

# *VECTOR MECHANICS FOR ENGINEERS: STATICS*

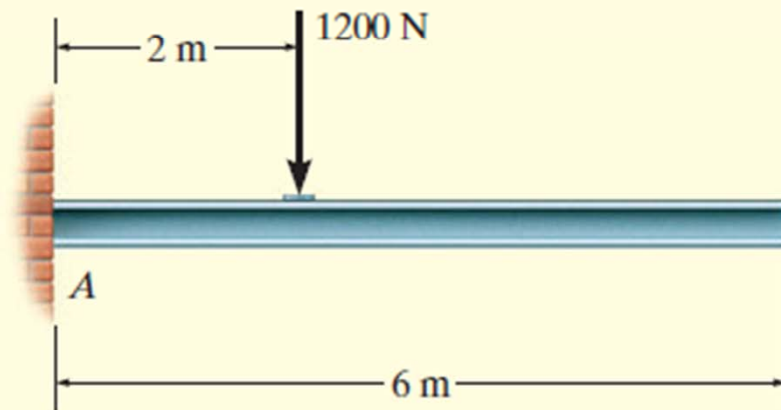
## **Chapter 4:**

Equilibrium of Rigid  
Bodies **Extra Examples**

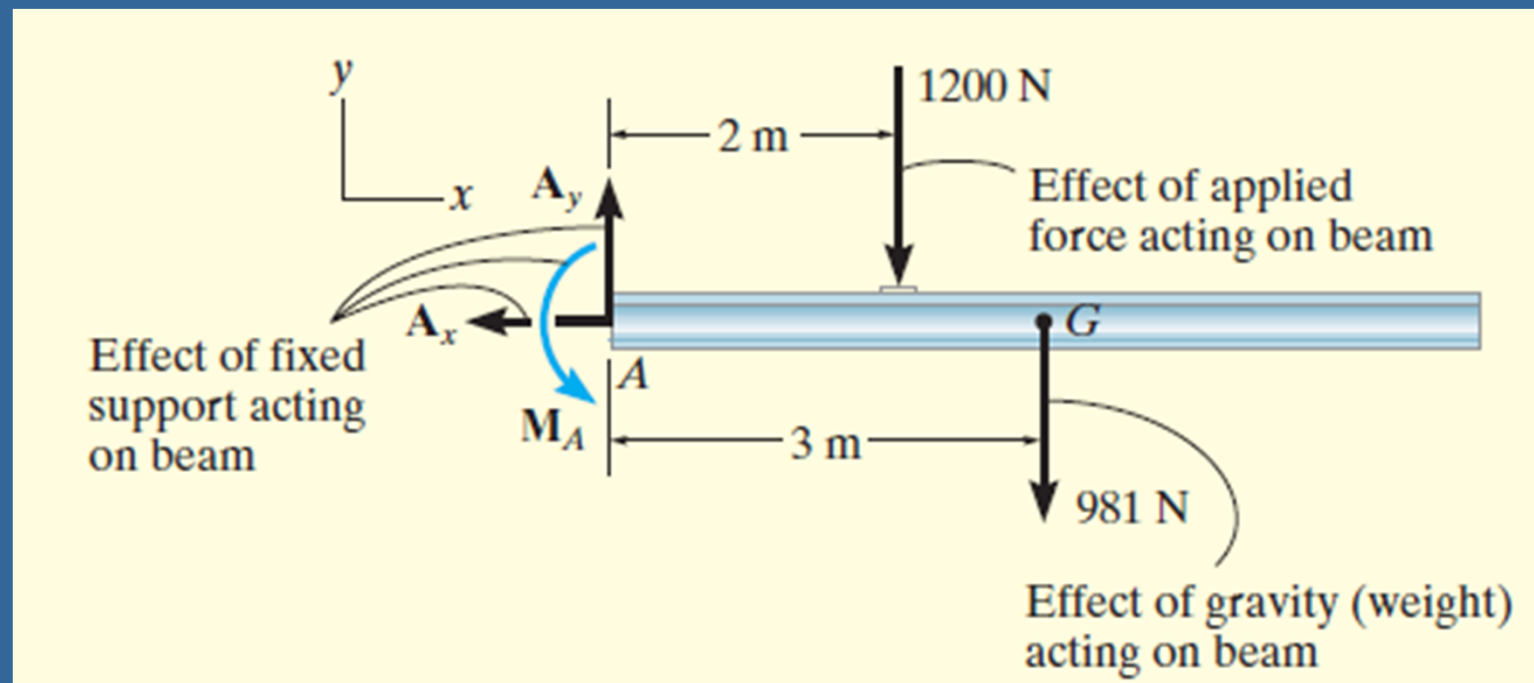
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## Sample 1:

Draw the free-body diagram of the uniform beam shown in Fig. The beam has a mass of 100 kg.

