DO NOT OPEN THIS TEST BOOKLET UNTIL YOU ARE TOLD TO DO SO

T.B.C. : PNGE-D-CVL

Test Booklet Series

Serial No.
0013820

TEST BOOKLET

PAPER II

CIVIL ENGINEERING

D

Time Allowed : Three Hours

Maximum Marks : 300

INSTRUCTIONS

1. IMMEDIATELY AFTER THE COMMENCEMENT OF THE EXAMINATION, YOU SHOULD CHECK THAT THIS TEST BOOKLET ***DOES NOT*** HAVE ANY UNPRINTED OR TORN OR MISSING PAGES OR ITEMS, ETC. IF SO, GET IT REPLACED BY A COMPLETE TEST BOOKLET.
2. **PLEASE NOTE THAT IT IS THE CANDIDATE'S RESPONSIBILITY TO ENCODE AND FILL IN THE ROLL NUMBER AND TEST BOOKLET SERIES CODE A, B, C OR D CAREFULLY AND WITHOUT ANY OMISSION OR DISCREPANCY AT THE APPROPRIATE PLACES IN THE *OMR* ANSWER SHEET. ANY OMISSION/DISCREPANCY WILL RENDER THE ANSWER SHEET LIABLE FOR REJECTION.**
3. You have to enter your Roll Number on the Test Booklet in the Box provided alongside. ***DO NOT*** write ***anything else*** on the Test Booklet.

1101916

4. This Test Booklet contains **150** items (questions). Each item comprises four responses (answers). You will select the response which you want to mark on the Answer Sheet. In case, you feel that there is more than one correct response, mark the response which you consider the best. In any case, choose **ONLY ONE** response for each item.
5. You have to mark your responses **ONLY** on the separate Answer Sheet provided. See directions in the Answer Sheet.
6. All items carry equal marks.
7. Before you proceed to mark in the Answer Sheet the response to various items in the Test Booklet, you have to fill in some particulars in the Answer Sheet as per instructions sent to you with your Admission Certificate.
8. After you have completed filling in all your responses on the Answer Sheet and the examination has concluded, you should hand over to the Invigilator ***only the Answer Sheet***. You are permitted to take away with you the Test Booklet.
9. Sheets for rough work are appended in the Test Booklet at the end.
10. **Penalty for wrong Answers :**

THERE WILL BE PENALTY FOR WRONG ANSWERS MARKED BY A CANDIDATE.

(i) There are four alternatives for the answer to every question. For each question for which a wrong answer has been given by the candidate, **one-third** of the marks assigned to that question will be deducted as penalty.

(ii) If a candidate gives more than one answer, it will be treated as **wrong answer** even if one of the given answers happens to be correct and there will be same penalty as above to that question.

(iii) If a question is left blank i.e. no answer is given by the candidate, there will be **no penalty** for that question.

DO NOT OPEN THIS TEST BOOKLET UNTIL YOU ARE TOLD TO DO SO

1. In the conveying of most building concrete from the mixer or truck to the form is done in bottom-dump buckets, then the chief danger during conveying is that of

(a) Transferring

(b) Moisture and temperature

(c) Segregation

(d) Vibrations

2. Which one of the following is NOT a property of an admixture ?

(a) Improve workability

(b) Increase strength

(c) Improve durability

(d) Increase permeability

3. Which one of the following is the creep co-efficient at any time ? (Where C_{ct} is the creep co-efficient at any time and C_{cu} is the ultimate creep co-efficient and t is the time in days after loading)

(a) $C_{ct} = \frac{t^{0.60}}{10+t^{0.60}} C_{cu}$

(b) $C_{ct} = \frac{t^{0.50}}{10+t^{0.50}} C_{cu}$

(c) $C_{ct} = \frac{t^{0.40}}{10+t^{0.40}} C_{cu}$

(d) $C_{ct} = \frac{t^{0.70}}{10+t^{0.70}} C_{cu}$

4. Consider the following statements regarding the design of T-beams :

1. To establish flange thickness h_f based on flexural requirements of the slab, which normally spans transversely between perpendicular T beams.

2. Determine the effective flange width b_f according to ACI limits.

3. Choose web dimensions b_w and d based on either negative bending requirements at the supports or shear requirements by setting a reasonable upper limit on the nominal unit shear stress V_u in the beam web.

Which of the above statements are correct ?

(a) 1 and 2 only

(b) 2 and 3 only

(c) 1 and 3 only

(d) 1, 2 and 3

5. What is the minimum thickness 'h' of nonprestressed one-way slabs of length 'L' for simply supported ?

(a) L/24

(b) L/10

(c) L/20

(d) L/28

6. What is the maximum bending moment of elastic plates in a square slab where q is the load shared on length l ?

(a) $0{\cdot}625\ ql^2$

(b) $0{\cdot}00625\ ql^2$

(c) $0{\cdot}0625\ ql^2$

(d) $0{\cdot}000625\ ql^2$

7. What is the load factor for stem in the design procedure for cantilever retaining walls with safety ?

(a) 1·2

(b) 1·6

(c) 2

(d) 2·5

8. Which one of the following types of equipment is used in topographic surveys and also for recording the shapes of buildings ?

(a) Electromagnetic distance measurement devices

(b) GPS

(c) Satellite camera

(d) Aerial camera

9. Match the following lists :

List I (*Correction*)	List II (*Formula*)
P. Absolute length (c_a)	1. $\frac{1}{24}\left(\frac{W}{P}\right)^2 L$
Q. Sag (c_g)	2. $\frac{h^2}{2L}$
R. Alignment (c_m)	3. $\frac{c}{l} L$

Select the correct answer using the code given below :

	P	Q	R
(a)	2	1	3
(b)	3	2	1
(c)	3	1	2
(d)	2	3	1

10. If sensitivity of a bubble tube is 30″ per 2 mm division what would be the error in staff reading on a vertically held staff at a distance of 200 m, when the bubble is out of centre by 2·5 divisions ?

(a) 0·073 m

(b) 0·73 m

(c) 0·0073 m

(d) 7·3 m

11. When a celestial body crosses the observer's meridian, it is said to be

(a) culminate

(b) vernal equinox

(c) obliquity

(d) celestial pole

12. Why the observations of field astronomy do not involve the measurement of declination and right ascension ?

(a) Because the altitude and azimuth are constantly changed to the motion of the celestial body

(b) Because the stars do not occupy fixed positions on the celestial sphere

(c) Because the distance of the sun from the earth is variable

(d) Because of the obliquity of the ecliptic

13. If the equality of back sight distance and foresight cannot be maintained, under such condition, which one of the following levelling types is most important part of geodetic surveying ?

(a) Spirit levelling

(b) Reciprocal levelling

(c) Trigonometric levelling

(d) Ordinary levelling

14. Consider the following statements regarding global positioning system (GPS) :

1. GPS cannot be used in all weather conditions.
2. In GPS surveying inter visibility between stations or points surveyed is not necessary.
3. High cost of GPS surveying has restricted the realization of the full potential of GPS.

Which of the above statements are correct ?

(a) 1 and 2 only

(b) 2 and 3 only

(c) 1 and 3 only

(d) 1, 2 and 3

15. Consider the following statements regarding remote sensing surveys :

1. Different types of land use are distinguishable on images.
2. Most images lack the horizontal perspective.
3. For surveys of small areas, the cost of mobilizing a remote sensing mission may be uneconomical

Which of the above statements is/are correct ?

(a) 1 and 2

(b) 2 and 3

(c) 2 only

(d) 3 only

16. If γ_s = unit weight of the material of falling sphere in g/cm^3, γ_t = unit weight of the liquid medium in g/cm^3, μ_t = viscosity of the liquid medium in g sec/cm^2, and D = diameter of the spherical particle in cm. According to Stokes' law, what is the formula for the terminal velocity (v) of the spherical particle ?

