

ORDRE DES INGÉNIEURS DU QUÉBEC

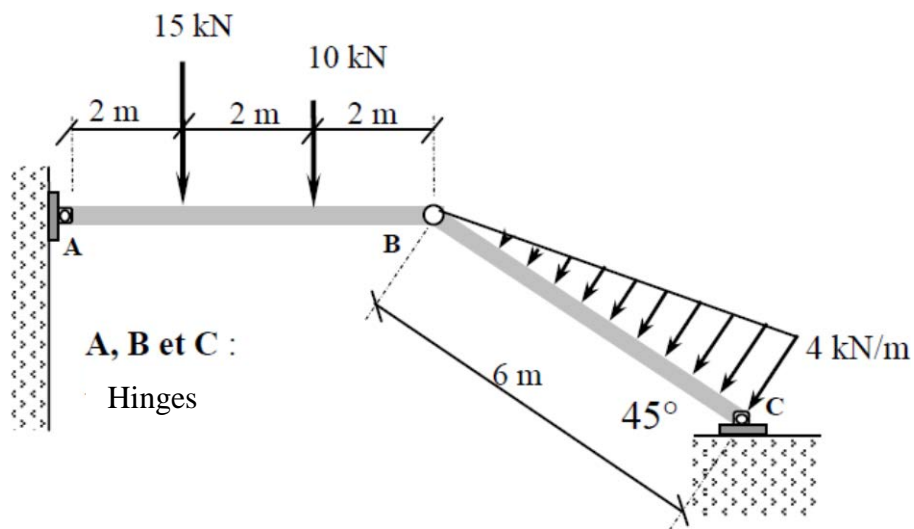
MAY 2018 SESSION

Open-book examination  
Calculators : only authorized models  
Duration : 3 hours

14-BA-A1 Elementary Structural Analysis

**Question 1 (25%)**

For the frame ABC shown on *Figure 1*, compute the support reactions and draw the normal force, shear force and bending moment diagrams. For each diagram, calculate and indicate maximum and minimum values and the longitudinal coordinates where they occur.



*Figure 1*

### Question 2 (25%)

For the beam ACB shown on Figure 2, use the principle of virtual work (unit force) to calculate the rotation and the vertical displacement at point C.

$$EI_{\text{beam}} = 10^4 \text{ kN.m}^2$$

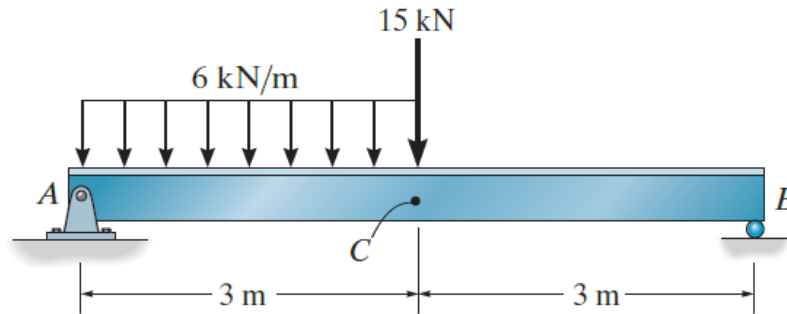


Figure 2

### Question 3 (25%)

For the indeterminate truss shown on Figure 3, determine **the axial forces in all members** by using the method of virtual work. Assume that *EA is the same constant for all members*.

Note: Consider AD as the redundant member.

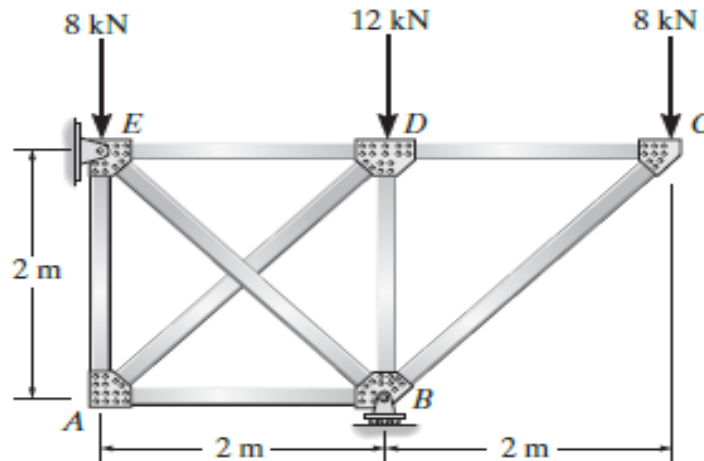


Figure 3

#### Question 4 (25%)

For the indeterminate frame shown on Figure 4, use the slope deflection method to:

1. Calculate the bending moments and shear forces at the ends of the three (3) members
2. Draw the free body diagram of each member and calculate the support reactions

Neglect the weight of the members and use the same numbering sequence as shown.

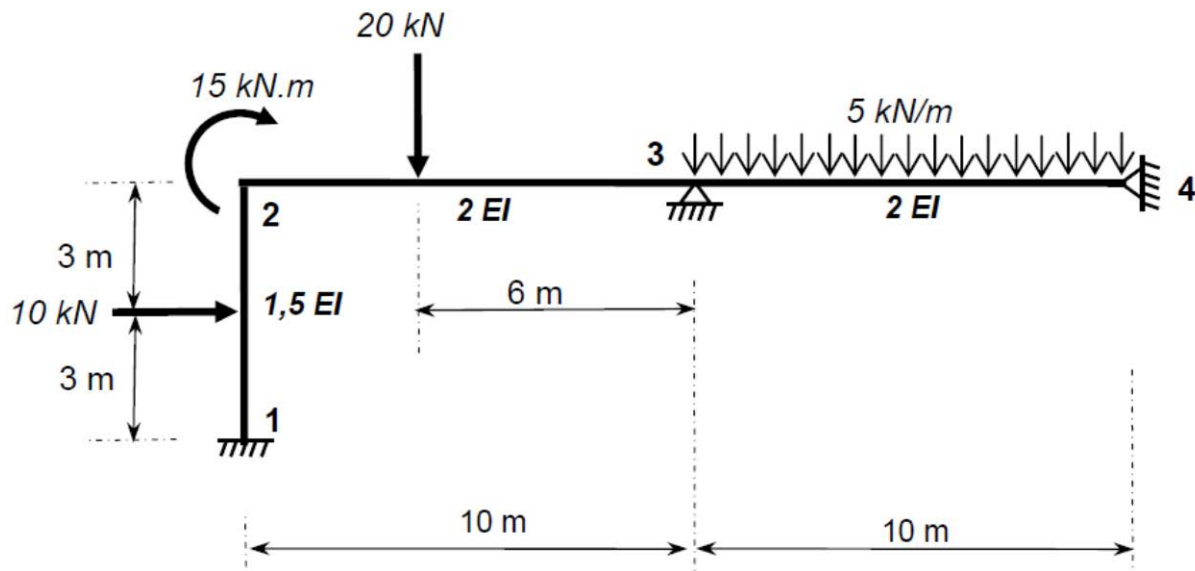


Figure 4