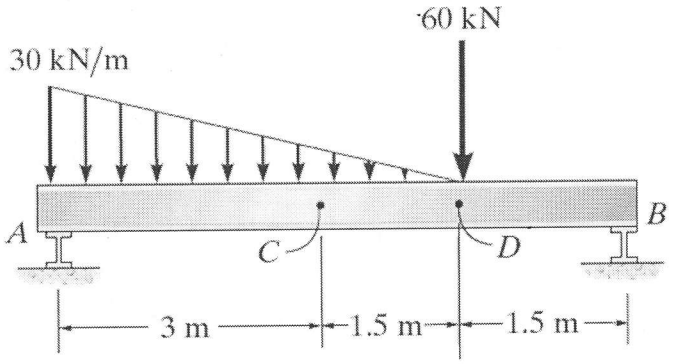
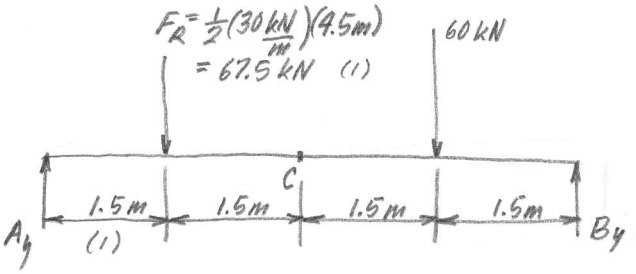
CME 260 – Mechanics of Materials
Exam #1 (01/19/2024)

Warrior ID # Grading

Do one of the two problems shown below (the second problem is on the back).
Show your work (you will not receive any credit if all you have is a final answer, right or wrong).

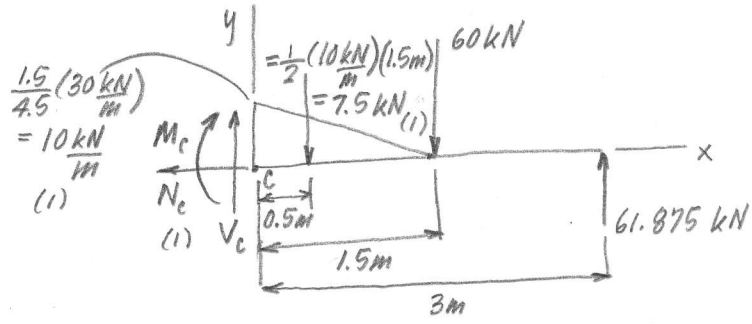
1. Determine the resultant internal loadings acting on the cross section at point C. Assume the reactions at the supports A and B are vertical.





$\Sigma M_A = 0,\ -(67.5\,kN)(1.5m) - (60\,kN)(4.5m) + B_y(6m) = 0$

$B_y = 61.875\,kN$ (1)



$\Sigma F_x = 0,\ \boxed{N_c = 0}$ (1)

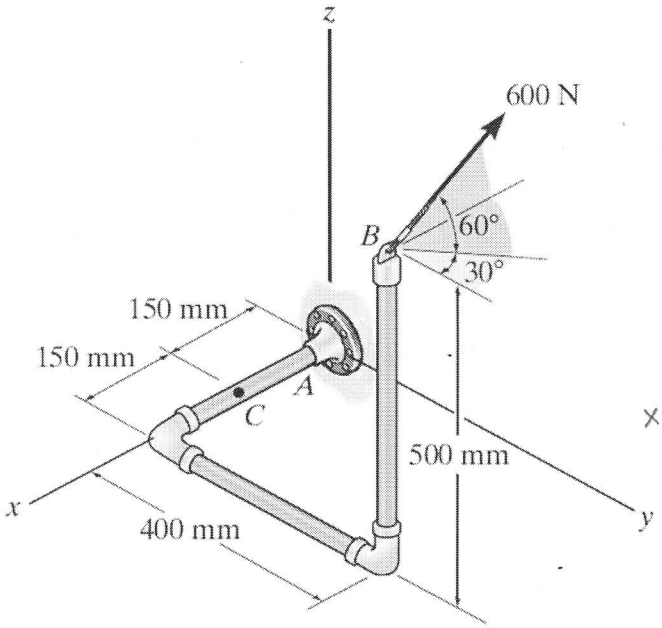
$\Sigma F_y = 0,\ V_c - 7.5\,kN - 60\,kN + 61.875\,kN = 0$