(a) $v = \frac{1}{18}\left[\frac{(\gamma_s - \gamma_t)}{\mu_t}\right] D^2$

(b) $v = \frac{1}{8}\left[\frac{(\gamma_s + \gamma_t)}{\mu_t}\right] D^2$

(c) $v = \frac{1}{12}\left[\frac{(\gamma_s - \gamma_t)}{\mu_t}\right] D^2$

(d) $v = \frac{1}{2}\left[\frac{(\gamma_s + \gamma_t)}{\mu_t}\right] D^2$

17. Consider the following statements regarding sedimentation analysis of soil particles based on Stokes' law :

1. The finer soil particles are never perfectly spherical.
2. All the soil grains may have the same specific gravity.
3. Particles constituting to fine soil fraction may carry surface electric charges.

Which of the above statements are correct ?

(a) 1 and 2 only

(b) 1 and 3 only

(c) 2 and 3 only

(d) 1, 2 and 3

18. What is meant by Thixotropy ?

(a) Property of a material which is manifested by its resistance to flow

(b) The ratio of the unconfined compression strength in the natural or undisturbed state to that in the remoulded state

(c) The compressive stress at failure, giving due allowance to the reduction in area of cross-section

(d) Phenomenon of strength loss-strength gain, with no change in volume or water content

19. Consider the following statements regarding energy heads :

1. The velocity head in soils is negligible.
2. Direction of flow is determined by the difference in total head.
3. Negative pore pressure cannot exist.

Which of the above statements are correct ?

(a) 1 and 2 only

(b) 1 and 3 only

(c) 2 and 3 only

(d) 1, 2 and 3

20. What is the value of coefficient of permeability for coarse gravel ?

(a) Greater than 100 mm/s

(b) Greater than 10 mm/s

(c) Greater than 1 mm/s

(d) Less than 0·1 mm/s

21. A reinforced concrete foundation, of dimensions 18 m × 36 m, exerts a uniform pressure of 180 kN/m^2 on a soil mass, with E-value 45 MN/m^2. What is the value of immediate settlement under the foundation ?

(a) 1 m

(b) 1·54 m

(c) 18 mm

(d) 54 mm

22. Which one of the following terms is defined as "Maximum pressure which a foundation can withstand without the occurrence of shear failure of the foundation" ?

(a) Gross bearing capacity

(b) Bearing capacity

(c) Ultimate bearing capacity

(d) Safe bearing capacity

23. If S_i = immediate settlement at a corner of a rectangular flexible foundation of size $L \times B$, B = Width of the foundation, q = Uniform pressure on the foundation, E_S = Modulus of elasticity of the soil beneath the foundation, ν = Poisson's ratio of the soil, and I_f = Influence value, which is dependent on L/B. What is the immediate settlement of a flexible foundation ?

(a) $S_i = q \cdot B\left(\frac{1+\nu^2}{E_s}\right) \cdot I_f$

(b) $S_i = q \cdot B\left(\frac{1-\nu}{E_s}\right) \cdot I_f$

(c) $S_i = q\left(\frac{1+\nu^2}{BE_s}\right) \cdot I_f$

(d) $S_i = q \cdot B\left(\frac{1-\nu^2}{E_s}\right) \cdot I_f$

24. Consider the following statements regarding bearing capacity values specified in building codes :

1. The codes tacitly assume that the allowable bearing capacity is dependent only on the soil type.

2. The codes assume that the bearing capacity is dependent of the size, shape and depth of foundation.

3. Building codes are usually not up-to-date

Which of the above statements are correct ?

(a) 1 and 2 only

(b) 1 and 3 only

(c) 2 and 3 only

(d) 1, 2 and 3

25. Which one of the following comprises two or more footings connected by a beam called strap ?

(a) Continuous footing

(b) Spread footing

(c) Combined footing

(d) Cantilever footing

26. A one way slab has effective span 3·6 m and is 150 mm thick. The live load expected on it is 3 kN/m^2. What are the design shear and loads for checking serviceability respectively ?

(a) 18·225 kN, 6·75 kN

(b) 16·225 kN, 5·75 kN

(c) 18·225 kN, 7·75 kN

(d) 15·225 kN, 8·75 kN

27. Consider the following statements regarding the strength of flanged sections in flexure where the moment of resisting capacity of the flanged sections depends upon the depth of neutral axis x_u :

1. If $x_u \leq D_f$, compressive force is in the flange only.

2. If $\frac{3}{7}x_u > D_f$, compressive stress in the flange is uniform.

3. If $x_u > D_f$ and $\frac{3}{7}x_u > D_f$, compressive stress in flange is non uniform.

Which of the above statements is/are correct ?

(a) 1 and 3

(b) 2 and 3

(c) 1 and 2

(d) 1 only

28. What is the maximum deflection for cantilever subjected to udl throughout ? (Where E is the modulus of elasticity of concrete, I is the moment of inertia, L is the length of the span, P is the point load)

(a) $\frac{5\omega L^3}{384EI}$

(b) $\frac{PL^3}{3EI}$

(c) $\frac{\omega L^4}{8EI}$

(d) $\frac{PL^3}{84EI}$

29. Which one of the following is the equation for width of the step in a staircase, consider R being the rise, T being tread, $D/2$ being the depth and b is the width ?

(a) $b = \sqrt{\frac{R^2}{T^2}}$

(b) $b = \sqrt{R^2 + T^2}$

(c) $b = \sqrt{R^2 \cdot T^2}$

(d) $b = \sqrt{R^2 - T^2}$

30. Which one of the following statements is correct under safety provisions of the ACI code ?

(a) Design strength is greater than required strength and design moment is greater than required moment

(b) Design strength is greater than required strength and design moment is less than required moment

(c) Design strength is less than required strength and design moment is greater than required moment

(d) Design strength is less than required strength and design moment is less than required moment

31. Consider the following statements regarding aerial photogrammetry :

1. Aerial photogrammetry has the ease with which topography of inaccessible areas can be detailed.

2. In aerial photogrammetry, there is possibility of omitting of few field data.

Which of the above statements is/are correct ?

(a) 1 only

(b) 2 only

(c) Both 1 and 2

(d) Neither 1 nor 2

32. Match the following lists :

List I (*Region*)	List II (*Wavelength*)
P. Reflected IR band	1. Less than 0·03 nm
Q. X-ray	2. 0·1 – 30 cm
R. Gamma ray	3. 0·7 – 3·0 μm
S. Microwave	4. 0·03 – 3·0 nm

Select the correct answer using the code given below :

	P	Q	R	S
(a)	2	3	1	4
(b)	3	4	1	2
(c)	4	1	3	2
(d)	4	1	2	3

33. Accurate transfer of surface alignment down a vertical shaft using two plumbwires can be achieved by

(a) Rise and fall method

(b) Collimation method

(c) Bowditch's method

(d) Weisbach triangle method

34. If R is the radius of the circle and Δ is deflection angle, what is the formula for external distance (E) in circular curve for use in design and setting out ?

