ESE (P), 2020

CIVIL ENGINEERING

1. When the deposit of efflorescence is more than 10% but less than 50% of the exposed area of the brick, the presence of efflorescence is
(a) Moderate (b) Slight
(c) Heavy (d) Serious

2. Mohs scale is used for stones to determine
(a) Flakiness index
(b) Durability
(c) Strength
(d) Hardness

3. Which of the following conditions are recommended for using sulphate resisting cement?
1. concrete to be used in foundation and basement, where soil is not infested with sulphates
2. concrete used for fabrication of pipes which are likely to be buried in marshy region or sulphate bearing soils
3. Concrete to be used in the construction of sewage treatment works

(a) 2 and 3 only (b) 1 and 2 only
(c) 1 and 3 only (d) 1, 2 and 3

4. Which one of the following cements is a deliquescent?
(a) Quick setting Portland cement
(b) White and Coloured cement
(c) Calcium Chloride cement
(4) Water Repellent cement

5. Consider the following data for concrete with mild exposure:
Water-cement ratio = 0.50
Water = 191.6 litre
The required cement content will be
(a) 561 kg/m^3 (b) 472 kg/m^3
(c) 383 kg/m^3 (d) 294 kg/m^3

6. The strength of a fully matured concrete sample is 500 kg/cm^2. When cured at an average temperature of 20°C in day, 10°C in night, datum temperature T_0 is –11°C. If Plowman constants A is 32 and B is 54, the strength of identical concrete at 7 days will be nearly
(a) 333 kg/cm^2 (b) 312 kg/cm^2
(c) 272 kg/cm^2 (d) 243 kg/cm^2

7. A sample of concrete is prepared by using 500 g of cement with water cement ratio of 0.55 and 240 N/mm^2 intrinsic strength of gel. The theoretical strength of concrete on full hydration will be nearly
(a) 148 N/mm^2 (b) 126 N/mm^2
(c) 104 N/mm^2 (d) 82 N/mm^2

8. The cement and water slurry coming on the top and setting on the surface is called
(a) Crazing
(b) Efflorescence
(c) Sulphate deterioration
(d) Laitance

9. Polymer concrete is most suitable for
(a) Sewage disposal works
(b) Mass concreting works
(c) Insulating exterior walls of an air-conditioned building
(d) Road repair works

10. Which one of the following limes will be used for finishing coat in plastering and white washing?
(a) Semi Hydraulic lime
(b) Kankar lime
(c) Magnesium/Dolomitic lime
(d) Eminently Hydraulic lime

11. Which one of the following light weight element will be added to enhance the protective properties for X-ray shielding mortars?
(a) Sodium (b) Potassium
(c) Lithium (d) Calcium

12. Which one of the following stone is produced by moulding a mixture of iron slag and Portland cement?

(a) Imperial stone (b) Garlic stone
(c) Ransom stone (d) Victoria stone

13. When a round bar material with diameter of 37.5 mm, length of 2.4 m, Young's modulus of 110 GN/m^2 and shear modulus of 42 GN/m^2 is stretched for 2.5 mm, its Bulk modulus will be nearly

(a) 104 GN/m^2 (b) 96 GN/m^2
(c) 84 GN/m^2 (d) 76 GN/m^2

14. A punch of 20 mm diameter is used to punch a hole in 8 mm thick plate. If the force required to create a hole is 110kN, the average shear stress in the plate will be nearly

(a) 410MPa (b) 320MPa
(c) 220MPa (d) 140MPa

15. A reinforced concrete circular section of 50,000 mm^2 cross-sectional area carries 6 reinforcing bars whose total area is 500 mm^2. If the concrete is not to be stressed more than 3.5MPa and modular ratio for steel and concrete is 18, the safe load the column can carry will be nearly

(a) 225kN (b) 205Kn
(c) 180kN (d) 160kN

16. The strain energy U stored due to bending of the cantilever beam due to point load at the free end will be

(a) $\frac{W^2l^3}{6EI}$ (b) $\frac{W^2l^2}{6EI}$
(c) $\frac{W^3l^3}{36EI}$ (d) $\frac{W^2l^3}{36EI}$

Where : W = Concentrated load
l = Length of a cantilever
EI = Flexural rigidity

17. A steel bar 2 m long, 20 mm wide and 15 mm thick is subjected to a tensile load of 30kN. If Poisson's ratio is 0.25 and Young's modulus is 200GPa, an increase in volume will be

(a) 160 mm^3 (b) 150 mm^3
(c) 140 mm^3 (d) 130 mm^3

18. A bolt is under an axial thrust of 9.6kN together with a transverse force of 4.8kN. If factor of safety is 3, yield strength of bolt material is 270 N/mm^2 and Poisson's ratio is 0.3, its diameter as per maximum principal stress theory will be nearly

(a) 13 mm (b) 15 mm
(c) 17 mm (d) 19 mm

19. In a material the principal stressed are 60 MN/m^2, 48 MN/m^2 and –36 MN/m^2. When the values of E = 200 GN/m^2 and $\frac{1}{m}$ = 0.3, the total strain energy per unit volume will be nearly

(a) 43.5 kNm/m^3 (b) 35.5 kNm/m^3
(c) 27.5 Nm/m^3 (d) 19.5 Nm/m^3

20. At a point in a two dimensional stress system, the normal stress on two mutually perpendicular planes are σ_{xx} and σ_{yy} and shear stress is τ_{xy}. One of the principal stresses will become zero when the value of shear stress τ_{xy} is

(a) $\pm(\sigma_{xx}\sigma_{yy})$ (b) $\pm\sqrt{\sigma_{xx}-\sigma_{yy}}$
(c) $\pm\sqrt{\sigma_{xx}+\sigma_{yy}}$ (d) $\pm\sqrt{\sigma_{xx}\sigma_{yy}}$