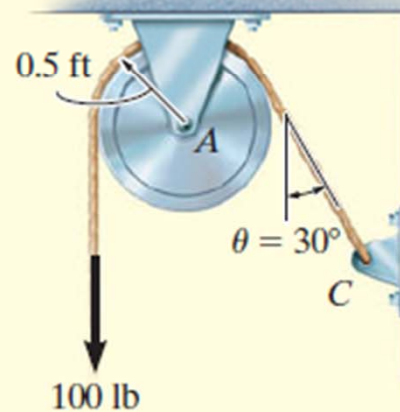


# Sample 1:



## Sample 4:

The cord shown in Fig. supports a force of 100 lb and wraps over the frictionless pulley. Determine the tension in the cord at  $C$  and the horizontal and vertical components of reaction at pin  $A$ .



## Sample 4:

$$\curvearrowleft + \sum M_A = 0; \quad 100 \text{ lb} (0.5 \text{ ft}) - T(0.5 \text{ ft}) = 0$$

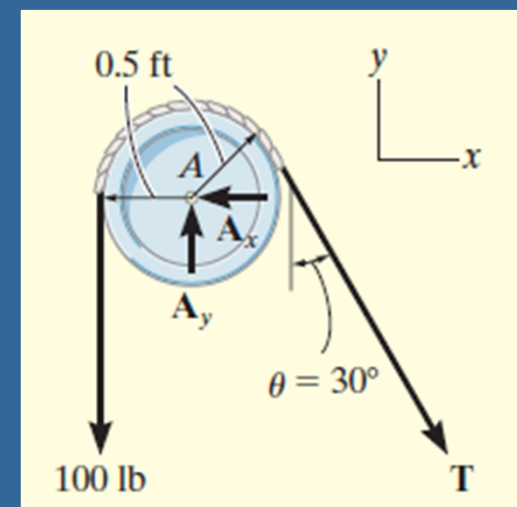
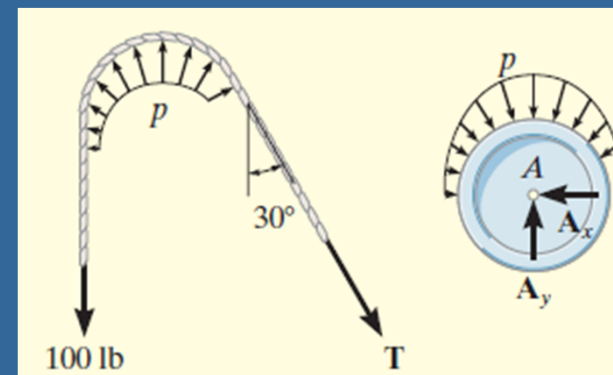
$$T = 100 \text{ lb}$$

$$\rightarrow + \sum F_x = 0; \quad -A_x + 100 \sin 30^\circ \text{ lb} = 0$$

$$A_x = 50.0 \text{ lb}$$

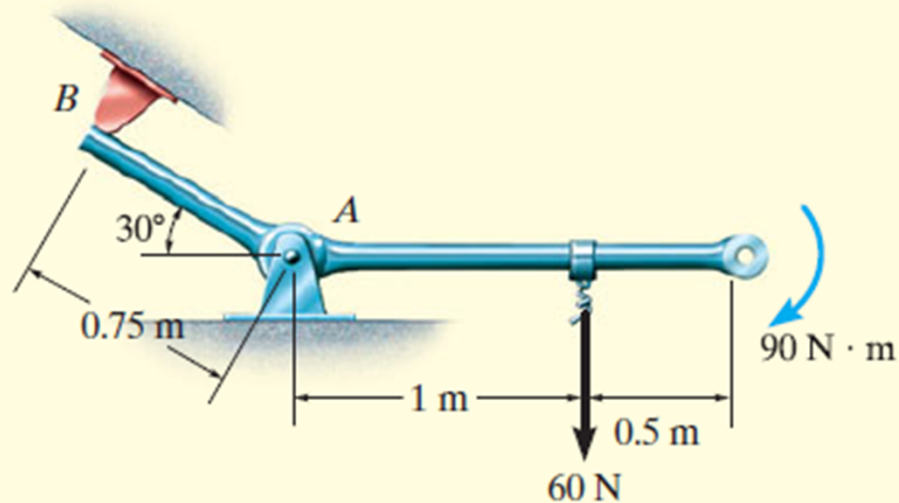
$$+ \uparrow \sum F_y = 0; \quad A_y - 100 \text{ lb} - 100 \cos 30^\circ \text{ lb} = 0$$

