

MIZORAM PUBLIC SERVICE COMMISSION
COMPETITIVE EXAMINATIONS FOR JUNIOR GRADE OF M.E.S.
UNDER PUBLIC WORKS DEPARTMENT, AUGUST, 2018.

CIVIL ENGINEERING
PAPER - I

Time Allowed : 3 hours

FM : 200

SECTION - A (Multiple Choice questions)

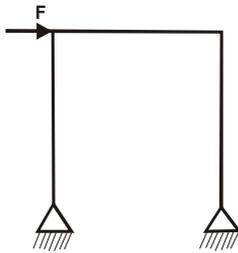
(100 Marks)

All questions carry equal mark of 2 each. Attempt all questions.

*This Section should be answered only on the **OMR Response Sheet** provided.*

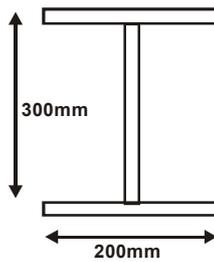
1. A three-hinged symmetrical parabolic arch of span 20 m and rise 5 m carries a uniformly distributed load of 2kN/m for the whole span. The bending moment at quarter point is
 - (a) 25 kNm (Hogging)
 - (b) 25 kNm (Sagging)
 - (c) 75 kNm (Sagging)
 - (d) Zero
2. The maximum strain at the level of compression steel for a rectangular section effective cover to compression steel as 'd' and neutral axis depth from compression face as x_u is
 - (a) $0.0035 (1 - x_u / d)$
 - (b) $0.0035 (1 - d' / x_u)$
 - (c) $0.002 (1 - x_u / d')$
 - (d) $0.002 (1 - d' / x_u)$
3. When checking the shear resistance of reinforced concrete beams for limit state of collapse as per IS-456, which nominal shear stress recommendation will be adhered. (Here, V_u is the shear force at vertical cross section, 'b' is breadth and 'd' is the effective depth of the beam)
 - (a) $\frac{V_u}{bd}$
 - (b) $\frac{0.5V_u}{bd}$
 - (c) $\frac{2V_u}{bd}$
 - (d) $\frac{V_u}{0.5bd}$
4. A thin walled cylindrical pressure vessel having a radius of 0.5m and wall thickness of 25 mm is subjected to an internal pressure of 700 kPa. The hoop stress thus developed is
 - (a) 0.014 MPa
 - (b) 0.14 MPa
 - (c) 1.4 MPa
 - (d) 14 MPa
5. In the theory of plastic bending of beams, the ratio of plastic moment to yield moment is called
 - (a) shape factor
 - (b) plastic section modulus
 - (c) modulus of resilience
 - (d) modulus of rigidity
6. The property by which an amount of energy is absorbed by a material without plastic deformation is called
 - (a) toughness
 - (b) ductility
 - (c) impact strength
 - (d) resilience
7. A steel bar of 2m length is fixed at both ends at 20°C. The coefficients of thermal expansion is $11 \times 10^{-6} \%$ and modulus of elasticity is $2 \times 10^5 \text{ kg/cm}^2$. If the temperature is changed to 18°C, then the bar will experience a stress of
 - (a) 22 kg/cm^2 (compressive)
 - (b) 22 kg/cm^2 (tensile)
 - (c) 44 kg/cm^2 (compressive)
 - (d) 44 kg/cm^2 (tensile)

8. If 'Euler' load for a column is 100 kN with crushing load of 1500 kN. The 'Rankine' load will be
(a) 600 kN (b) 800 kN
(c) 1200 kN (d) 1500 kN
9. A circular plate of 100mm diameter is welded to another plate by means of 6 mm fillet weld. If the permissible shearing stress in the weld equals 10 kg/mm^2 , then the greatest twisting moment that can be resisted by the weld will be
(a) 60 p kg-m (b) 120 p kg-m
(c) 212 p kg-m (d) 424 p kg-m
10. The number of simultaneous equations to be solved in the slope deflection method, is equal to :
(a) the degree of statical indeterminacy (b) the degree of kinematic indeterminacy
(c) the number of joints in the structure (d) none of the above
11. Maximum size of a fillet weld for a plate of square edge is
(a) 1.5 mm less than the thickness of the plate (b) one half of the thickness of the plate
(c) thickness of the plate itself (d) 1.5 mm more than the thickness of the plate
12. Consider beam as axially rigid, the degree of freedom of a plane frame shown below