(a) $E = R\left(\sec\frac{\Delta}{2} - 1\right)$

(b) $E = R\left(1 - \sec\frac{\Delta}{2}\right)$

(c) $E = R\left(\cos\frac{\Delta}{2} - 1\right)$

(d) $E = R\left(1 - \cos\frac{\Delta}{2}\right)$

35. Which one of the following situations is NOT at all suitable for tunneling ?

(a) If the beds are parallel to horizontal or have approximately zero degree inclination

(b) If the beds are vertically dipping and the axis of the tunnel is perpendicular to the strike

(c) If the strike of involved beds is parallel to the axis of the tunnel

(d) If the dip of involved beds is parallel to the axis of the tunnel

36. Which one of the following is NOT a necessity of specifications for construction ?

(a) Specification of a work is required to specify the quality and quantity of different materials required for a construction work and is one of the essential contract documents

(b) Specification is necessary to specify the equipment, tools and plans to be engaged for a work and thus enables to procure them beforehand

(c) Specification is an essential contract document and is required for Arbitration

(d) Specification has no impact on changes of cost of materials and tools i.e. the tender rate

37. What is the capital value of a premises consisting of land and a well-built house, let out for ₹800/- per month inclusive of all taxes. The house is in good condition. The rent by comparison with other premises is fair and is likely to be maintained. Assume the following data :

Outgoings : 18% of the gross rent, expected rate of return : 8%, future life of the building : 60 years.

(a) ₹98,400/-

(b) ₹141,687·50/-

(c) ₹110,687·50/-

(d) ₹88,400/-

38. Which one of the following is the advantage of lump sum contract ?

(a) In case of unforeseen hazards during construction, the contractor is put to unlimited hardship

(b) There may not be any hazard which could not be visualized beforehand

(c) It becomes intricate to accommodate additions, alterations of design and specifications

(d) Lump sum contract works better in civil engineering construction than for mechanical and electrical installations

39. Consider the following statements regarding the right of the contractor to terminate :

1. If the work is stopped by a court order for three months or more for any reasons.

2. If the architect fails to issue the certificate of payment in the stipulated period.

3. If the owner fails to pay the contractor after the stipulated period or certification for the payment from the consultant or the arbitrator.

Which of the above statements is/are correct ?

(a) 1 and 2

(b) 2 and 3

(c) 1 and 3

(d) 2 only

40. How many number of bricks are required in 10 m^3 of brick work ?

(a) 3000 numbers

(b) 5000 numbers

(c) 2000 numbers

(d) 4000 numbers

41. Consider the following statements regarding the essential insurance record to be maintained :

1. Workmen's compensation and employer's accountability insurance in accordance with applicable laws should be maintained.

2. Comprehensive general liability insurance to cover any solitary whichever body or the property should be maintained.

3. Comprehensive automobile liability insurance to cover any solitary whichever body or the property damage should be maintained.

Which of the above statements is/are correct ?

(a) 1 only

(b) 1 and 2

(c) 3 only

(d) 2 and 3

42. A supplier sends steel plates in a huge quantity to a contractor. The first batch was exhaustively examined for thickness and gave a standard deviation of 1·80. The contractor feels that the knowledge of mean within a range of 0·5 to its true value for a probability of 95% would be satisfactory. What is the size of sample ?

(a) 40 numbers

(b) 30 numbers

(c) 60 numbers

(d) 50 numbers

43. A preliminary survey indicates that 20% of the time of a gang of workers is spent ideally. What is the total number of observations required to determine the proportion of idle time within ±5% with 95% confidence limit ?

(a) 216 observations

(b) 226 observations

(c) 246 observations

(d) 236 observations

44. Consider the following statements regarding the dependency of crane load capacity :

1. The size of the crawlers is not a factor due to diminutive mounting which decreases the stability of any footing.
2. The strength of the boom is also one of the major governing factors in establishing load ratings, and any extension of the boom reduces the rating. Lowering the boom also increases the clearance radius and thus reduces the rated capacity.
3. The counterweight is added to the after-end of the machine. Manufacturer's specifications provided standard and maximum counterweights and also the crane ratings. Counter weights may be increased to a specified maximum, but the operating radius must not exceed that given by the manufacturer.

Which of the above statements is/are correct ?

(a) 1 and 2

(b) 1 and 3

(c) 1 only

(d) 2 and 3

45. Match the following lists regarding the physical properties of cement :

List I	List II
P. Loss on ignition	1. Causes expansion
Q. Insoluble residues	2. Due to evaporation of moisture and carbondioxide
R. Lime and alumina content	3. Due to inactive materials like gypsum
S. Sulphur content	4. Causes unsoundness

Select the correct answer using the code given below :

	P	Q	R	S
(a)	2	3	4	1
(b)	3	4	1	2
(c)	4	1	2	3
(d)	2	4	1	3

46. Which of the following is not a factor in the design of tension members ?

(a) Length of the connection

(b) Type of fabrication

(c) Connection eccentricity

(d) Gross area of the cross section

47. Match the following lists :

List I (*Members*)	List II (*Maximum effective slenderness ratio*)
P. A tension member in which a reversal of direct stress occurs due to loads other than wind or seismic forces	1. 350
Q. A member subjected to compressive forces resulting only from a combination of wind actions	2. 400
R. A member normally acting as a tie in a roof truss which is not considered effective when subject to reversal of stress resulting from the earthquake	3. 180
S. Members always in tension	4. 250

Select the correct answer using the code given below :

	P	Q	R	S
(a)	2	3	4	1
(b)	3	4	1	2
(c)	3	4	2	1
(d)	2	4	1	3

48. Which one of the following is NOT a parameter for determining the strength of the column ?

(a) Material of the column

(b) Cross-sectional configuration

(c) Width of the column

(d) Residual stress

49. Consider the following modes regarding the failure of an axially loaded column :

1. Local buckling

2. Squashing

3. Joint buckling

Which of the above modes are correct ?

(a) 2 and 3 only

(b) 1 and 2 only

(c) 1 and 3 only

(d) 1, 2 and 3

50. Match the following lists :

List I (*Sections*)	List II (*Limiting width to thickness ratio*)
P. Rolled section	1. $88\varepsilon^2$
Q. Welded section	2. 42ε
R. Circular hollow section	3. $15{\cdot}7\varepsilon$
S. Hot rolled RHS	4. $13{\cdot}6\varepsilon$

Select the correct answer using the code given below :

	P	Q	R	S
(a)	2	3	4	1
(b)	3	1	4	2
(c)	3	4	1	2
(d)	2	4	3	1

51. Match the following lists :

List I (*Types of beams with*)	List II (*Applications*)
P. Angles	1. Long spans and heavy loads
Q. Rolled I-sections	2. Roof purlin and sheeting rail
R. Castellated beams	3. Most frequently used as a beam
S. Plate girders	4. Long spans and light loads

Select the correct answer using the code given below :

	P	Q	R	S
(a)	3	4	1	2
(b)	3	1	4	2
(c)	2	3	4	1
(d)	2	4	1	3

52. Consider the following statements regarding the lateral torsional buckling of symmetric sections :

1. The beam has no initial imperfections and its behavior is elastic.
2. It is loaded by unequal and opposite end moments in the plane of the web.
3. The beam have residual stresses and its ends are simply supported vertically and laterally.

Which of the above statements is/are correct ?

(a) 2 and 3

(b) 3 only

(c) 1 and 2

(d) 1 only

53. Which of the following is NOT a functional requirement of a girder ?

(a) Strength to carry bending moment

(b) Vertical stiffness to satisfy any deflection limitation

(c) Strength to carry shear , i.e. adequate web area

(d) Stiffness to reduce the buckling or post-buckling strength of the web

54. Which one of the following is NOT a difference between the behaviour of the beam-columns subject to the bending moment about minor axis to major axis ?

