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UPPSC-AE : 2021
UTTAR PRADESH PUBLIC SERVICE COMMISSION
COMBINED STATE ENGINEERING SERVICES EXAM : ASSISTANT ENGINEER

| CIVIL ENGINEERING | Test No. **1** | BOOKLET SERIES **A** |

Full Syllabus Test : Civil Engineering Paper-I + Hindi

Duration: 2½ hr.   Maximum Marks: 375

## Read the following instructions carefully

1. Immediately after the commencement of the examination, you should check that this 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. Encode clearly the test booklet series **A, B, C** or **D,** as the case may be, in the appropriate place in the answer sheet using ball point pen (blue or black).

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.

4. This Test Booklet contains 125 questions. Each question comprises four responses (answers). All questions carry equal marks. There is provision of negative marking of 1 mark for every wrong answer attempted.

5. Use of calculator is not permitted.

6. Attempt **ALL** questions. Your total marks will depend **Only** on the number of correct responses with corresponding reduction for wrong answers marked by you.

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 invigilator **Only the Answer Sheet**. You are permitted to take away with you the Test Booklet.

DO NOT OPEN THIS BOOKLET UNTIL YOU ARE ASKED TO DO SO
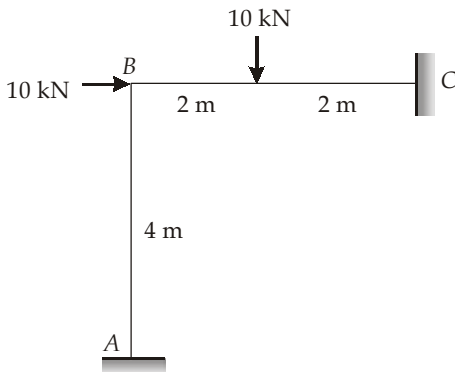
For any query write to us, at: **info@madeeasy.in**

SECTION-A : TECHNICAL

Q.1 The slope deflection equation at end B of the member BC for the portal frame shown in the figure is
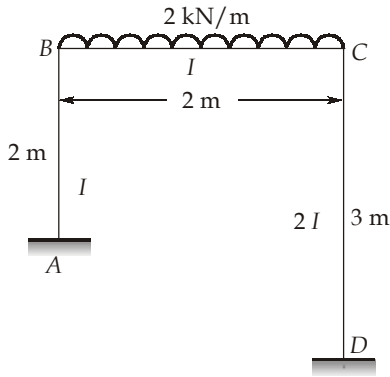
(a) $M_{BC} = 0.67 + EI\theta_B + 2EI\theta_C$
(b) $M_{BC} = -1 + 2EI\theta_B + EI\theta_C$
(c) $M_{BC} = -0.67 + 2EI\theta_B + EI\theta_C$
(d) $M_{BC} = 0.67 + 2EI\theta_B + EI\theta_C$

Q.2 Number of point of contraflexure in the given structure is

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

Q.3 For a 2 hinged parabolic arch, V is sum of the vertical forces in upward direction and H is horizontal thrust on the left hand side of section A-A. If α is the angle of tangent at the point on arch with horizontal, the normal thrust at section A-A from left hand side is given by
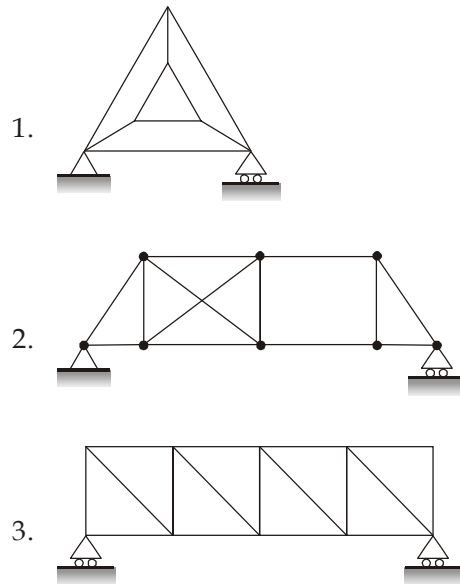
(a) $V\sin\alpha - H\cos\alpha$
(b) $V\cos\alpha - H\sin\alpha$
(c) $V\sin\alpha + H\cos\alpha$
(d) $V\cos\alpha + H\sin\alpha$

Q.4 A symmetrical parabolic arch of span L and rise h is hinged at both ends. The arch carries a UDL along the entire span. Which of the following has non-zero value?
1. Horizontal thrust.
2. Radial shear.
3. Bending moment.
4. Vertical reaction at support.
(a) 1, 2 and 3 only
(b) 2 and 3 only
(c) 1 and 4 only
(d) 3 and 4 only

Q.5 Which of the following trusses is/are unstable?

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

Q.6 For a stiffness matrix $[S] = \dfrac{EI}{63}\begin{bmatrix} 4 & -9 \\ -9 & 36 \end{bmatrix}$, what is its flexibility matrix?
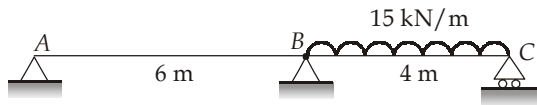
(a) $[F] = \dfrac{63}{EI}\begin{bmatrix} 36 & 9 \\ 9 & 4 \end{bmatrix}$

(b) $[F] = \dfrac{1}{EI}\begin{bmatrix} 36 & -9 \\ -9 & 4 \end{bmatrix}$

(c) $[F] = \dfrac{1}{EI}\begin{bmatrix} 36 & 9 \\ 9 & 4 \end{bmatrix}$

(d) $[F] = \dfrac{1}{EI}\begin{bmatrix} 4 & -9 \\ -9 & 36 \end{bmatrix}$

**Q.7** A continuous beam with uniform flexural rigidity is shown below.

Moment at *B* is
(a) 12 kN-m   (b) 14 kN-m
(c) 16 kN-m   (d) 18 kN-m

**Q.8** Which of the following is not a force method of analysis of structure?
(a) Method of consistent deformation
(b) Kani's method
(c) Column analogy method
(d) Clapeyron's theorem

Q.9 What are the fixed end moments at *A* and *B* of a beam *AB* fixed in direction and position at *A* and *B* when acted upon by loading such as shown in the figure below?
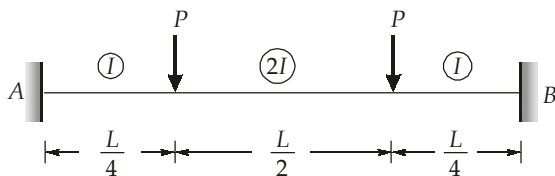
(a) $\dfrac{PL}{2}$ (b) $\dfrac{PL}{4}$

(c) $\dfrac{PL}{3}$ (d) $\dfrac{PL}{6}$

Q.10 What is the total degree of static indeterminacy, both internal and external of the plane frame shown below?
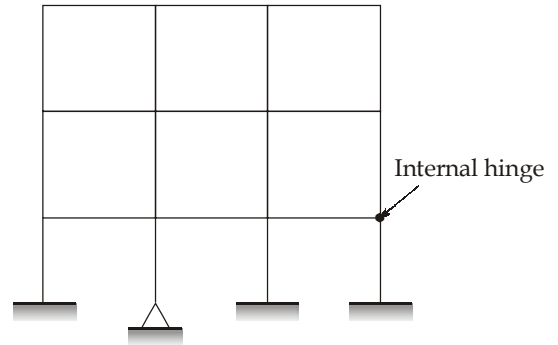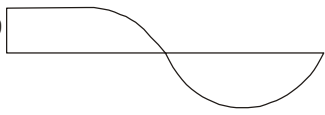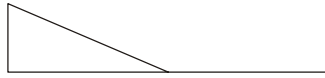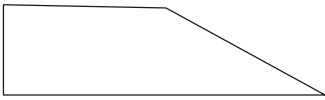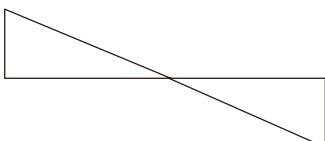

(a) 21   (b) 22
(c) 23   (d) 24

Q.11 The maximum bending moment caused by a set of concentrated moving loads is
(a) Always at a midpoint from where the adjacent load and centroid of set of loads are equidistant.
(b) Always between the mid-point and adjacent load.
(c) Always between the mid-point and centroid of set of the loads.
(d) Always under the adjacent load.

Q.12 The influence line for vertical reaction at *A* of the beam shown below is
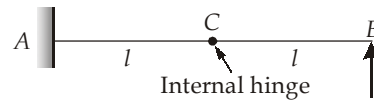
(a)

(b)

(c)

(d)

Q.13 Consider the following statements:
1. Horizontal thrust is same throughout the entire length of cable.
2. Greatest tension in a cable occurs at the lowest point.
3. Cable between two supports takes up the catenary shape if no load is acting on it.

Which of these statement(s) is/are correct?
(a) 1 and 2 only
(b) 2 and 3 only
(c) 1 and 3 only
(d) 1, 2 and 3

Q.14 Which are the unknowns to be determined in the flexibility method?
(a) Displacements
(b) Bending moments
(c) Forces
(d) Internal work done

Q.15 The artificial activity which indicates that an activity following it, cannot be started unless the preceding activity is completed, is known as
(a) Event
(b) Free float
(c) Dummy
(d) Constant

Q.16 Consider the following statements:
1. PERT analysis is event oriented.
2. CPM does not make any allowance for the uncertainties in the duration of time.
3. In CPM, indirect cost decreases with time.