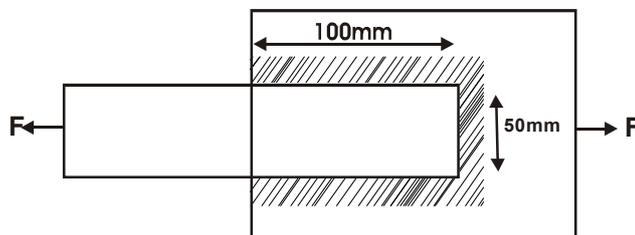


- (a) 6 (b) 7
(c) 8 (d) 9
13. For a linear elastic frame, if stiffness matrix is doubled, the existing stiffness matrix, the deflection of the resulting frame will be
(a) indeterminate value (b) the same as existing value
(c) half the existing value (d) twice the existing value
14. Match the following:
- | Group 1 | Group 2 |
|--------------------------------|---------------------|
| P Slope deflection method | 1 Force method |
| Q Moment deflection method | 2 Deflection method |
| R Method of three moments | |
| S Castigliano's second theorem | |
- (a) P-1, Q-2, R-1, S-2 (b) P-1, Q-1, R-2, S2
(c) P-2, Q-2, R-1, S-1 (d) P-2, Q-1, R-2, S-1
15. For a 25cm thick cement concrete pavement, analysis of stresses gives the following values
Wheel load stress due to corner loading 30 kg/cm^2
Wheel load stress due to edge loading 32 kg/cm^2
Warping stress at corner region during summer 9 kg/cm^2
Warping stress at corner region during winter 7 kg/cm^2
Warping stress at edge region during summer 8 kg/cm^2
Warping stress at edge region during winter 6 kg/cm^2
Frictional Stress during summer 5 kg/cm^2
Frictional Stress during winter 4 kg/cm^2
The most critical stress value for this pavement is
(a) 40 kg/cm^2 (b) 42 kg/cm^2
(c) 44 kg/cm^2 (d) 45 kg/cm^2

16. Which of the following is NOT correct for steel sections as per IS: 800-1984?
- (a) The maximum bending stress in tension or in compression in extreme fibre calculated on the effective section of a beam shall not exceed $0.66f_y$.
 - (b) The bearing stress in any part of a beam when calculated on the net area shall not exceed $0.75f_y$.
 - (c) The direct stress in compression on the gross sectional area of axial loaded compression member shall not exceed $0.6f_y$.
 - (d) None of these
17. An unstiffened web I section is fabricated from a 10mm thick plate by fillet welding as shown in the figure. If yield stress of steel is 250MPa, the maximum shear load that section can take is

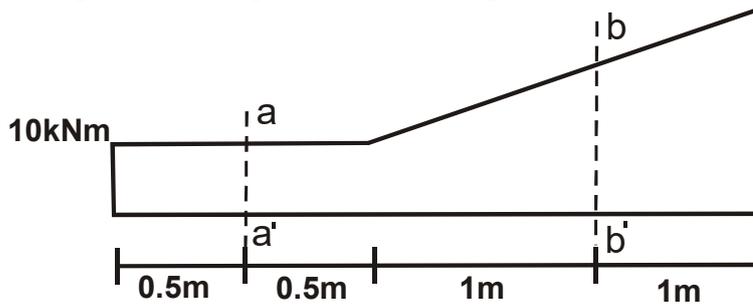


- (a) 300kN
 - (b) 337.5kN
 - (c) 350kN
 - (d) 750kN
18. A fillet-welded joint of 6mm size is shown in the figure. The welded surfaces meet at 60-90 degree and permissible stress in the fillet weld is 108MPa. The safe load that can be transmitted by the joint is