$$A_y = 187 \text{ lb}$$



## Sample 5:

The member shown in Fig. is pin connected at  $A$  and rests against a smooth support at  $B$ . Determine the horizontal and vertical components of reaction at the pin  $A$ .



# Sample 5:

$$\zeta + \Sigma M_A = 0; \quad -90 \text{ N} \cdot \text{m} - 60 \text{ N}(1 \text{ m}) + N_B(0.75 \text{ m}) = 0$$

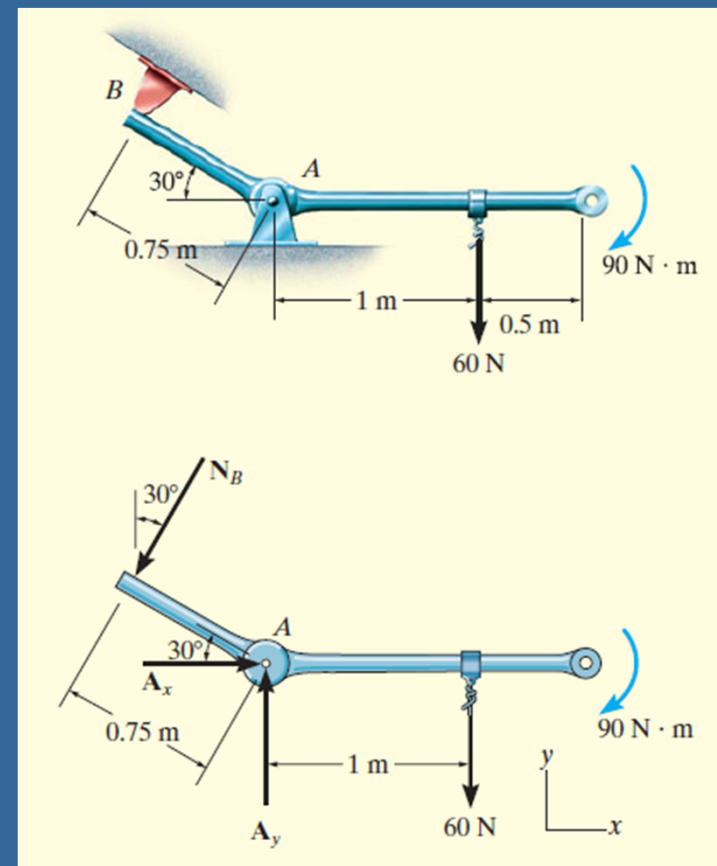
$$N_B = 200 \text{ N}$$

$$\rightarrow \Sigma F_x = 0; \quad A_x - 200 \sin 30^\circ \text{ N} = 0$$

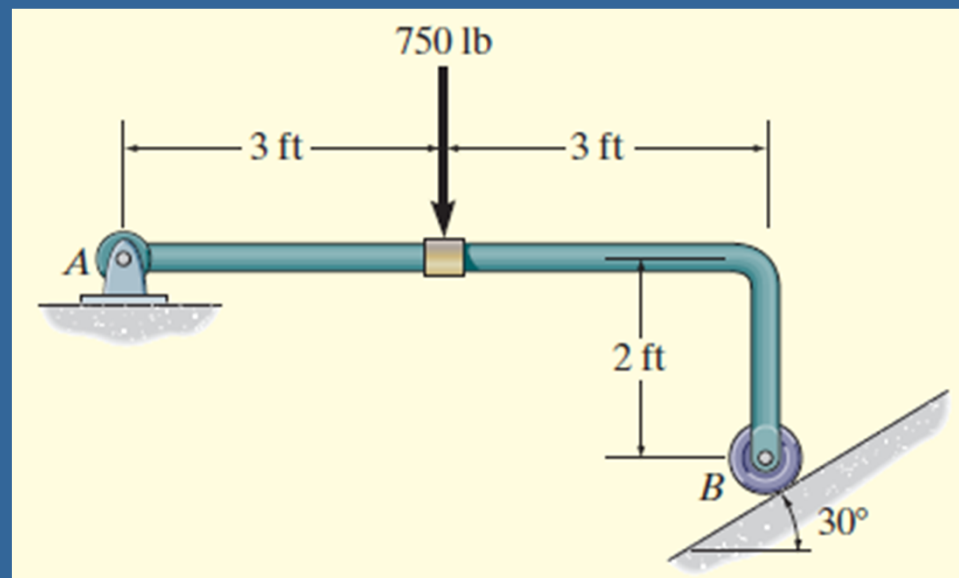
$$A_x = 100 \text{ N}$$

$$+\uparrow \Sigma F_y = 0; \quad A_y - 200 \cos 30^\circ \text{ N} - 60 \text{ N} = 0$$

$$A_y = 233 \text{ N}$$



