

Code: MEMD1T4

I M.Tech - I Semester - Regular Examinations – April, 2015

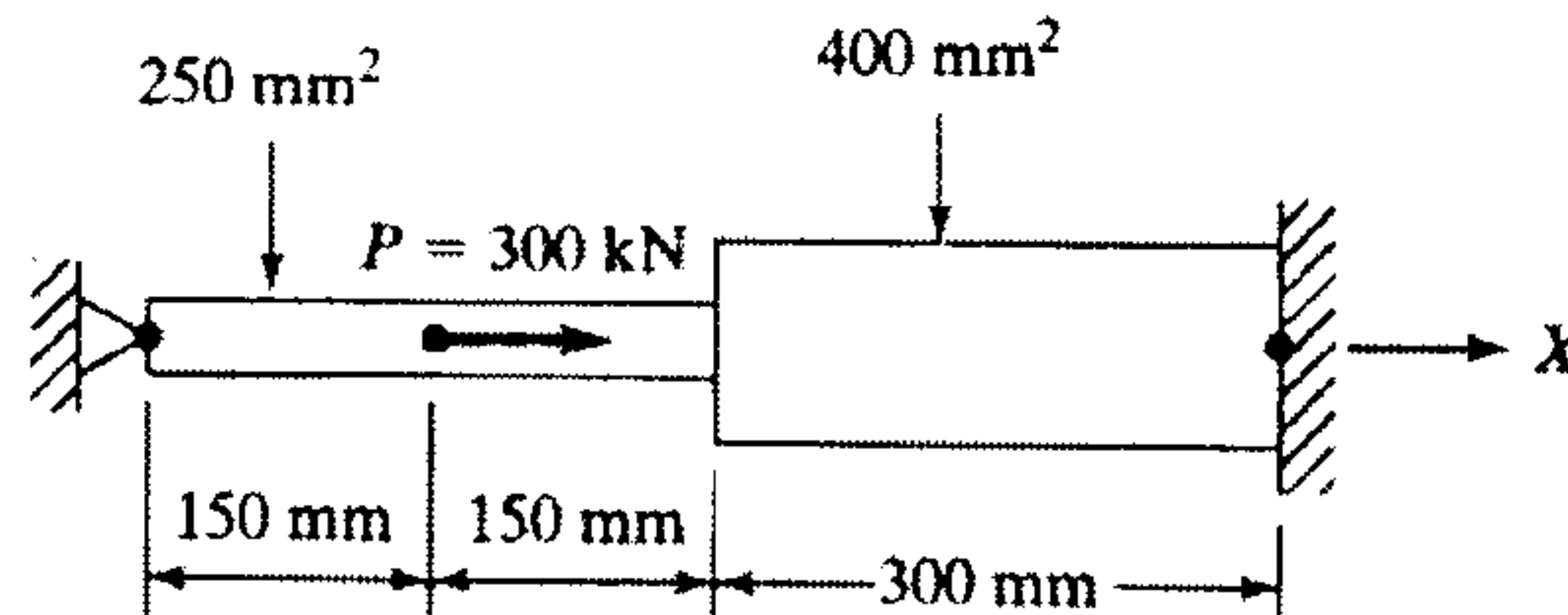
**FINITE ELEMENT METHODS  
(MACHINE DESIGN)**

Duration: 3 hours

Marks: 5x14=70

Answer any FIVE questions. All questions carry equal marks

1. Consider the bar loaded as shown in Figure 1. Determine the nodal displacements, element stresses, and support reactions. Solve the problem by hand calculation, adopting the elimination method for handling boundary conditions. 14 M



$$E = 200 \times 10^9 \text{ N/m}^2$$

$$(1 \text{ kN} = 1000 \text{ N})$$

Figure 1

2. Explain Galerkin and weighted residual methods with suitable examples. 14 M

3. For the three bar truss shown in Figure 2. Determine the displacement of node 1 and the stress in element 3. Area of cross section of each member =  $250\text{mm}^2$ ,  $E = 200\text{GPa}$