21. The deflection δ of the closed coil helical spring is

(a) $\frac{WR^2n}{8Cd^3}$ (b) $\frac{64WR^3n}{Cd^4}$
(c) $\frac{128WR^3n}{Cd^2}$ (d) $\frac{64WR^2n}{Cd^2}$

Where: W is the axial load
R is radius of the coil
n is the number of turns of coil
C is the modulus of rigidity
d is the diameter of the wire of the coil

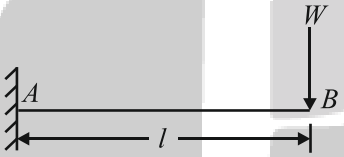
22. A closely-coiled helical spring of round steel wire 5 mm in diameter having 12 complete coils of 50 mm mean diameter is subjected to an axial load of 100 N. If modulus of rigidity is 80 GPa, the deflection of the spring will be

(a) 36 mm (b) 32 mm
(c) 28 mm (d) 24 mm

23. A hollow shaft of external and internal diameters as 100 mm and 40 mm respectively is transmitting power at 120 rpm. If the shearing stress is not to exceed 50 MPa, the power the shaft can transmit will be
(a) 100 kW (b) 120 kW
(c) 140 kW (d) 160 kW

24. A circular beam of 100 mm diameter is subjected to a shear force of 30kN. The maximum shear stress will be nearly
(a) 5.1MPa (b) 6.3MPa
(c) 7.5MPa (d) 8.7MPa

25. A cantilever beam *AB* as shown in figure is subjected to a point load of 12 kN over a span of 6 m with $E = 2 \times 10^5$ N/mm^2 and $I_{xx} = 6 \times 10^7$ mm^4. The deflection at the free end will be



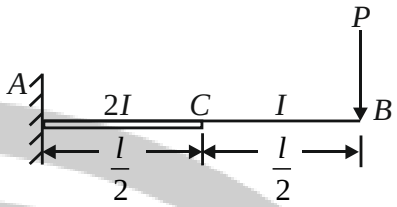
(a) 80 mm (b) 72 mm
(c) 64 mm (d) 56 mm

26. A floor has to carry a load of 12kN/m^2. The floor is supported on rectangular joists each 100 mm wide, 300 mm deep and 5 m long. If maximum stress in the joists should not exceed 8MN/m^2, the centre to centre distance of joists will be
(a) 430 mm (b) 400 mm
(c) 360 mm (d) 320 mm

27. A simply supported wooden beam 100 mm wide, 250 mm deep and 3 m long is carrying a uniformly distributed load of 40kN/m. The maximum shear stress will be
(a) 2.4MPa (b) 2.8MPa
(c) 3.2MPa (d) 3.6MPa

28. A simply supported beam of span 8 m carries a uniformly distributed load of 24 kN/m run over the whole span. The barn is propped at the middle of the span. The values of $E = 200 \times 10^6$ kN/m^2 and $I = 20 \times 10^{-5}$ m^4. The amount by which the prop should yield in order to make all three reactions equal will be nearly
(a) 20 mm (b) 15 mm
(c) 10 mm (d) 5 mm

29. A cantilever beam *ACB* has end *A* fixed and subjected to a point load *P* at free end *B*. The point *C* is mid-point of *AB* and the moment of inertia of *AC* is twice that of *CB*. The deflection at the free end will be



(a) $\frac{Pl^3}{3EI}$ (b) $\frac{Pl^3}{48EI}$
(c) $\frac{5Pl^3}{96EI}$ (d) $\frac{9Pl^3}{48EI}$

30. A beam of uniform cross-section, simply supported at ends carries a concentrated load *W* at midspan. If the ends of the beam are fixed and only load *P* is applied at the midspan such that the deflection at the centre remains the same, the value of the load *P* will be
(a) 6*W* (b) 4*W*
(c) 2*W* (d) *W*

31. Two wheel loads 200kN and 80kN spaced at 2 m apart move on the span of girder of 16 m. If any wheel load can lead the other, the maximum bending moment that can occur at a section of 6 m from the left end will be
(a) 1050kNm
(b) 990kNm
(c) 870kNm
(d) 750kNm

32. A beam of length *l* is fixed at its both ends and carries two concentrated loads of *W* each at a distance of $\frac{l}{3}$ from both ends. The fixed end moment at *A* will be
(a) $\frac{-Wl}{3}$
(b) $\frac{-2Wl}{9}$
(c) $\frac{-6Wl}{15}$
(d) $\frac{-4Wl}{27}$

33. The natural frequency of a mass *m* at the end of the cantilever beam of negligible mass with usual notations will be

(a) $\frac{1}{2\pi}\left(\frac{3EI}{mL^3}\right)^{\frac{1}{2}}$

(b) $\frac{1}{\pi}\left(\frac{6EI}{mL^3}\right)^{\frac{1}{2}}$

(c) $\frac{1}{2\pi}\left(\frac{6EI}{mL^3}\right)^{\frac{1}{2}}$

(d) $\frac{1}{\pi}\left(\frac{3EI}{mL^3}\right)^{\frac{1}{2}}$

34. The simple oscillator under idealized conditions of no-damping, once excited will oscillate indefinitely with constant amplitude at its natural frequency *f* will be

(a) $\frac{1}{2\pi}\sqrt{\frac{m}{k}}$ (b) $\frac{1}{\pi}\sqrt{\frac{k}{m}}$

(c) $\frac{1}{2\pi}\sqrt{\frac{k}{m}}$ (d) $\frac{1}{\pi}\sqrt{\frac{m}{k}}$

35. A cable carrying a load of 10kN/m run of horizontal span is stretched between supports of 100 m apart. If the supports are at same level and central dip of 8 m, the ratio of greatest and least tensions in the cable will be