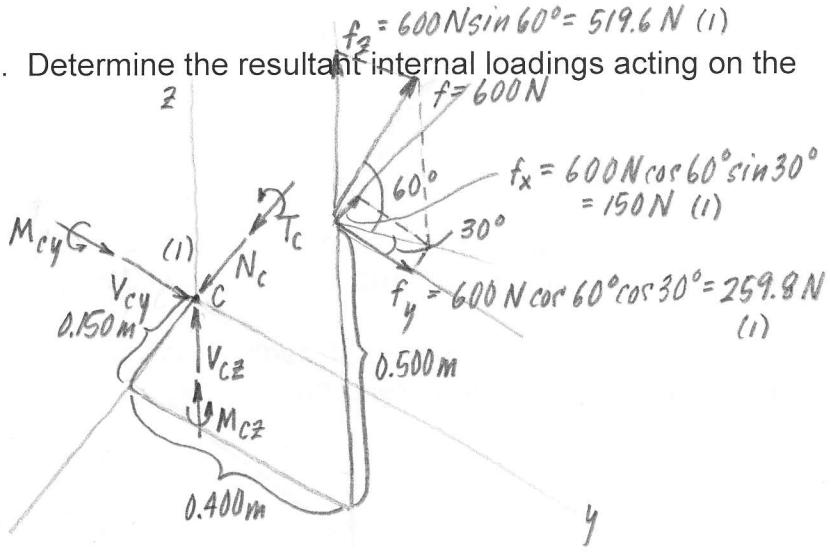
$\boxed{V_c = 5.625\,kN}$ (1)

$\Sigma M_c = 0,\ -M_c - (7.5\,kN)(0.5m) - (60\,kN)(1.5m) + (61.875\,kN)(3m) = 0$

$\boxed{M_c = 91.875\,kN\text{-}m}$ (2)

2. The pipe assembly is fixed to the wall at A. Determine the resultant internal loadings acting on the cross section at point C.





$\Sigma F_x = 0, \quad N_c - 150\,N = 0 \rightarrow \boxed{N_c = 150\,N}$ (1)

$\Sigma F_y = 0, \quad V_{cy} + 259.8\,N = 0 \rightarrow \boxed{V_{cy} = -260\,N}$ (1)

$\Sigma F_z = 0, \quad V_{cz} + 519.6\,N = 0 \rightarrow \boxed{V_{cz} = -520\,N}$ (1)

$\Sigma (M_c)_x = T_c - (259.8\,N)(0.500\,m) + (519.6\,N)(0.400\,m) = 0 \rightarrow \boxed{T_c = -77.9\,N\text{-}m}$ (1)

$\Sigma (M_c)_y = M_{cy} - (150\,N)(0.500\,m) - (519.6\,N)(0.150\,m) = 0 \rightarrow \boxed{M_{cy} = 153\,N\text{-}m}$ (1)

$\Sigma (M_c)_z = M_{cz} + (150\,N)(0.400\,m) + (259.8\,N)(0.150\,m) = 0 \rightarrow \boxed{M_{cz} = -99.0\,N\text{-}m}$ (1)

alternate method

$\Sigma M = 0, \quad T_c i + M_{cy} j + M_{cz} k +$

$(0.150i + 0.400j + 0.500k)(m) \times (-150i + 259.8j + 519.6k)(N) = 0$

$$\begin{vmatrix} + & - & + \\ i & j & k \\ 0.150 & 0.400 & 0.500 \\ -150 & 259.8 & 519.6 \end{vmatrix} \begin{matrix} (m) \\ (N) \end{matrix} = \begin{matrix} +i((0.400)(519.6)-(0.500)(259.8)) \\ -j((0.150)(519.6)-(0.500)(-150)) \\ +k((0.150)(259.8)-(0.400)(-150)) \end{matrix} \quad (N\text{-}m)$$

$= 77.94i - 152.94j + 98.97k\ (N\text{-}m)$

$i: \quad T_c + 77.94\,N\text{-}m = 0 \rightarrow \boxed{T_c = -77.9\,N\text{-}m}$ (1)

$j: \quad M_{cy} - 152.94\,N\text{-}m = 0 \rightarrow \boxed{M_{cy} = 153\,N\text{-}m}$ (1)

$k: \quad M_{cz} + 98.97\,N\text{-}m = 0 \rightarrow \boxed{M_{cz} = -99.0\,N\text{-}m}$ (1)