of a moving load only at a specified point on a member, whereas shear and moment diagrams represent the effect of fixed loads at all points along the axis of the member.
D. Influence lines represent the effect of a moving load only at a specified point, whereas shear and moment diagrams represent the effect of fixed loads at specified points.

31. Which of the following methods is not displacement method?
A. Moment distribution method
B. Column analogy method
C. Slope deflection method
D. Stiffness (Matrix) method

32. Bending moment at any section in a conjugate beam gives ---------- *(Fill the correct option)* in the actual beam.
A. deflection
B. slope
C. curvature
D. shear force

33. The deformation produced by a unit load is called
A. Stiffness
B. Unit strain
C. Unit displacement
D. Flexibility

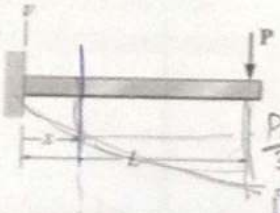
34. The degree of static indeterminacy up to which column analogy method can be used is
A. unrestricted
B. 2
C. 3
D. 4

35. The moment which makes all the fibres at the section to yield is known as
A. flexural rigidity
B. plastic moment capacity
C. moment of resistance
D. yield moment

36. Castigliano's theorem
A. is a tool for the analysis of statically indeterminate structures.
B. is based on the energy concept.
C. can be derived from Betti's generalized reciprocal theorem.
D. is valid for all above

37. Plastic collapse is defined as the failure stage at which
A. plastic hinges have formed in all the members.
B. the stresses in all the members crosses yield point.
C. sufficient number of plastic hinges have formed due to the loads (actions) in a structure leading to a failure mechanism.
D. Any of the above

38. Equation of deflection (v) at x for the following beam is



A. $v = \frac{P}{3EI}(x^3 - 6Lx^2)$
B. $v = \frac{P}{6EI}(x^3 - 3Lx^2)$
C. $v = \frac{P}{4EI}(x^3 - 2Lx^2)$
D. $v = \frac{P}{6EI}(3x^3 - Lx^2)$

39. Earthquake response spectrum
A. is representation of effects of a structure's acceleration/ velocity/ displacement.
B. is a curve plotted between maximum response of SDOF system subjected to specified earthquake ground motion and its time period (or frequency).
C. can be interpreted as the locus of maximum response of a SDOF system for given damping ratio.
D. All of the above

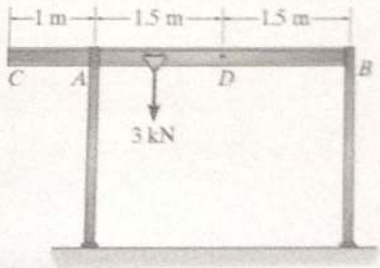
40. As per IS 1893, Ordinary Moment-Resisting Frame is a moment-resisting frame which
A. is not meeting special detailing requirements for ductile behaviour.
B. is meeting special detailing requirements for ductile behaviour.
C. complies with the requirements given in IS 4326.
D. complies with the requirements given in IS 13920.

41. On deriving the necessary relations between the force in the cable and its slope, following assumption(s) is/ are made:
A. The plane perpendicular to the longitudinal axis remains plane after bending.
B. The cable is perfectly flexible and inextensible.
C. The cable is in pure bending.
D. All of the above.

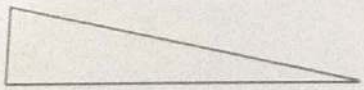
42. Funicular Arch
A. is a parabolic arch.
B. is subjected to a *uniform* horizontally distributed vertical load
C. resists only compressive forces.
D. All of the above.

43. A Tied Arch
A. allows the structure to behave as a rigid unit.
B. is in which tie rod carries the horizontal component of thrust at the support.
C. is unaffected by relative settlement of the supports.
D. All of the above.

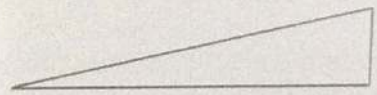
44. The frame structure shown is used to support a hoist for transferring loads for storage at points underneath it. It is anticipated that the load on the dolly is 3 kN and the beam CB has a mass of 24 kg/m. Assume the dolly has negligible size and can travel the entire length of the beam. Also, assume A is a pin and B is a roller. Choose the correct shape of IL diagram for reaction at A.



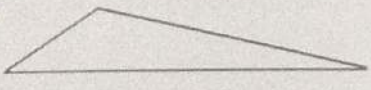
A.



B.



C.



D.

