VECTOR MECHANICS FOR ENGINEERS: **STATICS**

Chapter 4:

Equilibrium of Rigid Bodies Extra Examples

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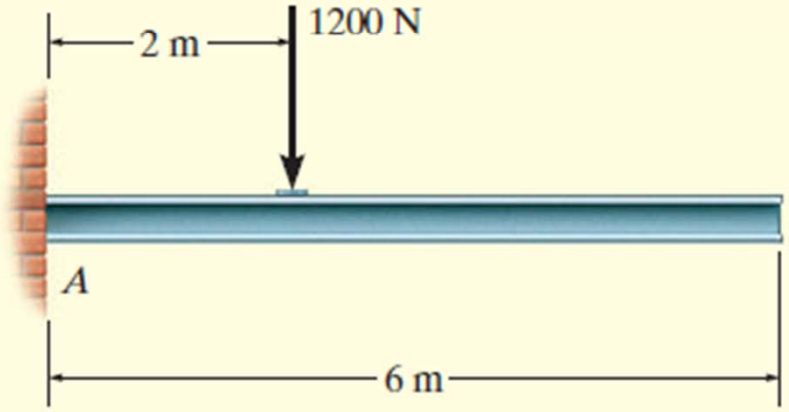
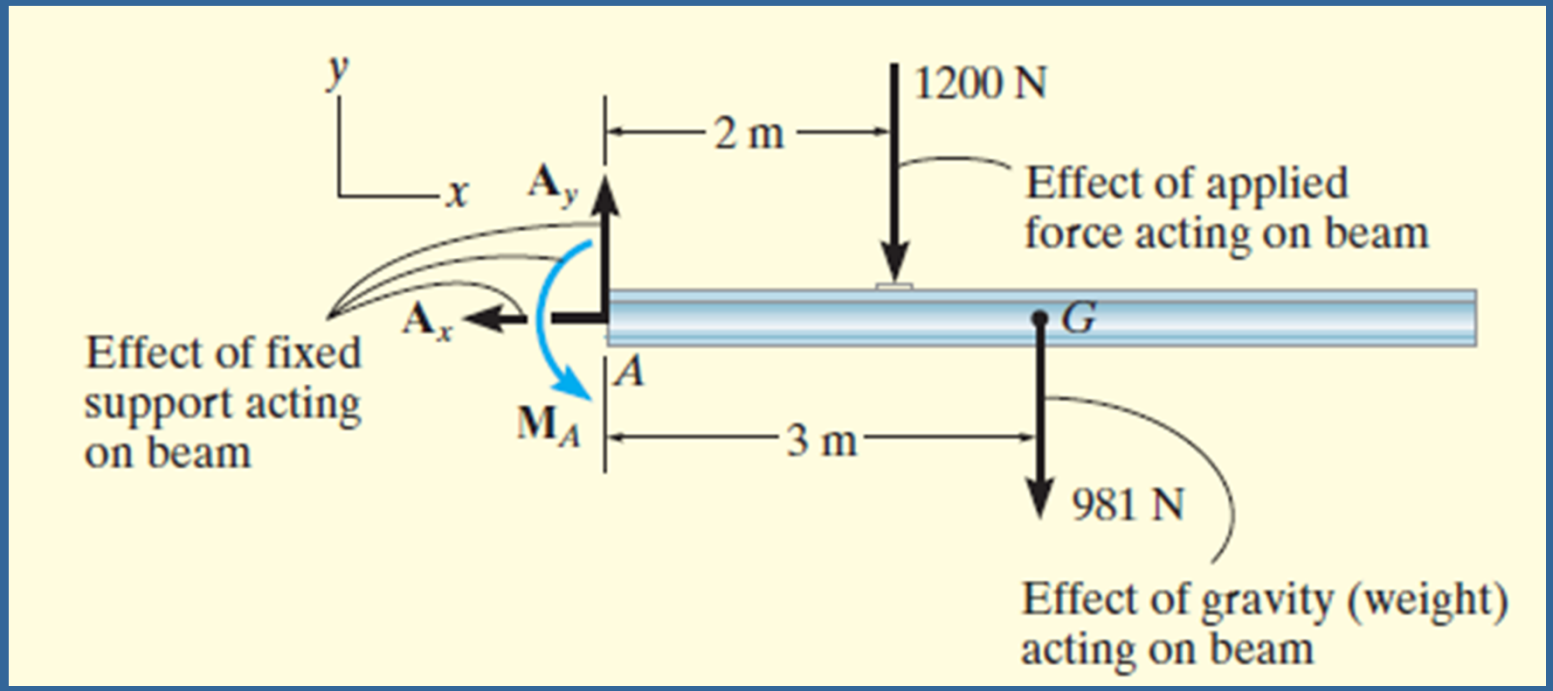
Sample 1:

