

Final Exam

Total Marks: 90

No. of Questions: 45 (Attempt all questions)

Choose the nearest answer.

1. The shown cross-section is:

- (A) Symmetrical about vertical axis. (B) Symmetrical about horizontal axis. (C) Not symmetrical

2. The areas 1, 2 and 3 are:

- (A) 1.44 m² (B) 1.22 m² (C) 1.44 m² (D) 2.40 m²
 2.07 m² 3.70 m² 2.70 m² 3.00 m²
 1.08 m² 1.10 m² 1.80 m² 0.60 m²

3. The total area of the cross-section is:

- (A) 4.59 m² (B) 5.02 m² (C) 6.20 m² (D) 5.94 m²

4. The first moment of the total area about the y_L -axis is:

- (A) 31.12 m³ (B) 14.22 m³ (C) 7.49 m³ (D) 12.31 m³

5. The first moment of the total area about the x_B -axis is:

- (A) 12.12 m³ (B) 9.47 m³ (C) 7.49 m³ (D) 12.31 m³

6. The centroidal Y_C -axis of the cross-section is at $\bar{x} = \dots$ from y_L -axis.

- (A) 1.35 m (B) 2.07 m (C) 2.4 m (D) 3.35 m

7. The centroidal X_C -axis of the cross-section is at $\bar{y} = \dots$ from x_B -axis.

- (A) 1.26 m (B) 1.70 m (C) 1.02 m (D) 1.59 m

8. The second moment of the cross-section about its centroidal X_C -axis is:

- (A) 3.53 m⁴ (B) 4.21 m⁴ (C) 4.21 m³ (D) 5.13 m⁴

9. The second moment of the cross-section about its centroidal Y_C -axis is:

- (A) 3.11 m⁴ (B) 5.01 m⁴ (C) 1.21 m⁴ (D) 2.13 m⁴

10. The product (mixed) moment of the cross-section about its centroidal X_C and Y_C -axes is:

- (A) 7.21 m⁴ (B) 1.44 m⁴ (C) -5.21 m⁴ (D) 4.10 m⁴

11. The principal axes (u and v) of the cross-section makes an angle θ with the horizontal axis = ... :

- (A) -45.0° (B) zero (C) -27.5° (D) 26.6°

12. The principal moments of inertia of the cross-section I_u and I_v are:

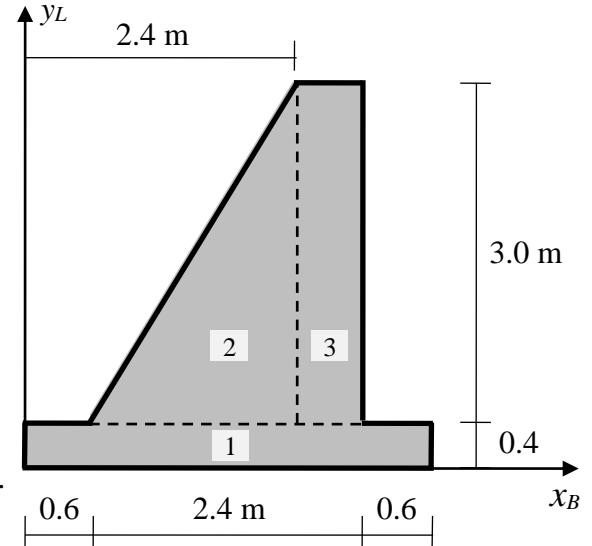
- (A) 8.58 m⁴ and 1.36 m⁴ (B) 5.88 m⁴ and 2.36 m⁴ (C) 6.44 m⁴ and 3.00 m⁴ (D) 5.21 m⁴ and 1.99 m⁴

13. The polar moment of inertia of the cross-section I_P is:

- (A) 9.94 m⁴ (B) 8.24 m⁴ (C) 9.44 m⁴ (D) 7.20 m⁴

14. The radius of gyration of the cross-section about its centroidal X_C -axis is:

- (A) 0.39 m (B) 0.71 m (C) 0.83 m (D) 0.93 m



A bar of variable cross-section is subjected to axial forces as shown. $E = 2.0 \text{ GPa}$

Allowable stress for **bronze** = 100 MPa

Allowable stress for **aluminum** = 90 MPa

Choose the nearest answer.

