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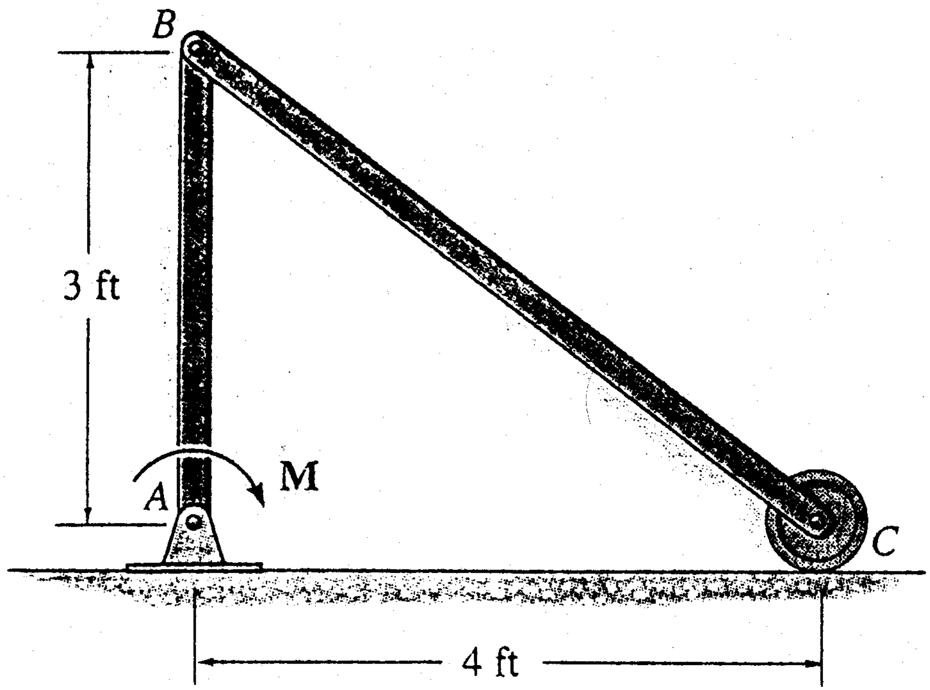
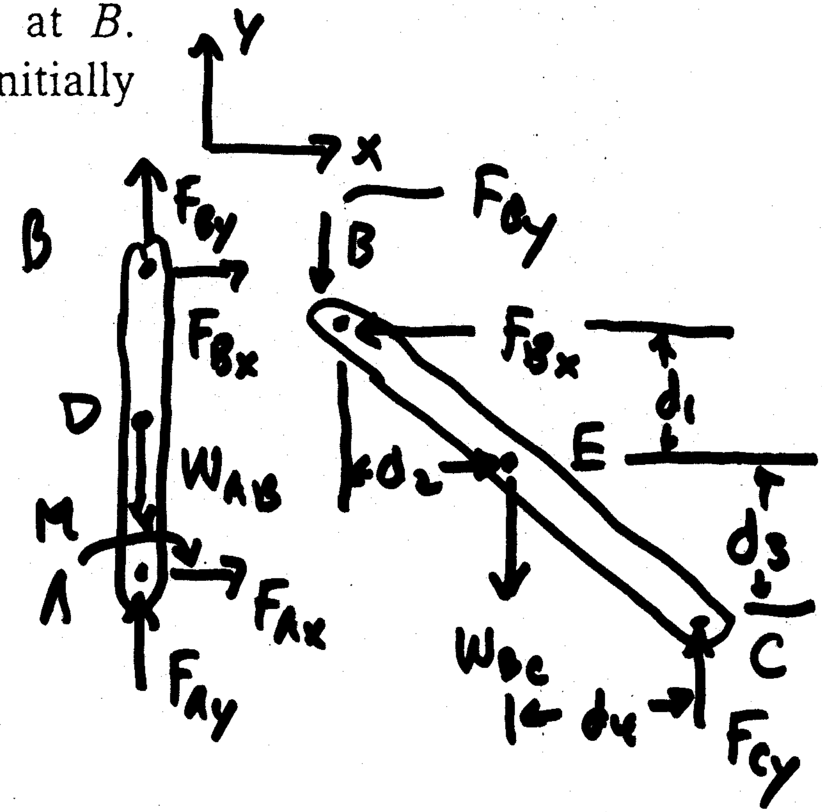
17-103. The two pin-connected bars each have a weight of 10 lb/ft. If a moment of $M = 60\ \text{lb}\cdot\text{ft}$ is applied to bar AB, determine the initial vertical reaction at C and the horizontal and vertical components of reaction at B. Neglect the size of the roller at C. The bars are initially at rest.



