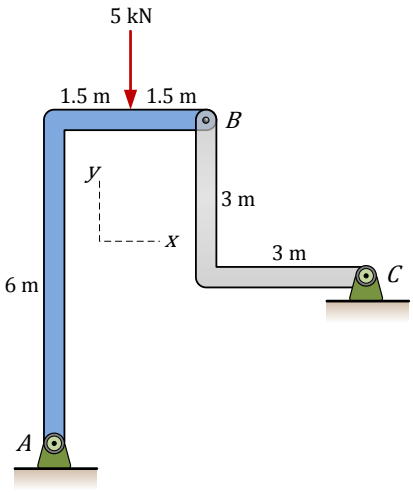
Question 4.11.

Determine the components of all forces acting on each member of the loaded frame.



Solution

BC is a two force member

$+\circlearrowleft \sum M_A = 0$

$-5(1.5) + B\cos 45°\,(6) + B\sin 45°\,(3) = 0$

$B = 1.179 \text{ kN}$

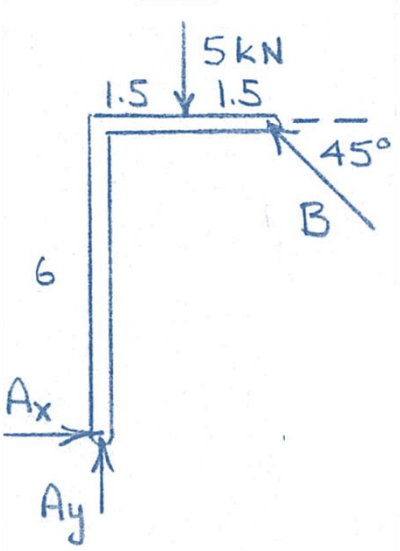
Resolving into components

$B_x = -B\cos 45°$

$B_x = -0.833 \text{ kN}$ (Answer)

$B_y = B\sin 45°$

$B_y = 0.833 \text{ kN}$ (Answer)



$+\uparrow \sum F_y = 0$

$A_y + B\sin 45° - 5 = 0$

$A_y + (1.179)\sin 45° - 5 = 0$

$A_y = 4.166 \text{ kN}$ (Answer)

$+\rightarrow \sum F_x = 0$

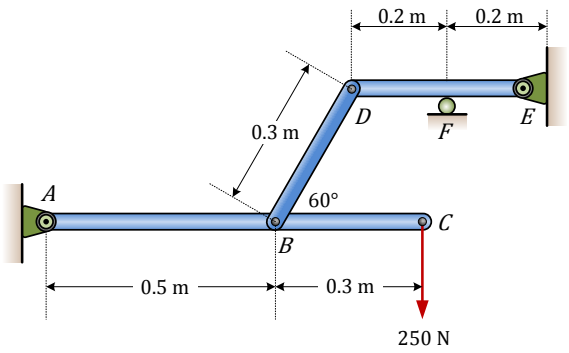
$A_x - B\cos 45° = 0$

$A_x - B\cos 45° = 0$

$A_x = 0.833 \text{ kN}$ (Answer)

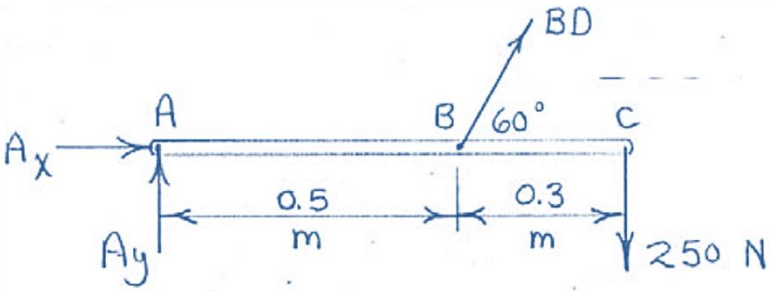
Question 4.12.

Determine the reaction at the roller F for the frame loaded as shown.