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

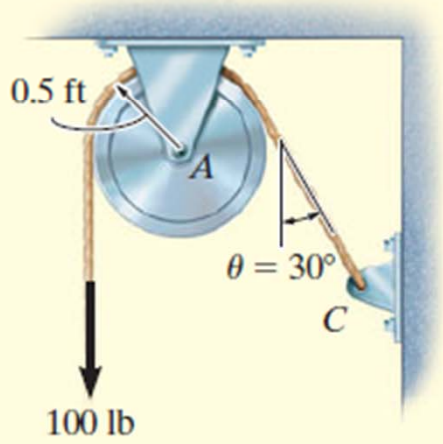


Sample 1:

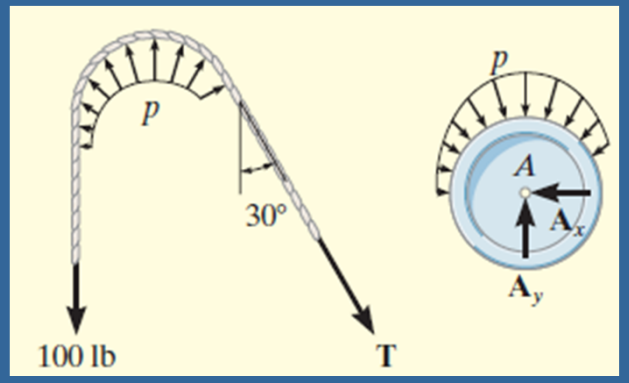

y
x
A_y
2 m
1200 N
Effect of applied
force acting on beam
A_x
G
Effect of fixed
support acting
on beam
A
M_A
3 m
981 N
Effect of gravity (weight)
acting on beam

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.



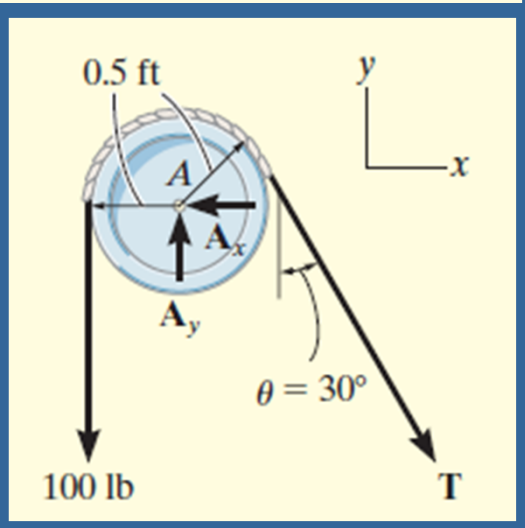
Sample 4:



$$\circlearrowleft +\Sigma M_A = 0; \qquad 100\ \text{lb}\,(0.5\ \text{ft}) - T(0.5\ \text{ft}) = 0$$
$$T = 100\ \text{lb}$$

