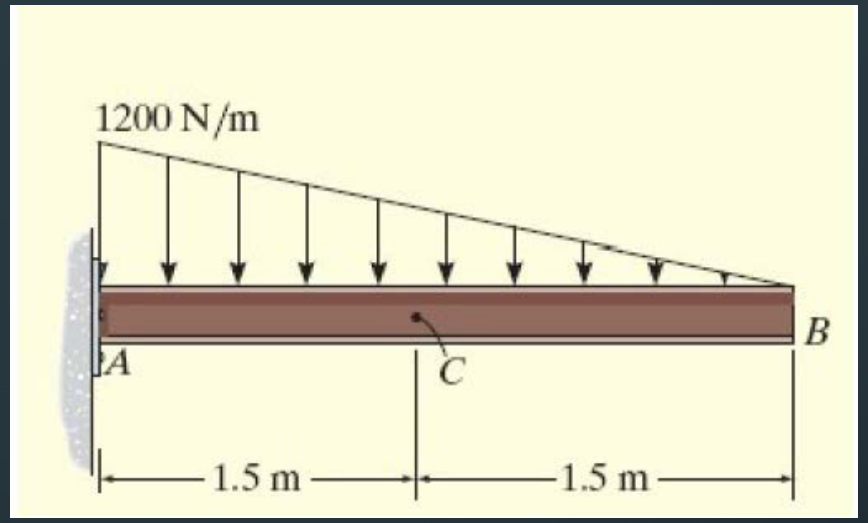
TUTORIAL SESSION 4

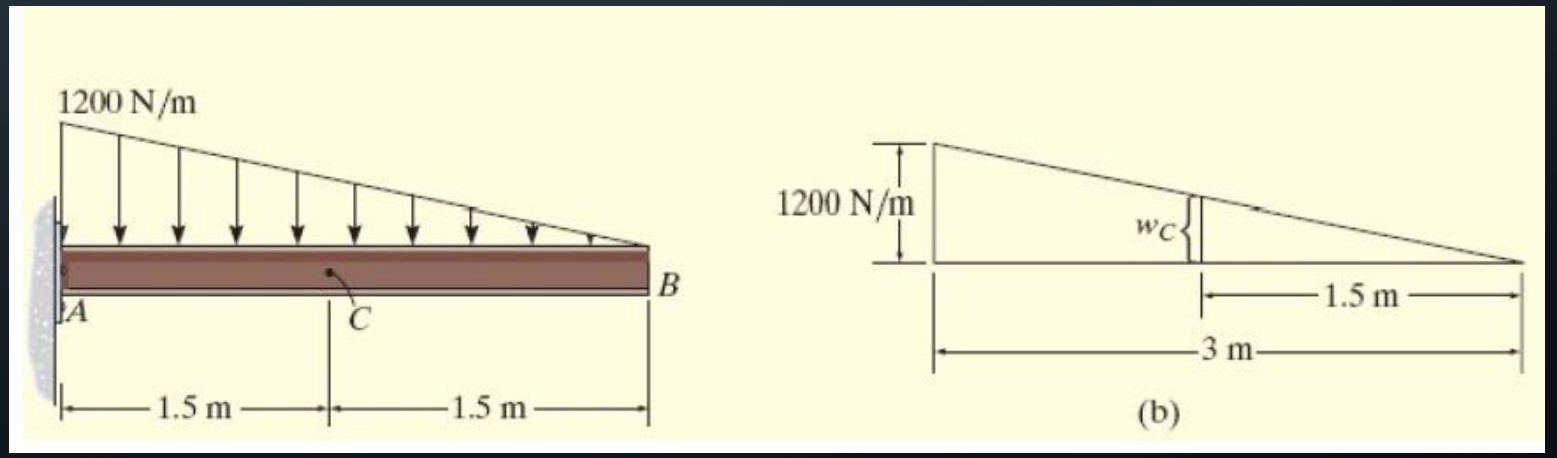
PROBLEMS ON:

