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T.B.C. : RSPV-T-LECV

Test Booklet Series

1022400

D

TEST BOOKLET

Paper-II

CIVIL ENGINEERING

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.

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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 all 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 a **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.

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$\frac{11 \times 64 \times 145}{7}$

$7 \overline{)102080}\ (14^{(1-D)}$

71

32

9280
92800
102080
7

145
×64
580
8700
9280

1. Which one of the following statements is ***not*** correct regarding soil sampling ?

(a) In open drive sampler, the most widely used sample tube has an internal diameter of 100 mm and a length of 450 mm. The area ratio is approximately 30%.

(b) In thin-walled sampler, the internal diameter may range from 35 to 100 mm. The area ratio is approximately 100%.

(c) In split-barrel sampler, the internal and external diameters are 35 and 50 mm, respectively. The area ratio is approximately 100%.

(d) Continuous sampler is a highly specialized type of sampler which is capable of obtaining undisturbed samples up to 25 m in length. The sampler is used mainly in soft clays.

2. Which one of the following statements is ***not*** correct regarding Taylor's stability number ?

(a) Taylor's stability number N is defined as $C_m / \gamma H$.

(b) The procedure is based on the Swedish method of slices.

(c) The results are embodied in Taylor's design charts which may be used for determining the factor of safety of a slope or for designing the height for a desired safety factor.

(d) It is an analytical approach.

3. A sample of sand, 5 cm in diameter and 15 cm long, was prepared at a porosity of 60% in a constant-head apparatus. The total head was kept constant at 30 cm and the amount of water collected in 5 seconds was 40 cm^3. The test temperature was 20°C. What is the seepage velocity ?

(a) 0·21 cm/s

(b) 0·98 cm/s

(c) 0·67 cm/s

(d) 0·45 cm/s

4. A soil layer is partially saturated due to capillary action and the degree of saturation is 50%. The height of point 'x' under consideration measured from groundwater table is 0·25 m. Assume unit weight of water is 10 kN/m^3. What is the approximate pore water pressure at point 'x' ?

(a) $-2{\cdot}5\ kN/m^2$

(b) $-1{\cdot}5\ kN/m^2$

(c) $-1{\cdot}25\ kN/m^2$

(d) $-2{\cdot}75\ kN/m^2$

5. Which one of the following statements is ***not*** correct regarding clay minerals ?

(a) The typical range of shrinkage limit of Kaolinite is 8·5 – 15.

(b) The typical range of shrinkage limit of Illite is 15 –17.

(c) The typical range of liquid limit of Montmorillonite is 100 – 900.

(d) The typical range of plastic limit of Montmorillonite is 50 – 100.

6. A dam has been constructed across a river over a permeable stratum of soil of limited thickness. The head of water on the upstream side is 18 m and on the downstream side is 8 m. The flow net constructed across the dam gives N_f as 6 and N_d as 12. If the equivalent coefficient of permeability is $1{\cdot}28 \times 10^{-3}$ cm/s, what is the quantity of seepage per unit length of the section per cm length of dam ?

(a) $0{\cdot}64 \times 10^{-3}\ cm^3/s$

(b) $0{\cdot}64\ cm^3/s$

(c) $2{\cdot}56 \times 10^{-3}\ cm^3/s$

(d) $2{\cdot}56\ cm^3/s$

7. An oedometer test has been performed on a clay sample of thickness 2 cm. 60% of consolidation has been observed after 15 minutes of loading under double drainage condition. What is the time taken to achieve same degree of consolidation for a 4 m clay layer on field under single drainage ?

(a) 167 days

(b) 16·7 days

(c) 1667 days

(d) 1·6 years

8. Match the following lists :

List-I	List-II
P. Bacteria	1. *Entamoeba histolytica*
Q. Virus	2. *Ancylostoma duodenale*
R. Protozoa	3. Hepatovirus A
S. Helminths	4. *Salmonella typhosa*

Select the correct answer using the code given below :

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

9. What is the BOD_5 of a water sample for the given data ?

Temperature of sample = 16°C; Initial dissolved oxygen at corresponding temperature is 10 mg/L; Dilution is 1:30, with seeded dilution water; Final dissolved oxygen of seeded dilution water is 8 mg/L; Final dissolved oxygen bottle with sample and seeded dilution water is 2 mg/L; Volume of BOD bottle is 300 mL.

(a) 183 mg/L

(b) 153 mg/L

(c) 220 mg/L

(d) 250 mg/L

10. As per the Manual on Water Supply and Treatment, Ministry of Urban Development, GOI, the fire demand for 1 lakh population is :

(a) 41,760 L/min

(b) 35,050 L/min

(c) 31,625 L/min

(d) 21,960 L/min

11. As per IS 10500:2012, the value of Nitrate in drinking water should be in the range of :

(a) up to 45 mg/L

(b) up to 60 mg/L

(c) up to 30 mg/L

(d) up to 15 mg/L

12. A confined aquifer is 6 m deep and the coefficient of permeability in the soil is 2 m^3/day-m^2. The wells are 100 m apart, and the difference in the water elevation in the wells is 3·0 m. The superficial velocity through the aquifer is :

(a) 0·09 m/day

(b) 0·12 m/day

(c) 0·03 m/day

(d) 0·06 m/day

13. A wastewater is expected to have BOD_3^{27} of about 300 mg/L. The initial DO of dilution water is 8·5 mg/L. The minimum DO that should remain is 1·5 mg/L. The dilution requirement for BOD determination is :

(a) 100 times dilution of the sample

(b) 50 times dilution of the sample

(c) 200 times dilution of the sample

(d) 150 times dilution of the sample

14. A sample of sludge has an SS concentration of 4000 mg/L. After settling for 30 minutes in a 1 L cylinder, the sludge occupies 400 mL. The Sludge Volume Index is :

(a) 100

(b) 50

(c) 200

(d) 150

15. Raw primary and waste activated sludge containing 4% solids is to be anaerobically digested at a loading of 3 kg/(m^3.day). The total sludge produced in the plant is 1500 kg of dry solids per day. Assume 1 L of sludge weighs about 1 kg. The approximate hydraulic retention time required is :

(a) 13·5 days

(b) 15·5 days

(c) 10·5 days

(d) 12·5 days

16. Which one of the following is ***not*** correct regarding measurement of horizontal distances ?

(a) Absolute correction of chain or tape = True length – Nominal length.

(b) Steel Tape will give better result than invar tape.

(c) Tape or chain supported at the two ends will always sag.

(d) The correction due to 'chain or tape not horizontal' is always subtractive.

17. In levelling, what is the combined collection (curvature and refraction) at a distance of 1 km ?

(a) $6{\cdot}7 \times 10^{-6}$ m

(b) 0·067 m

(c) 167·5 m

(d) 670 m

18. For setting out a rectangular platform ABCD, a rotating construction laser was used. It gave a reading of 0·878 m on a temporary B.M., having a level 45·110 m. The lowest corner A has a level 45·30 m. The platform has a cross fall of 1 in 1000 longitudinally and 1 in 250 transversely. If the platform is 8 m longitudinally, i.e., along AD or BD, and 40 m transversely, i.e., along AB or DC, what is the offset from the laser beam to the corner C of the platform ?