(a) 1.05 (b) 1.35
(c) 1.65 (d) 1.95

36. A cable is suspended between two points 75 m apart at the same level. It carries a uniformly distributed load of 12.5 kN per horizontal meter. If the maximum tension in the cable is limited to 1000 kN, the minimum central dip will be nearly

(a) 14 m (b) 12 m
(c) 10 m (d) 8 m

37. A tie bar 50 mm × 8 mm is to carry a load of 80 kN. A specimen of the same quality steel of cross-sectional area is 250 mm^2. For a maximum load of 125 kN carried by the specimen, the factor of safety in the design will be

(a) 3.0 (b) 2·5
(c) 2.0 (d) 1:5

38. Hanger connections are made when

(a) Beam as well as girder is meeting at different level. A plate or hanger is interposed between the beam and the girder and finally interconnected by means of angle cleats or bolts and rods.
(b) Beam as well as girder is meeting at same level. A plate is interposed between the beam and the girder
(c) The beams are meeting at different levels. A hanger is interposed between the beams and finally interconnected by means of angle cleats or bolts and rods
(d) The girders are meeting at same level. A plate is interposed between the girders and finally interconnected by means of bolts and rods.

39. The splicing of a column becomes necessary, where

(a) The available length of structural steel section is less than the required length of the column
(b) Section remains same throughout at all floors
(c) Only riveted columns are to be designed
(d) Splices should be designed to carry axial loads only

40. A tie bar 50 mm × 8 mm is to carry a load of 80 kN. A specimen of same quality steel of cross-sectional area is 250 mm^2. If the maximum load carried by the specimen is 125 kN, the guage length will be

(a) 133 mm (b) 126 mm
(c) 113 mm (d) 106 mm

41. The strength of a column depends on which of the following imperfections?

1. The material being isotropic and homogeneous
2. Geometric variations of columns
3. Eccentricity of load

(a) 1,2 and 3
(b) 2 and 3 only
(c) 1 and 3 only
(d) 1 and 2 only

42. Which of the following types of failures occur in the beam-column connections?
1. Failure by lateral-torsional buckling
2. Failure by combined instability in both the principal directions
3. Failure by combined twisting and bending on the torsionally weak sections
4. Failure by combined twisting and bending when plane of bending does not contain the shear centre

(a) 1, 2 and 3 only
(b) 1, 3 and 4 only
(c) 1, 2 and 4 only
(d) 2, 3 and 4 only

43. In a design of beam columns, the values of plastic section ratio β_b = 1, the plastic sectional modulus Z_{pz} = 3948812 mm^3, the yield stress f_y = 250 N/mm^2 and critical moment of M_{cr} = 16866 × 10^6 N.mm. The non-dimensional lateral torsional slenderness ratio will be nearly

(a) 0.141 (b) 0.242
(c) 0.323 (d) 0.424

44. As per Indian Railway Board, the impact factor *i* (also known as coefficient of dynamic augment, *CDA*) in steel girders for single track span is

(a) $\left[0.15+\frac{8}{6+L}\right] \not> 1.0$

(b) $\left[0.75+\frac{6}{8+L}\right] \not> 1.0$

(c) $\left[0.15+\frac{6}{8+L}\right] \not> 1.0$

(d) $\left[0.75+\frac{8}{6+L}\right] \not> 1.0$

Where : L is span

45. An *ISHB* 300 with plastic section modulus of 921.68 × 10^3 mm^3, flange width of 250 mm, the yield stress of 250 N/mm^2 is embedded in a pocket base to develop its strength with M 25 concrete in design of beam-column. The required depth will be nearly

(a) 475 mm (b) 425 mm
(c) 375 mm (d) 325 mm

46. In beam-columns or eccentric loaded columns, an elastic critical stress in compression f_{cc} is

(a) $\frac{\pi E}{\lambda}$

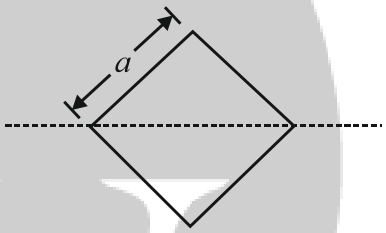
(b) $\frac{\pi^2 E}{\lambda^2}$

(c) $\frac{\pi E}{\lambda^2}$

(d) $\frac{\pi^2 E}{\lambda}$

Where : E = Modulus of elasticity of steel
λ = Slenderness ratio in the plane of bending

47. A square of side *a* is placed such that its diagonal is horizontal. The shape factor of the square will be



(a) 3.2
(b) 2.0
(c) 1.5
(d) 1.0

48. Which one of the following is the correct assumption made in evaluation of fully plastic moment?

(a) The upper and lower yield stresses and the modulus of elasticity have different values in compression and tension
(b) The material is homogeneous and isotropic in both the elastic and plastic states
(c) There will be resultant axial force on the beam
(d) Some layers of the material are not free to expand and contract longitudinally and laterally under stress

49. 49 As per IS-456 : 2000, cracking of concrete in tension zone cannot be avoided bụt can be limited by

1. Adhering to the codal requirements of minimum steel area
2. Proper and prolonged curing of concrete
3. Increasing water cement ratio to increase workability

(a) 1 and 2 only (b) 1 and 3 only
(c) 2 and 3 only (d) 1,2 and 3

50. Which of the following assumptions are made with respect to Euler's theory applied to columns?

1. The section of the column is uniform
2. The length of the column is very large compared to the lateral dimensions
3. The direct stress is large when compared with the bending stress

(a) 1,2 and 3 (b) 1 and 3 only
(c) 2 and 3 only (d) 1 and 2 only

51. A rectangular beam with b = 200 mm and effective depth d = 300 mm is subjected to limit state shear of 80 kN and torsional moment of 6 kNm. The equivalent value of shear will be