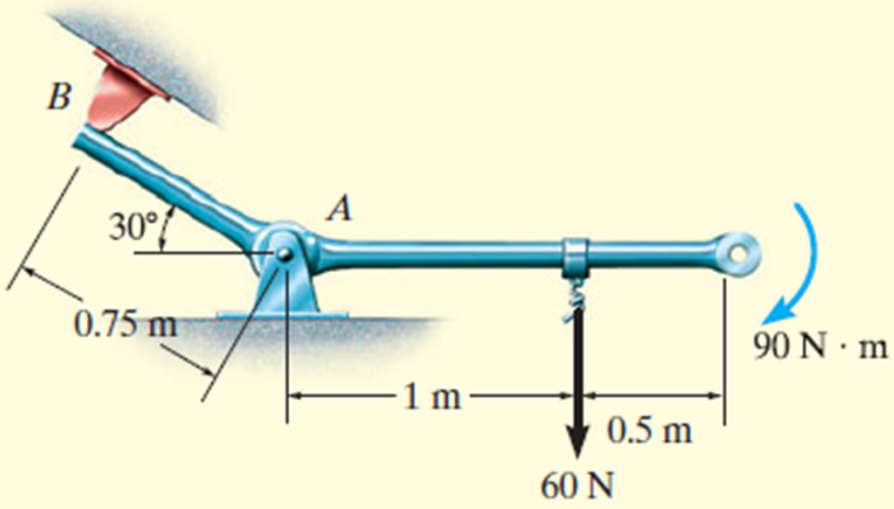
$$\pm\rightarrow \Sigma F_x = 0; \qquad -A_x + 100 \sin 30°\ \text{lb} = 0$$
$$A_x = 50.0\ \text{lb}$$

$$+\uparrow \Sigma F_y = 0; \qquad A_y - 100\ \text{lb} - 100 \cos 30°\ \text{lb} = 0$$
$$A_y = 187\ \text{lb}$$



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:

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

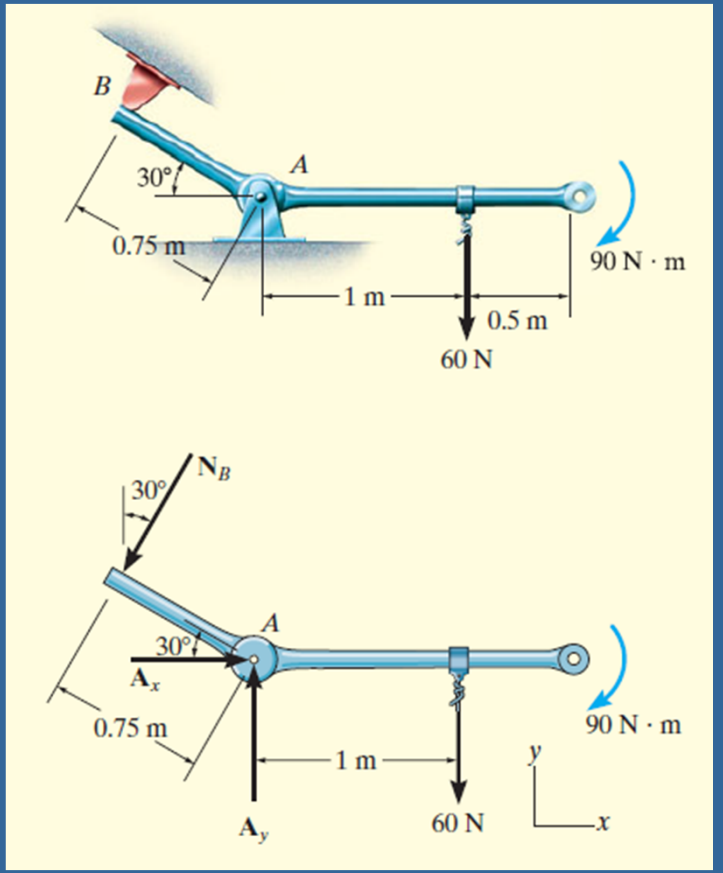
$$N_B = 200\ \text{N}$$

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

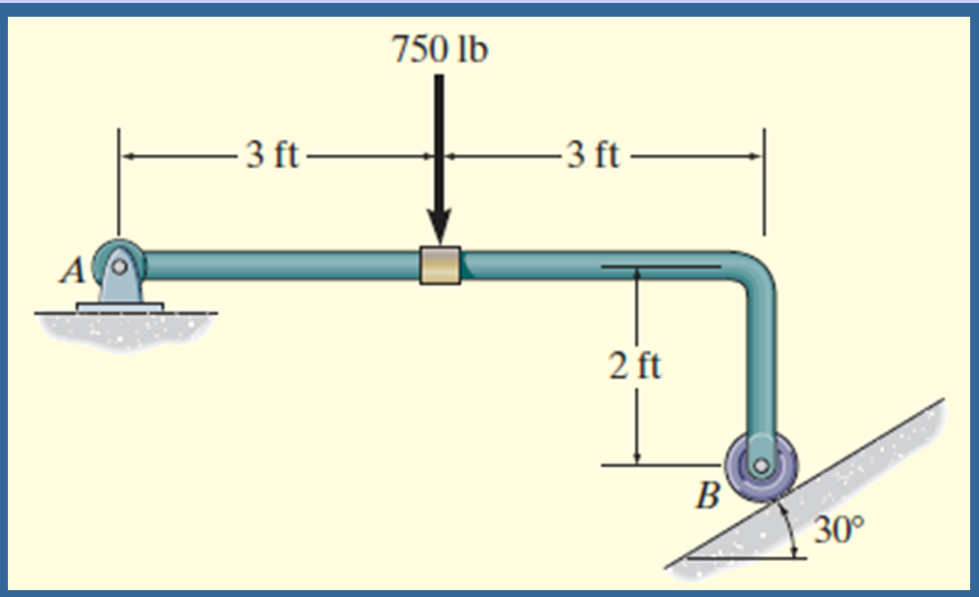
$$A_x = 100\ \text{N}$$

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

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

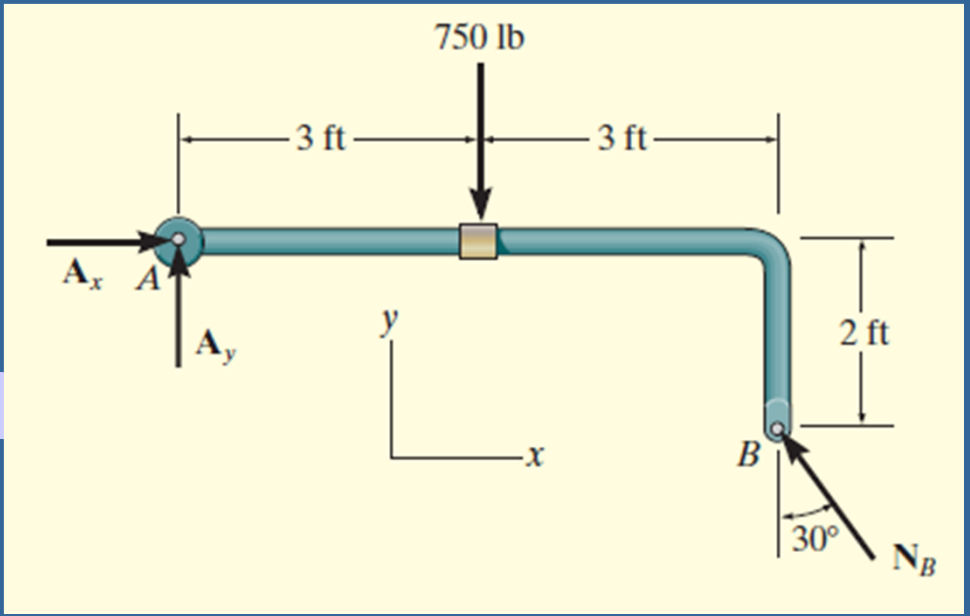


Sample 6:



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:



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

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

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

$$\overset{+}{\rightarrow} \Sigma F_x = 0; \qquad A_x - (536.2 \text{ lb}) \sin 30° = 0$$