(a) 0·688 m

(b) 0·528 m

(c) 0·520 m

(d) 0·680 m

19. Sight rails are used for setting out :

(a) large buildings

(b) bridges

(c) the gradient of canal beds

(d) the gradient of trench of bottom or pipe inverts

20. Location of points by resection requires pointings made on at least :

(a) one known station

(b) two known stations

(c) three known stations

(d) four known stations

21. Consider the length of the curve as L and radius of the curve as R. For a transition curve, the shift S of a circular curve is :

(a) $R^2/12\ L$

(b) $L^2/24\ R$

(c) $L^3/24\ R^2$

(d) $L^2/12\ R$

22. A reverse curve consists of :

(a) two circular arcs of different radii with their centres of curvature on the same side of the different tangents only.

(b) two circular arcs of same radius with their centres of curvature on the same side of the common tangent only.

(c) two circular arcs of different radii with their centres of curvature on the opposite side of the different tangents only.

(d) two circular arcs of same or different radii with their centres of curvature on the opposite side of the common tangent.

23. A parabola is preferred for vertical curves because :

(a) The slope is constant throughout.

(b) The rate of change of grade is constant throughout.

(c) The rate of change of radial acceleration is constant throughout.

(d) The rate of change of radial acceleration is zero.

24. Maximum ordinate on a Mass Haul Diagram occurs :

(a) at the end of a cut.

(b) at the end of an embankment.

(c) when cut and fill are balanced.

(d) at the midpoint of the cut.

25. Consider the following statements regarding anticline and syncline :

1. The presence of a syncline creates problem of seepage in a dam foundation.
2. There will be more bending of the anticlines in the upper strata and more joints due to tension stresses compared to lower strata.
3. A tunnel passing through a syncline will experience more lateral pressure in the middle part away from the portals.

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

26. A river is 2 m deep. The river bed consists of a depth of sand of saturated unit weight 20 kN/m^3. What is the effective vertical stress 5 m below the top of the sand ?

(a) 68·6 kN/m^2
(b) 119·6 kN/m^2
(c) 51 kN/m^2
(d) 10·2 kN/m^2

27. In an in-situ vane test on a saturated clay, a torque of 35 Nm is required to shear the soil. The vane is 50 mm wide by 100 mm long. What is the undrained strength of the clay ?

(a) 56 kN/m^2
(b) 76 kN/m^2
(c) 150 kN/m^2
(d) 50 kN/m^2

28. A footing 2·5 m × 2·5 m carries a pressure of 400 kN/m^2 at a depth of 1 m in sand. The saturated unit weight of the sand is 20 kN/m^3 and the unit weight above the water table is 17 kN/m^3. The design shear strength parameters are $c' = 0$ and $\phi = 40°$ ($N_q = 64$; $N_\gamma = 95$). What is the factor of safety with respect to shear failure, if the water table is 5 m below ground level ?

(a) 1·5
(b) 6
(c) 7
(d) 3

29. A long braced excavation in soft clay is 4 m wide and 8 m deep. The saturated unit weight of the clay is 20 kN/m^3 and the undrained shear strength adjacent to the bottom of the excavation is given by $c_u = 40$ kN/m^2 ($\phi_u = 0$). What is the factor of safety against base failure of the excavation ?
(Take $N_c = 7·1$)

(a) 1·5
(b) 3·25
(c) 1·25
(d) 1·8

30. Which one of the following is ***not*** correct regarding the typical values of the coefficient of earth pressure at rest ?

(a) For dense sand: 0·35
(b) For loose sand: 0·6
(c) Normally consolidated clay: 0·55
(d) Overconsolidated clay: 0·25

31. Identify the correct sequence of treatment flow scheme for groundwater with low mineral content but presence of objectionable gases :

(a) Raw Water – Aeration – Disinfectant – Disinfection Tank – Supply

(b) Raw Water – Disinfection Tank – Disinfectant – Aeration – Supply

(c) Raw Water – Disinfectant – Disinfection Tank – Sedimentation Tank – Aeration – Supply

(d) Raw Water – Disinfection Tank – Aeration – Sedimentation Tank – Supply

32. In solid waste management, compaction ratio is defined as :

(a) the ratio of the as-compacted density to the as-discarded density.

(b) the ratio of the as-discarded density to the as-compacted density.

(c) the ratio of the as-deposited density to the as-compacted density.

(d) the ratio of the as-compacted density to the as-deposited density.

33. Which of the following statements are correct regarding sound in environmental engineering ?

1. Sound Intensity can be defined as the time-weighted average sound power per unit area normal to the direction of propagation of the sound wave.
2. Sound Intensity can be defined as the time-weighted average sound power per unit area parallel to the direction of propagation of the sound wave.
3. Sound Pressure can be defined as the force on a unit surface area perpendicular to the direction of the sound.
4. Sound Pressure can be defined as the force on a unit surface area parallel to the direction of the sound.

Select the correct answer using the code given below :

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

34. Match the following lists :

List-I	*List-II*
P. IS 4954:1968	1. Measurement of noise emitted by moving vehicles
Q. IS 3028:1998	2. Code of practice for noise reduction in industrial buildings
R. IS 4758:1968	3. Recommendations for noise abatement in town planning
S. IS 3483:1965	4. Methods of measurement for noise emitted by machines

Select the correct answer using the code given below :

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

35. Which of the following statements are correct regarding landfills ?

1. The landfill must be proximate to wastewater treatment facilities.
2. Landfills are not compatible with airport siting.
3. The bottom of the landfill must be below the highest expected groundwater elevation.

Select the correct answer using the code given below :

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

36. A 20 cm storm occurred for 6 hrs in a catchment having a CN of 50. What is the net rainfall using SCS method ?

(a) 11·57 cm
(b) 15·70 cm
(c) 151·70 mm
(d) 17·51 cm

37. The sliding factor of a gravity dam is defined as :

(a) $\frac{\text{The stabilizing moment}}{\text{The overturning moment}}$

(b) $\frac{\text{The sum of the vertical forces}}{\text{The sum of the horizontal forces}}$

(c) $\frac{\text{The overturning moment}}{\text{The stabilizing moment}}$

(d) $\frac{\text{The sum of the horizontal forces}}{\text{The sum of the vertical forces}}$

38. The depths of penetrations along the length of a border strip at points 30 m apart were probed. The observed values are 2·0 m, 1·9 m, 1·8 m, 1·6 m and 1·5 m. The water distribution efficiency is :

(a) 0·905

(b) 0·805

(c) 0·725

(d) 0·685

39. Which one of the following statements is correct regarding aqueducts ?

1. The choice of a particular type of aqueduct does not depend upon its length.
2. The selection of a type of aqueduct lies on the considerations of economy.
3. On a very wide drainage, Type III aqueduct is most economical.
4. In Type III aqueduct, the width of the aqueduct is minimum but the cost of bank connections is maximum.

Select the correct answer using the code given below :

(a) 2 and 4

(b) 1 and 3

(c) 1 and 2

(d) 3 and 4

40. A storm with 12·0 cm precipitation produced a direct runoff of 6·8 cm. The time distribution of the storm is given in the following Table. What is the ϕ-index ?