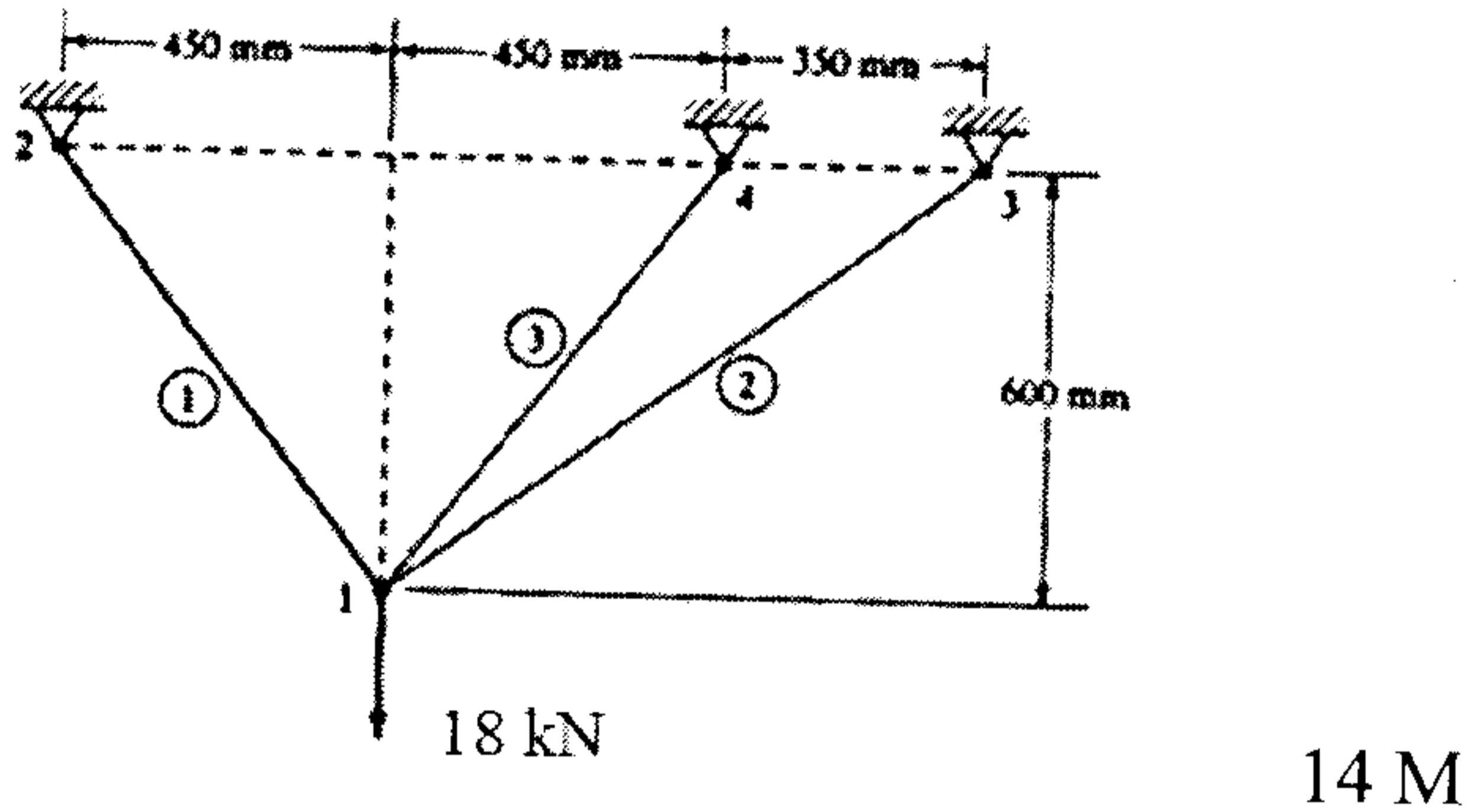


Figure 2

4. Find the deflection at the load and the slopes at the ends for the steel shaft shown in Figure 3. Consider the shaft to be simply supported at bearing A and B. 14 M