(a) 128 kN (b) 116 kN
(c) 104 kN (d) 92 kN

52. As per IS-456:2000, the value of maximum compression strain in concrete in axial compression for limit state of collapse is

(a) 0.001 (b) 0.002
(c) 0.003 (d) 0.004

53. The positive bending moment coefficient at the middle of the end-span of a continuous one way slab is

(a) $\left(\frac{w_l}{10}+\frac{w_d}{12}\right)L^2$

(b) $\left(\frac{w_l}{9}+\frac{w_d}{10}\right)L^2$

(c) $\left(\frac{w_l}{12}+\frac{w_d}{16}\right)L^2$

(d) $\left(\frac{w_l}{12}+\frac{w_d}{16}\right)L^2$

Where : w_l = Live laod
w_d = Dead load

54. Which of the following are the general design requirements of retaining wall?

1. The factor of safety against sliding should be at least 1.5
2. The factor of safety against overturning should be at least 2.0
3. The bearing pressure at toe should be less than the bearing capacity of the soil
4. The length of retaining wall to be cast in one go should not exceed 10" " m otherwise cracks may develop

(a) 1,2 and 3 only
(b) 1,3 and 4 only
(c) 1,2 and 4 only
(d) 2,3 and 4 only

55. Which of the following are the desirable properties for efficient functioning in design for movement joint of water tank?

1. The joint should accommodate repeated movement of the structure without loss of water-tightness
2. The design should provide for exclusion of grit and debris which would prevent the closing of the joint
3. The material used in the construction of movement joints should not slump unduly in hot weather or become brittle in cold weather

(a) 1,2 and 3 (b) 1 and 2 only
(c) 1 and 3 only (d) 2 and 3 only

56. A simply supported beam having 200 mm width and 450 mm effective depth supports a total uniformly distributed load of 2,00,000 N. The nominal shear stress will be nearly

(a) 0.8 N/mm^2 (b) 1.1 N/mm^2
(c) 1.8 N/mm^2 (d) 2.2 N/mm^2

57. Which of the following are correct for cover to reinforcement?

1. The reinforcement shall have a minimum clear cover of 20 mm or diameter of such bar whichever is more
2. At each end of reinforcing bar not less than 25 mm nor less than twice the diameter of such bar
3. Increased cover thickness may be provided when surface of concrete is exposed to the action of harmful chemicals.

(a) 1,2 and 3 (b) 1 and 2 only
(c) 1 and 3 only (d) 2 and 3 only

58. A beam of size 250 mm width and 460 mm effective depth is subjected to limit state moment of 146 kNm. If 20 grade concrete and Fe 415 steel are used, the area of steel required will be

(a) 435 mm^2 (b) 935 mm^2
(c) 1100 mm^2 (d) 1235 mm^2

59. Air permeability method is used to determine

(a) Soundness of cement
(b) Setting time
(c) Fineness of cement
(d) Resistance of cement

60. Which of the following assumptions are correct for the lateral torsional buckling of an I-section beam?

1. The beam is initially distorted
2. Its behaviour is elastic
3. It is loaded by equal and opposite end moments in the plane of the web

(a) 1 and 2 only (b) 2 and 3 only
(c) 1 and 3 only (d) 1,2 and 3

61. In an excavation of 3,000 cub.mtr of common earth for a canal project, 6 men can be effectively employed on the job. If an output of a man is taken as 100 cub.mtr per day, the duration of excavation activity will be

(a) 5 days (b) 6 days
(c) 7 days (d) 8 days

62. The project plan for construction

1. Clearly defines project's scope of work. It breaks down project objectives into clear, identifiable, attainable and verifiable goals
2. Identifies critical activities, thus enabling management of projects by exceptions
3. Provides the basis for coordinating the efforts of clients, consultants, architects, designers, quality surveyors, specialists, suppliers, contractors and project staff

(a) 1 and 2 only
(b) 1, 2 and 3
(c) 1 and 3 only
(d) 2 and 3 only

63. Which one of the following techniques is not covered in Project Network Analysis-?

(a) Critical Path Method
(b) Program Evaluation and Review Techniques
(c) Procedure Network Analysis
(d) Measurement Book

64. Which of the following statements are correct for Network Critical Path?

1. The path of critical activities, which links the start and end events is critical path
2. It is the path of activities having zero float
3. It is the path of events having zero slack
4. The sum of the duration of the critical activities along a critical path gives the duration of the project

(a) 1,2,3 and 4 (b) 1,2 and 3 only
(c) 1 and 4 only (d) 2,3 and 4 only

65. Independent float is an amount of time by which the start of an activity may be delayed without affecting

1. the preceding or the following activity
2. the start of a following activity
3. the completion of the project

(a) 1 only (b) 2 only
(c) 3 only (d) 1,2 and 3

66. Consider the following activity for the total project :

Activity	Immediate Predecessors	Duration (Days)
A	-	10
B	-	9
C	A	9
D	A	8
E	B	7
F	B	11
G	D, E	5

The total project duration for the critical path will be

(a) 25 days (b) 23 days
(c) 21 days (d) 19 days

67. By performing which of the following functions the construction manager can achieve the project goals?
1. Envisioning the task ahead
2. Setting targets and monitoring performance
3. Motivating the work force
4. Building the line supervisors team

(a) 1,2 and 4 only (b) 1,2 and 3 only
(c) 1,3 and 4 only (d) 1,2,3 and 4

68. The cost of the machine is ₹ 20,00,000, and if it is purchased under instalment basis; the company has to pay 25% of the cost at the time of purchase and the remaining amount in 10 annual equal instalments of ₹ 2,50,000 each. If rate of interest is 18%, compounded annually the present worth of the machine will be
(a) ₹ 17,01,000 (b) ₹ 16,22,500
(c) ₹ 15,43,000 (d) ₹ 14,64,500

