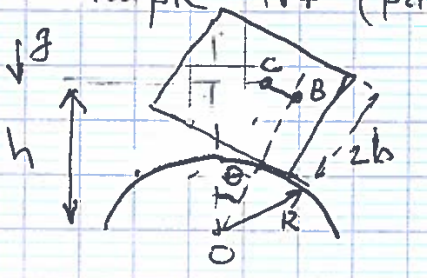
L17 One-dimensional systems

- bead on rigid wire $T = \frac{1}{2} m \dot{s}^2$ $s(t)$ – Track.
- rollercoaster

constrained forces do not do work → $E = T + U$ is valid.

* Example 4.7 (page 130)



BC is the distance rolled by the cube (bottom) along the cylinder $BC = r\theta$

$h = (r+b)\cos\theta + BC \sin\theta$

$U(h) = mgh$

$\frac{dU}{d\theta} = mg\left[-(r+b)\sin\theta + r\theta\cos\theta + r\sin\theta\right]$

$= mg\left[r\theta\cos\theta - b\sin\theta\right] \Rightarrow \theta \Rightarrow 0$

is equilibrium stable?

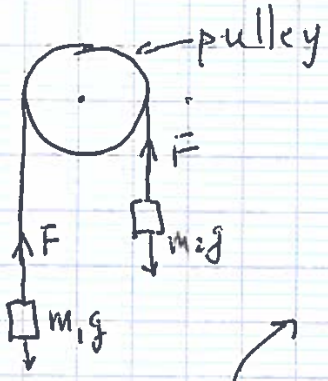
$\frac{\partial U}{\partial \theta^2} = mg\left[r\cos\theta - r\theta\sin\theta - b\cos\theta\right]$

$= mg(r-b)\Big|_{\theta=0}$

$r > b$ – stable

$r < b$ – unstable

* Atwood machine



$\Delta T_1 + \Delta U_1 = W_F$ – work by tension force F

$\Delta T_2 + \Delta U_2 = -W$

$\Delta(T_1 + T_2 + U_1 + U_2) = 0$

F – tension force does $\emptyset$ work for the combined system of m_1 & m_2

"constraining" force