

ORDRE DES INGÉNIEURS DU QUÉBEC

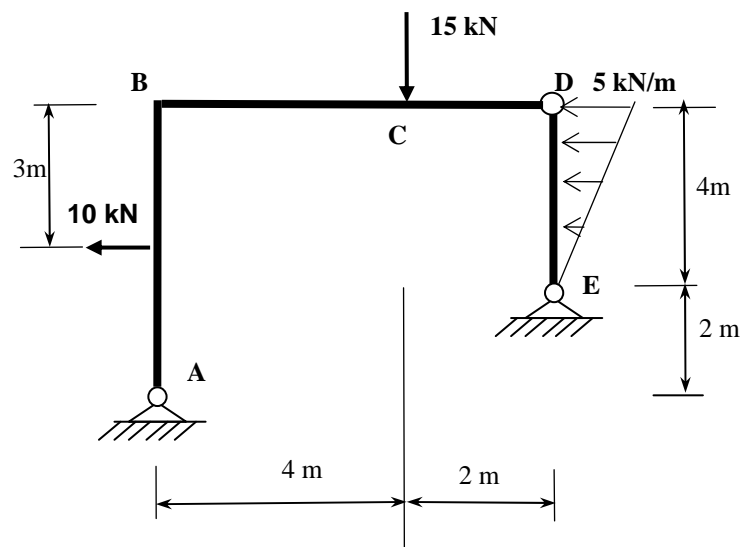
NOVEMBER 2017 SESSION

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

14-BA-A1 Elementary Structural Analysis

Question 1 (25%)

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



*Figure 1*

Question 2 (25%)

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

$$EI_{\text{beam}} = 10^6 \text{ kN.m}^2$$

*Note: Most used Mohr integrals are given in the Appendix*

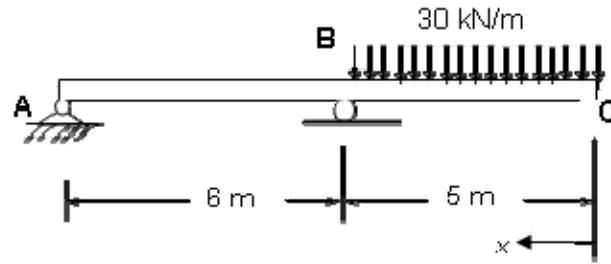


Figure 2

### 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 EB as the redundant member.

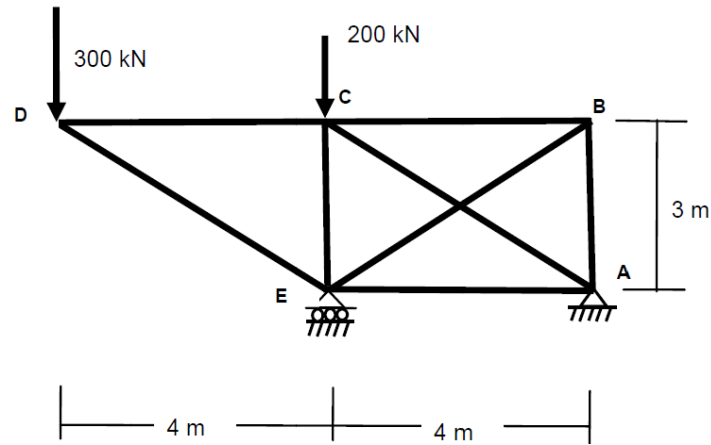


Figure 3

### Question 4 (25%)

Use the slope deflection method to draw the shear force and the bending moment diagrams of the indeterminate beam ABC shown on Figure 4. Neglect the weight of the members.  $EI$  = constant.

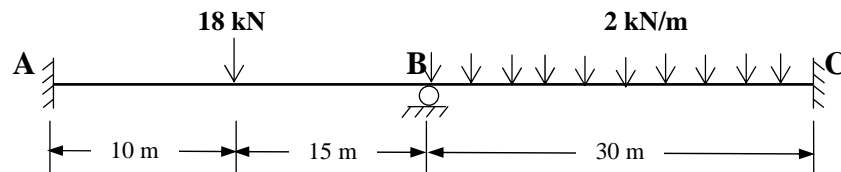


Figure 4