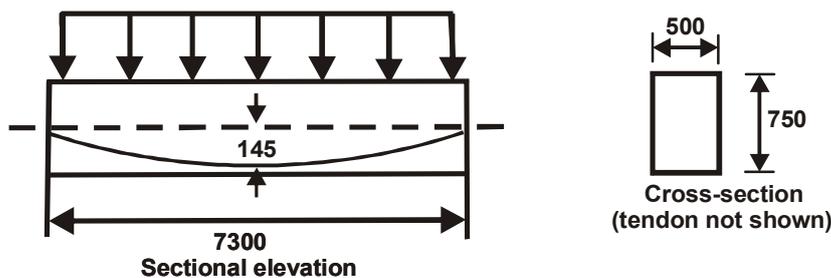
- (a) 109.5kN
 - (b) 113.4kN
 - (c) 151.6kN
 - (d) 162.7kN
19. The flexural strength of M 30 concrete as per IS: 456-2000 is
- (a) 3.83MPa
 - (b) 5.47MPa
 - (c) 21.23MPa
 - (d) 30.0MPa
20. If the principle stresses in a two-dimensional case are -10MPa and 20MPa respectively, then maximum shear stress at the point is
- (a) 10MPa
 - (b) 15MPa
 - (c) 20MPa
 - (d) 30MPa
21. A rectangular column section of 250mm x 400mm is reinforced with five steel bars of grade Fe 500, each of 20mm diameters. Concrete mix is M30. Axial load on the column section with minimum eccentricity as per IS: 456-2000 using limit state method can be applied upto
- (a) 1707.37 kN
 - (b) 1805.30 kN
 - (c) 1806.40 kN
 - (d) 1903.70 kN

22. The bending Moment diagram for a beam is given below:



The shear force at sections aa' and bb' respectively are of the magnitude

- (a) 100kN, 150kN (b) zero, 100kN
 (c) zero, 50kN (d) 100kN, 100kN
23. If a small concrete cube is submerged deep in still water in such a way that the pressure exerted on all faces of the cube is p , then the maximum shear stress developed inside the cube is
 (a) 0 (b) $p/2$
 (c) p (d) $2p$
24. As per IS 456:2000, for Limit State Design of a flexural member, the strain in reinforcing bars under tension at ultimate state should not be less than
 (a) $\frac{f_y}{E_x}$ (b) $\frac{f_y}{1.15E_x}$
 (c) $\frac{f_y}{E_x} + 0.002$ (d) $\frac{f_y}{1.15E_x} + 0.002$
25. In a steel plate with bolted connections, the rupture of the net section is a mode of failure under
 (a) Compression (b) Flexure
 (c) Shear (d) Tension
26. A simply supported beam is subjected to a uniformly distributed load of intensity w per unit length on half of the span from one end. The length of the span and the flexural stiffness are denoted as l and EI respectively. The deflection at mid-span of the beam is
 (a) $\frac{5}{6144} \frac{wl^4}{EI}$ (b) $\frac{5}{768} \frac{wl^4}{EI}$
 (c) $\frac{5}{384} \frac{wl^4}{EI}$ (d) $\frac{5}{192} \frac{wl^4}{EI}$
27. A concrete beam prestressed with a parabolic tendon is shown in the sketch. The eccentricity of the tendon is measured from the centroid of the cross-section. The applied prestressing force at service is 1620kN. The uniformly distributed load of 45kN/m includes the self-weight



All dimensions are in mm

The stress in the bottom fibre at mid-span is

- (a) 2.90 N/mm² (tension) (b) 2.90 N/mm² (compressive)
 (c) 4.32 N/mm² (tension) (d) 4.32 N/mm² (compressive)

28. Battens provided for a compressive member shall be designed to carry a transverse shear equal to
- (a) 2.5 % of axial force in member (b) 5.0% of axial force in member
(c) 10% of axial force in member (d) 30% of axial force in member
29. A symmetric frame ABC consists of two inclined members AB and BC, connected at B with rigid joint and hinged at A and C. The horizontal length AC is l . If a weight W is suspended at B, then the bending moment at B is
- (a) 0 (b) $\frac{Wl}{2}$
(c) $\frac{Wl}{4}$ (d) $\frac{Wl}{8}$
30. Codal provision for 33 grade Ordinary Portland Cement is
- (a) IS 269:1989 (b) IS 8112:1989
(c) IS 12269: 1987 (d) None of these
31. IS 12600:1989 is for
- (a) High alumina cement (b) Low heat cement
(c) Portland slag cement (d) Oil-well cement
32. Which of the following is admixtures at the time of mixing of concrete
- (a) Aggregates (b) Water
(c) Fibres (d) Gypsum
33. Ratio of mix design for M20 is
- (a) 1:2:4 (b) 1:1.5:3
(c) 1:1:2 (d) 1:2:3
34. Consider the following sentences
A grillage base is checked for
- (i) Bending (ii) Compression
(iii) Shear (iv) Web crippling
- Which of these sentences are correct?
- (a) All of these (b) i and iv
(c) i, iii and iv (d) i, ii and iv
35. The most efficient and economical section used as a beam is
- (a) I-section (b) L-section
(c) H-section (d) Circular section
36. Constituents of masonry construction includes
- (i) Masonry unit (bricks, concrete blocks, stone, etc.)
(ii) Mortar
(iii) Grout
(iv) Reinforcement (wood or steel bars, iron rods, etc.)
- Which of these are true.
- (a) All of them (b) None of these
(c) i, ii, and iii (d) i and ii
37. A reinforced concrete (RC) beam with width of 250 mm and effective depth of 400 mm is reinforced with Fe415 steel. As per the provisions of IS 456-2000, the minimum and maximum amount of tensile reinforcement (expressed in mm^2) for the section are, respectively
- (a) 205 and 4000 (b) 250 and 3500
(c) 270 and 2000 (d) 300 and 2500

