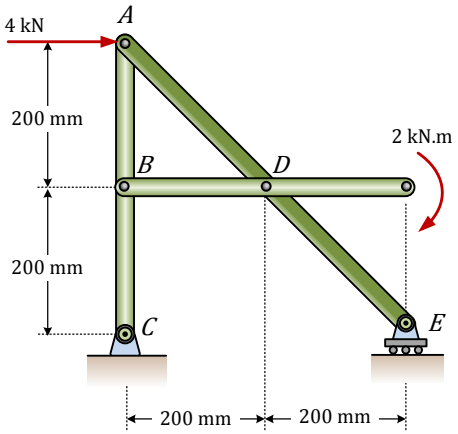
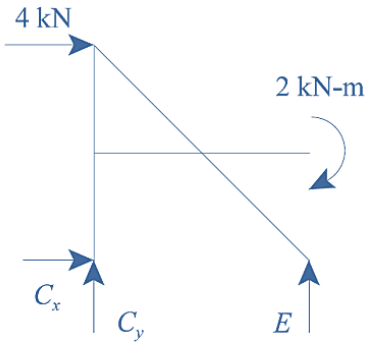
Question 4.7.



Determine the horizontal and vertical components of forces at pins B and C.

Solution

Draw the FBD of the entire structure



$+\rightarrow \sum F_x = 0$

$C_x + 4 = 0$

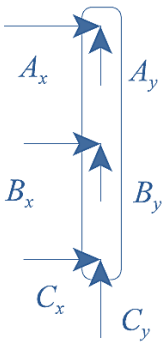
$C_x = -4 \text{ kN } (\rightarrow)$ (Answer)

$+\circlearrowleft \sum M_E = 0$

$-2 - C_y(0.4) - 4(0.4) = 0$

$C_y = -9 \text{ kN } (\uparrow)$ (Answer)

Draw the FBD of body ABC



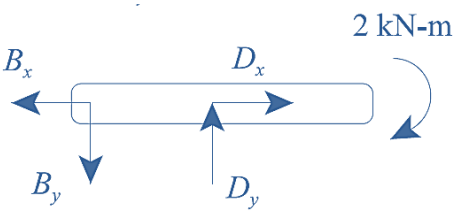
$+\circlearrowleft \sum M_A = 0$

$B_x(0.2) + C_x(0.4) = 0$

$B_x(0.2) + (-4)(0.4) = 0$

$B_x = 8 \text{ kN } (\rightarrow)$ (Answer)

Draw the FBD of body BD



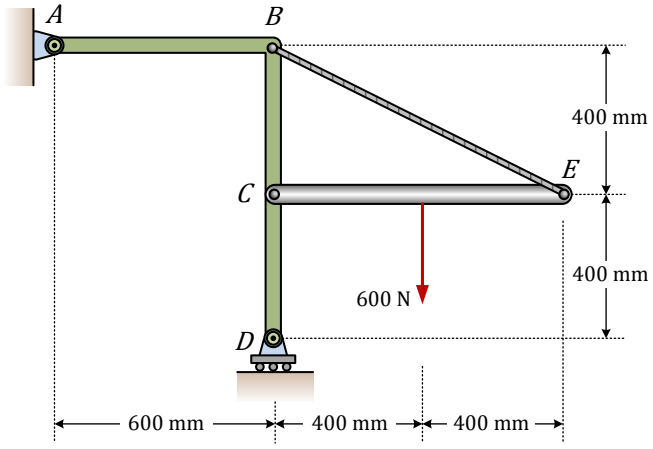
$+\circlearrowleft \sum M_D = 0$

$B_y(0.2) - 2 = 0$

$B_y = 10 \text{ kN } (\downarrow)$ (Answer)

Question 4.8.

Determine the reactions at member $ABCD$ at joints A, C and D.



Solution

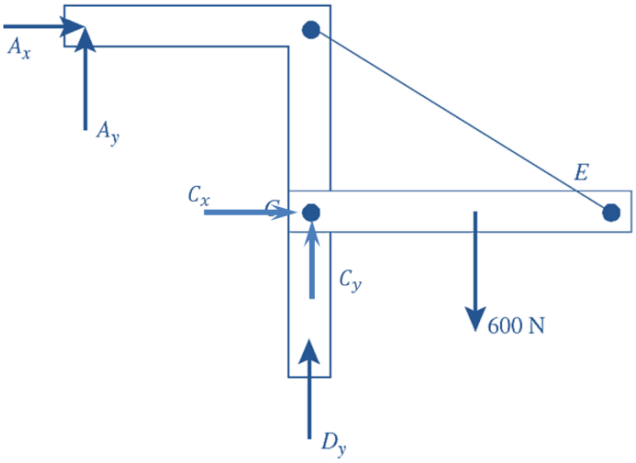
Solution

Draw the FBD of the entire structure

$+\circlearrowleft \sum M_A = 0$

$D_y(0.6) - 600(1) = 0$

$D_y = 1000 \text{ N } (\uparrow)$ (Answer)