- PROBLEMS REMAINING FROM LAST WEEK: INTERNAL FORCES
- SHEAR FORCE AND BENDING MOMENT DIAGRAMS OF BEAMS

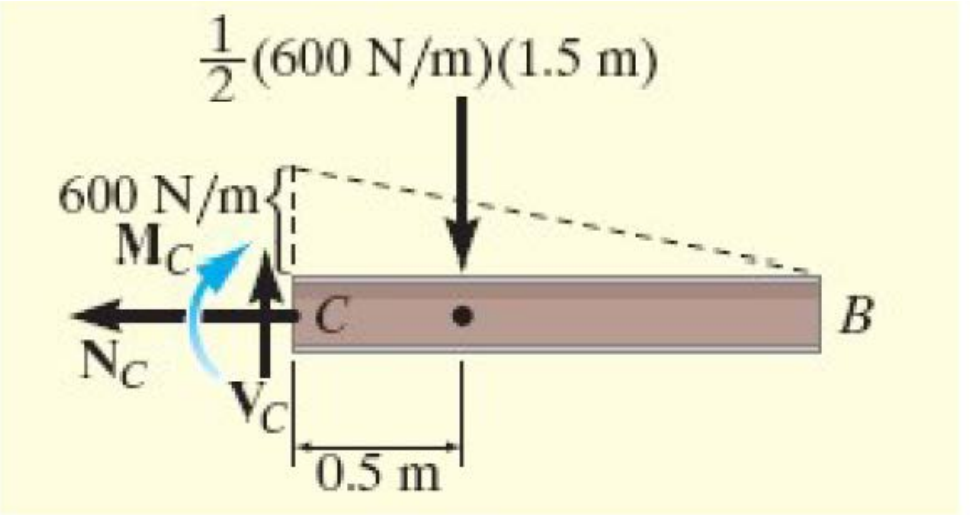
The following problems have been taken from Engineering Mechanics: Statics – R. C. Hibbeler 13th edition

1- Determine the internal forces at C.





$$w_c = 1200\text{N/m}\left(\frac{1.5\text{m}}{3\text{m}}\right) = 600\text{N/m}.$$



$\Sigma F_x = N_C = 0$

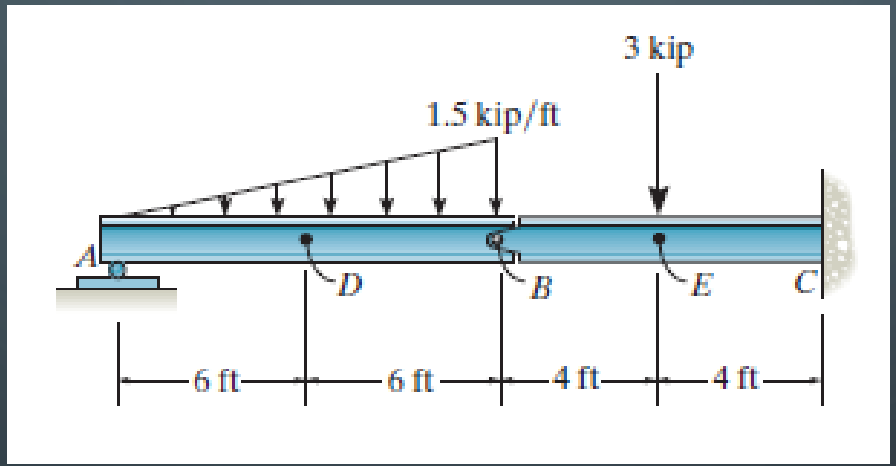
$\Sigma F_y = V_c - ½\ (600\ \text{N/m})(1.5\ \text{m}) = 0 : \quad V_c = 450\ \text{N}\ (\uparrow)$

$\Sigma M_C = -M_C - ½\ (600\ \text{N/m})(1.5\ \text{m})(0.5\ \text{m}) = 0$

$M_C = -225\ \text{Nm}\ (\text{CCW})$

2.

Determine the normal force, shear force, and moment in the beam at sections passing through points D and E. Point E is just to the right of the 3-kip load.