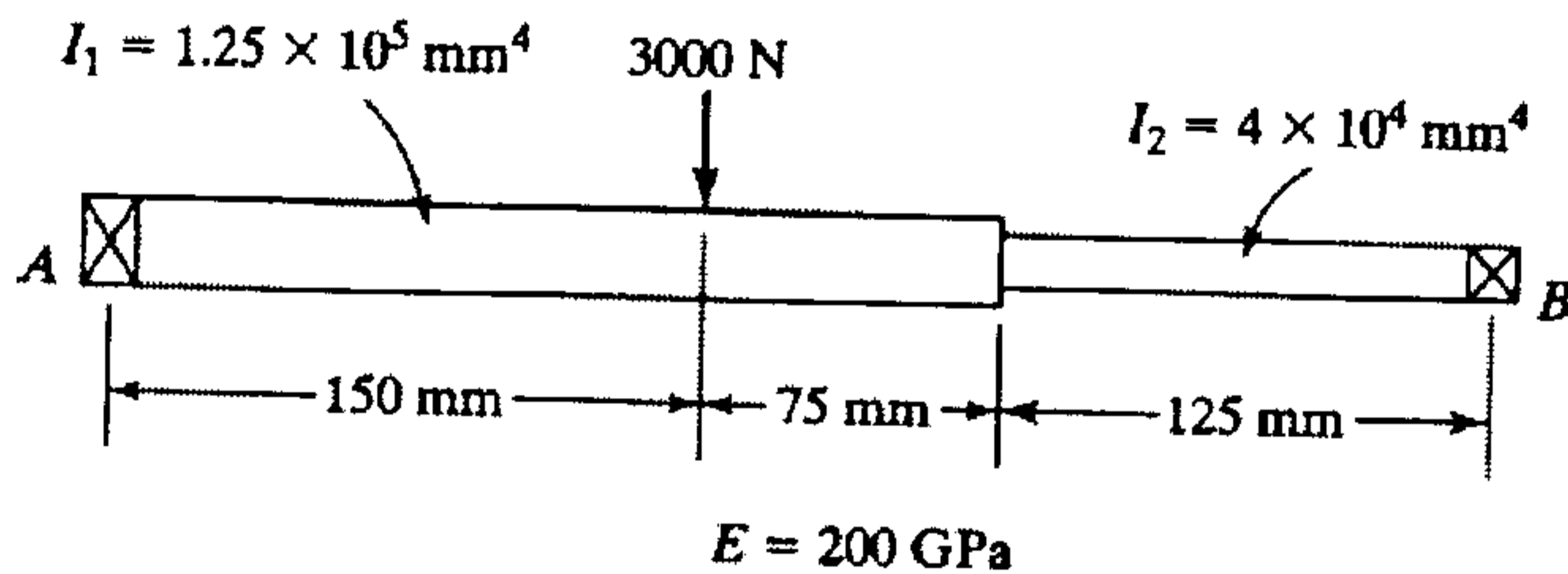


Figure 3

5. For the configuration shown in Figure 4. determine the deflection at the point of load application using a one-element model. If a mesh of several triangular elements is used. Comment on the stress values in the elements close to the tip. Use plane stress condition 14 M

