1. A small band of pirates climbs the smokestack to raise their flag on a rainy night. Pirates C and D each have a mass of 80 kg. They are tethered by an inextensible cable that is tied at point A, and slides frictionlessly at point B. Model their accident as shown at right; assume the two pulleys are massless and frictionless. What will the velocities of the two pirates be after pirate C has fallen 2m?
2. A fireman comes to the rescue of a pair of pirates stranded at the top of the smokestack. $l = 10$ cm, $\frac{dl}{dt} = 0.5$ cm/s, $r = 2$ cm, $\theta = 0^\circ$, $\frac{d\theta}{dt} = 0.2$ rad/s, $\omega = 0.1$ rad/s. $\frac{d^2l}{dr^2} = \frac{d^2\theta}{dr^2} = \frac{d\omega}{dt} = 0$. The ladder is attached to the truck by a hinge at A (Lego® part number 3149c01.) Assume that the ladder is very thin. Using any convenient coordinate system, write:

(a) The angular velocity and angular acceleration of the ladder.
(b) The velocity and acceleration of point A.
(c) The velocity and acceleration of point B.
3. The elevation motor for the back-up fire truck's ladder fails, causing the ladder to fall. The ladder is free to pivot about a horizontal pin at A. If \( \theta = \tan^{-1}(4/3) \), \( \frac{d\theta}{dt} = 1 \text{ rad/s} \), \( \omega = 0.2 \text{ rad/s} \), and \( \frac{d\omega}{dt} = 0 \), what is \( \frac{d^2\theta}{dt^2} \)? Model the ladder as a thin, uniform rod with a mass \( m = 20 \text{ kg} \).
4. A pair of pirates abandon their reckless ways and dispose of a plank by suspending it over a sharp corner as shown, then releasing it from rest.

(a) What is the initial acceleration of the center of gravity as a function of $d$?

(b) For what value of $d$ will the initial acceleration of the center of gravity be maximum?

(c) What is the corresponding initial angular acceleration?