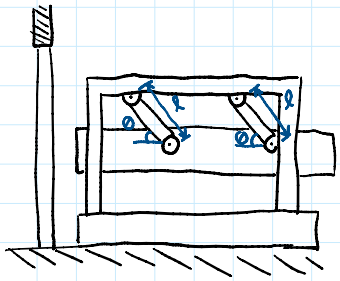
20-R-IM-DK-18

July 14, 2020 10:29 AM

Beginner Impact

Inspiration: 19-41 Hibbeler, 20-R-KIN-DIC-13



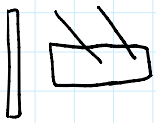
The siege on the castle of Santa Ono continues. The battering ram has been moved to the front and prepares to strike the door. If the ***200 kg*** log is released from rest at an angle of ***theta = 30 degrees***, determine the smallest angle the log will rebound to. The coefficient of restitution is between the log and the door is ***e = 0.4***. Assume the log strikes the door when the linkages are perpendicular to the ground. The linkages have length ***l = 1.2 m.***

$T_1 + V_1 = T_2 + V_2$ Set datum as top pin

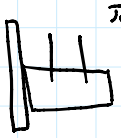
$$0 - \underset{m}{(200)}\underset{g}{(9.81)}\underset{l\sin\theta}{(1.2\sin 30)} = \underset{m}{\tfrac{1}{2}(200)}(v_2)^2 - \underset{m}{(200)}\underset{g}{(9.81)}\underset{l}{(1.2)}$$

$1177.2 = 100\,v_2^2$ $\quad v_2 = 3.4310\,34429$ m/s

State 1



State 2



Just before impact

State 3

Just after impact

State 4

$$e = \frac{v_3 - v_{door_3}}{v_{door_2} - v_2} = \frac{v_3 - 0}{0 - (-3431)} \qquad 0.4 = \frac{v_3}{3431} \qquad v_3 = 1.3724 \text{ m/s}$$

$T_3 + V_3 = T_4 + V_4$

$$\tfrac{1}{2}(200)(1.3724)^2 - 200(9.81)(1.2) = 0 - 200(9.81)(1.2\sin\theta)$$

$\frac{23}{25} = \sin\theta$ $\qquad \theta = 66.926°$