(a) In the case of slender members under small axial load, there is very little reduction of moment capacity below M_P, since lateral torsional buckling is not a problem in weak axis bending

(b) The moment of magnification is larger in the case of beam-columns bending about their weak axis

(c) As the slenderness decreases, the failure curves in the P/P_n, y-y axis plane change from convex to concave, showing decreasing dominance of minor axis bucking

(d) The failure of short/stocky members is either due to section strength being reached at the ends or at the section of larger magnified moment

55. In practical design of steel structures, on the vertical walls, external pressure coefficient on windward wall is

(a) 0·8

(b) 0·5

(c) −0·5

(d) −0·8

56. Consider the following statements regarding the behavior of a column under a compression load :

1. The stress-strain properties do not remain constant throughout the section.

2. Residual stresses due to cooling after rolling the steel section and those imposed by welding during construction exist in the section before loading.

3. Due to construction details, the load is perfectly concentric and the end conditions will not vary from case to case.

Which of the above statements is/are correct ?

(a) 1 and 2

(b) 1 only

(c) 2 only

(d) 1 and 3

57. What is the minimum load factor for dead load as per IS 800:1984 ?

(a) 1·3

(b) 1·7

(c) 2·3

(d) 2·7

58. What is the grain specific gravity for humus type soil ?

(a) 2·37

(b) 1·37

(c) 4·37

(d) 3·37

59. When the specific gravity of solids is known, which one of the following types of methods is used to determine the water content ?

(a) Pycnometer method

(b) Rapid moisture tester method

(c) Oven-drying method

(d) Sand-replacement method

60. Which one of the following soils are transported by wind ?

(a) Alluvial soils

(b) Lacustrine soils

(c) Aeolian soils

(d) Marine soils

61. What is the proportion of acid and alkalis permitted in the water used in construction ?

(a) A 100 ml sample of water should be neutralized by not more than 2 ml of 0·1 normal NaOH of 10 ml of 0·1 normal HCl

(b) A 200 ml sample of water should be neutralized by not more than 2 ml of 0·1 normal NaOH of 10 ml of 0·1 normal HCl

(c) A 300 ml sample of water should be neutralized by not more than 2 ml of 0·1 normal NaOH of 10 ml of 0·1 normal HCl

(d) A 50 ml sample of water should be neutralized by not more than 2 ml of 0·1 normal NaOH of 10 ml of 0·1 normal HCl

62. Match the following lists regarding different types of bricks with their applications :

List I	List II
P. Sand lime bricks	1. Tough, durable
Q. Face bricks	2. Edges and curves to suit the shape
R. Paving bricks	3. Cheaper and used only for backup
S. Sewer bricks	4. Where distinct brick work finish is intended

Select the correct answer using the code given below :

	P	Q	R	S
(a)	1	2	3	4
(b)	2	3	4	1
(c)	3	4	1	2
(d)	4	1	2	3

63. What are the two main categories of embankment slopes ?

(a) Flat and Steep

(b) Recoverable and Non-recoverable

(c) Desirable and Undesirable

(d) Hazardous and Non-hazardous

64. Match the following lists :

List I (*Median widths at intersections*)	List II (*Key features*)
P. Four feet or wider	1. Provides a pedestrian refuge and room for a dual left-turn bay
Q. Twenty-eight feet or wider	2. Provides a pedestrian refuge and room for a left-turn bay
R. Sixteen feet or wider	3. Provides a pedestrian refuge
S. Twenty feet or wider	4. Provides refuge for a crossing passenger car

Select the correct answer using the code given below :

	P	Q	R	S
(a)	4	1	2	3
(b)	3	1	2	4
(c)	3	4	2	1
(d)	2	3	4	1

65. If V_d is design speed (mph), t_{p-r} is perception-reaction time (sec), a is deceleration rate (ft/sec^2) and G is longitudinal grade of the road (%/100). What is the expression for stopping sight distance ?

(a) $SSD = 1{\cdot}468\ V_d t_{p-r} + \dfrac{V_d^2}{30\left(\left(\frac{a}{32{\cdot}2}\right) \pm G\right)}$

(b) $SSD = 1{\cdot}468\ V_d t_{p-r} + \dfrac{V_d^2}{\left(\frac{a}{32{\cdot}2}\right) \pm G}$

(c) $SSD = 1{\cdot}468\ V_d t_{p-r} - \dfrac{V_d^2}{30\left(\left(\frac{a}{32{\cdot}2}\right) \pm G\right)}$

(d) $SSD = 1{\cdot}468\ V_d t_{p-r} - \dfrac{V_d^2}{\left(\frac{a}{32{\cdot}2}\right) \pm G}$

66. If V_d is design speed (mph), e_{max} is maximum rate of superelevation, f_{max} is co-efficient of side friction. What is the expression for minimum radius of curvature (R_{min}) ?

(a) $R_{min} = \dfrac{V_d^2}{(0{\cdot}01 e_{min} + f_{max})}$

(b) $R_{min} = \dfrac{V_d^2}{15(e_{min} + f_{max})}$

(c) $R_{min} = \dfrac{V_d^2}{15(e_{min} - f_{max})}$

(d) $R_{min} = \dfrac{V_d^2}{15(0{\cdot}01 e_{min} + f_{max})}$

67. What is the major difficulty in establishing human surveillance in freeway management systems ?

(a) Difficulty in integrating electronic detection with human surveillance

(b) Infrastructure for providing video to the location of the human operator

(c) Human operators have superior judgment, but they may lose attention

(d) Lack of qualified human operators

68. The weighted average of the damages caused by the individual axle load group with respect to the corresponding volume of the traffic of each group is known as

(a) Lane distribution factor

(b) Load Safety factor

(c) Vehicle damage factor

(d) Heavy-vehicle adjustment factor

69. Which one of the following is a factor that is to be multiplied by the total traffic repetitions in a lane to convert it to equivalent repetitions along the maximum distressed path ?

(a) Lane distribution factor

(b) Load Safety factor

(c) Vehicle damage factor

(d) Lateral distribution factor

70. Consider the following statements regarding tunnel :

1. In hills with soft rocks, a tunnel is cheaper than a cutting.
2. The maintenance cost of a tunnel is considerably higher than that of a bridge.
3. The construction of a tunnel is costly as it requires special construction.

Which of the above statements are correct ?

(a) 1 and 2 only

(b) 2 and 3 only

(c) 1 and 3 only

(d) 1, 2 and 3

71. Match the following lists :

List I (*Size of the tunnel*)	List II (*Purpose of the tunnel*)
P. Circular	1. Water and sewage mains
Q. Elliptical	2. Roads and Railways
R. Horseshoe	3. Water and sewage

Select the correct answer using the code given below :

	P	Q	R
(a)	2	1	3
(b)	3	1	2
(c)	3	2	1
(d)	2	3	1

72. Consider the following statements regarding full face method for tunneling in hard rocks :

1. An entire section of the tunnel is tackled at one time.
2. Mucking tracks can be laid on the tunnel floor and extended as the work progresses.
3. It is suitable for unstable rocks.

Which of the above statements are correct ?

(a) 1 and 2 only

(b) 2 and 3 only

(c) 1 and 3 only

(d) 1, 2 and 3

73. Match the following lists :

List I (*Type of soil*)	List II (*Method of tunneling*)
P. Silt	1. One or two ports are opened and the material flows continuously into the tunnel.
Q. Clay	2. One or two port doors are opened. The material is excavated and deposited at the bottom of the tunnel.
R. Sand	3. Tunneling is of the open type. The material settles on the floor of the shield and it should be continuously removed.