38. Workability of concrete is carried out as per
(a) IS 1199(1959) (b) IS
39. Cement clinker consists of
I. C3S II. C3A
III. C2S IV. C4AF
(a) All of these (b) None of these
(c) I,II,III (d) I,II,IV
40. The effective length of a compression member of length L held in position and restrained in direction at one end and effectively restrained in direction but not held in position at the other end, is
(a) 1.0 L (b) 0.67 L
(c) 0.85 L (d) 2.0 L
41. The ratio of shearing stress to shearing strain within elastic limit, is known as
(a) modulus of elasticity (b) shear modulus of elasticity
(c) bulk modulus of elasticity (d) tangent modulus of elasticity
42. Column footing is provided
(a) to spread the column load over a larger area
(b) to ensure that intensity of bearing pressure between the column footing and soil does not exceed permissible bearing capacity of the soil
(c) to distribute the column load over soil through the column footing
(d) all of these
43. Net sectional area of a tension member, is equal to its gross section area
(a) plus the area of the rivet holes (b) divided by the area of rivet holes
(c) multiplied by the area of the rivet holes (d) minus the area of the rivet holes
44. If D is the overall thickness of the slab, the diameter of the reinforcing bars should not exceed
(a) $\frac{1}{2} D$ (b) $\frac{1}{4} D$
(c) $\frac{1}{6} D$ (d) $\frac{1}{8} D$
45. The grade of plain concrete to be used in sea water or structures exposed to sea water, should be
(a) M 10 (b) M 15
(c) M 20 (d) M 30
46. In compression members, the lap length of a bar should not be less than
(a) 12 j (b) 16 j
(c) 20 j (d) 24 j
47. The shape factor of standard rolled beam section varies from
(a) 1.10 to 1.20 (b) 1.20 to 1.30
(c) 1.30 to 1.40 (d) 1.40 to 1.50
48. For determining the support reactions at A and B of a three hinged arch, points B and C are joined and produced to intersect the load line at D and a line parallel to the load line through A at D'. Distances AD, DD' and AD' when measured were 4 cm, 3 cm and 5 cm respectively. The angle between the reactions at A and B is
(a) 30° (b) 45°
(c) 60° (d) 90°

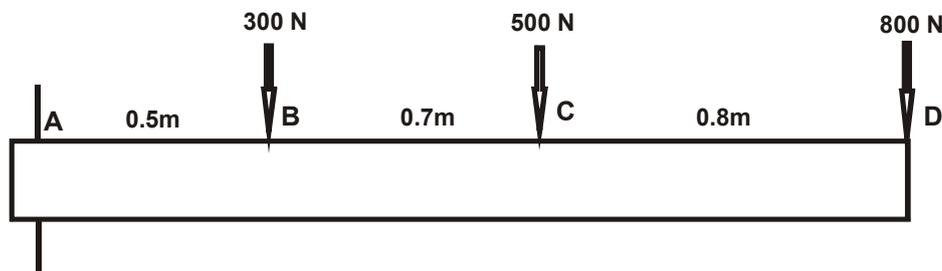
49. As per I.S. 456 - 1978, the pH value of water shall be
- (a) less than 6 (b) equal to 6
(c) not less than 6 (d) equal to 7
50. The masses of two balls are in the ratio of 2 : 1 and their respective velocities are in the ratio of 1 : 2 but in opposite direction before impact. If the coefficient of restitution is $\frac{1}{2}$, the velocities of separation of the balls will be equal to
- (a) half the original velocity in the opposite direction
(b) half the original velocity in the same direction
(c) original velocity in the same direction
(d) original velocity in the opposite direction

SECTION - B (Short answer type question)
(100 Marks)

All questions carry equal marks of 5 each.