(Take duration of excess rainfall as 8 hrs)

Time from start (hr)	Incremental rainfall in each hour (cm)
1	0·56
2	0·95
3	1·90
4	2·80
5	2·00
6	1·80
7	1·20
8	0·61

(a) 0·55 cm/hr

(b) 0·31 cm/hr

(c) 0·46 cm/hr

(d) 0·65 cm/hr

41. Consider the following statements regarding polluted water resources :

1. If the polluted water is discharged directly to the *recipient* (such as lakes and rivers) without treatment, it usually leads to serious deterioration of the ecological life in the water body.
2. The polluted water is usually treated in a sewage treatment plant before it is led to the recipient.

Which of the above statements is/are correct ?

(a) 1 only

(b) 2 only

(c) Both 1 and 2

(d) Neither 1 nor 2

42. In the context of clouds and raindrop formation, which one of the following give the minimum precipitation and are found at great heights (up to 12 kms) from the Earth's surface ?

(a) Cirrus
(b) Nimbostratus
(c) Cumulus
(d) Cumulonimbus

43. The annual evaporation from a lake with surface area of 1500 hectare is 240 cm. What is daily average evaporation rate in hectare-metre per day during the year ?

(a) 9·863 Ha.m
(b) 3600 Ha.m
(c) 360 Ha.m
(d) 986·3 Ha.m

44. In the process of drainage of water through soil during rainfall, the excess water present is called :

(a) Gravitational water
(b) Hygroscopic water
(c) Capillary water
(d) Saturation water

45. A cyclone formed outside the tropical zone near the boundary between warm and cold air is called :

(a) Extratropical Cyclone
(b) Tropical Cyclone
(c) Anticyclone
(d) Typhoon

46. While taking the stopping sight distance into consideration, when L > SSD, then the general equation for length L of the parabolic curve is :

(a) $L = \frac{NS^2}{\left(\sqrt{2H} + \sqrt{2h}\right)^2}$

(b) $L = \frac{2NS^2}{\sqrt{2H} + \sqrt{2h}}$

(c) $L = \frac{NS^2}{\left(\sqrt{H} + \sqrt{h}\right)^2}$

(d) $L = \frac{NS^2}{2\left(\sqrt{H} + \sqrt{h}\right)^2}$

47. For a street having 15 m width, what is the spacing between lighting units to produce average lux of 6·0 ?

(Take lamp size as 6000 lumen, coefficient of utilization as 0·5, and maintenance factor as 0·9)

(a) 30 m
(b) 15 m
(c) 45 m
(d) 60 m

48. Match the following lists :

List-I	*List-II*
P. Cut and Cover	1. Circular Tunnel
Q. Shield Driven	2. Horseshoe Tunnel
R. Sequential Excavation	3. Rectangular Tunnel

Select the correct answer using the code given below :

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

49. Select the correct order of steps in travel demand modelling :

(a) Trip Generation – Mode Choice – Trip Distribution – Traffic Assignment

(b) Trip Generation – Trip Distribution – Mode Choice – Traffic Assignment

(c) Traffic Assignment – Trip Generation – Trip Distribution – Mode Choice

(d) Mode Choice – Trip Generation – Trip Distribution – Traffic Assignment

50. Match the following lists with corresponding acceptability limits of physical properties of aggregates for Bituminous Macadam construction, that is recommended by the Ministry of Road Transport and Highways specifications for Road and Bridge works :

List-I		*List-II*
P. Los Angeles abrasion value	1.	12% maximum
Q. Aggregate impact value	2.	25% maximum
R. Soundness loss with sodium sulphate test	3.	30% maximum
S. Aggregate stripping value	4.	40% maximum

Select the correct answer using the code given below :

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

51. Which one of the following statements is correct regarding Marshall test ?

(a) With increase in bitumen content, flow value increases, air voids decrease and voids filled with bitumen increase.

(b) With increase in bitumen content, flow value increases, air voids decrease and voids filled with bitumen decrease.

(c) With increase in bitumen content, flow value decreases, air voids increase and voids filled with bitumen decrease.

(d) With increase in bitumen content, flow value decreases, air voids decrease and voids filled with bitumen decrease.

52. In Indian Railways, the field survey normally covers a width of :

(a) 100 m on either side of the track.

(b) 200 m on either side of the track.

(c) 300 m on either side of the track.

(d) 500 m on either side of the track.

53. In Indian Railways, the widening of the gauge (extra width) on curves is :

(a) $W = \frac{13(B+L)}{R^2}$

(b) $W = \frac{26(B+L)^2}{R}$

(c) $W = \frac{13(B+L)^2}{R}$

(d) $W = \frac{13(B+L)^2}{2R}$

54. What is the approximate psychological widening required for a pavement of 7 m on a horizontal curve of radius 225 m, if the longest wheel base of vehicle expected on the road is 7·0 m ?
(Take the design speed as 70 km/h)

(a) 0·40 m
(b) 0·50 m
(c) 0·60 m
(d) 0·70 m

55. As per IRC guidelines, match the following lists :

List-I	*List-II*
P. Initial walking time for pedestrian	1. 2·0 seconds
Q. Green time required for first vehicle to cross the STOP bar	2. 2·5 seconds
R. Reaction time – Overtaking sight distance	3. 6·0 seconds
S. Reaction time – Stopping sight distance	4. 7·0 seconds

Select the correct answer using the code given below :

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

56. What is the capacity of the road section, if speed (V) – density (K) study has resulted in a linear relationship V = 60 – 0·5K ?

(a) 1800
(b) 7200
(c) 900
(d) 3600

57. For the spot speed study distribution, x: N[55, 49], what is the speed of the next vehicle with a probability of 97·5% ?
(Take equivalent static on the standard normal distribution (z) = 1·96)

(a) 64 km/h
(b) 68 km/h
(c) 72 km/h
(d) 76 km/h

58. A line AB between the stations A and B was measured as 348 m using a 20 m tape, too short by 0.05 m. What is the correct length of AB ?

(a) 347·41 m
(b) 349·15 m
(c) 347·13 m
(d) 348·87 m

59. A tape of standard length 20 m at 85°F was used to measure a base line. The measured distance was 882·50 m. What is the true length of the line, if the mean temperature during measurement was 63°F and the coefficient of thermal expansion of the tape material is 6.5×10^{-6} per °F ?

(a) 872·982 m

(b) 879·282 m

(c) 882·374 m

(d) 882·626 m

60. With what accuracy must a difference in elevation between two ends of a 30 m tape be known if the difference in the elevation is 3 m and the accuracy ratio is to be at least 1 in 600000 ?