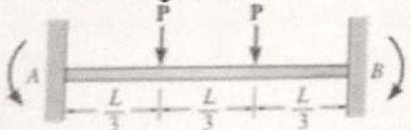
45. The influence line for a function (reaction, shear, or moment) is to the same scale as the deflected shape of the beam when the beam is acted upon by the function
A. Betti's Law
B. Maxwell's Theorem
C. Muller-Breslau Principle
D. Castigliano's Theorem

46. The equations of Slope and Deflection in the beams can be obtained by
A. Moment-Area Method
B. Double Integration Method
C. Conjugate Beam Method
D. All of the above

47. Principle of virtual work
A. was developed by John Bernoulli.
B. is sometimes referred to as the unit-load method.
C. can be used for beam, frame, or truss.
D. All of the above

48. The method of least work to determine slope and deflection
A. applies only to structures that have constant temperature, unyielding supports, and linear elastic material response.
B. can be applied to structures that are under variable temperature.
C. can be applied to structures of non-linear elastic materials.
D. Both B & C options are valid.

49. The fixed end moment for the following beam is



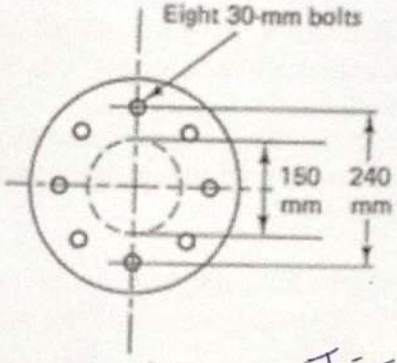
A. $\frac{PL}{3}$
B. $\frac{2PL}{9}$
C. $\frac{2PL}{7}$
D. $\frac{PL}{6}$

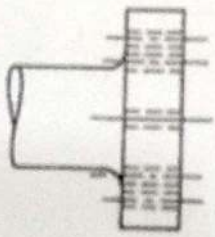
50. A steel spherical pressure vessel of radius 1m has a wall thickness of 10mm. The maximum membrane stresses (in MPa) caused by an internal pressure of 0.8 MPa if $E=200GPa$, $v=0.25$ is (Assume that internal and external diameters are equal)
A. 80
B. 40
C. 20
D. 10

51. The fractured specimen shown exhibits

A. ductile failure in tension
B. ductile failure in torsion
C. brittle failure in tension
D. brittle failure in torsion

52. The torque-carrying capacity of a steel coupling forged integrally with the shaft, as shown, as controlled by an allowable shear stress of 40 MPa in the eight bolts is





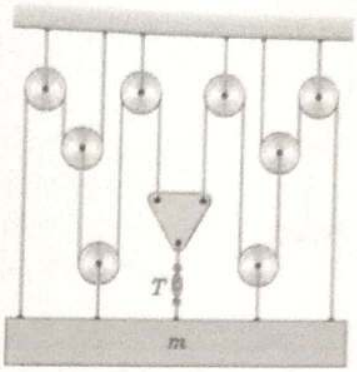
A. 27100 N-m
B. 54200 N-m
C. 1355 N-m
D. 2710 N-m

53. Under hydrostatic pressure (p), the octahedral shear stress is
A. zero
B. p/3
C. $\frac{\sqrt{2}}{3}p$
D. 2/3p

54. A hollow circular shaft whose inner diameter is half the outer diameter has a torsional strength equal to ---------- *(Fill correct option)* of that of a solid shaft of the same outside diameter.

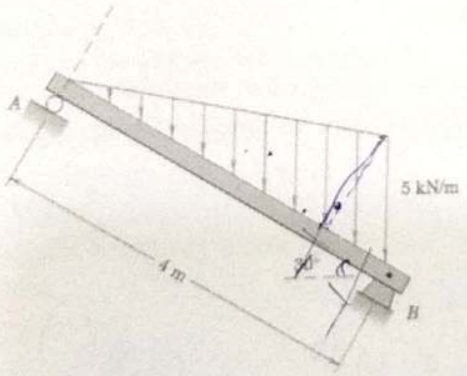
A. 15/8
B. 13/8
C. 17/16
D. 15/16

55. The tension T in the turnbuckle for the pulley–cable system (Neglecting the mass of the pulleys and cable) in terms of the mass m of the body which it supports is



A. 1/5 mg
B. 2/7 mg
C. 1/4 mg
D. 2/5 mg

56. An inclined beam subjected to the vertical load distribution as shown. Determine reaction at A. The value of the load distribution at the right end of the beam is 5 kN per horizontal meter.