This Section should be answered only on the Answer Sheet provided.

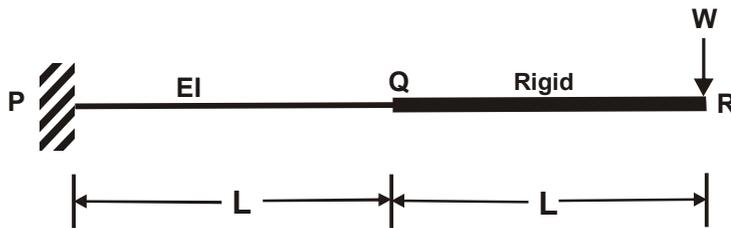
1. A truss member carries an axial tensile force of 7 kN. If permissible stress in the member is 130 MPa, determine the minimum area of the member required.
2. A wire 30 m long is subjected to a tensile force $P = 4.45$ kN. It is stretched by an amount of 25mm. Find the modulus of elasticity of the material if the cross sectional area of the wire is 25.8 mm^2 .
3. A cantilever beam of length 2m carries the point loads as shown in figure. Draw the shear force and bending moment diagram for the cantilever beam.



4. A column of wooden section 15 cm X 20 cm is 8 m long both ends being fixed. If the Young's modulus for timber = 18 kN/mm^2 , determine:
 - (i) The crippling load
 - (ii) Safe load of the column if factor of safety = 2
5. A beam 6m long, simply supported at its ends, is carrying a point load of 50 kN at its centre. The moment of inertia of the beam is given as equal to $80 \times 10^6 \text{ mm}^4$. If E for the material of the beam = $2.1 \times 10^5 \text{ N/mm}^2$. Calculate.
 - (i) Deflection at the center of the beam
 - (ii) Slope at the support
6. A singly reinforced rectangular concrete beam has a width of 150mm and an effective depth of 330mm. The characteristic compressive strength of concrete is 20 MPa. Adopt the stress block for concrete as given in IS 456-2000 and take limiting value of depth of neutral axis as 0.48 times the effective depth of the beam. Find the limiting value of the moment of resistance of the beam and limiting area of tension steel.

7. For a 25cm thick cement concrete pavement, analysis of stresses gives the following values
Wheel load stress due to corner loading 30kg/cm^2
Wheel load stress due to edge loading 32kg/cm^2
Warping stress at corner region during summer 9 kg/cm^2
Warping stress at corner region during winter 7 kg/cm^2
Warping stress at edge region during summer 8 kg/cm^2
Warping stress at edge region during winter 6 kg/cm^2
Frictional Stress during summer 5 kg/cm^2
Frictional Stress during winter 4 kg/cm^2
Find the most critical stress value for this pavement.

8. In the cantilever beam PQR shown in figure below, the segment PQ has flexural rigidity EI and the segment QR has infinite flexural rigidity. Find the deflection and slope of the beam at Q.



9. A doubly reinforced rectangular concrete beam has a width of 300mm and an effective depth of 500mm. the beam is reinforced with 2200mm^2 of steel in tension and 628mm^2 of steel in compression. The effective cover for compression steel is 50mm. Assume that both tension and compression steel yield. The grades of concrete and steel used are M20 and Fe250 respectively. The stress lock parameters (rounded off to first two decimal places) for concrete shall be as per IS 456:2000. Find the neutral axis and the moment of resistance of the section.
10. Estimate the strength of concrete at 28 days based on w/c law and gel/space ratio law. The weight of cement is 500 gms. w/c ratio is 0.5, and the fraction hydrated is 75%.
11. Explain various techniques used in NDT of concrete.
12. A solid shaft of diameter 30 mm is fixed at one end. It is subjected to a tensile force of 10kN and a torque of 60Nm. At a point on the surface of the shaft, determine the principal stresses and the maximum shear stresses.
13. To determine the quality of a brick, explain the various laboratory testing technique.
14. What is the advantage of a steel concrete composite column over conventional steel column?
15. What is the difference between pre- and post- tensioning.
16. Define characteristic compressive strength. Draw a sketch showing this and label appropriately.
17. Draw Odd Course and Even Course of 20 cm thick brick wall in (a) English Bond (b) Flemish Bond.
18. How do you (a) Transport concrete (b) compact concrete (c) cure concrete.
19. What is the distinction between 1-way and 2-way RCC slab system?
20. Differentiate between real structure and conjugate structure for beam with different support conditions.