Which of the above statement(s) is/are correct?
(a) 1 and 2 only
(b) 2 and 3 only
(c) 1 and 3 only
(d) 1, 2 and 3

Q.17 A revised estimate is prepared if the sanctioned estimate exceeds

(a) 4%
(b) 5%
(c) 6%
(d) 8%

Q.18 Which method of depreciation is more suitable for finding depreciation of civil engineering structures such as a building?
(a) Sinking fund method
(b) Straight line method
(c) Sum of year digit method
(d) Double declining balance method

Q.19 Item of work which is not included in the Plinth area estimate will be
(a) Wall thickness
(b) Balcony
(c) Service staircases
(d) Water supply and sanitary shaft

Q.20 Critical section for shear in a RCC beam when support reaction is creating compression is at:
(a) Face of support
(b) $d/2$ distance from face of support
(c) d distance from face of support
(d) Middle of the support

Q.21 Limit state of serviceability does not include
(a) Deflection
(b) Cracking
(c) Flexure
(d) Vibration

Q.22 The permissible value of bearing stress of concrete in RCC footing design as per LSM and WSM respectively when M25 concrete used is _____.
(a) 18.75 N/mm^2 and 10 N/mm^2
(b) 11.25 N/mm^2 and 6.25 N/mm^2
(c) 6.25 N/mm^2 and 11.25 N/mm^2
(d) 10 N/mm^2 and 18.75 N/mm^2

Q.23 As per limit state method, correct representation of stress-strain curve of steel or concrete in a structure is

(a)

0.45 f_{ck}

0.002 0.0035 Strain
Concrete

(b)

For ductile failure

$\dfrac{0.87 f_y}{1.15}$

Mild steel   Strain

(c)

0.67 f_{ck}

0.002 0.0035 Strain
Concrete

(d)

0.87 f_y

Mild steel   Strain
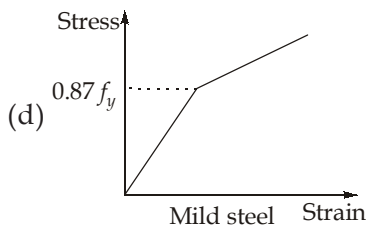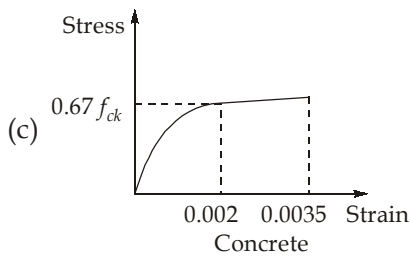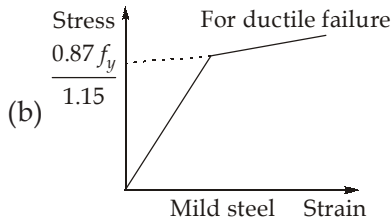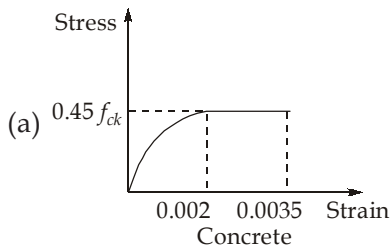
Q.24 A rectangular isolated footing of a square column of side 600 mm carrying axial factored load of 2500 kN, have area 25 m². If depth of footing provided is 900 mm then punching shear acting at a distance of 450 mm from the face of column is
(a) 0.60 N/mm²
(b) 0.42 N/mm²
(c) 0.56 N/mm²
(d) 0.25 N/mm²

Q.25 Minimum reinforcement to be provided in a water tank when its size is restricted to 15 m and deformed bars are used:

(a) 0.4% of surface zone
(b) 0.64% of surface zone
(c) 0.24% of surface zone
(d) 0.35% of surface zone

Q.26 Which of the following statement is incorrect about secondary compression failure?
(a) strain in steel is more than
$0.002 + \dfrac{0.87 f_y}{E_s}$
(b) Neutral axis move downward.
(c) Crack start to develop in concrete.
(d) Neutral axis moves upward.

Q.27 Torsion reinforcement provided at the corner of two way slab when one edge is continuous and other edge is simply supported is

(a) $\dfrac{3}{8} A_{st} (+ve)$ provide along shorter span

(b) $\dfrac{3}{4} A_{st} (+ve)$ provided in both direction

(c) $\dfrac{3}{8} A_{st} (+ve)$ provided in both direction

(d) $\dfrac{3}{4} A_{st} (+ve)$ provided along longer span

Q.28 A rectangular RCC beam of width 400 mm and effective depth 700 mm is reinforced with Fe415 steel. Depth of neutral axis for balanced failure as per WSM is
(Take σ_{st} = 230 N/mm²)
(a) 189.4 mm   (b) 336 mm
(c) 202.3 mm   (d) 280 mm

Q.29 A square column of side 600 mm is provided at the intersection of two perpendicular beams A and B having total depth 500 mm and 700 mm respectively. If floor to floor height of column is 4 m then

the minimum eccentricity of column in x-direction is:
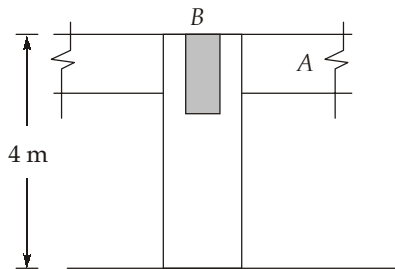
Elevation

Plan

(a) 20 mm   (b) 27 mm
(c) 26.6 mm   (d) 22.4 mm

Q.30 Maximum upward deflection allowed in prestressed concrete beam is

(a) $\dfrac{\text{Span}}{250}$

(b) Maximum of $\dfrac{\text{Span}}{350}$ or 20 mm

(c) $\dfrac{\text{Span}}{300}$

(d) Maximum of $\dfrac{\text{Span}}{250}$ or 20 mm

Q.31 Deflection of two way slab depends primarily on
(a) Longer span
(b) Shorter span
(c) Both longer span and shorter span
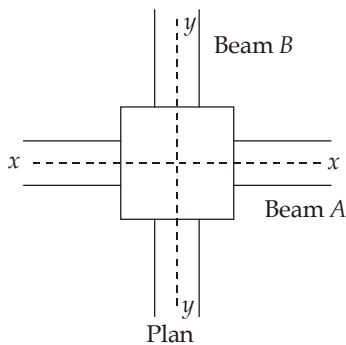(d) Independent of both spans

Q.32 Consider the following continuous slab of different spans with T-beam as shown in figure. The effective width of hatched T-beam will be
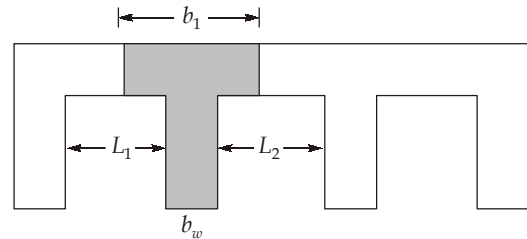
Assume:
$[L_1 = 1.5$ m, $L_2 = 1.8$ m, $b_w = 300$ mm]
(a) 1950 mm   (b) 2100 mm
(c) 1800 mm   (d) 1125 mm

Q.33 Interaction curve of a rectangular RCC column as shown in figure is divided into three zones. Which of the following statement regarding these zones is incorrect?
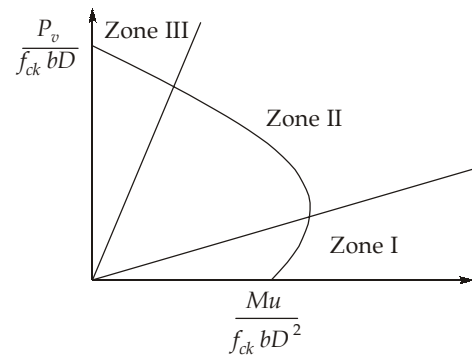
(a) Zone I is tension controlled region
(b) Zone II is compression controlled region
(c) Zone III is minimum eccentricity region
(d) Zone I is pure compression region

Q.34 Design of two-way slab when edges and corners are free to lift, follows:
(a) Marcus method
(b) Pigeavd's method
(c) Rankine Grashoff theory
(d) Yield line theory

Q.35 Loss due to shrinkage in a post tensioned member when initial loading is done after 8 days of concrete casting is _____ N/mm². (Take $E_s = 2.1 \times 10^5$)
(a) 42 N/mm²   (b) 63 N/mm²
(c) 46 N/mm²   (d) 70 N/mm²

Q.36 Match **List-I** (Name of brick) with **List-II** (Shape of brick) and select the correct answer using the codes given below the lists:
List-I
A. Cownose brick
B. King closer
C. Bullnose brick
D. Bevelled closer
List-II

1.

2.

3.

4.

Codes:

	A	B	C	D
(a)	2	1	4	3
(b)	1	3	2	4
(c)	4	2	3	1
(d)	3	4	1	2

Q.37 Consider the following statement regarding timber and pick the incorrect statement:
(a) Water stain is defect in timber caused due to natural forces.
(b) Seasoning of timber decreases the transportation and handling cost for timber sections.
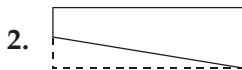
(c) Exogenous trees increases bulk by growing outwards and fibrous mass is seen in longitudinal section.
(d) Medullary rays extend from pith to cambium layer.

Q.38 Which of the following paint is used for painting gas and oil storage tanks?
(a) Asbestos paint
(b) Cellulose paint
(c) Luminous paint
(d) Aluminium paint

Q.39 Solution baryta is used for
(a) Prevention of timber
(b) Prevention of brick masonry
(c) Prevention of stones
(d) Prevention of bituminous surface

Q.40 The excess of lime in brick results in
(a) Efflorescence over brick surface
(b) Splitting of brick into pieces
(c) Non-uniform mix of clay and makes the brick weak
(d) Porous due to explosion of gases

Q.41 Which of the following statement is true for bulking of sand?
(a) The bulking of sand affects the weight proportioning of sand to a large extent.
(b) If proper allowance is not made for bulking of sand it results into under sanded mixes.
(c) It can be increased by adding more water into it upto saturation level.
(d) It occur more in coarse sand.

Q.42 Match **List-I** (Type of defect of timber) with **List-II** (Physical significant of defect) and select the correct answer using the codes given below the lists:
List-I
A. Star shake
B. Tight knot
**C.** Loose knot
D. Heart shake

List-II
1. Preliminary stage of live knot.
2. Crack extend from bark toward sap wood.
3. Preliminary stage of dead knot.
4. Crack extend from pith to sap wood.

Codes:

	A	B	C	D
(a)	2	1	3	4
(b)	4	2	3	1
(c)	4	3	2	1
(d)	3	1	2	4

Q.43 Consider the following alloys and select the wrong pair
(a) Bronze → Copper and Tin
(b) Monel metal → Nickel and Copper
(c) Duralumin → Aluminium and Copper
(d) German silver → Aluminium and Zinc

Q.44 Which one of the following is/are thermoplastic resin?
1. Vinyl
2. Cellulose
3. Urea formaldehyde
4. Methyl methacrylate
(a) 1, 2 and 4
(b) 1, 2 and 3 only
(c) 1, 3 and 4 only
(d) All of the above

Q.45 Which one of the following cement will be most suitable for construction of chimney?
(a) Low heat cement
(b) Quick setting time
(c) High alumina cement
(d) Blast furnace slag cement

Q.46 A highly workable concrete is tested by Flow table test and result of test shows average spread in diameter of concrete on table is 60 cm. What is percentage flow of concrete on flow table?
(a) 40%   (b) 140%
(c) 58%   (d) 128%

Q.47 Which of the following factors decreases the workability of concrete?
1. Roughness of aggregate.
2. Round shape of aggregate.
3. Smaller size of aggregate.
4. Well graded aggregate.
Select the correct answer using the codes given below:
(a) 1 and 3 only
(b) 2 and 4 only
(c) 1 and 4 only
(d) 2 and 3 only

Q.48 Which of the following is correct increasing order of binding property of Bouge's compound in cement?
(a) C_3A, C_4AF, C_3S, C_2S
(b) C_2S, C_4AF, C_3A, C_3S
(c) C_4AF, C_3A, C_2S, C_3S
(d) C_3S, C_2S, C_3A, C_4AF

Q.49 Consider the following component of stairs and their definitions, select the incorrect pair:
(a) Nosing: It is projecting part of tread beyond face of riser.
(b) Baluster: Vertical member of wood or metal supporting hand rail.
(c) Newel post: It is moulding provided under nosing to improve elevation of step.
(d) Head Room: It is minimum clearance between tread and overhead structure.

