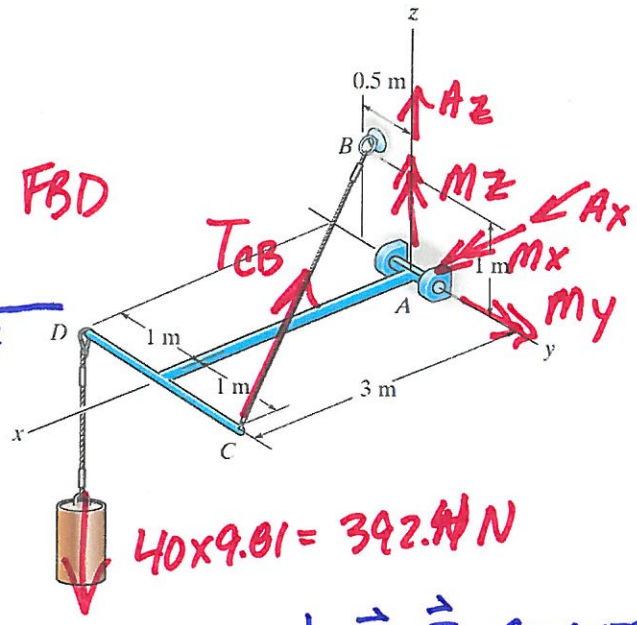
*5–76.

The member is supported by a pin at A and cable BC. Determine the components of reaction at these supports if the cylinder has a mass of 40 kg.



FBD

NONCONCURRENT

6 EQNS, 6 UNKS ☺

$\vec{r}_{CB} = [-3 \;\; -1.5 \;\; 1]$ $\quad |\vec{r}_{CB}| = \sqrt{3^2+1.5^2+1^2} = 3.5$

$\hat{u}_{CB} = \left[\frac{-3}{3.5} \;\; \frac{-1.5}{3.5} \;\; \frac{1}{3.5}\right]$

or $\left[\frac{-6}{7} \;\; \frac{-3}{7} \;\; \frac{2}{7}\right]$

FORCES, REACTIONS MOMENTS	$\vec{r}_{AF}$	$\vec{F}$	$\vec{r}\times\vec{F}$, COUPLES MOMENT REACTIONS
$\vec{R}_A$	—	$[A_x \;\; A_y \;\; A_z]$	—
$\vec{M}_A$	—	—	$[M_x \;\; 0 \;\; M_z]$
392.4	$[3 \;\; -1 \;\; 0]$	$[0 \;\; 0 \;\; -392.4]$	$[392.4 \;\; 1177.2 \;\; 0]$
$\vec{T}_{CB}$	$[0 \;\; -.5 \;\; 1]$	$\left[\frac{-6}{7} \;\; \frac{-3}{7} \;\; \frac{2}{7}\right]T_{CB}$	$[0.2857 \;\; -0.857 \;\; -0.428]T_{CB}$

$\Sigma M_y = 0$ $\quad 0 + 1177.2 - 0.857\,T_{CB} = 0$ $\quad T_{CB} = 1374\ N$

$\Sigma M_x = 0$ $\quad M_x + 392.4 + 0.2857\,T_{CB} = 0$ $\quad M_x = -785\ N\cdot m$