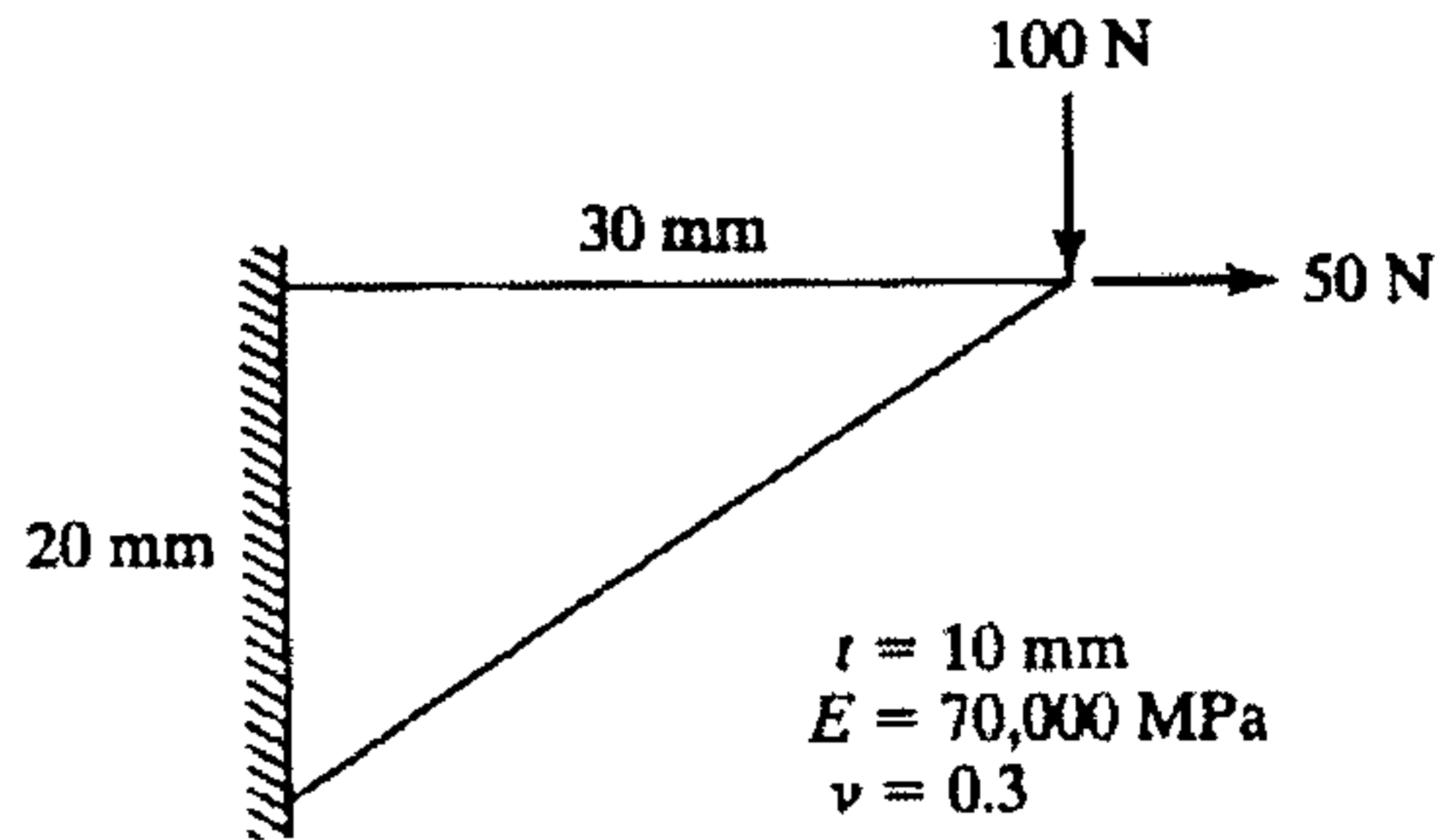


Figure 4

6. Evaluate the following using one point and two point Gauss quadrature.

$$\int_{-1}^1 \left[ 3e^x + x^2 + \frac{1}{(x+2)} \right] dx$$

14 M

7. Consider axial vibration of the steel bar shown in Figure 5.
- Develop the global stiffness and mass matrices.
  - By hand calculations, determine the lowest natural frequency and mode shape using the inverse iteration algorithm.