Q.50 Consider the given Purlin roof and identify the different component and choose the correct option
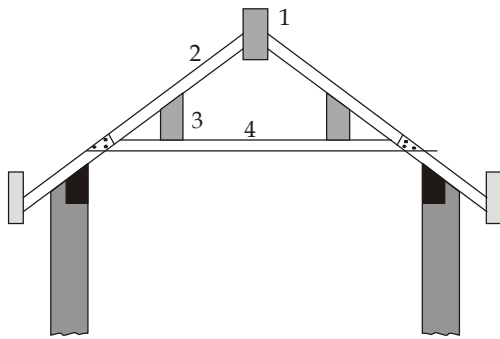
1. Ridge beam
2. Rafter
3. Collar beam
4. Purlin

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

Q.51 Which of the following is correct designation for double shutter door of opening size 1000 mm × 2100 mm?
(a) 10 DT 21   (b) 9 DS 21
(c) 8 DS 21   (d) 12 DT 21

Q.52 If two equal forces of magnitude P, act at an angle θ, then the resultant force will be

(a) $\dfrac{P}{2}\cos\dfrac{\theta}{2}$ (b) $2P\sin\dfrac{\theta}{2}$

(c) $2P\cos\dfrac{\theta}{2}$ (d) $\dfrac{P}{2}\sin\dfrac{\theta}{2}$

Q.53 Moment of inertia of rectangular section of size b × d about an axis passing through it's center of gravity and parallel to depth is

(a) $\dfrac{bd^3}{12}$ (b) $\dfrac{bd^3}{36}$

(c) $\dfrac{db^3}{12}$ (d) $\dfrac{db^3}{36}$

Q.54 A crane lifts a mass of 100 kg from rest and it attains an upward velocity of 2 m/s in 2 seconds gradually. What will be the tension in supporting cable?
(a) 2300 N   (b) 1800 N
(c) 1100 N   (d) 1300 N

Q.55 A 10 m long ladder is resting on a smooth vertical wall with its lower end 6 m from the wall. What should be coefficient of friction between the ladder and the floor for equilibrium?

(a) $\dfrac{1}{2}$ (b) $\dfrac{3}{8}$

(c) $\dfrac{4}{3}$ (d) $\dfrac{3}{4}$

Q.56 A circular disc rolls down an inclined plane. The rotational kinematic energy is _____ times of it's linear kinematic energy.

(a) $\dfrac{1}{8}$ (b) $\dfrac{1}{2}$

(c) $\dfrac{1}{6}$ (d) $\dfrac{1}{4}$

Q.57 A fine grained soil having plasticity index and plastic limit 18% and 22% respectively can be classified as
(a) MH   (b) MI
(c) CH   (d) CI

Q.58 A 6 m retaining wall contains pure cohesive soil as backfill whose undrained shear strength is 40 kPa and unit weight is 20 kN/m^3. What will be passive earth thrust on wall?
(a) 200 kN/m   (b) 40 kN/m
(c) 80 kN/m   (d) 840 kN/m

Q.59 The vertical stress increment due to point load of 600π kN, 3 m below center of square footing will be _____ kN/m^2.
(a) 100   (b) 200
(c) 150   (d) 280

Q.60 Consider the following ground condition
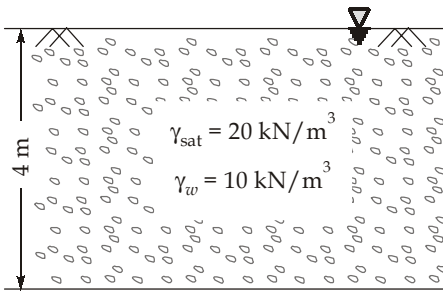
What will be increment in effective stress at center of above soil layer if a surcharge of 1 m dry sand of unit weight 18 kN/m³ applied gradually?
(a) 20 kN/m²　　(b) 38 kN/m²
(c) 18 kN/m²　　(d) Zero

Q.61 Consider the following statement regarding mineralogy of clay:
1. Kaolinite clay mineral possess least swelling as building block of kaolinite bonded together by strong water bond.
2. In octahedral unit, six oxygen atoms enclose Al, Mg or Fe at center.
(a) Only 1 is correct
(b) Only 2 is correct
(c) Both 1 and 2 are correct
(d) Neither 1 nor 2 are correct

Q.62 Flocculant structure of clay is formed when
1. Net electric force between adjacent soil particles at time of deposition are attractive.
2. Clay of this structure having high void ratio.
3. Platelets have edge to edge contact.
Which of these statements are correct?
(a) 1 and 3 only　(b) 2 and 3 only
(c) 1 and 2 only　(d) All are correct

Q.63 What is the relative density of a natural sample of uniformly graded soil in which total volume of soil grains is twice of total volume of void?

(a) 44.68%　　　(b) 73.21%
(c) 12.80%　　　(d) 91.08%

Q.64 The plasticity index and percentage of grains finer than 75 micron of soil sample are 36 and 18, it's activity ratio is _____ if 40% are silt.
(a) 0.9　　　　　(b) 0.6
(c) 1.5　　　　　(d) 3.3

Q.65 Which of the following soil is fine grained and contains cemented volcanic ash transported by wind or water?
(a) Loess soil　　(b) Bentonite soil
(c) Tuff soil　　　(d) Laterite soil

Q.66 Which of the following expression represent pressure head in soil at section x-x?
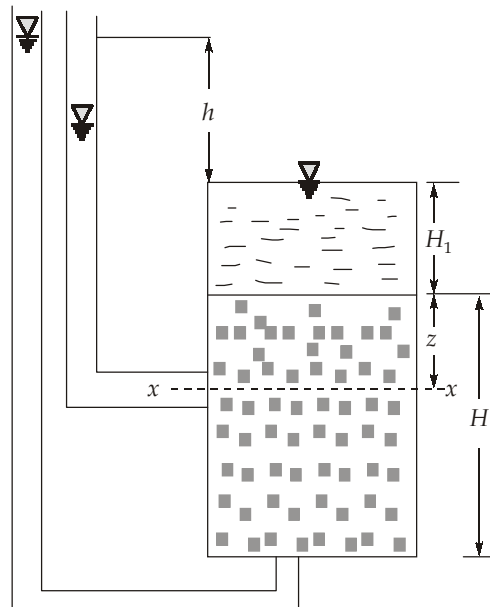
(a) $H + H_1 + iz$　(b) $H_1 + z + iz$
(c) $H_1 + H - iz$　(d) $H_1 + z + iz$

Q.67 Which of the following factors leads to show the decrement in permeability of soil?
1. Presence of organic matter in soil.
2. Higher specific surface area of soil.

3. Higher viscosity of fluid.
4. Bigger diameter of soil grain.
(a) 1, 2 and 3   (b) 2, 3 and 4
(c) 1, 2 and 4   (d) All of the above

Q.68 Which of the following soil parameter does not govern it's optimum moisture content?
(a) Compactive effort
(b) Plasticity of soil
(c) Compressibility of soil
(d) True specific gravity

Q.69 Consider the following e-p curve for a soil as shown in figure below:

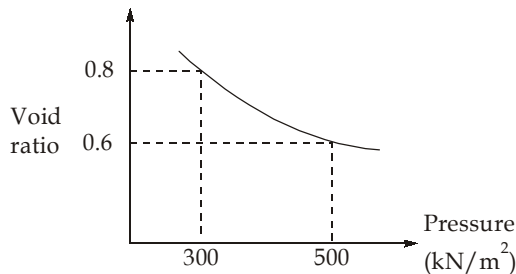
The coefficient of consolidation is _____ $\times 10^{-4}$ m^2/s. If coefficient of permeability of soil is 5×10^{-6} m/s.
(Take $\gamma_w = 10$ kN/m^3)
(a) 5   (b) 6
(c) 2   (d) 9

Q.70 A clay soil specimen when tested in UCS, gave an unconfined compressive strength of 200 kPa. A specimen of same clay with same condition tested for UU triaxial test under a cell pressure of 100 kN/m^2. The back pressure at failure of soil is
(a) 100 kPa   (b) 200 kPa
(c) 300 kPa   (d) 400 kPa

Q.71 An excavation is made with vertical face of 10 m in a clay soil having $C = 50$ kPa, $\gamma = 20$ kN/m^3 and $S_n = 0.1$. The FOS against failure of slope is

(a) 3.1   (b) 2.5
(c) 1.8   (d) 5.2

Q.72 A square footing of 2 m × 2 m is constructed at depth of 2 m in pure clay. As per Terzaghi, the net ultimate load carrying capacity of clay will be _____ kN. [Take undrained shear strength of clay is 50 kPa]
(a) 1482   (b) 1140
(c) 1311   (d) 1226

Q.73 A friction pile of 40 cm diameter and 12 m long driven in clay having an average unconfined compressive strength of 100 kN/m^2. If adhesion factor of clay is 0.8 then the load carrying capacity of pile will be
(a) 200π kN   (b) 192π kN
(c) 178π kN   (d) 196π kN

Q.74 Superposition principle is valid for
1. Linear elastic materials.
2. Structure undergoing small deformations.
3. Strain energy determination in an element of a structure.
(a) 1 and 2 only
(b) 1, 2 and 3
(c) 2 and 3 only
(d) 1 and 3 only

Q.75 At which point the stress strain curve of mild steel, plastic deformation is initiated?
(a) Elastic limit
(b) Proportional limit
(c) Upper yield point
(d) Lower yield point

Q.76 A cube contracts in volume by 0.05% when acted upon by normal uniform pressure of 2×10^6 N/m^2 on all sides. The bulk modulus of its material is
(a) 400 MPa   (b) 40 MPa
(c) 4000 MPa   (d) 40000 MPa

Q.77 Which of the following is an incorrect relationship?

(a) $E = 2G(1 + \mu)$

(b) $E = 3K(1 - 2\mu)$

(c) $E = \dfrac{9KG}{3G + K}$

(d) $E = \dfrac{3K - 2G}{6K + 2G}$

Q.78 A plane elastic body is subjected to a normal compressive stress (σ_x) in longitudinal direction for no change in length in lateral direction, what will be compressive stress that developed in lateral direction?