(a) 0·0005 m

(b) 0·0157 m

(c) 0·0003 m

(d) 0·0006 m

61. Soil materials which have the property to store water due to good number of pores in them, but passage of water through them is not possible, are called :

(a) Aquifuge

(b) Aquiclude

(c) Aquitard

(d) Aquifer

62. Which one of the following is ***not*** a type of groyne ?

(a) Repelling groyne

(b) Attracting groyne

(c) Perpendicular groyne

(d) Straight groyne

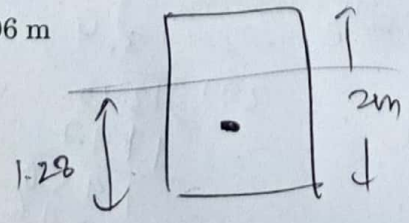
63. A wooden block of rectangular section 1·25 m wide, 2 m deep, 4 m long floats horizontally in sea water. The specific gravity of wood is 0·64 and water weighs 1000 kg(f)/m^3. Under this situation, the position of centre of buoyancy of wood is at :

(a) 1·28 m above the base

(b) 0·64 m above the base

(c) 0·32 m above the base

(d) 0·96 m above the base



64. A rectangular pontoon is 5 m long, 3 m wide and 1·20 m high. The depth of immersion of the pontoon is 1·0 m in sea water. If the centre of gravity is 0·6 m above the bottom of the pontoon, what is the metacentric height of the same ? (Take the density of sea water as 1000 kg/m^3)

(a) 0·65 m

(b) 0·85 m

(c) 0·75 m

(d) 0·50 m

65. What are the vorticity components at a point (1, 1, 1) for the following flow field ?

$u = 2x^2 + 3y$, $v = -2xy + 3y^2 + 3zy$,

$w = -1{\cdot}5z^2 + 2xz - 9y^2z$

(a) $\Omega_x = -21$ units, $\Omega_y = -2$ units, $\Omega_z = -5$ units

(b) $\Omega_x = -2$ units, $\Omega_y = -12$ units, $\Omega_z = -5$ units

(c) $\Omega_x = -2$ units, $\Omega_y = -21$ units, $\Omega_z = -5$ units

(d) $\Omega_x = -5$ units, $\Omega_y = -2$ units, $\Omega_z = -21$ units

66. Which of the following correctly depicts the continuity equation in its integral form ?

(a) $\frac{\partial \rho}{\partial x} + \nabla . \left(\rho \vec{V} \right) = 0$

(b) $\frac{\partial V}{\partial t} - \nabla . \left(\rho \vec{V} \right) = 0$

(c) $\frac{\partial \rho}{\partial t} + \nabla . \left(\rho \vec{V} \right) = 0$

(d) $\frac{\partial \rho}{\partial t} - \nabla . \left(\rho \vec{V} \right) = 0$

67. Which of the following sets of equations represent(s) possible two-dimensional incompressible flows ?

1. $u = x + y$; $v = x - y$
2. $u = x + 2y$; $v = x^2 - y^2$
3. $u = 4x + y$; $v = x - y^2$
4. $u = xt + 2y$; $v = x^2 - yt^2$
5. $u = xt^2$; $v = xyt - y^2$

Select the correct answer using the code given below :

(a) 1 only

(b) 1 and 2 only

(c) 1, 2 and 3 only

(d) 2, 3, 4 and 5

68. A venturimeter having area of $700\ cm^2 \times 150\ cm^2$ is inserted in a vertical pipe carrying water, flowing in the upward direction. A differential manometer connected to the inlet and throat gives a reading of 20 cm. What is the approximate discharge by assuming $C_d = 1{\cdot}0$ and $g = 1000\ cm/s^2$?

(a) 110 L/s

(b) 100 L/s

(c) 125 L/s

(d) 95 L/s

69. The flow of incompressible fluid is defined by $u = 2, v = 8x$. What is the stream function ? (where C = constant)

(a) $\varphi = -2x^2 + y + C$

(b) $\varphi = -4x^2 + 2y + C$

(c) $\varphi = -4x + 2y^2 + C$

(d) $\varphi = -4x - 2y^2 + C$

70. Water at 60°C flows between two large flat plates. The lower plate moves to the left at a speed of 0·3 m/s. The plate spacing is 3 mm and the flow is laminar. The pressure gradient required to produce zero net flow at a cross-section is :

(Take $\mu = 5 \times 10^{-4}\ Ns/m^2$ at 60°C)

(a) $-100\ N/m^2.m$

(b) $-10\ N/m^2.m$

(c) $-1000\ N/m^2.m$

(d) $-50\ N/m^2.m$

71. Without velocity of approach, the discharge through a Cipolletti weir is :

(a) $Q = \frac{2}{3} C_d L \sqrt{2g}\, H^{3/2}$

(b) $Q = \frac{1}{2} C_d L \sqrt{5g}\, H^{2/3}$

(c) $Q = \frac{2}{3} C_d L \sqrt{g}\, H^{2/3}$

(d) $Q = \frac{1}{2} C_d L \sqrt{5g}\, H^{3/2}$

72. The rate of flow of water through a horizontal pipe is 0·25 m^3/s. The diameter of the pipe which is 200 mm is suddenly enlarged to 400 mm. The pressure intensity in the smaller pipe is 11·772 N/cm^2. The approximate power lost due to enlargement is :

(Take $g = 10\ m/s^2$)

(a) 4·50 kW

(b) 9·00 kW

(c) 2·25 kW

(d) 1·80 kW

73. Water is flowing with a velocity of 1·5 m/s in a pipe of length 2500 m and of diameter 500 mm. At the end of the pipe, a valve is provided. What is the rise in pressure, if the valve is closed in 25 seconds ?

(Take the value of C as 1460 m/s)

(a) $15\ N/cm^2$

(b) $150\ N/cm^2$

(c) $7{\cdot}5\ N/cm^2$

(d) $75\ N/cm^2$

74. A Pelton wheel is having a mean bucket speed of 10 m/s with a jet of water flowing at the rate of 700 litre/s under a head of 31·25 m. The buckets deflect the jet through an angle of 150°. Assuming co-efficient of velocity as unity, g as 10 m/s^2, and the density of water as 1000 kg/m^3, the approximate power given by water to the runner of the turbine is :

(a) 196 kW

(b) 98 kW

(c) 49 kW

(d) 294 kW

75. Consider the following statements regarding the operating characteristic curves of centrifugal pumps :

1. The input power curve will pass through the origin.
2. The head curve will have maximum value of head when the discharge is maximum.
3. The output power curve will start from origin.
4. The efficiency curve will start from origin.

Which of the above statements are correct ?

(a) 1 and 2

(b) 3 and 4

(c) 2 and 4

(d) 1 and 3

76. Water absorption for burnt clay heavy duty bricks should not be more than :

(a) 10 percent

(b) 20 percent

(c) 5 percent

(d) 15 percent

77. The decomposition of felspar is represented as $K_2Al_2O_3.6H_2O + CO_2 + nH_2O =$

(a) $K_2CO_3 + Al_2O_3.2SiO_2.2H_2O + 4SiO_2.nH_2O$

(b) $K_2CO_3 + Al_2O_3.SiO_2.2H_2O + 4SiO_2.nH_2O$

(c) $K_2CO_3 + Al_2O_3.2SiO_2.H_2O + 4SiO_2.nH_2O$

(d) $K_2CO_3 + Al_2O_3.SiO_2.H_2O + 4SiO_2.nH_2O$

78. The metal oxide used to make emerald green glass is :

(a) MnO_2

(b) Cr_2O_7

(c) Cobalt oxide

(d) Iron oxide

79. Match the following lists :

List-I		*List-II*
P. Cupping	1.	Caused by wood limbs encased by wood of the free trunk
Q. Bowing	2.	Caused by grain irregularities in the board
R. Checks	3.	Small cracks appearing at the ends of boards due to rapid drying
S. Knots	4.	Unequal shrinking in the radial and tangential direction

Select the correct answer using the code given below :

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

80. Which one of the following statements is **not** correct regarding the fineness of cement ?

(a) Fine cement is more liable to suffer from shrinkage cracking than a coarse cement.