SOLUTION

$\zeta + \Sigma M_B = 0; \quad \frac{1}{2}(1.5)(12)(4) - A_y(12) = 0$

$A_y = 3 \text{ kip}$

$\pm\rightarrow \Sigma F_x = 0; \quad B_x = 0$

$+\uparrow \Sigma F_y = 0; \quad B_y + 3 - \frac{1}{2}(1.5)(12) = 0$

$B_y = 6 \text{ kip}$

$\pm\rightarrow \Sigma F_x = 0; \quad N_D = 0$

$+\uparrow \Sigma F_y = 0; \quad 3 - \frac{1}{2}(0.75)(6) - V_D = 0$

$V_D = 0.75 \text{ kip}$

$\zeta + \Sigma M_D = 0; \quad M_D + \frac{1}{2}(0.75)(6)(2) - 3(6) = 0$

$M_D = 13.5 \text{ kip} \cdot \text{ft}$

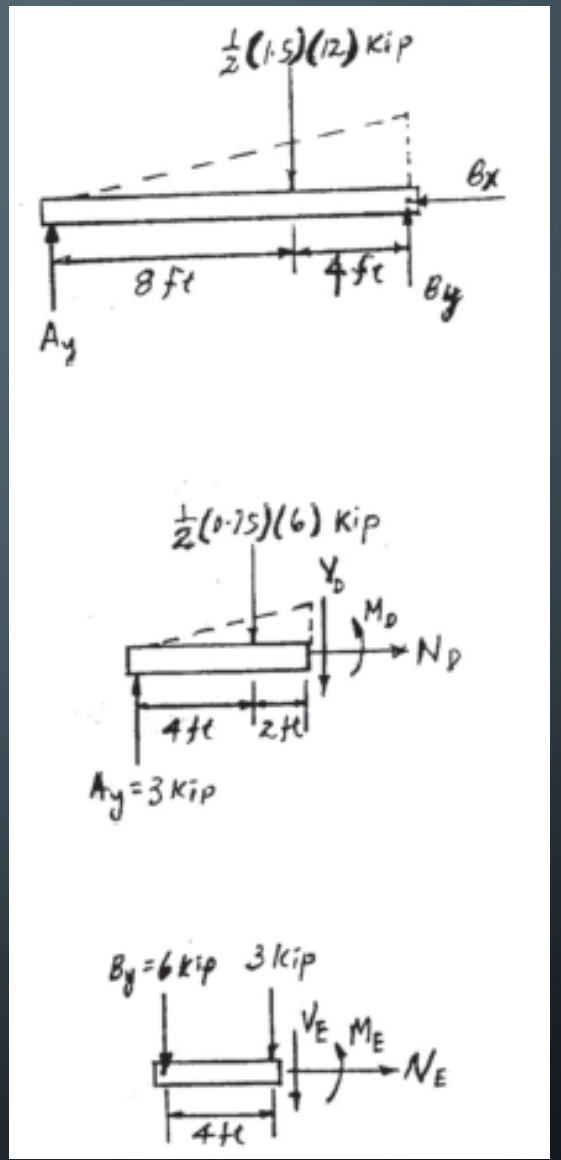
$\pm\rightarrow \Sigma F_x = 0; \quad N_E = 0$