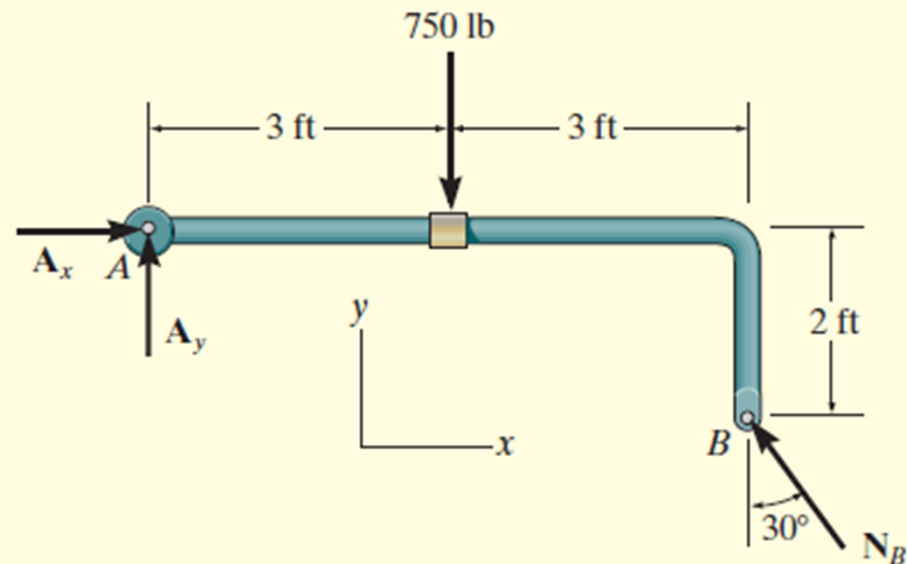
## Sample 6:



Determine the horizontal and vertical components of reaction on the member at the pin  $A$ , and the normal reaction at the roller  $B$  in Fig.



## Sample 6:



$$\zeta + \Sigma M_A = 0;$$

$$[N_B \cos 30^\circ](6 \text{ ft}) - [N_B \sin 30^\circ](2 \text{ ft}) - 750 \text{ lb}(3 \text{ ft}) = 0$$

$$N_B = 536.2 \text{ lb} = 536 \text{ lb}$$

$$\rightarrow \Sigma F_x = 0; \quad A_x - (536.2 \text{ lb}) \sin 30^\circ = 0$$

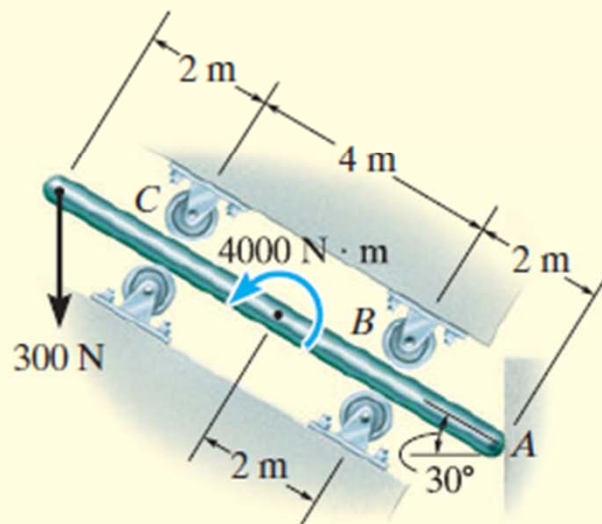
$$A_x = 268 \text{ lb}$$

$$+\uparrow \Sigma F_y = 0; \quad A_y + (536.2 \text{ lb}) \cos 30^\circ - 750 \text{ lb} = 0$$