15. The bar is subjected to:

- (A) Shear stress (B) Moment (C) Normal stress (D) Twisting moment

16. The normal force in the **bronze** part is:

- (A) P (B) F (C) $2F$ (D) $2F + P$

17. The normal force in the **aluminum** part is:

- (A) P (B) F (C) $2F$ (D) $2F + P$

18. The cross-section of the **bronze** part has area of:

- (A) 100 mm² (B) 300 mm² (C) 200 mm² (D) 50 mm²

19. The maximum safe value of P is:

- (A) 20 kN (B) 10 kN (C) 100 kN (D) 5 kN

20. The axial deformation of the **bronze** part only due to the maximum safe value of P is:

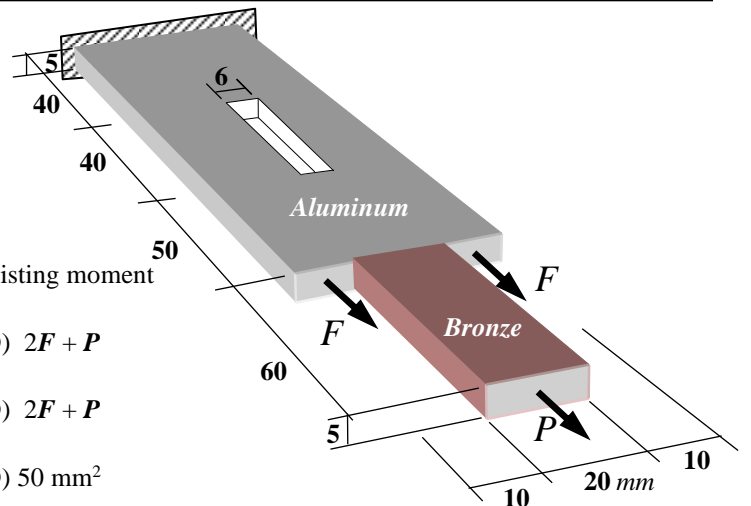
- (A) 6 mm (B) 10 mm (C) 3 mm (D) 1 mm

21. The critical cross-section of the **aluminum** part has area of:

- (A) 200 mm² (B) 30 mm² (C) 650 mm² (D) 170 mm²

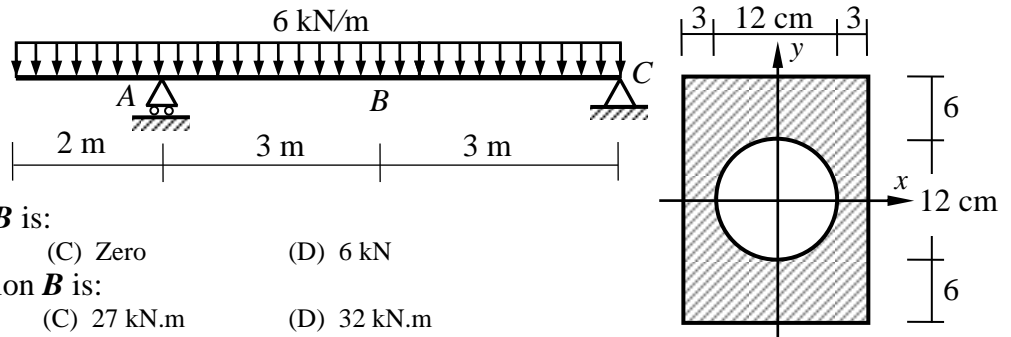
22. The maximum safe value of F is:

- (A) 1100 N (B) 2650 N (C) 7650 N (D) 5300 N



Please turn over

For the shown beam with the shown cross-section



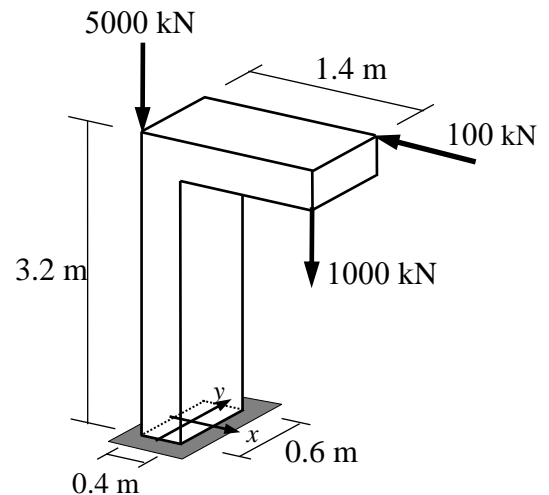
Choose the nearest answer.

