PROBLEM 8| CONSTRUCT THE SHEARFORCE, BENDING MOMENT, CURVATURE, AND DEFLECTION DIAGRAMS FOR THIS BEAM. USING THE SINGULARITY FUNCTIONS DISCUSSED IN CLASS, WRITE EXPRESSIONS FOR THE SHEAR FORCE, BENDING MOMENT, CURVATURE, AND DEFLECTION OF THIS BEAM.

GIVEN:

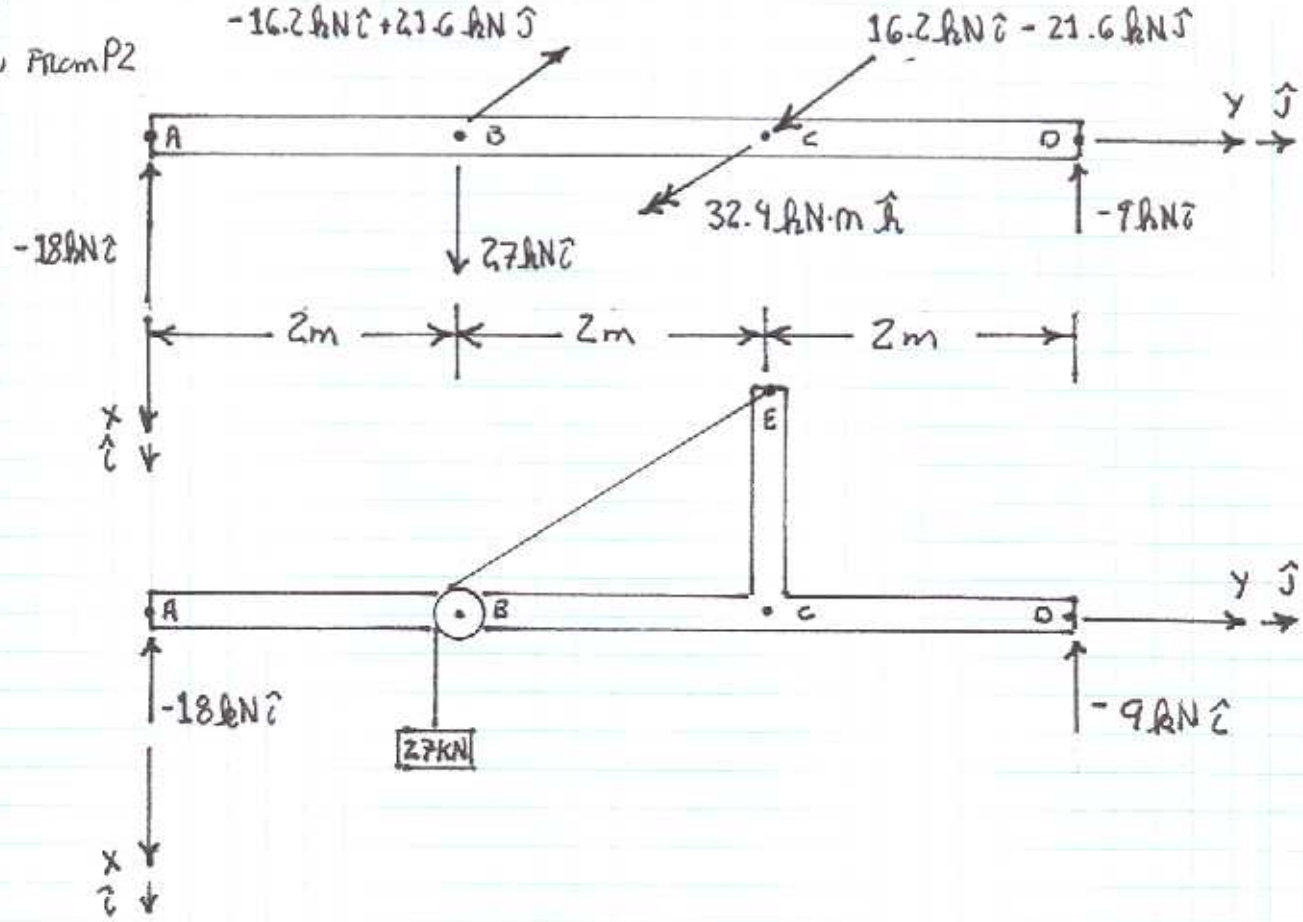
CONSTRAINTS
1. SIMPLY SUPPORTED BEAM OF LENGTH 6m
2. 27 KN LOAD APPLIED THROUGH A POLLEY ON THE BEAM

ASSUMPTIONS
1. PINS USED IN THE SUPPORTS ARE FRICTIONLESS
2. ROLLERS USED IN SUPPORTS ARE FRICTIONLESS
3. POLLEY USED TO SUPPORT STRING IS FRICTIONLESS
4. GRAVITY ACTS DOWNWARD
5. MASS OF THE BEAM CAN BE NEGLECTED.

