

**ENCE 353 Midterm 1, Open Notes and Open Book**

Name : \_\_\_\_\_

**Exam Format and Grading.** This exam has three questions. Partial credit will be given for partially correct answers, so please show all your working.

Question	Points	Score
1	15	
2	15	
3	10	
Total	40	

**Question 1 (15 points): Shear Forces, Bending Moments, and Axial Forces in an (almost straight) Beam Structure.**

Consider the three-span beam structure shown in Figure 1.

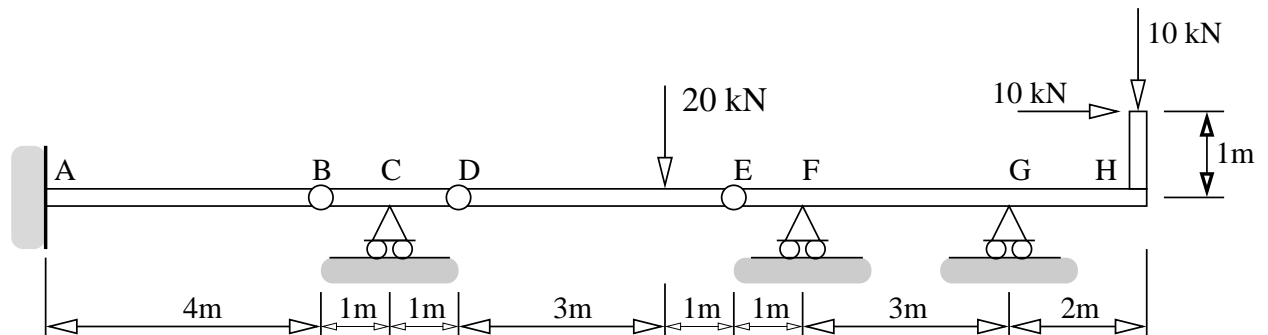


Figure 1: Three-span beam structure.

The cantilever is fully-fixed to the wall at Point A. Points B, D and E are hinges.

[1a] (2 pts). Compute the degree of indeterminacy for the three-span beam.

[1b] (5 pts). Compute the reactions at points A, C, F and G.

**[1c]** (8 pts). Compute and draw the shear force, bending moment, and axial force diagrams along the beam.

**Question 2 (15 points): Tension, Compression and Zero-Force Members in a Truss Structure.**

Consider the truss structure shown in Figure 2.

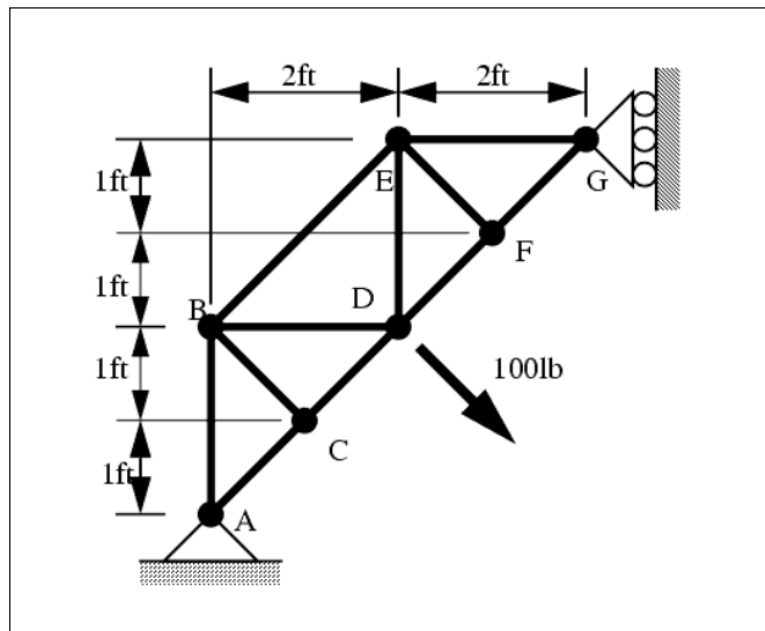


Figure 2: Simple truss structure

[2a] (3 pts). Identify the zero-force members and the axis of symmetry in this problem.

[2b] (4 pts). Compute the support reactions at points A and G.

[2c] (8 pts). Using the method of joints (or otherwise) compute the distribution of tension and compression forces in the truss structure.

**Note:** You can simplify the problem by eliminating the zero-force members from the analysis and taking advantage of the axis of symmetry in the problem.

**Question 3 (10 points): Degree's of Indeterminacy.**

[4a] (5 pts). Compute the degree of indeterminacy for the structure shown in Figure 3.

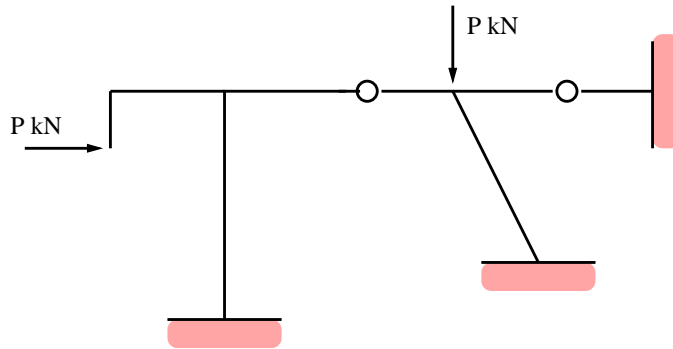


Figure 3: Simple portal frame.

[4b] (5 pts). The degree of indeterminacy for a two-dimensional planar frame is given by:  $D = n + r - 2j$ , where  $n$  = number of truss members,  $r$  = number of reaction forces, and  $j$  = number of pin joints in the frame. Compute the degree of indeterminacy for the truss structure shown in Figure 4.

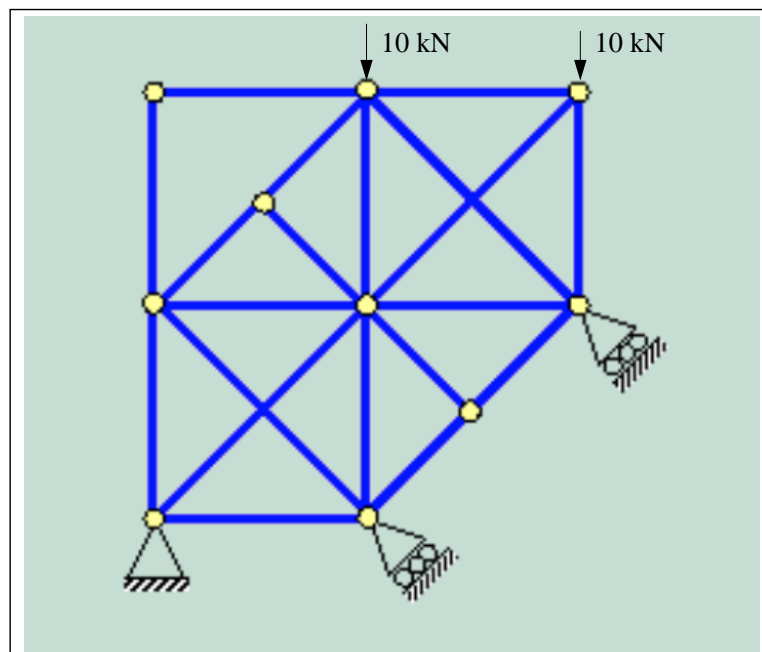


Figure 4: A more complicated frame structure.