(a) $\mu\sigma_x$

(b) $\dfrac{\mu}{\mu - 1}\sigma_x$

(c) $\dfrac{\sigma_x}{\mu - 1}$

(d) $\dfrac{\sigma_x}{\mu}$

Q.79 A copper bar of 30 cm length is fixed at the ends. One of the ends can yield by 0.05 cm. If the temperature of the bar is raised by 80°C, then the stress induced in the bar is (Take $\alpha = 20 \times 10^{-6}/°C$, $E = 10^6$ kg/cm²)

(a) 37.67 kg/cm²

(b) 66.67 MPa

(c) 32.67 MPa

(d) 0 MPa

Q.80 An element in the beam is subjected to following principal stresses, $\sigma_1 = 40$ MPa, $\sigma_2 = -30$ MPa, the diameter of the Mohr's circle is

(a) 35 MPa

(b) 5 MPa

(c) 70 MPa

(d) 10 MPa

Q.81 The point of contraflexure in the beam from C will be
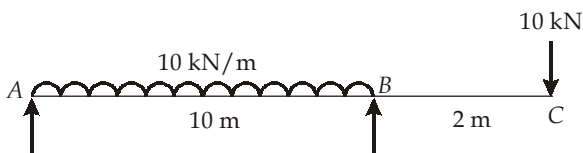
Q.82 Consider a beam rectangular in cross-section as shown.
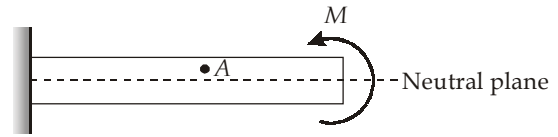
1. It is subjected to shear force.
2. Tensile stress is induced at A.
3. Compressive stress is induced at A.
4. Principal stress in element A is along neutral plane.

Which of the above statement(s) is/are correct?

(a) 1 and 3 only

(b) 2 and 4 only

(c) 1 and 2 only

(d) 3 and 4 only

Q.83 For a triangular section of a beam, ratio of average shear stress to shear stress at neutral axis is

(a) $\dfrac{3}{2}$

(b) $\dfrac{2}{3}$

(c) $\dfrac{4}{3}$

(d) $\dfrac{3}{4}$

Q.84 A 500 mm long copper rod is subjected to a torque such that the permissible shear strain is 0.0005. What will be the diameter of the rod if angle is twist is 0.05 radian?

(a) 50 mm

(b) 5 mm

(c) 100 mm

(d) 10 mm

Q.85 For the given simply supported beam
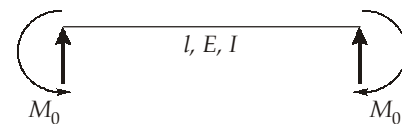
Maximum deflection in the beam is

(a) $\dfrac{M_0 l}{8EI}$

(b) $\dfrac{M_0 l^2}{2EI}$

(c) $\dfrac{M_0 l^2}{8EI}$

(d) $\dfrac{M_0 l}{8EI}$

Q.86 A solid circular column of radius r is used as a compression member to avoid any tensile stresses in the column eccentricity of load from the centroidal axes is less than

(a) $\dfrac{r}{8}$ (b) $\dfrac{r}{2}$

(c) r (d) $\dfrac{r}{4}$

Q.87 The equivalent spring stiffness for the arrangement shown below is:

(a) 60 kN/m   (b) 40 kN/m

(c) 30 kN/m   (d) $\dfrac{20}{9}$ kN/m

Q.88 Maximum strain energy theory is known as
(a) Von Mises and Henky's theory
(b) Coulomb, Tresca and Guest's theory
(c) St Venant's theory
(d) Beltrami's theory

Q.89 Density and Poisson's ratio of steel are
(a) 7.85 kg/m³, 0.25 respectively
(b) 7850 kg/m³, 0.25 respectively
(c) 7850 kg/m³, 0.3 respectively
(d) 785 kg/m³, 0.3 respectively
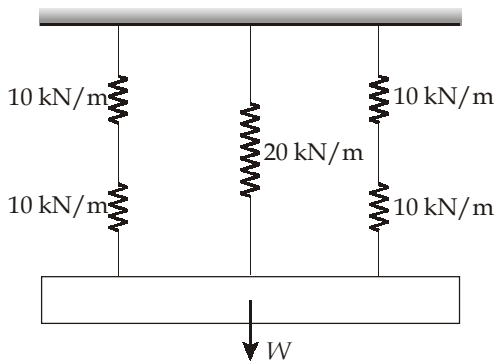
Q.90 Nominal shear strength of a bolt of grade 4.6 is
(a) 230 MPa   (b) 184.75 MPa
(c) 236 MPa   (d) 189 MPa

Q.91 Which of the following is/are correct with reference to welded connection?
1. Fillet weld connection is governed by shear strength of a particular section.
2. Butt weld connection is governed by tensile or compressive strength of a section.
(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

Q.92 The interaction equation for combined shear and tension as per IS 800:2007 will be

(a) $\left(\dfrac{V_b}{V_{db}}\right)^2 + \left(\dfrac{T_b}{T_{db}}\right)^2 \leq 1.4$

(b) $\left(\dfrac{V_b}{V_{db}}\right)^3 + \left(\dfrac{T_b}{T_{db}}\right)^3 \leq 1$

(c) $\dfrac{(V_b)^2}{(V_{db})^2} + \dfrac{(T_b)^2}{(T_{db})^2} \leq 1$

(d) $\left(\dfrac{V_b}{V_{db}}\right)^2 + \left(\dfrac{T_b}{T_{db}}\right)^2 \leq 1.8$

Q.93 A flat tie 180 ISF 18 is subjected to condition where stress reversal due to wind or seismic load is possible what will be the maximum length of flat as per IS 800 : 2007?
(a) 0.9 m   (b) 1.8 m
(c) 2 m   (d) 2.5 m
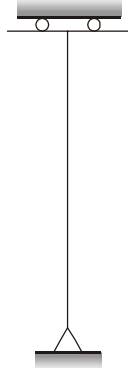
Q.94 Stress reduction factor in the design of a compression member as per IS 800 : 2007 is

(a) $\dfrac{1}{\phi^2 + \left(\phi^2 + \lambda^2\right)^2}$

(b) $\dfrac{1}{\phi^2 + \left(\phi^2 - \lambda^2\right)^2}$

(c) $\dfrac{1}{\phi + \left(\phi^2 + \lambda^2\right)^{1/2}}$

(d) $\dfrac{1}{\phi + \left(\phi^2 - \lambda^2\right)^{1/2}}$

Q.95 For the given column and its support, effective length factor as per IS 800 : 2007 is

(a) 0.65   (b) 2

(c) 0.8   (d) 1.2

Q.96 Which of the following is incorrect?

(a) Lacings are preferred in cases of eccentric loads

(b) Effective length factor of a double lacing bolted member is 0.7

(c) Effective slenderness ratio of a lacing member should not exceed 145

(d) None of these

Q.97 A steel column is supported by a steel base plate which is resting on a concrete footing of M25 grade. The bearing strength of concrete in (N/mm^2) is

(a) 11.25   (b) 6.25

(c) 25   (d) 3.5

Q.98 Longitudinal stiffener is used to

(a) Prevent web crippling

(b) prevent stress concentration

(c) increase buckling resistance of web against bending

(d) increase buckling resistance of web against shear

Q.99 Pitch of a roof truss is $\dfrac{\sqrt{3}}{2}$ then slope of the roof truss is

(a) 60°   (b) 30°

(c) 15°   (d) 45°

Q.100 Cross sections which develop plastic moment resistance but have inadequate plastic hinges are classified as:

(a) Plastic sections

(b) Semi-compact section

(c) Compact sections

(d) Slender section

SECTION-B : GENERAL HINDI

Q.101 'खटिया' शब्द में कौन–से प्रत्यय का प्रयोग हुआ है?

(a) या   (b) टिया

(c) इया   (d) इनमें से कोई नहीं।

Q.102 इनमें से कौन–सा शब्द 'बिजली' का अनेकार्थी शब्द है?

(a) चपला   (b) खग

(c) अंचल   (d) कनक

Q.103 'पुष्कर' शब्द का तद्भव रुप है :

(a) पुरुष   (b) पुष्प

(c) पुत्र   (d) पोखर

Q.104 हिंदी के उपन्यास 'मैला आँचल' के लेखक हैं–

(a) प्रेमचंद

(b) हजारी प्रसाद द्विवेदी

(c) फणीश्वर नाथ रेणु

(d) विष्णु प्रभाकर

Q.105 इनमें से शुद्ध वर्त्तनी शब्द है–

(a) दीपिका   (b) पुज्य

(c) अद्वितिय   (d) तत्व

Q.106 'अधजल गगरी छलकत जाए' लोकोक्ति का अर्थ है–

(a) परिश्रम में शक्ति होती है।

(b) स्वयं के घर में निर्बल भी बलवान होता है।

(c) सबका अलग मत।

(d) अयोग्य व्यक्ति ही अधिक इतराता है।

Q.107 इनमें से कौन–सा भिन्नार्थक शब्द–युग्म अशुद्ध है?

(a) अंश–अंस   (b) अन्य–अन्न

(c) चरम–चर्म   (d) निधन–धन

Q.108 'बच्चों ने खाना खाया' वाक्य में किस काल का बोध है?

(a) वर्तमान काल   (b) संदिग्ध भूतकाल

(c) सामान्य भूतकाल   (d) भविष्यत काल

Q.109 'जेठ' शब्द का स्त्रीलिंग रूप है –

(a) जेठी   (b) जेठानी

(c) जेठरानी   (d) इनमें से कोई नहीं

Q.110 'शायद आज वर्षा हो', यह किस प्रकार का वाक्य है?

(a) आज्ञावाचक   (b) संदेहवाचक

(c) संकेतवाचक   (d) विधानवाचक

Q.111 वे सर्वनाम जिन्हें बोलने वाला कर्त्ता स्वयं अपने लिए प्रयुक्त करता है, कहलाते हैं –

(a) सम्बन्धवाचक सर्वनाम

(b) निश्चयवाचक सर्वनाम

(c) निजवाचक सर्वनाम

(d) प्रश्नवाचक सर्वनाम

Q.112 निम्नलिखित वाक्यों में कौन–सा वाक्य सजातीय क्रिया का उदाहरण है?

(a) भानु पढ़ता है।

(b) रमेश पढ़कर सो गया।

(c) राधा मोहन से पत्र लिखवाती है।

(d) भारत ने लड़ाई लड़ी।

Q.113 इनमें से कौन–सा शब्द–युग्म लिंग–परिवर्तन के अनुसार शुद्ध नहीं है?

(a) कुम्हार–कुम्हारिन

(b) मुंशी–मुंशियाइन

(c) दाता–दात्री

(d) बुद्धिमान–बुद्धिमानी

Q.114 निम्नलिखित में से किस कारक का विभक्ति चिह्न 'के लिए' होता है?