$+\rightarrow \sum F_x = 0$

$A_x = 0$ (Answer)

$+\uparrow \sum F_y = 0$

$D_y + A_y - 600 = 0$

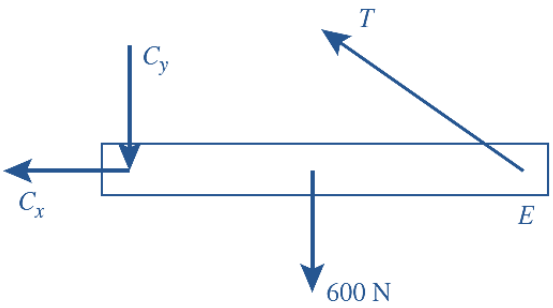
$A_y = -400 \text{ N } (\uparrow)$ (Answer)

Now examine bar CE. Note that the reactions on ABD are opposite to those on CE

$+\circlearrowleft \sum M_E = 0$

$600(0.4) + C_y(0.8) = 0$

$C_y = -300 \text{ N } (\downarrow)$ (Answer)



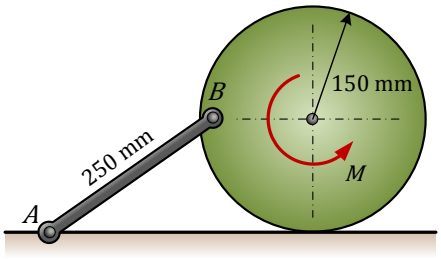
$+\circlearrowleft \sum M_B = 0$

$-C_x(0.4) - 600(0.4) = 0$

$C_x = -600 \text{ N } (\leftarrow)$ (Answer)

Question 4.9.

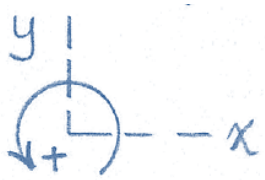
The strut AB of negligible mass is hinged to the horizontal surface at A and to the uniform 25 kg wheel at B. Determine the minimum couple M applied to the wheel which will cause it to slip if the coefficient of static friction between the wheel and the surface is 0.40.



Solution

$\sin\theta = \frac{150}{250} = 0.6$

$\cos\theta = 0.8$



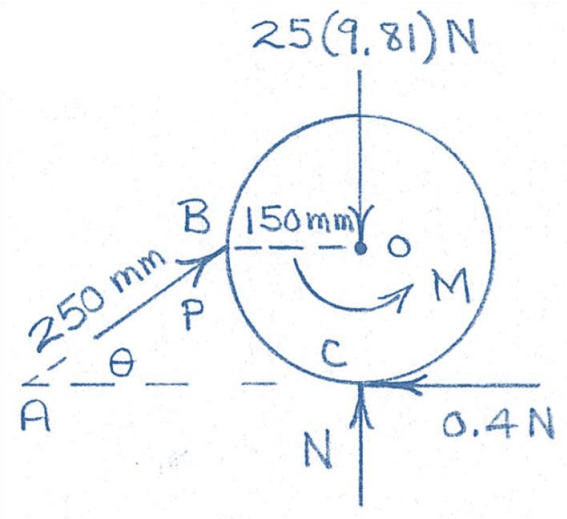
$\overline{AC} = \overline{AB}\cos\theta + 0.15$

$\overline{AC} = (0.25)0.8 + 0.15 = 0.35$ m

$+\rightarrow \sum F_x = 0$

$P\cos\theta - 0.4 = 0$

$P(0.8) - 0.4N = 0$ ------ (a)



$+\uparrow \sum F_y = 0$

$N + P(0.6) - 25(9.81) = 0$ ------ (b)

$+\circlearrowleft \sum M_A = 0$

$M - 25(9.81)(0.35) + N(0.35) = 0$ ------ (c)

Solving (a), (b) and(c) simultaneously

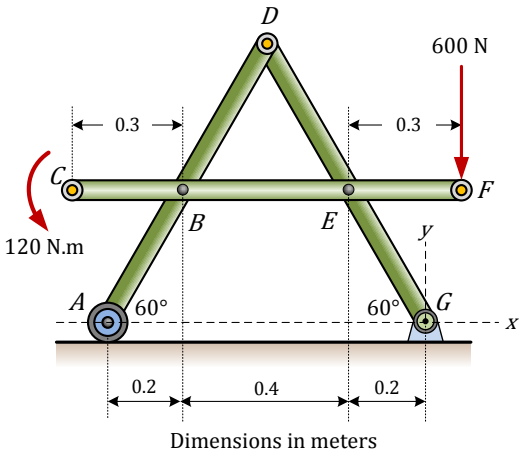
$N = 188.7$ N (Answer)

$M = 19.81$ N.m (Answer)

$P = 94.3$ N (Answer)

Question 4.10.