A. 3.75 kN
B. 2.5 kN
C. 3.33 kN
D. 5 kN

57. As per IS 800, the maximum effective slenderness ratio for a steel member carrying compressive loads resulting from dead loads and imposed loads is

A. 150
B. 180
C. 250
D. 300

58. The effective length of prismatic compression member for following boundary condition is

A. 1.2
B. 1.4
C. 1.8
D. 2.0

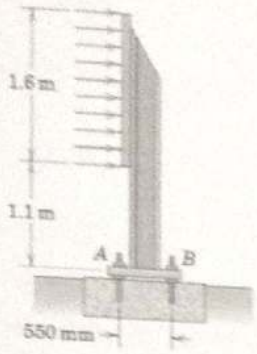
59. Lame's constants are (notations have usual meanings)

A. $\mu = \frac{E}{2(1+\upsilon)}; \lambda = \frac{\upsilon E}{(1+\upsilon)(1-2\upsilon)}$
B. $\mu = \frac{E}{2(1+\upsilon)}; \lambda = \frac{\upsilon E}{(1+\upsilon)(1+2\upsilon)}$
C. $\mu = \frac{E}{2(1-\upsilon)}; \lambda = \frac{\upsilon E}{(1+\upsilon)(1-2\upsilon)}$
D. $\mu = \frac{E}{2(1+\upsilon)}; \lambda = \frac{\upsilon E}{(1-\upsilon)(1+2\upsilon)}$

60. A circular shaft, subjected to a torsion such that maximum shear stress induced is 200 MPa. Find the strain energy in the shaft per unit volume (in N-mm/mm^3) if E=2×10^5 MPa; ν=0.25.

A. 1/10
B. 1/4
C. 3/20
D. 1/2

61. The wind blowing normal to the plane of the rectangular sign exerts a uniform pressure of 125 N/m^2 as indicated in the figure. Determine the changes in the forces exerted at A and B by each support. There are two symmetrically placed I-beam up- rights, and the width of the sign is 4 m.



A. ΔA=2764 N increase; ΔB=2764 N decrease
B. ΔA=1382 N increase; ΔB=1382 N decrease
C. ΔA=1382 N decrease; ΔB=1382 N increase
D. ΔA=2764 N decrease; ΔB=2764 N increase

62. For a symmetrical 2-hinged arch, if one of the supports settles down vertically, then the horizontal thrust
A. is increased.
B. is decreased.
C. remains unchanged.
D. becomes zero

63. On application of load on rigid jointed frame,
A. the angle between members at the joints remains same in spite of rotation and displacement, if any.
B. no rotation is produced.
C. no displacement is produced.
D. neither rotation nor displacement is produced.

64. As per IS 800, the time, in minutes, for the member to reach the limit state of structural inadequacy in a standard fire test is known as
A. fire warning period.
B. period of structural adequacy under fire.
C. fire collapse time.
D. None of the above

65. The influence of temperature on the modulus of elasticity is taken as follows for structures of mild steels and high strength low alloy steels when temperature, T (in degrees) is > 600°C but ≤ 1000°C :

A. $\frac{E(T)}{E(20)} = \frac{T}{2000 \times ln\left(\frac{T}{1100}\right)}$

B. $\frac{E(T)}{E(20)} = 1.0 + \left[\frac{T}{2000 \times ln\left(\frac{T}{1100}\right)}\right]$

C. $\frac{E(T)}{E(20)} = \frac{690\left[1 - \frac{T}{1000}\right]}{T - 53.5}$

D. $\frac{E(T)}{E(20)} = 1.0 + \frac{690\left[1 - \frac{T}{1000}\right]}{T - 53.5}$

where E(T) is Modulus of elasticity at temperature T, and E(20) is the modulus of elasticity at 20 ℃.

66. Plastic collapse is defined as the failure stage at which
A. plastic hinges have formed in all the members.
B. the stresses in all the members crosses yield point.
C. sufficient number of plastic hinges have formed due to the loads (actions) in a structure leading to a failure mechanism.
D. Any of the above

67. As per IS 800, maximum effective slenderness ratio for compression flange of a beam against lateral torsional buckling is
A. 300
B. 250
C. 180
D. 150

68. As per working stress design, In the load combinations involving wind or seismic loads, the permissible stresses in steel structural members may be increased by
A. 15%
B. 25%
C. 33%
D. 50%

69. The curve defining the relationship between the number of stress cycles to failure at constant stress range, during fatigue loading of structure is precisely known as
A. Column buckling curve
B. S-N Curve
C. Fatigue curve
D. Cyclic buckling curve

70. For a solid slab supported on two opposite edges and carrying single concentrated load, the effective width (b_{ef}) is calculated in accordance with (provided it should not exceed actual width of slab)

A. $kx\left(1+\frac{x}{l_{ef}}\right)-a$

B. $kx\left(1-\frac{x}{l_{ef}}\right)+a$

C. $kx+a\left(1+\frac{x}{l_{ef}}\right)$

D. $kx\left(1+\frac{x}{l_{ef}}\right)+a$

where, k-constant depending upon width to span ratio; x-distance of the centroid of the concentrated load from nearer support; l_{ef}-effective span; a-width of the contact area of concentrated load from nearer support