69. Which of the following relations are correct for determining different components of a bid price?
1. Bid price = Direct cost + Indirect cost + Mark up amount
2. Direct cost = Project overheads + Common plant and equipment cost + Common work men cost
3. Mark up amount = Profit + Contingency + Allowances for risks + General overheads

(a) 1,2 and 3 (b) 1 and 2 only
(c) 1 and 3 only (d) 2 and 3 only

70. Resource smoothing is
(a) An optimization and economical utilization of resources
(b) An adjustment of resources without affecting project duration
(c) A gradual increase in resources
(d) A gradual decrease in resources

71. In PERT technique, the time estimate of activities and probability of their occurrence follow
(a) Binomial distribution
(b) Normal distribution
(c) Poisson distribution
(d) β distribution

72. Indirect cost due to accidents includes
(a) Legal charges
(b) Medical expenses for the injured
(c) Compensation amount to the injured
(d) Over time payment to make up the loss of time

73. An oil of specific gravity 0.9 contained in a vessel. At a point the height of oil is 40 m and for the density of water = 1000 kg/m^3, the corresponding height of water at the point will be
(a) 28 m (b) 32 m
(c) 36 m (d) 40 m

74. When speed changes in case of centrifugal pump, which of the following points are correct?
1. The shape of the velocity triangle will remain same
2. Various angles will remain same
3. Magnitude of velocity will change proportionately

(a) 1 and 2 only (b) 1 and 3 only
(c) 2 and 3 only (d) 1,2 and 3

75. Which one of the following is the use of flow net analysis in fluid mechanics?
(a) To determine the streamlines and equipotential lines
(b) To determine downward lift pressure above hydraulic structure
(c) To determine the viscosity for given boundaries of flow
(d) To design the hydraulic structure

76. A jet propelled aircraft is flying at a speed of 1100 km/ hour at t = 20°C, k = 1.4 and R = 287 J/kg K. The Mach number at a point on the jet will be nearly
(a) 0.3 (b) 0.5
(c) 0.7 (d) 0.9

77. When the drag force becomes equal to the weight of the body, the acceleration ceases and the net external force acting in the body becomes
(a) Zero and the body will move at constant speed
(b) Light and the body will move forward
(c) Zero and the body will move fast
(d) High and the body will move at constant speed

78. Which one of the following statements is correct regarding flow in open channel?
(a) The curve for kinetic energy is a parabola
(b) The curve for potential energy is a parabola
(c) Specific energy is asymptotic to the vertical axis
(d) At critical depth the specific energy is maximum

79. Which one of the following statement is correct regarding critical state of flow through a channel section?
(a) Specific energy is a minimum for a given discharge
(b) Specific energy is a maximum for a given discharge
(c) The Froude number is greater than two
(d) The discharge is a minimum for a given specific force

80. Which one of the following statement is correct regarding centrifugal pumps?
(a) The discharge is fluctuating and pulsating
(b) It is used for large discharge through smaller heads
(c) The efficiency is low
(d) It runs at low speed

81. A hydraulic press has a ram of 300 mm diameter and a plunger of 45 mm diameter. When the force applied at the plunger is 50 N, the weight lifted by the hydraulic press will be nearly
(a) 2133 N (b) 2223 N
(c) 2316 N (d) 2406 N

82. Hydraulic efficiency of Francis turbine is
(a) Directly proportional to velocity of whirl at inlet and inversely proportional to net head on turbine
(b) Directly proportional to velocity of whirl at inlet and net head on turbine
(c) Inversely proportional to velocity of whirl at inlet and net head on turbine
(d) Inversely proportional to velocity of whirl at inlet and directly proportional to net head on turbine

83. A turbine develops 7225 kW power under a head of 25 m at 135rpm. The specific speed of the turbine will be nearly
(a) 245 *rpm* (b) 225 *rpm*
(c) 205 *rpm* (d) 185 *rpm*

84. Which one of the following is an example of bodies where both drag and lift forces are produced?
(a) Hydrofiles
(b) A tall chimney exposed to wind
(c) Flow of water past a bridge pier
(d) Motion of aeroplanes, submarines, torpedoes

85. The relative humidity h is a measure of air's capacity, at its existing temperature, to absorb further moisture, and is defined by the relation
(a) $\frac{e}{e_s}\times 100$ (b) $\frac{e_s}{e}\times 100$
(c) $\frac{2e_s}{e}\times 100$ (d) $\frac{2e}{e_s}\times 100$

86. Which one of the following is not a major deterrent in water harvesting through water tanks?
(a) Deforestation mainly due to population pressure in the catchments of tank systems
(b) Siltation
(c) Lack of maintenance and repairs and breaches of tank embankments
(d) Shallow depth of water tanks

87. Which one of the following is not a basic requirement for any well screen?
(a) Resistance to corrosion, incrustation and deterioration
(b) Enough structural strength to prevent collapse
(c) Suitability for excessive movement of sand into the well
(d) Minimum resistance to flow of water into the well

88. Which one of the following methods is not the category of Geophysical methods of sub-surface investigation?
(a) Electrical resistivity method
(b) Electric logging
(c) Gamma-ray logging
(d) Electrical response surveying

89. In which one of the following industries, the water requirement in kilo litres per unit of production is very high?
(a) Paper industry
(b) Steel industry
(c) Sugar industry
(d) Fertilizer industry

90. In drip irrigation system, which one of the following emitters is not based on definitions by American Society of Agricultural Engineers (ASAE)?
(a) Emitter
(b) Pulsating emitter
(c) Long path emitter
(d) Multi-outlet emitter