Select the correct answer using the code given below :

	P	Q	R
(a)	2	1	3
(b)	3	1	2
(c)	3	2	1
(d)	2	3	1

74. Which one of the following methods is achieved by drilling a drift through the tunnel from portal to portal ?

(a) Blow-in method

(b) Exhaust method

(c) Blow-out method

(d) Natural method

75. Which one of the following types of soils will usually shrink if drained or if subjected to repeated loading ?

(a) Non-cohesive soils

(b) Cohesive soils

(c) Peat

(d) Silts

76. What is the temperature of the tensile strength of the stone in water for 3 days ?

(a) 40°C to 50°C

(b) 10°C to 15°C

(c) 20°C to 30°C

(d) 5°C to 15°C

77. The decomposition of felspar is represented as

(a) $K_2AlO_3 \cdot 6H_2O + CO_2 + nH_2O =$
(Orthoclase)
$K_2CO_3 +$
(Alkaline carbonate)
$AlO_3 \cdot 2SiO_2 \cdot 2H_2O +$
(Kaolinite)
$4SiO_2 \cdot nH_2O$
(Hydrated silicate)

(b) $K_2Al_2O_3 \cdot 6H_2O + CO_2 + nH_2O =$
(Orthoclase)
$K_2CO_3 +$
(Alkaline carbonate)
$Al_2O_3 \cdot 2SiO_2 \cdot 2H_2O +$
(Kaolinite)
$4SiO_2 \cdot nH_2O$
(Hydrated silicate)

(c) $K_2Al_2O \cdot 6H_2O + CO_2 + nH_2O =$
(Orthoclase)
$K_2CO +$
(Alkaline carbonate)
$Al_2O_3 \cdot 2SiO_2 \cdot 2H_2O +$
(Kaolinite)
$4SiO_2 \cdot nH_2O$
(Hydrated silicate)

(d) $KAl_2O_3 \cdot 6H_2O + CO_2 + nH_2O =$
(Orthoclase)
$KCO_3 +$
(Alkaline carbonate)
$Al_2O_3 \cdot 2SiO_2 \cdot 2H_2O +$
(Kaolinite)
$4SiO_2 \cdot nH_2O$
(Hydrated silicate)

78. Match the following lists :

List I	List II
P. Trap and Basalt	1. Damp proofing and partitions
Q. Sandstone	2. Rough stone for masonry work
R. Laterite	3. Tile stone for roofing
S. Slate	4. Road metal and concrete aggregate

Select the correct answer using the code given below :

	P	Q	R	S
(a)	1	3	2	4
(b)	4	2	3	1
(c)	3	4	2	1
(d)	4	3	2	1

79. Consider the following statements regarding the characteristics of poor lime :

1. It requires less slaking time and hydrates very fast.
2. Setting and hardening is very fast.
3. The color varies from yellow to grey.

Which of the above statements is/are correct ?

(a) 1 only

(b) 1 and 2

(c) 3 only

(d) 1 and 3

80. Consider the following statements regarding the advantages of plywood :

1. It has good strength both along as well as across the grains.
2. It will not shrink or swell across the grains.
3. It can be curved into desired shapes.

Which of the above statements is/are correct ?

(a) 1 and 3

(b) 1 and 2

(c) 2 and 3

(d) 2 only

81. Match the following lists :

List I	List II
P. Bridges	1. Gamhar, haritaki
Q. Scientific Instruments	2. Red cedar, satin, sissoo
R. Railway carriage	3. Guava
S. Shuttering	4. Black wood, iron wood

Select the correct answer using the code given below :

	P	Q	R	S
(a)	1	2	3	4
(b)	2	3	4	1
(c)	3	2	4	1
(d)	4	2	1	3

82. Consider the following statements regarding calcined clay :

1. Its chief function is to impart strength and hydraulic properties of mortar.
2. It is dense, compact and impermeable concrete.
3. It increases the temperature of hydration and sets the concrete quickly.

Which of the above statements are correct ?

(a) 2 and 3 only

(b) 1 and 2 only

(c) 1 and 3 only

(d) 1, 2 and 3

83. What are the concrete stages production order respectively ?

(a) Batching, mixing, transporting, placing, curing, compacting, finishing

(b) Batching, transporting, mixing, placing, compacting, curing, finishing

(c) Batching, mixing, transporting, compacting, placing, curing, finishing

(d) Batching, mixing, transporting, placing, compacting, curing, finishing

84. Consider the following statements regarding the functions of admixtures :

1. It is to speed up the rate of development of strength at early ages.
2. It increases the strength of concrete.
3. It increases the heat of evolution and decreases the durability of concrete.

Which of the above statements is/are correct ?

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

85. Consider the following statements regarding the concrete mix design :

1. It is to be compressive with strength of standard test specimens
2. It is to be compiled with the durability requirements to accept the environment.
3. It is to be capable of mixed, transported, and compacted as efficiently as possible.

Which of the above statements are correct ?

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

86. Consider the following statements regarding the design requirements of concrete mix :

1. Grade of concrete : M20, M25 connotes the characteristic strength of 30 N/mm^2 to 35 N/mm^2.
2. Type of cement : The grade of OPC such as of 33, 43 or 53 grade.
3. Type of mixing and curing water : Whether fresh potable water, seawater, ground water is to be used.

Which of the above statements are correct ?

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

87. Consider the following statements regarding the characteristics of good mortar :

1. The density and strength of mortars made of the same class of aggregate decrease as the proportion of fine aggregate is increased.
2. It requires about twice as much cement to produce a mortar of given strength when fine sand is used as it does with coarse sand.
3. Even small percentage of mica if present considerably increases the tensile strength and adversely affects the compressive strength.

Which of the above statements are correct ?

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

88. How does the bulk modulus of elasticity of a fluid change with increasing pressure ?

(a) It remains constant

(b) It decreases with increase in pressure

(c) It increases with increase in pressure

(d) It becomes zero

89. Consider the following statements regarding stability of floating bodies :

1. If metacentre (M) lies above centroid (G), then the body is said to be in unstable equilibrium.

2. If metacentre (M) lies below centroid (G), then the body is said to be in unstable equilibrium.

3. If metacentre (M) coincides with centroid (G), then the body is said to be in stable equilibrium.

Which of the above statements is/are correct ?

(a) 1 and 3

(b) 2 and 3

(c) 2 only

(d) 1 only

90. If V_s is the velocity of the vector, r is the radius of curvature and $\frac{\partial V_n}{\partial t}$ is the local normal acceleration; what is the expression for total normal acceleration of fluid particles ?

(a) $\frac{dV_n}{dt} = V_s^2 + r\frac{\partial V_n}{\partial t}$

(b) $\frac{dV_n}{dt} = \frac{V_s^2}{r} + \frac{\partial V_n}{\partial t}$

(c) $\frac{dV_n}{dt} = r + V_s^2\frac{\partial V_n}{\partial t}$

(d) $\frac{dV_n}{dt} = \frac{r}{V_s^2} + \frac{\partial V_n}{\partial t}$

91. Which one of the following is the equation for extension of whole length of a uniformly tapering rectangular bars where b_1 and b_2 are the limits of widths ($b_2 > b_1$), length L, thickness t and the bar is subjected to an axial force P and elastic module E ?