Prob. 17–103



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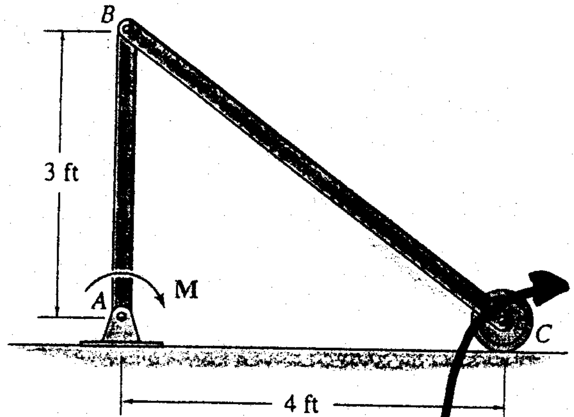

Prob. 17–103

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Newton's Laws

AB:

$\vec{a}_D = (a_D)_x \vec{i} + (a_D)_y \vec{j}$

$\Sigma F_x = m_{AB}(a_D)_x$ $\quad F_{Ax} + F_{Bx} = m_{AB}(a_D)_x$

$\Sigma F_y = m_{AB}(a_D)_y$ $\quad \cancel{F_{Ay} + F_{By} = m_{AB}(a_D)_y}$

$\Sigma M_D = I_D \alpha_{AB}$ $\quad F_{Ay} + F_{By} - W_{AB} = m_{AB}(a_D)_y$

$\cancel{-M\,F_{Ax}(1.5)}$ $- M + F_{Ax}(1.5) - F_{Bx}(1.5) = I_D \alpha_{AB}$

use $\frac{1}{12} m l^2$

"Dynamic balance of moments"

BC:

$\Sigma F_x = m_{BC}(a_E)_x$; $-F_{Bx} = m_{BC}(a_E)_x$

$\Sigma F_y = m_{BC}(a_E)_y$; $-F_{By} - W_{BC} + F_{Cy} = m_{BC}(a_E)_y$

$\Sigma M_E = I_E \alpha_{BC}$

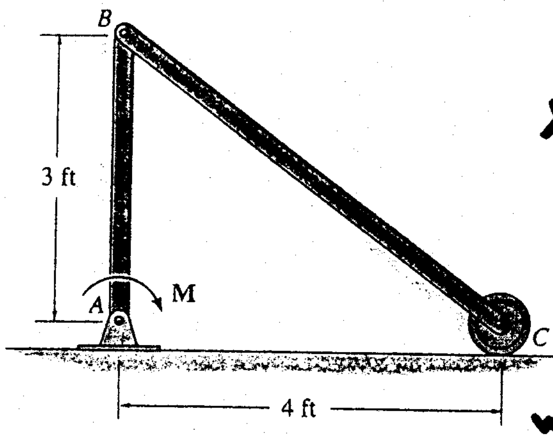
$F_{By}(d_2) + F_{Bx}(d_1) + F_{Cy}(d_4) = I_E \alpha_{BC}$

use $\frac{1}{12} m l^2$

Have 6 eqns

F_{Ax}, F_{Ay}, $(a_D)_x$, $(a_D)_y$,
F_{Bx}, F_{By}, α_{AB},
F_{Cy}, $(a_E)_x$, $(a_E)_y$,
α_{BC} 11 unkns!!

17-103. The tw‹ ·in-connected bars each have a weight of 10 lb/ft. If a n. ‹ent of $M = 60$ lb · ft is applied to bar AB, determine the initial vertical reaction at C and the horizontal and vertical components of reaction at B. Neglect the size of the roller at C. The bars are initially at rest.



Prob. 17–103

"Kinematic Constraints"

$$\vec{v}_B = \vec{v}_A + \cancel{\vec{\omega}_{AB}}^{\,0} \times \vec{r}_{B/A}$$

$$* \quad \vec{a}_B = \vec{a}_A + \vec{\alpha}_{AB} \times \vec{r}_{B/A} + \cancel{\vec{\omega}_{AB}}^{\,0} \times \cancel{\vec{\omega}_{AB}}^{\,0} \times \vec{r}_{B/A}$$

$$\vec{v}_C = \vec{v}_B + \cancel{\vec{\omega}_{BC}}^{\,0} \times \vec{r}_{C/B}$$

$$* \quad \vec{a}_C = \vec{a}_B + \vec{\alpha}_{BC} \times \vec{r}_{C/B} + \cancel{\vec{\omega}_{BC}}^{\,0} \times \cancel{\vec{\omega}_{BC}}^{\,0} \times \vec{r}_{C/B}$$

$\vec{v}_A = \vec{a}_A = 0$, $\vec{\alpha}_{AB} = \alpha_{AB}\vec{k}$, $\vec{r}_{B/A} = 3\vec{j}$

$\vec{v}_C = v_C\vec{i}$, $\vec{a}_C = a_C\vec{i}$, $\vec{\alpha}_{BC} = \alpha_{BC}\vec{k}$, $\vec{r}_{C/B} = \ldots\ldots$

** 4 eqns, $\alpha_{AB}, v_C, a_C, \alpha_{BC}$ $\Rightarrow$ Can find these unknowns.

<u>Now we use the known accels to determine the accel of pts D & E.</u>

<u>D & E.</u> $\vec{a}_D = \vec{a}_A + \vec{\alpha}_{AB} \times \vec{r}_{D/A} + \cancel{\vec{\omega}_{AB}}^{\,0} \times \cancel{\vec{\omega}_{AB}}^{\,0} \times \vec{r}_{D/A}$ $\Rightarrow$ Know $(a_D)_x, (a_D)_y$

$\vec{a}_E = \vec{a}_C + \vec{\alpha}_{BC} \times \vec{r}_{E/C} + \vec{\omega}_{BC} \times \vec{\omega}_{BC} \times \vec{r}_{E/C}$ $\Rightarrow$ Know $(a_E)_x, (a_E)_y$