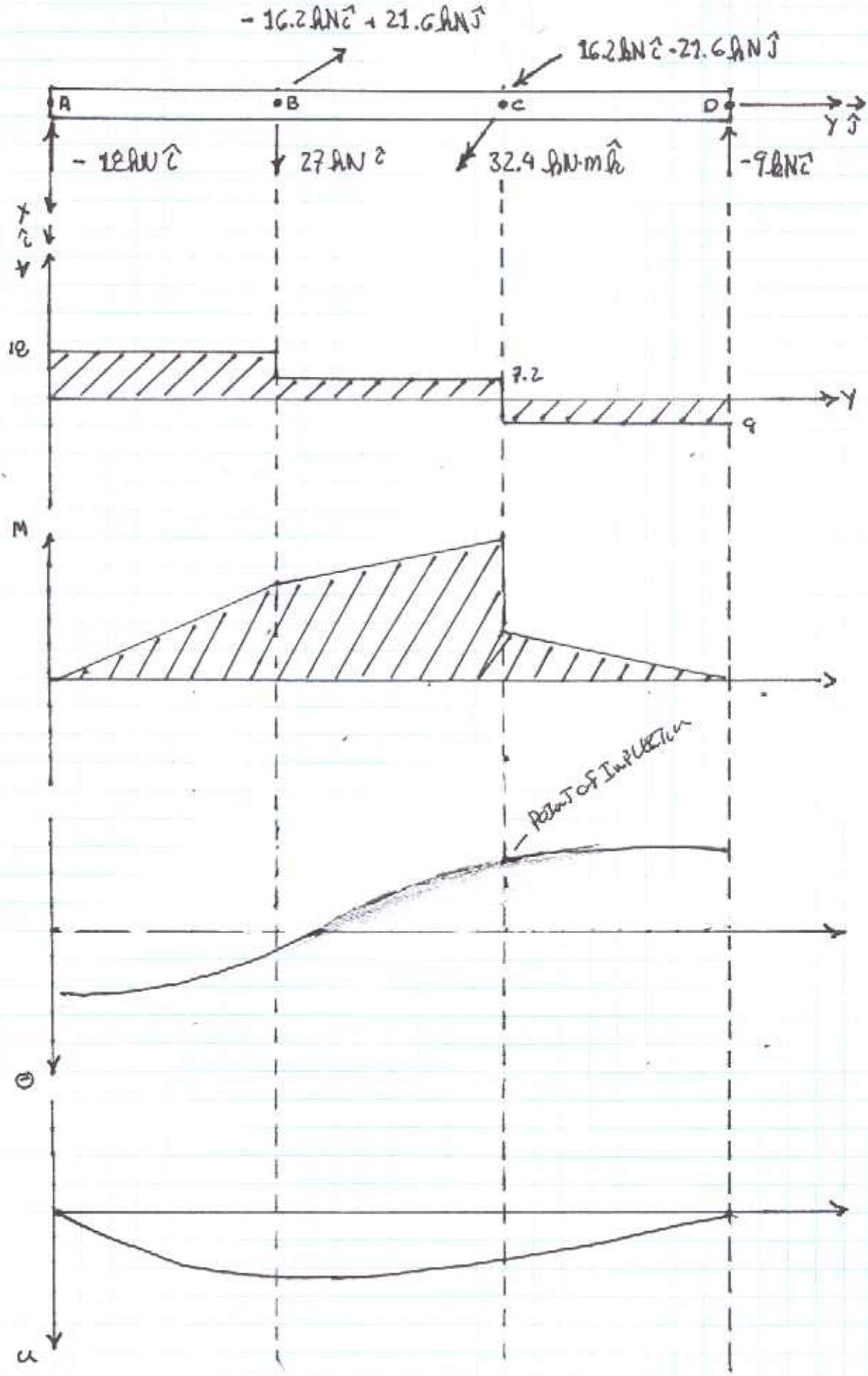
FIND:
1. SHEAR FORCE, BENDING MOMENT, CURVATURE, AND DEFLECTION DIAGRAMS
2. WRITE EXPRESSIONS FOR THE SHEAR FORCE, BENDING MOMENT, CURVATURE, AND DEFLECTION DIAGRAMS.