(a) $\Delta = \frac{PL}{(b_2 - b_1)tE}\log_e\frac{b_2}{b_1}$

(b) $\Delta = \frac{PL}{(b_2 - b_1)tE}\log_{10}\frac{b_1}{b_2}$

(c) $\Delta = \frac{PL}{(b_1 - b_2)tE}\log_{10}\frac{b_2}{b_1}$

(d) $\Delta = \frac{PLt}{(b_2 - b_1)E}\log_e\frac{b_2}{b_1}$

92. A conical bar tapers uniformly from a diameter of 15 mm to a diameter of 40 mm in a length of 400 mm. What is the elongation of the bar under an axial tensile force of 100 kN ? (Take $E = 2\times10^5$ N/mm^2)

(a) 0·242 mm

(b) 0·121 mm

(c) 0·424 mm

(d) 0·212 mm

93. A circular section tapering bar is rigidly fixed at both the ends. The diameter changes from 75 mm at one end to 150 mm at the other end, in a length of 1·2 m. What is the maximum stress in the bar if the temperature is raised by 32°C ? (Take $E = 2\times10^5$ N/mm^2 and $\alpha = 12\times10^{-6}$ per 1°C)

(a) 123·6 N/mm^2

(b) 143·6 N/mm^2

(c) 163·6 N/mm^2

(d) 153·6 N/mm^2

94. A thin type of steel is to be shrunk on to a rigid wheel of 900 mm diameter. What is the internal diameter of the tyre if the hoop stress is limited to 120 N/mm^2 ? (For the tyre take $\alpha = 12\times10^{-6}$ per °C and $E = 2\times10^5$ N/mm^2)

(a) 899·46 mm

(b) 819·46 mm

(c) 900·54 mm

(d) 800·54 mm

95. Consider the following statements regarding the effective stress and effective strain :

1. $\bar{\sigma}$ and $\bar{\varepsilon}$ will reduce to σ_x and ε_x in an x-direction tension test.

2. The incremental work per volume done in deforming a material plastically is $d\omega = \bar{\varepsilon}\, d\,\bar{\sigma}$.

3. It is usually assumed that the $\bar{\sigma}$ vs $\bar{\varepsilon}$ curve describes the strain hardening for loading under a constant stress ratio α, regardless of α*.

Which of the above statements is/are correct ?

(a) 2 and 3

(b) 3 only

(c) 1 and 3

(d) 2 only

96. A solid cylinder of steel is placed inside a copper tube. The assembly is compressed between rigid plates by forces P. What is the value of increase in temperature so that all the load is carried by the copper tube? (Let the parameters with suffix c represent copper and suffix s represent steel)

(a) $t = \dfrac{4P}{A_s E_s (\alpha_c - \alpha_s)}$

(b) $t = \dfrac{2P}{A_c E_c (\alpha_s - \alpha_c)}$

(c) $t = \dfrac{P(\alpha_c - \alpha_s)}{A_c E_c}$

(d) $t = \dfrac{P}{A_c E_c (\alpha_c - \alpha_s)}$

97. Match the following lists :

List I (*Materials*)	List II (*Modulus of elasticity*)
P. Aluminium alloys	1. 190
Q. Cast iron	2. 190 – 210
R. Copper	3. 70 – 79
S. Steel	4. 110 – 120
T. Wrought iron	5. 83 – 170

Select the correct answer using the code given below :

	P	Q	R	S	T
(a)	2	3	4	5	1
(b)	3	4	5	1	2
(c)	4	5	1	2	3
(d)	3	5	4	2	1

98. Which one of the following precipitations results from ocean air streams passing over land and being deflected upward by coastal mountains, thus cooling below saturation temperature and spilling moisture ?

(a) Convective precipitation

(b) Frontal precipitation

(c) Orographic precipitation

(d) Cyclonic precipitation

99. Which one of the following terms refers to the time between the end of the net rainfall and the end of the direct runoff hydrograph ?

(a) Recession time

(b) Time-to-peak

(c) Lag time

(d) Concentration time

100. Match the following lists :

List I (*Soil and vegetation*)	List II (*Infiltration rate* (mm/hr))
P. Forested loam	1. 10 – 70
Q. Loam pasture	2. 0 – 4
R. Sand	3. 3 – 15
S. Bare clay	4. 100 – 200

Select the correct answer using the code given below :

	P	Q	R	S
(a)	2	3	1	4
(b)	3	1	2	4
(c)	4	1	3	2
(d)	4	1	2	3

101. Match the following lists :

List I (*Type of surface*)	List II (*Value of coefficient of runoff*)
P. Wooded areas	1. 0·70 – 0·95
Q. Gravel roads and walks	2. 0·15 – 0·30
R. Macadamized Roads	3. 0·01 – 0·20
S. Watertight roof surfaces	4. 0·25 – 0·60

Select the correct answer using the code given below :

	P	Q	R	S
(a)	2	3	1	4
(b)	3	2	4	1
(c)	3	1	2	4
(d)	4	1	2	3

102. Consider the following statements regarding ground water :

1. Ground water is exhaustible and is evenly available.
2. Natural replenishment of the ground water resource is a very fast process.
3. Ground water is generally better than surface water in respect of biological characteristics.

Which of the above statements is/are correct ?

(a) 1 and 3 only

(b) 2 and 3 only

(c) 3 only

(d) 1, 2 and 3

103. Match the following lists :

List I (*Material*)	List II (*Specific yield %*)
P. Clay	1. 5 – 15
Q. Sand and gravel	2. 15 – 25
R. Sandstone	3. 0·5 – 5
S. Limestone	4. 1 – 10

Select the correct answer using the code given below :

	P	Q	R	S
(a)	2	3	1	4
(b)	1	2	4	3
(c)	3	1	2	4
(d)	4	2	1	3

104. A fully penetrating artesian well is pumped at a rate $Q = 1500\ m^3/day$ from an aquifer whose storage coefficient and transmissivity are 4×10^{-4} and $0{\cdot}145\ m^2/min$, respectively. Considering $\omega(u) = 8{\cdot}62$, what is the drawdowns at a distance 3 m from the production well after one hour of pumping ?

(a) 8·62 m

(b) 14·53 m

(c) 4·93 m

(d) 2·38 m

105. Water attached to soil particles through loose chemical bonds is termed as

(a) Capillary water

(b) Gravity water

(c) Hygroscopic water

(d) Field capacity

106. Consider the following statements regarding flow measurement through pipes :

1. The reduction in constriction diameter causes velocity to increase.

2. High velocities in constriction cause low pressures in the system.

3. The reduction in constriction diameter enables lesser accuracy in its measurement.

Which of the above statements is/are correct :

(a) 1 and 2

(b) 2 and 3

(c) 2 only

(d) 1 and 3

107. Consider the following statements regarding ultrasonic flowmeters :

1. There are no moving parts.

2. They cannot measure flow quantities in reverse flow.

3. There is no direct contact with the fluid, there is no danger of corrosion or clogging.

Which of the above statements are correct ?

(a) 1 and 2 only

(b) 1 and 3 only

(c) 2 and 3 only

(d) 1, 2 and 3

108. When the average flow is steady, which one of the following causes significant fluctuations in velocity, temperature and pressure ?

(a) Streamlines in turbulent flow

(b) Molecular diffusion in turbulent flow

(c) Eddy motion in turbulent flow

(d) Orderly flow in turbulent flow

109. Consider the following statements regarding uniform flow in channel :

1. The depth of flow and wetted area are constant at every section along the channel reach.

2. The velocity of flow and discharge are varying along the channel reach.

3. The total energy line, water surface and the channel bottom are all parallel.

Which of the above statements is/are correct ?

(a) 1 and 2

(b) 2 and 3

(c) 3 only

(d) 1 and 3

110. If Q = discharge into the channel, a = cross sectional area at the entrance, and D_n is depth at the channel entrance, what is the equation for depth of the reservoir (D_r) when the flow in the channel is subcritical ?

(a) $D_r = D_n - \frac{Q}{2ga^2}$

(b) $D_r = D_n - \frac{Q^2}{2ga^2}$

(c) $D_r = D_n + \frac{Q}{2ga^2}$

(d) $D_r = D_n + \frac{Q^2}{2ga^2}$

111. Which one of the following heads is defined as "the head against which a centrifugal pump has to work" ?

(a) Suction head

(b) Delivery head

(c) Static head

(d) Manometric head

112. Consider the following statements regarding positive-displacement pumps :

1. Positive-displacement pump is better able to handle shear sensitive liquids.

2. A well-scaled positive-displacement pump can create a significant vacuum pressure at its inlet, even when dry.

3. The rotor(s) of a positive displacement pump run at higher speeds than the rotor (impeller) of a dynamic pump at similar loads.