Calculate the x - and y - components of all forces acting on each member of the loaded frame.



Solution

As a whole

$+\circlearrowleft \sum M_G = 0$

$120 - A_y(0.8) - 600(0.1) = 0$

$A_y = 75$ N (Answer)

$+\uparrow \sum F_y = 0$

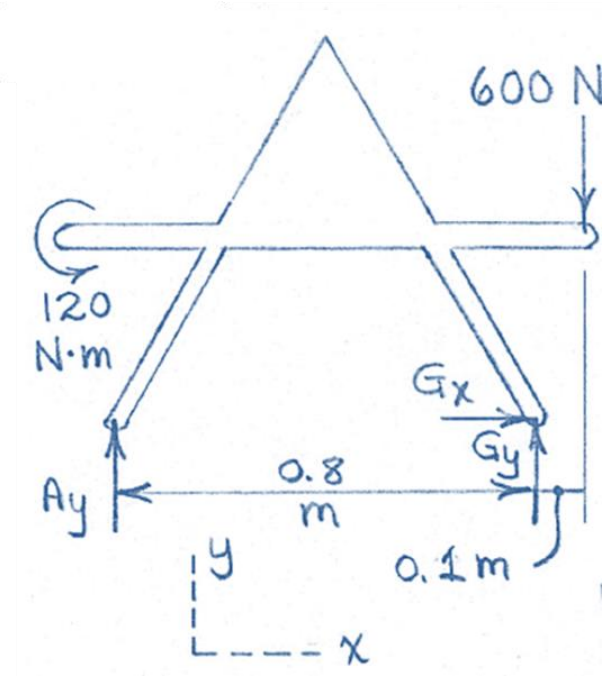
$G_y + A_y - 600 = 0$

$G_y + 75 - 600 = 0$

$G_y = 525$ N (Answer)

$+\rightarrow \sum F_x = 0$

$G_x = 0$ (Answer)



Member CF

$+\circlearrowleft \sum M_B = 0$

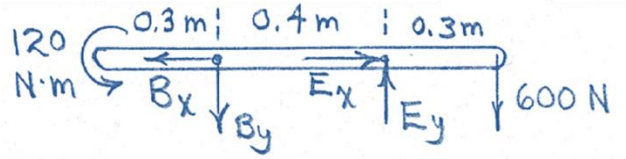
$120 + E_y(0.4) - 600(0.7) = 0$

$E_y = 750$ N (Answer)

$+\uparrow \sum F_y = 0$

$750 - 600 - B_y = 0$

$B_y = 150$ N (Answer)



Member AD

$+\uparrow \sum F_y = 0$

$75 - 150 - D_y = 0$

$D_y = 225$ N (Answer)

$+\circlearrowleft \sum M_B = 0$

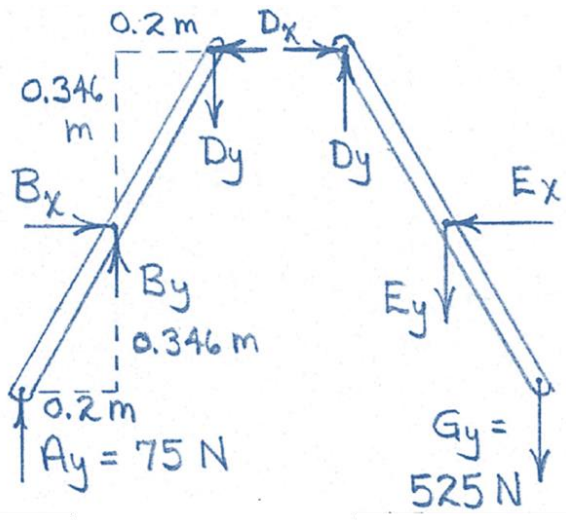
$0.346D_x + 0.2(225) - 0.2(75) = 0$

$D_x = 173.2$ N (Answer)

$+\rightarrow \sum F_x = 0$

$B_x - 173.2 = 0$

$B_x = 173.2$ N (Answer)



Member DG

$+\rightarrow \sum F_x = 0$

$173.2 - E_x = 0$

$E_x = 173.2$ N (Answer)