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Review for Exam III - Kinetics of Rigid Bodies (Chapter 17) text

Moment of Inertia:

- Two dimensional problems, I was calculated about an axis passing through a pt on a body
- Use tables in text don't compute I.

  I_G: for an axis passing through G
  I_P: for any other point.

  } axes are

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Parallel axis theorem

$$I_p = I_c + md^2$$

- $I_p = k_p^2 m$, k_p = radius of gyration

Equations of Motion

$$\Sigma \vec{F} = m\vec{a}_c$$

$$\Sigma F_x = m(a_c)_x$$

$$\Sigma F_y = m(a_c)_y$$

$$\Sigma F_n = m(a_c)_n$$

$$\Sigma F_t = m(a_c)_t$$

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$$\sum \vec{M}_G = I_G \vec{\alpha}$$

↑ moments caused by applied external forces

$$\sum \vec{M}_P = \underbrace{I_P \vec{\alpha} + m \vec{r}_{G/P} \times \vec{a}_P}_{\text{Kinetic moment}} = I_G \alpha + m \vec{r}_{G/P} \times \vec{a}_G$$

Fixed axis rotation about P

$$\sum \vec{M}_P = I_P \vec{\alpha} + 0 \quad (\vec{a}_P = 0)$$

30/3
ε 31/4

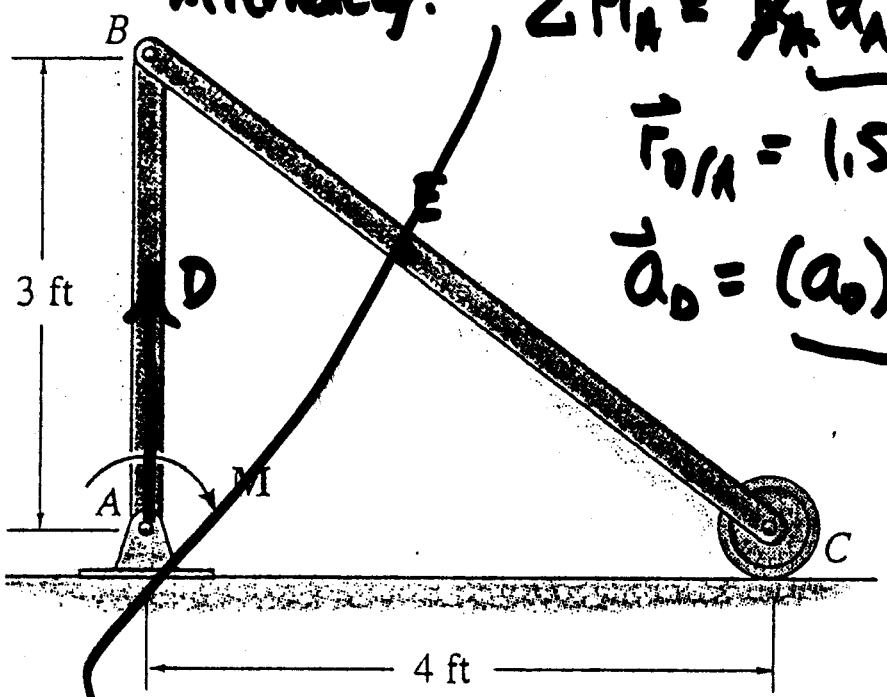
The two pin-connected bars each have a weight
/ft. If a moment of $M = 60$ lb · ft is applied to bar
ermine the initial vertical reaction at C and the
:al and vertical components of reaction at B.
the size of the roller at C. The bars are initially

In 29/2; we used $\Sigma M_D = I_D \alpha_{AB}$

Alternately: $\Sigma M_A = \cancel{I_A} \alpha_{AB} + M_{AB}\ \vec{r}_{D/A} \times \vec{a}_D$

$\vec{r}_{D/A} = 1.5\vec{j}$ — I_D 11/8/04

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



$D - F_{Dy}(3) - M = I_A \alpha_{AB} + M_{AB}(1.5\vec{j}) \times [\ \ ]$

Prob. 17–103

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Kinematic Constraints

Rolling w/o slip : $a_G = \alpha r$ with proper sign consistent with coordinate systems.

$$\text{if } |F| \leq \mu_s N$$

Rolling with slip: $F = \mu_k N$, must draw F with correct direction on FBD.

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$$\vec{a}_B = \vec{a}_A + \vec{\omega}_{AB} \times \vec{\omega}_{AB} \times \vec{r}_{B/A} + \vec{\alpha}_{AB} \times \vec{r}_{B/A}$$

Apply as necessary to relate known accels to $\vec{a}_C$, and to help determine $\vec{\alpha}_{AB}$.

- The rotating-frame version would also be a kinematic constraint, but won't appear on Exam III.

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Problem Solving Procedure

- Isolate each body
- Draw free body diagram for each body. FBD must contain
  - ⇒ All applied external forces, contact or gravity
  - ⇒ Coordinate system defining sign conventions
  - ⇒ Geometrical information, including the location of the point of application of each external, and the line of action

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- Write Newton's Laws. Identify each vector, if instructed, carry out cross products & other vector operations.
- Identify and count unknowns, # of equations.
- If unknowns > equations, develop kinematic constraints until unknowns = equations.
- Solve for unknowns.