Which of the above statements are correct ?

(a) 1 and 2 only

(b) 1 and 3 only

(c) 2 and 3 only

(d) 1, 2 and 3

113. Consider the following statements regarding draft tube of Francis turbine :

1. It permits a suction head to be established at the runner exit.

2. It makes possible to install the turbine above the tail race level without loss of head.

3. It converts a large proportion of velocity energy rejected from the runner into useful pressure energy.

Which of the above statements is/are correct ?

(a) 1 and 2 only

(b) 2 and 3 only

(c) 3 only

(d) 1, 2 and 3

114. Consider the following statements regarding Kaplan turbine :

1. The runner blades of Kaplan turbine runner are warped.

2. The blade angle is being greater at the hub than at the outer tip.

3. The peripheral velocity of the blades is being directly proportional to radius.

Which of the above statements is/are correct ?

(a) 1 and 3 only

(b) 2 and 3 only

(c) 3 only

(d) 1, 2 and 3

115. Match the following lists :

List I (*Specific speed* (rpm))	List II (*Type of turbine*)
P. 8-5 to 30	1. Francis turbine
Q. 50 to 340	2. Kaplan turbine
R. 255 to 860	3. Pelton wheel turbine with single jet

Select the correct answer using the code given below :

	P	Q	R
(a)	2	3	1
(b)	3	1	2
(c)	2	1	3
(d)	1	2	3

116. Consider the following statements regarding the difference between true strains and engineering strains :

1. True strains for equivalent amounts of deformation in tension and compression are equal including for sign.

2. True strains are additive. For a deformation consisting of several steps the overall strain is the sum of the strains in each step.

3. The volume change is related to the sum of the three normal strains. For constant volume, $\varepsilon_x + \varepsilon_y + \varepsilon_z = 0$.

Which of the above statements are correct ?

(a) 1 and 2 only

(b) 1 and 3 only

(c) 2 and 3 only

(d) 1, 2 and 3

117. Consider the following statements regarding the properties of materials :

1. A material in plastic state is temporarily deformed by the application of load and it has tendency to recover.

2. Ductility is the characteristic of a material to be drawn out longitudinally to a reduced section under the action of tensile force.

3. Malleability is a property of a material which permits the materials to be partially extended in all directions without rupture.

Which of the above statements is/are correct ?

(a) 1 and 2

(b) 2 only

(c) 3 only

(d) 1 and 3

118. Which one of the following statements is correct regarding the Mohr's circle of a plane Tensor ?

(a) σ is positive in tension and is plotted to the right of the origin. Compression is negative to the left

(b) τ is plotted negatively if it rotates the stress block clockwise

(c) Angles θ from one axis to another around the origin are in different direction

(d) Any orthogonal set of axes are 90° to one another on Mohr's circle

119. Consider the following regarding the general situations in linear elasticity :

1. The stress field is a function of only the boundary conditions, geometric shape and loading which are constant.
2. The stress field is a function of material properties like volume and deviatoric stiffness as well.
3. The loads are time independent.

Which of the above statements are correct ?

(a) 1, 2 and 3

(b) 1 and 3 only

(c) 1 and 2 only

(d) 2 and 3 only

120. Consider the following statements regarding two dimensional stress formulations :

1. In a plane stresses are identical for any given geometry, loading.
2. The in-plane stresses are different for plane strain or plane stress.
3. Linear viscoelastic stress fields are different for constant load and change with time.

Which of the above statements is/are correct ?

(a) 1 only

(b) 1 and 2

(c) 3 only

(d) 2 and 3

121. Match the following lists :

List I (*components*)	List II (*working*)
P. Trusses	1. Carry compressive force
Q. Cables	2. Located at the crown and supports elevations
R. Arches	3. Support their loads in tension
S. Three-hinged arches	4. Prevent collapse

Select the correct answer using the code given below :

	P	Q	R	S
(a)	4	3	1	2
(b)	3	2	4	1
(c)	4	1	2	3
(d)	2	3	4	1

122. Which one of the following is the condition for maximum shear in a cantilever ?

(a) It occurs when a series of concentrated loads are not placed at the farthest point away from the fixed support

(b) It occurs when a series of distributed loads are placed at the farthest point away from the fixed support

(c) It occurs when a series of concentrated loads are placed at the nearest point away from the fixed support

(d) It occurs when a series of concentrated loads are placed at the farthest point away from the fixed support

123. Match the following lists :

List I (*Type of commercial building/institution*)	List II (*Water demand in Litres per day*)
P. Restaurants	1. 45 per capita
Q. Nurses homes and medical quarters	2. 70 per seat
R. Cinemas, concert halls and theatre	3. 135 per capita
S. Factories	4. 15 per seat

Select the correct answer using the code given below :

	P	Q	R	S
(a)	4	1	2	3
(b)	2	1	4	3
(c)	4	3	2	1
(d)	2	3	4	1

124. Consider the following statements regarding quality difference of ground water and surface water :

1. The Turbidity of ground water is high, whereas surface water is little.
2. Total dissolved solids of ground water is lower than surface water.
3. Concentration of inorganic compounds or ions of ground water is higher than surface water.

Which of the above statements is/are correct ?

(a) 1 and 2

(b) 2 only

(c) 3 only

(d) 1 and 3

125. If P is population of town/city, Q is total quantity of water required during one year for a town/city; what is the formula for maximum daily per capita demand for a town/city ?

(a) $1{\cdot}8\times\frac{Q}{P\times 365}$

(b) $1{\cdot}8\times\frac{Q}{P\times 24}$

(c) $1{\cdot}5\times\frac{Q}{P\times 365}$

(d) $1{\cdot}5\times\frac{Q}{P\times 24}$

126. If P_n = Population at the end of n decade, P_o = Present population, P_{av} = Average arithmetic increase in the population (decadal), P_I = Average incremental increase in population, n = Number of decades; what is the mathematical representation of Incremental Increase Method ?

(a) $P_n = P_I \times n + (P_{av} + P_o)$

(b) $P_n = P_I + (P_{av} + P_o) \times n$

(c) $P_n = P_o + (P_{av} + P_I) \times n$

(d) $P_n = P_o \times n + (P_{av} + P_I)$

127. The impurities in water which are extremely small size particles and cannot be removed by settling and filtration are known as

(a) Suspended impurities

(b) Colloidal impurities

(c) Dissolved impurities

(d) Picked up impurities

128. What is the function of flocculator in the typical water treatment scheme for surface water ?

(a) To rapid dispersion of chemical coagulant(s) to encourage destabilization of colloids

(b) To permit the settlement of chemical 'flocs' along with colloidal particles

(c) To provide for gentle mixing of the destabilized colloids to promote agglomeration of colloids into large easily settleable flocs

(d) To remove the flocs and colloids which escape from the settlement in the secondary sedimentation tank

129. What is the function of rapid mixing in the typical water treatment flow scheme for ground water with high hardness ?

(a) To drive out the objectionable dissolved gas such as H_2S and CO_2

(b) To permit the settlement of chemical precipitates under gravity

(c) To reform the calcium and magnesium bicarbonates to prevent settlement of $CaCO_3$ under $Mg(OH)_2$ precipitates in the distribution lines

(d) To disperse the lime and soda ash to form the chemical precipitates

130. If Q is the water requirement in L/min and P is population in thousands, what is Buston's formula to determine fire demand ?