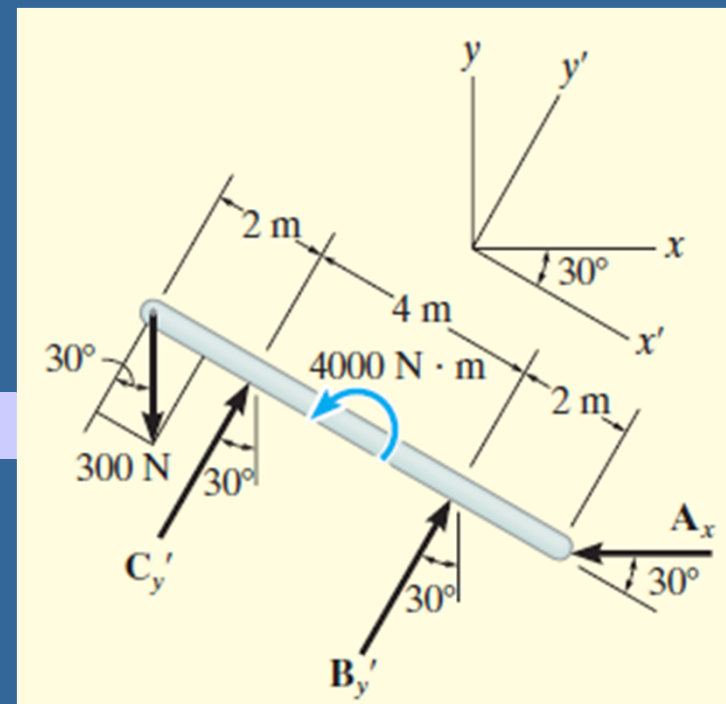
$$A_y = 286 \text{ lb}$$

## Sample 7:

The uniform smooth rod shown in Fig. is subjected to a force and couple moment. If the rod is supported at  $A$  by a smooth wall and at  $B$  and  $C$  either at the top or bottom by rollers, determine the reactions at these supports. Neglect the weight of the rod.



## Sample 7:



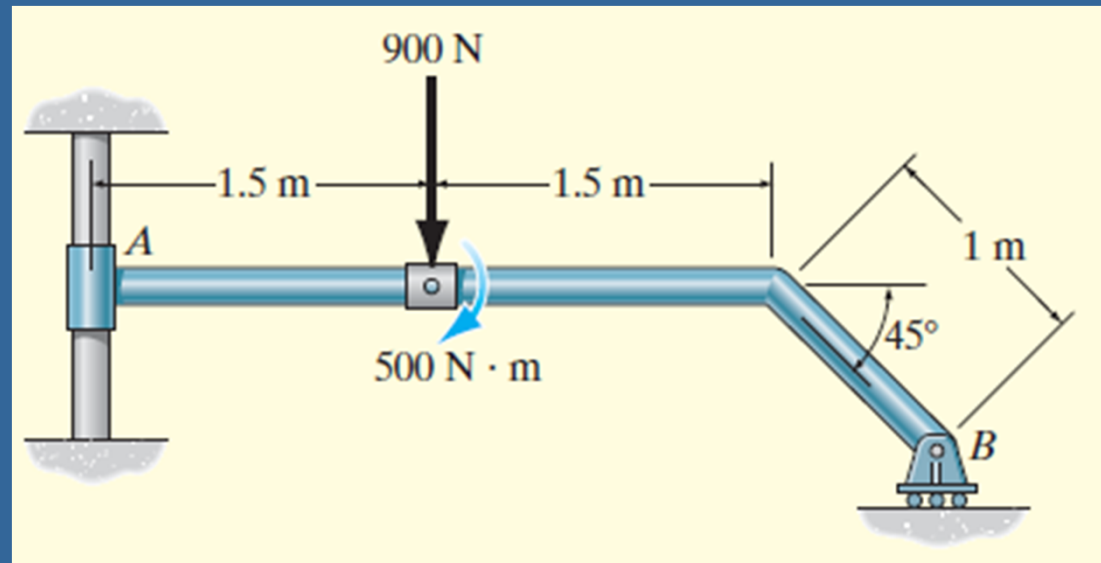
$$\begin{aligned} \rightarrow \Sigma F_x &= 0; & C_{y'} \sin 30^\circ + B_{y'} \sin 30^\circ - A_x &= 0 \\ + \uparrow \Sigma F_y &= 0; & -300 \text{ N} + C_{y'} \cos 30^\circ + B_{y'} \cos 30^\circ &= 0 \\ \curvearrowright + \Sigma M_A &= 0; & -B_{y'}(2 \text{ m}) + 4000 \text{ N} \cdot \text{m} - C_{y'}(6 \text{ m}) \\ & & + (300 \cos 30^\circ \text{ N})(8 \text{ m}) &= 0 \end{aligned}$$