$+\uparrow \Sigma F_y = 0; \quad -V_E - 3 - 6 = 0$

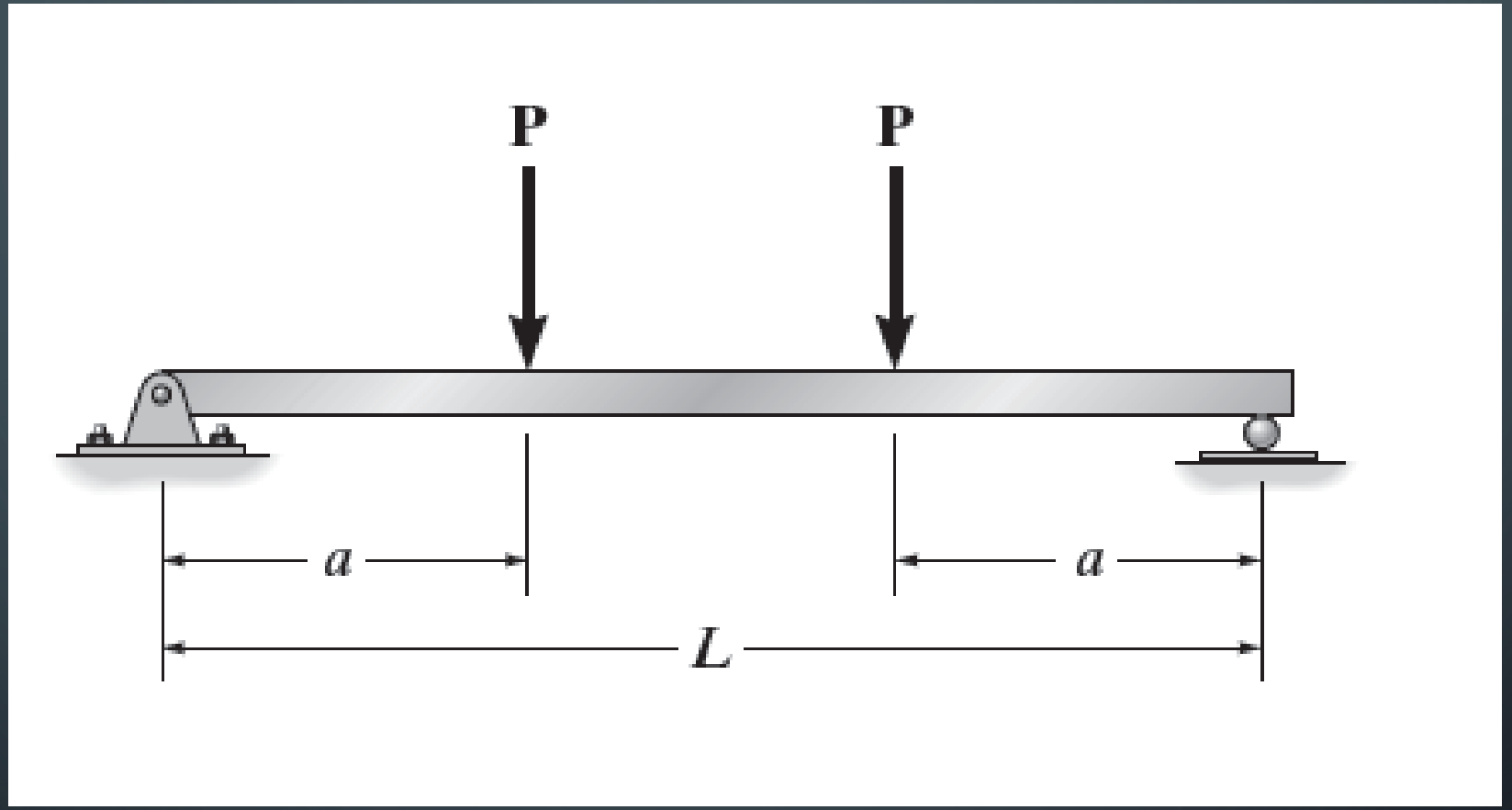
$V_E = -9 \text{ kip}$

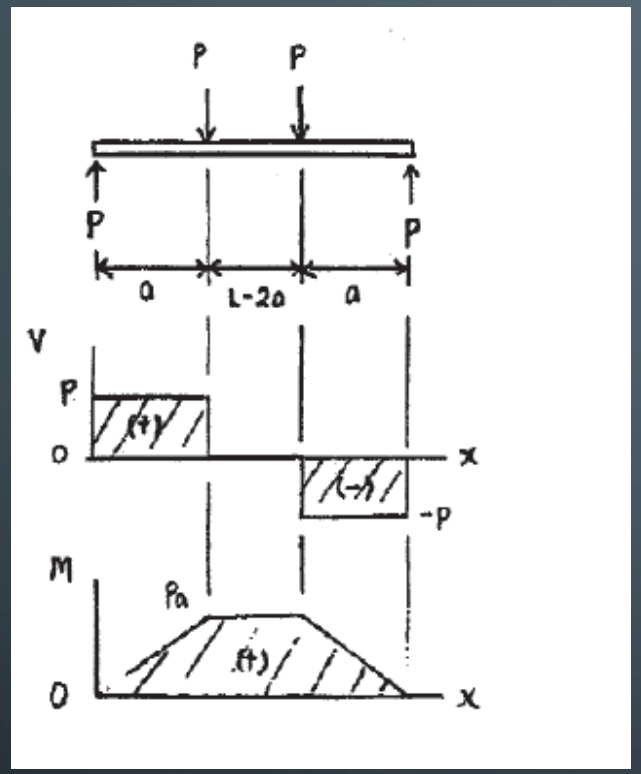
$\zeta + \Sigma M_E = 0; \quad M_E + 6(4) = 0$

$M_E = -24.0 \text{ kip} \cdot \text{ft}$

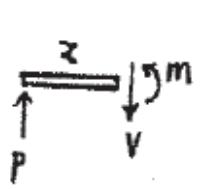


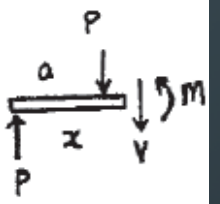
3 -





(a) For $0 \le x < a$





$+\uparrow \Sigma F_y = 0; \quad V = P$ **Ans.**

$\circlearrowleft +\Sigma M = 0; \quad M = Px$ **Ans.**

For $a < x < L - a$

$+\uparrow \Sigma F_y = 0; \quad V = 0$ **Ans.**

$\circlearrowleft +\Sigma M = 0; \quad -Px + P(x - a) + M = 0$

$M = Pa$ **Ans.**

For $L - a < x \le L$

$+\uparrow \Sigma F_y = 0; \quad V = -P$ **Ans.**

$\circlearrowleft +\Sigma M = 0; \quad -M + P(L - x) = 0$

$M = P(L - x)$ **Ans.**

Assignment problems