(b) Fine cement shows faster rate of heat evolution and total quantity of heat evolved is much larger than coarse cement.

(c) Fine cement will show faster rate of hardening than coarse cement.

(d) Fine cement shows the same setting time as coarse cement.

81. Match the following lists :

List-I (Types of cement)		*List-II (Uses)*
P. Rapid hardening	1.	Repair of bridges
Q. Quick-setting	2.	Dams
R. High alumina	3.	Concrete under water
S. Low-heat	4.	Refractory concrete in industries

Select the correct answer using the code given below :

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

82. The approximate composition of CaO in Portland cement is in the range of :

(a) 60% – 65%

(b) 50% – 55%

(c) 65% – 70%

(d) 55% – 60%

83. The percentage of MgO in cement is calculated using :

(a) Weight of residue × 32·4

(b) Weight of residue × 27·4

(c) Weight of residue × 42·7

(d) Weight of residue × 72·4

84. The minimum value of Modulus of Rupture for Class A lime should be :

(a) 1·15 N/mm^2

(b) 1·05 N/mm^2

(c) 1·50 N/mm^2

(d) 1·25 N/mm^2

85. Match the following lists :

List-I (Cement mortar for different works)		*List-II (Proportion of cement : Sand in mortar)*
P. Normal brickwork	1.	1 : 4
Q. Plastering work	2.	1 : 3
R. Grouting cavernous rocks	3.	1 : 6
S. Guniting	4.	1 : 1·5

Select the correct answer using the code given below :

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

86. Which one of the following statements is correct regarding the factors influencing strength of concrete ?

(a) If the size of cube is decreased, the compressive strength tends to increase and modulus of elasticity decreases.

(b) If the size of cube is decreased, the compressive strength tends to decrease and modulus of elasticity increases.

(c) If the size of cube is decreased, the compressive strength tends to increase and modulus of elasticity also increases.

(d) If the size of cube is decreased, the compressive strength tends to decrease and modulus of elasticity also decreases.

87. The cement content in a mix design is 378 kg/m^3, water content 170 kg, sand is 30% of total aggregate, entrapped air is 1%, specific gravity of cement, coarse aggregate and fine aggregate are, respectively 3·15, 2·70 and 2·60. The fine aggregate is approximately :

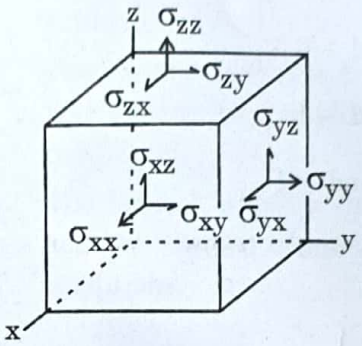
(a) 510 kg

(b) 600 kg

(c) 550 kg

(d) 450 kg

88. The component of stress acting on infinitesimal element is shown in the figure. Which one of the following statements is ***not*** correct ?



(a) The normal stress components are σ_{xx}, σ_{yy}, and σ_{zz}. The shear stress components are σ_{yz}, σ_{zx}, σ_{xy}, σ_{zy}, σ_{xz}, and σ_{yx}.

(b) On a free surface, the two shear stress components in the surface vanish, that is, if z is the normal to a free surface, $\sigma_{yz} = \sigma_{zx} = 0$.

(c) If the surfaces are assumed to have friction, then the shear stresses acting on the surface vanish, that is, $\sigma_{yz} = \sigma_{zx} = 0$.

(d) Unless there is a pressure acting on a free surface, the stress normal to it also vanishes, that is, $\sigma_{zz} = 0$.

89. An element 2 cm long is extended to twice of its initial length and then compressed to its initial length. The engineering strains for the extension and compression are, respectively :

(a) 1 and – 0·5

(b) 2 and – 1

(c) 0·5 and – 1

(d) 0·693 and – 0·693

90. A rectangular block is subjected to two perpendicular stresses of 10 MPa tension and 10 MPa compression. What are the stresses on planes inclined at 45° with the horizontal plane ?

(a) Normal Stress = 10 Mpa and Shear Stress = 20 Mpa

(b) Normal Stress = 0 Mpa and Shear Stress = – 10 Mpa (counter clockwise direction)

(c) Normal Stress = 5 Mpa and Shear Stress = – 20 Mpa (counter clockwise direction)

(d) Normal Stress = 10 Mpa and Shear Stress = 5 Mpa

91. The angle made by the resultant stress with the normal of the oblique plane is known as obliquity (ϕ) and is expressed as :

(a) $\tan \phi = \dfrac{\text{Shear Stress}}{\text{Normal Stress}}$

(b) $\cos \phi = \dfrac{\text{Shear Stress}}{\text{Normal Stress}}$

(c) $\tan \phi = \dfrac{\text{Normal Stress}}{\text{Tangential Stress}}$

(d) $\cos \phi = \dfrac{\text{Normal Stress}}{\text{Tangential Stress}}$

92. A central load of 2500 N is acting on a leaf spring. The leaf spring is to be made of 12 steel plates of 6 cm width and 5 mm thickness. If the bending stress is limited to 200 N/mm^2, then the length and deflection at the centre of the spring are, respectively :
(Assume Modulus of elasticity as 2×10^5 N/mm^2)

(a) 660 mm; 16·08 mm
(b) 760 mm; 26·08 mm
(c) 860 mm; 36·08 mm
(d) 960 mm; 46·08 mm

93. A 150 N load is acting on a close coiled helical spring. The mean coil diameter has to be 12 times that of the wire diameter. If the maximum shear stress is not to exceed 150 N/mm^2, what is the diameter of the coil ?

(a) 57·64 mm
(b) 67·64 mm
(c) 77·64 mm
(d) 87·64 mm

94. A circular rod of 20 mm diameter and 400 mm length is subjected to a tensile force of 50 kN. What is the volumetric strain, if Poisson's ratio = 0·25 and Young's modulus E = 2×10^5 N/mm^2 ?

(a) $79{\cdot}57 \times 10^{-5}$
(b) $39{\cdot}75 \times 10^{-5}$
(c) $79{\cdot}57 \times 10^{-3}$
(d) $39{\cdot}75 \times 10^{-3}$

95. A rod which tapers uniformly from 30 mm diameter to 15 mm diameter in a length of 300 mm is subjected to an axial load of 6 kN. If Young's modulus is 2×10^5 N/mm^2, what is the elongation of the rod ?

(a) $\frac{0 \cdot 06}{\pi}$ mm

(b) $\frac{0 \cdot 08}{\pi}$ mm

(c) $\frac{0 \cdot 6}{\pi}$ mm

(d) $\frac{0 \cdot 8}{\pi}$ mm

96. Which one of the following is a measure of the ability of a material to absorb energy before fracture ?

(a) Resilience

(b) Strain Energy Density

(c) Resilience Modulus

(d) Modulus of Toughness

97. A 10 coils 120 mm mean diameter closely coiled helical spring is made up of a 12 mm steel wire. If the spring is carrying an axial load of 150 N, what is the maximum shear stress ?

(Take modulus of rigidity $C = 8 \cdot 16 \times 10^4$ N/mm^2)

(a) 16·52 N/mm^2

(b) 20·52 N/mm^2

(c) 26·52 N/mm^2

(d) 32·52 N/mm^2

98. The optimistic time estimate is defined as :

(a) The best guess of the minimum time that would be required to complete the activity.