14 M

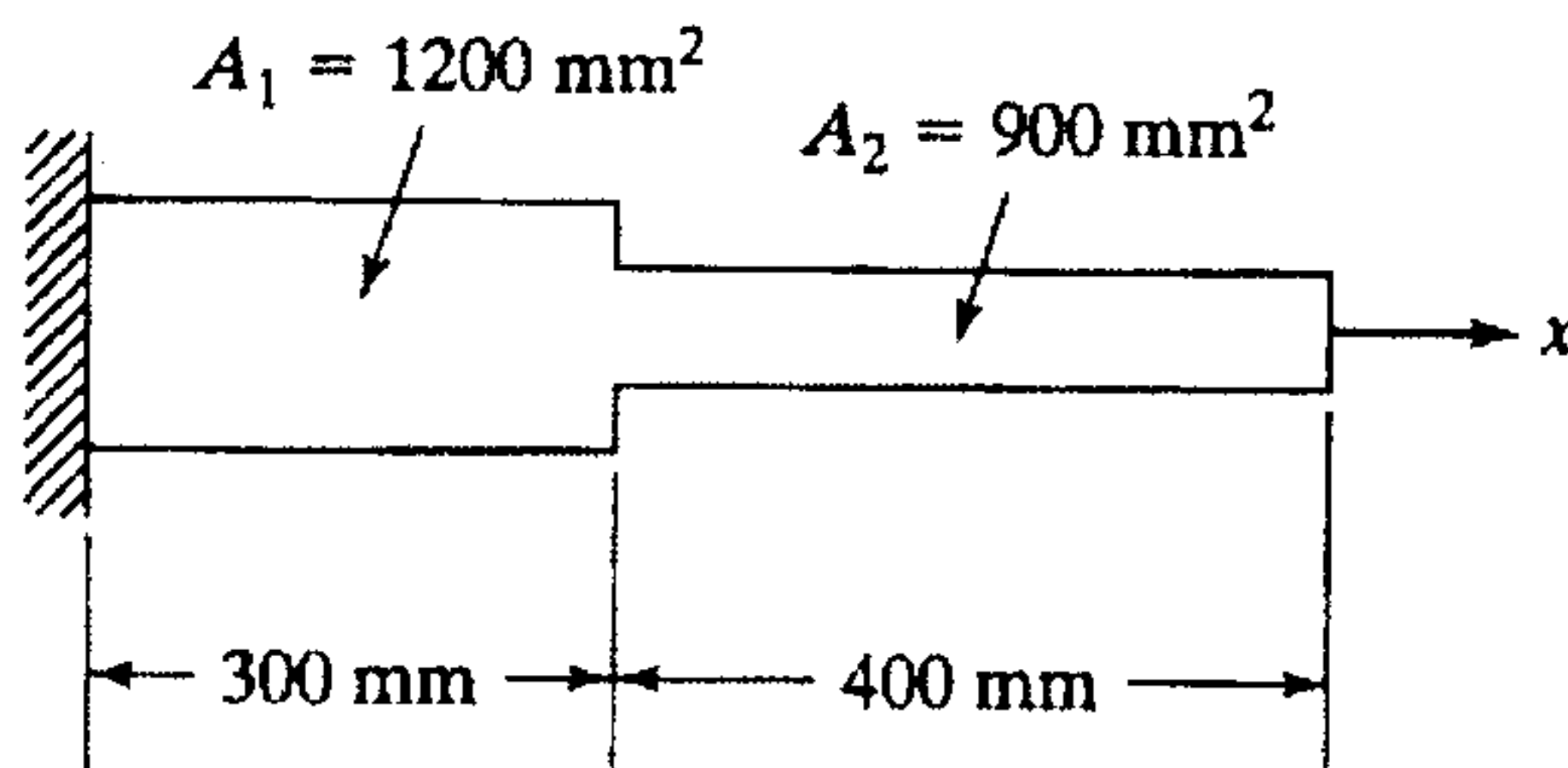


Figure 5

8. Write short notes on

a) h-refinement, p-refinement and convergence requirements.

10 M

b) Complete and incomplete interpolation functions.

4 M