$$B_{y'} = -1000.0 \text{ N} = -1 \text{ kN}$$

$$C_{y'} = 1346.4 \text{ N} = 1.35 \text{ kN}$$

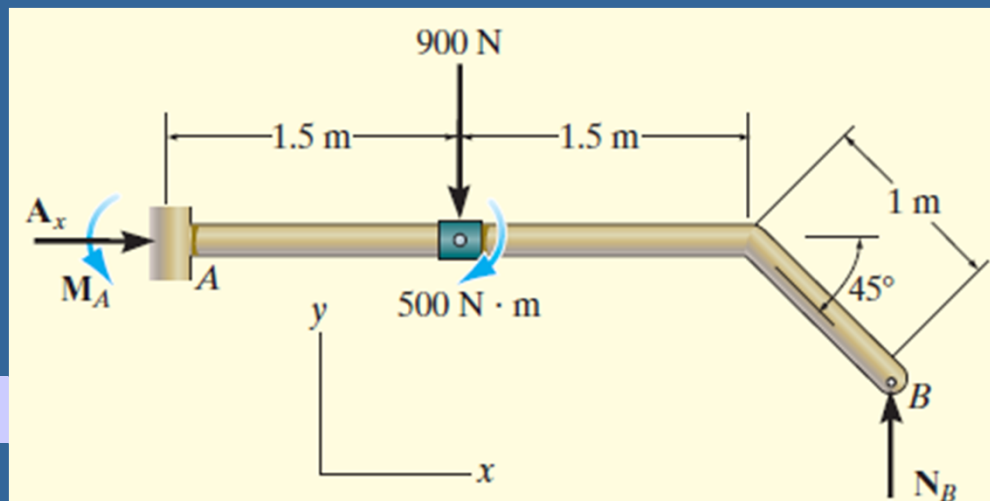
$$\begin{aligned} 1346.4 \sin 30^\circ \text{ N} + (-1000.0 \sin 30^\circ \text{ N}) - A_x &= 0 \\ A_x &= 173 \text{ N} \end{aligned}$$

## Sample 8:



Determine the support reactions on the member in Fig. The collar at *A* is fixed to the member and can slide vertically along the vertical shaft.

## Sample 8:



$$\begin{aligned} \rightarrow \Sigma F_x &= 0; & A_x &= 0 \\ +\uparrow \Sigma F_y &= 0; & N_B - 900 \text{ N} &= 0 \\ & & N_B &= 900 \text{ N} \end{aligned}$$

$$\begin{aligned} \zeta + \Sigma M_A &= 0; \\ M_A - 900 \text{ N}(1.5 \text{ m}) - 500 \text{ N} \cdot \text{m} + 900 \text{ N} [3 \text{ m} + (1 \text{ m}) \cos 45^\circ] &= 0 \\ M_A &= -1486 \text{ N} \cdot \text{m} = 1.49 \text{ kN} \cdot \text{m} \curvearrowright \end{aligned}$$

$$\begin{aligned} \zeta + \Sigma M_B &= 0; & M_A + 900 \text{ N} [1.5 \text{ m} + (1 \text{ m}) \cos 45^\circ] - 500 \text{ N} \cdot \text{m} &= 0 \\ M_A &= -1486 \text{ N} \cdot \text{m} = 1.49 \text{ kN} \cdot \text{m} \curvearrowright \end{aligned}$$