$\Sigma M_z = 0$ $\quad M_z + 0 - 0.428\,T_{CB} = 0$ $\quad M_z = 588\ N\cdot m$

$\Sigma F_x = 0$ $\quad A_x + 0 - \frac{6}{7}T_{CB} = 0$ $\quad A_x = 1177\ N$

$\Sigma F_y = 0$ $\quad A_y + 0 - \frac{3}{7}T_{CB} = 0$ $\quad A_y = 589\ N$

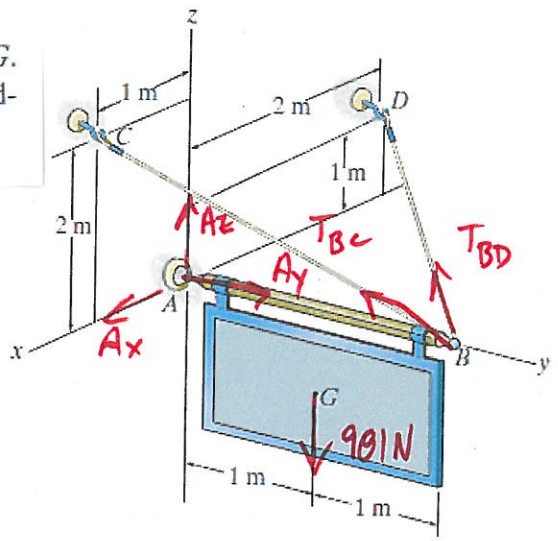
$\Sigma F_z = 0$ $\quad A_z - 392.4 + \frac{2}{7}T_{CB} = 0$ $\quad A_z = 0$

$\vec{R}_A = [1177 \;\; 589 \;\; 0]\ N\cdot m$

$\vec{M}_A = [-785 \;\; 0 \;\; 588]\ N\cdot m$

5–82.

The sign has a mass of 100 kg with center of mass at G. Determine the x, y, z components of reaction at the ball-and-socket joint A and the tension in wires BC and BD.



$\vec{BD} = [-2 \;\; -2 \;\; 1]$

$\hat{u}_{BD} = \dfrac{[-2 \;\; -2 \;\; 1]}{\sqrt{9}} = \left[-\frac{2}{3} \;\; -\frac{2}{3} \;\; \frac{1}{3}\right]$

$\vec{BC} = [1 \;\; -2 \;\; 2]$

$\hat{u}_{BC} = \dfrac{[1 \;\; -2 \;\; 2]}{\sqrt{9}} = \left[\frac{1}{3} \;\; -\frac{2}{3} \;\; \frac{2}{3}\right]$

NONCONCURRENT 6 EQNS 5 UNKS ☺

FORCES, REACTIONS MOMENTS	$\vec{r}_{F/A}$	$\vec{F}$	$\vec{r} \times \vec{F}$, COUPLES MOMENT REACTIONS
REACTIONS @ A	$[0 \;\; 0 \;\; 0]$	$[A_x \;\; A_y \;\; A_z]$	$[0 \;\; 0 \;\; 0]$
981 N	$[0 \;\; 1 \;\; 0]$	$[0 \;\; 0 \;\; -981]$	$[-981 \;\; 0 \;\; 0]$
T_{BD}	$[0 \;\; 2 \;\; 0]$	$\left[-\frac{2}{3} \;\; \frac{2}{3} \;\; \frac{1}{3}\right] T_{BD}$	$\left[\frac{2}{3} \;\; 0 \;\; 1\frac{1}{3}\right] T_{BD}$
T_{BC}	$[0 \;\; 2 \;\; 0]$	$\left[\frac{1}{3} \;\; -\frac{2}{3} \;\; \frac{2}{3}\right] T_{BC}$	$\left[1\frac{1}{3} \;\; 0 \;\; -\frac{2}{3}\right] T_{BC}$

$\Sigma M_x = 0$

$-981 + \frac{2}{3} T_{BD} + \frac{4}{3} T_{BC} = 0$

$\Sigma M_z = 0$

$\frac{4}{3} T_{BD} - \frac{2}{3} T_{BC} = 0$

$$\begin{bmatrix} \frac{2}{3} & \frac{4}{3} \\ \frac{4}{3} & -\frac{2}{3} \end{bmatrix} \begin{Bmatrix} T_{BD} \\ T_{BC} \end{Bmatrix} = \begin{Bmatrix} 981 \\ 0 \end{Bmatrix}$$

SOLVE

$T_{BD} = 295 \text{ N}$

$T_{BC} = 589 \text{ N}$

$\Sigma F_x = 0$

$A_x - \frac{2}{3} T_{BD} + \frac{1}{3} T_{BC} = 0 \qquad A_x = 0$

$\Sigma F_y = 0$

$A_y - \frac{2}{3} T_{BD} - \frac{2}{3} T_{BC} = 0 \qquad A_y = 587 \text{ N}$

$\Sigma F_z = 0$

$A_z - 981 + \frac{1}{3} T_{BD} + \frac{2}{3} T_{BC} = 0 \qquad A_z = 491 \text{ N}$

$\vec{A} = [0 \;\; 587 \;\; 491] \text{ N}$