(b) The best guess of the maximum time that would be required to complete the activity.

(c) The shortest possible time in which an activity can be completed, under ideal conditions.

(d) The longest possible time in which an activity can be completed, under any conditions.

99. What is the expected time of completion of an activity, if the optimistic time (t_0) is 4 days, most likely time (t_L) is 6 days and pessimistic time (t_P) is 11 days ?

(a) 6·5 days

(b) 9·5 days

(c) 3·25 days

(d) 4·25 days

100. Independent float is defined as :

(a) Maximum amount of time by which an activity can be delayed from early start without delaying the project.

(b) Maximum amount of time by which an activity can be delayed without delaying the early start of any following activity.

(c) Maximum amount of time by which an activity can be delayed without delaying the project but will cause delay to the early start of some following activity.

(d) Maximum amount of time by which an activity can be delayed without delaying the project; even if all predecessors are at late start and all successors at early start.

101. The details of marks of the technical and the financial bids of four bidders, who bid for a project having an estimated cost of ₹ 1,00,000 are given as follows :

Contractor	Score of Technical Bid	Financial Bid (INR)
A	80	1,35,000
B	75	1,25,000
C	45	1,01,000
D	60	1,15,000

To whom can the contract be awarded with the following conditions :

1. Technical score must be more than 50.
2. Job is awarded to the bidder with highest composite score evaluated considering equal weightage for financial and technical bid.
3. The call may be cancelled if the award price deviates more than 20% of the estimated cost.

Choose the correct answer from the options given below :

(a) Cancel the call, though contractor B is technically qualified but quoted more than 20% of the estimated cost.

(b) Cancel the call, though contractor A is technically qualified but quoted more than 20% of the estimated cost.

(c) Cancel the call, though contractor D is technically qualified but quoted more than 20% of the estimated cost.

(d) Contractor C

102. A construction firm is considering to execute a structural modification project in a running manufacturing mill. Due to technical reasons, the work is to be executed slowly and carefully. It is expected that only 20 tons of fabrication is possible in each month. The firm has an estimated fixed cost (equipment, supervision, overhead deployment) of ₹ 1,50,000 per month, variable cost (labour and material) of ₹ 30,000 per month and ₹ 35,000 for normal cost of fabrication. What is the rate that should be quoted by the firm to achieve at least 10% profit ?

(a) ₹ 35,000

(b) ₹ 41,000

(c) ₹ 45,000

(d) ₹ 49,000

103. A preliminary survey indicates that 20% of the time of a gang of workers is spent idly. What is the total number of observations required to determine the proportion of idle time within +/– 5% with 95% confidence limit ?
(Take Z values as 2·0)

(a) 256

(b) 128

(c) 512

(d) 1024

104. Construction of a military helipad at an altitude of 2400 m involves 88000 m^3 (loose) of excavation area in soft soil. This task needs to be completed in 200 working hours. The company entrusted two dozers, each with an output of 220 m^3/h under job conditions for task execution. It also holds wheel loaders and 22 m^3 dump trucks. One loader can load in trucks, about 120 m^3 of excavated soil per hour. The dump truck cycle time for disposal of excavated materials is 40 minutes. This includes 8 minutes of loading time by a loader team that consists of 2 loaders. In this case, the total number of dumpers required to complete the task on time is :

(a) 6

(b) 12

(c) 18

(d) 24

105. What is the amount of water required per hour for compacting loose soil being spread by a shovel and dozer at the rate of 230 m^3/h for a soil having density of 1·5 gm/m^3 and 8% moisture content needing 12% optimum moisture content for compaction ?

(a) 6900 litres/hour

(b) 13800 litres/hour

(c) 20700 litres/hour

(d) 27600 litres/hour

106. An element in plane stress is subjected to normal stresses $p_1 = 120$ N/mm^2 and $p_2 = 45$ N/mm^2 (both are tensile stresses) and shearing stress of 30 N/mm^2 (simple shear). What is the normal stress (p_n) acting as an element rotated through an angle 45° ?

(a) $P_n = -37{\cdot}5$ N/mm^2

(b) $P_n = 52{\cdot}5$ N/mm^2

(c) $P_n = -73{\cdot}5$ N/mm^2

(d) $P_n = 112{\cdot}5$ N/mm^2

107. At a point in an elastic material, a direct tensile stress of 70 N/mm^2 and a direct compressive stress of 50 N/mm^2 are applied on planes at right angles to each other. If the maximum principal stress in the material is limited to 75 N/mm^2, what is the maximum shear stress ?

(a) 65 N/mm^2

(b) 55 N/mm^2

(c) 75 N/mm^2

(d) 25 N/mm^2

108. A material has strength in tension, compression and shear as 30 N/mm^2, 90 N/mm^2 and 25 N/mm^2, respectively. If a specimen of diameter 25 mm is tested in compression, then identify the failure load and failure plane.

(a) Failure load is 14726 N and failure plane is 30° to the plane of axial compression

(b) Failure load is 24543 N and failure plane is 45° to the plane axial compression

(c) Failure load is 36574 N and failure plane is 60° to the plane of axial compression

(d) Failure load is 18745 N and failure plane is 90° to the plane of axial compression

109. A simply supported beam of span 3·0 m has a cross-section 120 mm × 180 mm. If the permissible stress in the material of the beam is 10 N/mm^2, what is the maximum uniformly distributed load (UDL) that it can carry ? (Ignore the moment due to self-weight)

(a) 9·72 kN/m

(b) 4·52 kN/m

(c) 5·76 kN/m

(d) 8·80 kN/m

110. A surveyor's steel tape 30 m long has a cross-section of 15 mm × 0·75 mm. With this, line AB is measured as 150 m. If the force applied during measurement is 120 N more than the force applied at the time of calibration, what is the actual length of the line ?
(Take the modulus of elasticity for steel as 200 kN/mm^2)

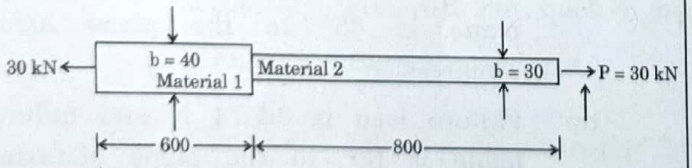
(a) 149·992 m

(b) 150·008 m

(c) 151·016 m

(d) 148·008 m

111. The stepped bar shown in the figure is made up of two different materials. Material 1 has Young's modulus = 2 × 10^5 N/mm^2, while that of Material 2 is 1 × 10^5 N/mm^2. What is the extension of the bar under a pull of 30 kN if both the portions are 20 mm in thickness ? (The dimensions shown below are in mm)



(a) 0·5125 mm

(b) 0·4000 mm

(c) 0·1125 mm

(d) 0·2875 mm

112. Two parallel walls, 8 m apart, are stayed together by a steel rod of 20 mm diameter passing through metal plates and nuts at each end. The nuts are screwed up to the plates while the bar is at a temperature of 400 K. What is the pull exerted by the bar after it has cooled to 300 K, if the total yielding at the two ends is 5 mm ?
(Take coefficient of thermal expansion for steel as 12 × 10^{-6} per K and Young's modulus of steel as 2 × 10^5 N/mm^2)

(a) 75·398 kN

(b) 240 kN

(c) 115 kN

(d) 36·128 kN

113. Which one of the following statements is ***not*** correct regarding principal stresses and planes ?

(a) The planes on which shearing stresses are zero are called principal planes and the stresses normal to principal planes are known as principal stresses.