(a) करण कारक   (b) सम्बन्ध कारक

(c) सम्प्रदान कारक   (d) इनमें से कोई नहीं।

Q.115 इनमें से 'लोप चिह्न' क्या है?

(a) =   (b) !

(c) ;   (d) .....

Q.116 इनमें से कौन–सा शब्द–युग्म वचन के अनुसार अशुद्ध है?

(a) शाम–शामें   (b) श्रोता–श्रोतें

(c) वधु–वधुएँ   (d) संस्था–संस्थाएँ

Q.117 ''चार सेर दूध'' किस प्रकार का विशेषण है?

(a) गुणवाचक विशेषण

(b) परिमाणवाचक विशेषण

(c) सार्वनामिक विशेषण

(d) इनमें से कोई नहीं।

Q.118 'अक्ल की रोटी खाना' मुहावरे का अर्थ है–

(a) अत्यधिक खाना

(b) कम खाना

(c) बुद्धिजीवी होना

(d) दिमाग का कम इस्तेमाल करना

Q.119 इनमें से कौन–सा शब्द बहुव्रीहि समास का उदाहरण नहीं है?

(a) जलज   (b) दशानन

(c) चक्रधर   (d) दोपहर

Q.120 'संकल्प' शब्द में निम्नलिखित उपसर्ग हैं–

(a) सम्   (b) संक्

(c) सं   (d) इनमें से कोई नहीं।

Q.121 'प्राचीन' शब्द का विपरीतार्थक शब्द होगा–

(a) अर्वाचीन   (b) नया

(c) आधुनिक   (d) पूर्वाचीन

Q.122 इनमें से कौन–सा शब्द–युग्म समोच्चारित भिन्नार्थक शब्द नहीं है?

(a) अभ्याश–अभ्यास (b) अपभोग–उपभोग

(c) अणु–दणु (d) इसमें से कोई नहीं।

Q.123 निम्नलिखित में से शुद्ध वाक्य कौन–सा है?

(a) तुमने मुस्कुरा दिया।

(b) अपने लड़के नेक बनाओ।

(c) उनकी दृष्टि चित्र पर गड़ी है।

(d) तृषा क्रोध में भरकर बोली।

Q.124 'उजला' शब्द का तत्सम रूप निम्नलिखित है–

(a) उजाला (b) उजूल

(c) आलोक (d) उज्जवल

Q.125 निम्नलिखित में से कौन–सा शब्द 'गोधूम' का तद्भव रूप है?

(a) गाय (b) गिद्ध

(c) गेहूँ (d) गोद

■■■■

Test Centres: Delhi, Hyderabad, Bhopal, Jaipur, Lucknow, Bhubaneswar, Pune, Kolkata, Patna

UPPSC-AE : 2021
ASSISTANT ENGINEER

CIVIL ENGINEERING

Test 1

Full Syllabus Test : Civil Engineering Paper-I + Hindi

ANSWER KEY

1.	(c)	26.	(b)	51.	(a)	76.	(c)	101.	(c)
2.	(c)	27.	(c)	52.	(c)	77.	(c)	102.	(a)
3.	(c)	28.	(c)	53.	(c)	78.	(a)	103.	(d)
4.	(c)	29.	(c)	54.	(c)	79.	(d)	104.	(c)
5.	(d)	30.	(c)	55.	(b)	80.	(c)	105.	(a)
6.	(c)	31.	(c)	56.	(b)	81.	(b)	106.	(d)
7.	(a)	32.	(a)	57.	(d)	82.	(d)	107.	(d)
8.	(b)	33.	(d)	58.	(d)	83.	(d)	108.	(c)
9.	(d)	34.	(c)	59.	(a)	84.	(d)	109.	(b)
10.	(d)	35.	(a)	60.	(c)	85.	(c)	110.	(c)
11.	(d)	36.	(d)	61.	(d)	86.	(d)	111.	(c)
12.	(c)	37.	(c)	62.	(a)	87.	(c)	112.	(d)
13.	(c)	38.	(d)	63.	(b)	88.	(d)	113.	(d)
14.	(c)	39.	(c)	64.	(d)	89.	(c)	114.	(c)
15.	(c)	40.	(b)	65.	(c)	90.	(a)	115.	(d)
16.	(a)	41.	(b)	66.	(b)	91.	(c)	116.	(b)
17.	(b)	42.	(a)	67.	(a)	92.	(c)	117.	(b)
18.	(b)	43.	(d)	68.	(d)	93.	(b)	118.	(c)
19.	(c)	44.	(a)	69.	(d)	94.	(d)	119.	(d)
20.	(c)	45.	(c)	70.	(b)	95.	(b)	120.	(a)
21.	(c)	46.	(b)	71.	(b)	96.	(d)	121.	(a)
22.	(b)	47.	(a)	72.	(a)	97.	(a)	122.	(c)
23.	(a)	48.	(c)	73.	(b)	98.	(c)	123.	(c)
24.	(b)	49.	(c)	74.	(a)	99.	(a)	124.	(d)
25.	(c)	50.	(a)	75.	(c)	100.	(c)	125.	(c)

DETAILED EXPLANATIONS

1.   (c)

$$M_{F_{BC}} = \frac{-2 \times 2^2}{12} = -\frac{2}{3} = -0.67 \text{ kNm}$$

Now, slope deflection equation at B:

$$M_{BC} = M_{F_{BC}} + \frac{2EI}{L}\left(2\theta_B + \theta_C - \frac{3\delta}{L}\right)$$

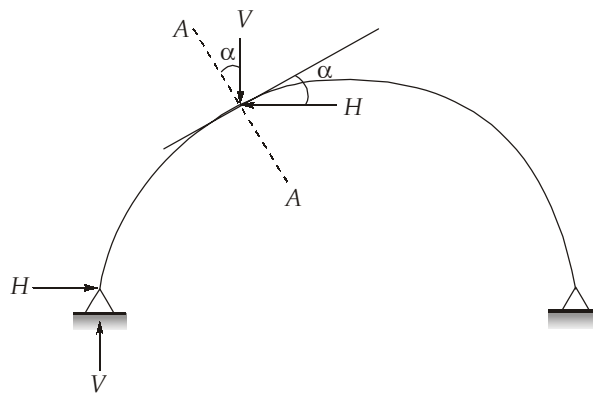$$M_{BC} = -0.67 + \frac{2EI}{2}(2\theta_B + \theta_C - 0)$$

$$M_{BC} = -0.67 + 2EI\theta_B + EI\theta_C$$

2.   (c)

For the member BC, P.O.C = 2 due to fixation of supports at both ends.

For the member BA, P.O.C = 1 due to carry over moment concept.

3.   (c)

Normal thrust at section A-A = $H\cos\alpha + V\sin\alpha$

4.   (c)

This arch will act as a theoretical arch or linear arch in which bending moment and radial shear both are zero along the entire arch.

5.   (d)

- In 1st structure, rigid body rotation of inner triangle.
- In 2nd structure, there is no inclined member to resist shear force in one of the part of given truss.
- In 3rd structure, rigid body translation of whole structure.

6.   (c)

Flexibility matrix is inverse of stiffness matrix.

$$[F] = \frac{1}{[S]}$$

$$[F] = \frac{1}{EI}\begin{bmatrix} 36 & 9 \\ 9 & 4 \end{bmatrix}$$

7.   **(a)**

Distribution factor:

		Stiffness	Total stiffness	D.F.
B	BA	3 EI/6	5EI/4	2/5
	BC	3 EI/4		3/5

FEM's:
$$M_{F_{BA}} = 0, \quad M_{F_{AB}} = 0$$

$$M_{F_{BC}} = \frac{-15 \times 4^2}{12} = -20\,\text{kNm}$$

$$M_{F_{CB}} = +20\ \text{kN-m}$$

Joints:	***A***		***B***	***C***
Members:	AB	BA	BC	CB
D.F.:	1	2/5	3/5	1
FEM's:	0	0	−20	20
Release and Co:	0	0		−20
			−10	
Net FEM's	0	0	− 30	0
Release	0	+12	+18	
Final end moments	0	+12	−12	0

8.   **(b)**

Kani's method is displacement method of analysis.

9.   **(d)**
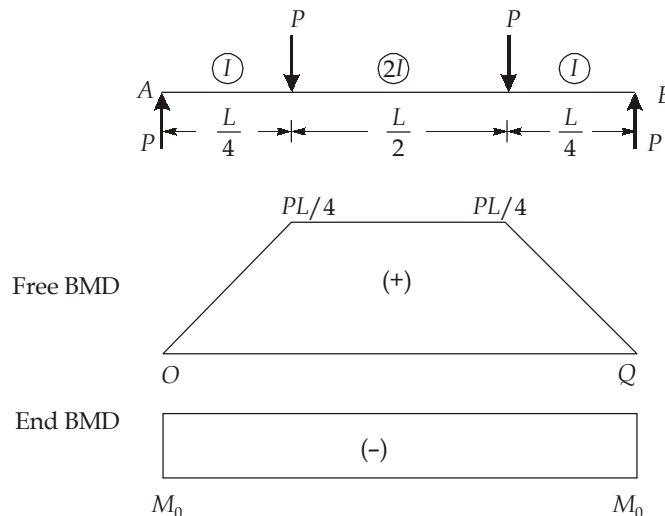
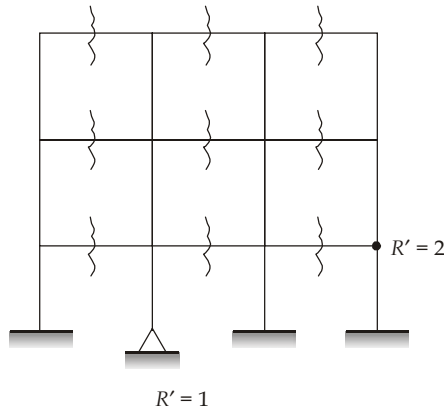$$\frac{\text{Area of BMD}_1\,(+\text{ve area})}{EI} = \frac{\text{Area of BMD}_2\,(-\text{ve area})}{EI}$$

$$\frac{\frac{1}{2}\times2\times\dfrac{L}{4}\times\dfrac{PL}{4}}{EI}+\frac{\dfrac{PL}{4}\times\dfrac{L}{2}}{2EI} = \frac{2\times M_o\dfrac{L}{4}}{EI}+\frac{M_o\dfrac{L}{2}}{2EI}$$

$$\frac{PL^2}{16}+\frac{PL^2}{16} = \frac{M_0L}{2}+\frac{M_0L}{4}$$

$$\frac{PL^2}{8} = \frac{3M_0L}{4}$$

$$M_0 = \frac{PL}{6}$$

10. (d)

$R' = 2$

$R' = 1$

$$D_s = 3C - R'$$
$$= 3(9) - (1 + 2)$$
$$= 27 - 3 = 24$$

16. (a)

In CPM, direct cost increases with decrease in time, whereas indirect cost increases with increase in time.