71. When there is no proper quality control for making the concrete for mix proportioning, the assumed standard deviation shall be increased by

A. 0.5 MPa
B. 1.0 MPa
C. 1.5 MPa
D. 2.0 MPa

72. Minimum period before striking formwork for 'props to beam and arches' of span over 6.0 m is

A. 7 days
B. 14 days
C. 21 days
D. 3 days

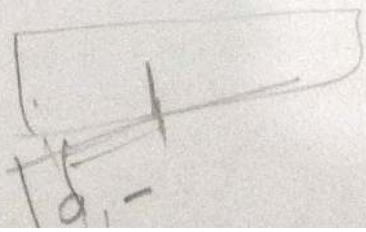
73. For a simply supported beam of 20 m span, the span to effective depth ratio for limiting the vertical deflection should not be greater than

A. 7
B. 20
C. 26
D. 10

74. For a solid cantilever slab carrying single concentrated load, the effective width (bef) is calculated in accordance with (provided it should not exceed 1/3 of the length of slab)

A. $a_1 - 1.2a$
B. $1.2\,a_1 - a$
C. $1.2\,a_1 + a$
D. $a_1 + 1.2a$

where, a_1-distance of concentrated load from the face of cantilever support; a-width of contact area of the concentrated load.



75. Choose the correct statement regarding reinforcement splicing
A. The splices are should as far as possible away from the sections of maximum stress and be staggered.
B. The splices in the flexural members should not be at sections where the bending moment is more than 50% of the moment of resistance.
C. Not more than half the bars should be spliced at a section.
D. All of the above

76. Side face reinforcement in the beam is provided when the depth of web exceeds
A. 500 mm
B. 750 mm
C. 1000 mm
D. 1250 mm

77. The hook length of vertical hoops in beam-web-reinforcement should be
A. 10d (but ≥ 75mm)
B. 8d (but ≥ 75mm)
C. 8d (but ≥ 100mm)
D. 10d (but ≥ 100mm)
where d is diameter of bar

78. When a column terminates into a footing or mat, special confining reinforcement shall extend into the footing or mat at least
A. 200 mm
B. 300 mm
C. 400 mm
D. 500 mm

79. Choose incorrect statement with reference to Flat Slabs.
A. The drops when provided shall be rectangular in plan.
B. A flat slab may be solid or may have recesses formed on the soffit.
C. Middle strip means a design strip bounded on each of its opposite sides by the column strip.
D. None of the above

80. In flexure, the maximum strain in tension reinforcement in the section at failure shall not be less than
A. 0.0020
B. 0.0035
C. $\frac{f_y}{1.15E_s} + 0.002$
D. $\frac{f_y}{1.15E_s} + 0.0035$
where, f_y is characteristic strength of steel, and E_s is modulus of elasticity of steel

81. A borrow soil has a dry density of 1.76 t/m^3. How many cubic metres of this soil be required to construct an embankment of 100m^3 with a dry density of 1.68 t/m^3.
A. 85
B. 95
C. 105
D. 110

$\frac{V_1}{1+e_1} = \frac{V_2}{1+e_2}$ $\gamma_d = \frac{W_s}{V}$ $V_s = \frac{V}{1+e}$

82. In the plasticity chart the equation of A-line dividing 'inorganic clay' from 'silt and organic soil' is
A. $0.37(w_L-20)$
B. $0.73(w_L-20)$
C. $0.90(w_L-10)$
D. $0.73(w_L-10)$

83. For what value of r/z will the vertical stress in any plane due to point load be maximum?
A. 0.718
B. 0.078
C. 0.817
D. 0.087

84. The deviator stress is given by
A. $\sigma_1 - \sigma_3$
B. $\sigma_1 + \sigma_3$
C. $\frac{\sigma_1-\sigma_3}{2}$
D. $\frac{\sigma_1+\sigma_3}{2}$

$\sigma_{3f} = \frac{\sigma_1-\sigma_3}{2}$

85. In a pile load test in dense soil, the safe load is taken as
A. 2/3 the final load at which the total settlement attains a value of 12mm
B. ½ the final load at which the settlement equals 10% of pile diameter
C. the smaller of a and b
D. ultimate load divided by factor of safety

$\sigma_1 f = \sigma_c + \sigma_d$

$\sigma_{3f} = \sigma_d$ $\quad \sigma_1 - \sigma_3 \frac{\sigma_c}{2}$

$\sigma_{1f} + \sigma_{3f} = \sigma_c + 2\sigma_d$