(b) The principal planes are the planes of maximum or minimum normal stresses.

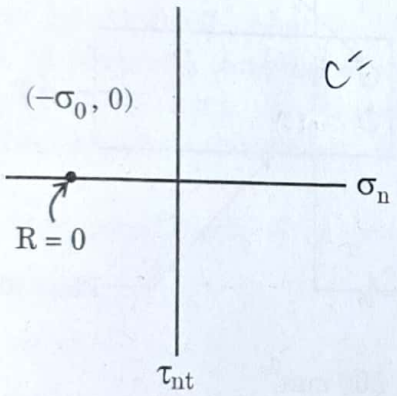
(c) The planes of extreme shearing stresses are at 90° to the principal planes.

(d) The sum of normal stresses in any two mutually perpendicular directions is constant in case of a general two-dimensional stress.

114. What is the maximum torque T_E that can be applied to a solid steel cylindrical shaft 8 cm in diameter, if the shaft is to remain elastic ? (Take the elastic limit in shear and the shear modulus as τ_0 = 145 MPa and G = 76 GPa, respectively)

(a) 14,580 N-m
(b) 7,290 N-m
(c) 3,645 N-m
(d) 29,160 N-m

115. Given the state of stress $\sigma_x = \sigma_y = -\sigma_0$ (where $\sigma_0 > 0$) and $\tau_{xy} = 0$ as shown in the figure, which one of the following statements is ***not*** correct ?



(a) The radius of the Mohr circle R = 0.
(b) No shear stress exists on any plane passing through this point.
(c) The state of stress shown here is called a state of 'Pure Shear'.
(d) The normal stress is same for all planes passing through this point.

116. A fixed-fixed beam 'AB' of length 3 m is subjected to a point load of 45 kN at a distance 2 m from left support 'A'. What are the vertical reaction forces at both the supports 'A' and 'B' ?

(a) R_A = 15 kN and R_B = 30 kN
(b) R_A = 15 kN and R_B = 11·67 kN
(c) R_A = 33·33 kN and R_B = 30 kN
(d) R_A = 11·67 kN and R_B = 33·33 kN

117. A cantilever wooden beam is 3 m long and carries a UDL of 4 kN/m. The cross-section of the beam is 100 mm width and 200 mm depth. What is the maximum bending stress for this section ?

(a) 2·7 MPa
(b) 27 MPa
(c) 270 MPa
(d) 0·27 MPa

118. In the context of measures of surfaces, which one of the following is ***not*** correct ?

(a) 1 Sq. mile = 2·590 Sq. kilometres
(b) 1 Sq. mile = 259 Hectares
(c) 1 Sq. mile = 640 Acres
(d) 1 Sq. mile = 10^9 Sq. centimetres

119. A hollow steel column carrying an axial load of 2·1 MN has an ultimate stress of 510 N/mm^2. The internal diameter of the column is 150 mm. Consider the factor of safety as 4. What is the external diameter of the column ?

(a) 201·49 mm
(b) 208·49 mm
(c) 214·49 mm
(d) 218·49 mm

120. The tensile stresses at a point across two mutually perpendicular planes are 150 N/mm^2 and 80 N/mm^2. What are the tangential and normal stresses, respectively, on a plane inclined at 30° to the axis of the minor stress ?

(a) 112·5 N/mm^2 ; 10·31 N/mm^2
(b) 122·5 N/mm^2 ; 20·31 N/mm^2
(c) 132·5 N/mm^2 ; 30·31 N/mm^2
(d) 142·5 N/mm^2 ; 40·31 N/mm^2

121. As per IS 1893:2016, what is the percentage of imposed load to be considered in the calculation of seismic weight, if the imposed uniformly distributed floor load is 4 kN/m^2 ?

(a) 25

(b) 50

(c) 40

(d) 75

122. Which one of the following statements is ***not*** correct regarding the response reduction factor ?

(a) It accounts for inherent system ductility.

(b) It accounts for redundancy.

(c) It influences the non-linear behaviour of a building during strong earthquake shaking.

(d) It accounts for the importance of the building.

123. Which one of the following statements is ***not*** correct regarding the working stress method ?

(a) Stress-strain relation is considered linear till yield stress.

(b) To take care of uncertainties in the design, permissible stress is kept as a fraction of yield stress.

(c) Increase of permissible stresses by 25% is permitted when dead load, live load and wind load are considered.

(d) Working stress method gives the uneconomical sections.

124. As per IS 800:2007, the maximum effective slenderness ratio for 'members always in tension (other than pre-tensioned members)' is :

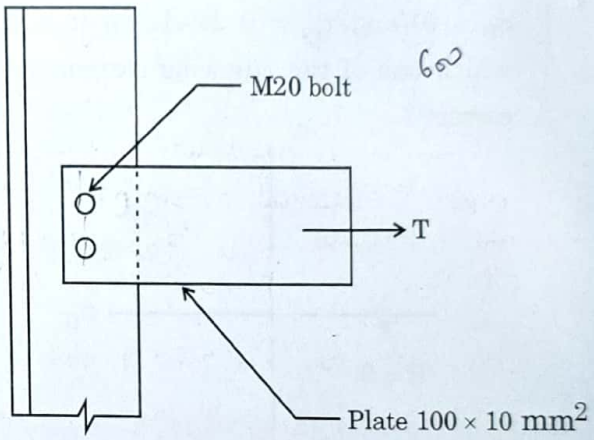
(a) 180

(b) 250

(c) 350

(d) 400

125. What is the net area for the tension member shown in the figure, in case of punched holes ?



(a) 560 mm^2

(b) 1000 mm^2

(c) 520 mm^2

(d) 440 mm^2

126. What is the design tensile strength of the plate 130 mm × 12 mm with holes for 16 mm diameter bolts by considering yielding of gross section ?

(Take f_y = 250 N/mm^2 and γ_{m0} = 1·1)

(a) 332·986 kN

(b) 340·570 kN

(c) 354·545 kN

(d) 380·765 kN

127. Consider the following statements :

The design strength of a tension member is the lowest of :

1. design strength due to yielding of gross-section.
2. rupture strength of critical section.
3. the block shear 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

128. As per IS 800:2007, what is the effective length of prismatic compression member for the restrained (both in translation and rotation) boundary conditions at both the ends ?
(Take L as actual length of the member)

(a) 2 L

(b) 0·65 L

(c) 0·8 L

(d) 1·2 L

129. What is the working load of a compression member with effective sectional area as 7500 mm^2 and design compressive stress of 300 N/mm^2 ?
(Take factor of safety (FoS) = 1·5)

(a) 2250 kN

(b) 1500 kN

(c) 750 kN

(d) 562·5 kN

130. Which one of the following statements related to a design of laced columns as per IS 800:2007 is ***not*** correct ?

(a) The slenderness ratio for lacing bars should not exceed 145.

(b) In bolted/riveted construction, the minimum width of lacing bars shall be four times the nominal diameter of the bolt/rivet.

