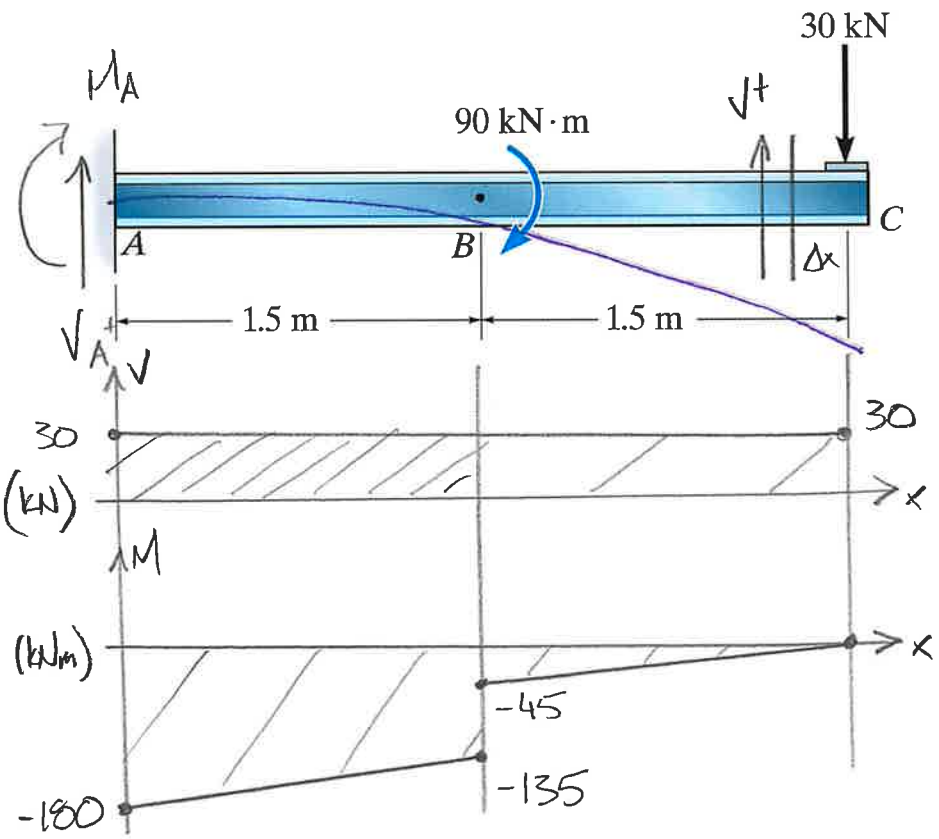
Example 7b-5: Use the conjugate beam method to determine the slope and displacement at point *C*. Assume that $E = 200$ GPa and $I = 300(10^6)$ mm^4.



$$\circlearrowleft +\Sigma M_A = 0 = -M_A - 90\,kN\cdot m - 30\,kN(3m)$$

$$M_A = -180\,kN\cdot m$$

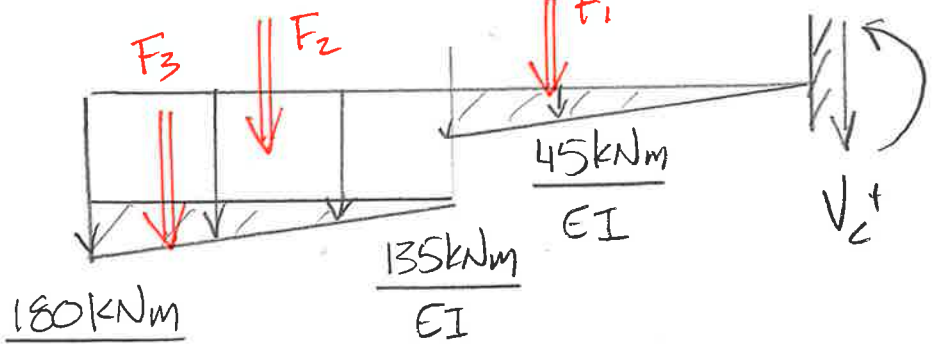
$$+\uparrow \Sigma F_y = 0 = V_A - 30\,kN \qquad V_A = 30\,kN$$

$$\circlearrowleft +\Sigma M_C = 0 = F_1(1m) + F_2(2.25m) + F_3(2.5) + M_C$$

$$M_C = -\frac{573.75\,kN\cdot m^3}{EI} \Rightarrow \theta_C$$

$$\theta_C = -\frac{573.75\,kN\cdot m^3}{200(10^6)\,kN/m^2 \;\; 300(10^6)\,mm^4}\left(\frac{10^3\,mm}{m}\right)^4$$

CONJUGATE BEAM



$$\theta_C = -0.0096\,m = -9.56\,mm$$

$$+\uparrow \Sigma F_y = 0 = -V_C - F_1 - F_2 - F_3 \qquad V_C = -\frac{270\,kN\cdot m^2}{EI}$$

$$\theta_C = -0.0045\ \text{RADIANS}$$

$$F_1 = \tfrac{1}{2}(1.5m)\frac{45\,kN\cdot m}{EI} = \frac{33.75\,kN\cdot m^2}{EI} \qquad F_3 = F_1 \qquad F_2 = 1.5m\left(\frac{135\,kN\cdot m}{EI}\right) = \frac{202.5\,kN\cdot m^2}{EI}$$