91. A Persian wheel with an average discharge of 230 litre/minute irrigates 1 hectare wheat crop in 50 hours. The average depth of irrigation will be nearly
(a) 4 cm (b) 5 cm
(c) 6 cm (d) 7 cm

92. Which one of the following is not the main cause for soil salinity and sodicity?
(a) Irrigation mismanagement
(b) Poor land levelling
(c) Use of heavy machinery, resulting in no soil compaction
(d) Leaching without adequate drainage

93. Which one of the following is not the major factor influencing seepage from a canal?
(a) Characteristics of the soil traversed by the canal system
(b) Area wetted by the canal
(c) Location of the canal.
(d) Frequencies of canal usage

94. Which of the following are the causes of failure of weirs?
1 Rupture of floor due to uplift
2 Rupture of floor due to suction caused by standing wave
3 Scour on the upstream and downstream of the weir
(a) 1 and 2 only
(b) 1 and 3 only
(c) 1,2 and 3
(d) 2 and 3 only

95. Which of the following are the principal factors influencing the choice of a particular method of lining?
1. Availability and cost of the material at the site or within easy reach
2. Velocity of flow in the channel
3. Cost of maintenance
(a) 1 and 2 only (b) 1 and 3 only
(c) 1,2 and 3 (d) 2 and 3 only

96. Which of the following are the objectives for river training?
1. High flood discharge may pass safely and quickly through the reach
2. To make the river course stable and reduce bank erosion to minimum
3. To check flow through canal
4. To provide a sufficient draft for navigation as well as good course for it
(a) 1,2 and 3 only
(b) 1,3 and 4 only
(c) 1,2 and 4 only
(d) 2,3 and 4 only

97. The transition region between unsaturated zone and saturated zone is called
(a) Capillary fringe
(b) Water table
(c) Yadose water zone
(d) Confining bed

98. Which of the following chemical parameters are associated with the organic content of water?
1. Biological Oxygen Demand (*BOD*)
2. Chemical Oxygen Demand (*COD*)
3. Total Organic Carbon (*TOC*) and Total Oxygen 'Demand (TOD)
(a) 1 and 2 only
(b) 1 and 3 only
(c) 2 and 3 only
(d) 1,2 and 3

99. When chlorine is dissolved in water, it reacts to form hypochlorous acid and hypochlorite ions. At pH < 5, chlorine exists in water as
(a) Elemental or molecular chlorine
(b) Remains in the form of hypochlorous acid
(c) Remains in the form of hypochlorite ions
(d) Remains in the form of both hypochlorous acid and hypochlorite ions

100. Reactive substances are
(a) Unstable under normal conditions. They can cause explosions and/or liberate toxic fumes, gases, and vapors when mixed with water
(b) Easily ignited and burn vigorously and persistently
(c) Liquids with pH less than 2 or greater than 12·5, and those that are capable of corroding metal containers
(d) Harmful or fatal when ingested or absorbed

101. The noise value of sound waves depends upon:
1. The frequency of sound waves
2. The intensity of sound waves
3. The time of exposure of sound waves
(a) 1 and 2 only (b) 1 and 3 only
(c) 2 and 3 only (d) 1,2 and 3

102. Which one of the following type of treatments will be used for neutralization of alkaline effluent?
(a) Lime stone treatment
(b) Caustic lime treatment
(c) Carbon dioxide treatment
(d) Hydrochloric acid treatment

103. Flocculation is the process of
(a) Gently mixing the water and coagulant allowing the formation of large particles of floc
(b) Removing relatively large floating and suspended debris
(c) Flow, which is slowed enough so that gravity will cause the floc to settle
(d) Mixture of solids and liquids collected from the settling tank are dewatered and disposed of

104. In solid waste management, waste utilization is achieved by
(a) Recover, Reclamation and Reproduce
(b) Reuse, Reclamation and Recycling
(c) Recover, Recycling and Reproduce
(d) Reuse, Reproduce and Recycling

105. The frequency range for hearing the sound by a human ear is in the range of
(a) 20 Hz – 200 kHz
(b) 10 Hz – 20 kHz
(c) 20 Hz – 20 kHz
(d) 10 Hz – 20 Hz

106. Physiological responses accompanying esponse and other noise exposures include :
1. A vascular response characteristic by peripheral vasoconstriction, changes in heart beat rate and blood pressure
2. Various glandular charges such as increased output of adrenaline evidenced by chemical changes in blood
3. Slow, deep breathing
(a) 1 and 2 only (b) 1 and 3 only
(c) 2 and 3 only (d) 1, 2 and 3

107. Electrostatic precipitators are used for removal of :
1. Gaseous contaminants
2. Liquid contaminants
3. Particulate contaminants
(a) 1 only (b) 2 only
(c) 3 only (d) 1, 2 and 3

108. Which one of the following type of ecology is dealt with autecology?
(a) Synecology
(b) Community ecology
(c) Ecosystem ecology
(d) Individual species ecology

109. A soil sample has a porosity of 40%, and the specific gravity of solid is 2.70. If the soil is 50% saturated, the unit weight will be nearly
(a) 22 kN/m^3 (b) 20 kN/m^3
(c) 18 kN/m^3 (d) 16 kN/m^3

110. Oven dry mass of a pat of clay is 10.8gm and mass of mercury displaced on immersion is 84.2gm. If the specific gravity of solids is 2.72 and the density of the mercury is 13.6 g/cm^3, the shrinkage limit of the soil will be nearly
(a) 12 % (b) 15 %
(c) 18 % (d) 21 %

111. The suitability number of a backfill for D_{50} = 1 mm, D_{20} = 0.5 mm and D_{10} = 0.08 mm will be nearly
(a) 16 (b) 18
(c) 20 (d) 22

112. The porosity of a soil n is
(a) $\frac{e}{1+e}$ (b) $\frac{e}{1-e}$
(c) $\frac{e+1}{e}$ (d) $\frac{e-1}{e}$
where : e = Void ratio