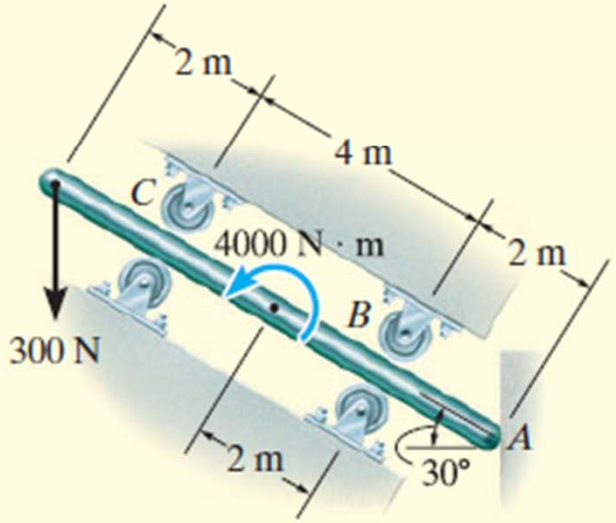
$$A_x = 268 \text{ lb}$$

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

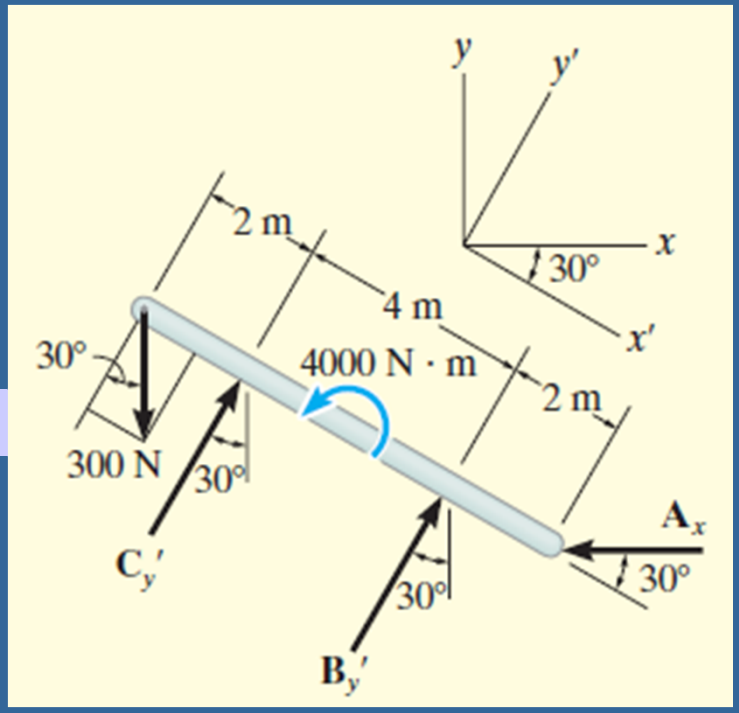
$$A_y = 286 \text{ lb}$$

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:



$$\overset{+}{\rightarrow} \Sigma F_x = 0; \qquad C_{y'} \sin 30° + B_{y'} \sin 30° - A_x = 0$$

$$+\uparrow \Sigma F_y = 0; \qquad -300 \text{ N} + C_{y'} \cos 30° + B_{y'} \cos 30° = 0$$

$$\circlearrowleft + \Sigma M_A = 0; \qquad -B_{y'}(2 \text{ m}) + 4000 \text{ N} \cdot \text{m} - C_{y'}(6 \text{ m}) + (300 \cos 30° \text{ N})(8 \text{ m}) = 0$$

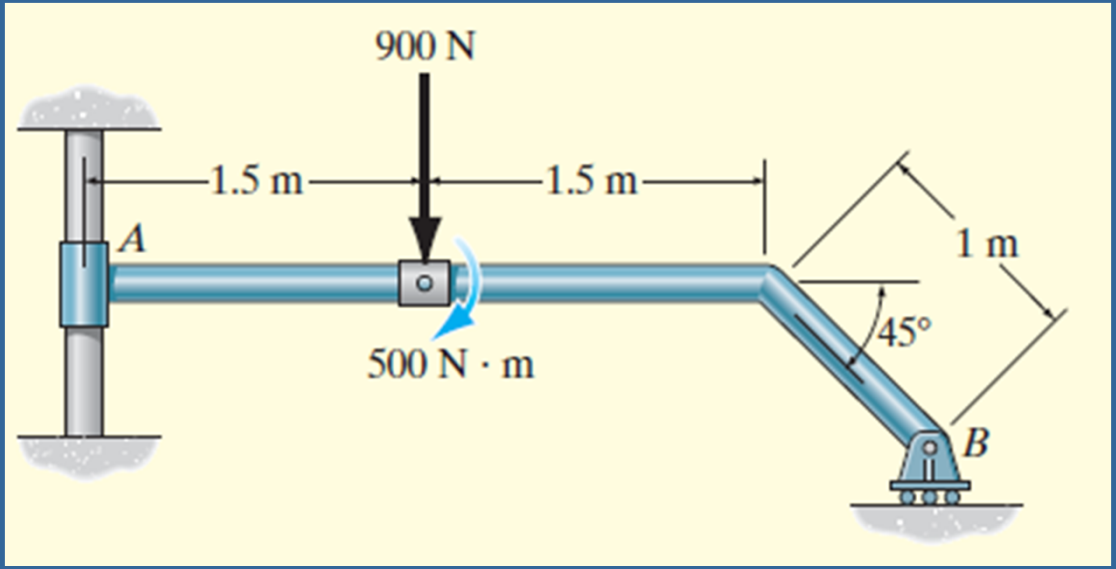
$$B_{y'} = -1000.0 \text{ N} = -1 \text{ kN}$$