(a) $Q = 5663\sqrt{P}$

(b) $Q = 3182\sqrt{P}$

(c) $Q = 4637\left(1 - 0{\cdot}01\sqrt{P}\right)$

(d) $Q = 100\sqrt{P}$

131. What is meant by soffit ?

(a) The system of pipes which conveys discharges in separate pipes to the drainage system

(b) A pipe or conduit which is owned by a local authority for conveyance of the sewage

(c) The highest point of the interior of a sewer pipe at any cross section

(d) The horizontal pipe lay below the floor level or below basement to receive the discharge of soil or waste water

132. What is the logical extension of the pit privy ?

(a) Septic tank and tile field

(b) Composting toilet

(c) Seepage pits

(d) Plastic pipe with holes

133. Consider the following statements regarding a good building/house drainage system :

1. The pipes should be of non-absorbent materials.

2. The system should have traps at all necessary points.

3. The branch drains should be as long as possible.

Which of the above statements are correct ?

(a) 1 and 2 only

(b) 2 and 3 only

(c) 1 and 3 only

(d) 1, 2 and 3

134. What is a drawback of aerobically digested sludges ?

(a) Odor reduction

(b) Enhanced putrescible

(c) Degraded of organic acids

(d) Difficulty in dewatering

135. What needs to be maintained to avoid the odour problem in tannery effluent treatment ?

(a) Low pH

(b) pH between 7 – 8

(c) pH between 9·5 – 10

(d) High pH

136. The water remaining in the soil after the removal of gravitational water is called

(a) Capillary water

(b) Gravity water

(c) Hygroscopic water

(d) Field capacity

137. The field capacity and permanent wilting point for a given 0·8 m root-zone soil are 35 and 10 per cent, respectively. At a given time, the soil moisture in the given soil is 20 per cent when a farmer irrigates the soil with 250 mm depth of water. Assuming bulk specific gravity of the soil as 1·6, what is the amount of water wasted from the consideration of irrigation ?

(a) 23·2%

(b) 58%

(c) 5·8%

(d) 19·2%

138. Match the following lists :

List I (*Soil texture*)	List II (*Field capacity* (%))
P. Sand	1. 5 – 10
Q. Loam	2. 27 – 35
R. Silty clay	3. 18 – 25
S. Clay	4. 32 – 40

Select the correct answer using the code given below :

	P	Q	R	S
(a)	4	3	2	1
(b)	1	3	2	4
(c)	3	1	2	4
(d)	4	2	1	3

139. If V is the wind velocity and F is the fetch, for $F < 32$ Km, what is the formula for wave height (h_w) in gravity dams ?

(a) $h_w = 1{\cdot}032\sqrt{VF} + 0{\cdot}76 + 0{\cdot}27F^{\frac{1}{4}}$

(b) $h_w = 0{\cdot}032\sqrt{VF} - 0{\cdot}76 - 0{\cdot}27F^{\frac{1}{4}}$

(c) $h_w = 1{\cdot}032\sqrt{VF} - 0{\cdot}76 + 0{\cdot}27F^{\frac{1}{4}}$

(d) $h_w = 0{\cdot}032\sqrt{VF} + 0{\cdot}76 - 0{\cdot}27F^{\frac{1}{4}}$

140. If c_1 = a dimensionless pressure co-efficient, α_h = horizontal acceleration factor, ρ = mass density of water, g = acceleration due to gravity, h = depth of the reservoir; what is the formula for the variation of horizontal hydrodynamic earthquke pressure with depth (P_e) in gravity dams ?

(a) $P_e = C_1 \alpha_h \frac{g}{h}$

(b) $P_e = \frac{C_1 \alpha_h}{gh}$

(c) $P_e = C_1 \alpha_h gh$

(d) $P_e = C_1 g(h + \alpha_h)$

141. Consider the following statements regarding the distribution shear stress assumptions :

1. For all values of y, q is uniform across the width of the cross-section, irrespective of its shape.

2. '$F = (dM/dx)$' is derived from the assumption that bending stress varies non-linearly across the section and is not zero at the centroid.

3. The material is homogenous and isotropic and the value of E is the same for tension as well as compression.

Which of the above statements is/are correct ?

(a) 1 and 2 only

(b) 2 and 3 only

(c) 1 and 3 only

(d) 1, 2 and 3

142. Which one of the following statements is NOT a property of the curves ?

(a) Both the systems of the curves cross each other at 45°.

(b) Each system crosses the N.A at 45°.

(c) At any point of a curve the tangent and normal give the directions of the two principal stresses.

(d) The intensity of stress along each curve is the greatest when it is parallel to the length of the beam and diminishes along the curve to zero, where it cuts a face of beam at right angles.

143. A rod of circular section is subjected to a shearing force on a plane perpendicular to its axis. What is the maximum shearing stress in terms of shearing force and rod diameter, if the rod is used as a beam with free ends and a central concentrated load, express the free length in terms of diameter for which the maximum shearing stress, due to shearing force is half the maximum direct stress ?

(a) $L = (3/2)\ D$

(b) $L = (1/2)\ D$

(c) $L = (5/2)\ D$

(d) $L = (2/3)\ D$

144. A beam 3 m long, simply supported at its ends is carrying a point load W at its mid-span. If the slope at the ends of the beam does not exceed 1°, what is the deflection at the mid-span ?

(a) 17·45 mm

(b) 17·45 cm

(c) 19·45 mm

(d) 19·45 cm

145. Consider the following statements regarding the end conditions and internal conditions of a conjugate beam :

1. A stable and statically determinate real beam will have a conjugate beam which is also stable and statically determinate.
2. An unstable real beam will have statically indeterminate conjugate beam. Hence if a conjugate beam is found to be statically indeterminate, it is concluded that the real beam is unstable and further analysis is not appropriate.
3. A statically indeterminate real beam will have stable conjugate beam. Hence its conjugate load must be such that it maintains equilibrium.

Which of the above statements is/are correct ?

(a) 1 and 3

(b) 2 and 3

(c) 1 and 2

(d) 1 only

146. Which one of the following is NOT an assumption of impact loading on a beam ?

(a) The falling weight sticks to the beam and moves/vibrates with it

(b) No energy loss takes place

(c) The beam is linearly non elastic

(d) The deflected shape of the beam is the same under a dynamic load as under the static load

147. Which one of the following is NOT an effect of wind on a structure ?

(a) The effect of wind on a structure depends upon the density and velocity of the air

(b) It depends upon the angle of incidence of the wind

(c) It depends upon the shape and stiffness of the structure

(d) It depends upon the smoothness of the structure surface.

148. Match the following lists :

List I (*Basic structural elements*)	List II (*Applications*)
P. Tin rods	1. Carry tensile and compressive loads
Q. Beams	2. Members that resist axial compressive force
R. Columns	3. Bracing
S. Trusses	4. Reinforced concreter

Select the correct answer using the code given below :

	P	Q	R	S
(a)	2	3	4	1
(b)	3	4	2	1
(c)	4	1	2	3
(d)	1	2	3	4

149. Consider the following statements regarding the principle of super position :

1. The total displacement of the stress at a point in a structure subjected to several external loadings can be determined by adding together the displacements caused by each of the external loads acting together.

2. The material must behave in a non-linear elastic manner.

3. The geometry of the structure must not undergo significant change when the loads are applied.

Which of the above statements is/are correct ?

(a) 1 and 2

(b) 2 only

(c) 3 only

(d) 1 and 3

150. What is the condition for stability of truss with b number of bars, r number of external support reactions with j number of joints ?

(a) $b + r = 2j$

(b) $b + r > 2j$

(c) $b + r < 2j$

(d) $b + r < j$