23. The normal force at cross-section **B** is:
 (A) 12 kN (B) 32 kN (C) Zero (D) 6 kN
24. The bending moment at cross-section **B** is:
 (A) 12 kN.m (B) 21 kN.m (C) 27 kN.m (D) 32 kN.m
25. The second moment of the cross-section about **x**-axis is:
 (A) 19718 cm⁴ (B) 20736 cm⁴ (C) 11663 cm⁴ (D) 1018 cm⁴
26. The maximum tensile normal stress is at **y** =
 (A) -6 cm (B) 24 cm (C) 12 cm (D) -12 cm
27. The maximum compressive normal stress is at **y** =
 (A) -6 cm (B) 24 cm (C) 12 cm (D) -12 cm
28. The normal stress due to bending moment is:
 (A) $\sigma = \frac{N}{A}$ (B) $\sigma = \frac{M}{I}y$ (C) $\sigma = \frac{N}{I}y$ (D) $\sigma = \frac{M}{y}$
29. The maximum tensile normal stress at cross-section **B** is:
 (A) 12.8 kN/cm² (B) 6.39 MPa (C) 9442 N/cm² (D) 12.78 MPa
30. The maximum compressive normal stress at cross-section **B** is:
 (A) -12.8 kN/cm² (B) -6.39 MPa (C) -9442 N/cm² (D) -12.78 MPa
31. The shear force at the cross-section just to the right of support **A** is:
 (A) 20 kN (B) -12 kN (C) 32 kN (D) -6 kN
32. The maximum shear stress due to bending at the cross-section just to the right of support **A** is:
 (A) 1.17 MPa (B) 1.95 MPa (C) 3.12 MPa (D) 0.59 MPa

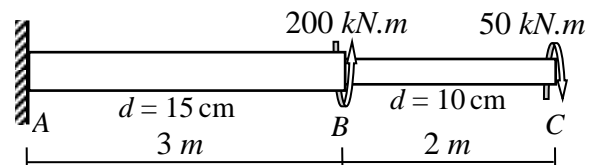
For the shown loaded column of base section of 0.4 m × 0.6 m. Neglect the column weight.

Choose the nearest answer.

33. The normal force at the base section is:
 (A) -5000 kN (B) -1000 kN (C) -6000 kN (D) -6100 kN
34. The bending moment about the **x**-axis of the base section is:
 (A) 1830 kN.m (B) 300 kN.m (C) 1500 kN.m (D) 1800 kN.m
35. The bending moment about the **y**-axis of the base section is:
 (A) 120 kN.m (B) -200 kN.m (C) 1000 kN.m (D) 320 kN.m
36. The area of the base section is:
 (A) 1.28 m² (B) 0.24 m² (C) 0.84 m² (D) 2.4 m²
37. The second moment of area about **x**-axis I_x of the base section is:
 (A) 0.0072 m⁴ (B) 0.0032 m⁴ (C) 0.0024 m⁴ (D) 0.32 m⁴
38. The second moment of area about **y**-axis I_y of the base section is:
 (A) 0.32 m⁴ (B) 0.0032 m⁴ (C) 0.0024 m⁴ (D) 0.0042 m⁴
39. The normal stress at the centroid of the base section is:
 (A) -20.8 MPa (B) -4.2 MPa (C) -25 MPa (D) -20833 kPa
40. The maximum tensile normal stress at the base section is:
 (A) 27.5 MPa (B) 45.7 MPa (C) 75.5 MPa (D) 57.5 MPa
41. The maximum compressive normal stress at the base section is:
 (A) -80.9 MPa (B) -27.5 MPa (C) -107.5 MPa (D) -57.5 MPa
42. The value of the shear force at the base section is:
 (A) 5000 kN (B) 1000 kN (C) 100 kN (D) zero
43. The value of the twisting moment about the **z**-axis of the base section is:
 (A) 30 kN.m (B) 200 kN.m (C) 400 kN.m (D) 60 kN.m



44. For the shown cantilevered beam of variable circular cross-section, the value of the twisting moment at **A** is:
 (A) 250 kN.m (B) 150 kN.m (C) 200 kN.m (D) 50 kN.m
45. The maximum shear stress in part **AB** due to twisting moment is:
 (A) 378 MPa (B) 226 MPa (C) 453 MPa (D) 755 MPa



With best wishes

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