18. (b)

Straight line method is used for all the assets which do not face obsolensce during its utility period.

21. (c)

Flexural comes under limit state of collapse.

22. (b)

Permissible bearing stress,

As per LSM	$0.45\,f_c$	$= 0.45 \times 25 = 11.25\text{ N/mm}^2$
As per WSM	$0.25\,f_{ck}$	$= 0.25 \times 25 = 6.25\text{ N/mm}^2$

24.   (b)

Punching shear, $\tau_p = \dfrac{P_u - w_v(a+d)(b+d)}{2[(a+d)d+(b+d)d]}$

$\Rightarrow$ $a = b = 600$ mm {for square column}

$\Rightarrow$ $w_u = \dfrac{P_u}{A} = \dfrac{2500}{25} = 100 \text{ kN/m}^2$

$\Rightarrow$ $d = 900$ mm

$\tau_p = \dfrac{2500 - 100(0.6+0.9)^2}{4[(600+900)\times 900]} \times 10^3 \text{ N/mm}^2$

$\tau_p = 0.42 \text{ N/mm}^2$

25.   (c)

As per IS 3370,

Minimum reinforcement when size is less than 15 m.
- 0.24% of surface zone in case of deformed bars.
- 0.4% in case of plane bars.

28.   (c)

We know that for WSM,

$\dfrac{x_c}{d} = \dfrac{m\sigma_{cbc}}{m\sigma_{cbc} + \sigma_{st}}$ ...(i)

Also, $m = \dfrac{280}{3\sigma_{cbc}}$

$\Rightarrow$ $m\sigma_{cbc} = \dfrac{280}{3}$
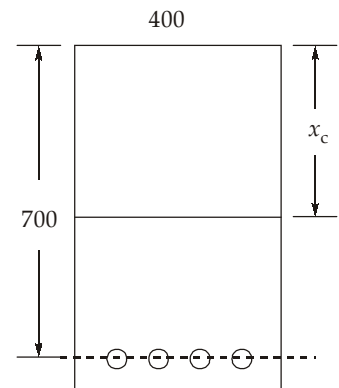
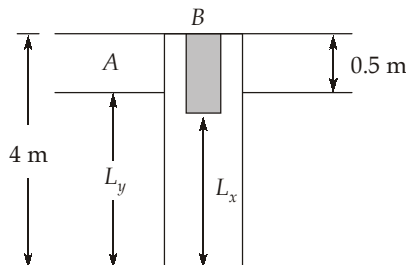Put $m\sigma_{cbc} = \dfrac{280}{3}$ in eq. (i)

$\dfrac{x_c}{d} = \dfrac{\dfrac{280}{3}}{\sigma_{st} + \dfrac{280}{3}}$

$\dfrac{x_c}{d} = 0.289$

$x_c = 0.289 \times 700 = 202.3$ mm

29.   (c)

Bending about an axis is prevented by beam perpendicular to that axis, so,

$$L_x = 4.0 - 0.7 = 3.3 \text{ m}$$

$$e_{min} = \begin{cases} \dfrac{L_x}{500} + \dfrac{\text{lateral dimension}}{30} \\ 20 \end{cases}$$

$$e_{min} = \begin{cases} \dfrac{3300}{500} + \dfrac{600}{30} \\ 20 \end{cases} = \max. \begin{cases} 26.6 \\ 20 \end{cases}$$

$$e_{min} = 26.6 \text{ mm}$$

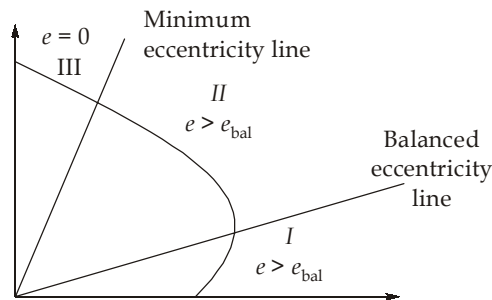**30.   (c)**

Refer IS 1343 : 2012.

32.   (a)

$$b_f = \frac{L_1}{2} + b_w + \frac{L_2}{2}$$

$$b_f = \frac{1.5}{2} + 0.3 + \frac{1.8}{2} = 1.95 \text{ m}$$

$$b_f = 1950 \text{ mm}$$

33.   (d)

Zone I :   Tension controlled region.

Zone II : Compression controlled region.

Zone III : Pure compression region.

35.   (a)

Loss due to shrinkage in post tensioned member is,

$$p_L = \frac{2 \times 10^{-4} \times E_s}{\log(T+2)}$$

$$p_L = \frac{2 \times 10^{-4} \times 2.1 \times 10^5}{\log(8+2)}$$

$$p_L = 42 \text{ N/mm}^2$$

37. **(c)**
- Exogenous trees increases bulk by growing outwards but fibrous mass is seen in longitudinal section of endogenous tree.
- The wood sometimes gets discoloured when it comes into contact with water, known as water stain and this defect is usually found in converted timber.

38. **(d)**
Aluminium paint resist heat and also possess electric resistance.
It is widely used for painting gas tank, hot water pipes, marine piers, oil storage tank, radiator etc.

39. **(c)**
A solution of barium hydroxide $Ba(OH)_2$ act as a preservative, when decay of stone is due to calcium sulphate.

$$Ba(OH)_2 + CaSO_4 \rightarrow BaSO_4 + Ca(OH)_2$$
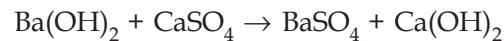
$Ca(OH)_2$ absorbs CO_2 from atmosphere and forms $CaCO_3$ which adds to the strength of stone.

40. **(b)**
The excess lump of lime converted into quick lime during burning and this quick lime slakes and expands in presence of moisture, such action results into splitting of bricks into pieces.

41. **(b)**
Bulking of sand occurs in fine sand which results into affect volumetric proportioning of sand to a large extent but can be eliminated by making sand fully saturated.

43. **(d)**
German silver also known as nickel silver. It is brass to which nickel is added.
i.e. Copper (50 – 80%), zinc (10 – 30%), and nickel (20 – 30%).

44. **(a)**
Urea formaldehyde is thermosetting resin.

45. **(c)**
High alumina cement contains 32% of bauxite or alumina content, which makes it highly resistive against temperature.

46. **(b)**

$$\% \text{ flow} = \frac{\text{Average spread in diameter (cm)-25}}{25} \times 100$$

$$= \frac{60-25}{25} \times 100 = 140\%$$

47. **(a)**
High roughness and small size of aggregate signifies the more surface area to get lubricated by cement paste which results in decrement in workability.

49. **(c)**
- Moulding provided under nosing to improve elevation of step is known as Scotia.
- Newel post is vertical member placed at ends of flight to connect ends of string and hand rail.

50. **(a)**
3 – Purlin
4 – Collar beam

51. **(a)**

$$D = \text{Door}$$
$$T = \text{Double shutter}$$
$$S = \text{Single shutter}$$

10 DT 21 means door opening denotes width of opening equal to 10 modules i.e. 10 × 100 = 1000 mm and height of opening equal to 21 modules i.e. 21 × 100 = 2100 mm.

52. **(c)**

$$R = \sqrt{P^2 + Q^2 + 2PQ\cos\theta}$$

$$R = \sqrt{P^2 + P^2 + 2(P)(P)\cos\theta}$$

$$R = \sqrt{2P^2 + 2P^2\cos\theta}$$

$$R = \sqrt{2P^2\left(\sin^2\frac{\theta}{2} + \cos^2\frac{\theta}{2} + \cos^2\frac{\theta}{2} - \sin^2\frac{\theta}{2}\right)}$$

$$R = 2P\cos\frac{\theta}{2}$$

53. **(c)**

$$\text{MOI about parallel to depth} = \frac{db^3}{12}$$

$$\text{MOI about parallel to width} = \frac{bd^3}{12}$$

54. **(c)**

$$m = 100 \text{ kg}$$

$$a = \frac{v}{t} = \frac{2}{2} = 1\,\text{m/s}^2$$
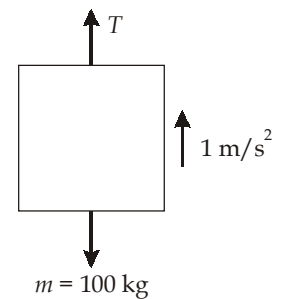
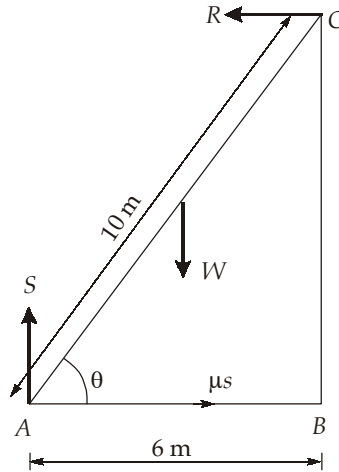$$F_{\text{net}} = T - W$$

Where,
$$T = ma + mg$$
$$T = m(1 + 10)$$
$$T = 100 \times (1 + 10)$$
$$T = 1100 \text{ N}$$

55.   (b)

From ΔABC

$$BC^2 = AC^2 - AB^2 = 10^2 - 6^2$$

i.e.,

$$BC = 8 \text{ m}$$

$$\Sigma V = 0 \qquad \therefore S = W$$

$$\Sigma M_C = 0$$

Taking moment about C,

$$(R \times 0) + (S \times 6) = W \times \frac{6}{2} + \mu S(8)$$

$$6S = 3W + 8\mu S$$

$$6S - 3S = 8\,\mu S$$

$$\mu = \frac{3}{8} = 0.375$$

56.   (b)

Linear kinematic energy, $LKE = \dfrac{1}{2}mV^2$

$$= \frac{1}{2}m(R\omega)^2$$

$$= \frac{1}{2}m\omega^2 R^2$$

Rotational kinematic energy, $RKE = \dfrac{1}{2}I\omega^2 = \dfrac{1}{2}m\left(\dfrac{R}{\sqrt{2}}\right)^2 \omega^2$
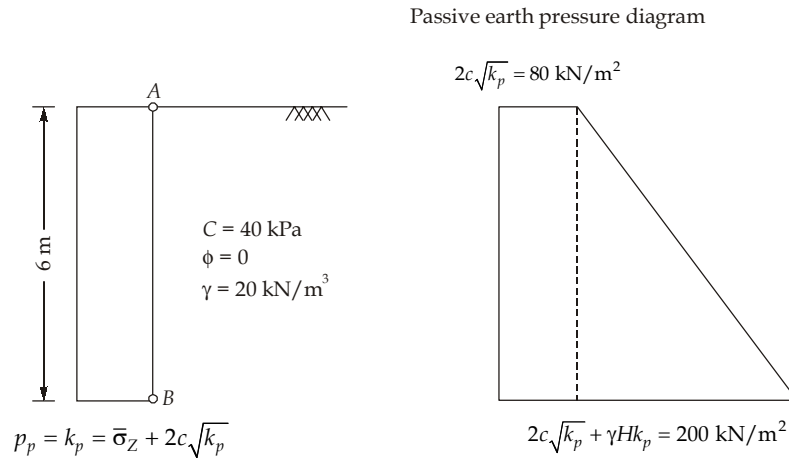
$$= \frac{1}{4}m\omega^2 R^2$$

$$RKE = \frac{1}{2}(LKE)$$

57. **(d)**

$$
\begin{aligned}
(I_p)_{\text{Soil}} &= w_L - w_p \\
18 &= w_L - 22 \\
w_L &= 40 \\
(I_p)_{\text{A line}} &= 0.73(w_L - 20) = 0.73(40 - 20) = 14.6 \\
\therefore \qquad (I_p)_{\text{soil}} &> (I_p)_{\text{A line}} \\
\text{and} \qquad (W_L)_{\text{soil}} &= 40\% > 35\% \\
&< 50\%
\end{aligned}
$$

∴ Soil can be classified as CI.

