PROBLEM 4 || The beam ABCDE shown in the figure has simple supports at A, C, and E and a hinge (or pin) at D. A load of 4 kN acts at the end of the bracket that extends from the beam at B, and a load of 2 kN acts at the midpoint of part DE. Draw the shear force and bending moment diagrams for the beam.

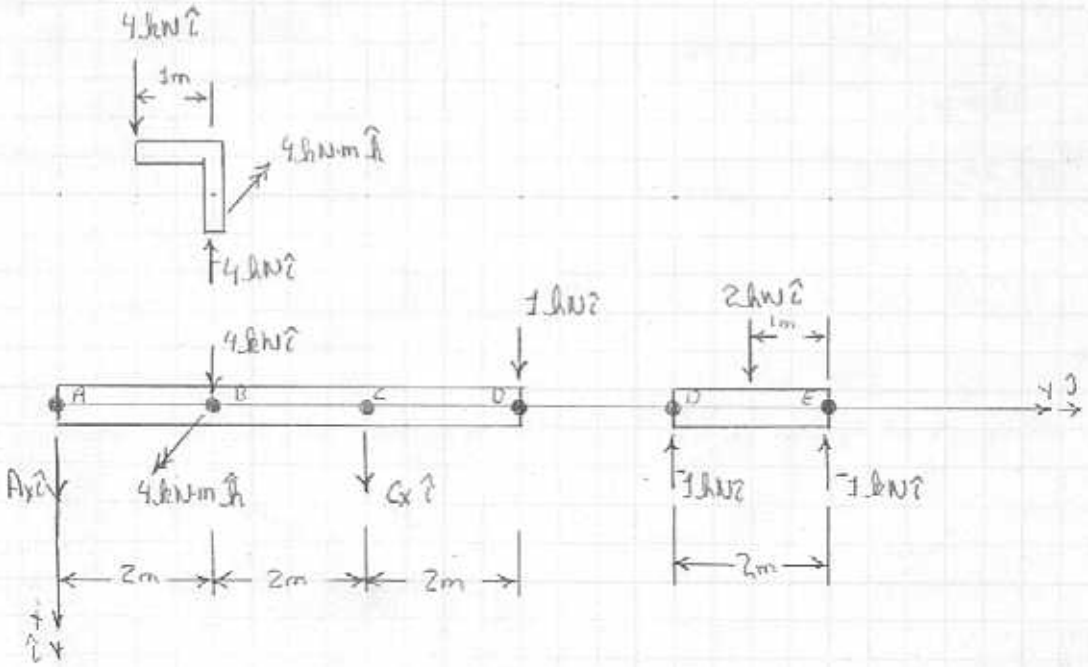
GIVEN:

1) CONSTRAINT
   - beam shown with pin supports at A and D
   - roller supports at C and E
2) ASSUMPTIONS
   - small deflections
   - all joints provide no resistance to moments

FIND:

1) Shear force and Bending moment Diagrams

FREE BODY DIAGRAM:



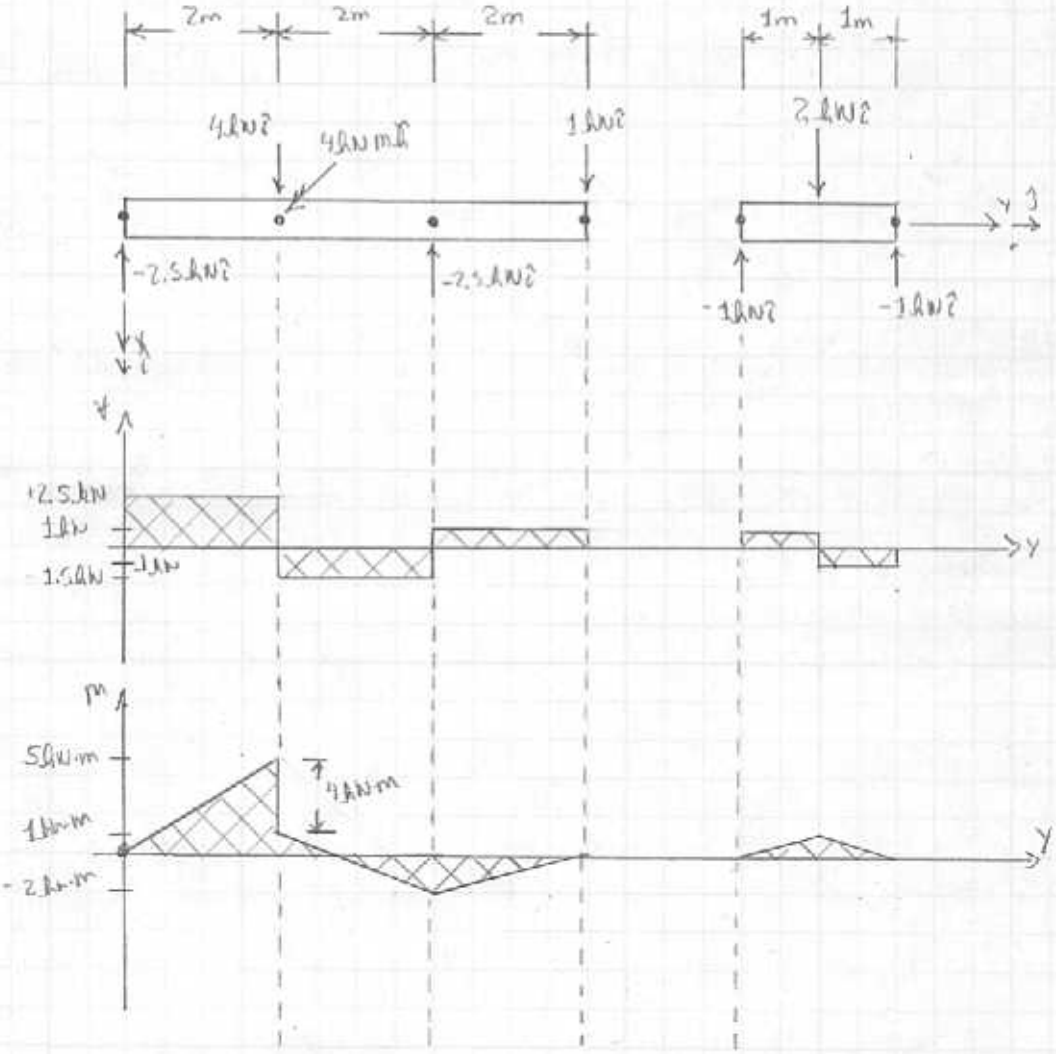
STATICS:

Starting with the solution to ABCD

$$\Sigma M_{z/k=B} = 0 = 4\,kN\cdot m - (2m)(4kN) - (4m)\cdot C_x - (6m)(1kN)$$

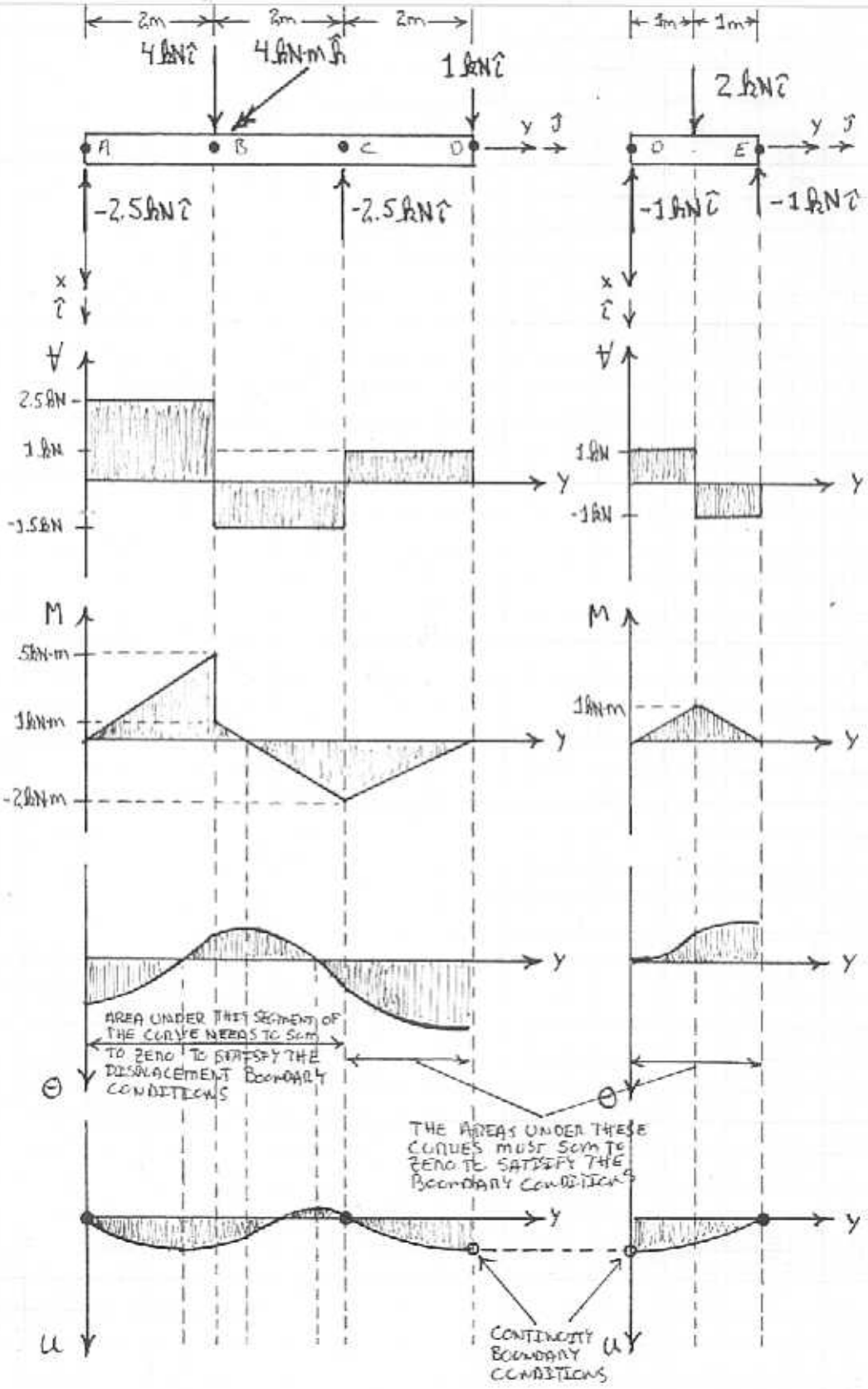
$$\Rightarrow \underline{C_x = -2.5\,kN}$$

$$\Sigma F_x = 0 = A_x + 4kN + C_x + 1kN \Rightarrow \underline{A_x = -2.5\,kN}$$



SUMMARY:

The equilibrium in this problem is trivial. The shear force and bending moment diagrams are drawn using direct integration.


2m
2m
2m
1m
1m
4 kN ↓
4 kN-m
1 kN ↓
2 kN ↓
A
B
C
D
E
y
-2.5 kN ↑
-2.5 kN ↑
-1 kN ↑
-1 kN ↑
x
V
2.5 kN
1 kN
-1.5 kN
1 kN
-1 kN
M
5 kN-m
1 kN-m
-2 kN-m
1 kN-m
θ
AREA UNDER THIS SEGMENT OF THE CURVE NEEDS TO SUM TO ZERO TO SATISFY THE DISPLACEMENT BOUNDARY CONDITIONS
THE AREAS UNDER THESE CURVES MUST SUM TO ZERO TO SATISFY THE BOUNDARY CONDITIONS
u
CONTINUITY BOUNDARY CONDITIONS