Solution

Consider member ABC

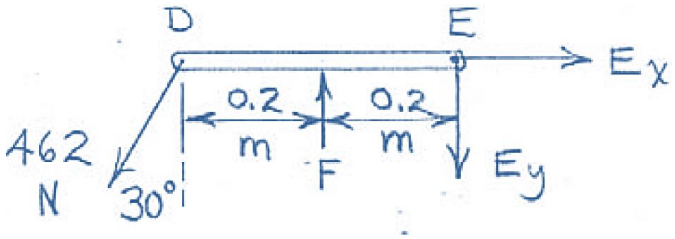


$+\circlearrowleft \sum M_A = 0$

$-250(0.8) + BD \sin 60°\,(0.5) = 0$

$BD = 462$ N

Consider member DE



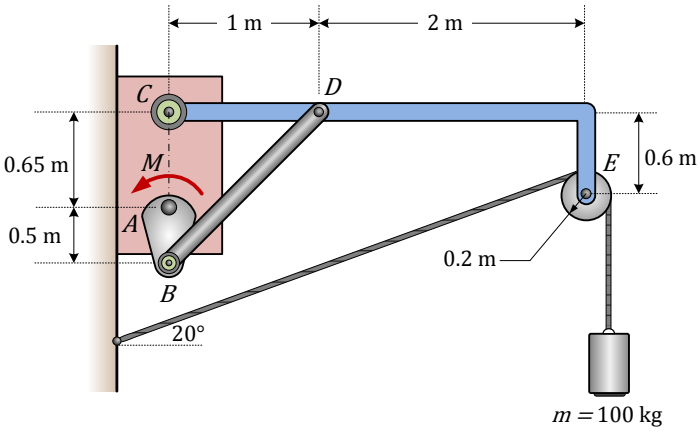
$+\circlearrowleft \sum M_E = 0$

$462 \cos 30°\,(0.4) - F(0.2) = 0$

$F = 800.2$ N (Answer)

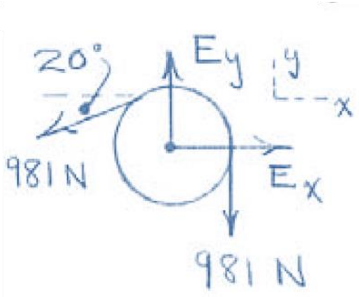
Question 4.13.

The cable makes 20° angle with the horizontal and the beam CD is horizontal, when the crank AB is vertical. Calculate the moment M required for the frame to be in equilibrium.



Solution

FBD of the pulley



$+\rightarrow \sum F_x = 0$

$E_x - 981\cos 20° = 0$

$E_x = 922$ N

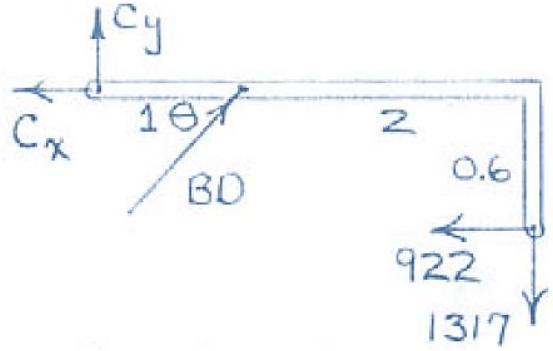
$+\uparrow \sum F_y = 0$

$E_y - 981\sin 20° - 981 = 0$

$E_y = 1317$ N

FBD of member CDE

$\theta = \tan^{-1}\left(\frac{1.15}{1}\right) = 48.99°$

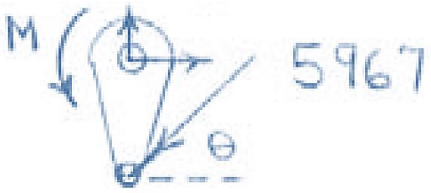


$+\circlearrowleft \sum M_C = 0$

$-1317(3) - 922(0.6) + BD\sin 48.99° = 0$

$BD = 5967$ N

FBD of crank AB



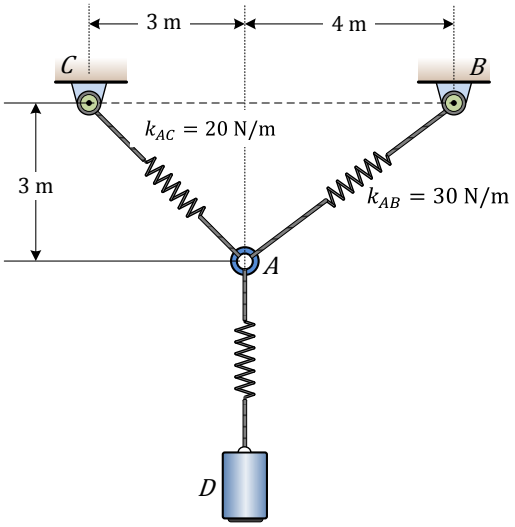
$+\circlearrowleft \sum M_A = 0$

$M - 5967\cos 48.99°\,(0.5) = 0$

$M = 1958$ N. m (Answer)

Question 4.14.

Determine the mass of the block at D, if the block is held in the equilibrium position shown. The spring AB is 3 m long when unstretched.



Solution

$F = kx = 30(5 - 3) = 60$ N

$+\rightarrow \sum F_x = 0$

$T\cos 45° - 60\left(\frac{4}{5}\right) = 0$

$T = 67.88$ N

$+\uparrow \sum F_y = 0$

$67.88\sin 45° - W + 60\left(\frac{3}{5}\right) = 0$

$W = 84$ N

$m = \frac{W}{g}$

$m = \frac{84}{9.81} = 8.56$ kg

(Answer)