58. **(d)**

Passive earth pressure diagram

$2c\sqrt{k_p} = 80 \text{ kN/m}^2$

A

$C = 40 \text{ kPa}$
$\phi = 0$
$\gamma = 20 \text{ kN/m}^3$

6 m

B

$p_p = k_p = \overline{\sigma}_Z + 2c\sqrt{k_p}$
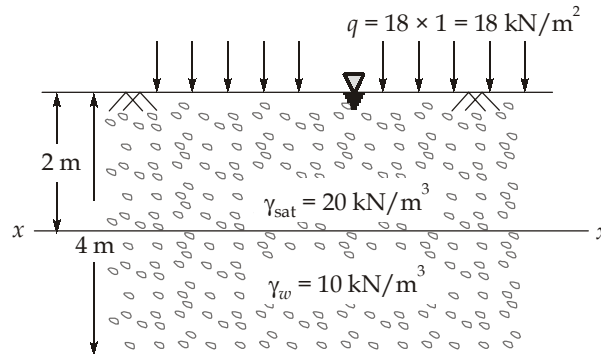
$2c\sqrt{k_p} + \gamma H k_p = 200 \text{ kN/m}^2$

$$
\begin{aligned}
k_p &= 1 \ (\text{for cohesive soil}) \\
(P_p)_A &= 2c\sqrt{k_p} = 2 \times 40 \times \sqrt{1} = 80 \text{ kPa} \\
(P_p)_B &= 2c\sqrt{k_p} + \gamma H k_p = 80 + 20(6)(1) = 200 \text{ kPa}
\end{aligned}
$$

Passive earth thrust on wall = Area under passive earth pressure diagram

$$
= \frac{1}{2}(80 + 200)(6) = 840 \text{ kN/m}
$$

59. **(a)**

$$
\sigma_z = \frac{3}{2\pi}\left[\frac{1}{1+\left(\dfrac{r}{z}\right)^2}\right]^{5/2} \times \frac{Q}{z^2}
$$

$$
r = 0 \text{ m}, z = 3 \text{ m}
$$

$$
\sigma_z = \frac{3}{2\pi}\left[\frac{1}{1+0}\right]^{5/2} \times \frac{600\pi}{(3)^2} = \frac{3}{2\pi} \times \frac{600\pi}{(3)^2}
$$

$$
\sigma_z = \frac{3}{2\pi} \times \frac{600\pi}{9} = 100 \text{ kN/m}^2
$$

60.   (c)

If surcharge applied suddenly

$$\sigma_{x\text{-}x} = \gamma_{sat}(2) + q$$
$$u = \gamma_w(2) + q$$
$$\sigma'_{x\text{-}x} = \gamma'(2)$$
$$= 10(2) = 20 \text{ kN/m}^2$$

If surcharge applied gradually

$$\sigma_{x\text{-}x} = \gamma_{sat}(2) + q$$
$$u = \gamma_w(2)$$
$$\sigma'_{x\text{-}x} = \gamma'(2) + q$$
$$= 10(2) + 18 = 38 \text{ kN/m}^2$$

Effective stress increased by 18 kN/m² if surcharge applied gradually.

61.   (d)

- Kaolinite clay mineral possess least swelling as building blocks of kaolinite bonded together by strong hydrogen bond.
- In octahedral unit, six hydroxyl atoms encloses Al, Mg or Fe at center.

62.   (a)

Clay of this structure having bigger size of void but disperse structure has volume of voids.

63.   (b)

$$e = \frac{V_v}{V_s}$$

$$e = \frac{V_v}{2V_v} = 0.5$$

$$I_D = \frac{e_{max} - e}{e_{max} - e_{min}} \qquad \begin{cases} \text{For uniformly graded soil} \\ \quad e_{max} = 0.91 \\ \quad e_{min} = 0.35 \end{cases}$$

∴
$$I_D = \frac{0.91 - 0.5}{0.91 - 0.35} = 0.7321 \text{ i.e. } 73.21\%$$

64. **(d)**

Percentage finer than 75μ = 18%

Out of this 18% fine grained soil, 40% is silt, so actual clay fraction in given soil sample is

= 18 × (0.6) = 10.8

$$A_t = \frac{Ip}{C} = \frac{36}{10.8} = 3.3$$

67. **(a)**

- Entrapped air, presence of foreign material, viscosity of fluid, entrapped gases inversely proportional to permeability of soil.
- Fine grained soil i.e. higher specific surface area of soil, possess lower permeability.

68. **(d)**

- Fine grained soil possess higher compressibility and higher plasticity results into higher amount of OMC and less amount of maximum dry density.
- Increment in compactive effort decreases the OMC and increases maximum dry density.

69. **(d)**

$$m_v = \frac{a_v}{1 + e_0}$$

$$m_v = \frac{\left(\dfrac{\Delta e}{\Delta \sigma}\right)}{1 + e_0}$$

$$m_v = \frac{\left(\dfrac{0.8 - 0.6}{500 - 300}\right)}{1 + 0.8}$$

$$m_v = \frac{5}{9} \times 10^{-3} \, \text{m}^2/\text{kN}$$

$$C_v = \frac{K}{m_v \gamma_w}$$

$$C_v = \frac{5 \times 10^{-6}}{\dfrac{5}{9} \times 10^{-3} \times 10}$$

$$C_v = 0.9 \times 10^{-3}$$
$$C_v = 9 \times 10^{-4} \, \text{m}^2/\text{s}$$

70. **(b)**

UCS test $\phi = 0, \sigma_3 = 0$

∴ $\sigma_1 = 2c$

     $200 = 2c$

∴ $c = 100 \, \text{kPa}$

UU test ($\phi = 0$)

$$\sigma_1 = \sigma_3 + 2c$$
$$\sigma_1 = 100 + 2(100)$$
$$\sigma_1 = 300 \text{ kPa}$$

$\therefore$ $\qquad \sigma_d = \sigma_1 - \sigma_3 = 300 - 100 = 200 \text{ kPa}$

71. **(b)**

$$S_n = \frac{C}{\gamma H_c}$$

$$0.1 = \frac{50}{20 \times H_c}$$

$$H_c = \frac{50}{20 \times 0.1}$$

$$H_c = 25 \text{ m}$$

Now, $\qquad$ FOS $= \dfrac{H_c}{H} = \dfrac{25}{10} = 2.5$

72. **(a)**

$$Q_{nu} = (1.3 \times 5.7 \times N_c) \, A_f$$
$$= 1.3 \times 5.7 \times 50 \times (2)^2$$
$$= 1482 \text{ kN}$$

73. **(b)**

$$Q_{up} = \alpha \bar{c} \pi D L$$

$$= \alpha \frac{\sigma_1}{2} \times \pi \times D \times L$$

$$= 0.8 \times \frac{100}{2} \times \pi \times 0.4 \times 12 = 192\pi \text{ kN}$$
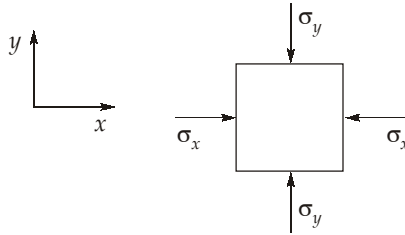
74. **(a)**

Superposition is not valid for
1. Deep beam.
2. Strain energies.
3. Non-circular members subjected to torsion.

76. **(c)**

Bulk modulus, $\qquad K = \dfrac{\sigma_v}{\in_v} = \dfrac{2 \times 10^6 \text{ N/m}^2}{\dfrac{0.05}{100}}$

$$= 4 \times 10^9 \text{ N/m}^2$$
$$= 4 \times 10^3 \text{ N/mm}^2$$
$$= 4000 \text{ MPa}$$
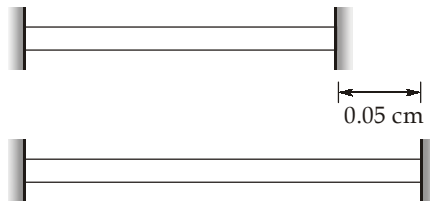
78. **(a)**

For body subjected to stress in 2-D.

$$\epsilon_y = 0 = -\frac{\sigma_y}{E} - \frac{\mu}{E}(-\sigma_x)$$

$$\frac{\sigma_y}{E} = \frac{\mu}{E}\sigma_x$$

$$\sigma_y = \mu\sigma_x$$

79. **(d)**

0.05 cm

Compatibility condition,

$$l\alpha\Delta T - 0.05 = \frac{\sigma \times l}{E}$$

$$l = 30 \text{ cm, } \Delta T = 80°C,$$

$$\alpha = 20 \times 10^{-6}/°C$$

$$E_c = 10^6 \text{ kg/cm}^2$$

$$30 \times 20 \times 10^{-6} \times 80 - 0.05 = \frac{\sigma \times 30}{10^6}$$

$$\frac{\sigma \times 30}{10^6} = -2 \times 10^{-3}$$

There is not enough change in length to induce stress in the bar.

i.e. $\qquad l\alpha\Delta T < 0.05 \text{ cm}$

$\Rightarrow \qquad$ Stress induced $= 0$

80. **(c)**

Radius of Mohr's circle, $\qquad R = \tau_{max}$
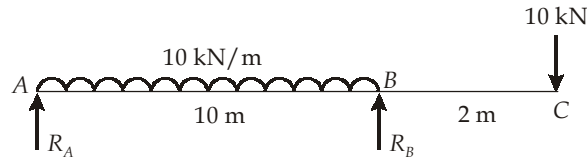
$$= \frac{\sigma_1 - \sigma_2}{2} = \frac{40 - (-30)}{2}$$

$$R = \frac{70}{2}\text{MPa}$$

Diameter $= 2 \times R$

$$= 70 \text{ MPa}$$

81.   (b)

$$\Sigma F_y = 0$$

$\Rightarrow$ $R_A + R_B = 110$ ...(i)

$$\Sigma M_B \text{ (CW)} = 0$$ ...(ii)

$$R_A \times 10 - 10 \times 10 \times 5 + 10 \times 2 = 0$$

$\Rightarrow$ $R_A = 48 \text{ kN}$

$$R_B = 110 - 48 = 62 \text{ kN from eq. (i)}$$

POC is the point BM changes sign i.e., where BM is zero.