113. A coarse-grained soil has a void ratio of 0.78 and specific gravity as 2.67. The critical gradient at which a quick sand condition occurs will be

(a) 0.62 (b) 0.74
(c) 0.82 (d) 0.94

114. Which of the following assumptions of the Rankine theory of lateral earth pressure are correct?

1. The soil mass is semi-infinite, homogeneous, dry and cohesionless
2. The ground surface is a plane which may be horizontal or inclined
3. The wall yields about the base and thus satisfies the deformation condition for plastic equilibrium

(a) 1 and 2 only
(b) 1 and 3 only
(c) 1, 2 and 3
(d) 2 and 3 only

115. The ratio of the horizontal stress to the vertical stress is called coefficient of

(a) Active earth pressure
(b) Passive earth pressure
(c) Earth pressure
(d) Plastic earth pressure

116. A bed consists of compressible clay of 4 m thickness with pervious sand on top and impervious rock at the bottom. In a consolidation test on an undisturbed specimen of clay from this deposit 90 % settlement was reached in 4 hours. The specimen was 20 mm thick. The time for the building founded over this deposit to reach 90 % of its final settlement will be

(a) 91 years
(b) 82 years
(c) 73 years
(d) 64 years

117. A 30 cm square bearing plate settles by 8 mm in the plate load test on cohesionless soil when the intensity of loading is 180 kN/m^2. The settlement of a shallow foundation of 1.5 m square under the same intensity of loading will be nearly

(a) 30 mm (b) 26 mm
(c) 22 mm (d) 18 mm

118. When the observed value of N exceeds 15, the corrected penetration number N_c as per Terzaghi and Peck recommendation in the silty fine sands will be

(a) $15-\frac{1}{2}(N_R-15)$

(b) $15-\frac{1}{2}(N_R+15)$

(c) $15+\frac{1}{2}(N_R-15)$

(d) $15+\frac{1}{2}(N_R+15)$

119. A canal of 4 m deep has side slopes of 1:1. The properties of the soil are c = 15 kN/m^2, ϕ = 15°, e = 0.76 and G = 2.7. Taylor's stability number for that sudden drawdown = 0.136. The factor of safety with respect to cohesion in the case of sudden drawdown will be

(a) 0.64 (b) 1.43
(c) 2.22 (d) 3.01

120. The stability or shear strength of finegrained soils can be increased by draining them with the passage of direct current through them. This process is known as

(a) Electro-osmosis
(b) Zeta potential
(c) Electro-chemical hardening
(d) Consolidation

121. The combined correction for curvature and refraction for a distance of 3400 m will be nearly

(a) 0.2 m (b) 0.4 m
(c) 0.6 m (d) 0.8 m

122. A 100 m tape is suspended between the ends under a pull of 200 N. If the weight of the tape is 30 N, the correct distance between the tape ends will be nearly

(a) 100.5 m
(b) 100.3 m
(c) 100.1 m
(d) 99.9 m

123. In horizontal distance measurement, the basic formula for distance in stadia tacheometry has an additive constant. An anallatic lens is inserted in the tacheometer to make this additive constant zero. This lens is
(a) Convex lens inserted between object glass and diaphragm
(b) Plano-convex lens between object glass and diaphragm
(c) Plano-convex lens between diaphragm and eye piece
(d) Convex lens inserted between diaphragm and eye piece

124. If the LMT is $8^h\ 12^m\ 16^s$ AM at 38°45' W longitude, the GMT will be
(a) $11^h\ 12^m\ 16^s$ AM
(b) $10^h\ 47^m\ 16^s$ AM
(c) $9^h\ 29^m\ 46^s$ AM
(d) $5^h\ 29^m\ 46^s$ AM

125. A section line *AB* appears to be 10·16 cm on a photograph for which the focal length is 16 cm. The corresponding line measures 2.54 cm on a map, which is to a scale $\frac{1}{50,000}$. The terrain has an average elevation of 200 m above mean sea level. The flying altitude of the aircraft above mean sea level during photograph will be
(a) 1800 m (b) 2000 m
(c) 2200 m (d) 2400 m

126. If back sight and foresight distances are balanced
1. The difference in elevation between two points can be directly calculated by taking difference of the two readings
2. No correction for the inclination of the line of sight is necessary
(a) 1 only (b) 2 only
(c) Both 1 and 2 (d) Neither 1 nor 2

127. A railway curve of 1350 m radius is to be set out to connect two tangents. If the design speed is 110kmph and the rate of change of acceleration is 0.3 m/s^3, the shift of the circular curve will be nearly
(a) 0.18 m (b) 0.16 m
(c) 0.14 m (d) 0.12 m

128. A theodolite is called a transit theodolite, when its telescope can be revolved through a complete revolution about its
(a) Vertical axis in an inclined plane
(b) Horizontal axis in an inclined plane
(c) Vertical axis in a horizontal plane
(d) Horizontal axis in a vertical plane

129. Stalactites and stalagmites are features of
(a) Stream erosion developed in limestone region by specific chemical reaction
(b) Ground water deposition in caves formed by precipitation from dripping water rich in calcium carbonate
(c) Marine erosion and deposition formed along coastal regions by selective erosion followed by deposition by waves
(d) A centripetal drainage in which streams from different directions flow towards a common central basin

130. Which of the following statements with reference to isogonic line are correct in magnetic declination?
1. It is drawn through the points of same declination
2. It does not form complete great circle
3. It radiates from north and south magnetic regions and follow irregular paths
(a) 1 and 2 only (b) 1 and 3 only
(c) 2 and 3 only (d) 1, 2 and 3