(c) Lacing bars should be inclined at 40° to 70° to the axis of built up member.

(d) The effective slenderness ratio of laced columns shall be taken as 1.05 times the actual maximum slenderness ratio, in order to account for shear deformation effects.

131. A roof of a hall measuring 8 m × 12 m consists of 100 mm thick reinforced concrete slab supported on I-beams spaced 3 m apart. The steel beam is designed considering finishing load of 1·5 kN/m^2 and live load of 1·5 kN/m^2. What is the permissible deflection for this beam as per IS 800:2007, by considering effective length of beam as 9 m ?

(a) 27·67 mm

(b) 14·5 mm

(c) 30 mm

(d) 35 mm

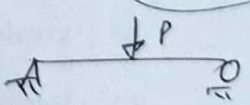
132. A simply supported beam of effective span 1·5 m is carrying a factored concentrated load of 360 kN at mid span. What is the section modulus of the beam?
(Take f_y = 250 N/mm^2 and γ_{m0} = 1·1)

(a) 594×10^3 mm^3

(b) 651×10^3 mm^3

(c) 768×10^3 mm^3

(d) 256×10^3 mm^3



$$M_e = \frac{Z_e f_y}{\gamma_{m0}}$$

$$Z_e = \frac{M_e \gamma_{m0}}{f_y}$$

133. What is the effective length of a simply supported beam of span length 7 m for the following restraint conditions at the support under normal loading conditions ?

Torsional restraint: Fully restrained;

Warping restraint: Both the flanges fully restrained

(a) 5·25 m

(b) 5·95 m

(c) 4·90 m

(d) 6·30 m

134. What is the bending moment in case of continuous purlins ?
(Take the effective length of the purlin as L and load intensity as w)

(a) $wL^2/8$

(b) $wL^2/10$

(c) $wL^2/32$

(d) $wL^2/24$

135. In the case of stiffened seated connection, to avoid local buckling, typically the ratio of outstanding leg length to its thickness should be :

(a) greater than 8

(b) less than 8

(c) less than 16

(d) greater than 16

136. What is the time required to grade and finish 30 km of road formation with width equal to thrice the width of the motor grader, using six passes of the motor grader with speed for each of the successive two passes as 6 km/h, 8 km/h and 10 km/h, respectively ?
(Take machine efficiency based on operator's skill, machine characteristics and working conditions as 75%)

(a) 45 hours

(b) 15 hours

(c) 90 hours

(d) 60 hours

137. Match the following lists :

List-I	*List-II*
P. ISO 9001:2015	1. Guidelines for Quality Plans
Q. ISO 9004:2018	2. Requirements for Quality Management Systems
R. ISO 10005:2018	3. Guidelines for Quality Management in Projects
S. ISO 10006:2017	4. Guidelines to achieve Sustained Success

Select the correct answer using the code given below :

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

138. For the following data, what is the rate of crashing ?

Crash cost = INR 10,000
Normal cost = INR 5,000
Normal time = 10 days
Crash time = 5 days

(a) INR 1000/day
(b) INR 5000/day
(c) INR 10000/day
(d) INR 500/day

139. Under time-related financial incentive schemes, the employee is paid :

(a) according to the overtime worked in proportion to the basic hourly wages and regulatory measures
(b) according to the measurable completed job
(c) for completing the fixed quantity of a specified job
(d) as bonus after a pre-determined time

140. Considering A and B as two activities of a project, what are the standard deviation of Activity A and B ?

Activity A	*Activity B*
Optimistic time (t_o) = 4 days	Optimistic time (t_o) = 4 days
Most likely time (t_L) = 7 days	Most likely time (t_L) = 6 days
Pessimistic time (t_P) = 16 days	Pessimistic time (t_P) = 22 days

(a) Standard deviation of Activity A = 2 and B = 3
(b) Standard deviation of Activity A = 6 and B = 9
(c) Standard deviation of Activity A = 4 and B = 6
(d) Standard deviation of Activity A = 4.5 and B = 3

141. If the standard deviation is 4 N/mm^2 and the desired characteristic strength is 20 N/mm^2, what is the mean strength of concrete ?

(a) 26·4 N/mm^2
(b) 14·6 N/mm^2
(c) 28 N/mm^2
(d) 16 N/mm^2

142. As per IS 456:2000, what is the creep coefficient of concrete at the age of 28 days of loading ?

(a) 2·2
(b) 1·1
(c) 1·6
(d) 2·8

143. As per IS 875 (Part 2) – 1987, what is the minimum imposed load that needs to be considered for living rooms ?

(a) udl = 3 kN/m^2; concentrated load = 4·5 kN
(b) udl = 4 kN/m^2; concentrated load = 2·7 kN
(c) udl = 2·5 kN/m^2; concentrated load = 2·7 kN
(d) udl = 2 kN/m^2; concentrated load = 1·8 kN

144. What is the typical unit weight of brick masonry used by designers ?

(a) 24 kN/m^3
(b) 20 kN/m^3
(c) 0·130 kN/m^3
(d) 25 kN/m^3

145. Which one of the following statements related to IS 875 (Part 3) – 1987 is ***not*** correct ?

(a) The design wind velocity depends on terrain, height and structure size.

(b) The design wind depends on topography.

(c) The design wind pressure is $0{\cdot}6 \times (\text{design wind velocity})^2$.

(d) Up to a height of 50 m, the wind pressure is considered to act uniformly.

146. As per IS 875 (Part 2) – 1987, what is the reduction in total distributed imposed load (in percent) for design of supporting structural elements in a structure with 10 floors ?

(a) 10%

(b) 20%

(c) 30%

(d) 40%

147. A one-way slab has effective span of 3·6 m and is 150 m thick. The live load expected on it is 3 kN/m^2.

What is the load for checking serviceability ?

(a) 14·4 kN

(b) 6·75 kN

(c) 0·75 kN

(d) 16·40 kN

148. As per IS 456:2000, the strength of concrete achieved in structure is taken as :

(a) $(2/3)^{rd}$ times the strength of the cube cast at laboratories.

(b) $(1/3)^{rd}$ times the strength of the cube cast at laboratories.

(c) $(1/6)^{th}$ times the strength of the cube cast at laboratories.

(d) $(1/4)^{th}$ times the strength of the cube cast at laboratories.

149. As per IS 456:2000, which one of the following statements is ***not*** correct ?

(a) The strain diagram across the depth of the cross-section is linear.

(b) The tensile strength of concrete is ignored.

(c) The stress in steel shall correspond to strain in steel.

(d) If a partial safety factor of 1·15 is used for design purpose, then the maximum stress in steel is limited to $0{\cdot}45f_y$.
(where f_y = characteristic strength of steel)

150. As per IS 1893:2016, what is the value of constant 'A' in the equation mentioned below for determining cyclic stress ratio (CSR) ?

$$CSR = A\left(\frac{a_{max}}{g}\right)\left(\frac{\sigma_{vo}}{\sigma'_{vo}}\right)r_d$$

where, a_{max} = Peak ground acceleration (PGA) preferably in terms of g,
g = acceleration due to gravity,
r_d = stress reduction factor.

(a) 0·5

(b) 0·15

(c) 0·36

(d) 0·65

3.6 × 3 × 0.15
45
180
1440
1820