Let in the span AB, at a distance x from A where

$$BM_{xx} = 48x - 10 \times x \times \frac{x}{2} = 0$$

$\Rightarrow$ $48x = 5x^2$

$$5x^2 - 48x = 0$$

$$x(5x - 48) = 0$$

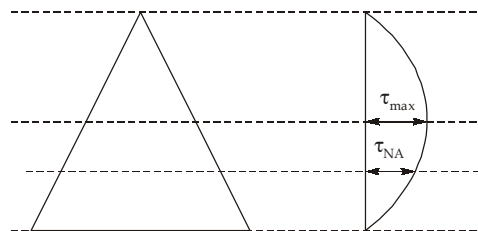$$x = 0, x = \frac{48}{5} = 9.6 \text{ m}$$

$$\text{POC from } C = 12 - 9.6 = 2.4 \text{ m}$$

82.   (d)
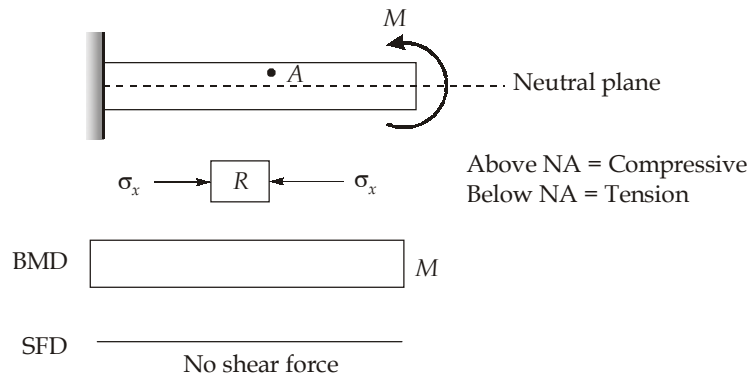
Since there is no shear force in the beam $\sigma_x = \sigma_1$ is principal stress and it is along neutral plane.

83.   (d)

$$\tau_{max} = \frac{3}{2}\tau_{avg}$$

$$\tau_{NA} = \frac{4}{3}\tau_{avg}$$

$$\frac{\tau_{avg}}{\tau_{NA}} = \frac{3}{4}$$

84. (d)

$$\gamma = 0.0005$$

$$\frac{T}{J} = \frac{G\theta}{l} = \frac{\tau}{R}$$

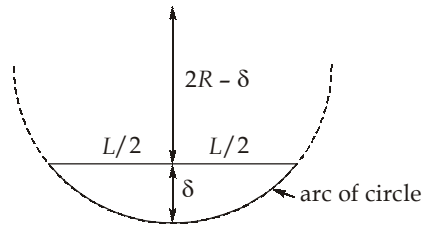$$\frac{\theta R}{l} = \frac{\tau}{G} = 0.0005$$

$$\frac{\theta R}{l} = 0.0005$$

$$R = \frac{0.0005 \times 500}{0.05}$$

$$R = 5\,mm$$

$$\text{Diameter} = 2R = 2 \times 5 = 10\,mm$$

85. (c)

In a circle

$$(2R - \delta)\delta = \frac{L}{2} \times \frac{L}{2}$$

$$2R \gg \delta$$

BMD for the beam

$$(2R)\delta = \frac{L^2}{4}$$

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

We know that

$$\frac{\sigma}{y} = \frac{E}{R} = \frac{M_o}{I}$$

$$\frac{1}{R} = \frac{M_o}{EI}$$

$$\delta = \frac{L^2}{8} \times \frac{M_o}{EI} = \frac{M_o L^2}{8EI}$$

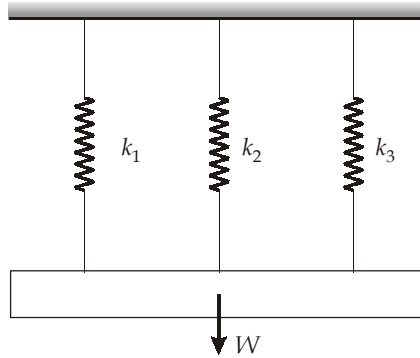**86.** **(d)**

To avoid any tensile stresses in the column.

$$e \leq \frac{D}{8}$$

$$e \leq \frac{(2r)}{8}$$

$$e \leq \frac{r}{4}$$

87. **(c)**

$$\frac{1}{k_1} = \frac{1}{10} + \frac{1}{10} = \frac{2}{10}$$

$\Rightarrow$ $k_1 = 5 \text{ kN/m}$

Similarly $\dfrac{1}{k_3} = \dfrac{1}{10} + \dfrac{1}{10} = \dfrac{2}{10}$

$\Rightarrow$ $k_3 = 5 \text{ kN/m}$

Now, k_1, k_2, k_3 are parallel,

$$k_{eq} = k_1 + k_2 + k_3$$
$$= 5 + 20 + 5 = 30 \text{ kN/m}$$

89. **(c)**

As per IS 800 : 2007, $\rho_{steel} = 7850 \text{ kg/m}^3$

$\mu = 0.3$

90. **(a)**

Nominal shear strength $= \dfrac{f_{ub}}{\sqrt{3}}$ ($f_{ub} = 400$ MPa, for 4.6 grade bolt)

$$= \frac{400}{\sqrt{3}} = 230.94 \text{ MPa} \simeq 230 \text{ MPa}$$

93.   (b)

Due to stress reversal occurring because of wind or seismic load,

Slenderness ratio ≤ 350

$$\frac{le}{r_{min}} \leq 350$$

For a flat plate, $r_{min} = \sqrt{\dfrac{I}{A}} = \sqrt{\dfrac{\frac{bt^3}{12}}{bt}} = \dfrac{t}{\sqrt{12}}$

$$l_e = 350 \times \frac{t}{\sqrt{12}}$$

$$\leq 350 \times \frac{18}{\sqrt{12}}$$

$$l_e \leq 1.818 \text{ m} \simeq 1.8 \text{ m}$$

97.   (a)

Bearing strength of concrete = $0.45 f_{ck}$

= 0.45×25

= 11.25 MPa

99.   (a)

Slope of truss = $2 \times$ pitch of truss

$$\tan\theta = 2 \times \frac{\sqrt{3}}{2} = \sqrt{3}$$

$$\theta = 60°$$

101. (c)

इया प्रत्यय– खटिया, डिबिया, बिटिया, इत्यादि।

102. (a)

चपला– बिजली, लक्ष्मी, चंचल स्त्री।

103. (d)

'पोखर' शब्द की उत्पत्ति 'पुष्कर' शब्द से हुई है।

104. (c)

फणीश्वर नाथ रेणु 'मैला आँचल' उपन्यास के रचयिता थे।

105. (a)

अशुद्ध शब्द		शुद्ध शब्द
पुज्य	:	पूज्य
अद्वितिय	:	अद्वितीय
तत्व	:	तत्त्व

107. (d)

अंश – भाग;   अंस – कन्धा

अन्य – दूसरा;   अन्न – अनाज

चरम – अंतिम;   चर्म – खाल

111. (c)

वे सर्वनाम जिन्हें बोलने वाला कर्त्ता स्वयं अपने लिए प्रयुक्त करता है, उन्हें निजवाचक सर्वनाम कहते हैं।

आप, अपना, स्वयं, खुद, आदि निजवाचक सर्वनाम हैं।

112. (d)

वे क्रियाएँ जहाँ कर्म तथा क्रिया दोनों एक ही धातु से बनकर साथ प्रयुक्त होती है, सजातीय क्रियाएँ कहलाती हैं। जैसे–
भारत ने लड़ाई लड़ी।

113. (d)

'बुद्धिमान–बुद्धिमती' शुद्ध शब्द–युग्म है।

114. (c)

वाक्य में कर्त्ता जिसे कुछ देता है अथवा जिसके लिए क्रिया करता है, उसे सम्प्रदान कारक कहते हैं। सम्प्रदान कारक का
विभक्ति चिहन 'के लिए' है किन्तु जब क्रिया द्विकर्मी हो तथा देने के अर्थ में प्रयुक्त हो वहाँ 'को' विभक्ति भी प्रयुक्त होती है।
जैसे– अनामिका ने प्रियंका को पुस्तक दी।

115. (d)

तुल्यता सूचक / समता सूचक → =

विस्मय सूचक → !

अर्द्ध विराम → ;

लोप चिहन → .....

116. (b)

एकवचन शब्दों के आगे लोग, जन, वर्ग, गण, वृन्द आदि शब्द लगाकर बहुवचन बनाते हैं,

जैसे– दलित–दलितवर्ग, भक्त–भक्तजन, श्रोता–श्रोतागण, तुम–तुमलोग, बाल–बालवृन्द, इत्यादि।

117. (b)

जो शब्द किसी वस्तु के परिमाण का बोध कराता है उसे परिमाणवाचक विशेषण कहते हैं। जैसे– चार सेर दूध, पाँच किलो
आटा, इत्यादि।

118. (c)

अक्ल की रोटी खाना (बुद्धिजीवी होना)–उदाहरणः वकील और पत्रकार दोनों अक्ल की रोटी खाते हैं।

119. (d)

बहुब्रीहि समास में कोई भी शब्द प्रधान नहीं होता। इसमें दोनों शब्द मिलाकर एक नया अर्थ प्रकट करते हैं।

जैसे – दशानन (दश हैं आनन जिसके)

      – चक्रधर (चक्र को धारण करता है जो)

      – जलज (जल में उत्पन्न होता है जो), इत्यादि।

122. (c)

अंस– कन्धा	:	अंश– भाग
अपभोग– बुरा व्यवहार	:	उपभोग– आस्वादन
अभ्याश– निकट	:	अभ्यास– बारम्बार प्रयत्न

123. (c)

शुद्ध वाक्य

* तुम मुस्कुरा दिये।
* अपने लड़कों को नेक बनाओ।
* तृषा क्रोध से भरकर बोली।

124. (d)

'उज्जवल' शब्द 'उजला' का तत्सम रूप है।

125. (c)

'गेहूँ' शब्द 'गोधूम' का तद्भव रूप है।

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