131. Mountains resulting from the depression or elevation of blocks of the earth crust on a large scale due to faulting and these elevated structures are commonly called
(a) Fault block mountains
(b) Volcanic mountains
(c) Relict mountains
(d) Residual mountains

132. A little gap is left between the head of the glaciated valley and the mass of the glacier ice. This gap is known as
(a) Bergs-chrund (b) Arete
(c) Horn (d) Cirque

133. The sight distance available on a road to a driver at any instance depends on
1. Features of the road ahead
2. Height of the driver's eye above the road surface
3. Height of the object above the road surface

(a) 1 and 2 only
(b) 1 and 3 only
(c) 2 and 3 only
(d) 1, 2 and 3

134. Consider the following data:
Design speed = 96 kmph
Speed of overtaken vehicle = 80 kmph
Reaction time for overtaking = 2 sec
Acceleration = 2.5 kmph/sec
The safe overtaking sight distance on a two-way traffic road will be nearly
(a) 646 m
(b) 556 m
(c) 466 m
(d) 376 m

135. Which one of the following statements is correct?
(a) The ratio of load on wheel to contact area or area of imprint is called as contact pressure
(b) The ratio of load on wheel to contact pressure is called as rigidity factor
(c) The value of rigidity factor is more than three for an average tyre pressure of 7 kg/cm^2
(d) Rigidity factor does not depend upon the degree of tension developed in walls of tyres

136. Which one of the following is not the correct type of critical load position in pavement slab design for the load on the pavement surface?
(a) Interior loading
(b) Edge loading
(c) Eccentric loading
(d) Corner loading

137. Which of the following statements are correct regarding Westergaard's concept for temperature stresses?
1. During the day, the top of the pavement slab gets heated under the sun light when the bottom of the slab becomes hot
2. During summer season as the mean temperature of the slab increases, the concrete pavement expands towards the expansion joints
3. Due to frictional force at the interface, compressive stress is developed at the bottom of the slab as it tends to expand

(a) 1 and 2 only (b) 2 and 3 only
(c) 1 and 3 only (d) 1, 2 and 3

138. Which of the following advantages are correct regarding Poly-centric shape tunnel?
1. It can be conveniently used for road and railway traffic
2. The number of centres and lengths of radii cannot be fixed
3. It can resist external and internal pressure due to its arch action

(a) 1 and 2 only
(b) 2 and 3 only
(c) 1 and 3 only
(d) 1, 2 and 3

139. Which one of the following statement is correct regarding Joumal friction?
(a) Caused due to the wave action of rails
(b) The amount does not depend upon the type of bearing
(c) For roller bearings, it varies from 0.5 to 1.0 kg per tonne
(d) For coupled boxes, it lubricates by hard grease from 0.5 kg to 1.0 kg per tonne.

140. For the construction of a 640 m long B.G. railway track by using a sleeper density of $M + 5$, and the length of each rail is 12.8 m, the number of sleepers required will be
(a) 1000 (b) 900
(c) 800 (d) 700

141. Which one of the following statement is correct regarding ballast used for railway tracks?
(a) The minimum depth of ballast for B.G. section is 20 cm-25 cm
(b) The quantity of stone ballast required for one metre length of track is 0.53 m^3 for B.G. section
(c) For M.G. section the width of ballast is 1.83 m
(d) The minimum depth of ballast for N.G. section is 10 cm

142. Which one of the following statement is correct?
(a) The radius of transition raises from infinity to a selected minimum in order to attain full super elevation and curvature gradually
(b) The compound curve is an arc of circle
(c) The radius of transition curve is constant for entire length
(d) The horizontal curves are provided whenever there is a change in gradient

143. A cross-over occur between two Metre Gauge parallel tracks of same crossing number 1 in 12 with straight intermediate portion between the reverse curves and the distance between the centres of tracks is 3.5 m. If the value of *G* is 1 m, the intermediate straight distance will be nearly
(a) 12 m (b) 15 m
(c) 18 m (d) 21 m

144. Which one of the following is the correct standard for provision of curves on railway track?
(a) Cant excess on B.G. shall not be allowed to exceed 105 mm
(b) Minimum radius of vertical curves for group A, Broad Gauge track is 4,000 m
(c) The minimum value of super- elevation according to Railway Board is $\frac{1}{10}$th of gauge
(d) The speed potential of curve is given by formula $E = \frac{V^2}{127R}$ where, *E* is superelevation in mm

Directions :
Each of the next Six (06) items consists of two statements, one labelled as the 'Statement (I)' and the other as 'Statement (II)'. You are to examine these two statements carefully and select the answers to these items using the codes given below :
Codes :
(a) Both Statement (I) and Statement (II) are individually true and Statement (II) is the correct explanation of Statement (I)
(b) Both Statement (I) and Statement (II) are individually true but Statement (II) is $N O T$ the correct explanation of Statement (I)
(c) Statement (I) is true but Statement (II) is false
(d) Statement (I) is false but Statement (II) is true

145. Statement (I): Finer grinding of cement results in early development of strength.
Statement (II): The finer the cement, the higher is the rate of hydration.

146. Statement (I): Pozzolana is added to cement to increase early strength.
Statement (II): It reduces the heat of hydration.

147. Statement (I): Coarser the particles, less is optimum moisture content.
Statement (II): The specific surface area of coarser particle is less.

148. Statement (I): A reverse curve consists of two arcs with their centres of curvature on opposite sides of the curve.
Statement (II): Superelevation can be provided conveniently at the intersection point of the two arcs.

149. Statement (I): The counter interval depends upon the nature of the ground whether it is undulating or flat.
Statement (II): In a hilly terrain or undulating ground a smaller interval is adopted, otherwise the contours will come too close for plotting due to the steep slope.

150. Statement (I): Geodetic survey cannot be done for works requiring high precision.
Statement (II): The curvature of earth is accounted for measurements in Geodetic survey.

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