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

$$1346.4 \sin 30° \text{ N} + (-1000.0 \sin 30° \text{ N}) - A_x = 0$$

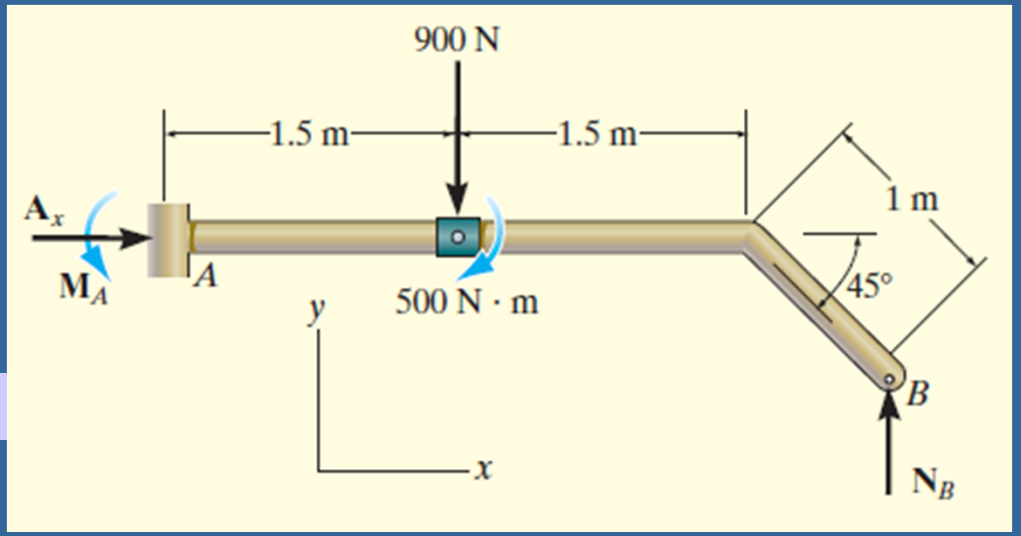
$$A_x = 173 \text{ N}$$

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:



$$\overset{+}{\rightarrow} \Sigma F_x = 0; \qquad A_x = 0$$

$$+\uparrow \Sigma F_y = 0; \qquad N_B - 900\ \text{N} = 0$$

$$N_B = 900\ \text{N}$$

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

$$M_A - 900\ \text{N}(1.5\ \text{m}) - 500\ \text{N} \cdot \text{m} + 900\ \text{N}\,[3\ \text{m} + (1\ \text{m})\cos 45°] = 0$$

$$M_A = -1486\ \text{N} \cdot \text{m} = 1.49\ \text{kN} \cdot \text{m} \circlearrowright$$

$$\zeta + \Sigma M_B = 0; \quad M_A + 900\ \text{N}\,[1.5\ \text{m} + (1\ \text{m})\cos 45°] - 500\ \text{N} \cdot \text{m} = 0$$

$$M_A = -1486\ \text{N} \cdot \text{m} = 1.49\ \text{kN} \cdot \text{m} \circlearrowright$$