ORDRE DES INGÉNIEURS DU QUÉBEC

MAY 2023 SESSION

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

16-CI-A1 Elementary Structural Analysis

Question 1 (25%)

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

Note that there is a hinge at node D.

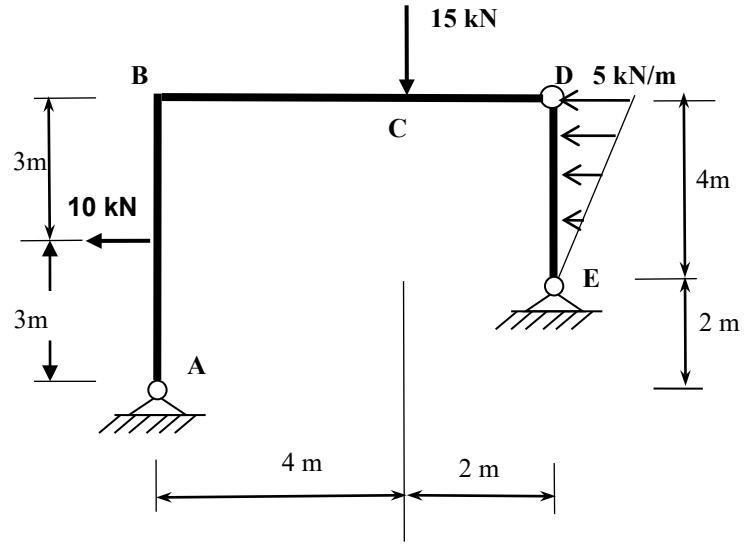

Figure 1

Question 2 (25%)

For the beam shown on Figure 2, calculate the rotation and the vertical displacement at point C.

$I_{beam} = 70*10^{6}\ mm^{4}$; E = 200 GPa

Use the moment area method

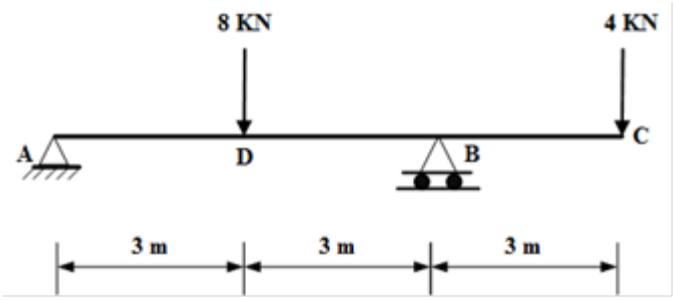

Figure 2

Question 3 (25%)

For the truss shown on Figure 3, determine the horizontal displacement of joint F due to applied loads, where P = 20 kN. All members have an area of 2 000 mm^2 and an elastic modulus E = 70 GPa.

Use the principle of virtual work.

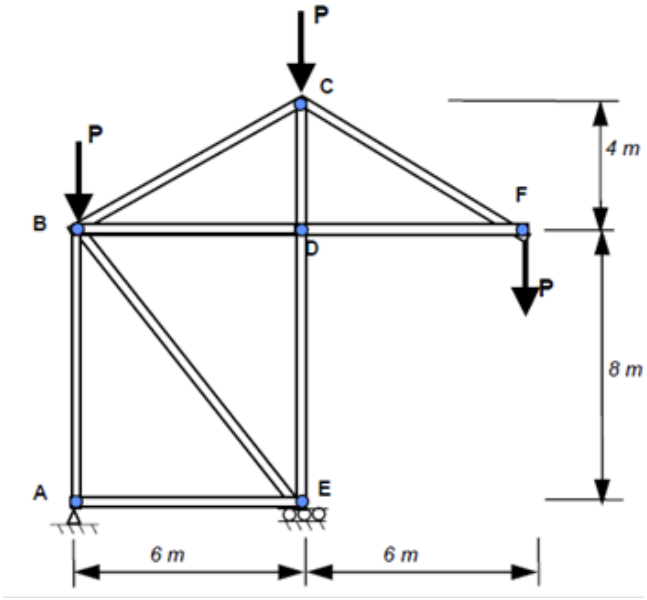

Figure 3

Question 4 (25%)

<u>Use the slope deflection method</u> to draw the shear force diagram and the bending moment diagram of the indeterminate frame shown on Figure 4. All members have the same value of flexural rigidity EI.

Neglect the weight of the members.

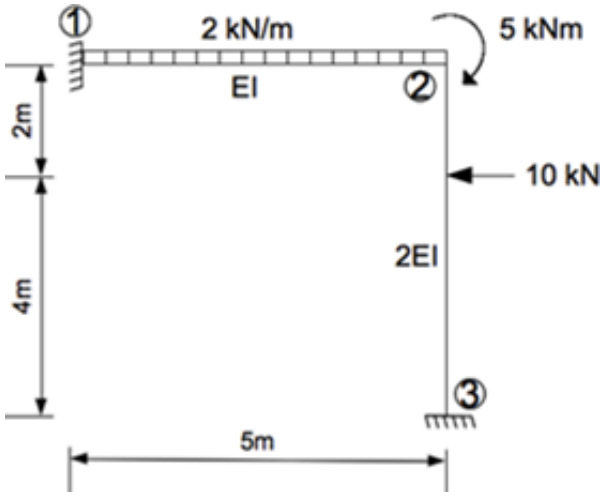

Figure 4