FIGURE:

SOLUTION FROM P2



SOLUTION


- 16.2 kN î + 21.6 kN ĵ
16.2 kN î - 21.6 kN ĵ
A
B
C
D
Y ĵ
- 12 kN î
27 kN î
32.4 kN·m k̂
-9 kN î
X
î
Y
10
7.2
Y
9
M
POINT OF INFLECTION
θ
u

NOW WRITING EXPRESSIONS

$$q_f(y) = -18\,kN\langle y-0\rangle^{-1} - 16.2\,kN\langle y-2m\rangle^{-1} + 27\,kN\langle y-2m\rangle^{-1} + 16.2\,kN\langle y-4m\rangle^{-1} + 32.4\,kN\cdot m\langle y-4m\rangle^{-2} - 9\,kN\cdot\langle y-6m\rangle^{-1}$$

$$= -18\,kN\langle y-0\rangle^{-1} + 10.8\,kN\langle y-2m\rangle^{-1} + 16.2\,kN\langle y-4m\rangle^{-1} + 32.4\,kN\cdot m\langle y-4m\rangle^{-2} - 9\,kN\langle y-6m\rangle^{-1}$$

THE LOADS IN THE Y DIRECTION ARE NOT INCLUDED SINCE THEY DO NOT CREATE MOMENTS ALONG THE BEAM.

$$V = -\int q_f(y)\,dy = 18\,kN\langle y-0\rangle^{0} - 10.8\,kN\langle y-2m\rangle^{0} - 16.2\,kN\langle y-4m\rangle^{0} - 32.4\,kN\cdot m\langle y-4m\rangle^{-1} + 9\,kN\langle y-6m\rangle^{0}$$

$$M = \int V(y)\,dy = 18\,kN\langle y-0\rangle^{1} - 10.8\,kN\langle y-2m\rangle^{1} - 16.2\,kN\langle y-4m\rangle^{1} - 32.4\,kN\cdot m\langle y-4m\rangle^{0} + 9\,kN\langle y-6m\rangle^{1}$$

$$\theta = \frac{-1}{EI}\int M(y)\,dy = \frac{1}{EI}\left[-\frac{18}{2}\,kN\langle y-0\rangle^{2} + \frac{10.8}{2}\,kN\langle y-2m\rangle^{2} + \frac{16.2}{2}\,kN\langle y-4m\rangle^{2} + 32.4\,kN\cdot m\langle y-4m\rangle^{1} - \frac{9\,kN}{2}\langle y-6m\rangle^{2} + C_1\right]$$

$$= \frac{1}{EI}\left[-9\,kN\langle y-0\rangle^{2} + 5.4\,kN\langle y-2m\rangle^{2} + 18.1\,kN\langle y-4m\rangle^{2} + 32.4\,kN\cdot m\langle y-4m\rangle^{1} - 4.5\,kN\langle y-6m\rangle^{2} + C_1\right]$$

$$u = \int \theta(y)\,dy = \frac{1}{EI}\left[-3\,kN\langle y-0\rangle^{3} + 1.8\,kN\langle y-2m\rangle^{3} + 6.033\,kN\langle y-4m\rangle^{3} + 16.2\,kN\cdot m\langle y-4m\rangle^{2} - 1.5\,kN\langle y-6m\rangle^{3} + C_1\cdot y + C_2\right]$$

THE FIRST B.C.

$$u(0) = 0 = \frac{1}{EI}\left[-3\,kN\,(0)^{3} + C_2\right] = C_2 = 0$$

THE SECOND B.C.

$$u(6m) = 0 = \frac{1}{EI}\left[-3\,kN\,(6m)^{3} + 1.8\,kN\,(4m)^{3} + 6.033\,kN\,(2m)^{3} + 16.2\,kN\cdot m(2m)^{2} - 1.5\,kN\,(0)^{3} + C_1\cdot(6m)\right]$$

$$\Rightarrow C_1 = 69.96\,kN\cdot m^{2}$$

$$\theta = \frac{1}{EI}\left[-9\,kN\langle y-0\rangle^2 + 5.4\,kN\langle y-2m\rangle^2 + 18.1\,kN\langle y-4m\rangle^2 + 32.4\,kN\cdot m\langle y-4m\rangle^1 - 4.5\,kN\langle y-6m\rangle^2 + 69.96\,kN\cdot m^2\right]$$

$$u = \frac{1}{EI}\left[-3\,kN\langle y-0\rangle^3 + 1.8\,kN\langle y-2m\rangle^3 + 6.033\,kN\langle y-4m\rangle^3 + 16.2\,kN\cdot m\langle y-4m\rangle^2 - 1.5\,kN\langle y-6m\rangle^3 + 69.96\,kN\cdot m^2\right]$$